The year is 1956. Polls show that only 10 percent of U. S. adults have ever bought an airline ticket. And, of course, the number of jetliners in scheduled U. S. service in 1956 is zero.

Skip now to 1966. A population survey by the Gallup Organization shows dramatic improvement, that instead of 10 percent, a healthy 42 percent of all American adults have bought at least one airline ticket. At year's end, there were 994 jetliners in scheduled U. S. service and these account for 92 percent of all U. S. passenger miles.

Change marked the decade. But between 1956 and 1966 there was only one truly important, independent variable in all air transport: the widespread use of jets. The carriers' conversion to turbine power brought air transportation within financial reach of millions of Americans.

Using the jetliner as their scalpel, airline managements have cut fares more than 10 percent in the last four years *despite* the upward spiral of consumer prices. In 1966 alone, U. S. airlines took delivery of 297 jet-propelled transports, absorbed their $1.5 billion cost, introduced the machines smoothly into service, and, in the process, reduced the average cost of flying one passenger mile by 3.4 percent. As the gross national product expanded and new purchasing power percolated through the economy, U. S. air fares continued their descent.

If 1951 is considered the index year, U. S. consumer prices are up about 25 percent now. But the average air fare per passenger mile is five percent less today than it was 15 years ago. The jets have enabled air carriers to overcome inflation.

Today's subsonic jetliners have allayed some non-flyers' fears, and it can be reasonably stated that the jumbo jets and supersonic transports will allay the fears of a great many more non-flyers. Why? Because the Boeing 747 and SST stand in precisely the same relationship to the Boeing 707 and Douglas DC-8 as the 707 and DC-8 stood in relation to the Douglas DC-7 and Lockheed Super Constellation in 1958.

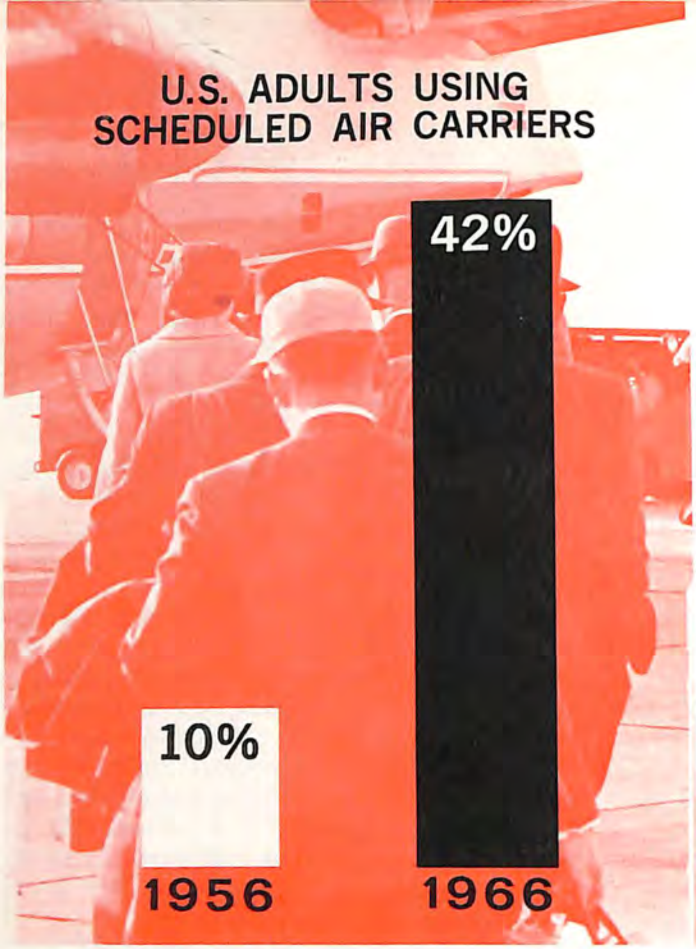
The 747 and SST will be highly attractive to passengers, and contribute strongly to increasing air travel.

Panelists and guests at a 1961 air transportation forum looked at this relationship from a slightly different perspective. The panel, chaired by Paul W. Cherington, professor of transportation at the Harvard Business School, collided with this question: "When will the airlines face up to the matter of fear? Non-users of air transport may not admit it, but this (fear) may prevent mass acceptance."

Walter H. Johnson, Jr., general corporate executive of Interpublic, Inc., responded as follows:

"The people for whom fear has been overcome in the use of the airplane are people who found the utility of the airplane of greater value to them and were therefore able to overcome fear . . . I believe you have to make people want to use the airplane so much that this want overcomes their natural fear of flight."

The Air Transport Association sponsored a seminar on the fear of flying with a panel composed of eight leading psychiatrists, psychologists and sociologists. The report of the panel's discussions made by an independent observer concluded: ". . . the problem,



beginning students was an admitted fear which arose most frequently among those "who were poorly motivated for flying."

At this point, four premises have been proposed.

Premise No. 1 is that the fear of flying and the fare of flying, until 10 years ago, kept 90 percent of the U. S. adult population permanently grounded.

Premise No. 2 is that between 1956 and 1966 the percentage of adult Americans who (at least once in their lives) had boarded a commercial airliner leaped from 10 to 42 percent.

Premise No. 3 is that the widespread introduction of turbine-powered transports during the 1956-1966 decade enabled airline managements to hold at least a constant fare line, thus bringing air travel within financial reach of many more wage-earners.

Premise No. 4 is that the human fear of flying is a rational fear, and, as such, will succumb to high motivation to fly.

How, then, might the airline-jetliner team have supplied that extra motivation during the 1956-1966 decade — not to veteran travelers — but to millions who had never set foot in an airplane? By experimenting with promotional fares, by demonstrating the safety of jet travel, by constantly improving the quality of the airline product, which is, in final analysis, efficiency coupled with comfort. These are a few of the more obvious answers.

The immense productivity of an airborne jetliner

boiled down to its simplest terminology, is simply that people don't realize how safe flying is. As one panelist phrased it:

'Fear of accidental death is not confined to flying, but in the ease of flying it is a unique fear because it is based on gross misunderstanding or misinformation.' "

Medical literature abounds in clinical studies of fear of flight in military airmen. In general, these studies deal not with veteran pilots in combat but with fledgling pilots undergoing primary training. The psychiatrists' conclusions are pertinent.

Courage is "a concoction of feelings that are not so very admirable. A touch of anger, a spice of vanity, a lot of obstinacy and a tawdry 'sporting' thrill . . . I shall never again admire a merely brave man." So wrote the airman's laureate, Antoine de Saint Exupéry; his analysis was chosen by three Navy doctors to open their definitive article, "The Fear of Flying Syndrome: A Re-Appraisal." Appearing in the February, 1964, issue of *Aerospace Medicine,* it pulled together 95 earlier studies of fear and flying. The authors concluded:

- That there is a basic universal fear of flying in all human beings, that this fear springs from a normal interest in one's personal safety and thus constitutes a "realistic" reaction.
- That some also suffer from a neurotic "fear of flying *syndrome*." Its chief symptom is not realistic fear but anxiety, which can surface as an ailment such as migraine.
- That by far the most common problem among

is powerful incentive for an airline to keep its jet fleet airborne, even during the less popular flying hours. Similarly, the jet's capaciousness supplies incentive to fill the jet. To keep jets filled and airborne, scheduled U. S. airlines began experimenting during the early 1960s with broad-based promotional fares: family fares, youth fares, then military standby fares, and, this year, "discover America" fares which offer a 25 percent roundtrip discount to adults beginning a trip one week and returning the next.

As the Air Transport Association puts it: "To a substantial extent the reductions in the price of air travel reflect the wider and wider introduction and popularity of promotional fare plans of various types . . . Airline passengers in 1966 paid a total of over $250 million less than they would have paid for the same trips at average fare levels prevailing four years earlier."

The promotional fare plans are not aimed solely at socioeconomic groups that can afford to fly, and do fly, such as $10,000-a-year-plus professional men (65 percent have been passengers), or businessmen in general (63 percent have been airborne). Airlines are also anxious to use promotional fares to lure aboard their jetliners those, say, with incomes less than $5,000 (only a 24 percent airline use factor), such as servicemen.

According to Trans World Airlines, the proportion of adult American flyers in the population has climbed four percentage points in each of the past two years. "If this growth trend continues," says Robert W. Rummel, TWA's vice president for planning and research, "60 percent of the adults in the United States will have taken an airline trip by 1970."

What's responsible? "The growing legions of air passengers testify to the drawing power of the jet transport, coupled with imaginative marketing efforts on a large scale," says Mr. Rummel.

Had jetliners brought increased risk to air travel, no such growth trends would be measurable now. As it is, however, the record built by the jetliners has helped the industry sell air travel in terms of its safety. ATA President Stuart Tipton began a recent speech: "I suspect there are some of you in the audience who are afraid to fly. Well, let's talk about fear. There was a time when the airlines didn't like to talk about it . . ."

Talking safety, the ATA president said that auto accidents are claiming about 52,500 American lives per year; that 2,400 of us are killed accidentally by firearms; that 7,200 drown while swimming or boating; that even bicycles cost 680 lives last year. About 112,000 Americans died accidentally in 1966, and of the total, exactly 59 died in fatal airliner accidents, he said.

Insurance companies charge airline pilots the same life insurance rates as they charge bank tellers. Insurance companies know, Mr. Tipton said, that you now have a 99.9995 percent probability of completing any scheduled flight safely. For automobile trips, divide that number by seven.

Fear of flying is succumbing to superior logic in this ninth year of the jet age.

AIA MANUFACTURING MEMBERS

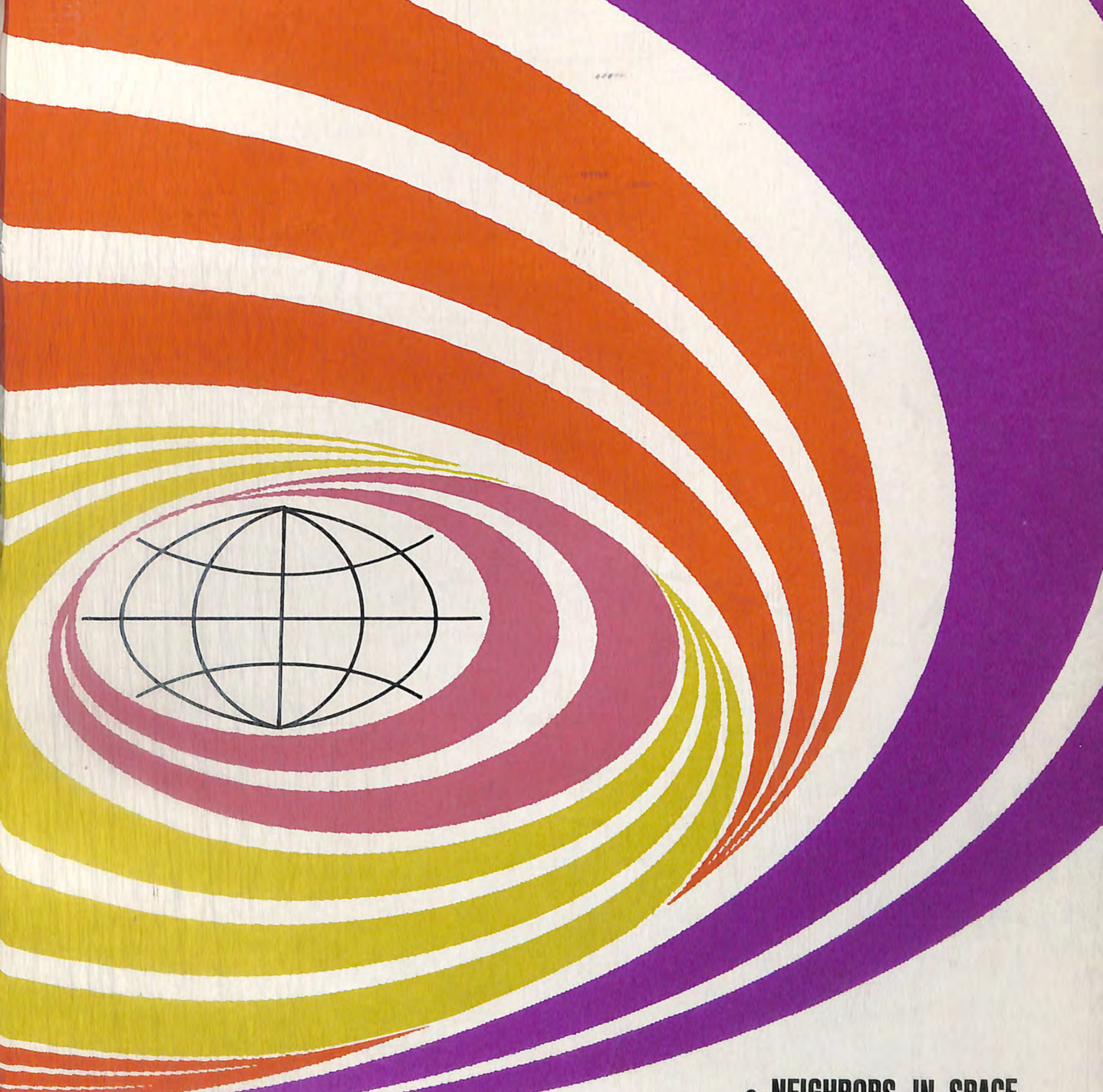
- Abex Corporation
- Aerodex, Inc.
- Aerojet-General Corporation
- Aeronca, Inc.
- Aeronutronic Division, Philco-Ford Corporation
- Aluminum Company of America
- Amphenol Connector Division
  - Amphenol Corp.
- Avco Corporation
- Beech Aircraft Corporation
- Bell Aerospace Corporation
- The Bendix Corporation
- 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
- Fairchild Hiller Corporation
- The Garrett Corporation
- General Dynamics Corporation
- General Electric Company
  - Defense Electronics Division
  - Flight Propulsion Division
  - Missile & Space Division
  - Defense Programs Division
- 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 Incorporated
- Honeywell Inc.
- Hughes Aircraft Company
- IBM Corporation
  - Federal Systems Division
- International Telephone & Telegraph Corp.
  - ITT Controls and Instruments Division
  - ITT Federal Laboratories
  - ITT Gilfillan, Inc.
- Kaiser Aerospace & Electronics Corporation
- Kaman Corporation
- Kollsman Instrument Corporation
- Lear Jet Industries, Inc.
- Lear Siegler, Inc.
- Ling-Temco-Vought, Inc.
- Lockheed Aircraft Corporation
- The Marquardt Corporation
- Martin Marietta Corporation
- McDonnell Douglas Corp.
- Menasco Manufacturing Company
- North American Aviation, Inc.
- Northrop Corporation
- Pacific Airmotive Corporation
- Piper Aircraft Corporation
- PneumoDynamics Corporation
- Radio Corporation of America
  - Defense Electronic Products
- Rockwell-Standard Corp.
  - Aircraft Divisions
- Rohr Corporation
- Ryan Aeronautical Company
- Solar, Division of International Harvester Co.
- Sperry Rand Corporation
  - Sperry Gyroscope Company
  - Sperry Phoenix Company
- Sundstrand Aviation, Division of Sundstrand Corporation
- Thiokol Chemical Corporation
- TRW Inc.
- Twin Industries Corp., Division of the Wheelabrator Corp.
- United Aircraft Corporation
- Westinghouse Electric Corporation
  - Aerospace Electrical Division
  - Aerospace Division
  - Astronuclear Laboratory
  - Marine Division

AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W., Washington, D. C. 20036

(See *Travelers Take the High Road,* page 14)

aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION · SUMMER 1967



• NEIGHBORS IN SPACE

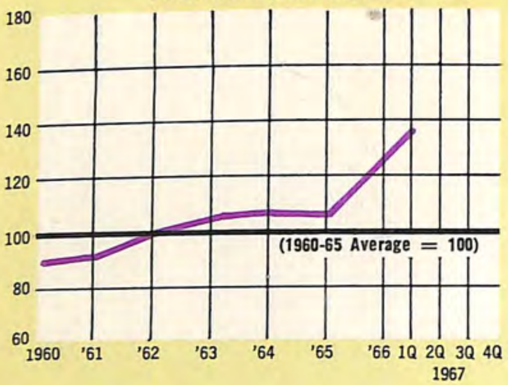
• THE AVIATION OPPORTUNITY

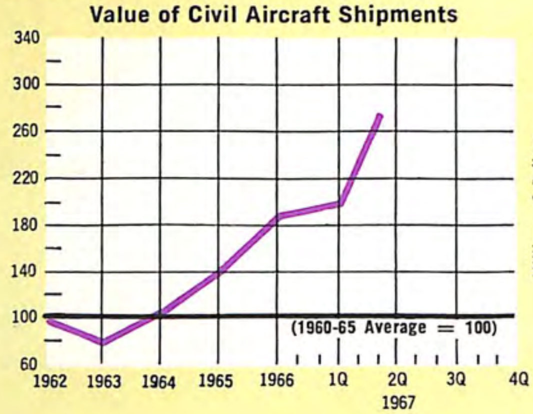
By KARL G. HARR, JR.

President, Aerospace Industries Association

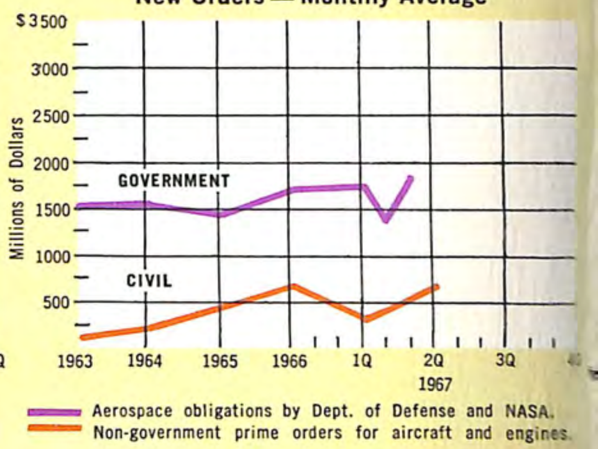
AEROSPACE ECONOMIC INDICATORS

CURRENT





OUTLOOK



ITEM	UNIT	PERIOD	1960-65 AVERAGE *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending March 31 1967	22.3	24.2	26.2
	Billion $	Quarterly	4.8		5.6	6.3	6.5
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	May 1967	785	1,079	1,651
Aircraft	Million $	Monthly	601	May 1967	584	719	1,147
Missiles & Space	Million $	Monthly	550	May 1967	201	360	504
Aerospace expenditures: Total	Million $	Monthly	1,067	May 1967	759	1,221	1,347
Aircraft	Million $	Monthly	561	May 1967	528	797	845
Missiles & Space	Million $	Monthly	506	May 1967	231	424	502
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920 ✢	June 1967	2,367	1,500	1,983
Aircraft	Million $	Monthly	447	June 1967	1,873	1,240	1,377
Missiles & Space	Million $	Monthly	473	June 1967	494	260	606
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	June 1967	385	213	352[E]
Expenditures	Million $	Monthly	130	June 1967	439	348	348[E]
UTILITY AIRCRAFT SALES							
Units	Number	Monthly	692	July 1967	1,089	1,178	984
Value	Million $	Monthly	15	July 1967	28	33[R]	25
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3 #	Quarter Ending June 30 1967	22.9	27.4	28.9[E]
U.S. Government	Billion $	Quarterly	11.6		13.8	15.5	16.0
Nongovernment	Billion $	Quarterly	3.7		9.1	11.9	12.9
EXPORTS							
Total (Including military)	Million $	Monthly	110	June 1967	137	157	184
New Commercial Transports	Million $	Monthly	24	June 1967	42	35	58
New Utility Aircraft	Million $	Monthly	2	June 1967	9	10	7
PROFITS							
Aerospace — Based on Sales	Percent	Quarterly	2.3	Quarter Ending March 31 1967	3.1	2.9	2.6
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		5.6	5.4	4.9
EMPLOYMENT: Total	Thousands	Monthly	1,132	June 1967	1,290	1,383	1,390[E]
Aircraft	Thousands	Monthly	499	June 1967	555	606	610
Missiles & Space	Thousands	Monthly	496	June 1967	563	602	604
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	June 1967	3.37	3.47	3.48[E]

R Revised
E Estimate
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
# Averages for 1961-65.
✢ Averages for fiscal years 1960-1965.

AEROSPACE EMPLOYMENT TO GAIN

Aerospace employment is expected to rise two percent from 1,381,000 last March to 1,409,000 by March 1968 due largely to a record backlog (estimated at $28.9 billion in the second quarter of 1967) and increasing deliveries of commercial aircraft. Employment on production and research and development of commercial and military aircraft is anticipated to rise from 816,000 in March 1967 to 838,000 in March 1968, a 2.7 percent increase. Employment by military aircraft manufacturers probably will remain stable during the period.

Statistics are compiled from 60 member companies of the Aerospace Industries Association reporting in the Association's Semi-Annual Survey of Aerospace Employment. Last April AIA predicted that aerospace employment would reach 1,384,000 by June 1967 and the actual figure was 1,390,000, a slight increase.

Employment in plants producing primarily commercial transport aircraft is anticipated to increase from 121,762 in March 1967 to 135,040 in March 1968, an 11 percent increase. This area of aerospace activity has been one of substantial growth with a 27 percent gain in employment between June 1966 and 1967 from 103,404 to 131,432.

General aviation employment is also expected to increase from 30,397 to 31,758 during the survey period. Rising demand for general aviation business jets as well as propeller-driven aircraft is expected by these firms to lead to increases in present levels of production in 1968, surpassing records achieved in 1966. Increasing numbers of student pilots, growing business utilization, pleasure flying and technological innovation has characterized this area.

Employment in helicopter plants producing both military and commercial aircraft is anticipated to decline by five percent in the period, peaking in the second quarter of 1967. Helicopter employment is expected to rise from 35,546 in March 1967 to 35,942 in June 1967 and then to decline to 33,560 by March 1968. This decrease is primarily due to some easing in military demand for accelerated production. Employment in these plants will still be higher than in March 1966.

A slight increase in missile and space employment is expected with the gain from 508,000 in March 1967 to 511,000 in March 1968. The reduction in space exploration programs will be offset by increased efforts on military space and missile requirements.

The survey indicates that aerospace firms anticipate missile employment to rise from 235,000 to 241,000, an increase of more than 2.5 percent in the period.

Product statistics reported here are not comparable with those reported in the Economic Indicators on the inside front cover because the statistics compiled in the survey designate product activity on the basis of primary plant activity.

AIA

aerospace

Official Publication of the
Aerospace Industries Association of America, Inc.

PRESIDENT • Karl G. Harr, Jr.
PUBLISHER • Glen Bayless

VOL. 5, NO. 7 *SUMMER 1967*

EDITOR • Gerald J. McAllister
ASSOCIATE EDITORS • Richard W. Balentine
• John J. Lee
ECONOMIST • Gerson N. Chanowitz
ART DIRECTOR • James J. Fisher

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 civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published monthly 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

Western Office: McCulloch Building, 6151 West Century Blvd., Los Angeles, Calif. 90045

Prototype of a French-built FR-1, designed to study very low frequency radio wave propagation, is prepared for a test at the Goddard Space Flight Center.

Indian launch crew mates Apache rocket to a Nike booster at the Equatorial Sounding Rocket Range, Thumba, India.

NEIGHBORS IN SPACE

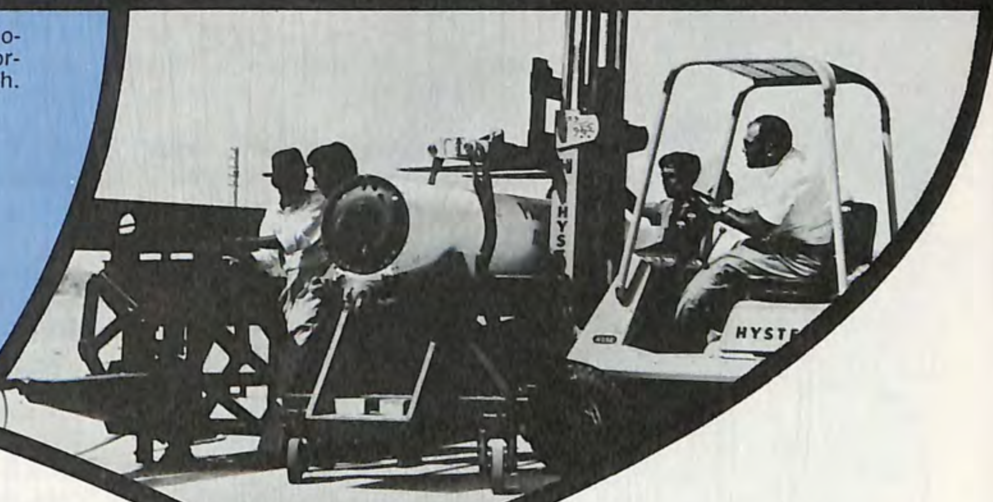
At some time roughly coincident with the 10th anniversary of space flight, on October 4, a new and unusual satellite will be launched. ESRO I, as the spacecraft is called, is unusual not in design or purpose, but in the heterogeneous nature of its assembly team.

Three of its experiments were provided by research establishments in the United Kingdom, others by a technical school in Denmark, a university in Norway and a geophysical observatory in Sweden. Into the fabrication of the satellite went hardware and brainpower from Belgium, France, the Federal Republic of Germany, Italy, the Netherlands, Switzerland and Spain.

The blastoff of ESRO I, a product of the European Space Research Organization, will mark the fifth

Member of a Japanese launch team checks the radiosonde payload of a MT-135 rocket. U. S.-Japan Meteorological Rocket Project conducts comparative research.

Pakistani crew trains for a sounding rocket launch. The machine lifts the first stage booster engine onto the launching vehicle.



launch this year of satellites built by nations other than the United States or the Soviet Union. France has already orbited two spacecraft, the United Kingdom and Italy one each. And there may be three additional "third nation" launches before the year ends.

All this activity underscores the growing universality of space research. For four and a half years after Sputnik 1, the U.S. and the U.S.S.R. shared space exclusivity, but today the roster of the world space club reads like the index to an atlas.

- Either independently or cooperatively, 15 nations are building primary equipment, spacecraft or launch vehicles.
- About two dozen countries are firing suborbital sounding rockets and there are more than a score of rocket research ranges outside the boundaries of the U.S. or the U.S.S.R.
- More than 70 nations are participating in some form of space activity, whether it be construction of flight vehicles, operation of ground-based stations, or training technicians for some future effort.

In the van of this international space movement is the National Aeronautics and Space Administration, which, through its Office of International Affairs, urges still broader participation and lends a helping hand to those who request it.

NASA's primary cooperative programs are with European nations, but the agency is also cooperating with the other great space power, the Soviet Union; with Iron Curtain countries such as Czechoslovakia, Hungary and Poland; with Mideastern nations like Iraq, Sudan and the United Arab Republic, as well as Israel; with such emerging African countries as Chad, Ghana, Tanzania and Zambia; on a training-only basis with Ceylon, Korea, Turkey and Venezuela; and with a great many other nations, large and small, developed and less developed, friendly and not so friendly. U.S. manufacturers are also cooperating, providing technical assistance and certain types of equipment not readily producible in the foreign countries.

The NASA international program is in line with Congressional direction in the Space Act of 1958, which espoused "cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof." Its aims and advantages were concisely summed by the late Dr. Hugh L. Dryden, NASA's Deputy Administrator at the time of his death: "The cooperative project helps advance American foreign policy abroad. It is a witness to the peaceful purposes of our space research and exploration. It contributes to the technical capabilities of our friends abroad. It promotes the establishment of new multilateral centers for cooperation. And it minimizes the amount of gold outflow."

The program is not an American give-away. Participating nations provide their own funds for their portions of a project and they pay for such equipment as is required from American manufacturers. Such payments are running near the $20,000,000 a year level, a small but growing export market. NASA's own contribution — which might be a launch or training facility, a booster or some sounding rockets, technical information or know-how — involves minimal outlay of U.S. money. And there is definitely a return on the investment; the data acquired from a given experiment, made available to everyone, complements NASA's own research.

Take ESRO I, for example. NASA is making available the Western Test Range in California and providing the launch vehicle, a four-stage Scout; but fabrication and ground testing of the satellite itself was financed *in toto* by the ESRO member nations. A polar ionospheric research satellite, ESRO I, on the surface, appears to duplicate similar research already performed by NASA. Not so, according to Arnold W. Frutkin, NASA's Assistant Administrator for International Affairs.

"There is as yet no such thing as a duplicating satellite," says Frutkin. "Even if there were two satellites with identical experiments — and there have not been yet — they would be launched at different times in the solar cycle, in different areas under different conditions, with different time/space correlations." Each satellite, however similar to a predecessor, makes its own contribution to the big scientific picture. So, to NASA, ESRO I amounts to an additional experiment performed at very low cost.

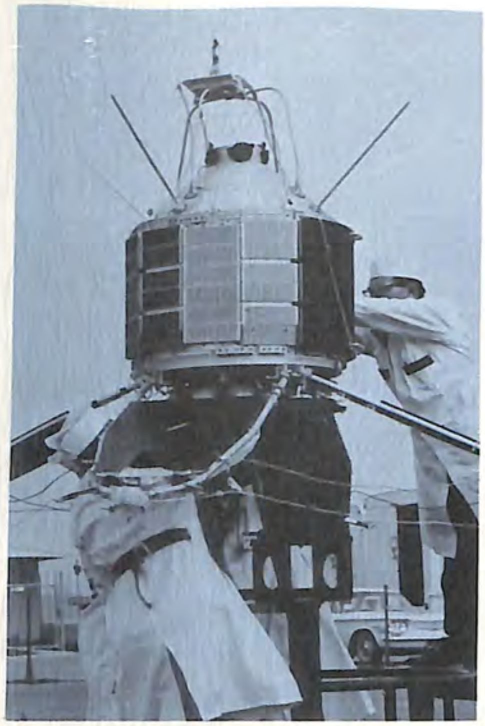
An even more striking illustration, not only of reciprocal benefit but also of the degree of technical prowess some third nations have attained, is the Italian-built San Marco II.

Launched earlier this year from a towable floating platform anchored in equatorial waters of the Indian Ocean, San Marco II was designed to measure air density, an experiment frequently conducted by NASA. But where NASA employed two basic methods of obtaining density data, the Italian team came up with a third: continuous measurement of air drag forces on a spacecraft, a technique exclusive to Italy. The successful launch of San Marco II gave scientists an opportunity to triple-check earlier data and resolve differences in readings.

Italian-financed, the floating platform was another innovation. The platform — actually two platforms, one a launcher, the other a control station — offers to cooperating nations an equatorial launch facility capable of handling boosters as large as the Scout, or, should circumstances dictate, a flexible base which could be moved to a new location. Although no agreement has yet been signed, NASA is planning to launch one of its own satellites from the ocean site.

NASA's cooperative program for satellite launchings was christened on April 26, 1962, when a NASA-provided Delta booster sent into orbit the U.K.'s Ariel I scientific satellite. The U.K. thus became the first third nation, or the first country other than the U.S. or the U.S.S.R. to build a successfully-orbited satellite. Since that time, NASA has helped launch two additional Ariels, two Canadian Alouettes, two San Marcos and one French FR-1. Under current agreements NASA will provide assistance on seven more satellite launches (three ESRO, two Canadian, one French and one German). NASA will also send into orbit, aboard its own observatory class satellites, experimental packages built by France, Italy, the Netherlands and the U.K. NASA's door is open to further proposals and there will undoubtedly be additional agreements involving both individual experiments and complete satellites.

Even broader than the satellite program, in terms of the number of nations engaged, is NASA's sponsorship of sounding rocket experiments. A sounding rocket does not go into orbit; it is lofted to altitudes



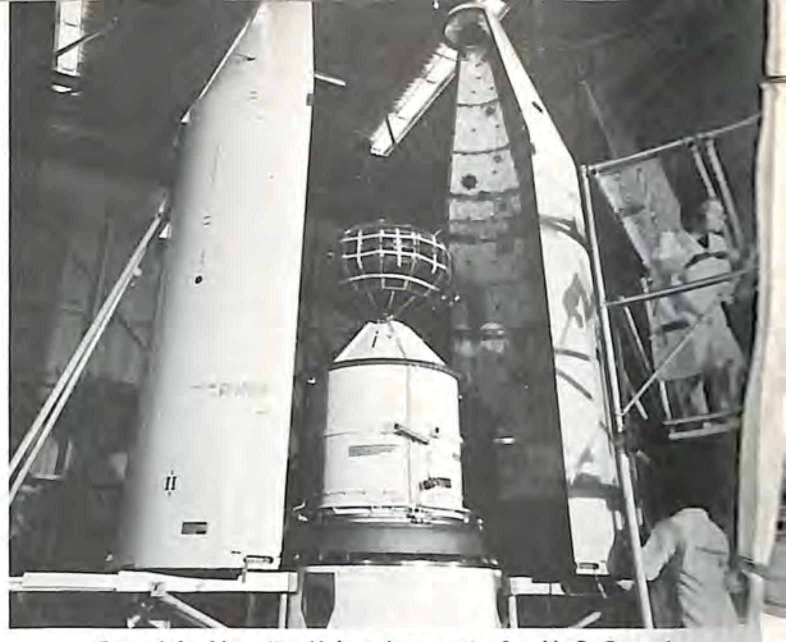
NASA's Western Test Range in California is the site for a checkout (left) of the United Kingdom satellite, U. K.-3. Above, the satellite, part of a U. S.-U. K. cooperative project, is prepared for launch.

from 40 to 200 miles to telemeter data for a brief period, then it falls back to earth. Its scientific importance stems from the fact that it explores altitudes above balloon capabilities but below those at which satellites usually operate. Relatively small and inexpensive, the sounding rocket offers a chance for the less affluent nations to participate in space research, and 24 countries are taking advantage of the opportunity to work with NASA.

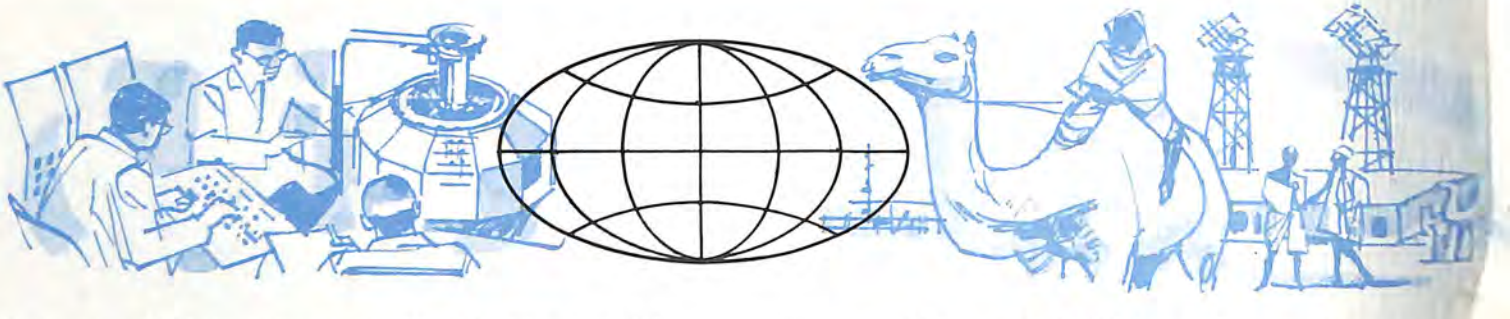
Here again cooperation is a two-way street. Because the data acquisition capability of the sounding rocket is limited to a localized area, a complete picture of the upper atmosphere demands a great many firings from a number of widely scattered sites. In the cooperative program, such sites are available. From Thumba at the southern tip of India and from Coronie in

Platform in the sea off the coast of Kenya, Africa, is used to launch Italy's San Marco spacecraft. Structure in background is the control center. The San Marco takes continuous equatorial air density measurements.

Sounding rocket is launched from the range at Birdling's Flat on the Canterbury Plains, New Zealand. The rocket carried an experiment designed under the sponsorship of the New Zealand Space Research Committee.



Canada's Alouette II is a key part of a U. S.-Canada International Satellites Ionospheric Studies program. Technicians check satellite which was launched from the Western Test Range, California.



Surinam, scientists can get equatorial upper air data from two different hemispheres. Ranges at Cape Karikari in New Zealand, Woomera in Australia and Chamical in Argentina permit soundings in the global deep south, below 30 degrees south latitude. ESRO's range at Kiruna, Sweden, and a Norwegian site on Andoy Island, both far above the Arctic Circle, allow studies of the scientifically-rich auroral zone. From more than a score of strategically-spotted sites, the cooperating nations are launching hundreds of sounding rockets a year, producing new volumes of upper air data complementary to the findings of the orbiting satellites.

A great many nations which are not launching rockets or satellites are getting an introduction to space technology through the ground-based portion of NASA's international cooperation program. This may involve joint or individual operation of a ground station for the reception and coordination of signals from NASA meteorological, communications, geodetic or scientific satellites; operations support, such as tracking; high altitude balloon soundings; observations of solar eclipses from aircraft; exchange of technical information through documents, computer tapes or microfiche (a form of microfilm); or training of foreign nationals at American universities and space facilities.

While NASA's international program has been the major impetus to the global spread of space research, there are other cooperative ventures in which the U. S. is not directly involved. There are, for instance, sharing programs between the U.S.S.R. and its satellite countries, between India and France, France and Argentina.

Six European nations — the U.K., France, Germany, Italy, Belgium and the Netherlands — have joined with Australia to form the European Launcher Development Organization (Australia, obviously not a European country, provided an ingredient not available in Europe, the great Woomera range). ELDO's intent is to produce a new launch vehicle capable of injecting a satellite into a synchronous orbit; called Europa, it is a four-stage booster with the U.K. building the first stage, France the second and fourth, Germany the third, and Italy supplying a test spacecraft. The first stage has already been successfully tested at Woomera and the complete vehicle is to be launched in 1969.

Aside from the many cooperative arrangements, some nations have embarked on purely national programs, attempting to develop certain space capabilities on an independent basis. Despite its contributions to ESRO, ELDO and several other cooperative efforts, France has managed to fund an extremely broad national effort and now ranks as the foremost third nation.

At Bretigny and Toulouse, the French operate two major space laboratories. At Hammaguir, Algeria, in the Sahara Desert, they built a large and well-equipped test range; now they are building a new one, sited to permit either polar or equatorial launches, in French Guiana. The nation has its own tracking network, extending from the homeland down through Africa.

A station of NASA's Deep Space Network is located at Robledo de Chavela, near Madrid, Spain. The station began operations two years ago to support Mariner IV on its Mars flyby.

Argentina's Orion II sounding rocket is used for upper atmospheric and space research. Launching arrangements were made by NASA and the Argentina Space Commission.

It fires 20 to 30 sounding rockets yearly and contemplates a build-up to 100. France has constructed a number of satellites, it has a flight-proven launch vehicle called *Diamant* and is developing a new family of relatively large boosters, the *Hyper Diamant, Diogene* 2 and *Vulcain*. In November, 1965, the 62,000 pound thrust *Diamant* sent into orbit the A1 scientific satellite and France became the first—and so far the only—nation other than the U.S. and the U.S.S.R. to launch a home-built satellite with a home-built booster. The French national space budget currently runs about $70,000,000 a year, by far the largest among the third nations.

Japan is also pursuing an energetic national space program, with annual expenditures of more than $25,000,000. Near Kagoshima on the southernmost island of Kyushu, the Japanese leveled the top of a mountain to construct a modern test range. They have developed a series of rockets ranging from small sounders up to the Mu, a large vehicle which compares roughly with the American Atlas. With its 80,000-pound thrust Lambda 4S booster, Japan has tried three times without success to orbit a test satellite, but may make another try this year. A full-fledged scientific satellite, to be boosted by the 400,000-pound thrust Mu, is slated for 1968 launch, prelude to a planned continuing series of scientific, communications and navigational satellites.

The U.K. and Germany have independent projects outside of their cooperative commitments, and of particular interest is the program undertaken by nonindustrial India. On its own resources, India built a small rocket range at Thumba, developed a capability for producing scientific instrumentation and started conducting independent sounding rocket launchings with purchased vehicles. Now the nation is moving further into space research; it is expanding the Thumba range, building its own rockets under French license, creating an electronics industry for space payload manufacture and even offering training to interested governments.

All of this international space activity hardly compares with the annual multi-billion dollar program of the great technological powers; total third nation annual expenditures are estimated at $300,000,000. But the 70-odd participants, particularly those with flight programs, are building a solid base for future effort. Some nations seem to be content with purely scientific programs on a cooperative basis. Others, impressed by the obvious commercial potential of space demonstrated by the American Comsat, may elect to strengthen their national capabilities and compete for a share of the market to be opened by future generations of applied spacecraft. The third nation direction — whether the emphasis will be on multilateral or independent programs — is not clear. What is clear, from the spaceward surge of the past five years and the quickening interest of nations newly exposed to the mysteries of space, is that the second decade of the Space Age will see a considerable further expansion of international effort.

Mr. Harr

THE AVIATION OPPORTUNITY

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

From remarks before the 1967 Jaycee International Air Show Symposium, Milwaukee, Wisconsin

Most people tend to look through the wrong end of the telescope as they approach the so-called "airport problem." Actually there is no "airport problem," there is rather an aviation opportunity and one of enormous potential.

As a nation, we are now faced with a new opportunity to reap the enormous economic, social and cultural benefits attendant upon saving time on an unprecedented scale. And because of quite recent technological developments this opportunity will soon become available to every segment of our society.

This involves the movement of people and goods in totally new dimensions of speed, distance, cost, quantity and reliability.

Our potential national aviation system amounts to no less than that, with all the obvious implications for the future economic well-being of the nation and for the nation's continued ability to represent to the rest of the world its most advanced and effective social system.

This prospect encompasses not merely the passenger airliner or the commercial cargo aircraft, but also the versatile and varied general aviation fleet which outnumbers commercial aircraft 50 to 1 today and will outnumber them 60 to 1 by 1975. Such aircraft, functionally speaking, are to the commercial passenger and cargo aircraft somewhat as private automobiles are to buses and trucks. That is, they provide the complement, the versatility and the independence of choice essential to the adequacy of a comprehensive system, just as private cars do on the ground. Thus they are and must continue to be an integral part of such a system if we are fully to avail ourselves of this aviation opportunity.

Let us therefore recognize that it is not the airport which is the "problem;" the problem is rather the absence of an over-all system which provides for the most effective use of air transportation.

There is no implied criticism of anyone for this deficiency. What blame there is must be shared by all. Moreover, we are living in times of rapid, almost frantic, social, economic and technological change. In such times the effort to keep clearly focused on the central facts is like watching a rapidly changing sunrise or sunset in which almost imperceptibly the colors change before your eyes, and that which was dominant a few seconds earlier is replaced almost without your noticing how it came about. The present reality and potential of air transportation of people and cargo just recently became one of those central facts.

Nevertheless none of us who has any degree of responsibility in connection therewith can any longer be excused for his failure to contribute his part toward the development of an adequate and effective air transportation system. For air transportation has indeed become a matter central to the national interest. It is no longer merely a peripheral supplement to our total transportation system; it is becoming quite literally the core of our transportation system. There are many statistics in support of this fact such as 10,000 new air travelers a day, a doubling and then a redoubling of passenger miles in a decade. . .

How do we go about establishing a system which will adequately provide for the growing importance of air transport?

With but two exceptions out of more than nine thousand airports, airports are owned and operated either privately or by local or regional authority.

They all have as their purpose bringing the benefits of air travel, both commercial and general, to their respective communities in the most effective way.

They provide the physical link between the community and aviation. As the significance of air travel is rapidly increasing so are they becoming rapidly more important gateways to the communities they serve.

They are part of the highly systematized operations of the airlines, and at the same time part of the less highly systematized but equally vital link with general aviation.

Yet while airport managers can and must make local decisions and determinations based on the particular circumstances of their communities, they cannot see very clearly the size and nature of the total system whose development so directly affects them.

Although the managers and owners of airports are obviously a key element in the air transportation system, it is neither fair nor appropriate to expect them to come up with the over-all answers.

What of the other elements of the aviation commu-

nity? The carriers, the manufacturers, the pilots, both commercial and private, and the like? All of these groups are of course highly motivated to find answers to this central problem. But with the possible exception of the manufacturers, who are in a sense one step removed from the problem, each has only a part of the picture.

Finally, what is the role of the federal government? A new Department of Transportation has just recently come into existence primarily on the principle that all modes of transportation must be viewed as parts of an effective over-all transportation system if the national interest is to be served. But can this agency alone come up with a federally-devised air transportation system which will have a chance of being accepted at the many thousands of diverse airport locations? I think not. The problem is too complex and involves too many interests and specialized elements. Its solution will require the cooperation, contribution, and skills of all of the elements of the aviation community as well as those of many non-aviation interests, ranging from municipal governments to the leadership in other non-aviation transportation modes.

The beginnings of such a solution are to be found in turning the weakness presented by so many disparate interests into a strength.

As we each have separate viewpoints and interests, so do we each have something special of value to contribute. We in the manufacturing end, for example, frequently boast of our rarefied skills in systems analysis. Here is a job calling for the use of that capability right in our own back yard. We will undertake to produce that component of the solution, factoring in all elements conceivably relevant.

The airlines have a unique and special experience crucial to such an analysis. They are more than willing to make their contribution.

The pilots, both carrier and general aviation, live most intimately and closely with the realities and practicalities involved in the actual operation of the system; while those charged with managing our airports are most directly affected by plans and programs for the future.

Each of these elements has a vital stake and vital part in the formulation of an effective national air transportation system.

As manufacturers of all types of aircraft, and as an industry whose health is very directly linked to the fulfillment of the air transportation promise, and as an industry confident of its systems analysis capabilities, we recognize our responsibility to assume a major leadership role in getting this ball rolling. We are already heavily engaged in so doing. . . .

Air travel both provides and promises the greatest hope that our economic, cultural and social life can continue to advance at a pace that will keep this nation in the forefront in the decades ahead.

That is the positive picture today. That is the situation that has almost imperceptibly moved into being. Its continuation, however, depends on the retention of a high degree of performance in all three of the basic elements — speed, economy and safety.

We must find, and find soon, answers commensurate in their scope and vision to the nature of the opportunity and the nature of the problems which jeopardize realization of this opportunity. . . .

The city that you can get in and out of fast, both with people and cargo, will be the economically healthy city of the future. Every hour of delay, every ounce of inefficiency in a transportation system is inevitably piled on to costs, to the detriment of the whole economy, available jobs, income, and competitive positions. . . .

If we all recognize the aviation opportunity for what it is, and have the courage, imagination and statesmanship to take the steps necessary to avail ourselves of it, however radical these steps may be, we will have struck a major blow for the future well-being of our citizens, our communities and our nation as a whole.

The United States represents only six percent of the world's population. The way we have been able to maintain our security, our unequalled standard of living and our economic growth rate has been by the wise and sophisticated use of our technological strength.

The so-called "airport problem" has merely moved front and center as a test of our continued ability to exploit technological advance to our national advantage. That is the opportunity aviation now affords us.

INSTANT AIRPORT

In the spirit of old-fashioned American barn raising, the people of Brockport, New York, collectively and inexpensively built themselves an airport — in one day.

Starting at 7 a.m., volunteer workers manned donated earth-moving equipment. Eleven hours and thirty-eight minutes later the first airplane touched down on the 3,500 foot runway. This twin-engine Navajo was followed onto the newly built strip by a single-engine airplane.

The airport development all started several years ago when a school teacher, Wayne J. (Jack) Mazzarella, wanted to get zoning permission from the city to build a private strip for his own airplane on farm land that he owned. The Chairman of the town's zoning board, although not an airplane owner himself, makes frequent use of charter and air-taxi airplanes in connection with his produce business. Recognizing the value of an airport to the economic growth of the community, the Zoning Board Chairman urged Mazzarella to consider building an industrial airpark.

Using the AIA Utility Airplane Council's airport development material as a guide, Mazzarella set about gaining community support. By the time final zoning changes were approved, community spirit for the airport reached an enthusiastic level. Mazzarella's telephone rang regularly with offers of assistance. One week before construction day, even the airport's previously most vocal opponent stopped Mazzarella on the street to offer his assistance and "a chain saw which is the only tool I have."

When the day for construction arrived, there were more than a dozen pieces of equipment and forty to fifty men on hand to put Brockport on the air map. Throughout the day, additional men and machines arrived as they finished their overtime work on other projects.

Junior Chamber of Commerce members cut oil drums in half and painted them yellow to be used as runway markers.

An airport neighbor served a picnic lunch in his backyard to the workers.

Site for the Brockport, New York, airport (above) was simply farm land. Eleven hours and 38 minutes later, a Piper Navajo landed (below) on a 3,500-foot runway built on the site.

One contractor took delivery of a giant scraper two days early so that it would be available for the airport work.

Students from Mazzarella's class helped to remove rocks and stones from the graded surface.

By late afternoon, top soil had been gouged away to a firm dirt base. Knolls had been leveled, and gulleys filled.

While Mazzarella drove a grader on a final drive down the runway — like a barber clicking the scissors around the ears after the haircut is complete — a twin-engine Piper Navajo made three low passes over the field. Then it landed, cutting a paper ribbon as it completed its roll-out.

Aboard the airplane was W. T. Piper, Sr., President of Piper Aircraft Corporation. A dean of the general aviation industry, and a founder member of the AIA Utility Airplane Council, Mr. Piper typifies the industry's concern and action in airport development work.

With the work completed of transforming a weed filled, rough field into a usable landing strip, the workers celebrated with an outdoor barbecue dinner.

As the two airplanes departed later that evening Mazzarella looked at the town's new airport and discussed future plans. The next step will be to pave the runway. Then taxiways, parking aprons and a small administration building will be added. Roads will be hacked through the surrounding area for ground access to both a residential and an industrial development area.

Mazzarella has offered to donate the airport area to the city and favorable action is expected this fall when the town council sets its budget for 1968.

With an operating airport, present businessmen, like the Chairman of the Zoning Board, now have a direct air link with markets throughout the nation. Future business prospects can be told "yes" when they inquire if Brockport has accommodations for air transportation.

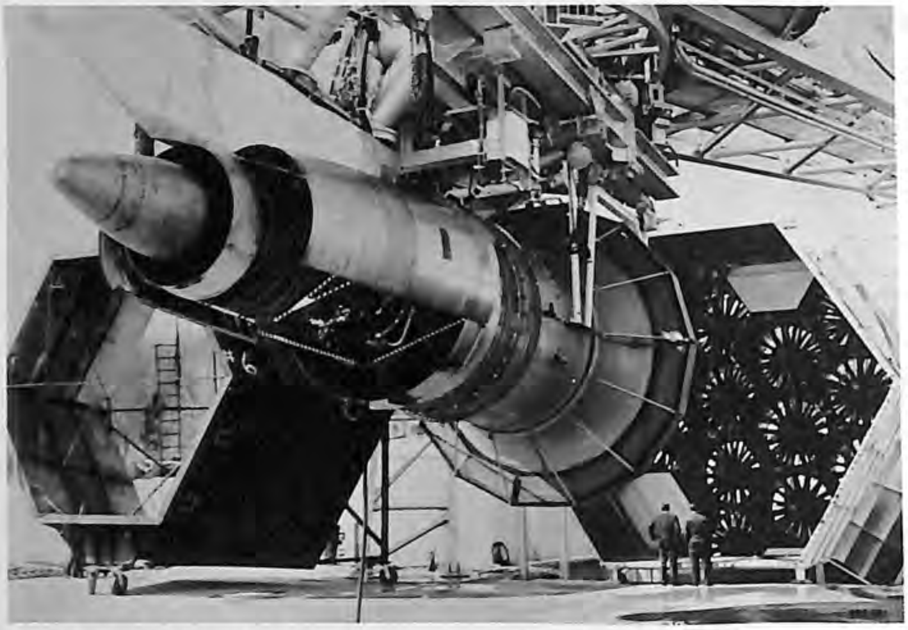
It took desire, determination and drive. The only expense to the town was fuel for the equipment. And, as one man commented, "that's oil for the lamps of progress."

Jack Mazzarella, sparkplug of the airport project, greets W. T. Piper, Sr., president of the Piper Aircraft Corp., (right, above), who landed in the first plane to visit the airport. Mr. Piper (below, upper left) speaks before a barbeque dinner celebrating completion of the airport.

Construction equipment moves into action (above) to level runway.

Oil drums (left) for runway markers were cut and painted by Junior Chamber of Commerce members.

Windsock billows (below) as earth-moving equipment grades area.



GE Tests Huge Jet Engine In New Crosswind Facility

General Electric has built what is believed to be the largest outdoor crosswind facility for testing large jet engines at Peebles, Ohio. The huge TF-39 turbofan engine the company is building for the Air Force/Lockheed C-5A is being tested in the facility which employs hurricane-like winds up to 120 knots provided by 13 fans.

The engine being tested is mounted in line with the air stream and can be rotated a complete 360 degrees to test the effect of various crosswinds, gusts and constant winds on engine starting and operating characteristics. Blades on all 13 fans are variable, permitting control of wind velocities at any speed between 0-knots and the maximum speed for each funnel configuration.

A cloud generator unit sprays water to create icing conditions. Ice particles, ranging in size from 15 to 25 microns, are used for portions of the anti-icing tests on the TF-39 turbofan.

Balsa Wood Encapsulates Space-Bound Instruments

A variety of "hard landing" capsule payloads have been developed by Philco-Ford to enable scientists to send delicate instruments to the moon and planets without destroying them on landing. Shells have been developed of balsa wood covered with a fiberglass coating to cushion the inner instrument package.

Because of the extreme shock of landing instruments at high speeds, the hard landing capsules must be outwardly protected with an energy absorbing material. The capsules are generally spherical in shape to allow for omnidirectional touchdown. Upon landing the outer shell of the capsule is released and mechanically peeled off in segments. This type of capsule provides the U.S. an economical means of obtaining vital lunar and planetary terrain information to aid future space travelers.

RCA Develops New REST Antenna System for Tracking

RCA's Missile and Surface Radar Division has developed a new antenna which adds electronic beam steering to the mechanical slewing used by precision monopulse radars which track high performance missiles, satellites and space probes.

The resulting array enables these radars to track as many as 20 targets simultaneously in a 10 degree field swept by inertialess electronic scanning. The 10 degree field also facilitates acquisition and tracking of maneuvering bodies or those which have unconventional trajectories or orbits.

The new system, known as REST (Radar Electronic Scan Technique), replaces the familiar paraboloid antenna, common to most tracking radars with a

planar array made up of thousands of dipoles. The dipoles are fed by a conventional horn feed through solid state phase shifters which are controlled by a beam steering programmer. The pattern of phase delays impressed on the array by the programmer and phase shifters can steer the beam five degrees in any direction from the array axis, providing a 10 degree cone of electronic scan.

Ryan Sink Rate Radar Measures Descent Rate

Flight tests are being conducted with both civilian and military aircraft using Ryan Aeronautical Company's Sink Rate Radar which measures rate of descent as the aircraft lands. Photo shows an engineer monitoring the descent rate

data as the plane makes a landing approach in the background. Such early detection and preventive maintenance prevents hard landings from weakening air frames.

In the past 16 years more than 3,000 airborne navigation systems have been designed and produced for use in 33 types of aircraft by Ryan. Designed for fixed and rotary-wing aircraft and spacecraft applications, more Airborne Precision Navigation designations have been applied to Ryan systems than any other company now in the airborne electronic system field.

Major share of its airborne navigation systems employ the use of continuous-wave Doppler radar design. This technique measures the difference in radar frequency between signals transmitted and the "echo" return. This difference is computed electronically to measure aircraft altitude and velocity.

Bell Develops Gravity Meter For On Board Measurement

A Shipboard Gravity Measuring System has been developed by Bell Aerosystems which enables precision measurement of gravity from on board a ship even in heavy seas.

Key components of the system include a gravity sensor, stabilized platform and dynamic digital filtering system. The sensor consists of Bell's Model VII inertial accelerometer. The platform has two degrees of freedom and uses accelerometers as level sensors and rate integrating gyros to stabilize the gravity sensor.

Initially provided for scientific and military applications, Bell expects to move into the commercial field using the system for oil exploration.

UTC Ships Record Tonnage Of Boosters for Titan III-C

Segmented parts of three complete 250-ton boosters for the Air Force Titan III-C made up the largest single shipment to date recently of solid-propellant booster rockets from Fremont, Calif., to Cape Kennedy, Fla. The rockets were produced by United Technology Center at Coyote, Calif., and shipped by rail.

Once loaded on 11 special heavy-duty rail cars, they joined a regularly scheduled freight train for the trip to Florida.

A pair of the 120-inch diameter rockets will deliver a combined liftoff thrust of about 2.5 million pounds. Already used for five launches of the Titan III-C, the 86-foot tall rockets have performed flawlessly on all flights.

The record shipment included fifteen 40-ton center segments and six smaller end segments and contained a total of 1,260,000 pounds of propellant.

This particular shipment will be used to build up booster rockets for the tenth and eleventh flights expected to take place late next year.

Goodyear Designs High-Speed Associative List Searcher

Goodyear Aerospace has designed and built a prototype Associative List Searcher (ALS) for the Air Force which may play a vital role as a shortcut to a broad spectrum of scientific, military and business data processing.

ALS is an ultra-high speed digital device capable of searching a list of 32,000 items in less than two one-millionths of a second (two microseconds). It is designed to search large, unorganized lists and is expected to be particularly valuable in certain "real time" data processing in which the usefulness of general purpose computers frequently is limited because they are too slow.

Potential military applications include high speed operations such as intelligence data handling, target recognition and information retrieval.

An ALS is designed for use in conjunction with a general purpose computer within a data processing system. In operation it compares an item from an incoming "search" list against the list of items stored in its memory to obtain intersects—the items that are common to both lists.

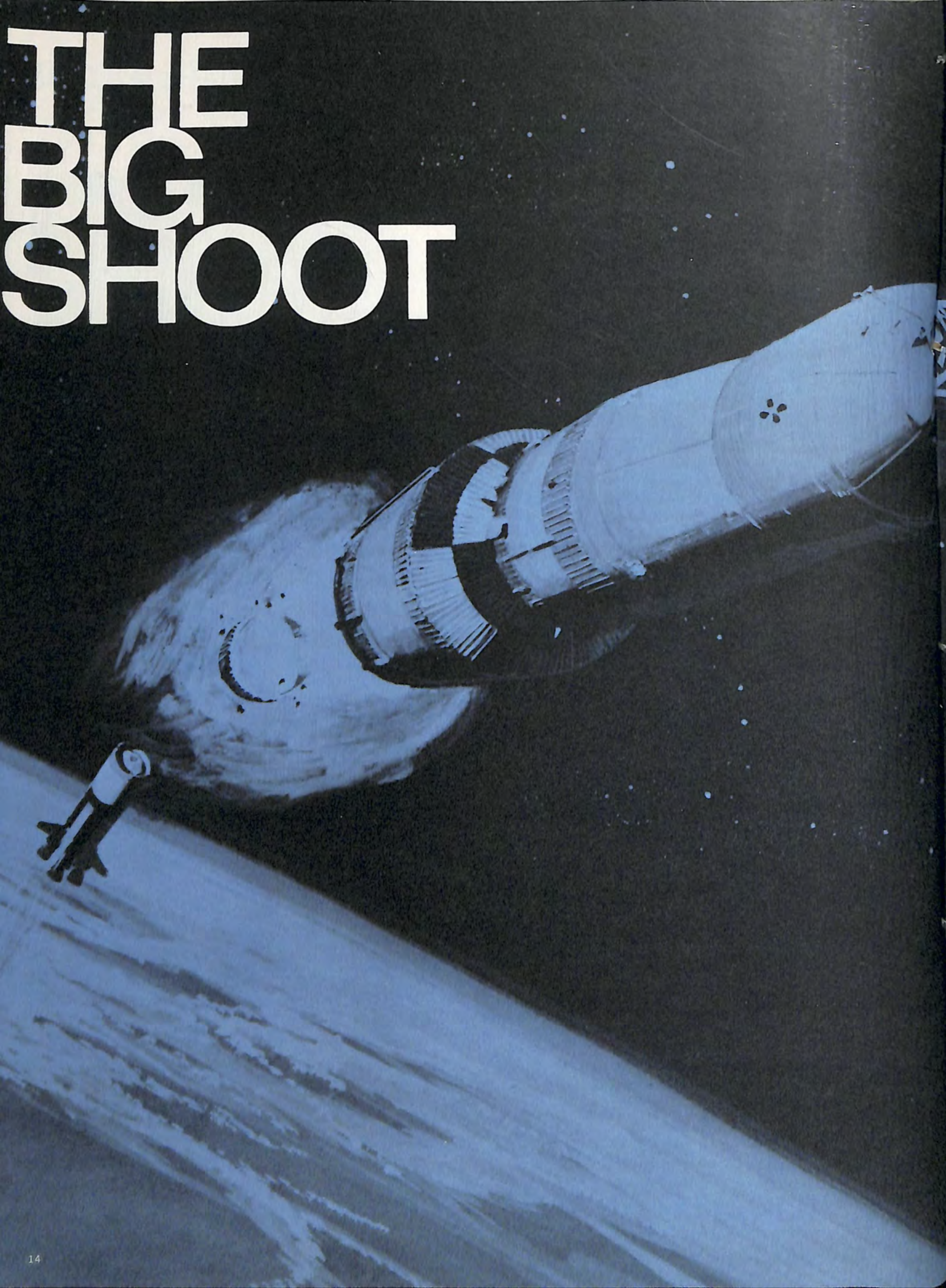
1967 Aerospace Year Book Records Industry's Progress

The 1967 Aerospace Year Book, standard reference of the U.S. aerospace industry for 45 years, has been published by Spartan Books of Washington, D. C., as an official publication of the Aerospace Industries Association.

The 580-page volume contains illustrated aerospace highlights of 1966 in aircraft missiles, launch vehicles, spacecraft, targets and drones, systems and engines; summaries of the year's activities of the leading U.S. aerospace manufacturers; highlights of federal research and development programs; and an account of the accomplishments during the year in the airlines and general aviation.

Writing in the foreword, Karl G. Harr, Jr., AIA president, comments upon the "unprecedented overall advance in the aerospace industry." Harr says 1966 was "a year of notice to all that the problems that lie in the path of fullest exploitation of aerospace potential must be solved if the public interest is to be best served."

THE BIG SHOOT



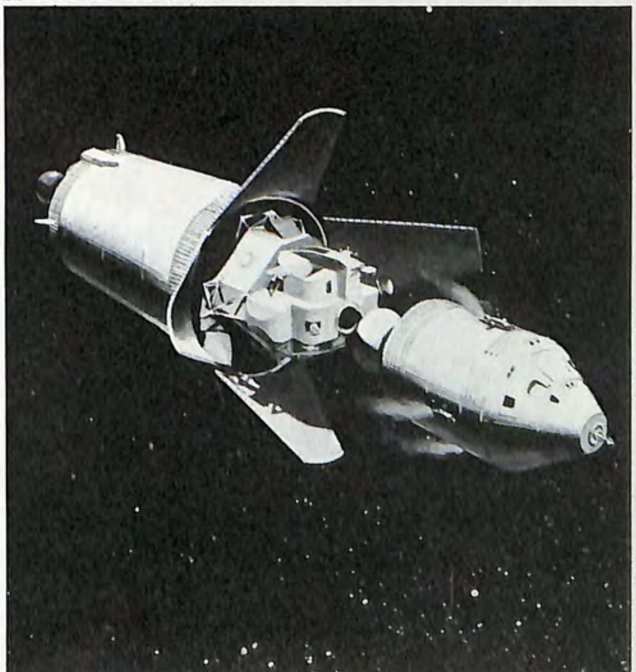
One day early this fall, the Apollo 4 will be launched from Complex 39, Cape Kennedy, Florida — the most significant U. S. test of man's ability to journey to the moon.

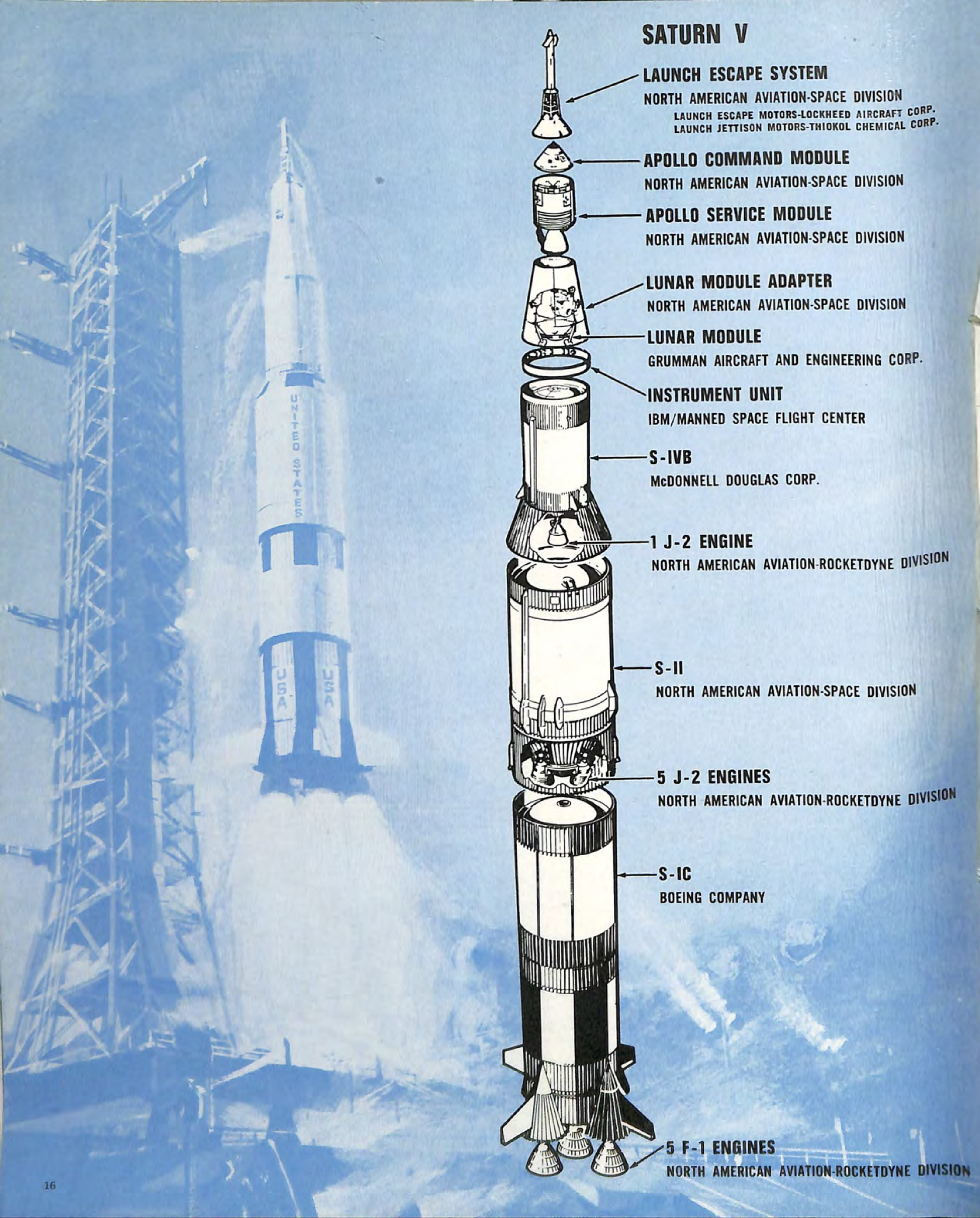
The launch is an "all-up" concept — the first unmanned test of Apollo/Saturn V in full lunar flight configuration. This gigantic, utterly complex system will be maneuvered from launch to intricate earth orbital tests to splash down.

The vast project has rolled along on many fronts simultaneously, under the National Aeronautics and Space Administration's "concurrency concept." This means that some of the building began before engineering drawings were completed; testing started while systems were only partially finished. Research, design, development, and testing were telescoped.

The "all-up" Apollo 4 launch is the concurrency concept applied to flight testing. As many components as possible will be tested in this flight. Previously, most space flight testing was done in a series of tests.

First stage of Saturn (left) drops away, and second stage ignites. The separation of the Apollo spacecraft from the booster is shown below.




SATURN V
LAUNCH ESCAPE SYSTEM
NORTH AMERICAN AVIATION-SPACE DIVISION
LAUNCH ESCAPE MOTORS-LOCKHEED AIRCRAFT CORP.
LAUNCH JETTISON MOTORS-THIOKOL CHEMICAL CORP.
APOLLO COMMAND MODULE
NORTH AMERICAN AVIATION-SPACE DIVISION
APOLLO SERVICE MODULE
NORTH AMERICAN AVIATION-SPACE DIVISION
LUNAR MODULE ADAPTER
NORTH AMERICAN AVIATION-SPACE DIVISION
LUNAR MODULE
GRUMMAN AIRCRAFT AND ENGINEERING CORP.
INSTRUMENT UNIT
IBM/MANNED SPACE FLIGHT CENTER
S-IVB
McDONNELL DOUGLAS CORP.
1 J-2 ENGINE
NORTH AMERICAN AVIATION-ROCKETDYNE DIVISION
S-II
NORTH AMERICAN AVIATION-SPACE DIVISION
5 J-2 ENGINES
NORTH AMERICAN AVIATION-ROCKETDYNE DIVISION
S-IC
BOEING COMPANY
5 F-1 ENGINES
NORTH AMERICAN AVIATION-ROCKETDYNE DIVISION
UNITED STATES
USA
USA

The first stage was fired aloft; then a second stage was added, and that combination tested. Finally, the entire rocket-spacecraft system was assembled and launched. The launch will consist of all three stages of the huge rocket — S-IC, S-II and S-IVB — and the unmanned Apollo spacecraft.

The "firsts" involved in this flight test are numerous. They involve largely the compatibility of hundreds of minor systems and, in turn, their compatibility with several major systems. Among the more important firsts:

- First full flight qualification of the complete lunar "stack" — everything to put man on the moon except the man.

- First flight test of a cluster of five F-1 engines hoisting a full load. They will deliver 7,610,000 pounds of thrust at takeoff and burn for 150 seconds.

- First full separation performance tests of the S-II and the S-IVB. The S-IVB had previously flown in a separation test with the uprated Saturn.

- First flight test of the S-II, largest hydrogen-oxygen fueled booster ever flown in the U. S. Five J-2 engines produce a thrust of 1,125,000 pounds for 370 seconds.

- First restart in flight of the third stage S-IVB, powered by a single J-2 engine. It will coast in a parking (100 mile) orbit for about three hours. This will be a significant achievement.

- First test of the Apollo spacecraft and subsystems in a deep space environment. The test will be higher than ever before — 9,900 miles. The Block II heat shield ablater will be tested in a 9 degree angle of reentry, steepest ever for the spacecraft at 25,000 mph. Once placed in a simulated translunar mode, one side of the spacecraft will remain continuously oriented toward the sun for 4 hours and 5 minutes. This maneuver will determine the effect of "cold soak" on subsystem operation.

These are merely highlights. In addition, it will be the first time a vehicle of this size has been fueled. The pad at Complex 39 will be cleared 10½ hours before launch for fueling. After a normal vehicle is fueled the crew returns to the pad for a final check. However, this will not be done in the Apollo 4 test because of the huge quantities of super cold fuel.

The performance of a small automatic programmer will be crucial to this test. The programmer, occupying a space of one cubic foot, will be expected to perform the thinking and analytical capabilities of three highly trained astronauts throughout the whole range of delicate, complicated maneuvers.

The efforts of thousands of aerospace contractors and tens of thousands of highly skilled and dedicated workers will go on the line when the five F-1 engines ignite with a roar that will shake the future.

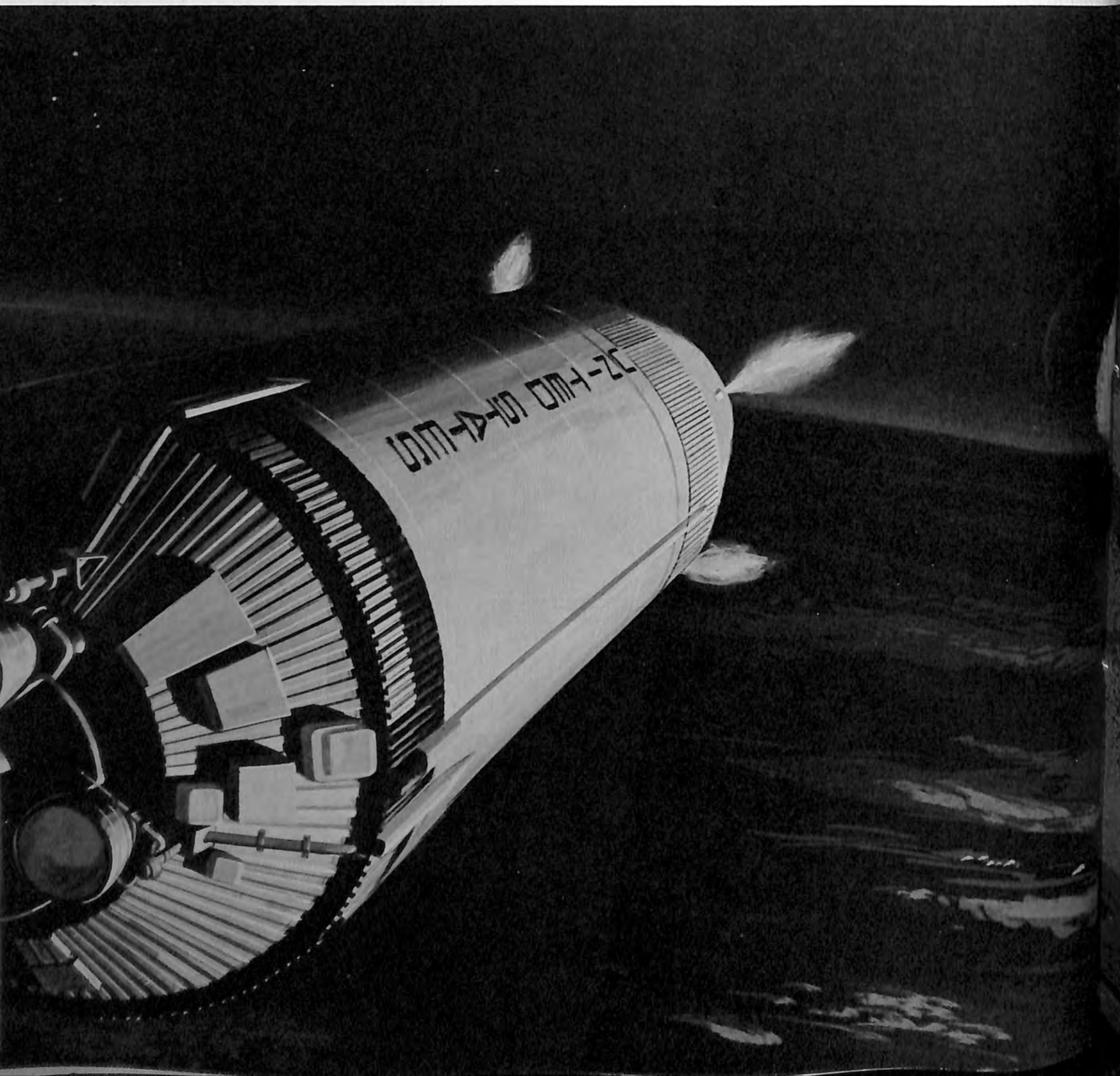
AIA MANUFACTURING MEMBERS

Abex Corporation
Aerodex, Inc.
Aerojet-General Corporation
Aeronca, Inc.
Aeronutronic Division, Philco-Ford Corporation
Aluminum Company of America
Amphenol Connector Division
  Amphenol Corp.
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
Fairchild Hiller Corporation
The Garrett Corporation
General Dynamics Corporation
General Electric Company
  Defense Electronics Division
  Flight Propulsion Division
  Missile & Space Division
  Defense Programs Division
General Motors Corporation
  Allison Division
General Precision Systems, Inc.
The B. F. Goodrich Company
Goodyear Aerospace Corporation
Grumman Aircraft Engineering Corp.
Gyrodyne Company of America, Inc.
Harvey Aluminum, Inc.
Hercules Incorporated
Honeywell Inc.
Hughes Aircraft Company
IBM Corporation
  Federal Systems Division
International Telephone & Telegraph Corp.
  ITT Controls and Instruments Division
  ITT Federal Laboratories
  ITT Gilfillan, Inc.
Kaiser Aerospace & Electronics Corporation
Kaman Corporation
Kollsman Instrument Corporation
Lear Jet Industries, Inc.
Lear Siegler, Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corporation
The Marquardt Corporation
Martin Marietta Corporation
McDonnell Douglas Corp.
Menasco Manufacturing Company
North American Aviation, Inc.
Northrop Corporation
Pacific Airmotive Corporation
Piper Aircraft Corporation
PneumoDynamics Corporation
Radio Corporation of America
  Defense Electronic Products
Rockwell-Standard Corp.
  Aircraft Divisions
Rohr Corporation
Ryan Aeronautical Company
Solar, Division of International
  Harvester Co.
Sperry Rand Corporation
  Sperry Gyroscope Company
  Sperry Phoenix Company
Sundstrand Aviation, Division of
  Sundstrand Corporation
Thiokol Chemical Corporation
TRW Inc.
Twin Industries Corp.,
  Division of the Wheelabrator Corp.
United Aircraft Corporation
Westinghouse Electric Corporation
  Aerospace Electrical Division
  Aerospace Division
  Astronuclear Laboratory
  Marine Division

AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W., Washington, D. C. 20036

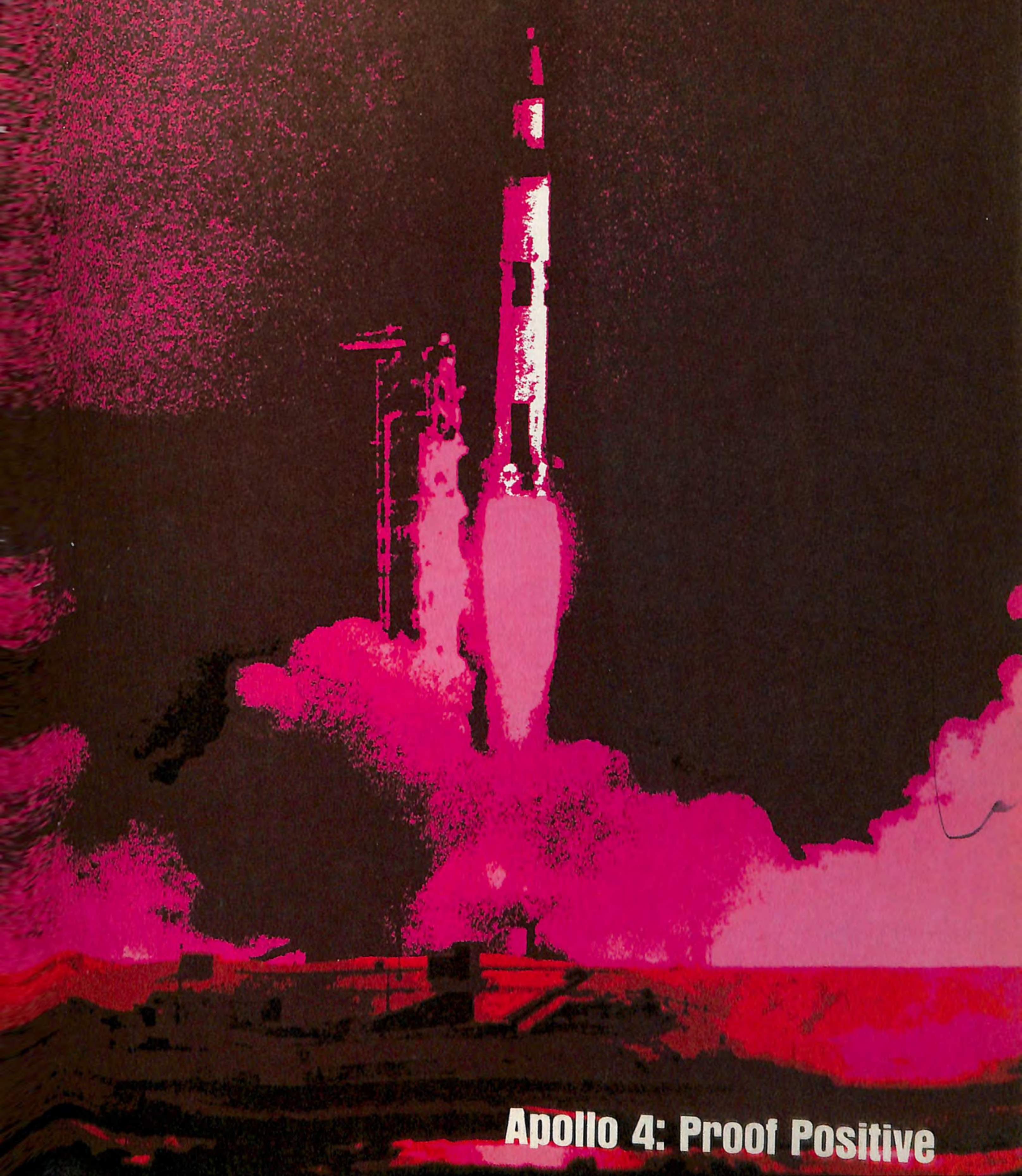
RETURN REQUESTED

(See *The Big Shoot*, page 14)



aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • WINTER 1967

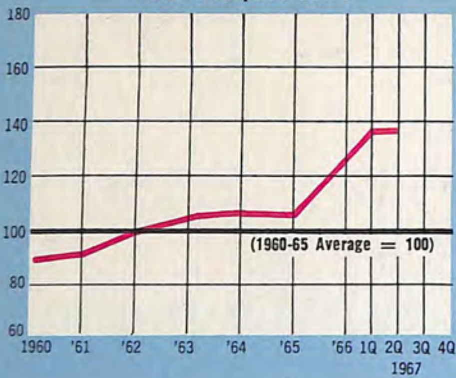


Apollo 4: Proof Positive

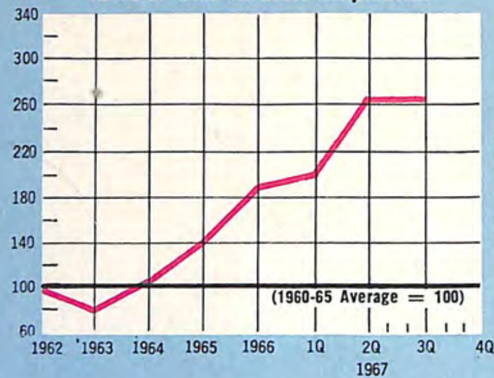
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales

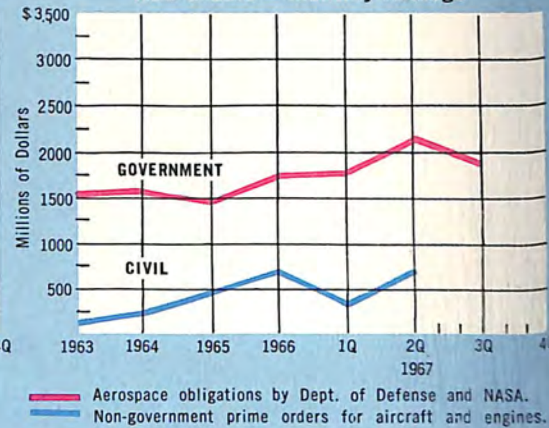


Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average



ITEM	UNIT	PERIOD	1960-65 AVERAGE *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $ Billion $	Annual Rate Quarterly	19.4 4.8	Quarter Ending June 30 1967	23.9 6.0	26.1 R 6.5	26.5 R 6.7
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	Sep. 1967	1,978	858	2,355
Aircraft	Million $	Monthly	601	Sep. 1967	1,205	309	1,488
Missiles & Space	Million $	Monthly	550	Sep. 1967	773	549	867
Aerospace expenditures: Total	Million $	Monthly	1,067	Sep. 1967	1,257	1,433	1,366
Aircraft	Million $	Monthly	561	Sep. 1967	777	939	930
Missiles & Space	Million $	Monthly	506	Sep. 1967	480	494	436
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920 ⁜	Oct. 1967	1,266	2,007	1,572
Aircraft	Million $	Monthly	447	Oct. 1967	919	1,483	1,249
Missiles & Space	Million $	Monthly	473	Oct. 1967	347	524	323
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	Sep. 1967	551	262	413
Expenditures	Million $	Monthly	130	Sep. 1967	409	359	312
UTILITY AIRCRAFT SALES							
Units	Number	Monthly	692	Nov. 1967	1,301	1,402	1,131
Value	Million $	Monthly	15	Nov. 1967	36	33	32
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3 #	Quarter Ending Sep. 30 1967	26.9	28.5	29.2 E
U.S. Government	Billion $	Quarterly	11.6		15.8	15.7	16.0
Nongovernment	Billion $	Quarterly	3.7		11.1	12.8	13.2
EXPORT							
Total (Including military)	Million $	Monthly	110	Sep. 1967	109	148	188
New Commercial Transports	Million $	Monthly	24	Sep. 1967	28	32	75
New Utility Aircraft	Million $	Monthly	2	Sep. 1967	5	8	5
PROFITS				Quarter Ending June 30 1967			
Aerospace — Based on Sales	Percent	Quarterly	2.3		3.2	2.6	2.5
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		5.9	4.9	5.2
EMPLOYMENT: Total	Thousands	Monthly	1,132	Sep. 1967	1,339	1,394	1,403 E
Aircraft	Thousands	Monthly	499	Sep. 1967	583	610	617
Missiles & Space	Thousands	Monthly	496	Sep. 1967	583	603	605
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	Sep. 1967	3.44	3.54	3.58 E

R Revised
E Estimate
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
\# Averages for 1961-65.
⁜ Averages for fiscal years 1960-1965.

AEROSPACE REVIEW AND FORECAST

Sales in the aerospace industry during 1967 reached $27.3 billion, a 13 percent increase over 1966 sales of $24.2 billion, and the Aerospace Industries Association predicts 1968 sales will increase nearly 7 percent over 1967 to $29.2 billion.

The gain in 1967 was due to increases in sales of commercial aerospace products, largely civil aircraft, and products for the Department of Defense.

The dramatic increase in turbine-powered transport sales is a major factor in over-all aerospace growth. From 1965 sales of $1,197 million to 1967 sales of $2,458 million, the increase was 105.3 percent, and from the 1965 sales to expected sales of $3,808 million in 1968, the increase is 218.1 percent.

Sales by the aerospace industry to the Department of Defense in 1967 were $15.9 billion, up from $13.3 billion in 1966, a gain of 19.5 percent. Defense Department sales in 1968 are expected to reach $16.1 billion.

Military aircraft sales rose from $8.4 billion in 1966 to $10.4 billion in 1967. Missile sales in 1967 increased $500 million over 1966, rising from $4.0 billion to $4.5 billion.

Non-military space sales declined in 1967 to $4.1 billion from the 1966 peak of $4.9 billion. Military space programs in 1967 remained stable at $1.0 billion.

Sales of nonaerospace products and services increased slightly between 1966 and 1967 from $2,323 million to $2,350 million. These sales represent work in such nonaerospace fields as oceanography, water desalination, rapid transit, urban problems, job retraining and other areas.

Production of general aviation aircraft declined between 1966 and 1967 from a record 15,747 units to 14,375, and the total value of shipments dropped from $444 million to $338 million. However, utility and executive aircraft production in 1968 should total a record 16,900 units, valued at $450 million.

Civilian helicopter production increased from 390 units in 1966 to 465 in 1967. Value of this production rose from $40 million in 1966 to $43 million in 1967. Helicopter production is expected to reach a record 500 units in 1968.

Growth of the aerospace backlog between 1966 and 1967 was substantial. Between the third quarter of 1966 and the third quarter of 1967 it rose from $26.9 billion to $29.2 billion, or 8.6 percent. Commercial aerospace backlog has shown the largest increase, rising from $11.1 billion to $13.2 billion during that period. An AIA survey shows that between the period of June 30, 1966 and 1967 the backlog of commercial transport aircraft alone rose from $4.7 billion to $7.1 billion, or 51 percent.

Exports totalled more than $1.95 billion in 1967, a gain of $400 million over 1966, and exports in 1968 are expected to exceed $2 billion.

Aerospace industry employment in 1967 reached 1,407,000 persons, making the industry the nation's largest manufacturing employer. Employment in 1968 should reach 1,430,000 because of the growth of civilian aircraft programs.

The level of net profits after taxes as a percentage of sales decreased from 3.0 percent in 1966 to 2.6 percent in 1967, according to the Securities and Exchange Commission.

AIA

aerospace

Official Publication of the Aerospace Industries Association of America, Inc.

PRESIDENT • Karl G. Harr, Jr.
PUBLISHER • Glen Bayless

VOL. 5, NO. 8 *WINTER 1967*

EDITOR • Gerald J. McAllister
ASSOCIATE EDITOR • Richard W. Balentine
ECONOMIST • Gerson N. Chanowitz
ART DIRECTOR • James J. Fisher

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;

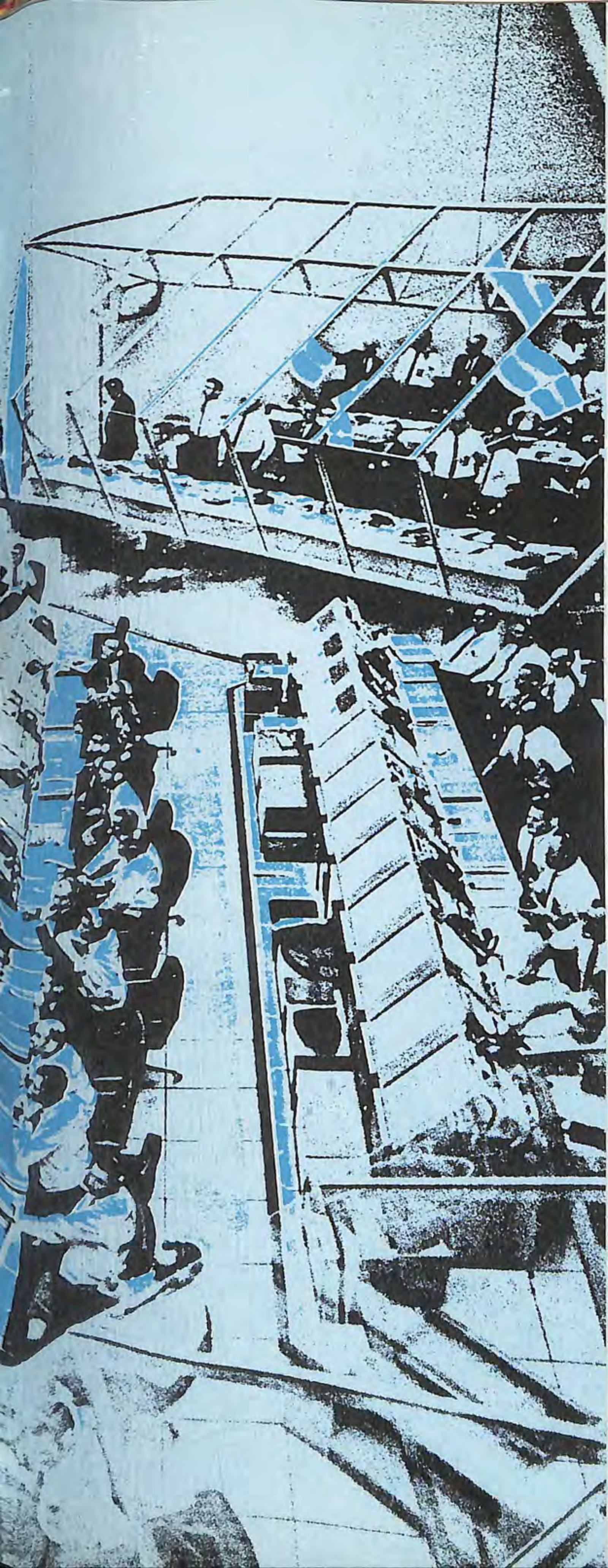
Foster understanding of civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published monthly 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

Western Office: McCulloch Building, 6151 West Century Blvd., Los Angeles, Calif. 90045



APOLLO 4: PROOF POSITIVE

It is a startling thought that when three American astronauts embark on a mission to the moon some two years hence every item of equipment in their multi-million-part vehicle will be going aloft for the first time.

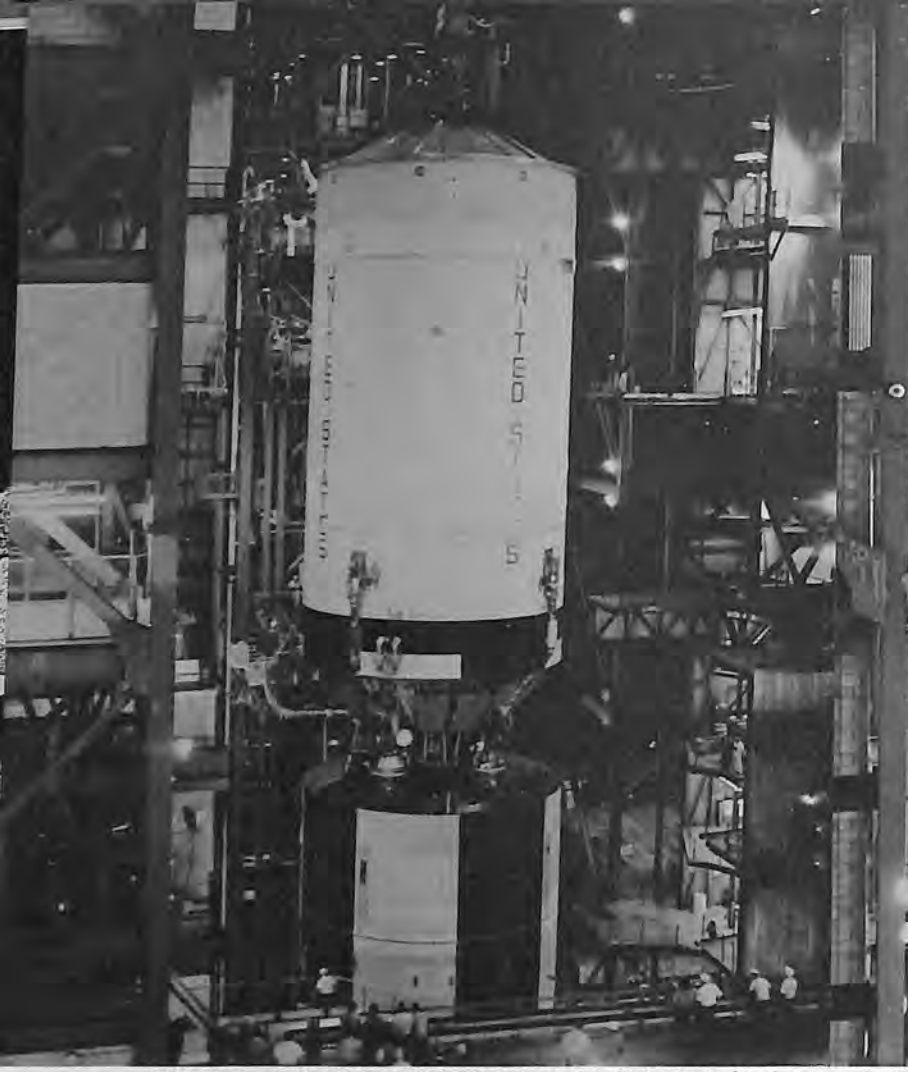
A modern airplane may have hundreds, even thousands of flight test hours before it enters operational service. But contemporary space technology dictates a one-flight lifetime for space vehicle components; the parts recovered are useful only for study purposes.

Yet the size, complexity and cost of the mammoth man-carrying space vehicles like NASA's Saturn V/Apollo permit no daily, repetitive tests such as might be conducted on a new airplane. Under present plans, the first Apollo manned earth-orbital flight will come after only three unmanned tests of the Saturn V moonbooster. And the lunar mission "Go!" may be signalled as early as the sixth manned Saturn V flight.

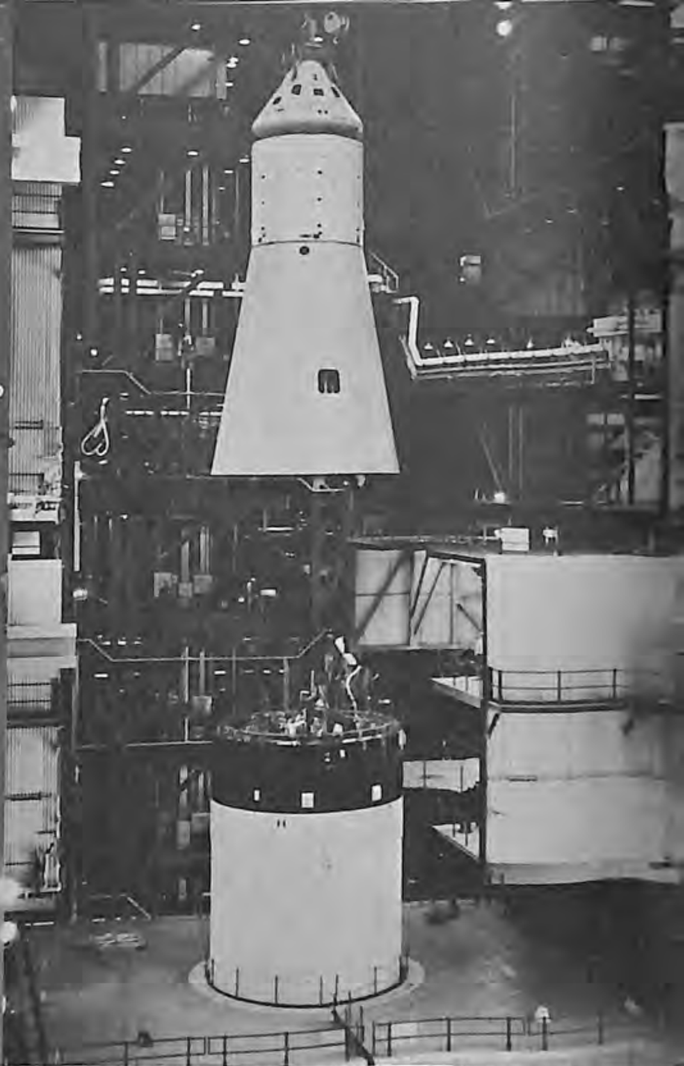
These facts point up the extraordinary type-reliability requirement for every article of equipment in the Saturn V/Apollo "stack;" since each item flies only once, *all* items of a given type must be perfect. The facts also underscore the tremendous significance of a flight test like the recent Apollo 4, for these flights, though few in number, represent the real proving ground for the lunar landing mission.

Apollo 4 was without doubt the most important unmanned space operation ever launched. A near flawless, "text book" test, it restored a great deal of the waning public confidence in the Apollo program. It proved the spaceworthiness and compatibility of the Saturn V/Apollo design and it served as the initial rehearsal for the lunar landing.

The lay observer, watching on television or reading the newspaper accounts, thrilled to the dramatic highlights of the momentous mission: the first-time blast-off of the world's mightiest launch vehicle, the injection of the spacecraft into simulated lunar trajectory and the fiery re-entry plunge of the Apollo Command Module at moon-return velocity of 25,000 miles per hour.



S-II stage of the Saturn V is mated to the first stage in the Vertical Assembly Building at Cape Kennedy, Fla. S-II stage was flown in a cluster of five J-2 engines for the first time during the Apollo 4 mission.



Apollo spacecraft is lowered and attached to the S-IVB stage. The S-IVB propulsion system provides the power for the Apollo spacecraft to leave earth orbit and start the journey to the moon.

These highlights, were but the "top of the iceberg," according to NASA mission director William C. Schneider. "Most of the things we were proving were below the surface, not readily apparent to the public view."

Aside from the primary objectives, the nine-hour mission included a great many individual tests of flight hardware. Of almost equal importance was the experience NASA and its contractors gained during months of pre-launch ground preparations. For example, there was the intensive, painstaking test and checkout of every item in the stack. These were precautionary measures designed to guarantee flight success, but at the same time NASA was studying the test procedures themselves. "We have to make sure the flight equipment works properly," says Schneider, "but we also have to learn how to best handle this equipment on the ground, to give it every chance to work in flight."

Apollo 4 served to prove the efficacy of the mobile launch concept, a new ground handling approach which has as its major aim the reduction of the time the space vehicle must spend on the launch pad, exposed to possible storm damage, dust contamination and corrosion. This involves assembly and checkout of the Saturn V/Apollo stack atop its launcher in an air conditioned building — the world's largest, naturally — then moving the whole launcher/stack some three and a half miles to the pad by means of an enormous, 6,000,000-pound crawler. The concept passed its greatest test several weeks before the flight, when the crawler picked up the 11,000,000-pound mobile launcher, topped by the 364-foot Saturn V/Apollo stack, and trundled the whole incredible package to the pad at the unspacelike pace of half a mile per hour.

With Apollo 4, NASA conclusively demonstrated the soundness of its bold new "all-up" approach to space testing. The all-up concept is, in essence, a calculated gamble, a leapfrogging philosophy which advocates compression of a number of lunar landing preliminaries into one flight. It balances the uncertainties of a number of first-time operations against a "confidence factor" based on the degree of equipment reliability achieved through the most exhaustive ground-test program in aerospace history. Normally, for instance, the basic stage of the Saturn V would have been flight tested alone. Next the first and second stages would have been sent aloft as a team, then all three stages of the launch vehicle, finally the complete booster/spacecraft stack. This would have involved at least four flights and about an additional year of preflight operations, post-flight analysis and the attendant extra millions of expense. Apollo 4's unquali-

Apollo 4 starts on its journey from the Vertical Assembly Building to the launch pad. The mobile launch concept achieved its major goal of reducing the time the launcher/stack must spend unprotected on the pad.

Enormous 6-million-pound trawler moves the Apollo package the three and a half miles from the assembly site. Speed at this time was one half mile per hour. Later the spacecraft reentered the earth's atmosphere at a speed of 25,000 mph.

fied success provided NASA with a bonus, not only in time and dollars, but in assurance that the all-up concept is feasible for future tests.

From the standpoint of proving the launch vehicle and spacecraft for their roles in the lunar landing program, there were at least a score of tests that could be considered "major," hundreds of individual systems on trial and literally thousands of measurements during Apollo 4. A thumbnail mission profile, a description of what was being investigated in the submerged as well as the visible portions of the iceberg, gives some idea of the exceptional effort involved in such a flight. One major system, the hold-down arms, received its first operational trial during the nine seconds between ignition of the first stage engines and the lift-off. The four hold-down arms are gigantic clamps which fix the space vehicle firmly to its mobile launcher. During assemby, checkout and transfer, the arms steady Saturn V, a safeguard against the possibility of toppling, but during launch they have another job: they refuse to allow the stack to depart the launcher unless all five Rocketdyne F-1 engines of the first stage are delivering full thrust. The arms get their information from a computerized system which monitors the energy values of each of the engines. Satisfied that all engines are in "Go!" condition, the electronic brain detonates explosive bolts in the hold-down arms, the clamps snap back and Saturn V/Apollo heads heavenward; if any engine is generating less than the required 1,500,000 pounds of thrust, the computer shuts down all engines.

On Apollo 4, the great arms had to resist well over a million pounds of "push," the difference between the 6,200,000 pound weight of the space vehicle and the upthrusting 7,500,000 pounds of propulsive energy. The strain was so great that, when the clamps released the vehicle, the huge 400-foot-tall, 5,500-ton mobile launcher stretched seven to eight inches.

Lift-off, of course, marked the first flight of the Boeing-built S-IC basic stage and the S-II second stage, built by North American Rockwell's Space Division. It was also the flight debut of the F-1 engines, which, in addition to providing the primary thrust had also to demonstrate their ability to "gimbal" or swivel to change the thrust line and make course corrections. The first demonstration came only seconds after lift-off, in the "pitch and roll maneuver."

On the pad, Saturn V/Apollo was aimed due east, but the mission plan called for an initial northeasterly heading. The change was effected by gimbaling of the appropriate engines, causing the stack to roll around its

Apollo 4 takes off on its historic mission. The five F-1 engines, in addition to providing the primary thrust of 7,500,000 pounds, demonstrated their ability to "gimbal" or change the thrust line and make course corrections.

Artist's conception shows the Apollo spacecraft Service Module engine firing. This engine handles all major velocity changes on a moon mission such as course corrections and injection into orbit around the moon.

vertical axis like a top in slow motion and pitch into the desired heading.

After separation of the first stage, and prior to ignition of the second stage engines, came a test known as the "ullage maneuver." When an upper stage separates from a lower, the sudden cessation of thrust causes the near-weightless propellant to slosh toward the top of the tank ("ullage" is the empty space in a beer barrel, or, in this case, the unfilled portion of the propellant tanks). Uncorrected, this would preclude engine operation, because the propellants are "climbing the wall" away from the engine inlets. The remedy was a four-second firing of eight ullage rockets, each producing 22,500 pounds thrust, mounted on the exterior of the S-II stage. The resultant acceleration provided a temporary artificial gravity which coaxed the propellants back toward the inlets.

With ignition of the S-II's five Rocketdyne J-2 engines, producing more than 1,000,000 pounds thrust, another test was accomplished; the hydrogen-fueled J-2 had flown before, but singly, never in a cluster.

A minor, but nonetheless important, test was performed shortly after the S-II went into action; the launch escape tower, the astronauts' "emergency exit" in case of an abort during launch, was jettisoned. Jettison tests had been made before with other boosters, but not under the dynamic conditions of a Saturn V launch.

New to flight test was the Lunar Module adapter, a truncated cone which fits over the moon taxi in the stack and protects it from exit heating, the friction of passage through the atmosphere on the outbound flight. There was no real Lunar Module in the Apollo 4 stack, but there was a dummy with the weight and configuration of the real thing. The adapter was load-measured to determine the vibrations to which the Lunar Module will be subjected and studied for the efficiency of its cork insulation in protecting it against friction heating.

Throughout the launch phase — and during some later maneuvers — a very important member of the stack was getting its first workout: IBM-built Saturn V Instrument Unit. A three-foot-tall ring jampacked with "black boxes," the Instrument Unit is the nerve center of the colossal launch vehicle, the navigator, monitor, information processor and supervisor of the three stages; its primary job is to send the signals to the various stages to direct the series of precise maneuvers that culminate in a lunar trajectory. Predecessor versions of the Instrument Unit had been flight tested aboard Saturn I and Uprated Saturn I vehicles, but its performance with its new Saturn V teammates needed careful checking.

Three hours and 12 minutes after launch came one of the primary Apollo 4 tests: the first re-start of a J-2 engine and a stimulated translunar injection. This is an absolute must for a lunar landing mission; without the 200,000-plus pounds of thrust the engine of the McDonnell Douglas S-IVB third stage provides, the Apollo spacecraft cannot leave earth orbit and start for the moon.

To the motorist accustomed to starting his car with a flick of the wrist, a re-start might seem a simple proposition. In space, with an engine as powerful as the J-2 and a fuel as tricky as hydrogen, it is a difficult and exacting operation which requires a complex of special equipment. The process involves, first of all, reconditioning the engine to the supercold (more than 400 degrees below zero) temperatures of its propellants after a three-hour "rest period" during which the engine was not in use; this is accomplished by running the liquid hydrogen and liquid oxygen propellants through the engine bleed system. Helium was also routed through the engine to purge it of contaminants left over from the first S-IVB burn, which kicked the spacecraft into earth orbit. A small "start tank," which provides gaseous hydrogen for the starting procedure, had to be re-filled. Then there was a firing of the S-IVB's ullage rockets, to give the propellants a headstart into the pumps. Finally, an automatic system checked temperatures, pressures and other conditions, verified that the engine was ready and so informed the Instrument Unit, which initiated the start. On Apollo 4, the J-2 came through this complicated procedure without a hitch and its thrust boosted the spacecraft into a flight path that simulated the start of a moon journey, an elliptical orbit with a high point more than 10,000 miles from earth. The S-IVB stage, its job now complete, separated from the stack to leave the spacecraft on its own.

Next came the first of two tests of the spacecraft's own propulsion system, the Aerojet-built 21,500-pound thrust Service Module engine which handles all of the major velocity changes on a lunar mission — course corrections, injection into orbit around the moon and moon-escape maneuvers. This engine differs from the big propulsive units of the three stages in a number of ways other than power output, notably in the fact that it has no pumps for the force-feeding of propellants into the engine; it depends on the pressure of helium gas introduced to the tanks to push the fluids into the thrust chamber. In addition, the propellants are "hypergolic," that is, the fuel and oxygen ignite on contact with each other and therefore need no ignition system. This combination of pressure-feeding and hypergolic propellants theoretically would permit the engine to operate in weightless space without a preliminary ullage maneuver. To check the validity of the theory, NASA conducted the first burn of the Service Module engine on a no-ullage basis. Like everything else on Apollo 4, it was successful.

The 25-second first burn also changed the apogee of the orbit, boosting it to more than 11,000 miles. For the next several hours, Apollo followed a roller-coaster trajectory up to the apogee, then "downhill," back toward earth, accelerating as it would on a lunar return. During this lengthy period, NASA conducted a "cold soak" test in which the spacecraft was so oriented that the heat shield was out of the sunlight and subjected to intense cold. The idea was to "precondition" the heat shield, to make it colder than it would normally be on re-entry, widening the temperature range and thereby providing the most severe re-entry test possible. Throughout the climb and descent, the Apollo environmental control system also underwent a thorough checkout under conditions approximating those it will encounter on a lunar mission.

Apollo's downhill acceleration was not sufficient to speed the spacecraft to lunar return velocity of 25,000 miles, the requirement for the heat shield test. To attain the necessary velocity, the Service Module engine was fired for the second time. This firing was in itself an important test, for at four and a half minutes it represented the longest burn of the engine to date.

As it plunged through the atmosphere in the all-important re-entry test, the Apollo Command Module reached temperatures of more than 5,000 degrees Fahrenheit. Nonetheless, the heat shield proved up to the task of protecting the capsule's interior; in fact, preliminary study of the recovered capsule showed that heat damage was less than anticipated. The re-entry test, of course, involved not only the heat shield, but a study of the other Command Module systems under the greatest heat loads they will ever experience. Of particular interest to the Apollo 4 team was the performance of the guidance and navigation system, which must direct the Command Module to a precise landing spot. The near-bullseye it scored demonstrated its ability to survive the rigors of re-entry.

These are but a few of the great many tests that made up Apollo 4, but they underline the great wealth of information and experience such a flight produces. The big, overall lesson learned from the mission is that the Saturn V/Apollo basic design is right, that the vehicle *can* send men to the moon and bring them back. That may seem a superfluous statement in view of the years of development and test that went into the Apollo program, but it is an inescapable fact that, until a system design is actually tested in space it is only theoretically sound, not positively sound. The proof of the design gives NASA wider latitude in correcting the new problems that will inevitably crop up; in seeking solutions, NASA can place emphasis on factors other than design.

Apollo 4, however, by no means resolved all the myriad problems of sending men to the moon. A good many major tests remain. The Lunar Module, for instance, has not yet flown. Some equipment already checked must be rechecked in advanced versions, for example, the Command Module itself and its parachute landing system. A variety of internal equipment must be further verified.

The Lunar Module will get its first flight test early in 1968, launched by an Uprated Saturn I rather than by the Saturn V superbooster. After that there will be a second Lunar Module test and two unmanned Saturn V tests before the start of manned Apollo flights in mid-1968. The NASA/contractor teams would like to believe that each of these missions will be another "text book" shot, but realistically they cannot expect that they will. Says NASA's Schneider, "Apollo 4 is a tough act to follow." — *JAMES J. HAGGERTY*

AEROSPACE NOTES

General Electric Develops Vulcan Air Defense System

General Electric's Defense Electronics Division has developed a new rapid-fire air defense system for use with the Chaparral missile system which it calls the Vulcan Air Defense System. It is designed to provide field commanders in forward battle areas a new low-altitude air defense capability. GE says it will be highly effective and versatile against low-flying subsonic aircraft, as well as such ground targets as unarmored vehicles and boats.

It is available in either a self-propelled or towed version and can be transported by helicopter.

The new system incorporates GE's 20mm Vulcan gun which can fire more than 6,000 shots per minute but for air defense has been modified to a firing rate of 1,000 to 3,000 shots per minute. The electrically-driven turret is self-contained and controlled by three solid-state servo-amplifiers. Power is supplied by three 24-volt nickel-cadmium batteries within the turret.

The gunner automatically acquires and tracks the target with the gyro lead-computing sight. The radar supplies the target range and range-rate data to the sight which automatically computes the lead angle required to hit the target.

Douglas Designs Space Life Raft to Return Astronauts

A Douglas Aircraft engineer has designed what he calls a Paracone space life raft that could return to earth carrying astronauts forced to abandon their spacecraft in flight.

The Paracone is a combination parachute and life boat that cradles its crewman in the center of a 25-foot diameter round-nosed cone of specially-coated synthetic fabric. It would protect the passenger from the searing heat of atmospheric entry, then would drop slowly to a nose-first landing on land or sea. A collapsible, air-filled compartment in the nose would absorb the shock of impact.

This vehicle would weigh about 300 pounds and could be folded and packaged as an integral part of each seat in the spacecraft. In an emergency abandonment of a spacecraft during launch or in orbit, the seat would be ejected from the vehicle, much like the ejection seats used in modern military jet planes.

Once the seat cleared the spacecraft, small attitude control rockets would stabilize it in the proper position for deployment of the Paracone and atmospheric entry. A radio beacon would begin transmitting an incessant signal to tracking stations on the ground.

Microscopic Boron Filament Produced by Goodyear

Boron filaments are inspected by a Goodyear Aerospace engineer at Goodyear Tire & Rubber Co. One is four-thousandths of an inch wide.

Scattered among the filaments are eight-inch-wide strips formed by encasing the filaments in resin. These can be molded under high pressure and high temperature into complex shapes such as jet engine turbine blades, aircraft ribs and helicopter rotor hubs.

The strips are lighter than aluminum, says Goodyear, but six times as stiff. They are twice as stiff as steel.

RCA Designs Electronic Oriental Typesetter

An electronic type-setting machine which can compose Chinese, Japanese and Korean written language directly from a keyboard has been developed by Radio Corporation of America for the U.S. Army.

Called the Chinese-Japanese-Korean Ideographic Composing Machine, it employs a technique that is the first practical departure from hand-set type in the 3,000-year history of these languages. By combining the latest in computer, television and optical techniques, it does away with the formidable typographical problems posed by ideographic languages with their "alphabets" of thousands of characters.

The machine can set 60 to 100 characters a minute from a storage bank of some 10,000 characters. Each character represents a word, a phrase or a complete sentence from any of the three languages. Formerly a man had to choose the correct characters by hand from massive cases of type.

The Army plans to use the machine in type-setting training publications, orientation literature, information leaflets and other printed materials in the three Oriental languages.

Bell Builds Lunar Trainers For Apollo Astronauts

Lunar-bound astronauts will train for the crucial landing procedure in a Lunar Landing Training Vehicle built by Bell Aerosystems. This spiderish, wingless simulator uses a unique combination of propulsion systems to sustain flight. Primary support is provided by a 4,200-

pound thrust turbofan engine, modified for vertical flight and installed on a gimbal mounting behind the cockpit.

The engine is automatically controlled and lifts five-sixths of the vehicle's weight and in so doing counteracts five-sixths of the earth's gravity. The remaining one-sixth earth gravity is comparable to the gravity on the moon. Lift for this remaining gravity is provided by two Bell rocket engines with a maximum of 500 pounds thrust each. Controlled by the pilot, these rocket engines simulate those used for lunar landings.

The LLTV has a cockpit and control system resembling that of the Apollo Lunar Module which is designed to ferry astronauts between their orbiting command module and the lunar surface. The vehicle accommodates a pilot and 200 pounds of instruments.

Three LLTVs are being built by Bell for the National Aeronautics and Space Administration. They will be used by Apollo astronauts at the Manned Spacecraft Center, Houston, Tex.

Aerojet Builds Altitude Simulator for Rocket Tests

A versatile altitude simulation facility for static test firings of liquid fueled and solid propellant rocket propulsion systems has been built by Aerojet-General Corp. at its Sacramento, California, plant.

It is designed to provide and maintain altitude conditions in excess of 100,000 feet during extended duration firings of up to 900 seconds.

Storage and run tankage at the facility provides for storable and cryogenic propellants including liquid fluorine. This permits testing systems using all liquid propellant combinations.

Current programs scheduled for testing include storable liquid fueled engines ranging from 75 to 600 pounds of thrust, a fluorine/amine unit of 7,500 pounds of thrust and solid rocket motors in the 4,000- to 6,000-pound thrust category.

Contemplated testing includes storable and cryogenic liquid fueled engines, space maneuvering multi-thruster systems and solid propellant and hybrid rocket motors with up to 30,000 pounds thrust.

Attitude Control Gyro Developed by Sperry

Sperry Rand's Sperry Flight Systems Division is developing a momentum-exchange device it calls a "control moment gyro" which could be used in future spacecraft to make many of the attitude maneuvers now performed by liquid-fuel reaction jets.

The device employs a large spinning rotor encased within a gimballing support structure attached to the spacecraft. Attitude corrections can be made by torquing the gimbals and thus transferring momentum between the rotor and the spacecraft. The torque motor pushes directly against the spacecraft while bracing against the spinning rotor.

Use of this device in future spacecraft would provide a significant weight reduction, says Sperry, in that less fuel would be required aboard the spacecraft to supply the reaction jets which would be used only when the control moment gyro becomes overloaded.

An 8,000-rpm prototype gyro built by Sperry weighs 60 pounds. The rotor is powered by an AC induction motor, which, when coupled to a converter, could be run from a DC electrical power source in space. The device is designed for use as either a one- or two-axis system depending upon the mission requirements.

New Battle Tank To Get Aeronutronic's Shillelagh

Main armament for the new Main Battle Tank being jointly developed by the U.S. and the Federal Republic of Germany is the Shillelagh missile system developed by Philco-Ford Corporation's Aeronutronic Division.

The surface-to-surface Shillelagh guided missile is fired from a 152mm dual-purpose gun and missile launcher which can also fire conventional ammunition. Designed as an anti-armor weapon, Shillelagh is guided to its target by a command system mounted on the launching vehicle which is capable of maneuvering the missile in flight to attack moving targets. No ranging or leading of the target is required. This results in extreme accuracy, with a high first-round "kill" probability.

This newest application for Shillelagh provides the Army with a mobile missile launcher. Aeronutronic also manufactures the guidance and control equipment for the Shillelagh system.

New Uses For Old Aircraft

U.S.-built aircraft never seem to retire. They are put to new productive tasks, most of them never envisioned by the designers of the aircraft.

Built into U.S. aircraft are reserves of structural strength that have enabled models to defy obsolescence for a decade or more. But not by accident is the strength there.

The Federal Aviation Administration, the military services, world airlines, pilots and passengers all demand that their aircraft be tough. So U.S. aircraft manufacturers build them a little tougher, to enhance the safety and satisfaction of their customers.

If, for example, FAA criteria specify that a spar withstand 2.5 negative Gs, aircraft manufacturers will build it to withstand three or more. Companies feel their standards should be higher.

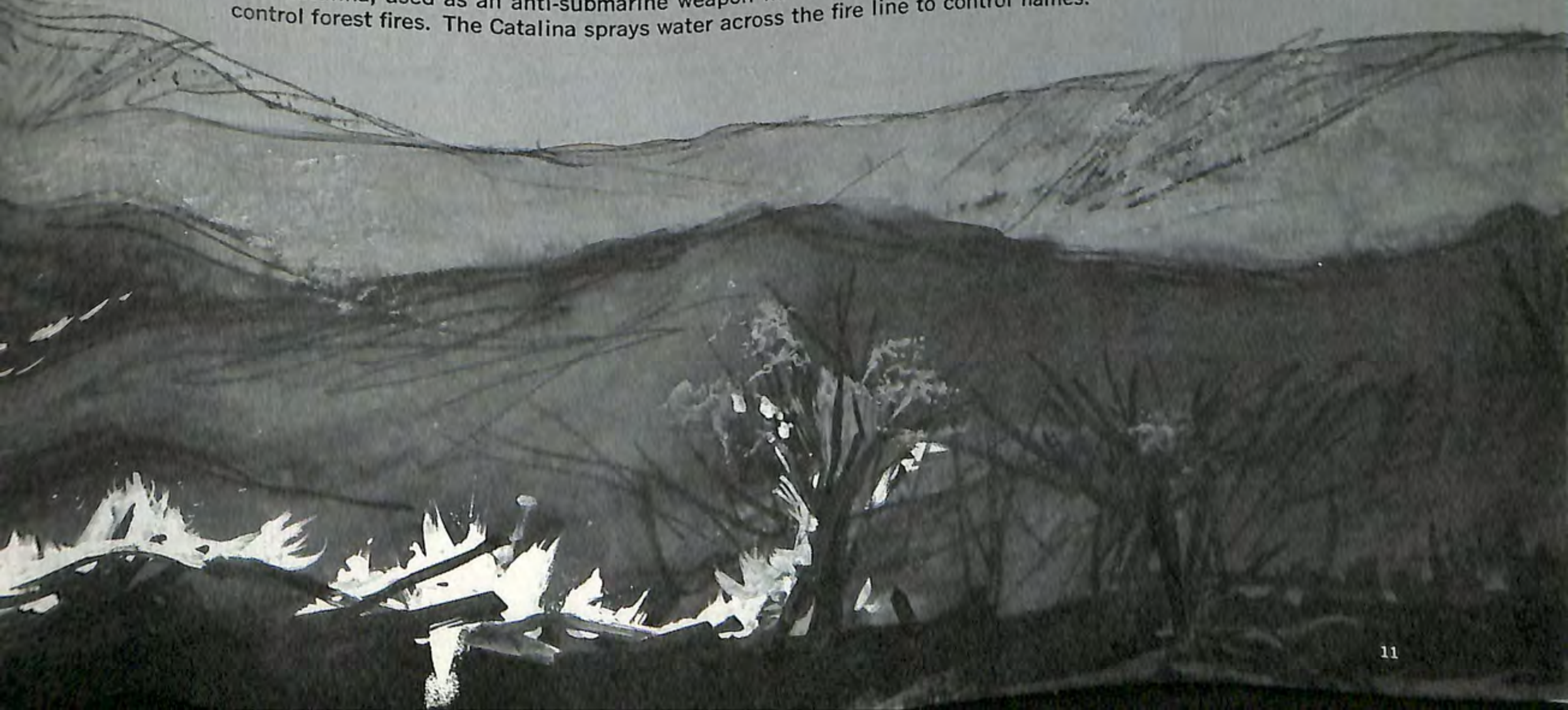
Seldom are U.S. aircraft retired simply because they have grown old. On the contrary, retirement usually results because technology has produced a new airplane that can do the job better, or because the passage of time has done away with the job itself.

It is at this point that enterprising airmen rescue surplus craft from the blast furnace, refit and refurbish them and harness their unexploited potential. For example:

In the north woods of Canada, PBY Catalina patrol bombers stand a kind of runway alert, waiting for forest rangers to order their scramble. Built during World War II, the twin-engine Catalinas, designed to find and destroy enemy submarines, now serve as water bombers.

When fire threatens the prime Canadian timberlands, Catalinas swoop through the smoke, laying down cur-

PBY Catalina, used as an anti-submarine weapon in World War II, today serves to control forest fires. The Catalina sprays water across the fire line to control flames.



tains of water, curtailing onslaught of the flames. In the spring and early summer, when fires are rare, the Catalinas earn their keep ferrying fishermen and civil servants to the north country's remote lakes and villages.

Facing the National Aeronautics and Space Administration, meanwhile, was a problem born of bigness. As rocket stages grew in size and in number, NASA challenged industry to eliminate the costly slowdowns that resulted when rockets were shipped by sea from California to Cape Kennedy.

Aero Spacelines Inc. responded by conceiving a new use for an old airplane.

Working with the Boeing B-377 Stratocruisers, Aero Spacelines fabricated the cavernous "Pregnant Guppy" with a fuselage that came apart in the middle. Many a Martin-built Titan traveled via Guppy to the Gemini launch complex at Cape Kennedy.

But soon the sheer bulk of the Saturn rocket became too much even for Guppy.

So Aero Spacelines put together the B-377SG "Super Guppy," whose assignment would be to haul the Douglas-built S-IVB third stage of the Saturn V launch vehicle, and North American Rockwell's Lunar Excursion Module adapter, from their factories to Florida. Now Aero Spacelines plans to construct a commercial version of the Super Guppy, one powered by turboprops, to haul Boeing 747 fuselage sections from subcontractors to the assembly line.

Many an airplane buff considers the Lockheed Constellation, with its fluid shark-like shape, the most attractive aircraft ever built. But it was not because of the Connie's looks that the U.S. government turned to it when it sought to bolster the morale of Americans serving in South Vietnam. The government needed a plane with endurance.

Beginning with three surplus Super Connies, the Air Force acquired compact television transmitters and installed them in the aircraft.

The Connies then were dispatched to Saigon with loads of video tape. Orbiting continuously through the day, these aging transports supply Vietnam with television programs.

Since its first flight in 1934, the Douglas DC-3 (or Air Force C-47) has played many a role for many a government and many an airline. Designed as the ultimate long-range airliner, this workhorse transport once towed gliders, taught navigators to navigate, skied across polar ice packs, airlifted dignitaries and dropped paratroops.

Now the AC-47 "Dragon Ships" are to be retired from Vietnamese duty, only to be replaced by the Lockheed C-130 Hercules and the Fairchild Hiller C-119 Flying Boxcar. Under current Air Force plans, the C-130s and C-119s are to be outfitted with 20 mm. cannon, then sent out to circle lazily above Viet Cong troop concentrations, focusing their firepower on areas as small as an efficiency apartment.

Not only has need born from Vietnamese fighting produced many an invention, it also has defined new missions for aircraft long in the Air Force inventory.

At the war's outset, North American Rockwell's rugged, easy-to-fly T-28 trainer was pressed into service as an attack bomber for the South Vietnamese defense forces. After almost six years of combat service, the South Vietnamese T-28s still strafe and bomb Viet Cong targets. The targets themselves are frequently spotted by Forward Air Controllers aloft in Cessna's twin-engine, pusher-puller O2-A, which was designed as a business aircraft.

Another Cessna product not designed for combat duty has been reconfigured as a precision bomber. The twin-jet T-37, conceived as a basic trainer for pilots, has become the YAT-37 and is now being evaluated as a counter-insurgency aircraft in Vietnam.

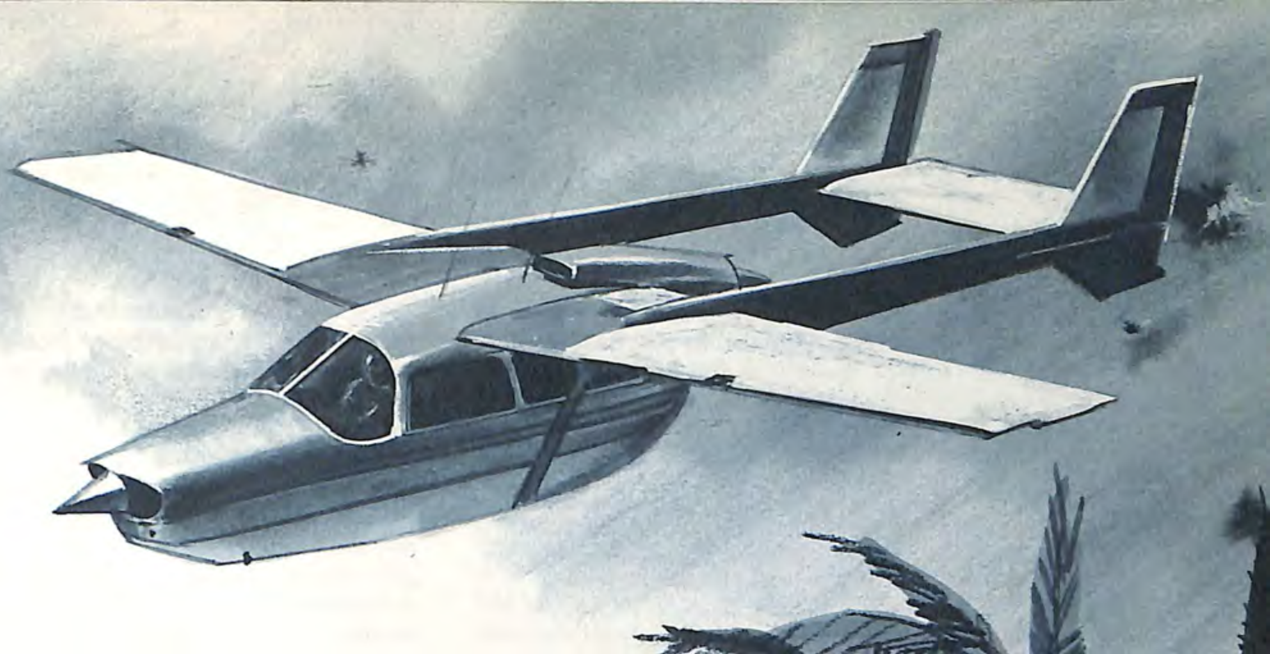
Going still farther back, contractors are doing a bustling business refurbishing North American P-51s which the United States may distribute to developing nations under the Military Assistance Program.

Used primarily as an air-to-air fighter during World War II, the Mustang still seems a useful weapon against lightly-armed guerrillas.

Not since the early 1930s has a Ford Trimotor rolled from anybody's assembly line. Now a new company plans to produce a modernized version of the old Tin Goose, for precisely the same reasons that made the original one so popular. Though slow, the Trimotor could almost lift its weight in payload, and from a relatively short strip.

The new Trimotor will fly under the name, "Bushmaster 2000." Although Federal Aviation Administration type certification is not due until next year, the manufacturer reports some 2,000 requests for information about the aircraft. One potential customer: U.S. Steel, which thinks the Bushmaster could well haul mining equipment through much of South America.

The U.S. Navy knew what it needed in the way of a "new" anti-submarine aircraft. Studies showed that the Lockheed Electra airliner could be adapted to do the



job. Now Lockheed's PV-3 Orion — in Navy gray — can stay aloft for almost a day if necessary, combing the seas for unidentified submarines.

Certainly the designers of the Boeing B-377 Stratocruiser never foresaw the use to which their product would be put by the Israeli Air Force.

In 1962, the Israelis acquired seven B-377s declared surplus by Pan American World Airways. At a time when no C-97s were available, Israeli Aircraft Industries disassembled the used airliners, replaced their skin, their bulkheads, their floor boards — building in military strength. Their goal was to build an assault transport.

IAI engineers designed a swing-tail for the 377s. They built in clam-shell doors in the lower aft fuselage, doors that would withstand air loads when opened in flight. They built an aerial delivery system capable of extracting five armored personnel carriers from the 377's hold in less than 30 seconds.

They installed a drag parachute to cut the plane's landing roll; they installed JATO racks to cut its take-off roll, all the while building engineering expertise and mastering the technology of large four-engine aircraft.

During the Israeli's six day war in June, the ex-Pan Am airliners dropped supplies to advancing tank columns and shuttled through Europe picking up parts for Israel's vital fighter fleet.

IAI had completed the conversion some fifteen years after the Boeing Co. stopped building the B-377.

Governor John A. Love

A STRATEGY

The following was excerpted from a report made by Governor John A. Love, of Colorado, Chairman of the Committee on State Planning, before the National Governors' Conference. The Institute on State Programming for the 70s served as staff to the Committee on State Planning. The Institute, directed by former Governor Jack M. Campbell, of New Mexico, is an independent, non-profit organization created in January, 1967, to strengthen state government by stimulating comprehensive, long range planning activities in all the states. The Institute's Industrial Advisory Committee assisted in supplying materials.

At the historic White Sulphur Springs Governors' Conference we lamented the present imbalance in our federal system. We were moved to alarm and action. We recognized the problem of the emerging city-state, and created a committee to spotlight the state's role in urban affairs. We calculated the overwhelming resources needed to solve the urban problem, and created a committee on tax sharing. We decided, however, that before the resources could be effectively applied to the problem, there was still another step to be taken. Our institutions had to be improved. Aware of the importance and the urgency of meeting this need, the governors created this committee on state planning and instructed it to review, in depth, the management techniques used by state government to analyze complex problems, inventory available resources, set realistic goals, evaluate potential alternatives, and implement action plans.

Any new problem or invention recalls to mind the oft-repeated statement that "the world will never be the same." Why, therefore, should we dare to distinguish today's problem? The answer lies in the information explosion brought out by science. Some have observed that ninety percent of the scientists that have been known in all the history of man are alive today. Every few years their work is doubling the world's storehouse of knowledge. Their work has produced an age of specialization, high technology, and rapid change. The pace, the intensity, and the resulting complexities of this scientific advance threaten any institution which does not keep abreast of it. All of man's institutions are caught in its tide. It does not give any institution, including state government, the option of standing still. States must, therefore, so position themselves as to be able to influence, channel and direct this tide or be overwhelmed by it. . . .

The problem is ours to face. What we often forget, but what has become apparent to the members of your Committee, is that state government is big business. If we measure the relative size of our institutions by the number of people we employ, the number of programs we manage, or the dollars we spend, state governments must be considered equivalent to all but the largest corporations in this country, or, for that matter, most of the governments represented in the United Nations. We must begin to scientifically manage our institutions as industry has learned to do. By so doing, we shall welcome constructive innovation, control its ingredients, and more fully understand its politics. . . .

This challenges us to define what state planning should be. Among other things, it should be considered a source of information and a research arm for the decision-makers — the governor and the legislature. It should give to these decision-makers the assistance required in setting goals; it should help determine the cost of alternatives; it should provide a communication network for state government; it should work to coordinate effort; it should staff the governor's situation-briefing room; and it should develop an early warning system for social and economic crises. This description of planning converts it to a management method. Some would argue that the word itself should be changed. This semantic quibbling can be decided later. What is important is that we make state planning more relevant to the governor. . . .

The words "comprehensive planning" and the technology of the systems approach can be applied to every level of planning, whether it be project or program planning, functional planning, or overall planning. These words are elusive. There are no exact definitions that are commonly accepted. The difference in the words merely attests to the fact that there are different levels and types of planning. All planning should be comprehensive. Every level of government, and each section, bureau, division, commission or department should plan. The central planning office should have the capacity to require that all agencies use the same information base, relate all planning activities to the governors' program, and insure that broad goals result in specific action in the shortest possible time.

State planning, in this light, may be many years away. While industry today has developed this capability, they learned through experience that the lead time is considerable in the process of selling the concept, employing and training personnel, adapting the technologies, and providing the financial resources. . . .

The development of ultra-complex weapons, space vehicles, communications systems, and other technological advancements has stimulated advancements in the art of management, too. The management, in fact, has sometimes been as important as the technology. . . .

One of the major management methods developed in this period is the systems approach. What is it? What can it do? When can it be used? How can we, as governors, use it? These are questions we would like to answer at least tentatively now, and more thoroughly in the coming months.

In a concise statement, the systems approach is a body of highly developed capabilities for the solution of complex problems. The systems approach looks at problems through their interrelationships in contrast to the

FOR PLANNING

more traditional view, which solely sees large problems consisting of separate parts. The systems approach discards the trial and error method, and does not solely rely on the inductive method. In everyday parlance that means "from the bottom up" — first gathering all facts and then analyzing them since the very data which we analyze can limit our view of the problem and thus restrict the number of possible solutions. Rather, while the systems approach uses the inductive approach to gather and analyze information, it also gives paramount importance to the objective through the deductive process or "from the top down." In short, it is a more orderly way of looking at all angles of a complex problem. Its characteristics are that it: (1) utilizes advanced technology, (2) works on large, complex problems, (3) can deal effectively with a very large number of variables such as physical, social, economic, environmental, and fiscal factors, and (4) is action oriented. Its principal elements are: (1) systems analysis, which defines the problem and offers possible avenues for its solution, (2) systems engineering, which designs the approach to the selected solution, including setting schedules and costs, and (3) systems management, which controls the program, the schedule, and the cost.

We feel that the answer to the question of where it is applicable lies in two areas. First, there are elements of this national resource which we can personally borrow or adopt right now to help make all of us more effective managers of state government. We all need better information on which to base decisions. We all want more effective control over the multitude of projects going on throughout our state. The systems approach, if embodied in our state planning operation, can help here.

Secondly, almost all of the problems each of us is struggling with on a daily basis — transportation, criminal justice, health, education — have a commonality. They are big, they are complex, they demand new approaches.

Consider, for example, the primary duty of every government — maintaining law and order. This involves a number of other problems. In this area, we face the interrelationships of poverty, organized crime, civil rights, and the condition of our slums and ghettos. Our police and national guard units, our judicial system, our educational system, our labor and employment practices, our welfare, public health and social service programs are all involved. . . .

As another example, consider the transportation plan. The facilities and services provided for the movement of people and goods should not only maximize convenience, safety and speed, but also produce the desired effect upon economic development, urbanization, the quality of life and environmental design. A cursory review of transportation history highlights these interrelationships. In the mid-1800's the nation opened the West with the railroad. The automobile has played a significant role in urbanizing our country. Air travel has increased the mobility of our people. We are now exploring space and are beginning to build high speed rail transit. With these movements have come problems — accidents, congestion, and pollution. Perhaps proper planning could have avoided the worst aspects of these problems and still allowed us to maximize opportunities.

As a final example, let us spotlight this summer's riots. All of us, in one way or another, are grappling with this problem, and in doing so are overwhelmed by the intricacies of it. If we are going to meet this problem, we must recognize that the solution involves an interdisciplinary analysis. We cannot afford the luxury of isolated state departments if we are to alleviate the problem and prevent further occurrences. The policies and programs of welfare, education, correction, unemployment security, health, transportation, and other agencies are all interrelated.

Let us ask what information was available during the past summer when we were concerned about existing or possible social disturbances in our states. Was it adequate? Was it complete? Did it reflect the interrelationships between various areas of public responsibility? Did it point to alternative solutions? Or were we required to act too late and largely by intuition? We must ask ourselves whether or not our departments and bureaus had adequate tools to meet their responsibilities. We must ask whether or not there was available to us a central planning operation which was strategically placed and whose scope was broad enough to tie all the necessary factors together for us to anticipate this problem and meet it effectively and in good time. We certainly are not, in this instance, speaking solely of long-range implications.

We should emphasize that there is nothing magical about the systems approach. It is not a scientific breakthrough. It certainly is not a cure-all. It is simply a procedure which does, in a more formalized way, what the best minds have always done — it views a problem objectively and in its proper perspective, considers all its relationships with other problems, weighs all of the possible alternatives and their consequences and costs, selects the alternative which offers the best solution from the standpoints of technical value, time, and costs, and then sees the project through the implementation stage. During the course of this, of course, the approach may be modified as new problems appear. . . .

The Committee believes that state planning is the best means available to strengthen the management hand of the governor. State planning is an important mechanism for coordinating interstate activities and for insuring that needs expressed through local, regional and metropolitan planning are encompassed in a state's overall program. Effective state planning must be broadly conceived and fully utilize all the modern tools and the total resources available. . . .

SPACE AND INDUSTRY

Following are excerpts from an address by John R. Moore, vice president, North American Rockwell Corp., and president, Aerospace and Systems Group, before the Economic Club of Detroit, Michigan.

We have just completed the first decade of the space program. It is, therefore, appropriate that we pause to ask ourselves where we stand, where we are going and if it is worth the effort.

It is perhaps ironical that we would have scant hope of beginning a successful assault on all the problems of the population explosion, the poisoning of our air and water, the depletion of natural resources, the increased demand for power, and the encroachment of false ideologies if it had not been for two hot wars, a cold war, and a space race. The investment in science, technology, and management which would not have been made without such national threats, has brought about advances that might have taken centuries at the pre-'39 pace. For what boards of directors would or could have authorized the commitments of resources on such large gambles with such unpredictable payoffs as nuclear energy, jet engines, high-speed computers, microelectronics, radar, communication information-handling systems, rocket engines and satellite systems?

It has been repeatedly demonstrated that it takes important, easily understood, very large, national threats or goals — with the potentially catastrophic or near millennial consequences — to stimulate the really significant advances that add so much to our standard of living and our chances of survival.

First, where do we stand? We have put 24 astronauts into space, and launched nearly 500 satellites. The nation has invested thirty billion dollars in space work and the outstanding results have affected our nation's economic structure, our patterns of corporate management, and our international relations.

The annual space budget has never represented more than one per cent of the gross national product. But this one per cent *directly* provides well-paid employment for nearly half a million people, including 60,000 highly paid scientists and engineers who represent a sizeable consumer demand in the market for luxury products and services.

Consider, first, those earthly benefits which accrue from the exploitation of space. Gemini II photographs of the Near East and North Africa indicated that it is possible to prepare geologic maps from orbiting satellites. Data for such maps, obtainable in a few hours, would take thousands of hours by previous methods.

It has been discovered that most of the known oil fields in the Middle East are located on previously undetected faults. A massive chromium deposit has been found in North Africa covering many hundreds of square miles. Many other geologic operations with small (150 to 600 pounds) satellites are possible in the near future.

One of the first applications of satellites was for worldwide navigation. These satellites are enabling ships and aircraft to determine their positions closer than 1.5 miles on open ocean.

The Interior Department has already talked of plans to orbit a series of satellites called EROS (Earth Resources Observation Satellites) to make maps and collect data on worldwide distribution of minerals, moisture content of soils, pollution of water, condition of crops, stands of timber, forest fires, and other land and sea conditions.

Communications satellites are just coming into their own as important links in worldwide voice and TV networks. As you are aware, present facilities for international communication are inadequate, and the demand is forecast to grow by 15 per cent a year or more. Some 49 nations have built or are planning ground stations to tie into the synchronous orbit communication satellite system established by the United States. These should be a powerful force for international understanding and, incidentally, increase the business of telephone, radio and TV industries.

Weather predictions are notably improving because of the Tiros and Nimbus meteorological satellites. A study by the House Committee on Science and Astronautics indicated that an improvement of only 10 per cent in weather prediction accuracy could mean savings totaling $2.5 billion annually to farmers, builders, airlines, shipping, the tourist trade, and public utilities. Future systems will be able to better detect storms in the embryonic state, so that warnings of weather dangers will go out sooner, reducing damage and loss of life. (Hurricane Beulah damage was held down due to early identification and precise tracking.) Large satellites, carrying complex multispectral lasers and detectors, will be capable of making weather measurements vertically as well as laterally. Such measurements in combination with the very high capacity microelectronic computers, also being developed, will usher in a whole new era of accurate, long-range weather forecasting. . . .

One significant aspect of large, highly technical programs is their serendipity. A Department of Defense study called Project Hindsight made a survey of some 20 major defense programs of the last decade that were generally considered to be of fairly routine design, test, and evaluation when the programs were started. It was also generally considered that all of their requirements for technology were within the current state of the art. Yet the Project Hindsight survey found

Mr. Moore

that, on the average, *37* per cent of the technical innovations making for program success occurred after the programs had started. A substantial number appeared even after production had started. This is because the hectic environment of large, high priority, single objective programs provides a powerful stimulus for technical progress.

Another reason is that many real problems involve the interaction and coupling of technologies. Such problems are only revealed in programs which attempt such interaction and coupling. . . .

Today when many new defense programs have been delayed, cutback, or stretched out by the costs of Vietnam, a major remaining factor in our technological momentum is the space program.

Government must continue to assume the initial risks for programs such as the supersonic transport whose objectives are nationally important, but whose size and uncertainties are beyond the capabilities of industry. However, industry is itself becoming increasingly willing to and capable of providing an important part of our technological momentum. It has been estimated that industry's investment in research and development will reach 15 billion dollars this year and twice that amount by 1974. . . .

But more important in the long run are the indirect benefits. Space has joined with defense programs to give us the technology, management and teams in being — both in government and industry — to attack the tremendous long leadtime systems problems of the future. Space has filled the gap in new defense system work caused by completion of our first effective strategic missile systems and the financial drain of Vietnam. Space is a frontier which inspires our youth to follow careers in engineering and science and thus helps assure a source of trained personnel to tackle the great problems of our future and fight the potential wrong-way technology gap with the Soviets. Space helps maintain the nation's momentum in science, technology, and the ability to solve massive complex problems.

Space has beckoned us just in time to provide the assets man will need — to meet the problems of exploding populations — to keep from choking to death — to provide adequate supplies of clean water — to exploit the oceans and find other replacements for depleted resources — to solve our problems of congestion in our cities and on our thoroughfares — to open up a new era of physical and psychological well being — and to help us govern populations many times as large as ours today. Space will help us keep faith with generations yet unborn.

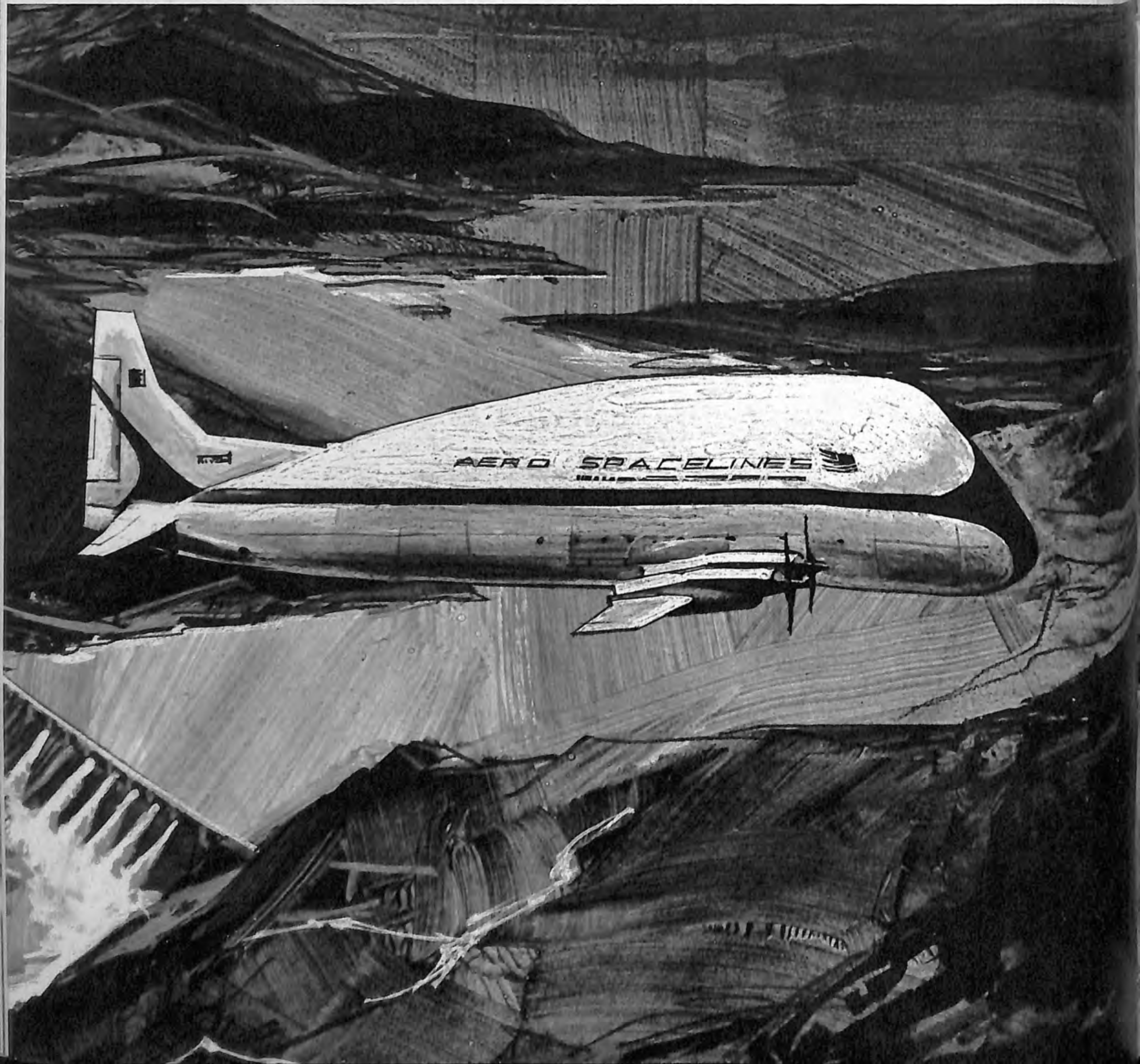
AIA MANUFACTURING MEMBERS

Abex Corporation
Aerodex, Inc.
Aerojet-General Corporation
Aeronca, Inc.
Aeronutronic Division, Philco-Ford Corporation
Aluminum Company of America
Amphenol Connector Division
  Amphenol Corp.
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
Curtiss-Wright Corporation
Fairchild Hiller Corporation
The Garrett Corporation
General Dynamics Corporation
General Electric Company
  Defense Electronics Division
  Flight Propulsion Division
  Missile & Space Division
  Defense Programs Division
General Motors Corporation
  Allison Division
General Precision Systems, Inc.
The B. F. Goodrich Company
Goodyear Aerospace Corporation
Grumman Aircraft Engineering Corp.
Gyrodyne Company of America, Inc.
Harvey Aluminum, Inc.
Hercules Incorporated
Honeywell Inc.
Hughes Aircraft Company
IBM Corporation
  Federal Systems Division
International Telephone & Telegraph Corp.
  Defense & Space Group
    ITT Avionics
    ITT Gilfillan, Inc.
    ITT Defense Communications
  ITT Controls & Instruments Division
Kaiser Aerospace & Electronics Corporation
Kaman Corporation
Kollsman Instrument Corporation
Lear Jet Industries, Inc.
Lear Siegler, Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corporation
The Marquardt Corporation
Martin Marietta Corporation
McDonnell Douglas Corp.
Menasco Manufacturing Company
North American Rockwell Corporation
Northrop Corporation
Pacific Airmotive Corporation
Piper Aircraft Corporation
Pneumo Dynamics Corporation
Radio Corporation of America
  Defense Electronic Products
Rohr Corporation
Ryan Aeronautical Company
Solar, Division of International
  Harvester Co.
Sperry Rand Corporation
  Sperry Gyroscope Company
  Sperry Systems Management
  Sperry Flight Systems Division
Sundstrand Aviation, Division of
  Sundstrand Corporation
Thiokol Chemical Corporation
TRW Inc.
Twin Industries Corp.
  Division of the Wheelabrator Corp.
United Aircraft Corporation
Westinghouse Electric Corporation
  Aerospace Electrical Division
  Aerospace Division
  Astronuclear Laboratory
  Marine Division

AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W., Washington, D. C. 20036

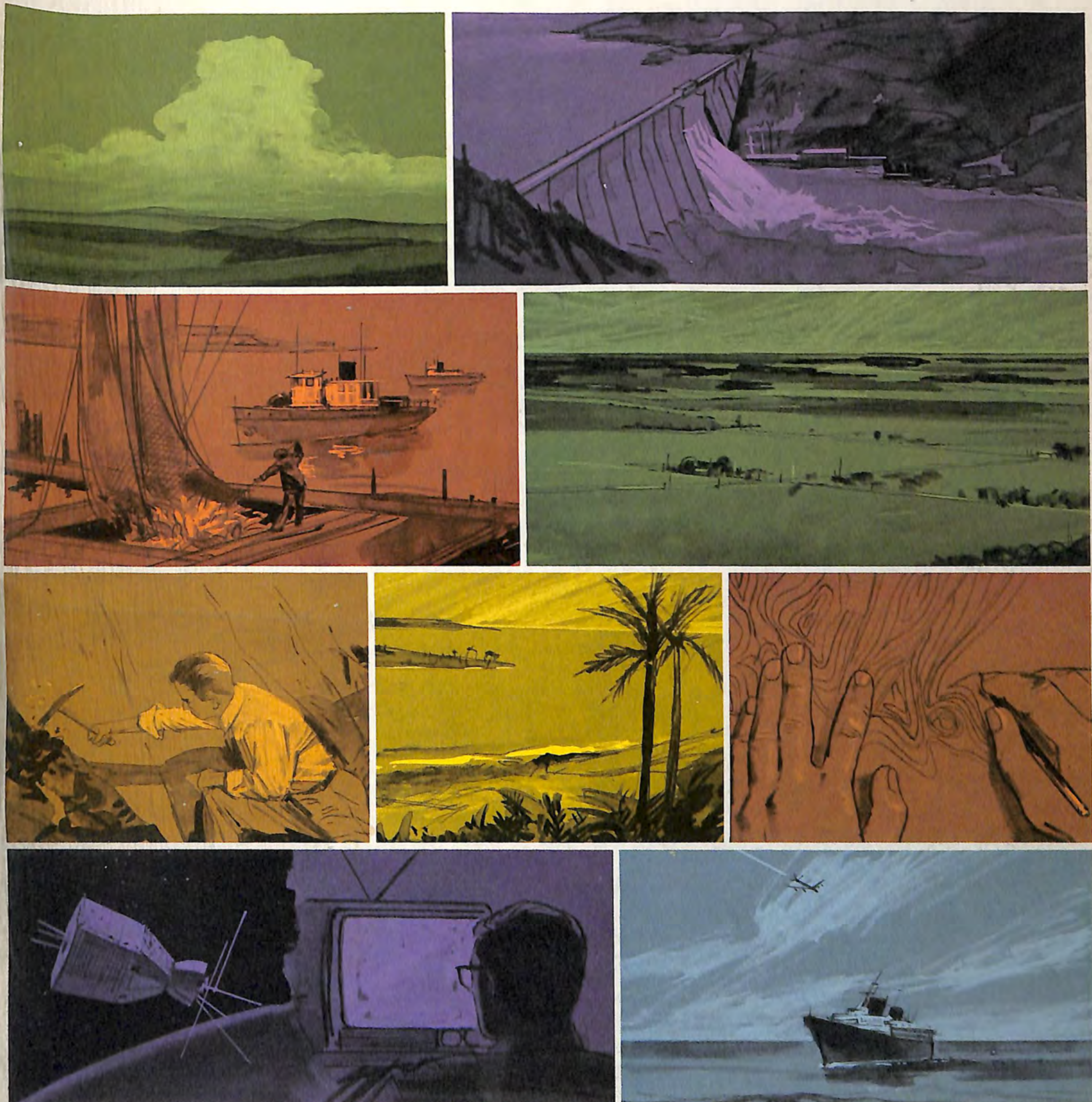
RETURN REQUESTED

The Super Guppy, capable of carrying the S-IVB stage of the Apollo/Saturn V launch vehicle, was fabricated from the Boeing B-377 airframe. (See *New Uses For Old Aircraft*, page 10).



aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • SPRING 1968

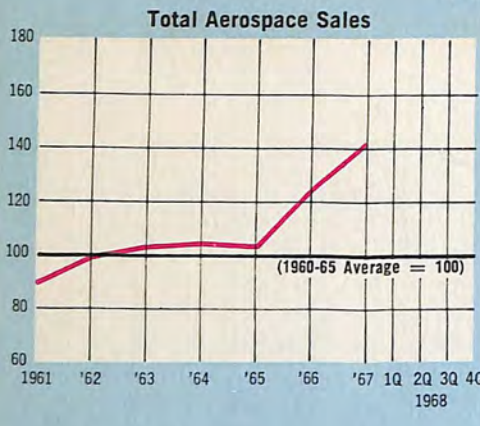


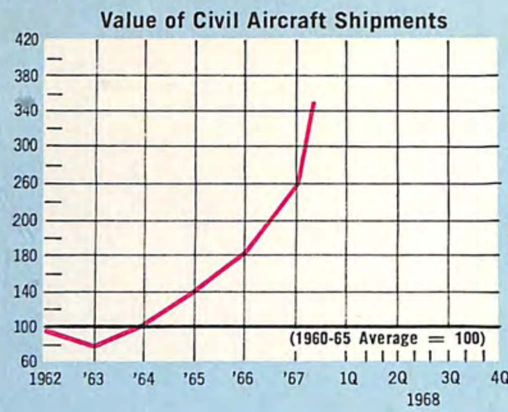
APPLICATIONS SATELLITES: HARVEST FROM SPACE

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

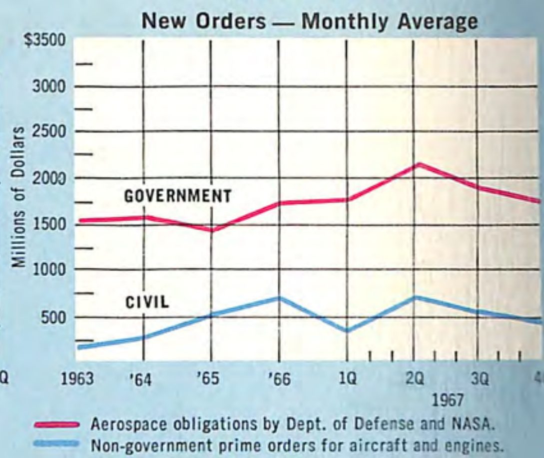
AEROSPACE ECONOMIC INDICATORS

CURRENT





OUTLOOK



ITEM	UNIT	PERIOD	1960-65 AVERAGE *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending Dec. 31 1967	24.6R	27.1R	27.2E
	Billion $	Quarterly	4.8		6.4	6.9	6.8
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	Jan. 1968	1,161	1,372	1,317
Aircraft	Million $	Monthly	601	Jan. 1968	767	915	818
Missiles & Space	Million $	Monthly	550	Jan. 1968	394	457	499
Aerospace expenditures: Total	Million $	Monthly	1,067	Jan. 1968	1,214	1,212	1,443
Aircraft	Million $	Monthly	561	Jan. 1968	885	882	944
Missiles & Space	Million $	Monthly	506	Jan. 1968	329	330	499
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920 ✣	Feb. 1968	894	790	953
Aircraft	Million $	Monthly	447	Feb. 1968	617	442	478
Missiles & Space	Million $	Monthly	473	Feb. 1968	277	348	475
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	Feb. 1968	359	218	267
Expenditures	Million $	Monthly	130	Feb. 1968	323	315	329
UTILITY AIRCRAFT SALES							
Units	Number	Monthly	692	Feb. 1968	1,025	1,254	1,191
Value	Million $	Monthly	15	Feb. 1968	28	34	35
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3 #	Quarter Ending Dec. 31 1967	27.5	29.9	30.7
U.S. Government	Billion $	Quarterly	11.6		15.7	16.7	17.7
Nongovernment	Billion $	Quarterly	3.7		11.8	13.2	13.0
EXPORT							
Total (Including military)	Million $	Monthly	110	Jan. 1968	148	261	272
New Commercial Transports	Million $	Monthly	24	Jan. 1968	30	59	107
New Utility Aircraft	Million $	Monthly	2	Jan. 1968	8	9	6
PROFITS				Quarter Ending Sep. 30 1967			
Aerospace — Based on Sales	Percent	Quarterly	2.3		2.7	2.5	2.6
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		5.4	5.2	4.7
EMPLOYMENT: Total	Thousands	Monthly	1,132	Jan. 1968	1,371	1,430	1,432E
Aircraft	Thousands	Monthly	499	Jan. 1968	601	629	630
Missiles & Space	Thousands	Monthly	496	Jan. 1968	596	620	621
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	Dec. 1967	3.48	3.64	3.63E

R Revised.
E Estimate.
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
\# Averages for 1961-65.
✣ Averages for fiscal years 1960-1965.

INVESTMENT IN SECURITY

As a vital part of the nation's defense industry, the aerospace industry has, within the limits of prudent management and available resources, played a major role in providing the Department of Defense a national industrial mobilization base responsive to peacetime and wartime requirements.

During a national emergency, the accelerated demand for increased military equipment and supplies creates long-term facilities investment requirements and risks that are in excess of what industry can be reasonably expected to assume.

To meet this problem, government furnishes industry those facilities critically needed to meet peak emergency requirements. These range from machine tools to entire manufacturing plants.

A recent inventory conducted by the General Accounting Office reveals that industry now has government-owned plants and equipment acquired at a total cost of $6.2 billion. This was acquired by or for the government during and prior to the Korean conflict. Much of it dates from World War II. In a recent survey by the Aerospace Industries Association, a representative number of member companies estimated that the current depreciated value of the government's facilities inventory in their hands — based upon industry's system of accounting for its own property — is now less than one-third the acquisition cost.

For its facilities investment in national defense plants over the years, the government receives significant benefits and returns. Obviously, it maintains ownership and control of the properties to insure their availability for national defense during emergency periods. Secondly, through lowered prices for products manufactured by means of its facilities the government receives both a return of and on investment.

The cost of facilities provided by contractors is normally recovered through depreciation charges included as an element of cost in the sales price of articles produced. The sales price also includes other associated costs such as property taxes and insurance. When government facilities are furnished, the cost and price of the product are lower since depreciation charges, property taxes and insurance on such facilities are not included in the sales price. Therefore, the government receives, through lower prices, the equivalent of a return of investment comparable to the return of investment obtained by private industry.

Additionally, the Armed Services Procurement Regulation requires consideration of the extent of government facilities to be furnished in the establishment of the basic profit rates. This results in the government obtaining a return on its investment through further reductions of prices as a result of lower basic profit rates which are substantially below those earned by industry in general. To the extent that unused capacity of the government facilities can be made available for commercial or non-government work, the return on investment is further enhanced through receipt of rental income.

When government-furnished facilities are not being used for government production, contractors often occupy them with commercial work resulting in substantial benefits to the government. The obvious monetary benefit is the receipt of rental income from commercial use of the facilities in lieu of maintaining idle plant capacity or less than maximum equipment utilization.

But when the need arises for government's use of its furnished facilities, they are ready and waiting to be employed to meet the additional demands of the national emergency.

AIA

aerospace

Official Publication of the
Aerospace Industries Association of America, Inc.

PRESIDENT • Karl G. Harr, Jr.

VOL. 6, NO. 1 *SPRING 1968*

EDITOR • Gerald J. McAllister
ASSOCIATE EDITOR • Richard W. Balentine
ECONOMIST • Gerson N. Chanowitz
ART DIRECTOR • James J. Fisher

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 civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published monthly 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

Western Office: McCulloch Building, 6151 West Century Blvd., Los Angeles, Calif. 90045

APPLICATIONS SATELLITES: HARVEST FROM SPACE

By Karl G. Harr, Jr.

President, Aerospace Industries Association

Although the first decade of American space flight produced many concrete dividends, the concept of funding space research as an investment has not yet found wide acceptance. One reason is that some of the benefits that have accrued to date have been largely intangible — renewed national prestige, expanding technological capability and enormous scientific gain. Another is that full realization of the more practical benefits demands a greater degree of technological maturity than it was possible to achieve in a single decade.

However, we are now approaching such technological maturity. The work of the past 10 years has provided the United States with a broad base of knowledge and know-how from which we can proceed to the harvest of space gain. There is reason to believe that the investment will pay far greater bonuses in the not-too-distant future, not only in indirect benefits but in hard economic return. The monetary value alone may run into billions of dollars a year.

Such is the preliminary conclusion of a study now being conducted for the National Aeronautics and Space Administration by the National Academy of Sciences-National Research Council. The Space Applications Summer Study, as it is known, is concerned with the benefits that may be derived from advanced development of applications satellites, those designed to perform practical tasks rather than seek information of a purely scientific nature. The study group's interim report recommends a further developmental push in those applications areas already being pursued by the United States and at the same time it proposes a series of new applied spacecraft which have become feasible because of the technological thrust of the first decade.

The applications fall into two general categories. The first deals with the observation of the earth, its environment and its resources, and the translation of acquired data into useful purposes; this category embraces agriculture, forestry, oceanography, hydrology, meteorology, geology, geodesy, geography and cartography. The other grouping includes the broad field of public communications — television, broadcasting, telephone services and a variety of forms of record and data transmission. The categories differ both in the types of space and ground equipment they require and in the manner of organization that will be needed to manage the systems.

The distinguished scientists and engineers engaged in the study are clearly impressed by the great potential of applied satellites. They state in their interim report that "the benefits to be obtained from practical space applications appear to be large, larger, in fact, than most of the participants in the study anticipated, and much larger than the cost of achieving those benefits."

What, specifically, are the benefits?

To the pragmatist who cares little for the scientific, technological or social gains, spacecraft applications offer financial dividends which the study group classes as potentially "enormous." These monetary gains may accrue in a number of ways. A satellite system may provide a more economical way to accomplish a function already being performed, as is the case with the communications satellites. It may allow economies through more efficient management of existing functions, an area exemplified by the space-based agricultural survey. The gains may be reflected in increased business for private corporations, or, in applications managed by public agencies, in direct user economies. To cite just one of many examples in the study group's report, an advanced system of weather satellites offers a benefit to the economy "in the range of one billion dollars per year."

But the advantages go far beyond dollar value. Less tangible, but perhaps even more important than the economic return, are the potential contributions to the "welfare of the planet." They include such possibilities as greater world food availability in a period of population explosion that threatens widespread famine; enhancement of safety in the world air travel system by means of a space-based system of navigation; more effective management of water supplies, irrigation and flood control; and raising the general educational level of the world's peoples through inexpensive, direct-broadcast public television.

A major intangible benefit is the contribution that applications satellites can make to the U.S. aim of bringing the nations of the world closer together. Steps already taken in that direction, steps made possible by American equipment and techniques, include the 54-nation International Telecommunications Satellite Consortium and the global space-meteorology program in which 42 nations are participating. Advanced technology can produce new satellites which will make possible improved cooperative management of earth's total resources, a boon to all nations and particularly to those which are classified as "less developed."

The opportunity to harvest these gains is here. We cannot, however, expect such tremendous potential benefits to fall into the national lap, any more than we can expect dividends from a stock we have not purchased. We must pursue the advanced applications program aggressively, and that means increasing our investment.

How great an increase is needed cannot, at this stage, be clearly stated. The study group recommends a doubling of the current rate of applications technology funding, which runs to about $100 million. While exact future costs must await further definition, it would appear that a broad program of applied satellite technology can be accomplished within reasonable annual expenditures, since the recommended program contemplates the use of unmanned systems. One indicator is the experience of the first space decade: the research and development costs for civil applications throughout that period totaled an estimated $550 million or about two percent of all civil space expenditures.

Were there no monetary benefits involved, the advanced satellite applications program would still be worthwhile for the major improvements it offers to man's way of life. Yet these new space systems promise not only to pay for themselves, but to provide hard income several times the output. As we start the second decade of American space research, we are in a position to take full advantage of the technology we built in the first decade and, by so doing, to elevate the status of every man.

AIA

"It is quite possible that a relatively unpublicized part of the space program, that directed toward realizing the practical benefits to be derived from it, will ultimately prove to be the most significant to mankind."

So states the introduction to the report of a National Academy of Sciences - National Research Council study group on applied spacecraft. Some 90 top level scientists and engineers, representing a great variety of backgrounds and experience, are participating in the Space Application Summer Study, started last June and scheduled for conclusion in August of this year.

The group's interim report, based on 1967 effort, concludes that economic benefits which may amount to billions of dollars a year are possible if the nation underwrites "an extensive and coherent program" of advanced satellite applications research and development.

From the technological standpoint, there appear to be no major barriers to achievement of the goals outlined by the study group. "A turning point has been reached," the report says, "at which we can now describe with conviction and in some detail the many specific ways in which space vehicles and space technology will become important elements in our economic, industrial and social world. Applications that were speculative and vague only a few years ago now appear credible and attractive. The space program has broken the plausibility barrier."

There are, however, some non-technical obstacles to be overcome. One is that satellites are essentially global in character and they know no political boundaries, so there are certain "delicate and complicated international problems" to be ironed out.

Further, support of the contemplated program demands far greater awareness of the potential benefits of applied spacecraft than currently exists. Deploring a general lack of understanding, the study group found that even "managers, scientists and engineers in the user fields are not yet aware of the potential uses of earth satellites." The group called for development of "a substantial process of education among technologists, industries and government agencies."

Given the solution to these problems, and an adequate annual rate of funding, the NAS-NRC group holds forth some exciting applications possibilities for the near-term future.

Meteorology

Since 1960, when NASA launched the first weather satellite, there has been substantial and continuous improvement in equipment capabilities and techniques of space-based weather reporting. Today's NASA-ESSA operational satellites fill several of the requirements for an advanced system which would make possible truly long-range forecasts of as much as two weeks. They cannot, however, handle all of the requirements. Among the advancements needed are new satellite sensors capable of providing complete temperature and moisture profiles of the atmosphere in addition to cloud cover photographs.

The major requirement for a long-range system is not a new spacecraft but a ground-based mathematical model for the simulation of large-scale atmospheric processes. Twenty years of research in this area, together with recent advances in computer technology, have pushed model development to a high level of capability. Perfection of these models through continuing research is the key to accurate forecasting for periods of from five to 14 days.

The models must be provided with daily worldwide inputs. To get them, the Meteorology Panel suggested a system, to be operational about 1972, composed of five satellites. Four of them would operate in synchronous orbit, the fifth in polar orbit at an altitude of 700 miles. They would be backed by superpressure balloons operating in the stratosphere and interrogated by the satellites. This interim system would make possible extended forecasts until about 1978, when new sensory equipment and new techniques would be able to fill the

gaps and provide all the model input needed for two-week forecasts.

The panel's costing estimates for such a system are surprisingly low, compared with NASA's current meteorological satellite program of about $50 million a year. The interim 1972-78 space weather net of five satellites and 1,000 balloons, together with research and development expenditures and the cost of ground stations and data handling facilities, would run to $70 million annually. The post-1978 program would be "slightly larger."

The benefits to be obtained from a completely reliable two-week weather forecasting system are immense. The stated economic return of about a billion dollars a year is a conservative estimate. The Meteorology Panel surveyed two specific areas — construction and agriculture, in the U.S. alone — and concluded that realizable savings should amount to $800 million annually. There would be additional economic benefits in such other weather-sensitive fields as transportation, flood control and water-resource allocation, maintenance of public utility systems and sports-recreational activities. On the international level, there would be large benefits to management of agriculture and food-distribution programs in the developing countries, and since the U.S. is committed to an extensive food-relief program, any measures that help foreign production may be classed as further U.S. benefits.

Accepting only the conservative estimate, the gain would outstrip costs by a factor of better than 14 to one. And, looking farther down the road, the panel offers the far-reaching thought that, from the advancement of the entire field of meteorology a sophisticated satellite/model system would bring, it might be possible to move on to the goal of weather control.

Hydrology

Hydrology is the study of earth's water resources and their application to man's use. Many of the requirements for advancing the science of hydrology can be satisfied by other programs, space meteorology, for instance, for improved weather forecasting is a basic need.

There are, however, a great many ways in which a specially-designed hydrological satellite can make important contributions. To mention just a few, a space-based system can permit forecasting precipitation, temperature and stream flow and allow rapid transmission of such data to users; it can supply reliable information on evaporation from water and land, rainfall distribution and drainage basins, data on soil moisture over large areas, data on snow cover, snow water content and the melting rate, and new information on currents and tidal effects. There is a major immediate requirement: A complete inventory of the world's lakes, reservoirs and snows to be used in developing models of the hydrologic cycle during the International Hydrologic Decade (1965-1974).

As an interim program, to be operational before 1975, the study group proposes two types of satellites: a Hydrologic Communications Satellite (HCS) and a Hydrologic Sensing Satellite (HSS). The former would collect data from 10,000 to 50,000 automatic ground stations all over the world and telemeter it to using centers. The sensing satellite would supplement the

ground-based data through global photography and infrared/radar imagery. An advanced HSS-2, to be available after 1975, would perform all the tasks of its predecessor, but with greater resolution, and would provide additional important information such as a complete catalogue of world rainfall, the movement of atmospheric water vapor and the biochemical characteristics of water.

Cost estimates are necessarily loose because some parts of the program would be carried out in conjunction with other earth-resource surveys, but the study group estimated $25 million for a collection system embracing 10,000 new stations in addition to 8,000 already operating (which provide recorded data on a once-a-month basis). The initial sensing satellite would cost $40-50 million, plus $20-25 million per year.

Benefits are not subject to direct measurement either, but the study group looks to "significant" gains through better understanding of large water systems and through improved management of water resources. The panel cited, as indication of much larger potential return, examples of $5 million per year in management of municipal water supplies and a sum larger than that in irrigation and flood control.

Oceanography

Space technology to date has had little impact on oceanography and there is no real base of knowledge from which to launch an immediate applications program. The study group has, however, identified a number of potential applications of considerable importance. Space systems can sample only the surface and about one percent of the depth, but this is the portion most significant to man.

Some examples of applications include prediction of fish locations and isolation of plankton areas, with vast implications in the world food problem; more efficient ship routing by monitoring currents, storms, and icebergs; and detection of weather conditions in the making.

The panel feels that long-term benefits will accrue from a system which combines the sensing satellite with the collection satellite, which picks up information from automatic buoys and relays it to central data-handling banks. But it is too early to recommend specific types of spacecraft. Instead, the group suggests a twofold research program covering a) development of new sensory equipment and b) an effort by the oceanographic community to identify those areas where satellites can be useful. Such a program would cost about $10 million a year.

Similarly, the benefits are still vague, but it is the feeling of the group that potential savings to shipping, fishing and coastal engineering industries can run to hundreds of millions of dollars a year.

Forestry, Agriculture and Geography

The United States is the world's most efficient farm nation, thanks to a highly organized system of crop reporting and land use. But the entire world stands to gain, and even the U.S. operation can be considerably improved, by space-based agricultural and forestry surveys which employ "multi-spectral imagery." This means simply standard and infrared photography of

which would be distributed directly to thousands of users. Since these users are already trained in photo analysis, data processing requirements would be minimal. A second phase would involve development of more sophisticated sensors to determine detailed geological structure and rock identity, information which would be fed to the CERI center advocated for the forestry-agriculture program.

GEROS program costs would amount to $42 million and Phase II research and development would come to $35 million.

GEROS could produce enormous economic benefit by speeding up the rate at which mineral reserves could be discovered. A five percent speed-up, the group estimates, would be worth about $2 billion. Here again the intangible benefits are very impressive. If new reserves can be found more rapidly, more effective resource management is possible through better long-range planning. Substitutes for materials threatened with short supply may be hunted before the needs become critical, with consequent effect on export and import policies. And there is benefit to the world community in the fact that assistance could be provided to developing countries which may have vast amounts of undiscovered mineral wealth.

Geodesy

Geodesy is not a new application; there is already under way a National Geodetic Satellite Program. It has two objectives. Physical geodesy involves an investigation of the earth's gravity field and determination of a unified coordinate system. Geometric geodesy covers a determination of the size and shape of the earth, together with precision location of a great many reference points in the unified coordinate system.

The NAS-NRC team feels that NASA's current program in geometric geodesy is adequate and that it should be continued. It also advances a proposal for a greater effort in physical geodesy, specifically, four new satellites to be launched at about one-year intervals from 1969 through 1972.

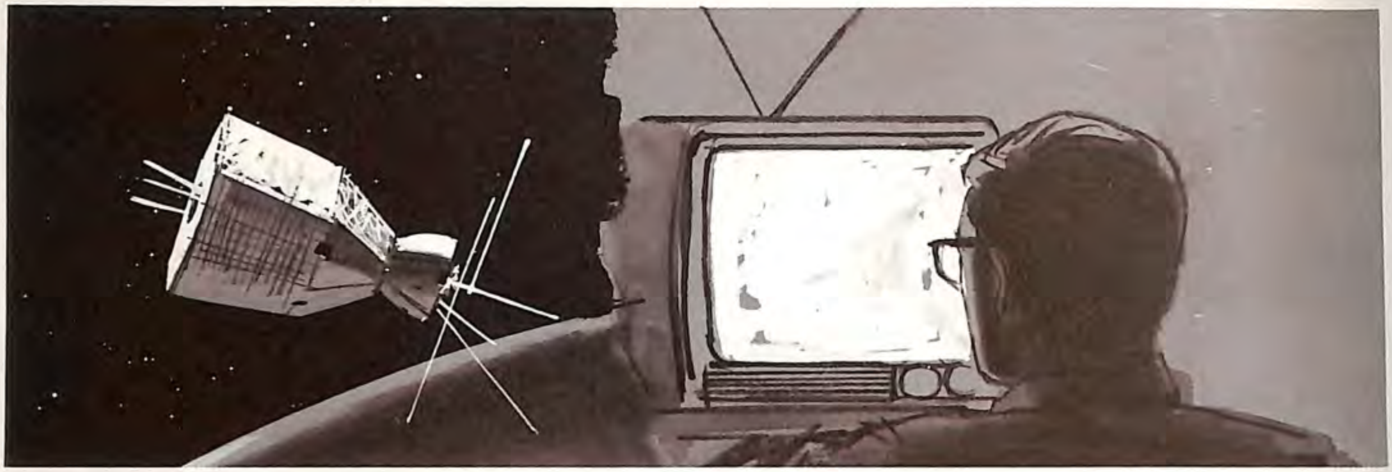
The latter program would require expenditures of $5-10 million a year. The geometric program should cost $5.3 million annually for the next five years.

Benefits from geodesy are largely indirect, but they can be very important to other disciplines, such as oceanography and cartography. However, the panel did find some specific examples of how direct economic benefits could be achieved: better knowledge of the earth could result in improved prediction of spacecraft orbits and reduce tracking costs, and more and better earth reference points could reduce position-fixing costs involved in remote-area mineral development. Identified benefits amount to $4-10 million a year, roughly equivalent to the cost of the proposed new physical geodesy program.

Cartography

Cartography, the depiction of the physical surface of the earth, can be substantially improved by orbiting spacecraft; the requisite global photography can be accomplished in a much shorter time than by aircraft techniques.

To advance the art of cartography, the study group



proposes a series of four flights of satellites in low altitude orbit (80-120 miles). These satellites would be capable of returning film packages to earth, because TV photos do not provide the desired quality for mapmaking. The flights would be made in the 1972-75 time period to initiate new charting and to update existing world maps. Cost of the program would be about $60 million.

Since mapmaking has traditionally been a public-service function of government, the group made no attempt to estimate direct economic value. But it is clear that space cartography does offer cash bonuses. The great advantage of the satellite is the large area covered by a single picture, hence far fewer pictures to assemble into mosaics. One of the proposed satellites could cover the United States with 550 stereo pairs of frames; the same coverage by airplane would require 100,000 pairs. Assembly of the aircraft photos costs five to 10 times the cost of the photography, where the cost of assembling only 550 pairs is negligible. Obviously there is a comparable reduction in assembly time. The group concludes only that "the savings in map production costs can be enormous, amounting to many times the cost of the photography."

Point-to-Point Communications

Since there already exists an international point-to-point comsat network, there is no question about either the technical or economic feasibility of the communications satellite. The panel, therefore, used the existing system as a departure point and concentrated on ways to improve the communications satellite for the greater portion of the traffic it is expected to handle in the future. It recommended a development focusing on lower cost to the user and optimum use of available frequencies and orbital space (while space is limitless, there is a limit to the number of useful positions for satellites, particularly those of the synchronous variety). The cost of the continuing research and development program was estimated at $16 million, plus another $11 million later to flight test new types of satellite antennas.

Although the benefits of the comsat system are clearly enormous in potential, the group did not attempt to assign dollar values except for two examples:

The annual cost of the 1,200-channel Intelsat III comsat is about half that of a 720-circuit cable and the savings come to $8 million a year.

A combined telephone/television domestic system for the United States would by 1980 return an investment saving of $200 million.

Broadcasting

Broadcasting, in the terms of the study group, refers to television broadcasting, and it differs from the existing comsat network primarily in the type of signals transmitted and the type of reception equipment needed on the ground.

The point-to-point system requires elaborate ground equipment, primarily a huge antenna, for reception of satellite signals; the signals are then re-transmitted. Thus, TV is available only to those living within a relatively short distance from a transmitter. This is not much of a drawback in the United States, with its multiplicity of TV stations. But even in the U.S. there various kinds of trees and crops, which reflect light in different bands of the visible and infrared ranges of the spectrum. Properly processed, such imagery can reveal the identity of all types of vegetation observed, and the satellite of course, can make observations in a day that would take years by other means.

The information thus received would be fed to a central bank and utilized for more effective management of the earth's resources. The center would provide such vital output as general information for planning and development; seasonal information for agriculture, forest and range crops; local information for individual farm management; emergency information for disaster relief; and scientific data for research and education.

There would be spillover into the geographic field. For example, surveys made at periodic intervals can provide information useful in urban and suburban planning by making apparent patterns of growth and changing land uses.

The study group recommends a two-pronged approach. The first phase consists of a Global Land Use satellite (GLU), to be operating in three to five years. In polar orbit, it would provide continuous coverage of the earth at a constant sun angle, producing world land use maps and sectional photos (100 miles square) for interpretation by many thousands of users.

In addition, the group proposes a 12-year research program aimed at creating the central data bank, to be known as the Center for Earth Resources Information. CERI, in addition to its informational output, would be devoted to development of new hardware, such as spacecraft, sensors and ground equipment; to finding new ways of interpreting the information obtained; and to study how best to utilize the information.

Research and development costs, for both CERI and GLU, would run to an estimated $284 million and CERI would cost $50 million a year to operate. Balanced against these costs are annual economic gains in world-wide agriculture and forestry of as much as $80 million annually. No dollar value was assigned to geography spillover, but the panel noted that sensor development would be useful in companion programs like hydrology and oceanography. And in this area the intangible benefits are particularly noteworthy. "Modest improvements in agricultural efficiencies," the study group states, "can often mean the difference between subsistence and starvation, between stable and unstable governments."

Geology

Geologists have long used aircraft equipped with sensing devices to explore for minerals, oil and gas in the earth's crust. The geological satellite offers tremendous expansion of area coverage and great compression of exploration time. Gemini photographs indicated promising possibilities, but there is need for hardware specifically developed for geological requirements, for example, types of illumination and spacecraft synchronization for different sun angles; in short, the satellite needs systems other than those used in aircraft.

The study group recommends a Geological Resource Study of North and South America. GEROS, as it is called, would be put into operation in two to three years and would employ both aircraft and spacecraft to produce data in the form of photo and radar imagery,

are gap areas and abroad there are millions of people to whom television is still a Buck Rogers dream.

The broadcast satellite can make possible international or local transmission of TV signals direct to home receivers, or, alternatively, to a community TV like the local movie house. In other words, TV can be available to anyone who has a receiver. The broadcast system involves transferring a major portion of the ground capability to the spacecraft; the satellite requires great power, improved antennas and transmitters designed for use with extremely simple ground antennas. The satellites, of course, would necessarily be much larger than those now in service, the size depending on the desired area of coverage, which could be a single time zone, a whole country or a multi-nation region of the earth. A suggested U.S.-wide prototype system would employ three 5,800-pound satellites; others discussed involved spacecraft weights ranging from 2,300 to 20,000 pounds.

The major advantage is cheaper service, which could open the door to extremely broad instructional, educational, cultural and public interest television.

"The implications are spectacular," says the panel. There are clearly economic benefits to developing nations all over the world which do not yet have TV distribution systems. More important is the dramatic possibility of a rapid elevation of the world educational level through broadcasting. The study group concludes: "Of all the potential applications of space, broadcasting is perhaps the most exciting in its nearness and in its inherent capacity for good."

The panel recommended a research program aimed at development of the requisite satellite components, but pointed out that broadcasting is already technologically feasible. The limiting factors, it said, are not technical restraints, but economic, political and demographic considerations.

Navigation and Traffic Control

Since 1962 the U.S. Navy has operated a system of navigational satellites for precise position determination by its submarines and surface vessels. The technology has been verified, and with completely feasible advancements the system can be extended to include the world's aircraft and commercial shipping.

The panel suggested two types of space systems. One would employ three synchronous satellites spaced 120 degrees apart, providing coverage between north and south latitudes of 70 degrees. The second would have coverage through six spacecraft spaced at 60 degrees.

The cost of setting up an operational navigational and traffic control system is estimated at $300 million over a period of 10 years; this includes initial investment and yearly operation. User equipment would cost between $2,500 and $20,000 per installation; it would take $150 million to equip the U.S. marine fleet plus large military, commercial and business aircraft.

Since the system is essentially a safety service, economic return should be subordinated to the saving of lives. There are, however, visible economic aspects. The panel estimates that benefits from improved ship and aircraft routing, reduction in cost of search and rescue operations, reduction in ship losses due to collision and better location of fishing grounds could amount to $50 million a year. This is approximately the annual cost of operating the system. —*James J. Haggerty*

AEROSPACE NOTES

'Night Window' Will Give Pilots Daylight View

Pilots may soon have the capability of obtaining clear, daylight-like views of night-darkened terrain using a device recently developed by Kollsman Instrument Corp.

Called "Night Window" by its developers, it uses advanced optics to display an enhanced three-dimensional image with the same depth, size and realism a pilot would see if looking at the scene during daylight. The brightened view is projected on a foot-square transparent screen behind the aircraft windshield.

A laboratory model of the "Night Window" system has undergone helicopter field trials and the Air Force and Navy are evaluating the system as a possible solution to night navigation and landing problems.

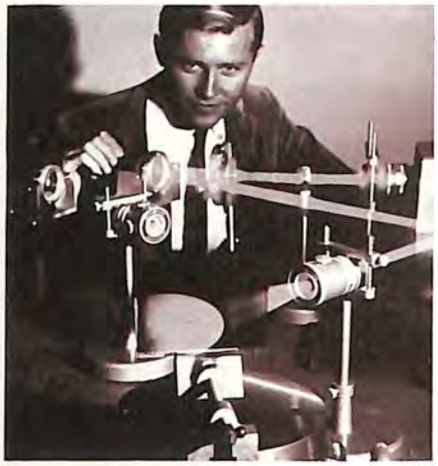
Kollsman has proposed the system for installation on forward-observer reconnaissance aircraft for Vietnam. Other possible military applications include tanks, river patrol boats, and motor vehicles engaged in night movement. Auto and commercial aircraft uses appear practical in the future.

Martin Devises Photographic Technique To Study Planets

Scientists on earth may be able to study the rock and plants on other planets by means of a three-dimensional photographic technique — holography — using a laser and a lenseless camera under development at Martin Marietta Corp. for use on unmanned spacecraft.

The technique uses a laser light to illuminate a geological specimen and records the resulting diffraction pattern on a sensitized plate. A three-dimensional image of the specimen is projected by directing a laser beam, as shown in the photo, to the holographic plate.

In this way, a scientist can view the image from different angles in much the same manner that he would view the actual object.



New Apollo Module Hatch Readied for Space Check

A new quick-opening, one-piece hatch for the Apollo command module will be qualified for space flight on the unmanned Apollo 6 mission this year. In the photo a technician at North American Rockwell Corp.'s Space Division checks an engineering mockup of the new hatch.

North American Rockwell is the principal contractor for the Apollo command and service modules. The new hatch has already undergone a series of ground tests before it is checked out in a space mission.

Swing-out Cabinet Designed For Orbital Spacework

Under simulated zero-g condition in a six-degrees-of-freedom simulator built by Convair Division of General Dynamics, an "astronaut" demonstrates the use of a new swing-out cabinet for equipment installation in large spacecraft.

The swing-out concept is necessary to give astronauts under zero-g easy access to equipment in order to inspect, remove and replace. They also have access to the cabin structure for maintenance and repair.

The Convair cabinet pivots out from the inside wall of the spacecraft, has positive locking in the open and closed positions and has braking action between the two positions.

In the photo the demonstrator moves the cabinet with his left hand while the right hand grasps a restraint similar to one that would be installed in spacecraft to prevent his moving away from the cabinet.

Philco-Ford Building Advanced Space Simulator

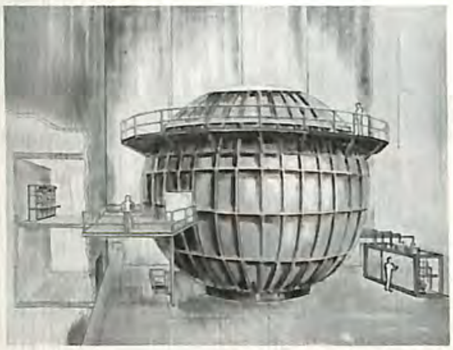
Construction has begun for the Space & Re-entry Systems Division of Philco-Ford Corp., of a spherical stainless steel space simulator which is to be one of the most advanced space simulation facilities in operation.

It will be 38.5 feet in diameter and make use of the latest vacuum pumping techniques to duplicate the space environment. In order to simulate the cold of outer space the entire sphere will be lined with panels cooled by liquid nitrogen to a temperature of about —300 degrees F. To simulate heat from the sun and other sources in space, quartz lamps will be used.

Aerodynamic heating during exit from earth's atmosphere can also be simulated by means of heat lamp arrays entirely surrounding the tested spacecraft. The simulator can also be equipped to evaluate performance of star trackers, horizon sensors, despun antennas, communication and telemetry systems while the spacecraft is in a space environment.

A 400-channel digital data acquisition system will be installed to gather data, sampling and processing it in tabular or graphic form.

Design of the simulator allows for future modification to add an artificial sun to make the chamber suitable for tests involving men-in-space suits within the chamber.



Goodyear Tires Carry Sub Across Ocean Floor

Tires built by Goodyear Tire and Rubber Company for the tail wheel of a C-47 military transport, are being used to carry an all-aluminum submarine known as the Aluminaut across the ocean floor. The Aluminaut was designed for use in undersea exploration.

The tires are filled with water to prevent problems caused by difference in pressure at and below sea level.

Lockheed C-5 Rolls Out; First Flight This Summer

The world's largest airplane, the Lockheed C-5 Galaxy was rolled out of the Lockheed-Georgia Company plant at Marietta, Georgia, in March, with President Johnson present to call it the beginning of "a new era in America's power."

Destined for first flight this summer, the C-5 will be delivered to the Military Airlift Command in 1969. It is powered by four General Electric TF-39 engines each of which consumes approximately 42 tons of air per minute. The new aircraft carries 49,000 gallons of fuel, enough for the average American car to make 130 round trips between New York and Los Angeles or 31 trips around the world.

The cargo compartment is large enough to hold an eight-lane bowling alley, about 100 Volkswagens at one time or six fully-loaded standard buses. The Wright Brothers first flight was less than the 121 feet length of the cargo floor.

The flight deck, with pilot, co-pilot, navigator, flight engineer and observer stations, also has provisions for two students or instructor seats, one each at the navigator and flight engineer stations.

UTC Helps Foresters Burn Logging Debris

Drawing on its experience in aerospace research and production of rocket motors, United Technology Center has created a system for igniting forest wastes remotely. It consists of a rifle-like launcher and a self-propelled incendiary projectile that bursts and ignites on impact.

The system has a range of about 1,500 feet and is versatile enough to be fired from the shoulder, from a prone position, or from a mount on a truck or jeep. The incendiary projectile contains its own propelling charge which also ignites a delayed fuse to assure ignition.

UTC's device is seen as an able assist to the Forest Service which annually burns about 500,000 acres of logging debris in the western U.S. to reduce fire hazard and facilitate reforestation.

At the present time, about three-fourths of such debris fires are ignited by men equipped with torches and fuses but use of torches has proved hazardous to the men who must walk within and along the edges of debris areas.

1. First air mail flight from Washington's Potomac Park readies for take-off May 15, 1918. President Woodrow Wilson attended ceremonies.

2. Boeing 40-A biplane was one of the early carriers of the mail. This 1927 craft could carry 1,600 pounds of mail and two passengers.

3. First international contract air mail flight — between Seattle and Vancouver, B.C. — was flown in this Boeing Model C seaplane of 1917.

4. Ford tri-motor mail-passenger plane had a special mail compartment in its wing which facilitated loading of the growing amount of air mail.

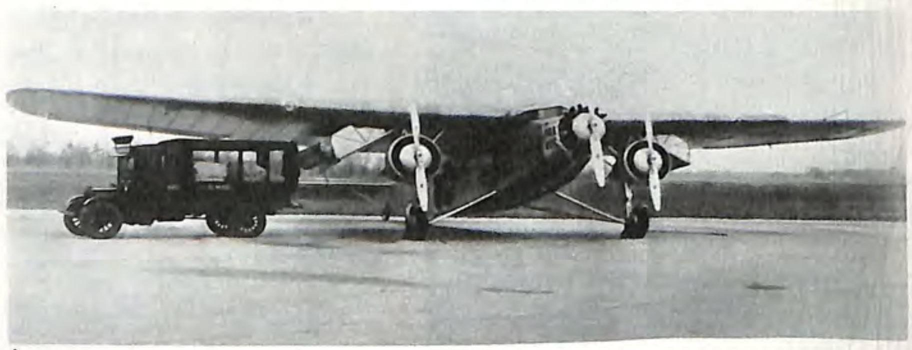
5. Many early air mail flights originated from makeshift fields piloted by a hardy band of ex-World War I fliers and barnstormers.

6. Today's commercial air fleet operates from busy airports piloted by highly trained crews carrying a million pounds of air mail daily.


1


2


3


4

5

6

50TH ANNIVERSARY Air Mail Service

Mail a first class letter in almost any part of the U. S. today and chances are excellent that it will go by air. All first class mail that can be expedited by air transport is now being airlifted, a significant step in the development of air mail service in the 50th year since its establishment. ■ The Post Office Department is now utilizing 12,000 air schedules a day in the U. S. using every mode of air transportation including air taxis. Interconnected in a vast air mail network are more than 500 cities regularly served by commercial airlines. For the price of a six-cent first class stamp, the U. S. public is receiving service that did not exist to any important degree even a year ago. ■ The day is fast approaching when a single priority class of mail service merging first class and air mail will move letter mail by whatever means is most expeditious. ■ Rapid strides in air mail service have come about primarily because of the development of U. S. jet transports which provide a growing airline capacity to haul the mails; and as the newer, larger aircraft come along, that capacity will be even greater. On any average day U. S. airlines today carry more than 1,500,000 pounds of air mail. ■ During 1967, U. S. airlines acquired 387 new jet transports worth more than $2 billion and purchases are expected to reach $8.3 billion for the 1,124 aircraft the airlines are buying in the 1967-1971 equipment program. ■ Another important factor in the shift from surface to air transport of the mails has been the decline in the mail-carrying passenger train. Thirty years ago there were 10,000 mail-hauling daily trains. As recently as 1957 there were 2,627 trains a day. But today there are only about 741 passenger trains available for moving the mails. ■ To celebrate the 50th anniversary of the first regular air mail service, the Air Mail Pioneers together with the National Aeronautics Association plans to fly a rebuilt DeHaviland DH-4 aircraft, one of the early U. S. mail planes, across the country "in easy stages." The plane is to be displayed at the Smithsonian Institution during May and will be accepted for exhibition in the National Air and Space Museum. ■ The program will honor the establishment of the first regular air mail route which was flown under Army auspices between New York and Washington. A stop was scheduled in Philadelphia for refueling and an exchange of mail. The route was 218 miles long and called for one round trip per day except Sundays. It was financed by a $100,000 Congressional appropriation. ■ First flight of the new service was piloted by Army Lt. James Edgerton who delivered 10,000 letters to Washington from New York and Philadelphia when he landed a World War I Curtiss "Jenny" on a polo field in Potomac Park. President Woodrow Wilson led the group of dignitaries who gathered at the field to inaugurate the new service officially. ■ The debut was less than auspicious. At the last minute they found out the airplane was out of gas. Then after taking off, the pilot followed the wrong railroad tracks, which served as the "iron compass" of early fliers and broke his propeller when he crash landed in the plowed field of a farm near Waldorf, Md. ■ U. S. airlines in 1967 carried 970,988,000 ton miles of mail, an increase of nearly 30 percent of the previous year. Regular airmail accounted for 592,148,000 ton miles of service, an increase of a little more than nine percent. The airlift of first class mail on a space-available basis accounted for 379,475,000 ton-miles of service, representing a gain in 1967 of 82.7 percent. ■ Another important growth factor in the carriage of the mail has been the introduction of more jet aircraft into local service airline fleets. Of the 588 cities receiving airline service today, 418 are served exclusively by local service carriers. The movement of first class mail in 1967 by these carriers grew by 225 percent from 1,050,000 ton miles in 1966 to 3,406,000 in 1967. ■ Fifty years after its establishment air mail has reached a new era made possible by remarkable advantages of economic U. S. aircraft and an efficient airline system.

Quest for Quiet Jets

The battle to abate aircraft noise has been waged by the aerospace industry on a broad scale since long before the introduction of the turbine engine. The ultimate solution has yet to be found. But it is recognized that manufacturers' efforts must be combined with that of local communities whose responsibility it is to control the use of land around airports. Aircraft operators must continue the refinement of aircraft in-flight operating procedures in the vicinity of airports.

As industry's engineers developed larger and more powerful engines for increasingly-larger aircraft, company-initiated and funded research programs have been conducted in an attempt to ameliorate the noise problem along the nation's expanding airways.

Jet engine noise suppression devices resulted in some improvement but it was clearly evident to the industry that entirely new technologies were needed to bring about still greater progress in this area.

A few years after the introduction of the first generation of jet aircraft, major propulsion advances were made with the development of the fan-jet engine which brought about significant reductions in the principal source of engine noise that until that time had been the main target of engine noise reduction efforts. However, the fan-jet revealed noise characteristics of its own and engine fan noise became the dominant source of annoyance. Industry efforts were expanded in an effort to eliminate this problem.

Over the past several years it is estimated that the principal manufacturers of transport aircraft and jet engines have spent $125 million to $150 million on engine noise reduction projects. Currently industry expenditures in this area exceed $15 million annually.

Because of the complicated relationship of the many elements that make up the development processes in the design of new engine technology, specific identification and delineation of company-expended funds devoted to resolving the noise problem cannot be clearly defined. The research, design and pre-prototype costs incurred in the development of modern jet aircraft engines can exceed a quarter of a billion dollars. Although increased noise attenuation is always part of the engine's total design objectives, no practical means exists to identify that portion of funds devoted solely to solving the problem of noise.

It is technology and not cost that is the pacing factor in achieving more dramatic results in noise reduction.

Gaps exist in industry's knowledge with respect to such fundamental problems as the basic physical mechanism of noise generation particularly with respect to the nature of noise generated by the rotating elements of engines and the mixing of jet exhausts with the surrounding air. More knowledge is required on noise propagation within the engine and exhaust ducts and on the fundamentals of noise absorption including the characteristics of acceptable and safe attenuation materials.

In its efforts to find solutions to the problem, the National Aeronautics and Space Administration has awarded contracts to several principal aircraft manufacturers to develop, test and demonstrate a sound attenuating engine nacelle for existing engines on currently-operating aircraft. Cost data and noise reduction information developed from these contracts is expected to be available late in 1969. NASA has also let a contract to study the cost of installing new technology engines in present jet airliners.

Together with the Air Transport Association, the Aerospace Industries Association is having a systems analysis research program conducted on the abatement of aircraft noise. In order to construct the computer-driven model to be used in this program, it was necessary to generate representative costs for a retrofit program of four-engine aircraft. Accordingly, it was determined that if the whole fleet of four-engine jet transports were to be treated, the costs of installing sound dampening nacelles alone would be from $600,000 to $800,000 per aircraft. The installation of new technology engines is estimated to cost between $3 and $4 million per aircraft.

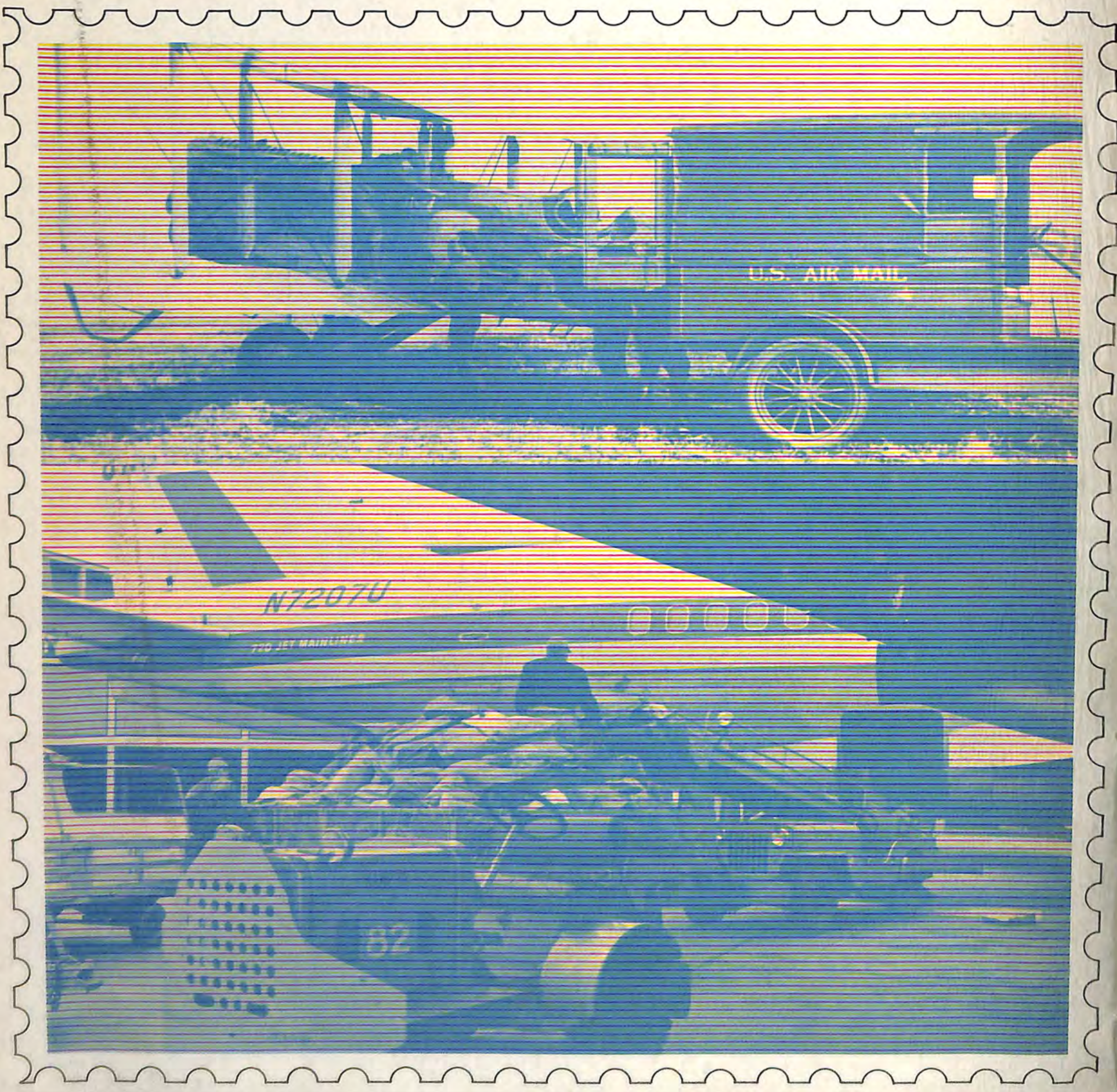
As long as the problem persists, the aerospace industry will be continuing its efforts to help provide the solution.

AIA MANUFACTURING MEMBERS

Abex Corporation
Aerodex, Inc.
Aerojet-General Corporation
Aeronca, Inc.
Aeronutronic Division, Philco-Ford Corporation
Amphenol Connector Division
  Amphenol Corp.
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
Curtiss-Wright Corporation
Fairchild Hiller Corporation
The Garrett Corporation
General Dynamics Corporation
General Electric Company
  Defense Electronics Division
  Flight Propulsion Division
  Missile & Space Division
  Defense Programs Division
General Motors Corporation
  Allison Division
General Precision Systems, Inc.
The B. F. Goodrich Company
Goodyear Aerospace Corporation
Grumman Aircraft Engineering Corp.
Gyrodyne Company of America, Inc.
Harvey Aluminum, Inc.
Hercules Incorporated
Honeywell Inc.
Hughes Aircraft Company
IBM Corporation
  Federal Systems Division
International Telephone & Telegraph Corp.
  Defense & Space Group
    ITT Avionics
    ITT Gilfillan, Inc.
    ITT Defense Communications
  ITT Aerospace Controls
Kaiser Aerospace & Electronics Corporation
Kaman Corporation
Kollsman Instrument Corporation
Lear Jet Industries, Inc.
Lear Siegler, Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corporation
The Marquardt Corporation
Martin Marietta Corporation
McDonnell Douglas Corp.
Menasco Manufacturing Company
North American Rockwell Corporation
Northrop Corporation
Pacific Airmotive Corporation
Piper Aircraft Corporation
Pneumo Dynamics Corporation
RCA
  Defense Electronic Products
Rohr Corporation
Ryan Aeronautical Company
Solar, Division of International
  Harvester Co.
Sperry Rand Corporation
  Sperry Gyroscope Company
  Sperry Systems Management
  Sperry Flight Systems Division
Sundstrand Aviation, Division of
  Sundstrand Corporation
Thiokol Chemical Corporation
TRW Inc.
Twin Industries Corp.
  Division of the Wheelabrator Corp.
United Aircraft Corporation
Westinghouse Electric Corporation
  Aerospace Electrical Division
  Aerospace Division
  Astronuclear Laboratory
  Marine Division

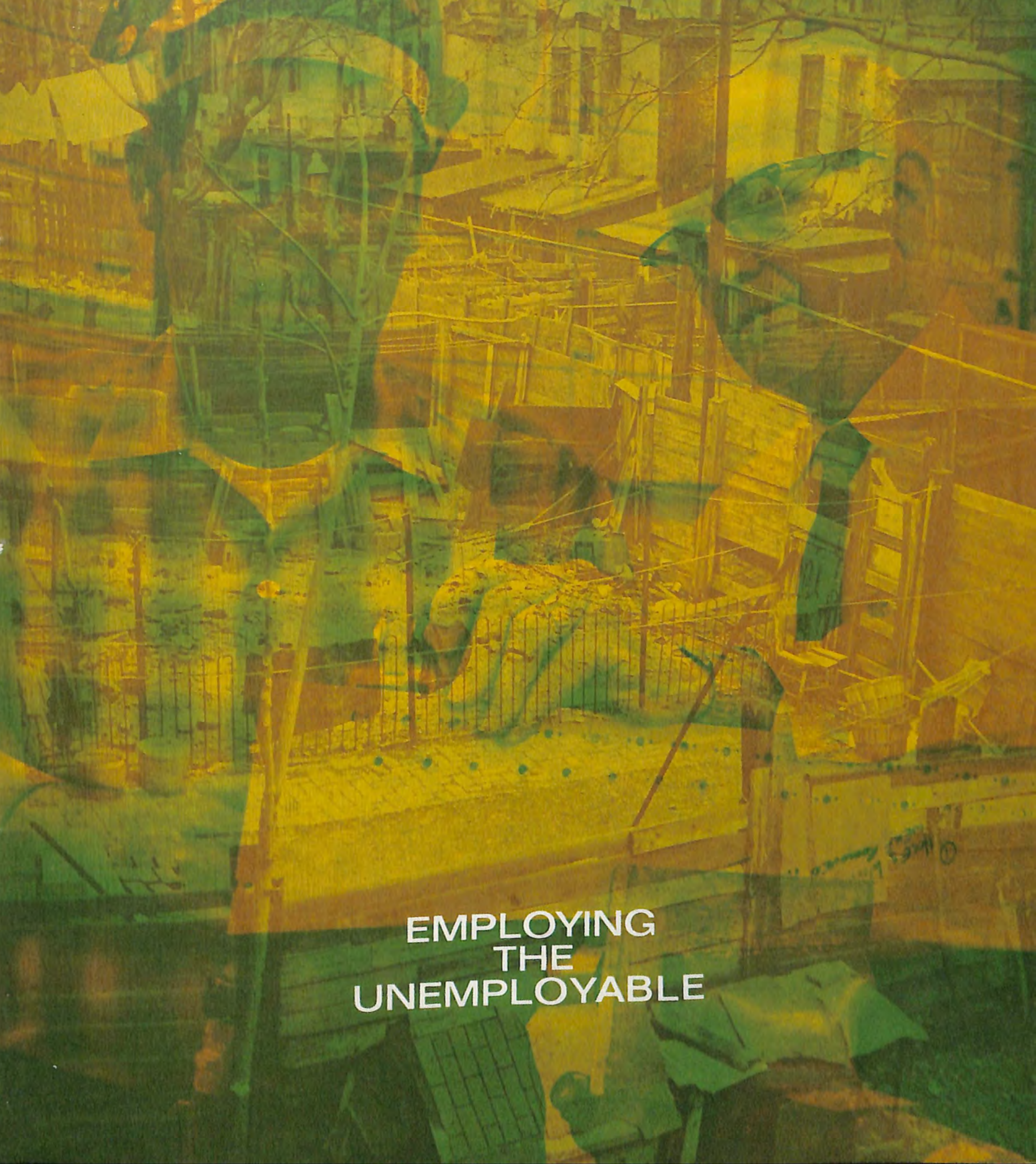
AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W., Washington, D. C. 20036
RETURN REQUESTED

Converted World War I fighters carried the first air mail 50 years ago when a few mail sacks could handle the volume. Today's modern jet airliners carry a million pounds of air mail daily across the nation and the globe. (See *50th Anniversary: Air Mail Service* page 14).



aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • FALL 1968

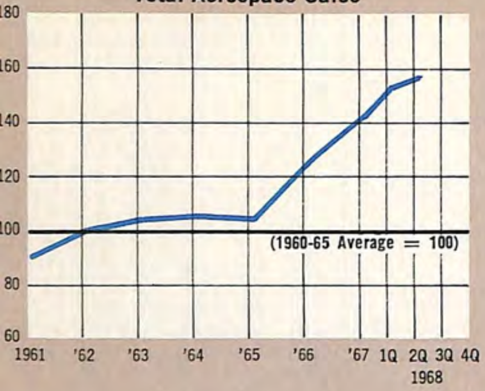


EMPLOYING THE UNEMPLOYABLE

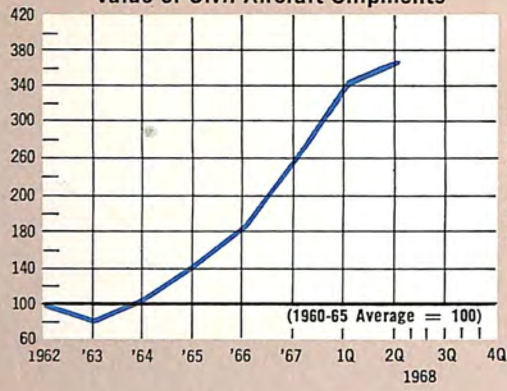
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales

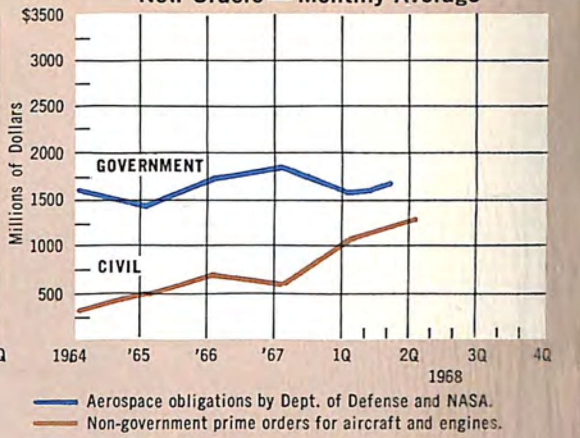


Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average



ITEM	UNIT	PERIOD	AVERAGE 1960-65 *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending June 30 1968	27.0	29.7	30.2E
	Billion $	Quarterly	4.8		6.8	7.4	7.7
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	May 1968	1,651	1,424	1,447
Aircraft	Million $	Monthly	601	May 1968	1,147	956	1,171
Missiles & Space	Million $	Monthly	550	May 1968	504	468	276
Aerospace expenditures: Total	Million $	Monthly	1,067	May 1968	1,348	1,417	1,499
Aircraft	Million $	Monthly	561	May 1968	846	928	1,009
Missiles & Space	Million $	Monthly	506	May 1968	502	489	490
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920 ✣	May 1968	1,496	1,151	1,578
Aircraft	Million $	Monthly	447	May 1968	1,240	834	1,129
Missiles & Space	Million $	Monthly	473	May 1968	256	317	449
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	June 1968	366	235	334
Expenditures	Million $	Monthly	130	June 1968	349	367	387
GENERAL AVIATION AIRCRAFT SALES							
Units	Number	Monthly	692	July 1968	998	1,014	998
Value	Million $	Monthly	15	July 1968	33	33	33
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3 #	Quarter Ending June 30 1968	28.9	33.6	34.3E
U.S. Government	Billion $	Quarterly	11.6		16.1	18.7	18.9
Nongovernment	Billion $	Quarterly	3.7		12.8	14.9	15.4
EXPORTS							
Total (Including military)	Million $	Monthly	110	June 1968	187	255	244
New Commercial Transports	Million $	Monthly	24	June 1968	58	107	106
New Utility Aircraft	Million $	Monthly	2	June 1968	7	7	7
PROFITS							
Aerospace — Based on Sales	Percent	Quarterly	2.3	Quarter Ending Mar. 31 1968	2.6	2.9	2.9
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		4.9	5.2	5.0
EMPLOYMENT: Total	Thousands	Monthly	1,132	June 1968	1,387	1,413	1,417E
Aircraft	Thousands	Monthly	499	June 1968	608	629	632
Missiles & Space	Thousands	Monthly	496	June 1968	598	607	608
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	June 1968	3.48	3.63	3.65E

E Estimate.
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
# Averages for 1961-65.
✣ Averages for fiscal years 1960-1965.

Source: Aerospace Industries Association

A COMMITMENT

By Karl G. Harr, Jr.
President, Aerospace Industries Association

The aerospace industry historically has existed and flourished in an atmosphere of challenge. The challenge has been largely to technological and managerial excellence and innovation, and the response of industry has produced advanced weapon systems for national defense, a space exploration program that has created vast horizons for human endeavor and civil aircraft that are revolutionizing passenger travel and cargo movement.

Underlying such accomplishments, and fully as vital as the industry's professional abilities, is its *commitment* that it can and will be responsive to national requirements.

Today the aerospace industry, along with all of U.S. industry, has assumed another commitment, a deep and earnest commitment, to bring the disadvantaged minorities into the productive mainstream of U.S. life.

Since job opportunities can be shut off because a man lacks even the most rudimentary education or training to undertake them, equal opportunity is not enough.

Some of the efforts of aerospace companies truly to open up job opportunities are described in this issue of *Aerospace Magazine* (see *Employing The Unemployable,* p. 2). Where there is dedication between those needing help and those offering it, promising results are being experienced. These first steps, on the whole, represent real progress.

The National Alliance of Businessmen (NAB) is the primary force in finding jobs. The federal government, through the Job Opportunities in the Business Sector (JOBS) program, is providing funds for some of the training. The Department of Labor recently released the following figures on government-sponsored training of the hard-core jobless by groupings of major industries.

- The automotive industry will train 3,420 long-term jobless for an expenditure of about $7.8 million.
- The aerospace industry will train 2,276 persons for an expenditure of $7.5 million.
- Electronics and research and development will train 2,194 persons for an expenditure of about $6.8 million.*

This progress is certainly encouraging, but it must be viewed in the context of overall socioeconomic problems produced by the accelerating dynamics of our times — including a population explosion. The problem of men without training and jobs cannot be viewed separately from the problems of air and water pollution, crime, transportation congestion, waste disposal and the like.

The aerospace industry's reservoir of technological and managerial capabilities is also being addressed to these other major socioeconomic problems. The demonstrated ingenuity of this industry, coupled with its historic commitment to national requirements, are the primary assets in meeting both needs.

---

* *Much of the electronics and research and development is within the aerospace industry but were separately classified by the Department of Labor.*

AIA

aerospace

Official Publication of the
Aerospace Industries Association of America, Inc.

PRESIDENT • Karl G. Harr, Jr.
VICE PRESIDENT • V. J. Adduci

VOL. 6, NO. 2 *FALL 1968*

EDITOR • Gerald J. McAllister
ASSOCIATE EDITOR • Richard W. Balentine
ECONOMIST • Gerson N. Chanowitz
ART DIRECTOR • James J. Fisher

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 civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published 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

Western Office: McCulloch Building, 6151 West Century Blvd., Los Angeles, Calif. 90045

EMPLOYING THE UNE

The aerospace industry has made significant progress in solving the problem of the hard-core unemployed of the nation by hiring and training those previously believed to be unemployable. Industry has proved that people from the ghetto can become productive, and so it has helped to lift the sights of the nation to the target of employment for everyone able to work. No one believes that the problem is solved; it isn't. But a start has been made, and a course set for the future.

Companies in the aerospace industry have been acutely aware of the plight of the hard-core unemployed, for many of their plants are in or near the major cities of the nation.

It was quite natural, then, that the aerospace industry took a thoughtful approach regarding the state of those who have had little chance for a semi-skilled, much less, skilled job. The reason: the companies that produced the airplanes in World War II proved that unskilled workers could be trained to produce the high precision craft that flew around the world in support of the military mission of the United States and its allies. It may be a bit distant in time for some to recall, but the housewife who became Rosie the Riveter was a heroine, and she had many male counterparts.

In examining the problem of the hard-core unemployed, the thrust of the program centers on those who because of lack of education and skills have been relegated out of the potential work force. Some of them may also be physically handicapped, and of course they are receiving every consideration.

Experience in hiring the hard-core has been good, from the standpoint of both employee and employer. This is not a make-work or charitable operation. Companies have accepted their civic responsibility in trying to solve unemployment in the ghetto, at the same time recognizing their accountability to their stockholders. The new employees have proved to be productive.

The aerospace industry has been highly active in the National Alliance of Businessmen (NAB) formed as a result of President Johnson's Manpower Message to Congress on January 23, 1968 in which he asked American business to find permanent jobs for the hard-core unemployed.

Aerospace executives help the alliance at the national level. They also donate their talents locally — NAB operates in 50 of the nation's largest cities.

The elite of American management has been involved in the NAB. All over the nation executives are knocking on the doors of their corporate neighbors asking for pledges of jobs for the hard-core. Usually they are members of a team of businessmen (on loan from their companies), a metropolitan chairman of the local NAB, and a representative of the Department of Labor. In addition to locating jobs, the team works with public and private organizations to find and recruit the disadvantaged.

Large companies with wide experience in training the unskilled (this is true of aerospace organizations) lead the way in this field and can pass along their expertise to smaller corporations.

Many aerospace companies have encouraged their subcontractors to hire the hard-core jobless. There are approximately 40,000 subcontractors in the industry. Letters to the subcontractors have advised them that with all other factors equal (price, delivery date, quality, etc.) the firm hiring the hard-core jobless will be given special consideration.

Here are examples of what individual companies in the aerospace industry are doing to assist in the problem of hard-core unemployed.

AEROJET-GENERAL CORP.

An action by Aerojet-General is another example of the idea that the so-called unemployable, are not only able to work, but do good work. The Watts Manu-

MPLOYABLE

facturing Co. was established by Aerojet-General in the Los Angeles area, and workers from this area were recruited and trained. The company turns out tents and wooden shipping crates, and with these heretofore unemployables, the company is competing with other companies and is about to turn a profit.

AVCO CORP.

Avco is building a printing plant, worth almost $2 million, in Roxbury, Mass., that will employ 250 Negroes and Puerto Ricans who live nearby. The plant will eventually handle all of Avco's printing, and in three years it will become so independent that it will take on outside work.

But, more important, management will work itself out of jobs in three years and give the spots to the hard-core people. Avco's selection of employees goes to the heart of many problems in the nation. Top officials told the recruiting and training executive to hire his staff in this ratio: 15 percent ex-convict, 10 percent mothers on welfare, 25 percent hard-core unemployed, and the rest part time workers.

The company instituted classes in remedial reading and writing, mathematics essential to shop work, and allied subjects.

THE BENDIX CORP.

Bendix operates 51 divisions and subsidiaries in the United States where there are relatively few Negroes and hard-core unemployed. Yet during the last year, Bendix has increased its minority group employment from 3,363 to 4,413.

Bendix has had a strong dictate from the top in the problem of the hard-core. The chief executive officer told his senior executives to "give careful consideration to this grave challenge and opportunity presented to American business in helping solve this pressing problem — the employment of the disadvantaged."

Bendix has many programs that take into account the underprivileged; this includes, of course, the training and hiring of specialists in the manufacturing operations of the company. However, the corporation will train clerk-typists who do only 18 words a minute at the machine, and with eight to ten weeks of classroom and on-the-job work have them turning out 45 words a minute.

THE BOEING COMPANY

Boeing's involvement in reducing hard-core unemployment goes back several years when it signed an equal employment opportunity pledge with a number of other companies in the Seattle area. It was more than a promise: a booklet listing companies that would talk to anyone about a job was published and circulated widely and the the addressees were urged to apply.

Later, Boeing participated in opening an Employment Opportunities Center and a number of Job Fairs, the later seminar-like meetings in which jobs for the disadvantaged were discussed. These activities led to involvement in the NAB: a Boeing executive is the metropolitan director, and two other company employees were asigned to the office.

Boeing's NAB commitment is to hire and train 350 hard-core unemployed in the Seattle area over a one-year period. Boeing management has stressed the necessity for special consideration in helping these new employees to help themselves.

Boeing also has tackled the hard-core problem by inviting high-school students from the most heavily populated minority areas in Seattle to visit its plant and to hear about the jobs they could fill. Seattle school officials joined with the company in this project. It worked.

Further, a Vocational Guidance Institute, in cooperation with the Seattle Chamber of Commerce, has been helped by Boeing. This will emphasize the special needs of the disadvantaged.

On the other side of the country, the Vertol division of Boeing (located near Philadelphia) has assisted the Opportunities Industrialization Center, a self-help institution. That organization, church-sponsored, sparked the same kind of center in Seattle. Boeing hired about a third of the graduates.

CESSNA AIRCRAFT CO.

One perhaps may think that the hard-core unemployed are concentrated in the very large cities. However, Cessna in Wichita, Kansas, has recruited personnel at Job Corps centers and has hired many who have been trained under the Manpower Development Training Act. It has also been involved in the Office of Economic Opportunity Community Action Program.

Again, here is a company that has taken action on the line of social rehabilitation. For example, Cessna hired a 19-year-old who had never held a job for more than two weeks. He was given 120 hours of non-productive and on-the-job training. When assigned to a paying job he was at first incapable and frequently absent. But the company stayed with him, counseling and helping. Today, the company reports, "he appears to be developing into a productive citizen."

FAIRCHILD HILLER CORP.

Fairchild Hiller has joined hands with the Model Inner City Community Organization (MICCO), other community groups and the federal government in attacking the hard-core unemployment program in Washington, D. C.

MICCO is a non-profit confederation of organizations with more than 160 members, whose goal is to assure citizen participation in the social, economic, and physical renewal of the Shaw urban renewal area.

As their tool, Fairchild Hiller and MICCO have formed Fairmicco, a District of Columbia corporation. Fairmicco will be a profit oriented manufacturing company. Located in Washington's Model City area, it is teaching the hard-core jobless meaningful new skills and how to get—and hold—a job as it manufactures various products.

Fairmicco will train and utilize employees in three fields of work: woodworking, sheet metal, and electrical. All are applicable to the products to be manufactured under contract by Fairmicco, and to the production of products required to renew neighborhoods.

GENERAL DYNAMICS CORP.

General Dynamics in recent years has initiated and implemented a number of programs designed to train and employ people who, through a lack of opportunity or education, could not find productive, regular work. While some of these programs have been conducted independently, others have been in close cooperation with local, state and federal efforts. Some highlights include:

- Electronics Division, Rochester, New York: More than 300 hard-core unemployed without work skills of any kind underwent more than 7,000 hours of job-skill training during the past year. Most had little or no schooling and had never held a regular job. At the program's peak, 466 were accepted for pre-employment training and 408 actually began training.
- Quincy Division, Quincy, Mass.: In March, in cooperation with the Action for Boston Community Development (ABCD) agency under a grant from the U.S. Department of Labor, the Quincy division opened a welding school to train and hire 200 hard-core. Students are paid as they learn. While graduates are free to seek employment elsewhere, Quincy hopes to hire all its graduates, each of whom then receives an additional 26 weeks on-the-job training at full salary.
- Navajo Facility, Fort Defiance, Ariz.: More than 100 Navajos, most trained on the job site, are presently employed at a General Dynamics plant at Fort Defiance, Ariz., built and largely staffed by the Navajo tribe. The plant was financed by tribal funds and leased to General Dynamics for electronic component assembly and electrical harness fabrication. At full production, 200 Navajos will be employed with an annual payroll of more than a half-million dollars.
- San Antonio Facility, San Antonio, Tex.: Under auspices of the Federal Job Development Test Program, coordinated by the U.S. Department of Commerce, General Dynamics opened its San Antonio facility in March of this year. More than 150 men and women, most of them Mexican-Americans and Negroes, are now employed. Of five factory foremen, three have been promoted from this hard-core nucleus. Five others

A graduate of a training program at McDonnell Douglas Corp., St. Louis, is now a sheet metal assembler and riveter.

Junior typists improve their speed in a class at the Kansas City Division of Bendix to meet requirements for higher paying jobs.

Fairmicco employees work with a mass production hammer. This is a project of Fairchild Hiller and the Model Inner City Community Organization of Washington, D.C., to provide employment for the hard-core.

have been promoted to supervisory jobs. Peak employment of San Antonio hard-core will exceed 200, in various metalworking and woodworking skills in support of F-111 production.

• Fort Worth Division, Fort Worth, Tex.: The Fort Worth division has been conducting training programs for some time. Since 1966, more than 3,000 unskilled have been trained and hired at company expense. These people did not qualify for employment before training. Many were Negroes, Mexican-Americans and Indians. Following three to eight weeks of paid training, they are employed at such skills as plumbing and hydraulics, sheet metalworking, metal fitting, aircraft assembly, inspection and quality control, tool grinding and hydraulics assembly, etc. Many are now in supervisory positions. During 1967, one-third of all minority group employees received at least one promotion.

In addition to company-funded training, more than 560 have been hired and trained under programs funded jointly by the company and the U.S. Department of Labor under the Manpower Development Training Act.

A new program launched this year is designed to train 350 more hard-core. Education levels are often as low as a functional sixth-grade education.

In addition, as part of the National Alliance of Businessmen (NAB) program, the Fort Worth division recruited and hired well over 200 needy area youths this past summer.

• Plans for Progress: In January of this year, General Dynamics Board Chairman Roger Lewis assumed chairmanship of the Advisory Council, Plans for Progress, which is the national voluntary equal employment opportunity program of American business.

GENERAL PRECISION

Pinkerton's, Inc. the famous detective agency, wrote to the Breckinridge Job Corps Center in Morganfield, Kentucky to say that one of its graduates "is, in our opinion, an outstanding graduate of your Center." The young man was then employed by Pinkerton, and had satisfactorily worked at "several large industrial plants requiring extensive patrol and involving learning the techniques of general plant security." Pinkerton's new employee was one of many who had gone through the Breckinridge Job Corps Center, operated by Graflex, Inc., a subsidiary of General Precision Equipment Corps.

THE B. F. GOODRICH COMPANY

Goodrich has appointed a manager of Equal Employment Opportunity at a high level on its management staff. A statement by Harry B. Warner, president of Goodrich, has strongly established company policy: "It is clearly in the interest of the country . . . that our society accomplish whatever changes may be required to provide equal employment opportunities for all . . . The purpose of this notice is to re-emphasize that discriminatory practices will not be tolerated within the company . . . Our company has made very substantial progress in providing equal employment opportunity to all, but much remains to be done."

HUGHES AIRCRAFT COMPANY

The general manager of Hughes Aircraft Company in Culver City, California, is chairman of the district for the NAB, and 17 Hughes employees are calling on companies in the area to get pledges for jobs for the hard-core.

Hughes is emphasizing a 30-week program for training secretaries, mostly Negro girls, for what was described as "the first white-collar job in their family history."

The response to the program had been highly gratifying for those who are taking it. "Many of them are realizing a sense of dignity they never had before. They all want to work. And through this program they begin to identify with the requirements of their employer. And so they become more independent," a company official stated.

LOCKHEED AIRCRAFT CORP.

"The nation's economic growth requires the development and full use of all its manpower resources," a Lockheed publication says. The corporation has pursued that course in its hiring, training and promotion policies, and it has made this policy profitable. The company has proved that it can hire, train and permanently employ the hard-core and make them into productive employees able to carry their own weight.

It may seem to some that Lockheed went about this in a hard way: a policy was established that called for almost the most unlikely to be hired; to qualify one had to be unemployed, a school dropout, an inconsistent record of working for anyone, and yearly income of $3,000 or less.

The hiring of the hard-core has worked out well at Lockheed. Production on the part of these new employees: first rate, just as good as older employees.

MARTIN MARIETTA CORP.

This corporation spearheaded an organization of six other large companies in an effort to alleviate the hard-core unemployment problem. It put the headquarters of the effort in the Bedford-Stuyvesant section of Brooklyn, a predominantly Negro part of New York City. This is another example of the aerospace industry bringing jobs to the areas where unemployed live.

San Antonio facility of General Dynamics was established to help train the unskilled and previously unemployed. Instructor demonstrates a safe method to hold board strip.

Two trainees work at a machine at United Aircraft's training center for the disadvantaged in Hartford, Conn.

McDONNELL DOUGLAS CORP.

James S. McDonnell, chairman of the McDonnell Douglas Corp., set the tone of his organization's participation in trying to cure the hard-core problem: he is a national director of the NAB and chairman of its region that embraces ten mid-western states. The corporation has had numerous programs on its own for the undertrained for the past four years. Recently it took on two more under the JOBS program of the NAB. One was for training in clerical and in-plant food services skills. Another, called STEP (Summer Training Employment) provided industrial orientation and job training for high school students from the poor neighborhoods in St. Louis. The first of these were financed partly by federal funds; this is the first time that the company has taken advantage of such funding.

It would be difficult to sort out the most valuable — from the standpoint of the hard-core — of McDonnell Douglas programs, but one of the most interesting is vestibule training. This is a curriculum that teaches the use of basic production tools, materials and equipment used in the development of basic skills and knowledge essential to fill a starting job.

The jobs include electrical fabrication and installation, mechanical installations, machine operation, inspection, and sheet metal assembly. The programs run from three to eight weeks. A trainee is paid $1.65 an hour plus a 23¢ per hour cost-of-living allowance. Many trainees have gone into permanent employment with the company.

McDonnell Douglas has many other hard-core related enterprises.

NORTH AMERICAN ROCKWELL CORP.

North American Rockwell has formed a new subsidiary designed specifically to hire the hard-core unemployed. The new operation will operate a manufacturing and service facility in central Los Angeles. Employees will perform machine shop supporting operations, update engineering drawings, do typing and key punching, and produce plastic bags, covers and binders, shipping pallets and crates. They also will get elementary school training.

Starting wages will be $2 an hour, and the newcomers will be offered jobs when they finish training.

NORTHROP CORP.

Northrop, which manufactures the fuselage of the Boeing 747, said that in filling this contract, it employed "the highest possible percentage of Negro and other minority personnel, consistent with the requirements of the program."

Northrop hired one-third Negroes and other minority racial personnel that accounted for half of the work force on the 747. The assembly facility is near the Watts area of Los Angeles.

Since the inauguration of the program, several of the workers have been promoted to foremen.

RCA

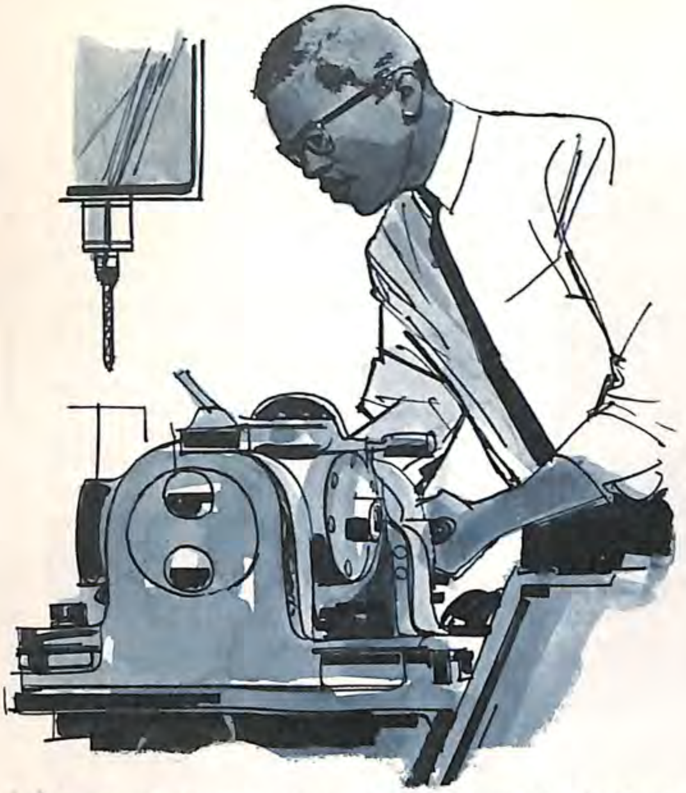
RCA's Defense Electronic Products organization, with activities is in New Jersey, Massachusetts and California, expends considerable effort in providing jobs and job training for the hard-core inside and outside the company.

A member of the NAB, RCA has committed itself to hiring a number of disadvantaged. RCA has lent 30 executives to canvass business in South Jersey for jobs for the poor. The company also helps the Opportunities Industrialization Center (a self help program) with money, equipment for training, furniture and fixtures. Company employees have followed that pattern, donating their time to OIC in activities such as financial advice, personnel matters and job placement procedures teaching technical subjects in the evenings and other activities.

RCA funds have gone into the Camden Housing Improvement Project, which rehabilitates scores of rundown houses, then sells them, usually on a lease-purchase arrangement, to low-income families. The project is financed by loans from banking and industrial firms of which RCA is one. The company has allocated $100,000 to the project, most of which is expected to be returned to RCA as the program continues.

The Citizens Advisory Council of Camden, Burlington and Gloucester counties (New Jersey) was recently inaugurated to increase job opportunities, and improve housing and education for the poor. An RCA vice president heads the council and the company was active in organizing it.

About five percent of the RCA Van Nuys, California



plant personnel came from the unemployed, disadvantaged or those requiring additional training. The plant has also furnished skilled personnel for outside training programs, which is also true in the Burlington, Massachusetts facility.

SPERRY RAND

Sperry Rand has a particularly large program for the clearly disadvantaged. In Shreveport, Louisiana, it is training some 2,000 employees in factory occupations, and it has presently enrolled over 1,000 in various courses. For the first Opportunities Industrialization Center in Philadelphia, Pa., Univac contributed a solid-state computer to the operation and trained people to use and maintain the machine. Company divisions are assisting in the setting up of other OIC projects in Minneapolis and Omaha. The Vickers division has offered to donate a former training school building to the Detroit NAB program, will help equip it as required and solicit retired employees to serve as instructors.

UNITED AIRCRAFT CORP.

Based in Hartford, Connecticut, United Aircraft has taken broad steps toward alleviating the hard-core problem in the greater Hartford area. At its own expense, the corporation has established a center for training and basic education that will make it possible for the unemployed to get jobs. Several companies in the area sponsor trainees.

Here are some of the areas in which UAC programs have been concentrated: machine tool operation, sheet metal, materials handling, assembling and bench mechanics. But the schedule also calls for non-manufacturing jobs, such as typing, filing, cashier work, sales clerkship, stock and mail handling.

This program is geared to the individual; each proceeds at his own pace with counseling from a professional staff assembled by United. Upon completion of the course, each trainee is guaranteed a job by the company that sponsored him in training.

WESTINGHOUSE ELECTRIC CORP.

D. C. Burnham, president of Westinghouse, is the Pittsburgh metropolitan chairman for the NAB, and the company's director of industrial relations is the metropolitan director.

In its operations, Westinghouse has zeroed in on the hard-core in an effort to add them to its work force. At one of its largest plants, the company has put foremen through a program on the problems that they are bound to encounter with people who never before held steady jobs. This is done through the Westinghouse Learning Corporation. It has concentrated on teaching the hard-core unemployed basic things such as what a job interview is like, how an application form looks, the importance of personal neatness and of getting to work on time, along with some basic reading and writing. Westinghouse draws on its experience in operating Job Corps Centers and VISTA training programs.

NAB Gets 310,000 Job Pledges

The National Alliance of Businessmen, in a progress report to President Johnson, disclosed that 310,000 jobs have been pledged for the disadvantaged, and 140,000 people placed on the job. Of these, 40,000 hard-core jobless are on full-time jobs and 100,000 youths are on summer jobs. With 40,000 hard-core people now on the job and eleven months remaining to fill the first year hard-core goal of 100,000, the Alliance is well ahead of schedule in its basic assignment.

Within six months after the Alliance was formed, it had mobilized a team of 8,000 business and government people, and had solicited 50,000 employers. Forty percent of the firms contacted responded with job offers. Campaign contributions from private sources (personnel, services, materials, and so on) amounted to more than $15 million, while government out-of-pocket cost was less than $500,000.

In the same time, the Alliance induced employers to submit 706 training contract proposals, resulting in 433 written contracts involving 800 companies and 33,000 trainees, at a contract dollar amount of $91 million.

Proposing that there be a single hard-core goal with a year-round youth program, NAB Executive Vice Chairman Leo C. Beebe, said that while job pledges as a whole exceeded the 300,000 target, the ratio of summer jobs to full-time jobs fell below expectations. Summer job pledges reached 145,000 against the 200,000 objective. The shortfall is more than made up in the hard-core pledges which reached 165,000 or 65 percent over objective. Some 35 percent of these hard-core jobs will be filled by out of school youths who need full-time employment.

AEROSPACE NOTES

UTC Develops Small Rockets For NASA Launch Model

United Technology Center has supplied NASA's Saturn Improvement Studies program with scaled-down versions of the 120-inch and 156-inch diameter solid rocket boosters it produces at Sunnyvale, Calif. The small, 1/58th scale boosters will be used in test firings with a model of the Saturn launch facility to examine the effect of increased exhaust flow on launch pad hardware and flame dispersal trenches.

NASA is currently evaluating proposed modifications to its Saturn 1B and Saturn V launch vehicles, including the possible use of full-scale 120-inch-diameter rocket motors as a booster stage or for boost augmentation.

Artist's rendering depicts NASA's Saturn 1B space vehicle with four 120-inch-diameter, solid-propellant rockets capable of developing nearly five million pounds of liftoff thrust. This is one of several possible advanced configurations under study.

Aerojet Designs Lunar Cargo Mission Spacecraft

An artist's concept shows a special cargo-laden spacecraft descending onto the surface of the moon in a one-way delivery mission which Aerojet-General Corporation says is now possible using an Apollo Service Propulsion System engine built by its Liquid Rocket Operations in Sacramento, Calif.

The SPS, built under contract to North American Rockwell's Space Division, is currently scheduled for a mission duty cycle in excess of eight minutes duration to place the Apollo spacecraft in a lunar orbit of 80 miles for the Apollo lunar mission.

The service module engine could begin its burn in the retro mode at a distance of 722 miles above the moon's surface. Another burn would reduce the closing velocity placing the spacecraft at a hovering altitude of 1,000 feet. Terminal descent could then be accomplished by pulsed mode engine operation. Aerojet engineers figure touch-down velocity could be less than seven and one-half feet per second using the pulsed mode operation.

TRW Produces Portable Battery-Pulsed Laser

Scientists at TRW Systems Group have developed a reliable high current cold cathode enabling them to produce a portable, battery-operated pulsed argon ion laser for the first time.

The new laser weighs less than seven pounds, requires only 2.5 watts of input power and emits a green beam which permits its use as an underwater tool. It could also be used as a signaling rendezvous device for scuba divers and aquanauts.

TRW is also developing a smaller, flashlight-size model of the portable laser with a seven-watt peak output in a 300 nanosecond pulse at continuously variable pulse repetition frequency of 0 to 500 cycles per second.

The unique field emitting cathode has a demonstrated lifetime of more than 100 million pulses and in a neon ion laser application, peak currents in excess of 1,000 amperes were obtained with no indication of current saturation.

The cathode is a highly reliable, low cost metal that neither deteriorates nor contaminates the system.

Goodyear Designs Largest Parabolic Space Antenna

The largest X-band parabolic antenna ever designed for an orbiting spacecraft has been built for NASA's Goddard Space Flight Center by Goodyear Aerospace Corp.

When deployed in space it is 30 feet in diameter and programmed for the F and G models of the Applications Technology Satellite (ATS) now under consideration as second-generation spacecraft in the ATS program.

The new antenna is a paraboloid with a "petal" design that allows it to be collapsed for packaging into a launch vehicle nose cone. During the launch phase, the antenna is contained in an eight-foot-diameter package. Once the spacecraft leaves earth's atmosphere and the protective nose cone is removed, the structure will deploy on command.

A series of hinged "petals" deploy into a parabolic contour. Framework of the "petals" is made of rigid lightweight aluminum honeycomb core and tita-

nium facings. Upon this framework is stretched an expanded mesh of aluminum foil to form the reflective surface.

Goodyear engineers report the petal design offers better structural continuity, better surface tolerances and greater reliability for successful deployment as well as providing better command and control communications with space vehicles and better transmission of data from these vehicles.

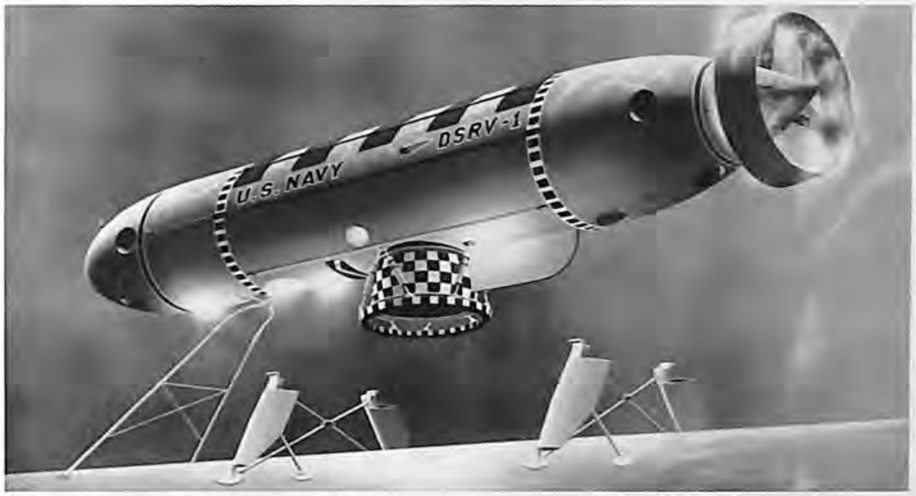
Honeywell Builds ASW 'Copter Trainer for Navy

An anti-submarine warfare (ASW) helicopter tactical trainer that simulates battle conditions with remarkable realism has been designed and built by Honeywell's Marine Systems Center in West Covina, Calif., for the Naval Training Device Center.

The trainer is used by the Navy to train helicopter pilots how to detect, track and sink submarines. Installed at the Naval Air Station at Imperial Beach, Calif., two years ago, the trainer has established a highly commendable record of reliability and effectiveness in training ASW helicopter pilots.

The Navy has realized a significant savings in time and expense by training its pilots in the shore-based trainer instead of using real helicopters, surface ships and submarines for the same training at sea.

Battle exercises are worked out and controlled by an instructor, aided by a special Honeywell-developed analog computer. He sits at a console behind the cockpits creating the simulated sea battle on eight-foot square screen.



Rohr Designs Fiberglass Hull for Navy DSRV-1

Outer fiberglass hull of the Navy's DSRV-1 deep submergence rescue vessel is being built by Rohr Corporation's Space Products Division under contract to Lockheed Aircraft Corp. DSRV is 50 feet long, and resembles a huge torpedo in shape. It is designed to dive under its own power to a sunken submarine, attach itself to a hatch on the disabled craft's deck and transfer the crewmen into the rescue vehicle.

The electrically-powered craft maneuvers by means of a fan in a cylindrical duct, which can serve as a rudder or elevator. The vehicle hull also is equipped with thruster openings for jetting streams of water for maneuverability.

The outer hull is to be epoxy preimpregnated fiberglass. DSRV is designed to work at depths of 3,500 feet and can be quickly transported by air to distant locations.

Industry to Sustain Pace Of Technological Progress

The aerospace industry must be prepared to assume increasing responsibility for sustaining the pace of the nation's technological progress, Charles R. Able, chairman and chief executive officer of the McDonnell Douglas Astronautics Co., told the National Space Club recently. He called for greater industry-government teamwork to meet the challenge of preserving technical superiority in the face of budgetary limitations.

"The space program is not a cost, but an investment in our future—an investment that promises to return many times our original outlay. We must continue to make this investment in technology," Able said.

Both economic and political strength are derivatives of technological progress, he added. Neglect of the technical base that has been built through the space program would doom the nation to the loss of great economic benefits from our communication, weather, and earth resources satellite programs, and would also cause an inevitable loss of international leadership.

Remote Mine-Detector Jeep Developed by Ryan for Army

Safer mine-sweeping of enemy roads will be possible with the development by Ryan of a remote-controlled mine-detecting jeep shown in this artist's concept. Ryan is developing this device for the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., for prototype models of the control system to be installed in Army jeeps and tested by Ryan.

Jet Transports: The Third

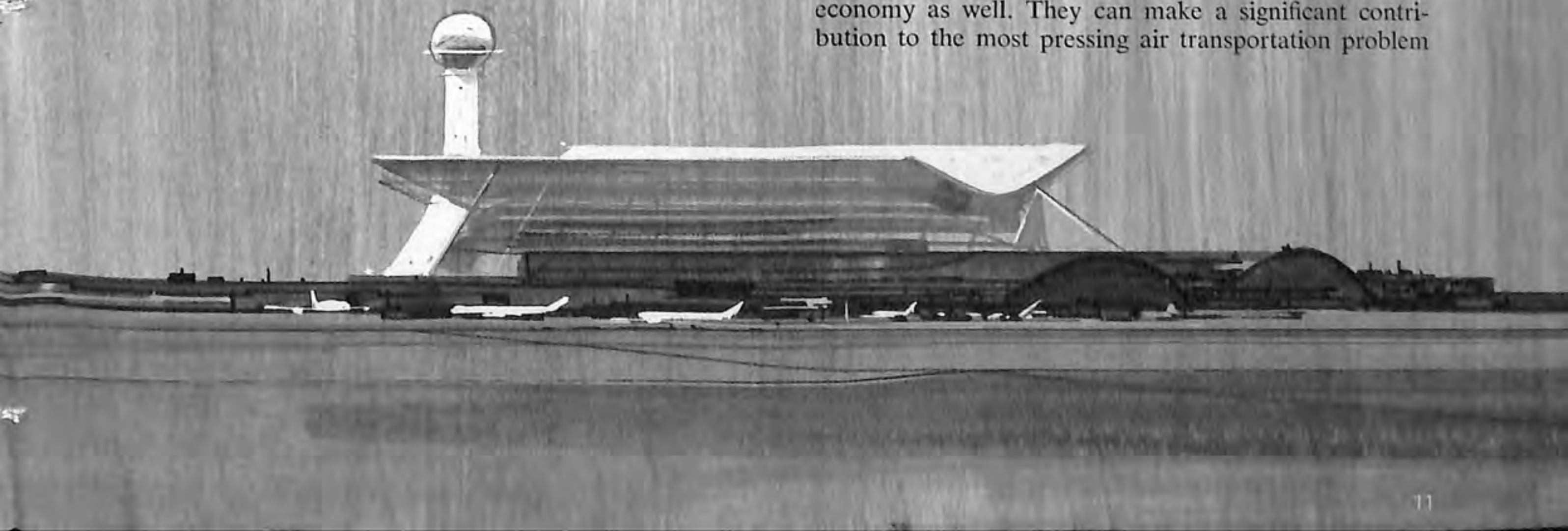
Generation

The airline and aircraft manufacturers in October mark the 10th anniversary of a great aerospace revolution — the inauguration of commercial jet travel. It was on October 26, 1958 that Pan American World Airways introduced the Boeing 707 to regular service, ushering in an era of far greater speed, comfort and safety in air transportation and touching off an explosion in air travel growth.

Such is the dynamism of aerospace progress that before the October decennial another air transport revolution will get under way. On September 30, the Boeing 747 will roll out of its construction plant to begin the extensive ground-test preliminaries to first flight. The 747 is the largest airplane ever built for airline passenger service but that is incidental to its greater import: it is the harbinger of the new revolution, the advance member of a jet transport family that promises to effect even more far-reaching changes in the air transportation system than did the transition from piston to turbojet power.

Known as the "third generation jetliners" or the "advanced technology jets," the family includes, in addition to the 747, a pair of "airbuses" — McDonnell Douglas DC-10 and the Lockheed L-1011. The airplanes share some common characteristics: mighty turbofan engines which rank among the most powerful ever built, greater speed and safety provisions than their predecessors, the ability to operate from existing runways despite their size, very wide fuselages and high-volume interiors which permit passenger capacities ranging from 250 to almost 500.

Collectively, these aircraft will have enormous beneficial impact, not only on air travel but on the national economy as well. They can make a significant contribution to the most pressing air transportation problem



Jet Transports: The Third Generation

of the day — airport and airways congestion. To the passenger, they offer new standards of comfort and convenience. To the airline, they make possible greater earning capacity per plane. This increased productivity can be translated into lower fares, permitting the airlines to reach deeper into that vast potential market of people who have never flown. They will provide a major assist to the government's continuing balance of payments problem through anticipated high-volume sales to foreign carriers. And, despite the tremendous thrust values of their new-type power plants, which range from 39,500 to 43,500 pounds per engine, the third generation jets offer an appreciable reduction in noise output.

First of the generation to go into scheduled airline service will be the 747, a four-engine behemoth which has a gross weight of more than 700,000 pounds, more than double that of the largest of its 707 ancestors, and a capacity of from 300 to 490 passengers, depending on how an airline chooses to arrange its seats. The 747 will make its first flight around year-end and it will be introduced to airline operation in October, 1969.

The McDonnell Douglas DC-10 and the Lockheed L-1011 are "trijets," with two engines in wing mountings and a third on the vertical tail. The airbuses are smaller than the 747, if the term "smaller" can validly be applied to airplanes which are heavier than any jetliner now flying; they weigh in the vicinity of 400,000 pounds and carry from 250 to 350 passengers. They will be in test flight status in 1970 and in service in 1971.

The advanced technology jetliners are in part complementary, in part competitive. The 747, with a maximum range of 8,000 miles, was designed principally for the long-haul market, but a special version of it may operate in the short/medium range field. The DC-10 and L-1011, intended for short and intermediate length route segments, have considerable flexibility and can operate at transcontinental distances.

The new family of passenger jets incorporates a number of advances in aircraft technology since their forbears went into service a decade ago — advances in materials, structures, maintainability and an extreme degree of equipment reliability. Example: an all-weather landing system able to function even when there is a failure in the electronic components. The key factor which permitted development of the new planes, however, was the advent of the super-powered engines called "high bypass ratio turbofans."

That technical-sounding term simply means that a great deal more air flows around the engine's combustion chamber than goes through it. The first generation jets have powerplants in which all the air taken into the engine is directed through the combustion chamber, where it is burned and exhausted as propulsive gas. A later development now in airline service is the turbofan, in which some of the air, shoved rearward by a powerful fan, bypasses the combustion chamber; channeled through ducts to the tailpipe, it mixes with the burned gas being exhausted. The bypass air, or fan exhaust, provides supplementary thrust to that of the hot jet of gas; in a typical in-service turbofan, the normal jet thrust exhaust produces about 60 percent of the engine's total thrust while the fan exhaust develops the other 40 percent. In these engines, the amount of air bypassing the combustion chamber is about one and one-half times that being burned, or a "bypass ratio" of one and a half to one.

The power plants of the new generation of jetliners have much higher bypass ratios. The General Electric CF6 engine which powers the DC-10, for instance, has a ratio of six to one and at sea level it derives some 85 percent of its total power from fan air, while the burned jet exhaust accounts for only 15 percent. The Pratt & Whitney Aircraft JT9D engine, power plant for the Boeing 747, has a five to one ratio and it gets 77 percent of its thrust from the fan bypass airflow. These high bypass ratios provide some very attractive engine characteristics, primary of which is a rate of fuel consumption about 25 percent better than in-service turbofans, which in themselves are economical propulsion systems.

A fortunate byproduct of the high bypass ratio system is a lower noise level. The new turbofans have a higher mass airflow and a lower exhaust velocity than contemporary jets, and these factors combine to produce basically lower noise levels and frequencies more readily adaptable to sound-suppression techniques. The CF6 engine, for example, although it develops more than double the thrust of a DC-8 engine, will have a sound output as much as 15 decibels lower.

The big advantage of the new airplanes is their exceptional capacity, averaging more than twice the seats of today's jetliners. Clearly, one airplane carrying the load equivalent of two eases the strain on the air traffic control system; it is one blip on the radar instead of two. The third generation transports are not in themselves a panacea for the airways/airports congestion problem, since traffic will continue to grow, but they will contribute substantially to the solution; they will permit the airlines to absorb the indicated growth and reduce the required number of flight departures.

Direct operating costs of the aircraft will run roughly 25 percent below those of the first generation jetliners. Actually, the reduction could have been lower, says McDonnell Douglas Corp.'s Robert E. Hage, citing the DC-10's design history.

"Were we to design the DC-10 to have the same comfort, operating limitations, noise levels and performance as the DC-8, we could well have reduced the operating cost an additional 13 percent, largely due to the advanced technology engine. But DC-8 levels weren't good enough." McDonnell Douglas chose, as did Boeing and Lockheed, to "invest" some of the technology gains in such areas as better performance, bulky 10-wheeled landing gear to spread touchdown impact over a wider area, redundant systems for

Four Pratt & Whitney Aircraft JT9D advanced technology turbofan engines power the 747. Each engine produces more than twice the thrust of the JT3D which powers the 707.

An interior configuration of the 747 first class section has a stairway leading to the upper level.

This interior arrangement shows a lounge installed behind the flight deck which is above the main passenger cabin of the 747.

The first 747 straddles the huge manufacturing bay where the new jetliners are being built.

Jet Transports: The Third Generation

A possible configuration of the coach section of the DC-10 features comfort and luxury.

A centralized food preparation center in the DC-10 is located on the deck below the main passenger area.

Three General Electric CF6/36-6 high bypass turbofan engines power the DC-10. Large fan provides a high bypass ratio for low fuel consumption.

greater equipment reliability, noise attenuation provisions and the extra-wide body for increased passenger comfort. Each of these considerations imposed its price in weight and cost, but the levies are outweighed by the bonuses to operator and passenger alike.

Coupled with lower operating costs is the greater earning capacity of the new jetliners due to the vastly increased number of seats. Super-productivity will enable the aircraft to pay for themselves in a shorter period of time and permit the airlines to pass on some of the economies of operation to the traveling public. Airline rates are still a great bargain in an inflated world economy, but the high-capacity jets make possible even lower fare levels that will inevitably attract the huge market of people who have never flown or who fly infrequently.

Because of indicated high-volume production, the third generation jets will have an important influence on the U.S. Gross National Product, on the international trade balance and the balance of payments. It is estimated that the market, over the next 10-12 years, runs to 400-500 units for the long-haul 747 and 1,000 for the airbuses. That adds up to about $25 billion worth of airplanes, a good percentage of them to be sold to foreign carriers.

As for traveler convenience, one aerospace executive says, "The airplane has finally grown big enough to take care of the passenger properly." Interior dimensions are, of course, considerably greater than those of present-day transports, not only from wall to wall but from floor to ceiling. The generous increases in cabin volume per passenger tend to create a roomlike, rather than a tubelike, atmosphere.

Airlines— and passengers seeking the lowest possible fares — will still want a certain amount of "high density" seating. A typical coach arrangement has nine seats abreast, with seat widths approximately the same as those of present economy-class configurations, but the cramped feeling will be minimized by two aisles instead of one. With not too great a loss of payload, the airline can go to an eight-abreast configuration with substantially wider seats and aisles. And the first class compartment — six king-size seats abreast with wide double aisles — offers new standards of luxury. The roomy interiors suggest the possibility of a new blue-ribbon class of travel in which multi-seat areas would be compartmented by movable partitions, creating roomettes for invalid travel, in-flight conferences, work or simply super-comfort.

While the size of the aircraft offer a number of advantages, it will necessarily effect some changes in passenger handling. A third generation jet, for instance, might carry as many as 1,000 pieces of baggage, compared with about 500 in the largest contemporary airliners. The airlines are already at work on that problem, developing an automated luggage delivery system which uses electronically-controlled carts to move bags from airplane to claim area in less than three minutes. But the problems of handling so great a number of passengers per flight will demand some alterations in terminal facilities and techniques. One proposal, by Lockheed vice president-science and engineering Willis M. Hawkins, suggests that flight operations and terminal be separated, with advantages to both. Hawkins advocates "packaging" passengers in the manner that air cargo is packaged.

"The ground congestion at airports is caused not only by the number of passengers, but by the fact that they arrive one or two per automobile. If the automobile stays at the airport there is a parking problem, and if the automobile does not remain at the airport that means that at least two or three people have probably arrived to help launch the passenger. These people demand places to see the airplane, to have snacks or cocktails, buy souvenirs, etc., all of which induces the installation of additional facilities with their attendant additional congestion.

"If the auxiliary services and the waving goodbye could take place in satellite terminals far from the airport, and if the passengers could arrive in chunks of 40 to 60 per vehicle, delivered directly to the airplane, expensive real estate could be reserved for the use of the airplane itself. As for the passenger, his lot would be substantially improved since the handling of baggage and the waiting, if any, would be experienced closer to home; the satellites could be located in many areas of the community where it would never be possible to locate the airport."

The new revolution will naturally have substantial impact on air cargo as well as passenger services. Boeing is already working on a cargo version of the 747 and it is likely that a cargo airbus will appear. The all-cargo 747F will be capable of hauling transcontinentally more than 215,000 pounds of cargo, compared with less than 100,000 pounds for the Boeing 707-320C multipurpose transport. Cargo craft based upon the airbus designs will probably be able to move close to 200,000 pounds of payload over shorter distances.

And in the design mill is an even larger plane, the Lockheed L-500. The L-500 is not, strictly speaking, a member of the third generation family since it is not yet in hardware status and it would enter service three to five years behind the airbuses. It is, however, a close relative of the advanced technology family in that it is a commercial derivative of the USAF's C-5A, already flying. The L-500 will be able to haul 270,000 pounds across the Atlantic, or, to translate its capability into more familiar terms, it could bring 90 Volkswagens from Germany to the United States.

Such enormous capacities cannot help but give air cargo, which has experienced spectacular growth, new impetus. The great interior volume of the new aircraft permits a broader range of air-transportable products and new efficiency in containerization. Most importantly, however, increased capacity permits lower shipment rates and further broadens the market for cargo carriers. — *James J. Haggerty*

Streamlined food and beverage service will be available on the L-1011. Stewardesses can serve up to 27 dinners from one cart.

Main coach section of the L-1011 will have first class roominess for air travelers.

Attache cases, hat boxes and other carry-on personal luggage fit nicely in the overhead storage compartments of the L-1011.

Your Share in Freedom

The 1968 U. S. Savings Bonds campaign represents a challenge to the aerospace industry to again set an example of patriotic leadership for the rest of the nation's business community. At the opening of the drive, the percentage of aerospace employee participation in the Payroll Savings plan for buying Bonds was higher than for the workers in any other industry. ★ More than 70 out of every 100 employees in the industry now buy Savings Bonds and Freedom Shares through payroll allotments where they work. Twelve aerospace firms are among the top 20 corporations in the nation in percentage of employee participation in Payroll Savings. ★ The nationwide campaign to enroll at least two-million men and women as new Bond buyers or for increased participation in Payroll Savings is being headed by a prominent aerospace executive, William P. Gwinn, president and chief executive officer of United Aircraft Corporation, East Hartford, Connecticut. He succeeded Daniel J. Haughton, chairman of the board of Lockheed Aircraft Corporation, Burbank, California, who led the 1967 Payroll Savings drive to an over-quota conclusion. ★ Ten of the 49 geographic and industry members of Mr. Gwinn's committee are executives of aerospace firms: Vernon R. Rawlings, vice president, Martin Marietta Corporation, Baltimore; C. F. Adams, chairman of the board, Raytheon Company, Lexington, Massachusetts; Horace A. Shepard, president, TRW, Inc., Cleveland; Clyde Skeen, president, Ling-Temco-Vought, Inc., Dallas; Robert O. Fickes, president and chairman, Philco-Ford Corporation, Philadelphia; J. L. Atwood, president, North American Rockwell Corporation, El Segundo, California; James M. Roche, chairman of the board, General Motors Corporation, New York; D. C. Burnham, president, Westinghouse Electric Corporation, Pittsburgh; John D. Harper, president, Aluminum Company of America, Pittsburgh, and T. Vincent Learson, president, IBM, Armonk, New York. The campaign within the aerospace industry is being headed by Mr. Atwood. Under his leadership, the aerospace industry has already surpassed its Treasury-assigned goal of 45,000 new savers, and emphasis is now being placed on boosting average industry participation to over

75 percent. The 12 aerospace concerns in the top 20 companies in the Bond program now have at least 80 percent participation by their employees. ★ To individuals, U. S. Savings Bonds represent shares in America's future. The investment is guaranteed, and grows rapidly through the automatic purchase of Bonds as sufficient funds accumulate in the employee's payroll allotment account. ★ Sale of Savings Bonds helps protect the dollar and combat inflation because Bonds play an important role in management of the federal debt. When more people buy Bonds, it helps spread the federal debt over a much broader base of the public. And every Bond sold lessens the government's need to go into commercial money markets for the funds it needs for debt management, which tends to force interest rates upward. Right now more than 51 billion dollars worth of Series E and H Bonds are outstanding, or nearly one-quarter of the publicly held portion of the debt. ★ The continued availability of the new Freedom Shares, introduced last year, is an added inducement for individuals to invest through Payroll Savings. The Freedom Share pays 5.00 percent interest when held to maturity in four-and-a-half years. Freedom Shares can only be purchased in combination with Series E Bonds, which pay 4.25 percent interest over their seven-year life, on approximately a one-for-one basis through Payroll Savings or at banks. ★ Commenting on the Savings Bonds campaign, Mr. Gwinn said, "Aside from the practical benefit of Payroll Savings to employer and employee, there is another very compelling reason for every American to support the program — and that is patriotism. Patriotism has not gone out of style. There just happens to be a tendency among some people today to take everything for granted, including their country. ★ "Our nation is based on individual liberty and the free enterprise system. We who benefit from this way of life have an obligation to reciprocate. Supporting Payroll Savings is a practical expression of patriotism, for employer and employee alike. It is significant that a very high percentage of the men and women in our armed forces have signed up for Payroll Savings. If they buy Bonds where they work, even in a combat zone, then everyone here at home should do the same."

PROTECT FREEDOM

PROMOTE PAYROLL SAVINGS

A Crucial Time For Technology

The following article was condensed from remarks by Mr. T. A. Wilson, president, The Boeing Company, before an audience at the California Institute of Technology.

MR. WILSON

At the very time when the case for technology seems obvious, we are in danger of seeing a de-emphasis of activity in this realm.

We are in a period when the focus is on the dollar—for very good reason. People are becoming aware — or Congressmen are at least — that some $137 billion have gone into research and development in the past ten years and that over half of those dollars have been public funds. A few years ago, when the focus was more on our technological race with the Soviet Union, that fact would have been generally applauded.

Now it is viewed in the environment of other problems like minority unrest, equal opportunity, crime in our streets, population pressures, disease, poverty, hunger, urban blight, pollution.

These problems are real. They cry for attention. I'm thoroughly in favor of intercepting these problems — or retrieving the ball if we've lost it — but I think a further advance of technology must be a part of the process. Certainly technology should not be cast in the role of a competitor to the main stream of this effort. One of the fundamental factors that has made us strong as a nation has been our constantly advancing technology, which has fed our growth. It is the yeast in the economy that expands in all directions — and now it has an urgent new direction in which to expand. . . .

. . . If the appropriate relationship between technology and the solution to the pressing problems of the day can be seen, there is an unprecedented opportunity before us.

The really basic solutions in the realm of power, food, water, and increase of wealth versus population growth, depend on continued advance of technology. Atomic power offers a remedy for parts of the world that are without the natural resources for power generation. A new strain of rice is proving to be a partial answer to food production in the Philippines. Large scale desalination of seawater is being proposed for the desert Middle East. New forms of locomotion and traffic control are being forced by urban transportation tie-ups, and so on. The demands for change and the expectations of change are so great that just pecking at the problems of society by conventional methods is not going to get us to the post office.

But I'm sure the all-important reason for continuing to move forward technologically is economic. Applied science is basic to the advance of our standard of living — both in the generation of wealth and the distribution of it. Our economic growth is not brought about by everyone working that much harder; in fact man works less — it comes from accomplishing more with the work that each man does.

Actually we have become accustomed to talking in terms of spin-offs from scientific discovery and experimentation which result in new employment and business activity. The television industry was spun off the microwave radar developments prior to World War II. Lesser spin-offs like Teflon fry-pans are constantly occurring from science and engineering, and they will continue to occur, along with more substantial ones.

Our space people can get very enthusiastic about the long range prospects for bigger effects. They envision a whole new order of communication in which the individual has his pictophone console that will connect him with anyone anywhere via the satellites, and will bring in any type of needed information whether library research or an orbital view of fish migration in the Caribbean or crop growth in Kansas.

But politically speaking, the spin-off theory is not a tangible package to sell. You can't tell in advance in just what direction spin-offs are going to occur. You have to accept the basic proposition that they do occur.

There is another compelling reason for maintaining at least the present level of technological effort in this country. I think it is categorical that as you increase the performance of an article or a system to meet the demands of society, each increment of improvement requires progressively more effort, until finally you reach a point where the constraints fence you in. Then it takes a breakthrough to get outside the fence. . . .

All government R&D should not be oriented to provable ends. The military is not advancing technically as it should. There is still a place for the experimental model. A national security policy that does not insure technological leadership is not security — it is insecurity.

In the realm of truly open-ended endeavors, we have the space program as a classic example. We ought to make sure that its ends stay open, at least in part, after the current goal of the moon is reached. Quite apart from the direct returns in scientific discovery and the continuing technological spin-offs, I have referred to, I think there are unseen revenues from the space effort in the stimulus it provides to youth, to education and to the enlarging of all our perspectives. It tends to push away the limitations to thinking, at a time when society is crowded, frustrated and depressed by limitation. It provides a fresh outlook which is precisely the type of outlook that must be taken toward solving our problems on the surface of the earth. . . .

Of course social and urban problems are more difficult to solve than those such as food production, communication, transportation, etc., that industry has more successfully dealt with in the past. The present urban situation presents a very muddy picture, with a fantastic array of interrelated problems and pressures. Someone has to perform a clarifying role if we are to have novel and effective approaches to these problems. It may be that the key universities can serve in this capacity and become the catalysts to action. Cal Tech's planned approach to humanities is certainly a step in the right direction. I commend the institute for its "Science for Mankind" program.

I'd like to get back to the proposition that technological research and development is fundamental to the process of moving ahead on all fronts. The question arises, whose responsibility is this basic advance? The government's? The academic community? Industry's? I think it is inescapable that all these must be involved. The government must certainly be involved, and in a strong supporting role. National goals are at stake. These goals have to be a few marks higher than can be met with known technology. Therefore, the element of venture or risk cannot be completely removed from government policy any more than it can from corporate policy if we are to remain viable and dynamic as a nation, avoiding stagnation and decline.

Basic research is a venture, space exploration is a venture. The SST is a venture. If we wait until we fully see the end rewards before starting, we never start. But we might ask ourselves how much credit we deserve as a nation for the original decision to establish moon landings as a national goal. Or did we do it mainly under the goad of Soviet competition? The Soviet Union established it as a national objective and we responded. We are dependent on public opinion for national objectives, and the Soviet chal-

A Crucial Time For Technology

lenge gave public opinion its motivation. However, if a move is not pressed on us as an answer to a threat does the public appreciate the rewards enough to embark on technology advance as a policy in its own right and be willing to pay the bill? I think the determination of whether or not we have a science moratorium may lie in the answer to this question.

Actually the challenge presented by our urban crises and the effects of poverty at home and in other countries can be taken as a prod to action just as Soviet military and space rivalry has been. But in those cases, technology was accepted as the method of meeting the challenges, whereas with urban emergencies we are in effect being told we must draw back from technology. I have faith that an informed and aware citizenry will make the right decision, but we all share the obligation of informing the public.

The general advancement of technology should not depend just on the expenditure of government money — I certainly don't want to imply that. But I'm distressed at the criticism of the use of government money. It is very appropriate that industry should share in the costs of R&D, to provide an incentive for efficiency, but it must be appreciated also that industry puts a lot of money into research in commercial areas that subsequently benefits the government sector. . . .

In some countries the whole burden of research and development is public — or national. We would not want that arrangement. But I think public and private interests do run parallel. I think aerospace is an excellent example of a business where technology advance is vital to our international competitive position. This industry is not asking for barriers against foreign imports; it generates large exports and large favorable balance of payments by application of technology.

Past experience has shown that where significant long-term needs exist, industry eventually finds a way to provide solutions, and at a profit. Often it is with government support, at least initially, as has been the case in all major forms of transportation development — rails, roads, ships, airports — and in the development of our petroleum supply.

It is not hard to conceive of industry solutions to things like low-cost housing, cost effective urban transportation, and even vocational training on a broad scale. If this results from the profit motive, I don't think that requires an apology. If industry gets a job done well, it is recognized by society as performing a useful, legitimate role, and society is willing to pay it a reasonable fee to make this result possible.

But the market for what we might call "improvement" or "problem solving" in the urban area is not very clearly defined, to say the least. It is diffuse and multi-customer. It is not well researched. And the customer — the urban entity if you can identify it — is not skilled in specifying requirements.

To get at the answers will no doubt require the combined efforts of government, universities and industry in defining the jobs to be done and creating the market that mobilizes the required effort. Government may have to be the enabler, the university the thinker, industry the doer, although these are certainly not mutually exclusive roles. . . .

Quite possibly the universities can provide the independent non-political "data banks" of pertinent information and "know-how" for local governments and citizen groups to consult. In Seattle our Forward Thrust program planners found that their most time-consuming problem was in getting good data and analyzing them. Forward Thrust was, and is, a combined community effort to put together and fund an integrated program to take care of several of the Puget Sound area's needs such as urban transportation, sewage disposal, reduction of juvenile delinquency, etc. The program has made it possible to plan projects such as a multi-purpose stadium on the one hand while insuring that funds are also available for youth centers and other desperately needed facilities.

This effort is just one example of the aroused public interest which exists throughout the country. There are some jillion committees concerned with our urban situation; in fact — several in each community and at every level of both government and industry. I would hesitate to call this effort chaotic but it is far from integrated.

It would be regrettable if these groups leave an aggressive, purposeful national technology advancement effort out of the process of finding solutions to today's problems. As I may have at least faintly implied already, I think this effort is mandatory.

Consequently, ladies and gentlemen, my message is — forward technology! I think we have a head of steam up in this country and it would be disastrous to turn off the engine just as we're coming to the grade.

AIA MANUFACTURING MEMBERS

Abex Corporation
Aerodex, Inc.
Aerojet-General Corporation
Aeronca, Inc.
Aeronutronic Division, Philco-Ford Corporation
Amphenol Connector Division
  Amphenol Corp.
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
Curtiss-Wright Corporation
Fairchild Hiller Corporation
The Garrett Corporation
General Dynamics Corporation
General Electric Company
  Defense Electronics Division
  Flight Propulsion Division
  Missile & Space Division
  Defense Programs Division
General Motors Corporation
  Allison Division
General Precision Systems, Inc.
  A Subsidiary of the Singer Co.
The B. F. Goodrich Company
Goodyear Aerospace Corporation
Grumman Aircraft Engineering Corp.
Gyrodyne Company of America, Inc.
Harvey Aluminum, Inc.
Hercules Incorporated
Honeywell Inc.
Hughes Aircraft Company
IBM Corporation
  Federal Systems Division
International Telephone & Telegraph Corp.
  Defense & Space Group
    ITT Avionics
    ITT Gilfillan, Inc.
    ITT Defense Communications
  ITT Aerospace Controls
Kaiser Aerospace & Electronics Corporation
Kaman Corporation
Kollsman Instrument Corporation
Lear Jet Industries, Inc.
Lear Siegler, Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corporation
CCI Marquardt Corporation
Martin Marietta Corporation
McDonnell Douglas Corp.
Menasco Manufacturing Company
North American Rockwell Corporation
Northrop Corporation
Pacific Airmotive Corporation
Piper Aircraft Corporation
Pneumo Dynamics Corporation
RCA
  Defense Electronic Products
Rohr Corporation
Ryan Aeronautical Company
Solar, Division of International
  Harvester Co.
Sperry Rand Corporation
  Sperry Gyroscope Division
  Sperry Systems Management Division
  Sperry Flight Systems Division
Sundstrand Aviation, Division of
  Sundstrand Corporation
Thiokol Chemical Corporation
TRW Inc.
Twin Industries Corp.
  Division of the Wheelabrator Corp.
United Aircraft Corporation
Universal Oil Products Company
Westinghouse Electric Corporation
  Aerospace Electrical Division
  Aerospace Division
  Astronuclear Laboratory
  Marine Division

AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W., Washington, D. C. 20036

RETURN REQUESTED

Bulk Rate
U. S. POSTAGE
PAID
Washington, D. C.
Permit No. 2796

Mockup of Boeing 747 shows the three economy class sections. The 20-foot fuselage allows use of wider seats than current jetliner economy sections. (See *Jet Transports: The Third Generation*, page 10).

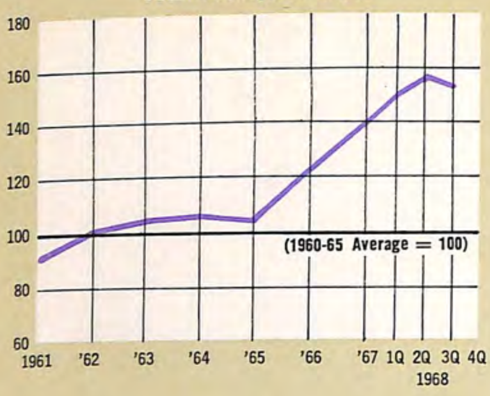
aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION WINTER 1969

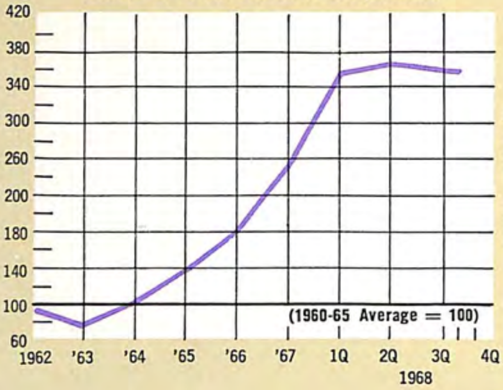
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales

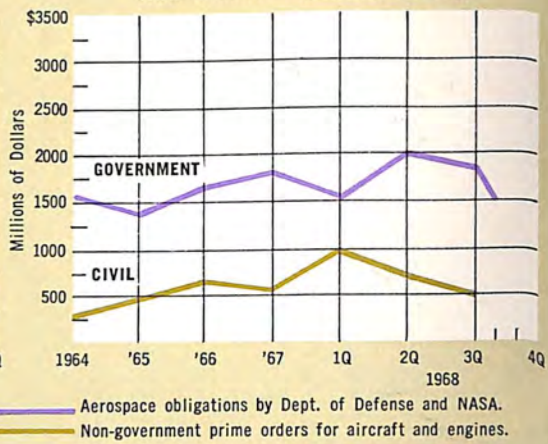


Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average



ITEM	UNIT	PERIOD	AVERAGE 1960-65 *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending Sept 30 1968	27.1	30.1	29.5^E
	Billion $	Quarterly	4.8		6.9	7.6	7.0
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	Oct 1968	1,891	2,161	1,195
Aircraft	Million $	Monthly	601	Oct 1968	1,326	1,173	526
Missiles & Space	Million $	Monthly	550	Oct 1968	565	988	669
Aerospace expenditures: Total	Million $	Monthly	1,067	Oct 1968	1,410	1,298	1,425
Aircraft	Million $	Monthly	561	Oct 1968	867	868	872
Missiles & Space	Million $	Monthly	506	Oct 1968	543	430	553
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920-ǂ	Sept 1968	1,998	847	1,971
Aircraft	Million $	Monthly	447	Sept 1968	1,484	577	1,156
Missiles & Space	Million $	Monthly	473	Sept 1968	514	270	815
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	Oct 1968	254	301	369
Expenditures	Million $	Monthly	130	Oct 1968	544	287	330
UTILITY AIRCRAFT SALES							
Units	Number	Monthly	692	Dec 1968	1,273	1,008	985
Value	Million $	Monthly	15	Dec 1968	37	38	37
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3#	Quarter Ending Sept 30 1968	28.6^R	30.6^R	31.2^R
U.S. Government	Billion $	Quarterly	11.6		NA	15.8	17.2
Nongovernment	Billion $	Quarterly	3.7		NA	14.8	14.0
EXPORTS							
Total (Including military)	Million $	Monthly	110	Oct 1968	151	221	213
New Commercial Transports	Million $	Monthly	24	Oct 1968	38	81	39
New Utility Aircraft	Million $	Monthly	2	Oct 1968	7	8	10
PROFITS				Quarter Ending Sept 30 1968			
Aerospace — Based on Sales	Percent	Quarterly	2.3		2.6	3.2	3.4
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		4.7	5.2	4.9
EMPLOYMENT: Total	Thousands	Monthly	1,132	Sept 1968	1,404	1,421	1,414^E
Aircraft	Thousands	Monthly	469	Sept 1968	617	632	627
Missiles & Space	Thousands	Monthly	496	Sept 1968	606	611	609
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	Sept 1968	3.57	3.65	3.69^E

R Revised by the Census Bureau. NA = Not Available.
E Estimate.
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
# Averages for 1961-65.
ǂ Averages for fiscal years 1960-1965.

Source: Aerospace Industries Association

CONTROLLING AIR POLLUTION

A comprehensive and voluntary program by engine and aircraft manufacturers and the airlines is significantly reducing the amount of air pollution caused by aircraft engines.

The pollution caused by aircraft turbine and piston engines is small compared to other sources, according to measurements by air pollution authorities. However, with the growing number of such engines for air transport, marine and general installation uses there is a natural concern over any possible increases in pollution levels from these sources.

The Aerospace Industries Association and the Air Transport Association have furnished the National Center for Air Pollution Control of the Department of Health, Education and Welfare with a detailed report of what has been done and is being done to solve the problem.

Key points of the report include:

• Aircraft engine contribution to total gaseous emissions into the atmosphere is generally less than 2 percent.

• Smoke content by weight of aircraft engines is generally very low, but it does result in a highly visible effect because of the very small size and finely divided nature of the smoke particles produced. This is roughly comparable to the high visibility of fog compared to a light rain.

• Investigations of the production of oxides of nitrogen in turbine engines show that the total quantities are generally less than 60 parts per million. This compares with a typical automobile output of 1,700 parts per million.

What is being done?

The intensive efforts of industry have been aimed at the source of pollution: the engine itself. Research has led to an improved understanding of the causes of smoke formation in turbine engines which has resulted in the development of combustor (the area where fuel is burned) design.

The smoke reduction design technology encompasses all aspects of combustor design, including fuel injection methods, fuel and air mixing methods, flame stabilization methods and temperature control methods.

Smoke emission, and methods of elimination, are now evaluated at the earliest stages of development of all new turbine combustors to insure low smoke engines. Significant progress has been made in developing such combustors for some engines now in service and they produce an acceptable level of smoke. These combustors are now being evaluated in short to intermediate range aircraft. Combustors producing lower levels of smoke are being developed for all current production and future turbine engines.

A broad technological base for the design of combustors with sharply reduced smoke emission levels has been developed. Smoke emissions can be reduced or even eliminated by various design features which generally result in leaning out the combustion zone of the combustor. However, to accomplish this without affecting the performance and durability of the combustor requires exacting developmental work to control precisely the manner in which additional air is introduced into the combustion zone.

The report to the Department of Health, Education and Welfare sums up the confident outlook of the aerospace and air transport industries:

"As a result of continuing efforts, it is expected that all aircraft placed in service during the early 1970's will have fully acceptable smoke emission levels and that, in that time period, many aircraft with current production engines will have been equipped with modified combustors which will reduce smoke."

AIA

aerospace

Official Publication of the Aerospace Industries Association of America, Inc.

PRESIDENT • Karl G. Harr, Jr.
SENIOR VICE PRESIDENT • V. J. Adduci
DIRECTOR OF PUBLIC AFFAIRS • Carlyle H. Jones

VOL. 7, NO. 1 *WINTER 1969*

EDITOR • Gerald J. McAllister
ASSOCIATE EDITOR • Richard W. Balentine
ECONOMIST • Gerson N. Chanowitz
ART DIRECTOR • James J. Fisher

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 civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published 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

Western Office: McCulloch Building, 6151 West Century Blvd., Los Angeles, Calif. 90045

THE AEROSPACE INDUSTRY: TODAY

1968 AEROSPACE ECONOMIC HIGHLIGHTS

Sales: $30.1 billion, a 10.5 percent increase over 1967.

Backlog: $30.2 billion (at the end of the third quarter), a gain

Exports: $2.9 billion, a 32 percent increase over 1967.

Employment: 1,400,000 workers, a slight gain over 1967.

Commercial sales: $6.4 billion, a 39 percent increase over 1967

AND TOMORROW

.6 percent over 1967.

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

Over the past several years the aerospace industry has experienced development at a pace more rapid than anything in its past, expanding annually at approximately a 10 percent rate. Innovation has kept pace with this growth; and just ahead as realities are developments which as recently as two years ago still seemed fantasy.

During the past year alone the industry set records in almost every respect. Aerospace sales reached an all time high of $30.1 billion, an increase of almost $3 billion above 1967. Except in the case of non-military space sales, every category of aerospace business registered gains. The most dramatic advance and perhaps the most significant one, occurred in commercial aerospace sales which increased by 39 percent to a record setting $6.4 billion. Another record was shattered as aerospace exports rose 32 percent to a $3 billion level. The key to both of these gains is found primarily in the deliveries of turbine-powered transports, which continued their climb and resulted in an all time production high of 691 units. Noteworthy, too, is the fact that commercial helicopter deliveries passed the 500 mark for the first time.

These trends, with minor temporary adjustments, will continue over at least the medium range future. Every element of the industry and its markets, present and potential, appears to be basically sound; and the opportunities for growth continue to develop rapidly.

In terms of events, unquestionably the aerospace highlight of 1968 was the Christmastime flight of Apollo 8. The pin-point perfection of the mission, which for the first time placed man in orbit around the moon, surely represents man's greatest technological achievement to date.

The mission involved nearly every scientific discipline, and a remarkable job of coordination between government and industry that resulted in the six-day, 500,000 mile flight capped by orbiting the moon for 20 hours. The implications are almost limitless. It conclusively demonstrated man's capability to explore the moon and the planets.

Programs for very large aircraft, both military and commercial, also moved ahead impressively. The C-5A, the world's largest aircraft, was rolled out and made its first flight. Production plans were announced for the high passenger capacity L-1011 and the DC-10 turbine transports; and the intercontinental range 747 jet transport with its ultimate capacity of nearly 500 passengers was also rolled out. The impact of these transports on air travel promises to be as great as was that of the first jet transports introduced in 1958.

1968 saw the successful completion of the Lunar Surveyor Program as well as the launching of the world's most sophisticated and complex scientific satellite, the Orbiting Astronautical Observatory. Views of the universe from the OAO are confidently expected to gain more knowledge of astronomy than has been acquired in all the years since Galileo's invention of the telescope.

On the military space front, 1968 saw completion of the Initial Defense Satellite Communications System, a successful launch of the LES 6 experimental forerunner of the Tactical Communications Satellite system which will provide a new dimension for communication at the battlefield level, as well as an acceleration of the Manned Orbiting Laboratory (MOL). Last year also saw increased funding for the Sentinel anti-ballistic missile system and initial procurement of the Cheyenne helicopter.

It is clear that 1968 produced a giant step forward into the national aerospace future. This pace will continue during 1969.

From a statistical point of view, a slight decline in sales to about $29.6 billion is anticipated. This represents a temporary but sharp decline of about 25 percent in jet transport sales, as several models are phased out prior to the initiation of deliveries of the new high capacity models (the DC-10, the L-1011 and the 747). The temporary nature of this decline is illustrated by the fact that, as of June 30 last, unfilled orders for jet transports were at an all time high of slightly more than $10 billion.

A continuing increase in sales of helicopters, executive and utility aircraft is anticipated next year, as well as a modest increase in the level of defense sales and nonaerospace sales. Civil space sales will continue to decline somewhat.

The industry's backlog at year's end amounted to $30 billion, and for the first time since pre-World War II days reflected a smaller percentage of backlog for U.S. government orders than for orders of other customers. In the third quarter of 1968 U.S. government orders are estimated at $14.5 billion while orders from other customers are estimated to reach $15.6 billion. Obviously from the standpoint of market diversification and increased profit potential, this represents a healthy trend.

Developments with respect to the Vietnamese war of course will continue to affect the nature of the industry's defense market. Procurement by the Department of Defense is expected to decline slightly with the ending of the Vietnam conflict but a number of defense programs deferred by the war will be initiated with particular emphasis on new bombers, missile system improvements, fighter/attack close support aircraft, antisubmarine warfare reconnaissance aircraft, helicopters and V/STOL aircraft. The federal budget for Fiscal Year 1970 provides for such new projects as well as increases for research and development generally.

There are many reasons for being confidently bullish about the short and medium range future at least. Each year we are pushing more rapidly toward the ultimate billion dollar market that awaits an economically viable vertical lift aircraft for inter- and intra-city passenger travel. Each year we are steadily if undramatically increasing our nonaerospace markets. During this decade, for example, sales to this market have nearly doubled — and the trend has been steadily upward. Each year we are getting nearer to the potential market, conservatively estimated, of $20 billion for the SST (about half of which market will be composed of foreign airlines). Admittedly all three of these areas represent futures and contain big ifs. However, in each case 1968 has represented a solid if unspectacular advance toward reducing these ifs to realities.

But the real star of the firmament of the next decade's markets lies in the fantastically fast and widespread arrival of the world-wide demand for air travel. This demand is reflected impressively in the market for all types of aircraft. It is reflected spectacularly in the market for jet transports.

Figures available now and as we look into the immediate future years prove that, in terms of passenger air travel, we have only seen the beginning — if we can insure that our airways and airports keep pace with the advances being made in the other elements of our air transportation system. Because of its major and direct relationship to our total national economy, this "if" is one that should concern us all whether directly connected with this industry or not.

PRODUCTION OF CIVIL AIRCRAFT

Calendar Year	TOTAL NUMBER[a]		TURBINE POWERED TRANSPORT TYPES[b]		HELICOPTERS[c]		UTILITY AND EXECUTIVE[d]	
	Number	% Chg.	Number	% Chg.	Number	% Chg.	Number	% Chg.
1965	12,543	+24.8	233	+42.9	388	−13.8	11,852	+26.9
1966	16,777	+29.7	344	+47.6	390	+ 0.5	15,747	+32.9
1967	14,660	−12.6	480	+39.5	455	+16.7	13,577	−13.8
1968[E]	15,202	+ 3.7	691	+44.0	511	+12.3	14,000	+ 3.1
1969[E]	16,510	+ 8.6	515	−25.5	545	+ 6.7	15,450	+10.4

E — Estimated
[a] Total, based on Census releases, may differ from the sum of components which is based on different sources.
[b] Includes Boeing, Douglas, Fairchild, and Lockheed, turbine-powered transports produced.
[c] Based on Census reports.
[d] Includes jet transports produced by utility and executive aircraft manufacturers.

Source: Government agencies and AIA.

AEROSPACE INDUSTRY SALES BY PRODUCT GROUP

(MILLIONS OF DOLLARS)

Calendar Year	TOTAL		AIRCRAFT		MISSILES		SPACE		NON-AEROSPACE	
	Value	% Chg.	Value	% Chg.	Value	% Chg.	Value	% Chg.	Value	% Chg.
1965	20,670		9,747	+ 9.4	3,626	−30.8	5,329	+12.9	1,968	+14.4
1966	24,610	+19.1	11,951	+22.6	4,053	+11.7	5,969	+12.0	2,637	+34.0
1967	27,267	+10.8	14,981	+25.4	4,417	+ 8.9	5,290	−11.4	2,579	− 2.2
1968[E]	30,123	+10.5	17,412	+16.2	4,817	+ 9.1	5,168	− 2.3	2,726	+ 5.8
1969[E]	29,637	− 1.6	16,352	− 6.1	5,317	+10.4	5,068	− 1.9	2,900	+ 6.4

E — Estimated

Source: Government agencies and AIA.

AEROSPACE INDUSTRY SALES BY CUSTOMER

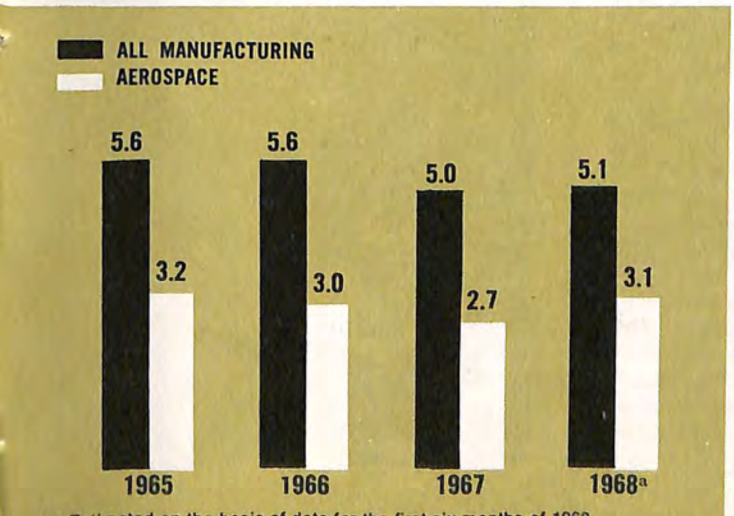
(MILLIONS OF DOLLARS)

Calendar Year	TOTAL		DEPARTMENT OF DEFENSE		NASA & AEC		COMMERCIAL AEROSPACE SALES		NON-AEROSPACE	
	Value	% Chg.	Value	% Chg.	Value	% Chg.	Value	% Chg.	Value	% Chg.
1965	20,670		11,396	−13.8	4,490	+23.5	2,812	+39.4	1,968	+14.4
1966	24,610	+19.1	13,284	+16.6	5,026	+11.9	3,663	+30.3	2,637	+34.0
1967	27,267	+10.8	15,855	+19.4	4,201	−16.4	4,632	+26.4	2,579	− 2.2
1968[E]	30,123	+10.5	16,914	+ 6.7	4,047	− 3.7	6,436	+38.9	2,726	+ 5.7
1969[E]	29,637	− 1.6	17,214	+ 1.8	3,847	− 4.9	5,676	−11.8	2,900	+ 6.4

E — Estimated

Source: Government agencies and AIA.

NET PROFIT AFTER TAXES AS A PERCENT OF SALES

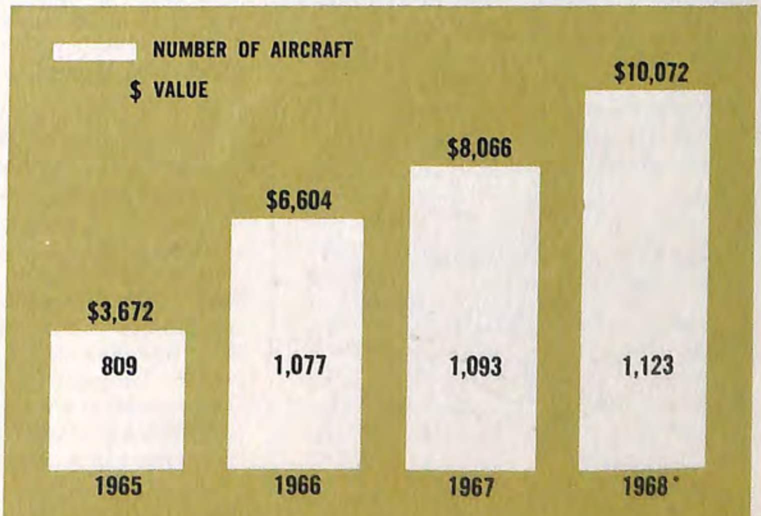


a Estimated on the basis of data for the first six months of 1968.

Source: Securities & Exchange Commission — Federal Trade Commission.

TOTAL ORDERS FOR TRANSPORT AIRCRAFT

(MILLIONS OF DOLLARS)



* Order as of June 30, 1968

AEROSPACE NOTES

GE Electron Microscope Probes Crystal Structure

Scientists at the General Electric Research Center at Schenectady, N.Y., have developed a highly advanced electron microscope by which it is possible to resolve with greater clarity than ever before interatomic spacings in crystals.

Within a crystal, the planes of atoms are so close together — about ten billionth of an inch apart — that they are much too small to be seen under an optical microscope because light waves are about a thousand times too long to resolve them. This basic limitation is overcome by taking advantage of the very short wave lengths of the beam of electrons in an electron microscope.

In examining crystals of germanium and silicon, GE scientists have been able to magnify interplanar spacings 500,000 times with such good image quality that they could be enlarged photographically another 40 times without becoming intolerably fuzzy.

Ability to observe imperfections in crystals is of great practical importance since they can play an important role in determining the strength and hardness of metals and ceramics and are crucial to the inner workings of such solid-state devices as transistors and switches without moving parts.

Astronaut Tests Space Devices at Martin

A zero-gravity simulator at Martin Marietta Corporation's space complex at Denver is being used to evaluate space walking devices such as "backpacks" and hand-held maneuvering units designed for the Apollo Applications Program. Martin Marietta is experiments integrating contractor for AAP.

In the photo Astronaut Bruce McCandless is shown gliding along a silvery curtain representing a portion of an orbital work shop held in the jaws of the simulator.

These simulation tests of various astronaut devices are being performed under a joint contract with the Air Force and National Aeronautics and Space Administration.

Ryan Firebees Complete First Shipboard Launches

First ship-launch tests of the jet-powered Ryan Firebee aerial target have been completed on Navy ranges in both the Atlantic and Pacific Oceans demonstrating a new fleet capability.

Normally launched from ground pads or aircraft modified to serve as airborne launch platforms, the Firebee completed a series of test launches near Puerto Rico from the deck of the decommissioned destroyer *Killen* and from a remote-controlled converted aviation rescue boat out of the Navy's Missile Center at Pt. Mugu, Calif.

The first three flights of the Caribbean series were conducted for tracking purposes while the balance functioned as targets for ships engaged in air defense practice. The Firebees were successfully recovered by helicopters from open sea areas and returned to base installations for rehabilitation and restoration to operational status.

Goodyear's Tiny Tire to Move Cargo in Giant Boeing 747

What Goodyear Tire & Rubber Company calls its "Tom Thumb" pneumatic tire is to be used to help solve the problem of handling cargo within the huge Boeing 747 jet transport.

Moving on 45 of these tiny tires — each is just nine inches in diameter and about three and one-half inches wide — cargo containers can be eased quickly through the cavernous cargo areas of the 747. The tires are located beneath the deck of the cargo hold. As containers of luggage are placed in the hold, a member of the cargo-loading crew can raise the motor-driven tires individually by means of a control panel.

When a spinning tire comes in contact with the bottom of a cargo pad, the container is pushed on its way to its proper place in the hold. The tires have an inflation pressure of 18 to 20 pounds.

Such a system is required because the big transport has about a two and one-half degree incline toward the nose when loading.

Grumman Designs Largest Shielded Anechoic Chamber

Grumman Aircraft Engineering Corp. has designed and built the largest shielded anechoic chamber for high power radio frequency radiation testing ever constructed. Full-scale integration testing is about to begin on a major aircraft program employing sophisticated electronic countermeasures systems.

Not only is the 87 foot square by 42 foot high chamber the largest of its kind ever constructed, but it also represents a major step forward in the methods of testing aircraft electronic systems. Previously these chambers were small and testing was performed on scale models of antennas and aircraft. In this chamber, systems will be tested as part of the entire aircraft weapon system and not as individual elements.

With the new chamber, the Navy and Grumman will have the means of isolating an aircraft from all sources of outside interference. Testing in an outside environment leads to ghosts, as experienced in TV, which are the result of reflections off buildings, hillsides and other objects. In addition, the intrusion of snow, rain, cold, and heat affects the testing devices which leads to measurement errors. These, and many other factors led to development of the radio frequency anechoic materials installed in these chambers.

The radio frequency material lining the chamber consists of pyramidal shapes, two feet square and six feet high. All sides of the chambers are completely covered with a total of 7,300 pyramids.

The first aircraft to be tested in the new anechoic chamber is the Navy Grumman EA-6B four-place electronic warfare aircraft.

Liner Elizabeth II to Use ITT Space Navigation System

The world's newest luxury liner, the Queen Elizabeth II, is the first passenger vessel to be guided by a man-made "star." An International Telephone and Telegraph Corp. Satellite Navigation System has been installed which provides the liner with a precise navigation system utilizing space satellites to determine its position anywhere on the oceans.

The ITT System provides position location with accuracies to approximately 1/10 of a nautical mile in all types of weather. It makes use of existing polar-orbiting satellites of the U.S. Navy Navigation Satellite System which have been operational since 1964.

A group of Navy satellites circles the earth continually crossing over the North and South Poles. Each satellite, broadcasting signals which continuously announce its position, orbits the earth every 108 minutes. The Navy determines the exact orbit of each satellite by radar measurements processed by computers on the ground. This information is fed back twice daily into electronic "memories" aboard the satellites.

As each satellite orbits, it broadcasts its exact location every two minutes. On board ship, the equipment determines the position of the vessel with respect to the satellite's known location at the instant of the broadcast.

Avco Builds Modular Health Facility for Medical School

Combining aerospace technology with medical expertise, the Aerostructures Division of Avco Corporation is collaborating with Meharry Medical College at Nashville, Tenn., in the design and construction of a modular health services facility. The facility will cost substantially less to operate than conventional health centers.

The circular-shaped unit has patient rooms forming the outer ring, the hub of which contains surgery facilities, essential services such as food, maintenance and storage and a highly sophisticated control center electronically monitoring the condition of each patient. Because of its compactness it can be operated by a relatively small staff.

Designed to accommodate anywhere from 22 to 88 patients at a time, the unit can also be adapted as an outpatient clinic and research operation.

The Health Services facility will be constructed of standard building panels, cut to size, and machined and welded extrusions. Units are expected to be particularly suitable for rural areas and densely populated inner-city residential zones.

Honeywell Develops Heart Measurement Device

Honeywell's biomedical products department at Denver has developed a flexible transducer mounting arm which aids hospital personnel in obtaining physiological data from ailing heart and shock patients.

The arm adjusts and locates pressure transducers and other sensors on the same level as a patient's heart to facilitate accurate measurements. The firm is supplying the mounting arm as an accessory device for cardiac catheterization laboratories, operating rooms and shock cart units.

Telescopic and ball-joint features of the mechanical arm permit mobility in three planes of motion and locking of the sensor into proper position near the patient. In addition, other devices like the flushing syringe shown, can be attached to the arm.

BY DR. CHARLES S. SHELDON II
Acting Chief, Science Policy Research Division
Legislative Reference Service, Library of Congress

In 1957, Sputnik changed the world view of the Soviet Union as an ideologically troublesome, but technologically backward nation.

The image had lagged behind the reality, but the shock of the early space triumphs brought for a time an overreaction that the Russians were immediately capable of conducting any advanced engineering or military task on many broad fronts.

To a degree, those who deprecated Soviet achievements of that period were right. The Soviet scientific programs were being run on a shoestring with a careful management of news to maximize impact and shock on the rest of the world. But now things have changed. The Soviet Union though still well behind the United States in gross national product has increasingly recognized what modern science and technology can do, and it has made enormous investments in many fields, including space, which have gone far to transform the somewhat backward country of only a few years ago.

Consumer expectations have been rewarded with some improvements, but the country has continued to put a heavy emphasis upon its expansionist power in heavy industry, science, and military strength. Today, the Soviet Union through steady application in fields of advanced technology has developed a fairly comprehensive and confident program of modernization.

Any outsider, and indeed the Russians themselves, must find it hard to develop a perspective on these revolutionary changes without any judgments being strongly influenced by subjective factors. The purpose of this survey is to convey something of a picture of the state of Soviet technological society and its implications for the United States.

The Soviet Union has developed three space launch complexes in surprisingly close parallel to the United States situation. Tyuratam is the principal launch site, like Cape Kennedy a place of diverse capabilities to support missile development, R & D space flights, manned, lunar, planetary, and communications flights. Plesetsk is the Vandenberg of the U.S.S.R., devoted largely to military support missions, but also used for weather and other high inclination satellite launchings. Kapustin Yar, used for early vertical probes and for shorter range missiles, also launches modest space payloads, like a combined White Sands, New Mexico, and Wallops Island, Virginia.

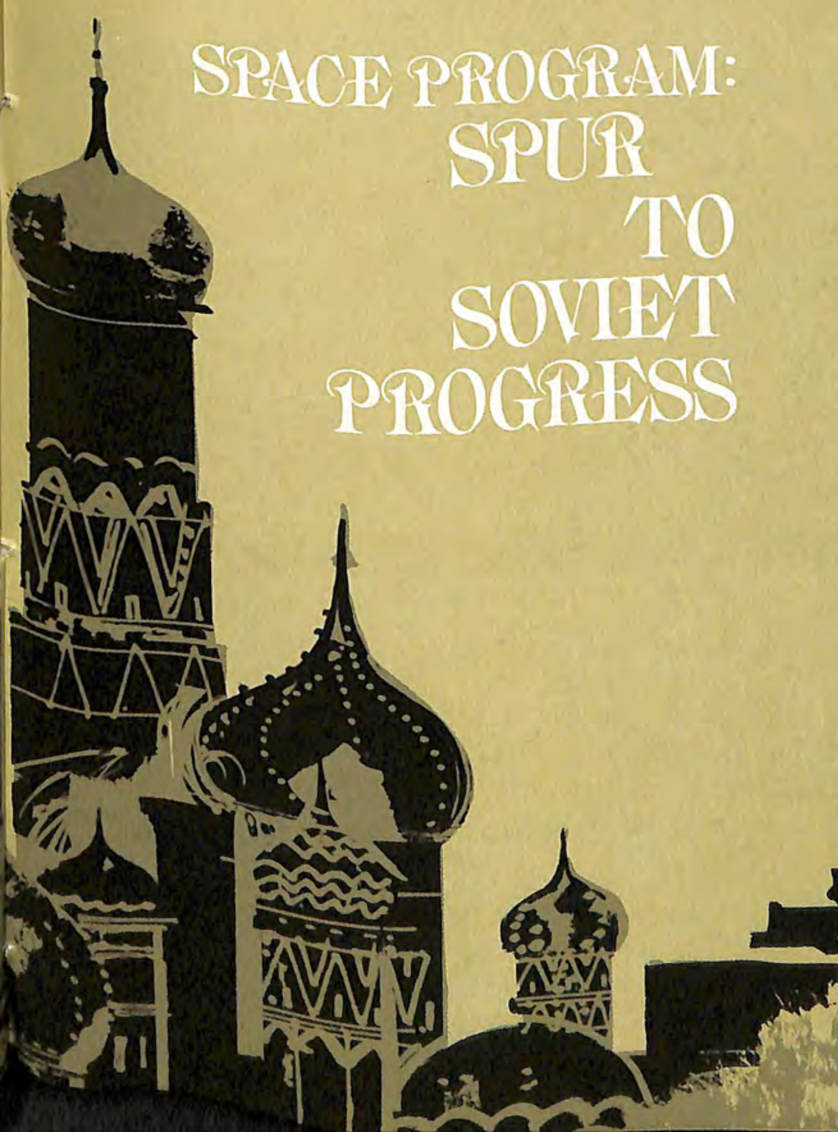
The basic launch vehicle of the Soviet Union is a modification of their 1957 ICBM. With a first stage thrust of 1.1 million pounds, it can place up to 16,500

pounds of payload in Earth orbit, and through highly repetitive use is both reliable and economical. In supporting roles are two lesser launch vehicles derived from the Sandal and Skean military missiles in all probability, and one other ICBM-related vehicle used for space military purposes. Coming into wider use is a vehicle employed at the present time only for space with a first stage thrust of over three million pounds, and a capacity to Earth orbit of 40 to 60 thousand pounds. It has also supported the Zond flights to the moon and return.

The Soviet Union has developed a limited number of standard bus payloads which with some adaptation will fulfill many missions. One size meets most missions with weight requirements under 1,000 pounds. The basic Vostok manned craft is probably also used for military photographic missions. The basic interplanetary craft has also supported lunar missions and communications needs. Now the Soyuz manned craft may turn out to be the Zond for trips around the Moon and future unmanned flights to the planets.

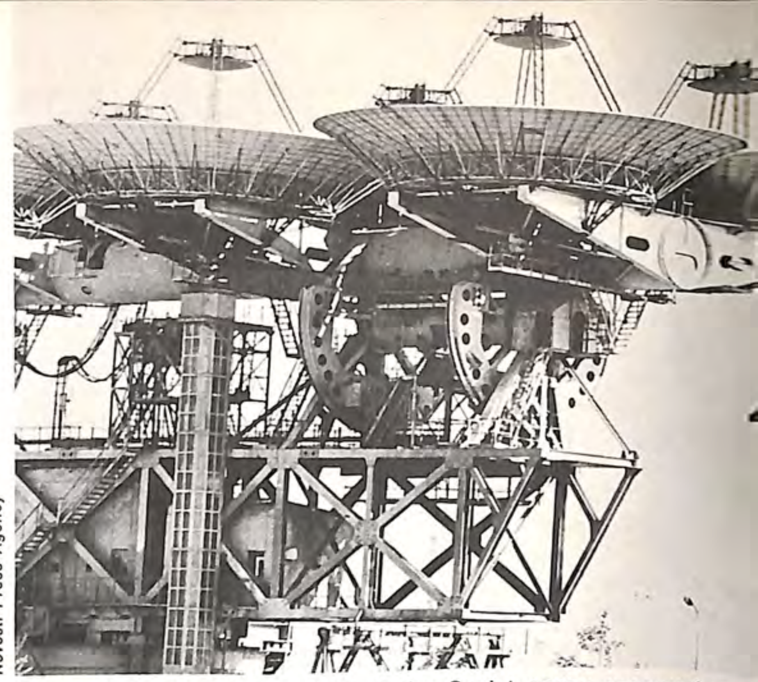
The Soviet space program has established general capabilities to launch payloads at times selected in advance; to deliver those payloads where desired; to track cooperative and uncooperative spacecraft; to maneuver in space, rendezvous, and dock; to send signals over great distances; to support life in space;

SPACE PROGRAM: SPUR TO SOVIET PROGRESS



Novosti Press Agency

First visitors to the K. Tsiolkovsky State Museum devoted to the history of astronautics at Kaluga view Soviet space vehicles.



Novosti Press Agency

This battery of dish antennas at the Soviet space communicati center enable Russian space engineers to receive and tra radio signals from Soviet space probes. Each dish has diameter of approximately 52 feet and weighs about 1,500 to

and to return to chosen areas on Earth even from escape velocities, including use of aerodynamic lift.

Russia has long had an elite corps of scientists, and in recent years the prestige and numbers of these scientists have grown to a position of prominence in Soviet society beyond the normal guideline of Communist party rank. These scientists have been permitted to conduct broad programs of exploration both in Earth orbit and in deep space as part of the Soviet commitment to science in general, presumably for the ultimate though unspecifiable benefits which will follow such basic research.

Though slower to apply such work than the United States, the Soviet Union operates full-fledged space applications programs in weather reporting and communications. They are also actively investigating the prospects for Earth resources satellites, using multisensor devices to support mineral exploration, fish searches, forest and crop management, land utilization, and urban development.

Military applications have not been neglected. Navigation satellites support Soviet navy ships. The use of electronic ferrets in space is a likely supplement to what their trawlers do at sea. The biggest single element in their entire space program is one of military photographic observation worldwide, year in and year out. Unlike the United States, the Russians have deployed a space fractional orbit bombardment system which may be ready for operational deployment. Recent maneuvering flights begin to hint at a space inspection and intercept capability.

Although manned flights overlap other purposes in space, they represent such a large investment as to warrant separate mention. Space stations and deep space flights are both close at hand in the Soviet capability.

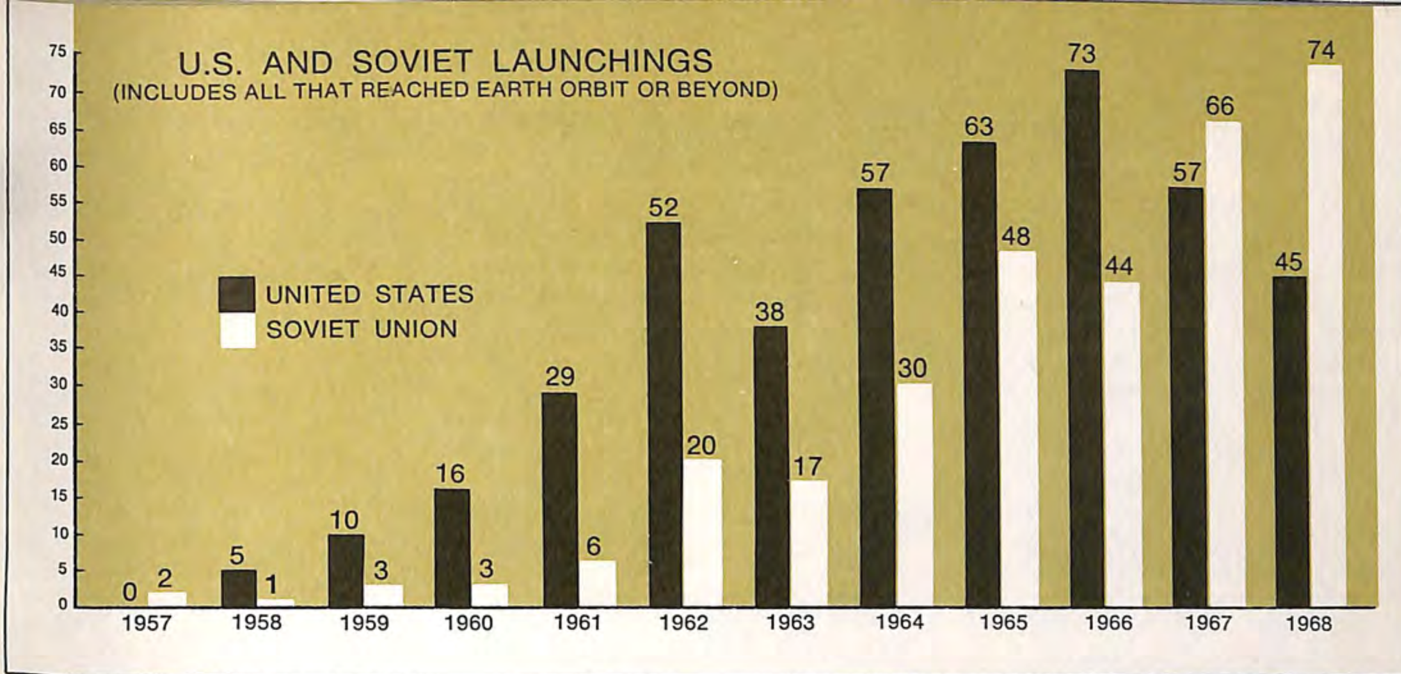
It is clear that overall, the Soviet Union is rapidly creating a broad capability to operate in space for many national purposes; and if assessments by the National Aeronautics and Space Administration are correct that shortly a vehicle larger than the Saturn V will appear, the Russians will be moving toward their repeatedly announced goal of opening the entire solar system to their manned flights.

The effect of all this is to give them not only practical working tools in the civil and military areas, but also to create a world image of progress and leadership which is hard to gainsay.

Few people a decade ago visualized the far-reaching consequences of the rapid maturing of major space programs to the nations conducting them, and this was undoubtedly true in the Soviet Union. There has been an interaction between general technological advance and progress in space.

During the 1950's, there were little-heeded warnings that the Soviet Union was putting heavy emphasis upon the training of scientists and engineers, even though it lagged educationally in total number of students. The United States had a larger pool of people with modern training, but the gap in the replenishment rate was pointed toward later trouble.

Today, some of those trends have begun to exact their toll. The high demands for people with quality training across a broad spectrum of scientific knowledge and engineering know-how engendered by the space program have applied an increasing pressure on the pool of Soviet manpower, but a pressure matched by expanded training efforts. Although, even in Soviet society, there have been detractors of the space program, it has been even more a source of high motivation for the able youth to work hard to gain the training which would permit them to win rapid advancements



Source: Goddard Satellite Situation Reports

and high positions of service in the expanding field of space. Soviet education has changed with Sputnik as much as that historic event triggered reviews and changes in the U. S.

Soviet literature is increasingly reflecting other unexpected changes in their productive capacity. They now recognize, as if light had just been thrown on the subject, that their large space program is revolutionizing their general industrial plant. It is not that technology transfer to less dynamic industries is certain or complete, but, even so, vast segments of the machine industry, armaments, electronics, optics, and instrumentation are being restructured by technical revolutions growing out of their space work. Improved concepts of quality control are coming into use, with better products in metallurgy, plastics, ceramics, fiber composites, and so forth. Soviet processes and products are showing a marked improvement in precision, in application of automatic machines.

Many experts argue that overall, the Soviet Union still lags behind the United States in its electronics, its trend toward integrated circuits, and in its best computer. But if this gap, which may be two to four years, is real, it is small comfort considering the rush toward further investment in improvements in all these areas. Some of the Soviet hardware in applications such as radar, communications, and instrumentation may be equal or superior to competitive products anywhere.

Soviet systems applications developed for space are available to apply to a far wider range of industrial, transportation, resource extraction, military, and social problems. A nation capable of mounting a large space program can take on a wide range of difficult but possible tasks such as no earlier generation would have had the temerity to consider.

Any Westerner can point with accuracy to flaws in Soviet society, many of them crucial in our set of values. In housing, consumer durables, and other items, some shortages persist. More critical is the ever-present threat of suppression of freedom with a return to aspects of Stalinism wherever conditions begin to ease enough that people take heart and begin to relax their vigilance against disclosure of private feelings about liberty and self-expression.

Whole generations of Soviet citizens were sacrificed in the collectivization of farms and the growth of industrial capacity, especially in capital goods, during the 1920's, the 1930's, and on to the present, with added burdens occasioned by the losses of World War II. Those who survived these ravages now have the basic investment in capital and know-how to exploit the rich resources of this vast land more than double the geographic size of the United States. Arable land is limited, but probably is not now crucial to general expansion. This society also has built one of the largest and most modern merchant fleets in the world both at home and through orders placed in foreign shipyards.

Along with this industrial progress, the Soviet Union has maintained large military forces which have been repeatedly modernized since World War II. The army of today is far different from the makeshift one that walked across Europe defeating German field forces, and depending on animal transport and foraging and plundering as it went. Mechanized, motorized divisions with modern armor, good communications, chemical warfare capabilities, and nuclear weapons for its tactical missiles are a major threat on land. Recent operations in Czechoslovakia gave indication of what such a force might do if really put to the test. A traditionally large submarine force for defensive purposes has been increasingly re-equipped with longer-range nuclear submarines, both attack and missile-carrying. There never has been a Soviet strategic air force as strong as our Strategic Air Command, but it is still a menace. Successive airshows have unveiled one generation after another of high performance aircraft especially for interception and fighter-bomber duties. And these aircraft have been produced in such numbers that, like tanks and artillery, fairly late models have been available for export to areas where they will serve Soviet political aims of revolution and conquest.

Especially striking has been the Soviet creation of a strategic rocket force. Some of the best trained, most highly motivated men have gone into these forces so closely related to the space program. Missiles have provided launch vehicles, and space work has led to improved missiles. Troops of the strategic rocket forces conduct Soviet space launchings. Regardless of the count on who has the larger number of nuclear warheads, the Soviet Union just as much as the United States has the technical potential for destroying any other nation. So far, command and control systems and prudence in use of these forces have not permitted them to be unleashed. Now international stability is in question with moves toward ABM's, multiple warhead missiles, and space weapons.

The military threat of Soviet power cannot be minimized. But even if the big powers do avoid general war with a nuclear exchange, there are other challenges to our security from Soviet society.

The interaction between science and space, with its pay-off in many other fields, is strikingly present in the Soviet Union, and that country will gain in any future world which puts a premium on intellectual and technological leadership.

Soviet scientists represent an elite group with fewer restrictions upon their freedom to think and be creative than any other group of Soviet citizens. They are paid well, given fringe benefits of housing and travel. They are supported in many areas with special institutes for research, and with rapid translation services to tap the literary output of science world-wide. They themselves issue a very large number of journals and publications.

It has become the fashion in the Soviet Union to create science cities of various types. An entirely new city near Novosibirsk, named Akademgorok, features a vast array of technical institutes and laboratory facilities where the new elite live with a degree of freedom quite favorable by Soviet norms. There is a more specialized Star City near Moscow where the cosmonauts train.They also describe a Space City somewhere near the Tyuratam launch site where space hardware is fabricated and tested. Now a second general science city is being built near Irkutsk, and will soon have as many as eight research institutes, along with a university and polytechnical institute. Along with the attention to theoretical matters and basic research, there is a flavor of practicality sought in the work of these scientific institutes.

The Soviet Union has taken a strong interest in high energy physics, and the work done with accelerators at Dubna has drawn scholars from all over the world. Work on controlled thermonuclear reactors appears to continue at a higher level of effort than in the United States.

Soviet investment in the earth sciences has been especially striking. Its oceanographic ships operate in all oceans. Its arctic research, as one might expect, has long enjoyed strong support. Other fields are also well nourished.

A peasant land, highly dependent on agriculture, and long, comfortable decades behind the U. S. in Gross National Product and industrial prowess, is being revolutionized by education, capital investment, science, and space activity. Catapulted into the modern age, it still lags in GNP, but its disposable margins of product to support armaments, selected foreign aid, further scientific growth, and to pursue ideological objectives constitute a serious challenge and even a threat.

The U. S. has long sought accommodations with the Soviet Union, without surrender of our vital interests. Even if war is avoided, as all rational men must hope, any aggressive pursuit of different objectives, including an expansion of economic, ideological, and intellectual hegemony by the Soviet Union is a challenge to the United States. Not the least of these is the tremendous, and undoubtedly carefully calculated, Soviet thrust into outer space. This space challenge the United States must ponder with concern, if not alarm. Expansion into space by both powers and by other nations may bring conflict, or may provide some ultimate accommodation and cooperation beyond what can be accomplished today. Treaties to limit the spread of weapons to space, to rescue astronauts, and proposals for an international lunar laboratory may be hopeful signs in this direction.

But any prospect for mutual advantages is likely to come from parties of near equal capabilities. Overall, our scientific and industrial strength is unsurpassed. Concern with maintaining a balance across this broad front, not neglecting major areas, will remain a challenge to the American people and their leaders for the indefinite future.

DR. CHARLES S. SHELDON II shared in the drafting of both the National Aeronautics and Space Act of 1958 and the Communications Satellite Act of 1962. Earlier he co-authored a study of the Soviet economy for the Joint Economics Committee of Congress. He served as Technical Director of the House Science and Astronautics Committee until 1961, then on the staff of the President's Space Council until 1966. Since then he has been Acting Chief of the Science Policy Research Division, Legislative Reference Service, Library of Congress, as well as their Senior Specialist in Space and Transportation Technology. He is the author of more than thirty published studies, including the 1967 Congressional report, "Review of the Soviet Space Program with Comparative United States Data." He is a fellow of the American Astronautical Society, a Fellow of the British Interplanetary Society, an Associate Fellow of the American Institute of Aeronautics and Astronautics, and this year a distinguished Traveling Lecturer for AIAA.

GENERAL AVIATION: CLIMBING STRONG

General aviation manufacturers, coming off a record-setting year in 1968, are looking forward to an even more prosperous 1969 for one of the fastest-growing segments of aviation.

The promise of general aviation, which the industry saw bloom and fade in the aftermath of World War II, now appears to be soundly on its way to fulfillment.

The reasons for this resurgence are not hard to find. General aviation, embracing air taxis, corporation aircraft and private airplanes, is expanding on the basis of rapid growth in these fields.

Federal Aviation Administration statistics show there are now over 114,166 aircraft in the general aviation fleet, compared to some 2,595 airliners using the nation's airways. This means the number of general aviation aircraft has just about doubled since 1954. What is not generally realized by those who still think of general aviation in terms of a single private pilot boring holes in the sky for his own amusement is that more than 66,000 of these aircraft are capable of carrying four or more passengers. Some 14,651 of them are multi-engine airplanes.

This fleet contributes significantly to the nation's business and commerce. The company president arriv-

ing in a community to decide whether to locate a new plant there may arrive in an airliner — or he may just as likely land in an air taxi or his own corporate aircraft.

One airline alone estimates that some 30,000 of its connecting passengers in one year were delivered by air taxis.

The most recent annual figure also shows that export of 2,807 general aviation aircraft by seven companies brought some $91.5 million toward solving the U.S. balance of payments problem.

The manufacturers reporting to the Utility Airplane Council of the Aerospace Industries Association delivered 13,698 aircraft with a manufacturers' net billing value of $425,862,000. While this did not approach the 15,747 aircraft and $444,910,000 of 1966, it was an 18.4 percent dollar increase over 1967.

What is behind this boom in general aviation manufacturing?

An important new factor is the rapid growth of the air taxi business. Once consisting of widely scattered charter services, this industry now includes over 270 operators from coast to coast. In 1968 they flew over three and a half million passengers, many of them into and out of airports not served by commercial airlines.

Air taxi service, in light and medium aircraft, is of two types. One is the "on call" service, much like its automotive counterpart. A businessman, arriving by commercial airliner at a major airport, can arrange for

an air taxi to whisk him on to his destination at a smaller town, which may have infrequent or no airline service. He also may use air taxi between smaller towns which have no scheduled service whatever.

The other type of air taxi service, becoming increasingly popular, operates on a schedule just like a major airline. But its smaller airplanes serve many towns which the airlines find it uneconomic to consider, thus making a major contribution to the nation's transportation system. These air taxis also operate as a feeder service, carrying passengers and cargo to and from the larger airports to make connections with the major airlines for long-distance flights.

Between 1963 and 1966, the number of air taxi operators offering scheduled flights increased tenfold. More than 980 aircraft now are in use on such schedules. Scheduled air taxi service is sold on a fixed cost per seat basis, with published fares, whereas the user of "on call" air taxis must pay for the full charter, unless arrangements have been made to share with others.

Growth of the air taxi business has been supported strongly by the United States Post Office Department as a rapid, efficient means of mail transportation. One reason for this support is apparent in the fact that the number of mail-carrying trains dwindled from 10,000 in 1930 to 897 in 1967. Another reason is that much air mail is handled at night when airline schedules are light.

It was in 1967 that the Post Office Department undertook a major expansion of the air taxi mail program, with 11 operators serving 15 routes. By the end of that year, the Post Office says, use of air taxis had resulted in improved service to 137 sectional centers serving 9,000 post offices.

By the end of 1968, the Post Office was sending mail over nearly 200 routes and considering additional contracts which would bring the total to 240-250 routes. This was designed to provide service to an additional 245 sectional centers serving another 17,000 communities.

In 1967, air taxi operators carried 300,000 ton/miles of mail with revenues of $180,000. The Post Office predicts that by 1972 this will reach 35,300,000 ton/miles with revenues of $15,700,000. The growing role which the air taxi plays, and will continue to play, in

the nation's air transportation system is clearly evident in these figures.

The air taxi industry has come a long way from the days of a lonely operator with one or two airplanes hoping for charter business on a windswept and nearly deserted airport. That operator today is part of a busy nationwide network for transportation of passengers, mail and cargo.

Air taxi also has played a role in the growth of another segment of general aviation. Many a company president making use of fast, convenient air taxi service, perhaps between towns with no scheduled air or rail links, has begun to think about the advantages of a corporate airplane.

Corporate aviation, like air taxi, is big business today — and likely to get bigger. A recent study indicates there are 390,000 U.S. business organizations that profitably could make use of and can afford a business aircraft. The potential still existing for this segment of the business is apparent when it is realized there are only about 40,000 business aircraft in use today.

Manufacturers of business aircraft are stepping up their efforts to tap this market. One, for example, recently unveiled its new eight-place twin-jet which will cost $590,000. A second also is said to have plans for a new business jet.

This indicates the extent to which modern aircraft have made an impact in this field. It is estimated there now are as many as 600 pure jets in the business fleet. These are not all small aircraft. The value of a business jet has made it worthwhile for some companies to spend millions of dollars for a corporate aircraft. Among the business airplanes on display at the 1968 annual meeting of the National Business Aircraft Association were corporate versions of three transport aircraft, all familiar sights on the nation's airlines.

The maturity of business aviation also is demonstrated in the fact that many companies, formerly reluctant to admit ownership of corporate aircraft for fear that stockholders would consider them a frivolous expenditure, now are quite proud to publicize use of this fine business tool. Whereas companies once operated their business aircraft without markings, scores of the nation's best known trademarks can be spotted today on corporate airplanes parked on airport ramps across the country. General Motors, for example, makes no secret of the fact that it operates a fleet of more than two dozen twin-engine aircraft.

Businessmen have been among the first to discover that many of the nation's airports have infrequent or no airline service. There are more than 9,000 airports in the nation. The airlines serve 515 of these. Nearly 70 percent of all airline passengers are enplaned at only 22 hub areas. The businessman, eager to go where he wants when he wants, finds the business airplane a corporate asset which can save both time and money, particularly when traveling outside of these 22 hub areas.

Growing use of business aircraft can be seen in the upsurge in 1968 billings by general aviation manufacturers for twin-piston and twin-turboprop models, popular for business use. The largest gains were in sales of 6-10 passenger medium twins. (Growth of air taxi service also was, in part, responsible for the popularity of this category.)

Statistics compiled on use patterns and hours flown by general aviation aircraft by the FAA are indicative of the major role played in the nation's business and commerce. In September, 1968, the FAA released a report showing general aviation had flown nearly 22 million hours in 1967 in the following categories: business and executive flying, 5 million hours; personal flying, 6.8 million; agricultural, 1.1 million; flight instruction, 5.7 million; air taxi-commuter, 1.7 million; industrial, special and others, 1.6 million.

Even the commercial airlines find a use for business jets. Trans World Airlines uses two small jets for pilot training and Continental employs one for the same purpose.

(Perhaps another reason for the popularity of business aircraft can be found in a recent report from Washington National Airport. It can cost as little as $2 a day to park a business aircraft on the ramp there. It costs $2.50 a day to park a car.)

The one weak spot in the general aviation picture is the fall-off in 1968 of new student starts. The private flying market is, of course, closely related to the number of persons newly learning to fly.

As a spokesman for the 150,000-member Aircraft Owners and Pilots Association says, "You can't sell airplanes to people who don't fly."

While the down-turn in student starts which occurred in mid-1968 is cause for concern, there is as yet no alarm. These figures show why: Student starts in 1963 totaled 70,000; in 1967, they totaled 159,399 and 1968 was running ahead of that figure until July.

General aviation manufacturers are stepping up their campaigns to attract new customers to the field.

One recently introduced "a new concept in flight training" to its dealers. The plan calls for establishment of nationwide centers, offering a company developed syllabus for a packaged franchise program. Standardization of the course will enable students to change instructors or shift from one flight center to another without falling behind. Training is to be given exclusively in the company's training aircraft by dealers and other qualified flight schools.

Other manufacturers have similar programs, all aimed at getting new students to start training in their particular aircraft. Statistics have shown that students, in the great majority, tend to continue flying the kind of aircraft they learned on; that when the time comes to purchase their first aircraft, they buy that same type; and that when they up-grade to a more expensive, perhaps multi-engine, aircraft, they stay with the same line. Thus, it is very much to the manufacturer's advantage to have a stake in flight training.

Another powerful antidote which is expected to reverse the drop in new student starts is inclusion of modified flight training provisions in the new GI Bill. This provides that the student must already have his private license, or the equivalent in qualified flight hours. The bill then will fund his training for a commercial license.

Unlike the post-World War II GI Bill, which supported ground-up flight training and lured many students only temporarily interested, the new bill is expected to better serve the industry by attracting the serious pilot.

Most of those learning to fly today are not, as often imagined, kids taking up a sport. A study made by one manufacturer shows that the median age for a new pilot is 32; that the median age for the purchaser of an aircraft is 44.

These are people buying airplanes for the serious purpose of transportation. This is supported by the fact that about 90% of general aviation aircraft now leaving the factory are equipped electronically for IFR (instrument flight regulations) flying, according to the Aircraft Owners and Pilots Association.

"There is a definite trend to pilot upgrading," says an AOPA spokesman. "The number of our members getting instrument ratings is growing at a fantastic rate."

While improving the capabilities of general aviation pilots, this increase in the numbers of pilots qualified to fly in bad weather means the load on an already over-burdened federal air traffic control system is being increased. Both general aviation and the airlines have been urging federal legislation for modernization of air traffic control facilities.

With an eye to all 10,000 of the nation's airports and the 114,000 general aviation airplanes, as well as the 515 points served by 2,600 airliners, Joseph T. Geuting, Jr., manager of the Utility Airplane Council, says, "We must make every place in the nation air-accessible to every other place."

It appears general aviation is bent on doing just exactly that.

By January 1, 1977, the FAA predicts, there will be 180,000 general aviation airplanes in the air compared to some 114,000 on January 1, 1967. General aviation aircraft will be logging 35,000,000 hours in 1977 compared to some 17,500,000 a decade earlier.

"Those forecasts, we believe, are quite conservative," says a spokesman for the Utility Airplane Council. "Each year the industry has been exceeding the forecasts."

General aviation, it is clear, is fully prepared to fulfill its major role in the national air transportation system by making communities all across the land "air accessible" for people, cargo and mail.

AIRLINES SET RECORDS IN 1968

The U.S. scheduled airlines set new traffic records in 1968. Revenue ton miles — the overall measure of passenger and cargo traffic in scheduled and charter service — were up an estimated 15.6 percent for the calendar year, from 15.68 billion to 18.13 billion.

However, industry earnings fell 42.4 percent for the 12 months ending September 30, 1968. For the 1968 period, the earnings were $274 million and for the comparable 1967 period, $476 million.

During 1968, deliveries of new aircraft reached a peak of 478 aircraft valued at $2.56 billion. Stuart G. Tipton, president of the Air Transport Association, pointed out that this record number of deliveries accounts for almost one-half of the total airline re-equipment program for the years of 1968-1972 and beyond which now totals 1,058 new aircraft worth $7.83 billion.

For delivery in 1969, the airlines have on order 309 jet aircraft worth $1.90 billion.

In addition to their extensive re-equipment program, the airlines have embarked on a massive investment program designed to expand their airport terminal facilities to handle the new generation of wide-bodied jets and the millions of passengers they will carry. During the four years 1968-1971, the industry will spend $1.5 billion and in the next four-year period from 1972-1975, they will spend another $1 billion.

This means that all told the airlines will invest more than $10.3 billion in aircraft and airports over the eight year period 1968-1975 to provide improved service to the traveling public.

Despite the increased traffic, the industry's financial picture continued to decline. For the year ended September 30, 1968, operating revenues totalled $7.56 billion, up 13.2 percent over the year ended September 30, 1967. However, operating expenses grew faster at a rate of 18.2 percent to $6.96 billion.

This growing squeeze on operating profit was a contributing factor in the industry's substantial decline in net income which was down 42.4 percent to $274 million from $476 million for the comparable period of 1967.

Pointing up this profit squeeze was the decline in passenger yield, or revenue per revenue mile, which was for the year ended September 30, 5.46 cents while for the previous 12-month period it was 5.51 cents. Tipton noted that this decline in yield, brought about by the growing use of discount fares, meant savings of $56.5 million for air travelers over the 12 months.

During the same period, overall revenue per revenue ton mile, or unit revenue, fell from 44.21 cents to 43.05 cents, while unit costs rose to 39.62 cents from 38.97 cents, causing unit operating profit to fall from 5.24 cents to 3.43 cents.

The rate of return on investment — the basic measure of the financial health of the industry — was 6.0 percent based on preliminary figures for the year ended September 30, 1968, considerably below the 10.5 percent the Civil Aeronautics Board has set as a reasonable rate of return. For the previous 12 months, the rate of return was 9.5 percent. These rates of returns are on total investment excluding investment tax credit.

Tipton said that greatly increased air traffic and airport congestion and delays were also a factor in decreased earnings. The airlines estimated that delays cost them over $100 million in calendar 1968, compared with $67 million in 1967.

As of September, 1968, airline employment totalled 300,000, up 13.1 percent over September 30, 1967. Payrolls amounted to $2.8 billion, up from $2.4 billion. The average annual wage for airline employees topped $9,500, compared to $8,950 for a comparable period of 1967.

The airline safety rate, or number of passenger fatalities per 100 million passenger miles, was 0.26 in calendar year 1968, compared with 0.22 for 1967. Tipton noted that this was the 17th year in a row that the rate has been below 1.0.

AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W., Washington, D. C. 20036
RETURN REQUESTED

(See *General Aviation: Climbing Strong*, page 13).

aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • SPRING-SUMMER 1969

• **THE UNITED STATES SST— ASSET FOR NATIONAL PROGRESS**

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

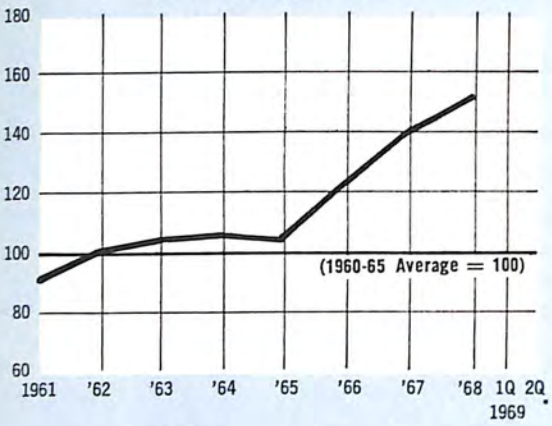
• **THE FINANCING CHALLENGE— AEROSPACE EXPORTS**

By ALFRED H. VON KLEMPERER
Senior Vice President
Morgan Guaranty Trust Company of New York

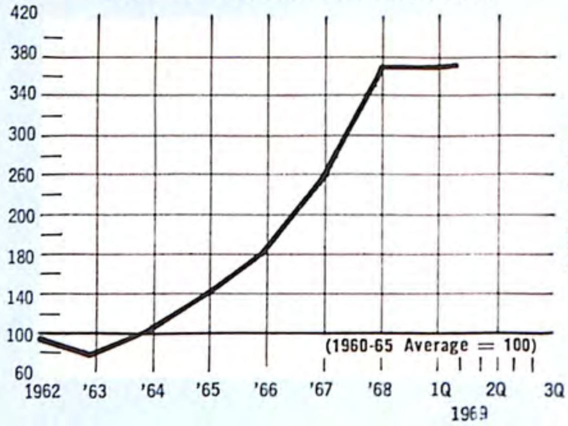
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales

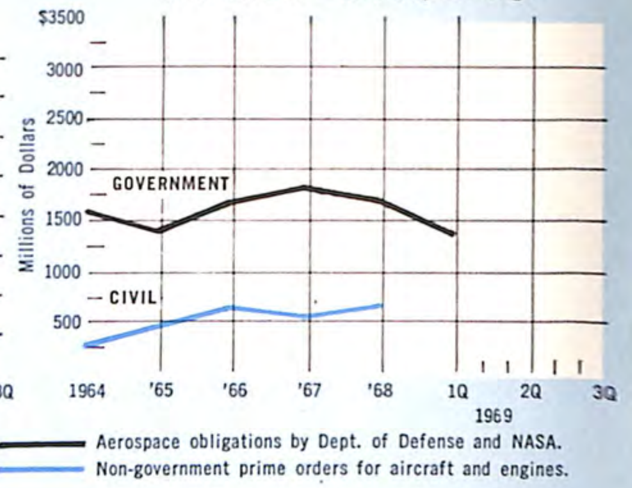


Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average



ITEM	UNIT	PERIOD	AVERAGE 1960-65 *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PERIOD † PRECEDING	PERIOD LATEST
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending Dec 31 1968	27.3	29.4	29.5
	Billion $	Quarterly	4.8		6.8	7.0	7.4
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	Mar 1969	1,580	1,199	1,059
Aircraft	Million $	Monthly	601	Mar 1969	1,034	743	643
Missiles & Space	Million $	Monthly	550	Mar 1969	546	456	416
Aerospace expenditures: Total	Million $	Monthly	1,067	Mar 1969	1,521	1,239	1,432
Aircraft	Million $	Monthly	561	Mar 1969	1,006	786	916
Missiles & Space	Million $	Monthly	506	Mar 1969	515	453	516
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920✢	Mar 1969	961	1,059	808
Aircraft	Million $	Monthly	447	Mar 1969	574	741	545
Missiles & Space	Million $	Monthly	473	Mar 1969	387	318	263
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	Apr 1969	227	306	190
Expenditures	Million $	Monthly	130	Apr 1969	308	321	288
UTILITY AIRCRAFT SALES							
Units	Number	Monthly	692	May 1969	1,250	1,364	1,193
Value	Million $	Monthly	15	May 1969	37	53	41
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3#	Quarter Ending Dec 31 1968	30.7	31.5	30.9
U.S. Government	Billion $	Quarterly	11.6		17.7	17.3	16.3
Nongovernment	Billion $	Quarterly	3.7		13.0	14.2	14.6
EXPORTS							
Total (Including military)	Million $	Monthly	110	Mar 1969	192	253	315
New Commercial Transports	Million $	Monthly	24	Mar 1969	100	137	78
New Utility Aircraft	Million $	Monthly	2	Mar 1969	10	9	13
PROFITS				Quarter Ending Dec 31 1968			
Aerospace — Based on Sales	Percent	Quarterly	2.3		2.9	3.4	3.3
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		5.2	4.9	5.2
EMPLOYMENT: Total	Thousands	Monthly	1,132	Mar 1969	1,431	1,370	1,388[E]
Aircraft	Thousands	Monthly	469	Mar 1969	636	601	614
Missiles & Space	Thousands	Monthly	496	Mar 1969	616	592	597
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	Mar 1969	3.62	3.85	3.84[E]

[R] Revised by the Census Bureau.
[E] Estimate.
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
# Averages for 1961-65.
✢ Averages for fiscal years 1960-1965.

Source: Aerospace Industries Association

PROTECTION FOR THE TRAVELER

When an accident occurs in commercial air commerce it normally can be classified as catastrophic because of the large number of persons usually involved. As aircraft become larger in the future the infrequent accident, if and when it may occur, could even be more catastrophic.

At the present time, an injured person, or his next of kin, may select any number of jurisdictions in which to bring suit. State courts may assume jurisdiction of an action for a variety of reasons.

Cause of an airplane accident is not readily apparent in most cases. Accident investigations can take months or years and then the cause may not be conclusively established. Meantime, litigation may be started by the injured or the next of kin of those killed in the accident.

When the cause of an accident is unknown, the plaintiffs' counsel will often name numerous defendants and base the litigation on a variety of legal theories. With increasing frequency, the manufacturers of the aircraft and the government are being named defendants in addition to the air carrier.

A defendant cannot ignore such litigation and will aggressively defend himself to prove that he was not responsible, a procedure which can take years. Meanwhile the aggrieved families wait for some resolution of the case at a time when they can usually least afford to do so. Many aircraft cases in the courts today have been pending for more than ten years. If the case is determined in favor of the plaintiffs, they may find that their court-awarded damages are reduced substantially because of attorneys' fees and legal costs.

Because of expanding legal theories, ever increasing demands and escalating jury verdicts, there has been a worsening loss experience suffered by insurance companies with the result that their rates are now higher and the amount of insurance they are willing to underwrite is reduced.

Some airlines and aircraft manufacturers find they cannot buy all the insurance they otherwise might feel it prudent to have and the danger is always present that the insurers may decline to assume further risks and even cancel policies which are already in force. This can leave a company without any insurance. If this is the case when a major tragedy occurs, bankruptcy is a likely prospect. Thus, the successful litigant would be unable to collect his judgment and employees and stockholders of the bankrupt firm would suffer untold losses.

Our present system places the traveling public, the airlines, the manufacturers, and their respective insurance companies in economic jeopardy. It subjects all parties, including the government, to endless litigation and it endangers the very economic structure of our transportation system itself.

The expanding use of our airways and the rapid development of faster and larger aircraft requires that both the public and our national interests must be adequately protected through prompt action at the federal level. Within months some of the new, larger aircraft will be placed in operation. There is an urgent need to deal with the whole area of problems arising from aircraft accidents in a fashion which will assure an expeditious remedy to those who suffer their consequences, as well as to foster a healthy commercial air transportation industry in this country.

AIA

aerospace

Official Publication of the
Aerospace Industries Association of America, Inc.

PRESIDENT • Karl G. Harr, Jr.
SENIOR VICE PRESIDENT • V. J. Adduci
DIRECTOR OF PUBLIC AFFAIRS • Carlyle H. Jones

VOL. 7, NO. 2 *SPRING-SUMMER 1969*

EDITOR • Gerald J. McAllister
ASSOCIATE EDITOR • Richard W. Balentine
ECONOMIST • Gerson N. Chanowitz
ART DIRECTOR • James J. Fisher

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 civil aviation as a prime factor in domestic and international travel and trade;

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

AEROSPACE is published 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

Western Office: McCulloch Building, 6151 West Century Blvd., Los Angeles, Calif. 90045

The United States SST

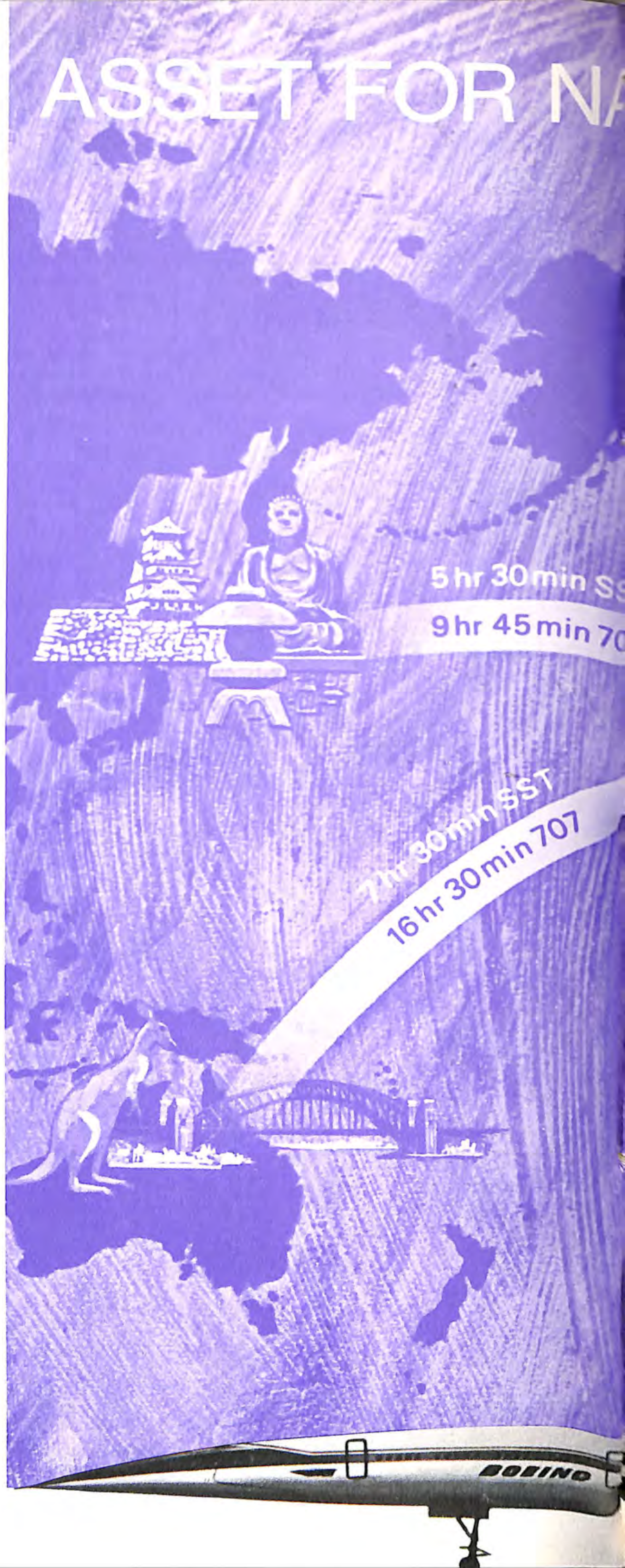
By KARL G. HARR, JR.
President, Aerospace Industries Association

A distinctive U. S. capability is in broad technological advances, and the application of those advances to commercial products. In the world of aviation the supersonic transport (SST) is a prime example of how meaningful public benefits can accrue from the logical progression of aerospace technology.

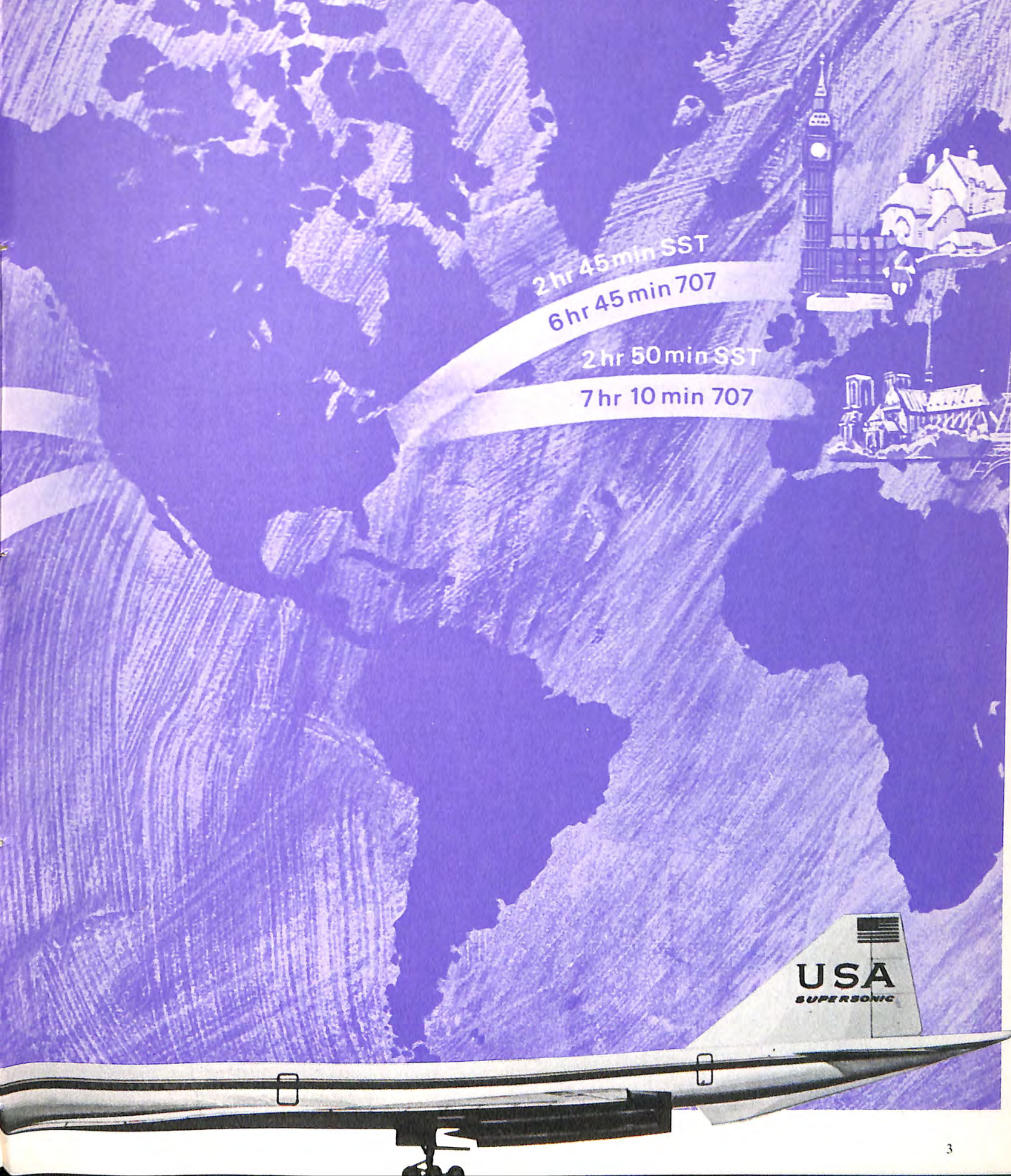
As the SST emerges on the scene, the U. S. holds a dominant position in the manufacture of commercial transport aircraft. However, its leadership in transport development is now being strongly challenged by Britain, France, and Russia which have their supersonic transports in the flight test stage. The Russians have announced that their TU-144 SST is in production; sales have been made to foreign customers and operational flight is scheduled in 1971. The prospects for the U. S. future in aviation depend to a very large degree on responding to this competitive challenge. Inasmuch as the commercial aircraft industry and its supporting industries have become major factors in our economy, both domestic and international considerations are involved.

Today there is general agreement that the level of commercial airline traffic will increase by approximately six-fold between 1968 and 1990. This is a startling forecast of future demand. Sophisticated innovations such as the SST are destined to serve such growth.

Looking ahead to the late 1970s and 1980s we visualize a world with increased population, increased average incomes, increased leisure time, increased international interests, increased business pace. Contemplating these projections of existing trends, the logic of the SST in the decades now imminent is clear. Because of its time-saving advantages, it will fill a key portion of the much-enlarged air traffic requirement — the long-range flights where its speed promises the greatest advantage.



TIONAL PROGRESS



Air conditioned cabin of the U. S. SST will remain at a comfortable 75 degrees with a cabin pressure equivalent to that found at 6,400 feet. Outside, aerodynamic heating will raise the exterior skin temperature to 450 degrees Fahrenheit.

Not only will an American SST be an aircraft suited to, in fact demanded by its time, but it will bring important economic benefits to the nation.

For example, aircraft exports have been and continue to be a significant and favorable influence in the U. S. balance of trade. The U. S. supersonic transport design is in a position now to obtain at least $20 billion of the $25 billion world market through the sale of an estimated 500 SSTs in the 1970s and 1980s, 270 of them to foreign airlines.

Domestically, one of the most attractive contributions of the SST program is in the area of employment. Development and long-term production of an SST within this country will sustain an estimated average employment level of 50,000 among the prime airframe and engine manufacturers and the first level of subcontractors.

Supplementing this basic level of effort will be additional employment in practically every state in the Union among the countless number of subcontracting industries, the manufacturers of ground support equipment and ground installation facilities and the host of basic industries such as metals, plastics, petroleum, glass, chemical and many others. This supplemental labor force is expected to maintain an annual rate in excess of one hundred thousand. The combined and cumulative income derived by such a direct and supporting labor force in more than 6,000 companies may well exceed $33 billion in 1990.

There are many ways of creating jobs but in doing so the interests of the nation are best served when projects are evaluated on the quality as well as quantity of jobs provided, their effect on the population and the overall economics of the nation. The SST program meets all these criteria. Jobs in the supersonic program not only contribute to the maintenance of favorable balances of trade in foreign competition but they also result in the achievement of higher education and skill levels which add to the economic health and wealth of our society. Out of the economic dynamics of an investment in the SST will come help to finance the large domestic needs for social betterment.

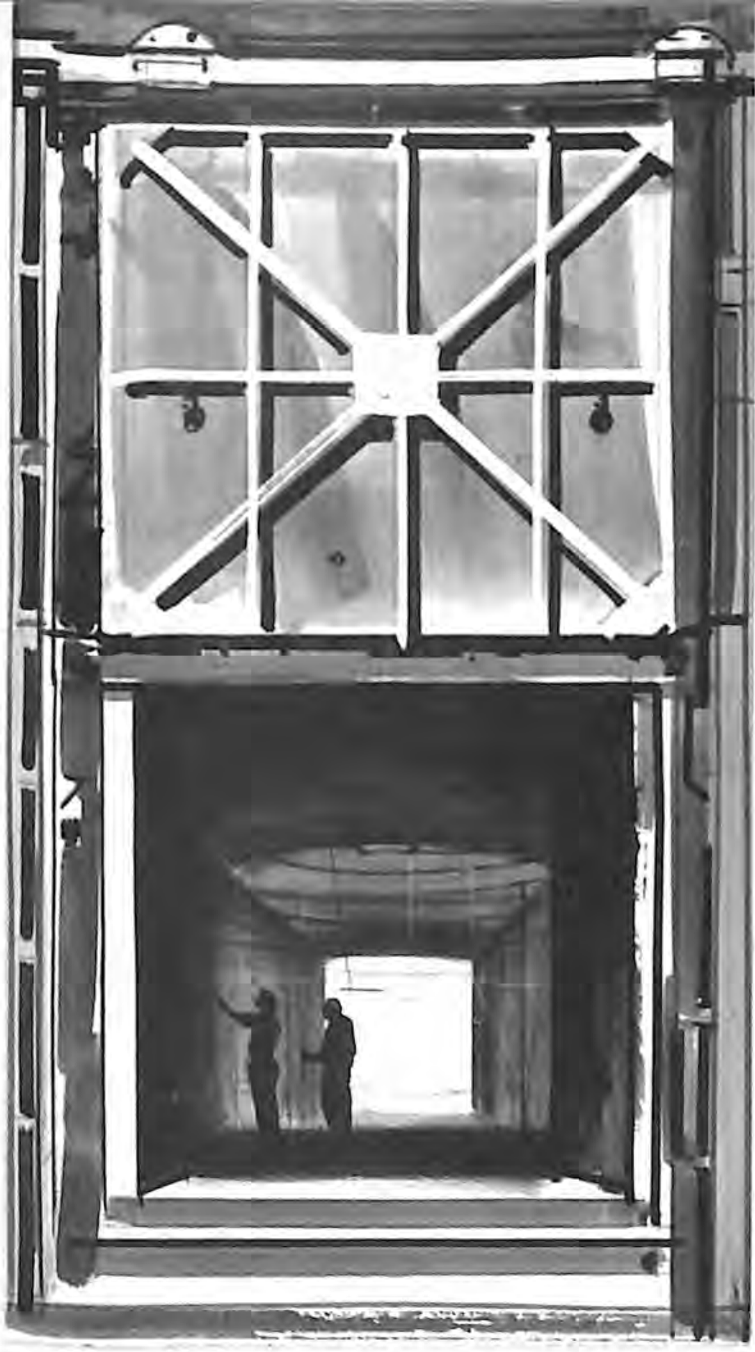
Further, the SST development embodies four areas in which major improvements can be expected from the advanced aviation technology required.

The first is speed. In the commercial context, an improvement in speed means sustained cruising speed over long ranges as opposed to maximum bursts of short duration. Milestones in aviation history have often been marked by remarkable increases in speed attained. Presently the entire free-world fleet of subsonic jet transports is operating at its most efficient cruise speed just below the speed of sound. It is clear that the next major step will be to attain supersonic speeds over commercially required ranges. Supersonic speeds are being achieved in many military applications, but not for sustained long distance flight or for long service life. The SST will bring this latter capability to commercial air operations.

The second area is that of materials and the development of new materials. The rate of progress in aviation is dependent upon the development of satisfactory materials with the proper aerodynamic and structural weight efficiency and manufacturing properties. Specific requirements are dictated by increasing speeds, ranges and sizes of airplanes while obtaining decreasing costs per unit of transport capability.

The innovative nature of aircraft developers and their high volume requirements stimulate the development of the entire materials industry and support installation of large capacity extraction and processing facilities. In accomplishing a supersonic speed regime another major materials development appears to be on the immediate

Production of the supersonic transport will generate hundreds of thousands of jobs at all levels across the nation as program dollars are spent and re-spent throughout the economy.



This furnace is capable of stress relieving parts up to 70 feet long at temperatures up to 1,500 degrees. It is installed at Boeing's new titanium fabrication facility. A much more efficient structural material, titanium permits higher speeds than would aluminum because of its high temperature properties. Higher speed allows the airplane to be more productive in terms of seat miles per day and when the speed exceeds Mach 1, operating costs go down.

horizon. Inasmuch as supersonic speeds generate large amounts of frictional heat, materials of all kinds are being developed to function in this heat environment. If the past is a guide, these developments will have wide application beyond aviation.

The third element ready for major advancement is the instrument and flight control systems' contribution to the safety and reliability of the airplane. It has been a long step in terms of technology from the early days when the pilot flew by simple air speed and altimeter indicators and had no communication with the ground, to today's cockpit environment with banks of specialized instruments and electronic systems, as well as complete transcontinental contact with air traffic controllers and ground navigation facilities. The supersonic speed environment is causing a reexamination of the nature of the pilot's workload. This analysis is already beginning to result in new concepts of automatic flight management, navigation, air traffic control, landing and checkout systems which will increase safety, reliability and dispatch assurance. While the SST program has become the catalyst for accelerated effort in this area, it is highly significant that it coincides with the increasingly critical development needs resulting from today's troublesome air traffic congestion.

The need for larger and quieter power plants give rise to the fourth area of beneficial development. Progress in the aviation industry, particularly commercial service, is dependent upon the development of large, efficient power plants for both subsonic and supersonic aircraft.

Recently, significant progress has been made in quieting noise attributable to compressors and inlet configurations. However the suppression of jet exhaust noise still remains an area for further development, and it will probably require the greatest effort in the near future. A major technical effort on noise suppression is part of the SST program and the investment of effort on the SST engine will also have important spinoff applications to subsonic engines.

As it stands today, the U. S. SST program offers a very superior competitive position for the United States, even with its later implementation. A key reason is that the U. S. airplane is based on the technology of titanium as the structural metal as opposed to the use of aluminum in the European supersonic transports. Titanium is a much more efficient structural material, permitting higher speeds than would aluminum because of its high temperature properties. This is a double-barreled benefit. First, the achievement of higher speed allows the airplane to be more productive in terms of seat-miles per day. Secondly, past the speed of Mach 1, the efficiency increases with speed. In other words, operating costs go down.

Permitting speeds up to or beyond Mach 2.7, the use of titanium brings significant gains in the basic efficiency of the machine. The foreign airplanes, while they appear to be well conceived and well executed, are designed around the upper limit of aluminum technology. The U. S. SST program, using titanium as a structural metal, in effect establishes a new level of technology with room for growth in terms of speed and structural efficiency. Such future growth would further enhance the economic desirability of the SST.

The higher technological plateau established by the titanium SST, improved automatic flight control systems and improved power plants will provide direct and tangible benefits to future subsonic aircraft programs which are expected to have substantial growth concurrent with the expansion of supersonic flight. It will be difficult for foreign competition to achieve this higher plateau in either the supersonic or subsonic regimes in a timely manner.

The SST will become another extraordinary American product, making a long-time contribution to U. S. progress and the world economy, and providing the improved mobility required by our changing times.

It is imperative to national growth in its broadest sense that the U. S. move promptly and forcefully to carry forward a viable SST program.

AEROSPACE NOTES

Cessna Encourages Air Age Education in Schools

Cessna Aircraft is now making available to elementary, high school and college teachers a package of materials to help in establishing air age education programs in their classrooms.

Recently the elementary kits have been expanded to include charts explaining gas turbine engine principles and cloud structures to aid in meteorology study. A turbine engine chart included in the kit enables the teacher to present lessons about gas turbine powerplants and integrate jet engine concepts with other areas of science.

Cessna publishes "Cross Currents," a quarterly newsletter, which provides a comprehensive account of new books, materials, ideas and new workshop opportunities.

Other new programs include Programmed Assistance to Vocational Education which offers technical support for vocational schools, revised and updated teacher guides for high school and college courses and regular mailings of new materials to high schools.

Honeywell Markets New Digital Airliner Computer

Honeywell's Aerospace Division has designed a digital air data computer which can perform the complex, split-second calculations required to keep future airliners and military aircraft flying safely and efficiently.

Key to the computer is a solid-state pressure transducer capable of converting pressure inputs into frequency modulated digital outputs. Present analog systems require a more complex electro-mechanical mechanism to translate signals into digital language before being fed into the computer.

Honeywell believes digital systems provide a greater measure of efficiency and reliability. The system is the result of five years of study and development effort.

Currently the computer is programmed to provide control and instrument output signals for altitude, air speed and temperature functions. The system also incorporates a digital to analog converter in order to provide usable data to those instruments that presently require an analog signal input.

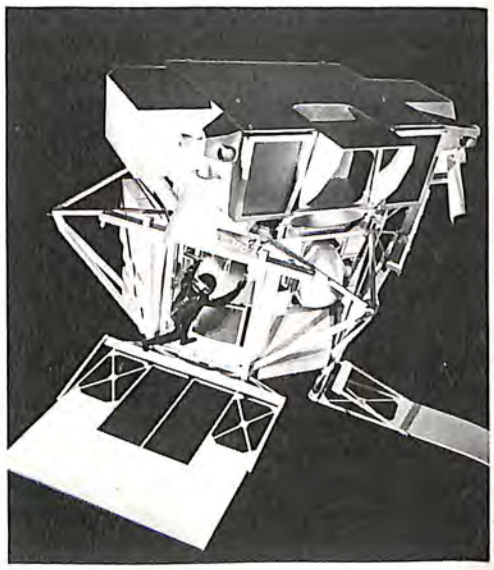
Heart of the solid-state transducer is a single crystal silicon diaphragm no bigger than a quarter. On the face of this silicon wafer are diffused two piezo-resistive elements that control two oscillators. The oscillators in turn produce frequency modulated outputs that can be fed to the computer.

NASA Operates Martin ATM Simulator at Marshall

Scientists and engineers developing the telescope system known as the Apollo Telescope Mount (ATM) are using a full-sized simulator representing a giant telescope assembly built by Martin Marietta. Installed at Marshall Space Flight Center, the simulator is being used to test design ideas.

The National Aeronautics and Space Administration plans to launch the ATM in 1972 into earth orbit of about 240 miles as part of the Apollo Applications Program. Crews will use the telescope and its special cameras to photograph solar storms which are evident across a wide portion of the light spectrum. Advantage of the orbiting telescope is to obtain a clear view of the sun unobstructed by earth's atmosphere.

The ATM will be operated by one or two astronauts from inside a pressurized compartment of a modified Lunar Module similar to one being used in the current Apollo manned moon landing program. The LM is attached permanently by an external web of metal trussing to the rear of the telescope assembly which consists of a cylindrical cannister 9½ feet long and almost 7 feet in diameter.



Boeing 747s Get Goodrich Inflated Evacuation Slides

Inflatable evacuation slides and ramps built by the B. F. Goodrich Company will be part of the Boeing 747 superjet's safety equipment.

The slides and ramps are stored in the plane's ten main entrance doors and adjacent to the crew service door. When required, each slide will be automatically deployed and inflated by the combined action of a cool-gas generator and ambient air aspirator. The automatic process for each slide is triggered by opening the particular door from the inside.

Besides providing a comfortable cushion for passengers, the inflatable slides can also be used as auxiliary flotation gear. They are made of lightweight, coated fabric, range in length from eight-foot ramps to a 38-foot single land slide used by the crew. Except for the two over-wing ramps, the slides are the longest used on any aircraft.

Compact Antenna 'Umbrellas' Into 30-foot Dish in Space

Goodyear space engineers have developed a compact metal communications antenna that "umbrellas" into a circular 30-foot antenna once in orbit. It is the largest dish-shaped antenna ever designed for an orbiting spacecraft.

Folded to about one-fourth its open size, the antenna fits inside the launch vehicle nose cone. It is being considered for the F and G flights of the Applications Technology Satellite (ATS) which are scheduled for the early 1970s to test advanced techniques and components for communications, meteorological and navigational satellites.

The dish-shaped reflector consists of a series of hinged petals framed with rigid, extremely lightweight Bondolite, an aluminum honeycomb sandwich material developed by Goodyear Aerospace. A wire mesh that is stretched over these frames forms the reflective surface.

Orbiting 22,500 miles from earth, the antenna will be used as a reflector off which radio signals can be bounced. This will make possible improved communications between earth stations and space vehicles, Goodyear engineers state.

Aerojet Activates Advanced Microcircuit Producer

A computerized Automatic Vacuum Deposition System capable of producing 10,000 thin-film microelectronic circuits in a single pumpdown sequence has been activated at Aerojet-General's Electronics Division. It is considered to be one of the most advanced facilities of its kind in existence.

Production quantities of microcircuits containing thin-film resistors, capacitors, interconnections, crossovers, distributed parameter filters, inductors, and passivating films can be deposited in this system in a single 12-to-16-hour pumpdown sequence.

Use of this system permits volume production of complex linear circuits which can be priced competitively with other methods of producing thin and thick film circuits.

It makes use of an ion-pumped, high-vacuum chamber containing four deposition stations each capable of handling eight electron beam gun source evaporation mechanisms. It also permits mounting 120 four by five inch substrates on a continuous belt, which is mounted over four mask carrier turntables, each capable of handling eight mask set combinations.

The ultra-high vacuum deposition equipment eliminates chemical interaction of evaporated source materials with residual gases in the vacuum system and permits rapid, precise registration of a succession of masks to any substrate during mechanism articulation with an accuracy of better than 0.0002 inch.

UTC Develops Miniature Ballistic Test Firing Range

To measure the aerodynamic drag of micron-size metal particles similar to those expelled through rocket nozzles using solid propellants, United Aircraft's United Technology Center has developed a miniature ballistic test firing range capable of accelerating and measuring the supersonic velocities of particles a hundred times smaller than a grain of sand.

UTC fires a single particle down the ballistic range with dead-eye accuracy at speeds approaching 1,000 miles per hour by accelerating it with up to 70,000 volts of electricity. During its flight it must travel through a series of chambers, passing from one chamber to another through an orifice no larger than 1/64 of an inch.

As the particle moves through the chambers, instruments record its size and deceleration. With this information, scientists correlate the relationship of the particle's size and velocity to the loss in performance.

Data obtained from repeated tests will enable propulsion experts to predict performance losses caused by the particles and to design more efficient rocket systems.

THE FINANCING CHALLENGE

AEROSPACE EXPORTS

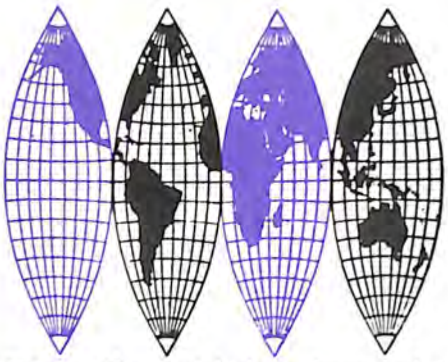
By ALFRED H. VON KLEMPERER
Senior Vice President
Morgan Guaranty Trust Company of New York

The present and future role of the commercial banks in financing the export of aerospace products must be considered within the general situation prevailing for export financing in the United States.

In looking at the problem in this broader context, it is clear that there has been no dearth of institutions, skills, and funds for such financing during the past few years. During most of that period, although somewhat less in recent months, American exporters have benefited from an unequalled mix of commercial bank and governmental facilities, combined with the competitive advantage of relatively low interest rates.

If there is some justified dissatisfaction among exporters, it is due to the fact that this massive support could not always be mobilized in an effective manner. Export financing has been hampered by a lack of coordination between the governmental and private sectors. It has also suffered from a rather persistent confusion in the policies and practices of governmental agencies which have not always been able to agree on and carry out a cohesive policy of aggressive export promotion and finance.

The U.S. Department of Commerce, and the government as a whole, have consistently championed a maximum expansion of export sales and finance for balance-of-payments reasons. On the other hand, the Federal Reserve System has serious doubts about the balance-of-payments effect of some export financing. It has included "without recourse" financing for U.S. exports



among the restrictions imposed on foreign lending by commercial banks. The Export-Import Bank has, in the past, been all too hesitant in adopting novel and bold techniques with which to match the promotional efforts of other government departments. The commercial banks, too, must carry some of the blame. They have been slow in adapting themselves to the novel requirements of "without recourse" export financing. They have felt that this activity involves them in risks and procedures which they had traditionally considered to be outside their competence and beyond prudent banking.

Despite these shortcomings, we as a nation have done a remarkable job in converting ourselves, since the advent of our balance-of-payments difficulties in the early 1950s, from a country where official export promotion did not exist to one where the financing of foreign sales is receiving vigorous support. Additionally, the institutional and psychological groundwork has been laid for considerable potential expansion during coming years.

Unfortunately, this progress is now being threatened by the recent appearance of two unfavorable factors that did not exist in past years. First, the rapid rise of interest rates in the United States has negated an important cost advantage which American exporters enjoyed in the past. U.S. interest rates are now higher than those of some of our principal competitor countries, and government subsidized rediscount facilities in some of these countries give additional advantages to their exporters. The second threat to export financing has been the growing shortage of funds in the U.S. money and capital markets. Neither of these developments are likely to be passing phenomena. They, together with the need for improving coordination of government policies, represent the principal task facing the new Administration in Washington in connection with export financing. A recognition by the banking community that export financing is a national necessity and should be pursued despite the unusual costs and difficulties involved, is the essential counterpart of this governmental effort.

The specific outlook for commercial bank financing of aerospace exports is very similar to the general situation outlined previously. The most important single question here is that of magnitude. It is particularly applicable to exports of civilian jet aircraft for which the very lowest estimates place the financing requirements over the next ten years at $13 billion. Smaller, but still sizable additional funds will be needed for other aerospace products, such as helicopters, small aircraft, related communications and airport equipment, and, importantly, military items.

These are huge needs by any standards. They compare to total outstanding commercial and industrial loans of the so-called "large U.S. commercial banks" of about $75 billion and to less than $10 billion of total foreign loans and investments of American banks subject to Federal Reserve controls.

The problem of potential demand as against available funds is an acute one and the most important question that has to be solved. The problem is complicated by the fact that many of these items are produced by a relatively small number of U.S. corporations which have equal or even heavier credit requirements for their domestic sales. On the buyers' side, too, there is a considerable concentration in a limited number of importers, principally foreign airlines and governmental agencies. This concentration presents potentially a special credit problem to the lenders and borrowers.

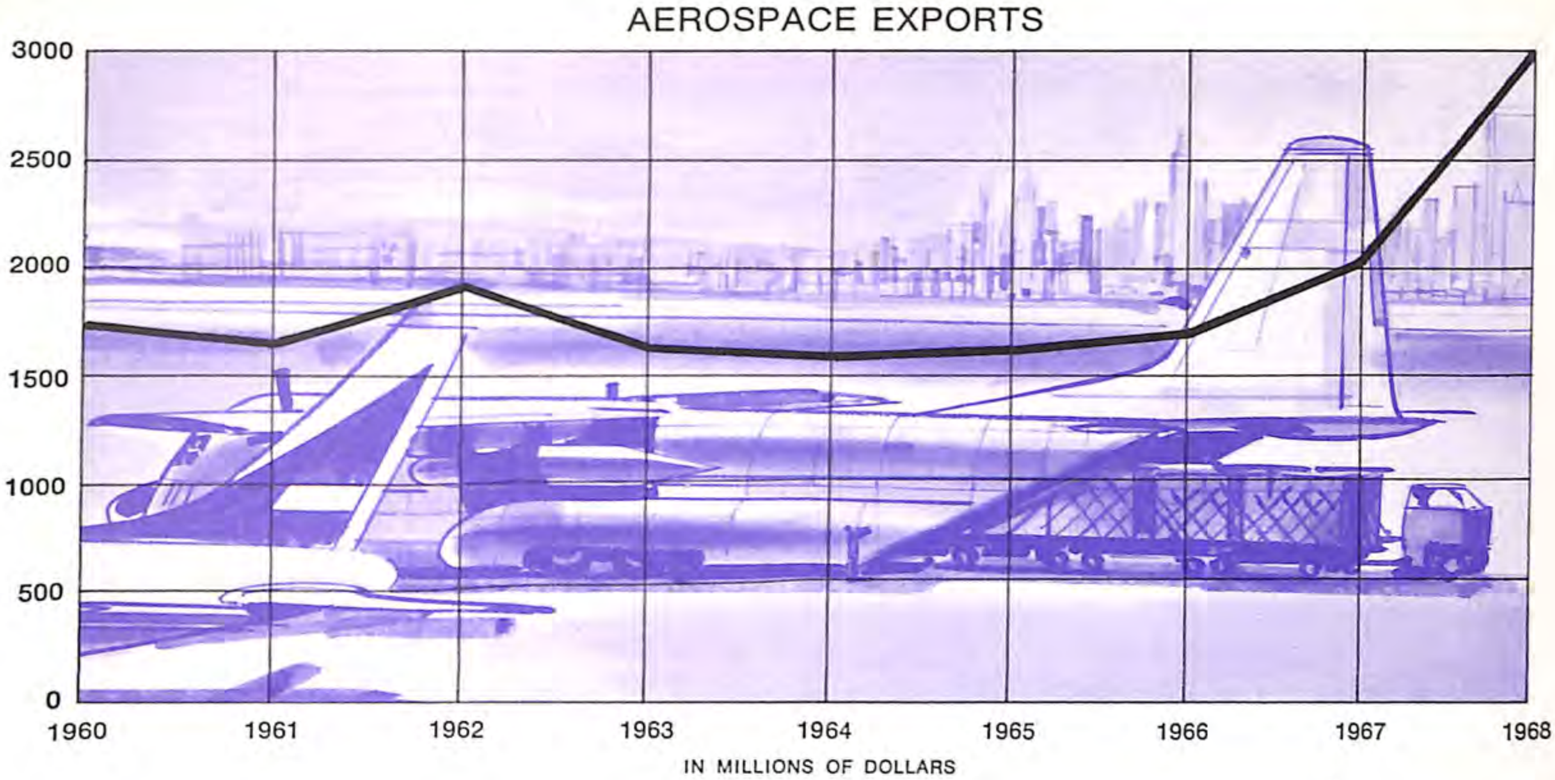
There is a further complication connected with balance-of-payments considerations. The credit terms which can be granted for loans carrying a full or partial guarantee of the U.S. Government — frequently an essential requirement — are a great deal shorter than the life expectancies or practical amortization schedules justified for modern aircraft. As a result, repayment terms for typical American loans for transport aircraft are too short for the financial capacity of some foreign buyers. This is an additional credit problem.

It is clear that the capacity of the commercial banks to provide all the funds for additional financing of aerospace exports is well below the projected demand, and that partial government guarantees are a prerequisite.

To solve the question of available funds, the banking system must tap the capital market for a sizable portion of the loans. Past efforts on their part to do joint export financing with insurance companies and other institutional investors have not been productive. First, these institutions too are subject to Federal Reserve restrictions on foreign loans; second, they are traditionally not geared to do export financing; third, they too suffer from a shortage of funds and, finally, the maturities involved in typical export financing of aerospace exports have in the past been too short to fit the lending pattern of non-bank lenders.

In a major effort to solve the problem of fund availability, about 50 American banks have banded together through the Bankers' Association for Foreign Trade in an effort to tap the long-term capital market for some of the required money.

They commissioned the investment banking house of Dillon Read & Co. which devised a plan under which a Private Export Finance Corporation (PEFCO) would be established. The banks would be the principal stockholders. They would sell to PEFCO the Export-Import Bank guaranteed portion of export loans. PEFCO



would assemble this paper in a number of bank-trusteed pools which would serve as collateral for the sale, in the public market, of a mixture of short- and long-term obligations of PEFCO. Success of this project is predicated on governmental cooperation.

Since the plan has been developed, extensive negotiations have been carried on with the various governmental agencies involved. With the appointment of a new president at the Export-Import Bank, negotiations have been resumed in an active way after some delays caused by the change in Administrations. It is hoped that a definite agreement can be reached between the various parties and that the commercial banks can proceed with this project and mobilize large sums for exports of aerospace and other items of capital equipment.

Additionally, Export-Import Bank will have to remain in the picture as a lender of last resort for transactions where the private sector is incapable of furnishing financing of any kind at reasonable cost.

PEFCO, however, cannot solve the problem of high interest rates because it will be dependent on market funds. In this area the United States must be mindful of the various schemes involving subsidized rediscount rates for export paper which exist in a number of our principal competitor countries.

Even in this country we have had some subsidized rates for many years, such as the interest rates on AID loans and the Export-Import Bank's lending rate on project loans which have been generally below those prevailing in the money and capital markets. Obviously this problem could theoretically be solved by financing all exports through these government agencies.

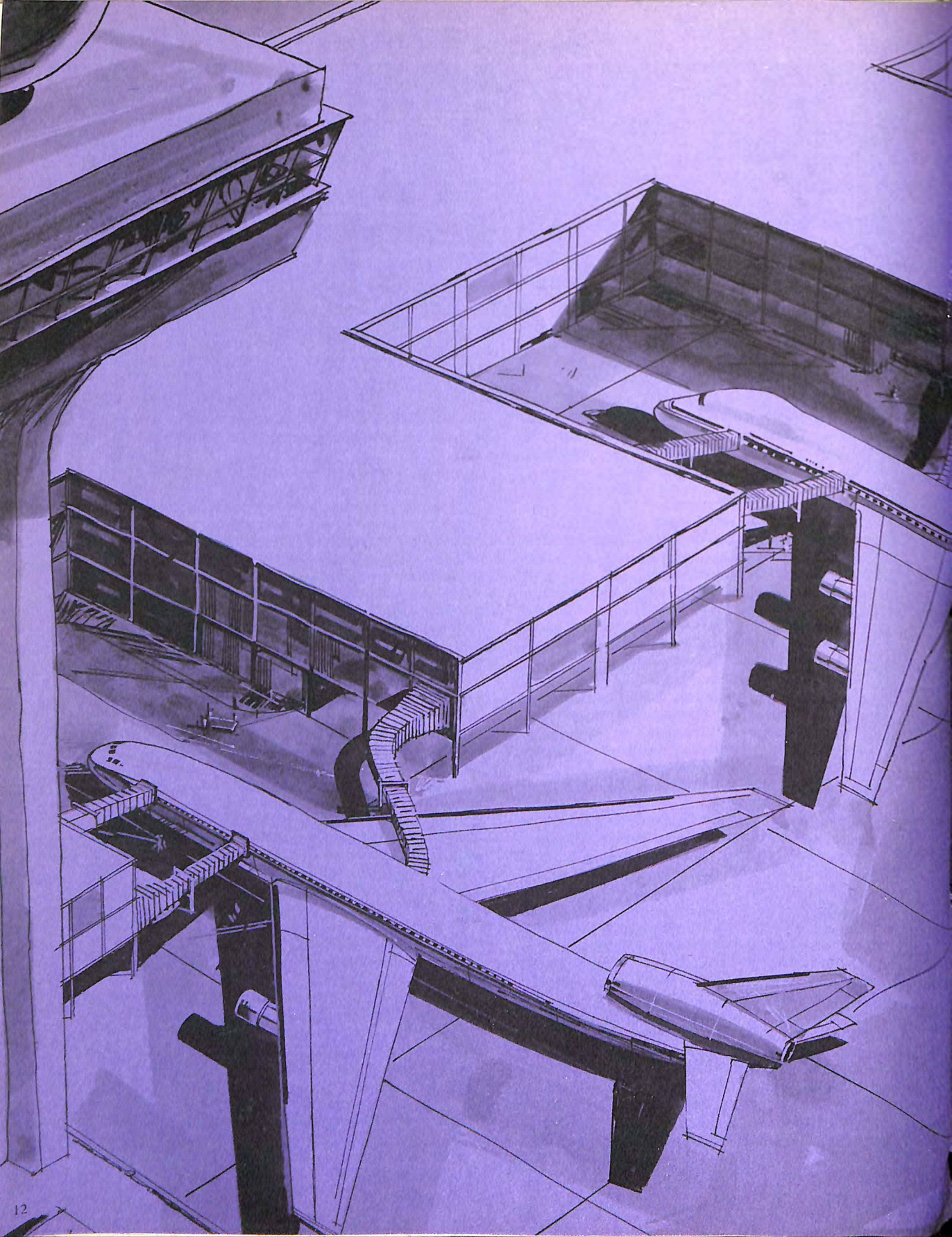
This would, however, be a self-defeating solution because of the unfavorable effects that Export-Import Bank loans have on the federal budget. Also, it would drive commercial banks out of the export business and would make it impossible for them to continue the extensive services which they are now rendering in connection with export promotion and financing all over the country.

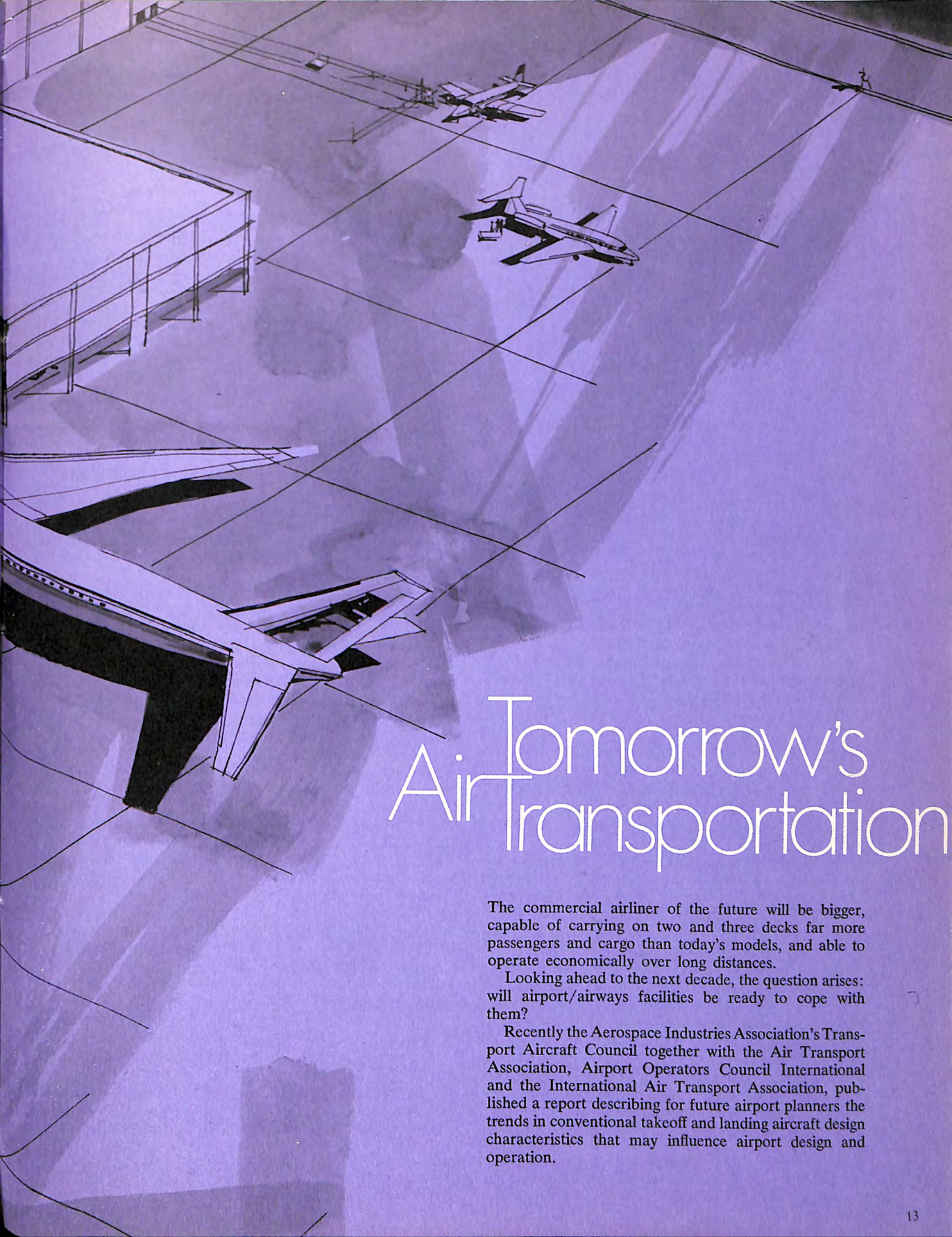
Somehow, the United States must now move toward a system through which the private market can rediscount at least a part of *essential* export loans at subsidized rates *to meet foreign government competition.* This could be done, as at present, through a broadening of the Export-Import Bank's rediscount facility. Some exporters and bankers claim that it should be handled through the Federal Reserve System as the only means of isolating export financing from price and fund availability problems. Starting down the road of subsidies is not a matter to be taken lightly. An effort should be made to discuss with other governments limitations on subsidies for interest costs, similar to the limitations on credit terms now attempted through the Berne Union. However, the outlook for success of these talks is not promising. Action is overdue and the United States must prepare its defensive measures now. The disappearance of our export surplus makes action on this front an essential balance-of-payments measure.

To summarize, there are three principal tasks which need to be taken if the commercial banking system is to play more than a nominal role in the financing needs of aerospace exports:

- The banks must mobilize funds in the capital market to complement their own resources;
- The guarantees and promotional facilities available from the government must be aggressively developed and administered;
- The question of competitive cost of money for export financing must be solved.

These three problems are of a nature where cooperation between the private and government sectors is essential. Neither of them can go it alone. All of these problems can be solved if this cooperation is achieved.





Tomorrow's Air Transportation

The commercial airliner of the future will be bigger, capable of carrying on two and three decks far more passengers and cargo than today's models, and able to operate economically over long distances.

Looking ahead to the next decade, the question arises: will airport/airways facilities be ready to cope with them?

Recently the Aerospace Industries Association's Transport Aircraft Council together with the Air Transport Association, Airport Operators Council International and the International Air Transport Association, published a report describing for future airport planners the trends in conventional takeoff and landing aircraft design characteristics that may influence airport design and operation.

Tomorrow's Air Transportation

"A challenge now exists in the air transportation industry to meet the demands of passenger and cargo growth projections through 1985," the report points out.

Revenue passenger-mile demand, which has more than doubled in the past ten years, is expected to more than triple during the next decade reflecting the tremendous increase in the number of passengers who will be travelling by that time. To assure meeting these demands, airport planners must be kept informed of the trends of new aircraft characteristics.

In an effort to meet this challenge sufficiently in advance to create a "relatively trouble-free environment" in the future, the report, entitled "Transport Aircraft Characteristics, Trends and Growth Projections," provides these following details.

More passengers travelling greater distances will require continued increase in aircraft size so that by 1980 the travelling public will be flying in aircraft with gross weights of one and one-half million pounds with the prospect that they may go as high as two million pounds by 1985 as compared to the 300,000 pound gross weight of present-day long range airliners.

Although size limitations will be influenced primarily by specific transportation requirements, operational economics and airport facilities, these greatly increased aircraft weights are within the capabilities of present-day technology. Similarly, planners of future underground airport facilities and overpass structures will have to take into consideration the greater weights of aircraft in accommodating their movement and parking.

Not only will transport aircraft be heavier but they will be longer, extending to 350 feet by 1985 compared to lengths of about 150 feet for present long range aircraft.

As aircraft are built larger they will probably become multi-deck to accommodate the additional passengers and cargo. By the end of the late 1970s, not only double but triple deck aircraft may be operating. This will necessitate new requirements for air terminal design and passenger handling. The Boeing 747, for example, will provide a seating capacity for up to approximately 500 economy class passengers with growth versions accommodating 600. The next generation jet transport, which may enter service in the late 1970s, is projected to provide seating for 800 to 1,000 passengers on two or three passenger decks.

As aircraft grow in size, wingspan and tail height are certain to follow. It is expected that the two-million pound airplane which should be operational in the mid-1980s, will have a tail height of 90 to 100 feet compared to the 34-foot tail of the Boeing 727-200. The wingspan of a one and one-half million pound transport of the late 1970s would be approximately 275 feet as compared to the 108 feet of the 727. This means that more turnaround room on airport aprons will be required as well as adequate parking space on ramps outside air terminals.

The amount of air freight handled by U. S. airlines has increased at a much greater rate than passenger demand since the introduction of the jet transport. Within the next 12 years, air freight is expected to increase by a factor of ten. Total ton-miles of air freight carried per year will equal and exceed that for passenger payload sometime prior to 1980.

Single-deck aircraft appear to satisfy all requirements for cargo configurations up to approximately 275,000 pounds of payload. Double-deck arrangements are expected to be adequate for payloads to one million pounds. If the air freight market continues to increase as is projected, it can be expected that multi-deck freighters will enter service in the late 1970s.

The single-deck freighter now in operation, such as the Boeing 707-320CF and the Douglas DC-8-63F, are converted versions of basic passenger aircraft and have a payload capability in the 100,000 pound range. The cargo handling systems and airplane turnaround requirements are within existing airport capabilities.

However, the next generation freighter will be specifically designed to operate profitably with 200,000 to 400,000 pounds of payload over ranges of 2,000 to 4,000 nautical miles. Advances will be required in cargo handling operations to reduce turnaround time of the aircraft on the ground in order to increase aircraft utilization.

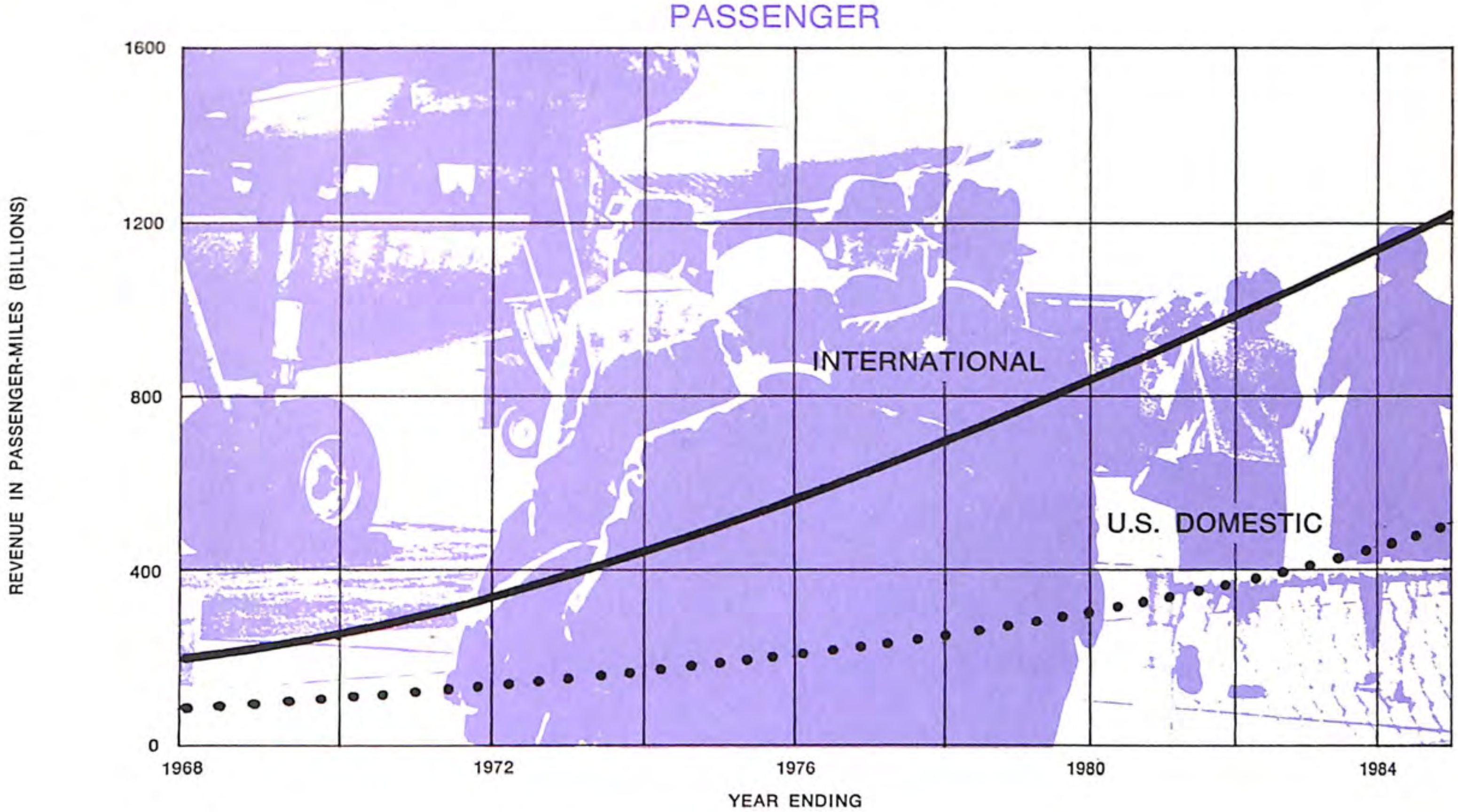
"Design innovations and new concepts are not fixed," the report observes. "They will be developed as the cargo/passenger market continues to mature and grow; therefore, the data presented in the report is subject to change and will be revised as required."

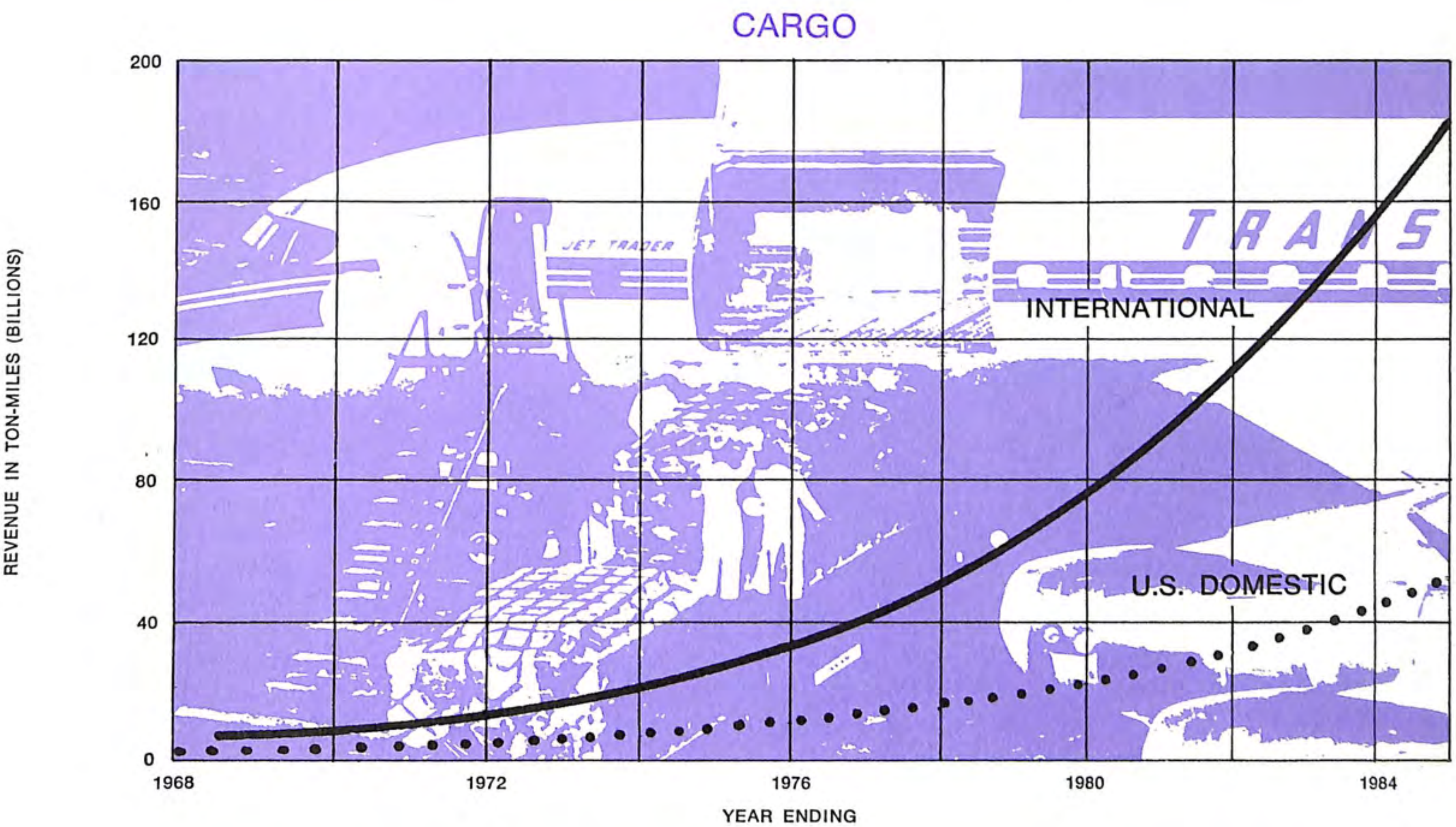
The general aviation industry, too, is obviously concerned about adequate airport facilities to handle its burgeoning growth. General aviation's fleet, which jumped from 58,790 in 1955 to 122,200 active aircraft in 1967, is expected to increase to 260,000 in 1980, or 112.8 percent higher within the next 11 years.

General aviation carried 100 million passengers in 1967, 50 percent of all passengers who traveled by air that year. By 1980 this number is expected to increase to 317 million.

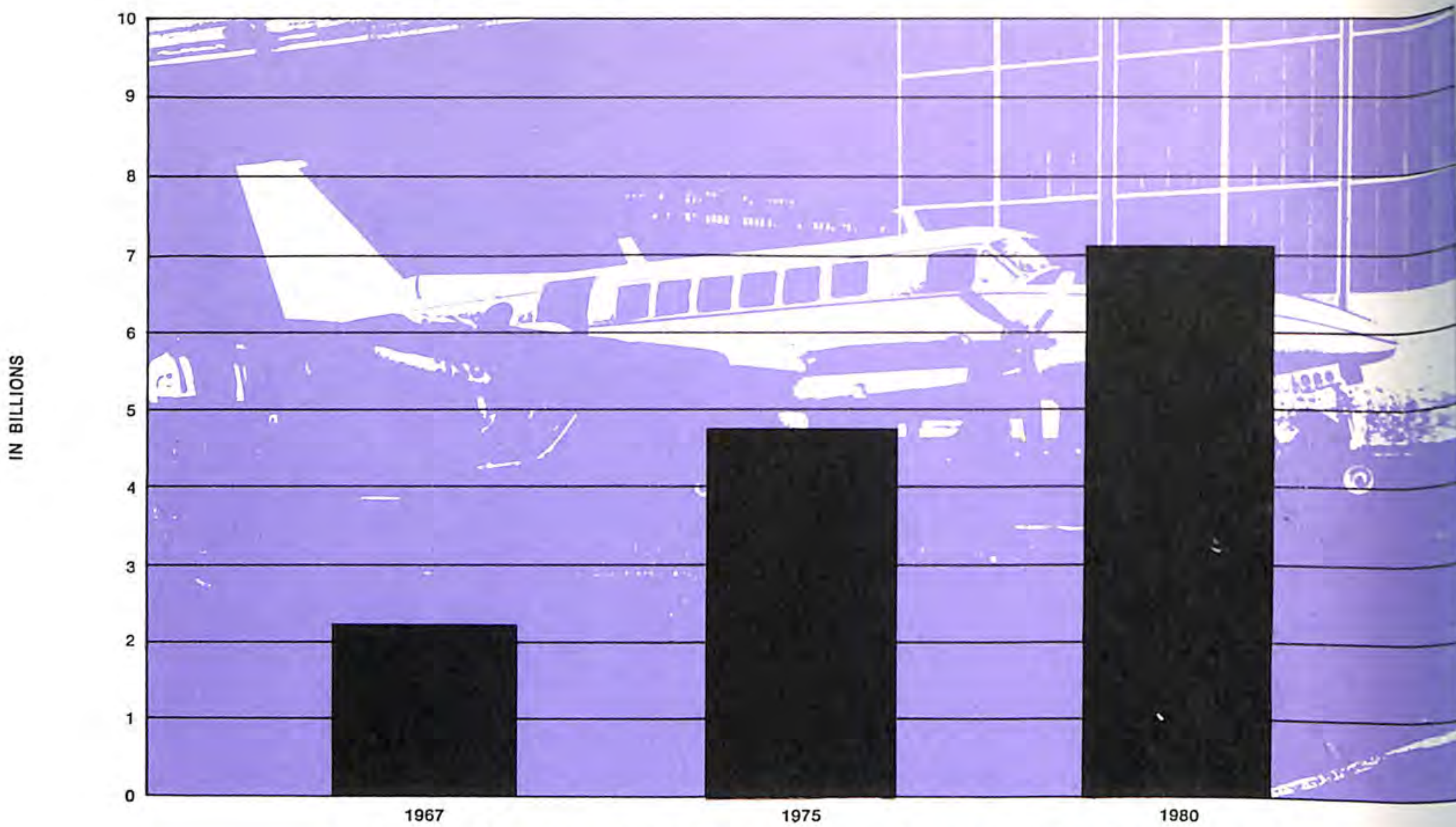
Recently, the Utility Airplane Council of the AIA commissioned R. Dixon Speas Associates, a consulting firm, to make a detailed study of the impact of general

TYPICAL PASSENGER/CARGO GROWTH FORECAST





ECONOMIC IMPACT OF GENERAL AVIATION



Included in the direct economic impact of general aviation are new aircraft sales, used aircraft transactions, operating costs, pilots' wages and administrative expenses, manufacturers' investment, government expenses and other factors.

aviation activity through 1980. The study, entitled "The Magnitude and Economic Impact of General Aviation," reveals the following information:

"The explosive growth of air travel in the past decade, the acceptance of the general aviation aircraft for extensive business use at and away from hub airports and the availability of aircraft with greatly increased utility have created a need for more complete data to be used in planning the airways/airports system," the report states.

The study adds that the "UAC has long believed that the air traffic control system and the related airport facilities must at all times be adequate to insure that the continuing growth of all forms of air transportation will be encouraged and unconstrained so that the public will gain the full benefit of the entire air transportation system."

Highest rate of growth in general aviation in the next 11 years is expected to occur in turbine-powered aircraft where a 631.9 percent gain is forecast — from 1,585 in 1967 to 11,600 in 1980 — owing to the increased acceptance of turbine power in corporate aircraft and the rapidly growing third level scheduled airlines. However, piston-powered aircraft will dominate the general aircraft fleet for many years to come.

Utilization per aircraft is expected to increase from an average 198 hours per year in 1967 to 244 hours in 1980. The turbine-powered fleet will continue to experience a particularly higher utilization "because of the high initial cost and high performance capabilities which tends to force higher utilization and subsequently the production of more total flight hours than small and less advanced equipment," says the report.

Speas forecasts that the local and itinerant movement of general aviation aircraft within the U. S. can be expected to nearly double in the next decade jumping from an estimated 121 million movements in 1970 to more than 237 million in 1980.

Geographical distribution of the U. S. general aviation fleet spreads from Los Angeles where the largest number, 4,596 in 1967, is expected to grow by 130.6 percent to 10,600 in 1980, to Washington which is expected to more than double from 2,040 in 1970 to 5,200 aircraft by 1980.

Importance of the general aviation industry to the national economy is clear when you consider that in 1967 general aviation activities accounted for $2.2 billion of the total U. S. Gross National Product. By 1980 this figure is forecast to reach $7.1 billion, an increase of 222.7 percent. Aircraft production alone is expected to jump from $668 million in 1967 to $2.3 billion by 1980, according to the Dixon Speas study.

There can be no doubt that a considerably expanded unconstrained airways/airports system will be necessary in the decade ahead to accomodate the forecast volume of traffic.

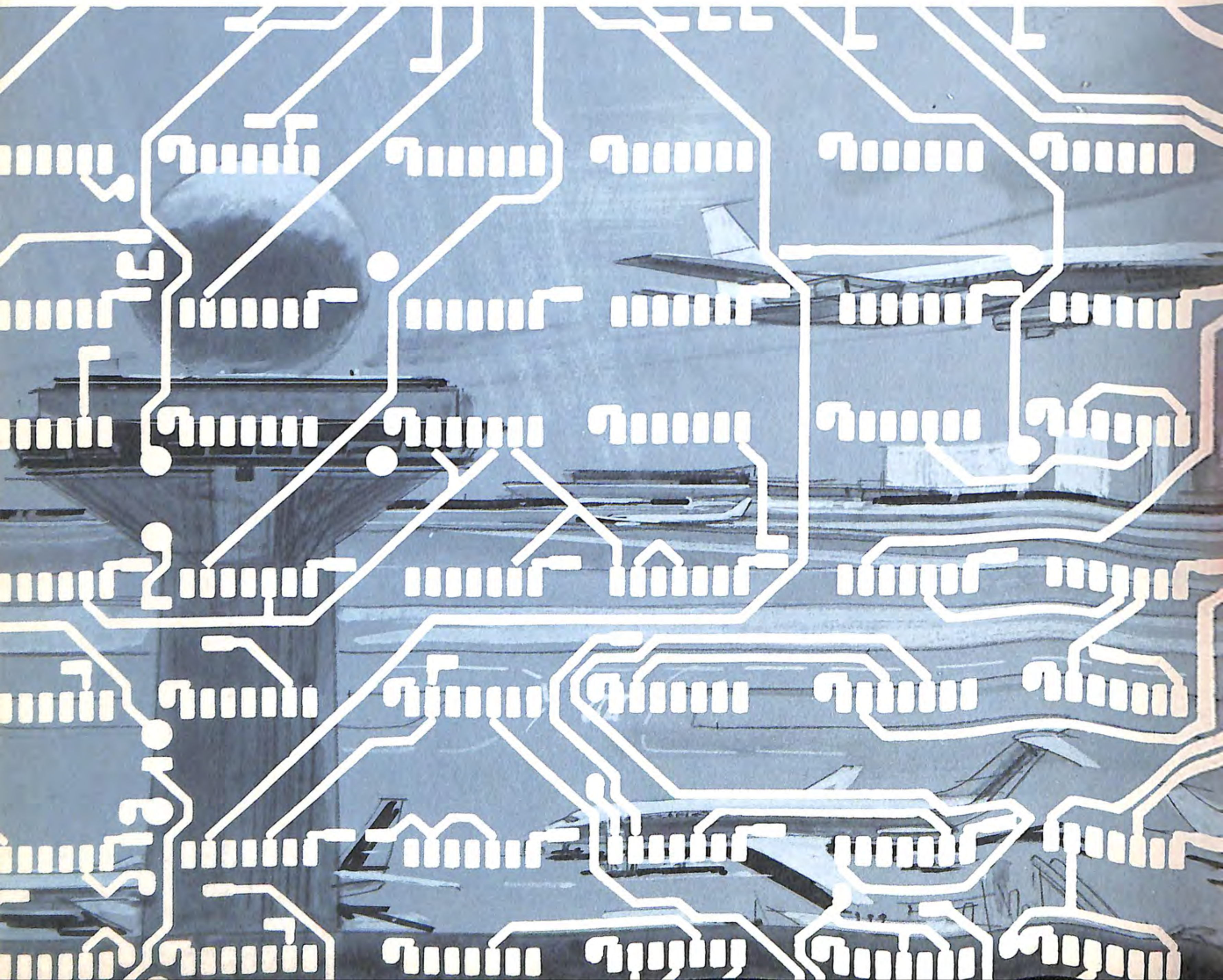
AIA MANUFACTURING MEMBERS

Abex Corporation
Aerodex, Inc.
Aerojet-General Corporation
Aeronca, Inc.
Aeronutronic Division, Philco-Ford Corporation
Amphenol Connector Division
  The Bunker-Ramo Corp.
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
Curtiss-Wright Corporation
Fairchild Hiller Corporation
The Garrett Corporation
General Dynamics Corporation
General Electric Company
  Defense Electronics Division
  Aircraft Engine Division
  Missile & Space Division
  Defense Programs Division
General Motors Corporation
  Allison Division
The B. F. Goodrich Company
Goodyear Aerospace Corporation
Grumman Aerospace Corporation
  A Subsidiary of Grumman Corporation
Gyrodyne Company of America, Inc.
Harvey Aluminum, Inc.
Hercules Incorporated
Honeywell Inc.
Hughes Aircraft Company
IBM Corporation
  Federal Systems Division
International Telephone and Telegraph Corporation
  Defense-Space Group
    ITT Aerospace/Optical Division
    ITT Avionics Division
    ITT Defense Communications Division
Kaiser Aerospace & Electronics Corporation
Kaman Corporation
Kollsman Instrument Corporation
Lear Jet Industries, Inc.
Lear Siegler, Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corporation
The Marquardt Company
Martin Marietta Corporation
McDonnell Douglas Corp.
Menasco Manufacturing Company
North American Rockwell Corporation
Northrop Corporation
Pacific Airmotive Corporation
Piper Aircraft Corporation
Pneumo Dynamics Corporation
RCA
  Defense Electronic Products
Rohr Corporation
Ryan Aeronautical Company
Singer-General Precision, Inc.
  A Subsidiary of the Singer Co.
Solar, Division of International
  Harvester Co.
Sperry Rand Corporation
  Sperry Gyroscope Division
  Sperry Systems Management Division
  Sperry Flight Systems Division
  Vickers Division
Sundstrand Aviation, Division of
  Sundstrand Corporation
Thiokol Chemical Corporation
TRW Inc.
Twin Industries Corp.
  Division of the Wheelabrator Corp.
United Aircraft Corporation
Universal Oil Products Company
Westinghouse Electric Corporation
  Aerospace Electrical Division
  Aerospace Division
  Astronuclear Laboratory
  Marine Division

AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W., Washington, D. C. 20036

RETURN REQUESTED

Requirement for an airport/airways program is a critical problem facing the aviation community (see *Tomorrow's Air Transportation*, page 12).



aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • FALL 1969

GOALS FOR AMERICA

AIA

aerospace

Official Publication of the
Aerospace Industries Association of America, Inc.

PRESIDENT • Karl G. Harr, Jr.
SENIOR VICE PRESIDENT • V. J. Adduci
DIRECTOR OF PUBLIC AFFAIRS • Carlyle H. Jones

VOL. 7, NO. 3 *FALL 1969*

EDITOR • Gerald J. McAllister
ASSOCIATE EDITOR • Richard W. Balentine
ECONOMIST • Gerson N. Chanowitz
ART DIRECTOR • James J. Fisher

CONTENTS

AEROSPACE is published 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

Western Office: McCulloch Building, 6151 West Century Blvd., Los Angeles, Calif. 90045

The aerospace industry is privileged to dedicate this issue of *Aerospace Magazine* to a discussion of "Goals for America" by those federal officials having primary responsibility for charting and directing our nation's domestic programs. The articles underscore the need for imagination and innovation in seeking solutions to today's and tomorrow's most pressing problems.

In view of the unique perspective provided by so distinguished a panel of authors, the Association and its members are sponsoring an expanded distribution of this issue.

Karl G. Harr, Jr.

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

Goals for America

BY SPIRO T. AGNEW
Vice President of the United States

'Revitalizing the instruments of government has consequently come to dominate all other goals.'

The ultimate goal for America is constant. While the philosophy and strategy may vary, the advancement of our people toward a just and abundant society remains the fundamental aspiration of all Administrations.

To understand this Administration's goals for America, it is first necessary to understand the pressures of our time. The America inherited by President Nixon was beset by war, inflation and an intangible spiritual malaise. Obviously, the first two problems contributed heavily to the latter. Yet overriding these precise grievances were misty doubts and frustration over government's inability to solve compelling problems.

Increasing crime and violence, increasing alienation among our young, and the apparent polarization of our people on the basis of race and income generated widespread disillusion. Our institutions were failing to reflect, preserve and impart our values.

Thus, it fell to the new Administration to move in three areas. A drive to achieve peace and combat inflation became immediate goals, for the pace of all domestic progress is hinged upon realizing these objectives.

The third goal is the restoration of the American citizens' confidence in the American system. This cannot be achieved by rhetoric. This cannot be bought by federal funds. This must be done by sweeping reform and realignment within the institution of government.

Revitalizing the instruments of government has consequently come to dominate all other goals. The major domestic targets — the problems of the cities and the poor — are in a sense tactical problems. Their solution depends upon innovation and improvement of government services. The adjustment of the machinery of government in response to the pressure of the time is the Nixon strategy.

Three major themes are manifest throughout all actions. First, there is an increased emphasis on the individual — his rights and responsibilities, his opportunity and equity. Second, there is an insistence on restoring all possible power to state and local governments. Third, is a commitment to the planning and organization necessary to reach the roots of a problem, to eliminate the cause rather than treat the symptom. Just as the three goals reflect the pressures of the times, these three themes woven into all programs also reflect President Nixon's philosophy — essentially centrist and pragmatic.

New executive instruments — the Urban Affairs Council, the Environmental Quality Council, the Office of Intergovernmental Relations — have been established to secure the comprehensive vision necessary to attain national goals.

Reform can be found in the streamlining of the federal field services, reorganization in the Department of Labor, and the proposal to reorganize the Post Office and to eliminate the archaic patronage system.

In addition, the Administration has proposed legislation for tax reform and tax relief, to revise the Selective Service System, and to redesign the Office of Economic Opportunity.

Overshadowing all these are the President's proposals to establish a family assistance program and initiate revenue sharing with the States. The new approach to welfare is the umbrella to achieve many goals. It asserts that every able-bodied citizen should be self-supporting and have the opportunity to earn a decent wage. By its broadened provision for day care centers it opens opportunities for the very young — presently the victims of the welfare cycle. It provides equity for the working poor. This is certainly the most dynamic step in humanizing government of the post-depression era.

Revenue sharing too, represents a whole new direction. After four decades of increasing centralization, a move is being made to restore the intended balance to the federal system. It is an affirmation of confidence in state and local governments and a recognition that their potential to respond to and serve their citizens is indeed greater than Washington's.

The Administration's specific goals will be discussed fully in the following pages. But all goals are approached from one premise: the Nixon goals are not to solve all problems from Washington, but to put before the people and those in government closest to the people the resources necessary to solve their problems for themselves.

The American people will only be confident in the American system when they can see with certainty that they are, in fact, in command.

Agriculture Goals

By CLIFFORD M. HARDIN
Secretary of Agriculture

'One of our urgent needs is to make rural America more attractive economically, culturally, and socially.'

Although people on farms now number less than 5 percent of U. S. population — compared with 15 percent in 1950 and 35 percent in 1910 — their contribution to the American economy is as important as it ever was.

Agriculture is the nation's biggest single industry. It employs more people than the utilities, transportation, and the steel and auto industries combined.

Agriculture is a $50 billion customer in the American economy. Farmers annually buy tractors, other motor vehicles, machinery, and equipment containing 6.5 million tons of steel; more petroleum than any other single industry; and more electricity than all the people and industries in Chicago, Detroit, Boston, Baltimore, and Washington, D. C., combined.

Agriculture is efficient. Farm output per man-hour over the past 15 years has increased at a compound rate of 5.3 percent per year — nearly double the rate of 2.7 percent for non-farm industry.

These facts indicate the importance of agriculture to the national economy and constitute the background against which we must consider our goals in agriculture.

Major goals are:

- To improve the economic position of agricultural producers.
- To devise programs that will more effectively balance agricultural production with needs.
- To wipe out poverty-caused malnutrition and raise nutrition levels for those Americans who now have inadequate diets.
- To improve the quality and safety of the nation's food supply.
- To conserve and improve America's natural resources and create a more wholesome natural environment.
- To expand opportunity throughout rural America.

Despite their ever-increasing efficiency and productivity, agricultural producers in general have not shared equitably in the Nation's economic progress. The average person on a U. S. farm in 1968 had less than three-fourths as much income as the average American non-farmer.

It is usually assumed that increased productivity and efficiency will bring commensurate economic rewards. But this has not always been the case for agriculture. Increased productivity has sometimes meant *less* net income.

Largely due to agriculture's rapidly rising efficiency, American consumers pay only about 17 percent of their disposable or after-taxes income for the world's most abundant, varied, and wholesome food supply — less than consumers have ever paid before in this or any other country of the world.

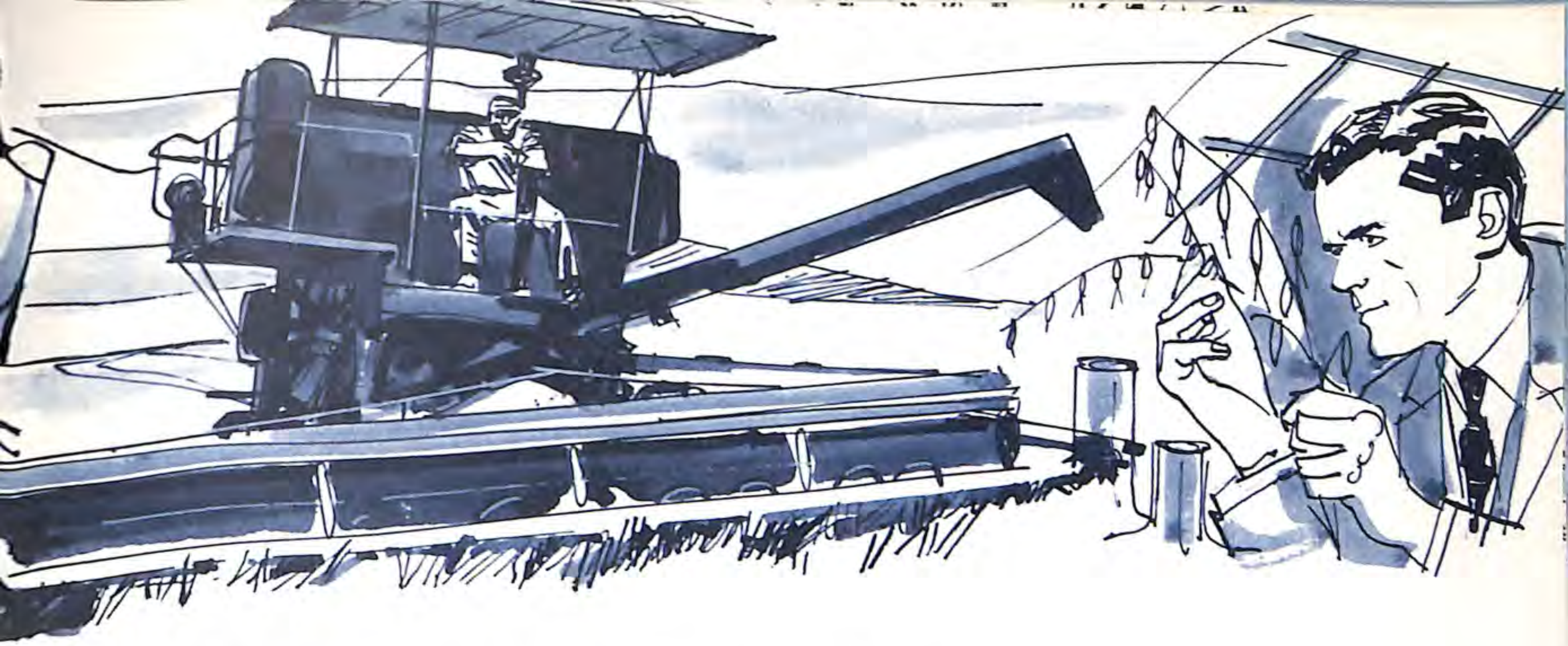
Moreover, most of the consumer "food dollar" goes for marketing and other services. Taking out distribution costs, "eating out" costs, and foods that the U. S. does not produce, such as coffee, tea, and bananas, farmers receive only about 5 percent of consumers' disposable income.

One of our foremost goals is to help assure American farmers the *opportunity* to earn from their labor and resources.

Agriculture's income problems stem largely from the fact that farmers, through new technology, have expanded their capacity to produce faster than markets have grown. Over the years, many programs have been legislated to help balance production with needs, and they have met with some success. However, no group of programs has proved fully satisfactory.

Working closely with agricultural leaders and with the Congress, we seek to develop new approaches that will be more nearly equitable, more effective, and therefore more acceptable to farmers and the general public alike.

One of our biggest responsibilities is to wipe out



poverty-caused malnutrition and improve nutritional standards nationwide. It is unthinkable that hunger, insufficient protein, and other nutritional deficiencies should stunt the physical and mental development of large numbers of our people, especially young children, in this land of abundance. Yet this is happening.

The initial focus of our attack on undernutrition naturally centers on the most serious aspects of the problem — severe hunger and malnutrition among the poor. Our goal is to overcome these problems as efficiently, effectively, and speedily as possible.

The principal instrument for this purpose is the Food Stamp Program. Since studies indicate that it costs on the average at least $100 per month to provide a nutritionally adequate diet for a family of four, we seek, through the Food Stamp Program, to provide food purchasing power at that general level for program participants. Accordingly, we are seeking a sharp expansion in this program.

Other food assistance activities, such as food donations to the needy and lunch and breakfast programs for children must be dovetailed into a truly comprehensive attack on undernutrition.

We are strongly committed to improving nutrition education, especially but not exclusively among low-income families, as well as expanding knowledge of how different foods affect health, vigor, and length of life.

To coördinate all these activities, we have established the Food and Nutrition Service as a separate agency within the Department. A White House Conference on Food and Nutrition scheduled for this fall will give further impetus to the national efforts to improve health and vigor through good nutrition.

Closely allied with the attack on malnutrition is another of our major responsibilities — assuring the American public a food supply that is not only abundant and reasonable in cost, but that is clean, wholesome, and properly labeled. The recently enacted meat and poultry inspection laws are important steps in this direction.

We are fully committed to assuring the American public that they are being provided with wholesome and properly labeled meat and poultry, whether shipped interstate or intrastate. We are no less committed to maintaining high standards for all agricultural products for which we are authorized to offer consumer protective services.

As America grows, demands on our national resources continue to multiply. If we are to have an expanded national economy, we must plan for an expanded resource base. Pure air, clean water, stable soils, productive land, abundant wildlife, natural beauty, and recreational opportunities are all interrelated and mutually supporting objectives.

Still another vital objective is to help rural America participate more fully in the nation's growth and development.

Since 1950 our national population has increased by more than 50 million, but the population of rural America has remained unchanged. All the 50 million additional people have been crowded into urban areas, many of them already overly congested.

U. S. population may increase by another 100 million by the end of the present century. If present trends persist, between 75 and 90 percent of that increase could be concentrated in cities. President Nixon has warned, "It *will* happen that way unless there is a change with regard to life in rural America."

Though rural America has little more than one-fourth of the nation's people, it has close to 40 percent of the nation's poverty, and nearly half of the nation's substandard housing.

One of our urgent needs, therefore, is to make rural America more attractive economically, culturally, and socially. This is vital to a healthy dispersal of population throughout the Nation.

These are some of our goals in agriculture. We seek, in President Nixon's words, "an efficient, flourishing agricultural economy keyed to opportunity and abundance, with family farm enterprise as its cornerstone." To strive for these goals is in the national interest. To achieve them will be to create a greater America for all our people.

Commerce Goals

BY MAURICE H. STANS
Secretary of Commerce

'We are dedicated to foster, serve and promote the nation's economic development and technological advancement — for we believe that in the American enterprise system lies mankind's greatest hope, strength and opportunity.'

In the closing days of this sometimes harsh and bitter decade, mankind has been privileged to witness the most remarkable feat in human history: the landing of men on the moon.

Fulfilling this dream of the ages not only cast a new brightness into the future, but it illuminated the fact that when men put their combined talents to a single test almost nothing is impossible.

The promise of new discoveries, magnificent triumphs and great adventures always lies ahead of us, if we commit ourselves to the effort needed to achieve them.

Success of the moon mission, as we have all been reminded, resulted from a declared national goal. With that goal now fulfilled, the time has come to take a look at where we go from here — not only in space, but in the challenging confines of our own world.

Certainly we want to spread the benefits of our space age science and technology to all segments of society. But beyond that it is time to review our capabilities and objectives in all areas of concern, to determine what might be done to refashion our world into a better, saner, healthier and still more prosperous place for ourselves and our children.

The setting of national goals is not to be done lightly, and few have the capacity to do so. Perhaps no single department or agency of government has in itself the capability of raising an ultimate standard of national achievement toward which all may strive.

Yet each segment of government, like each segment of the private sector, does have a capacity for inspiration, and for enormous input into national goals once established.

The U.S. Department of Commerce might be considered a case in point. Known basically for its concern with the nation's economic health, industrial progress and the expansion of trade at home and abroad, the Department nevertheless is one of the government's largest scientific operations. Its scientific services and achievements, which play a continuing role in the daily economic growth and development of the nation, have contributed greatly to fulfillment of the national goal in space.

For example, the Department of Commerce has the world's largest fleet of satellites in orbit around the earth, collecting data for accurate weather forecasts. Our weathermen also chart the weather for space lift-offs and landings, and forecast space storms.

Our Patent Office is the world's greatest repository of applied technology, with three and one-half million patents granted to the products of creative Americans, including those of rocketry and its allied sciences.

Our National Bureau of Standards, once concerned only with simple measurements of weight, length and physical quantity, helps make possible the accurate performance of the most delicate instruments within the Apollo space capsule.

Commerce's Coast and Geodetic Survey scientists, now taking measurements of the changing face of the earth, one day may be summoned to assist in surveying the surface of the moon.

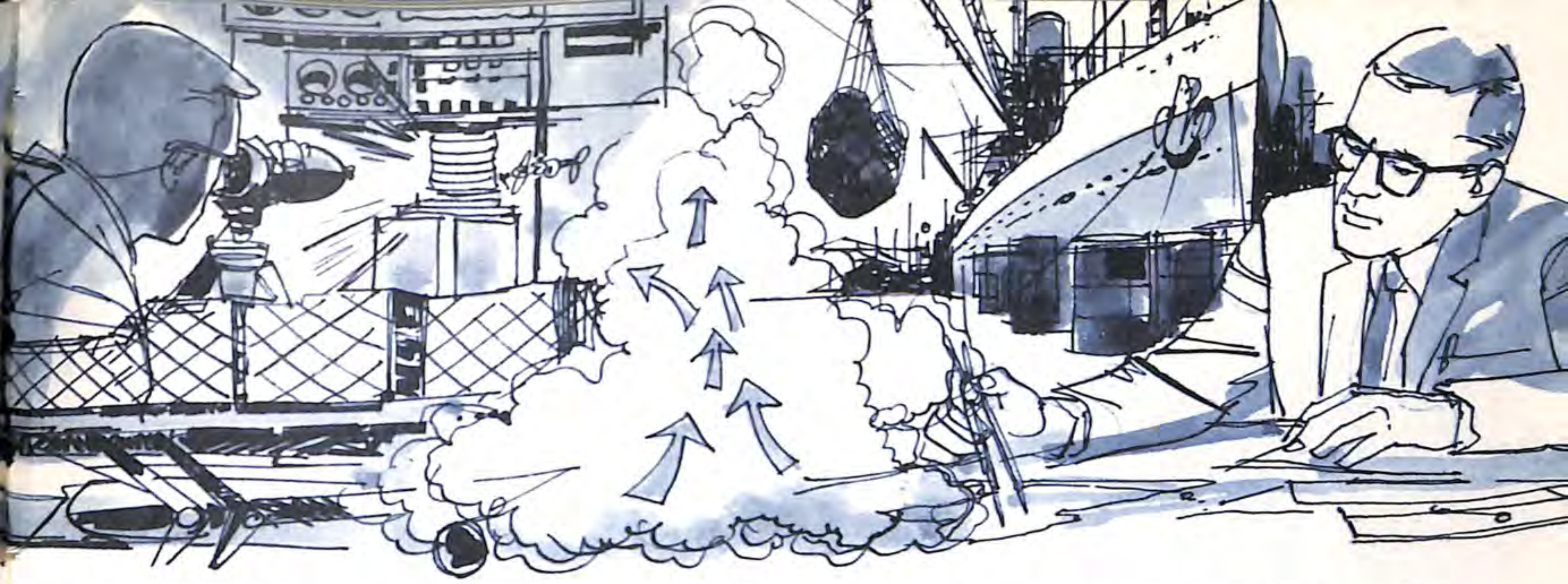
This is just a partial inventory of the services which the nation has used in scaling upward toward one national goal.

To help realize other goals yet unborn, Commerce — like other agencies of government — is shedding light in many surprising directions.

Through the resources of the Economic Development Administration, we help stimulate jobs for the unemployed and redevelopment of communities with persistent unemployment problems.

Through the newly-created Office of Minority Business Enterprise, we are developing a national strategy involving business, universities, government, foundations and others in a growing national effort to foster private business ownership among all minority groups of Americans.

Through a network of offices across the country and throughout the world, the Department of Commerce works to strengthen the international economic position



of the United States, contributing to the maximum growth of our free market economy and rebuilding a favorable balance in our international trade, for the benefit of every American.

Through our Maritime Administration, we are planning the first productive steps in two decades toward restoring the vigor of the long-neglected American merchant marine.

Through our Bureau of the Census, we seek, find and give the nation the information it needs for the development and progress of cities, counties, states, schools, housing, highways, minorities, manpower training, civil rights, and a host of other vital national interests.

Each of these efforts in its own limited way serves or represents a national goal. And no one can say to what specific future goal any or all of them may contribute. But we do know this:

The Department of Commerce — and indeed the government as a whole — is only one part of the creative partnership between the public and private sectors which must be brought to bear in reaching for any national goal.

For government cannot set goals alone; it can do so, with hope of success, only when it can rely on the productive strength and resources of the private sector. It cannot achieve them except as it is aided by the nation's business and industry, by its academic world and above all by the support of its private citizens.

National goals spring largely from problems, from needs or from inspiration and vision. They are fulfilled only by truly national dedication.

Recognizing that fact, if we at Commerce *could* prescribe a single goal worthy of such dedication, it would be this:

To achieve sustained maximum growth, without inflation, under conditions of full employment and equal opportunity.

The full resources of this Department already are committed to that goal.

We are dedicated to foster, serve and promote the nation's economic development and technological advancement — for we believe that in the American enterprise system lies mankind's greatest hope, strength and opportunity. The road of competitive freedom has led from the rutted paths of colonial America to the surface of the moon — and the world has watched in wonder at our achievements along the way.

A strong economy, vigorous new cities, a clean and healthy environment — all of these are interrelated, all are of primary concern to this Department, all are worthy of this nation's finest efforts.

Toward their achievement we are engaged in the following efforts:

- Promoting progressive business policies and growth throughout the country.
- Assisting states, communities and individuals toward economic progress.
- Assuring effective use and growth of the Nation's scientific and technical resources.
- Acquiring, analyzing and disseminating information concerning the Nation and the economy to help achieve increased social and economic benefit.
- Strengthening the international economic position of the United States.

As part of this final commitment, we have asked our friends, allies and trading partners around the world to join us in a common commitment to the Four Economic Freedoms — highways to progress across the borders:

Freedom to Travel
Freedom to Trade
Freedom to Invest
Freedom to Exchange Technology

In our time we have begun to see historic progress made toward realizing these freedoms for many of the countries of the world. Much effort remains to be made before they become realities.

But as they are achieved, gradually, our country will benefit, and so will others which share in the strength, the hope and the opportunities inherent in competitive enterprise.

Combining the talents of many to the single task of broadening American enterprise and developing it for the benefit of all — this is the goal of the Department of Commerce. We offer it as a goal worthy of the partnership between government and the private sector, and worthy of a free nation.

Health, Education, and Welfare Goals

BY ROBERT H. FINCH
Secretary of Health, Education, and Welfare

'We define our contribution not so much in terms of setting precise goals that all must accept, as of focusing concern and energies and resources.'

The dimensions of our concerns, and of the mandate for human services implicit in this Department's responsibilities, are literally without limit.

There is no cut-off point for desirable quality and breadth of educational opportunity — or for adequacy of health care — or for supportive assistance to the handicapped, the impoverished, the disadvantaged. And these *are* the dimensions of our concerns.

Indeed, it can be claimed that the mandate of the Department of Health, Education, and Welfare is to enhance the quality of life that potentially ought to be within the reach of every American — as a birthright.

Within this vast context, the first practical limitation is imposed by available resources — a second, by the outreach of any governmental effort — a third, by the independent vitality of our pluralistic institutions — and a fourth, by the diverse range of human innovation and imagination.

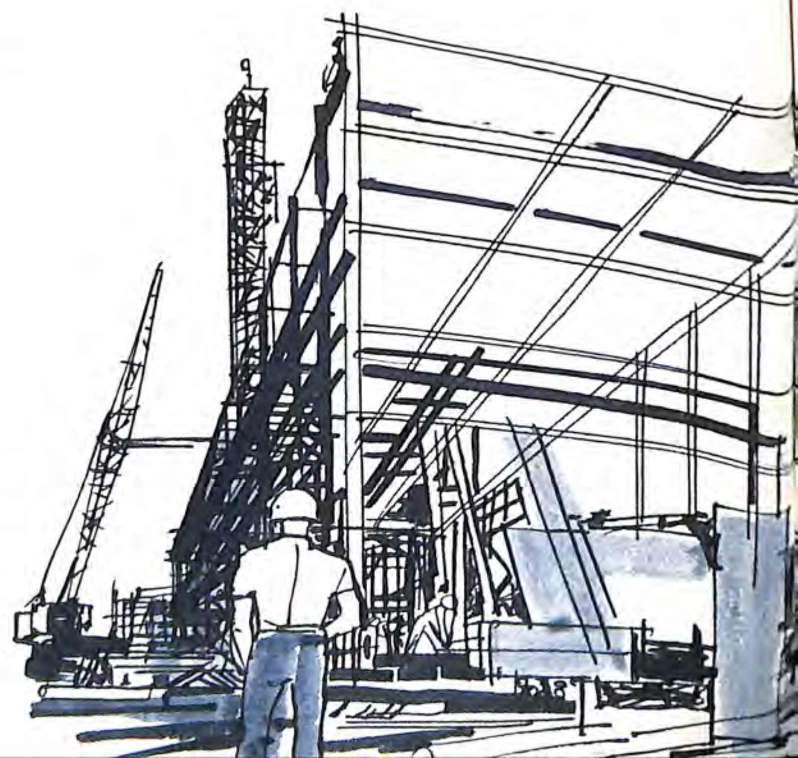
These are counsels of humility, not of despair.

Our immediate goals are thus addressed to maximizing the *impact* of every dollar we do spend (some $52 billion this year, compared with $2 billion when HEW was established just sixteen years ago), and to using the leverage of the nearly 300 programs we administer (up from 70 in 1954) to stimulate at every level of American society the *effective delivery* of human services. That is where imagination — innovation, experimentation, incentives — comes critically into play.

Our first discovery, upon assuming office in January, defined for us our first priority. We discovered that we could not measure the impact of effectiveness of our efforts, that we did not know what worked and what did not — or, indeed, whether the targets built into our ongoing programs were in fact being achieved. And so our first priority became the upgrading of the planning and evaluation function, in every area of the Department's responsibility.

It is a short and inevitable step from planning-and-evaluation as a *functional* component to the demonstration *program* — and these initial months have been spent in gearing up for major innovations, of which the following constitute a brief checklist:

- The *Office of Child Development* will attempt to package the full spectrum of services, both to the individual and to the family-unit, that address the first five years of life — the critical developmental years. Much of the impetus for this initiative was provided by Head Start. We plan to range outward from that focus into prenatal care, nutrition, family counseling, and the vital initial inputs into the teaching-learning process.



▪ The *Office of New Careers* represents an effort to concentrate all our manpower training resources for the development of para-professional aides and technicians, literally the extensions of scarce expertise in all the health professions, in teaching, and in rehabilitation skills. It represents, at the same time, an effort to broaden career opportunities for all those who lack the training to compete in this ever more sophisticated technological society.

▪ Our proposed revisions in the Hill-Burton program aim toward a retargeting of *hospital construction* subsidies, in the direction of early-care and extended-care facilities and away from acute-care facilities. Its focus increasingly would be on health-care in the inner city where the needs are greatest and the shortages most critical.

▪ We have in the planning stage programs for *experimental schools* and for strongly enhancing the development of two-year *community colleges*. Both would expand available educational options — by creating flexible new institutional models, new scope for curricular innovation, new emphasis on vocational opportunities, and needed new focus for total community involvement.

▪ We are stepping up experimentation with unconventional modes of propulsion, to hasten the development of motor vehicles that will serve the public convenience without abusing the human environment. This is but one test program, now under way. It signifies, however, a broad new thrust into a range of programs aimed at preserving — and recreating — a life-enhancing *human environment* for a burgeoning population.

▪ The first crucial step has at last been taken to turn the corner from a welfare-dependency system, a burden alike to clients and taxpayers, toward a job-oriented *family assistance program* that will benefit the working poor as well as the totally impoverished. It is keyed to job training and work incentives, and to the stability of the family unit. It is a first step, too, into what the President has termed the "new federalism."

These, then, are a few of the innovations we have put in motion. Contrasted with the endless proliferation of categorical programs of the last three decades, all have been planned as "open-ended" programs — whose ultimate success and impact will depend on the shared involvement of State and local agencies, and of the private and voluntary sectors of our society.

We define our contribution not so much in terms of setting precise goals that all must accept, as of focusing concern and energies and resources. We conceive our role as brokers of ideas and catalysts of experimental models. We intend to develop an expanded range of options in every area of our responsibility — and then to offer them as tested approaches, available for implementation by all the diverse components of our pluralistic society.

This, indeed, is the essence of the "new federalism."

And toward the same broad set of goals, we also must strive to put our own house in order. Within the Department of Health, Education, and Welfare, there is a new emphasis on interdisciplinary approaches to human problems — as in the area of child development, for example, there are no distinct boundaries between health and educational concerns, and neither can be wholly separated from the impacts of our welfare systems.

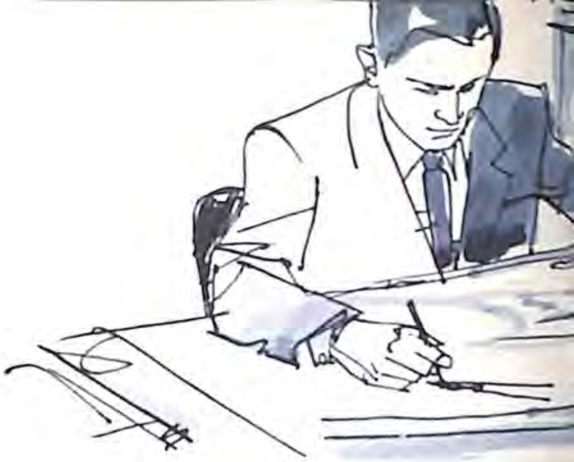
Within the federal government as a whole, the President has assigned the label "most urgent" to vehicles for effective coordination — to such domestic strategy boards as the Urban Affairs Council — and to the coordinated delivery of services in the field. One of his first Executive Orders created unified regional structures for five interrelated departments and agencies, HEW among them.

At the outset I noted that the overarching concerns of this Department are limitless — but that our available resources, our proper constitutional role, and our sheer human talents never can wholly encompass our potential responsibilities. Always there will remain a certain gap between challenges and capabilities.

We have set ourselves no less a goal, ultimately, than the bridging of that gap.

Housing Goals

BY GEORGE ROMNEY
Secretary of Housing and Urban Development



'Housing should be central to all our plans for remaking the urban environment to provide a better life for our people.'

In June, we launched Operation Breakthrough to develop a housing industry capable of meeting the nation's need for more than 2½ million units yearly at costs to match American incomes. This is essential if our great and growing housing need is to be satisfied.

More than 2½ million units is more housing than we ever before built in one year. In our largest production year, 1950, we achieved 1,970,000 housing starts. But the average in the last ten years, from 1959 through 1968, has been less than 1.5 million units per year.

Thus, housing production hovers around 1.5 million units, in contrast with 2.6 million which Congress determined we need annually to achieve the "goal of a decent home and a suitable living environment for every American family."

Congress enunciated the national housing goal in 1949. In 1968 Congress restated it and quantified it with the assertion that it could "be substantially achieved within the next decade by the construction or rehabilitation of twenty-six million housing units, six million of these for low and moderate income families."

Congress thus set a ten-year timetable for realizing the goal. The challenge to us all is how best to realize it; to translate into reality — not in the remote future, but in the years that lie immediately ahead — a goal which requires a volume of homebuilding greater than ever before reached; greater than the country has been tooled up to produce.

The stark fact is that we have been falling behind in homebuilding, instead of advancing to meet increasing needs. In the last three years, when we needed 5 million new units of non-farm housing to take care of the increased number of families, to offset losses from the housing supply, and to meet migration demands, we actually started less than 4 million. The result was a production deficit of more than one million housing units. And continuation of present production levels would mean an ever mounting deficit.

This Administration is convinced that to achieve domestic tranquility, our people must be decently housed and our cities made decent places to live. Moreover, sufficient and adequate housing at costs that low-income people can meet is the basic answer to slums. Decent housing must replace the shameful substandard units where nearly 6 million American families live — six million too many for a nation of unparalleled wealth and resources.

In fact, housing should be central to all our plans for remaking the urban environment to provide a better life for our people. Without better housing available to those who are not now adequately housed, the likelihood of making a lasting impact on other urban problems is greatly diminished.

A fresh, hard look at the facts of housing deficiency has led to the design of Operation Breakthrough and the plan to stimulate production of attractive, quality housing in the needed volume.

Operation Breakthrough is a cooperative effort by federal, state, and local governments, by industry, by private developers, and by labor, to apply the nation's industrial might to the solution of the nation's housing problems.

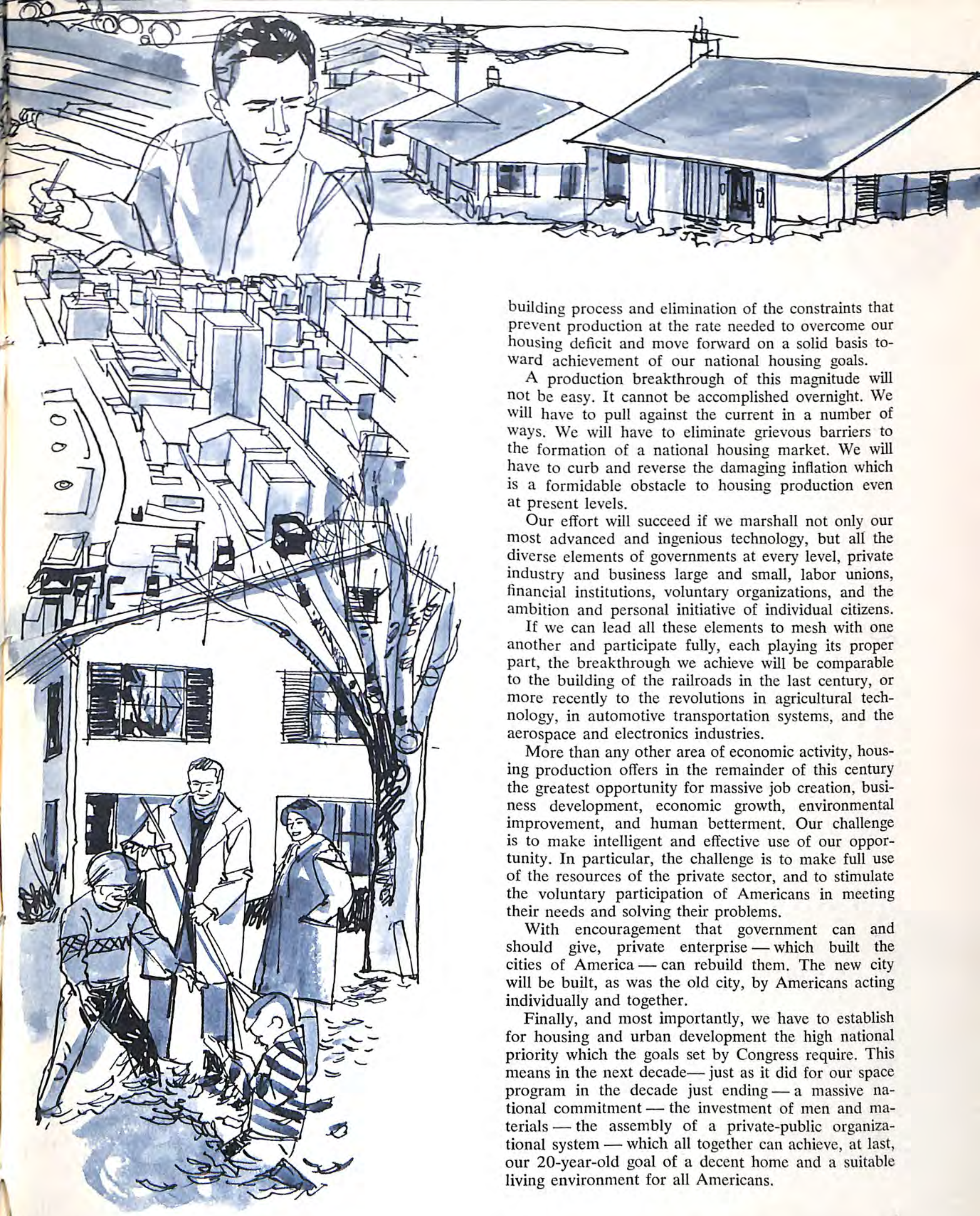
Breakthrough contemplates the aggregation of regional and local markets large enough to justify the investments — in research and development, in plant equipment, and in managerial capacity — needed to generate volume production.

It contemplates making those markets practically attractive, by finding ways around the problems of obsolete and excessively restrictive codes and zoning practices.

It contemplates breaking through the shortage of construction workers — by increasing the supply of skilled and semi-skilled workers and by increasing productivity.

It contemplates modernization and systematization of every element of housing production. It is not just a matter of new technology. It will affect land use patterns, site design and site preparation, financing, management, building design, materials technology, production technology, marketing, and every other aspect of the production and delivery of housing. It will involve bringing together and making available at the right time and the right places all the essentials of money, land, materials, and people.

There is no question that America has the potential capability to house all of its people adequately. Toward this objective, Operation Breakthrough takes a new tack: it encourages the establishment of a total



building process and elimination of the constraints that prevent production at the rate needed to overcome our housing deficit and move forward on a solid basis toward achievement of our national housing goals.

A production breakthrough of this magnitude will not be easy. It cannot be accomplished overnight. We will have to pull against the current in a number of ways. We will have to eliminate grievous barriers to the formation of a national housing market. We will have to curb and reverse the damaging inflation which is a formidable obstacle to housing production even at present levels.

Our effort will succeed if we marshall not only our most advanced and ingenious technology, but all the diverse elements of governments at every level, private industry and business large and small, labor unions, financial institutions, voluntary organizations, and the ambition and personal initiative of individual citizens.

If we can lead all these elements to mesh with one another and participate fully, each playing its proper part, the breakthrough we achieve will be comparable to the building of the railroads in the last century, or more recently to the revolutions in agricultural technology, in automotive transportation systems, and the aerospace and electronics industries.

More than any other area of economic activity, housing production offers in the remainder of this century the greatest opportunity for massive job creation, business development, economic growth, environmental improvement, and human betterment. Our challenge is to make intelligent and effective use of our opportunity. In particular, the challenge is to make full use of the resources of the private sector, and to stimulate the voluntary participation of Americans in meeting their needs and solving their problems.

With encouragement that government can and should give, private enterprise — which built the cities of America — can rebuild them. The new city will be built, as was the old city, by Americans acting individually and together.

Finally, and most importantly, we have to establish for housing and urban development the high national priority which the goals set by Congress require. This means in the next decade— just as it did for our space program in the decade just ending — a massive national commitment — the investment of men and materials — the assembly of a private-public organizational system — which all together can achieve, at last, our 20-year-old goal of a decent home and a suitable living environment for all Americans.

Natural Resource Goals

BY WALTER J. HICKEL
Secretary of the Interior

'We are working to meet the urgent resource challenges of the seventies with the conviction that what is required is a strategy of quality for the future to match the strategy of quantity of the past.'

In 1907, President Theodore Roosevelt said that the conservation and proper use of our natural resources constitutes the fundamental problem which underlies almost every other problem of our national life.

Because of the growth of resource problems which President Roosevelt foresaw far ahead of his time, this statement is even more true today.

In dealing with what President Nixon has called the greatest threat to our environment in our history, we must be sure we set our goals wisely and move to reach them vigorously and promptly.

The Department of the Interior has, as one of its most important responsibilities, the management of natural resources throughout our nation. These responsibilities also extend to our oceans.

I believe we must look ahead to the year 2000 and ask what problems we will face by then. We must stop simply "reacting" to problems. We must start anticipating them.

Our natural resources should be catalogued and inventoried, both in general and specifically, for various uses, whether for preservation for beauty, or as resources for development to accommodate people.

The resources in and under the ocean are also going to have to be catalogued. And we are going to have to have a stronger program in oceanography before we really understand what's out there and how best to utilize it.

There will be areas for the mining of hard minerals and areas for oil, and areas to be set aside for other uses. We should take a hard, visionary look at the resources of our vast continental shelf. We must come up with a long range program that's not only in the interests of the people of America, but literally for all the people of the world.

One of our most important priorities must be coping with pollution of water.

Next year we plan to present a far-reaching analysis to Congress to provide for a really major anti-pollution program. We cannot afford "piecemeal" planning.

What we should strive for is to get started now with a payment schedule for pollution control spread over the next 30 years.

What government should do is encourage understanding that pollution costs money and that measures to prevent air and water pollution and help clean up

the environment *make* money.

When we consider our cities, we're looking at man-made, natural, and human resources, and all can be damaged or even destroyed by pollution. Even sweet, pure rainfall on a city which has a quarter of its surface covered with asphalt or concrete can create environmental problems.

Government must enlighten management, and set down regulations where the government is involved. It has to do this — even to itself. Some of the real polluters of air and water are government installations.

On federal lands, projects and leases — both onshore and offshore — we have to set regulations that are attainable. And then, as technology makes it possible, we can tighten up the regulations. We cannot have a program that says we're going to have mountain pure water tomorrow in the Hudson River. It's just not attainable. We must first undo the wrong that has been done, then set guidelines and then encourage the cities and industry to comply.

We also need a planned program for the future to conserve our wilderness areas and parks.

We've got to look ahead far enough, to the press of population in the year 2000 and even beyond, to what's going to be — or should be — developed; what's going to be used for the "pleasures of living," and the "pleasures of viewing." Until we do that, I fear we're going to have development on a "catch-as-catch-can" basis.

The federal government needs to acquire more land to provide recreational opportunities in and near our large centers of population.

An example is what we are doing at Breezy Point, Sandy Hook and Jamaica Bay in New York City to develop a Gateway National Recreation Area to provide unique recreational areas, and areas of wildlife and natural beauty.

This particular project will be immediately accessible to roughly ten million people. A person won't have to take two weeks to get out and rejuvenate his mind and body. Here he can do it over a weekend, or in an evening, or a day.

The federal government has an obligation to its "investors" — our millions of citizens.

Consider the grazing lands in the Great West.

We cannot expect continually to receive revenues from those lands without harming the environment.

We're going to have to determine what are the best uses for these lands.

I think we can find areas where land is not utilized to its highest degree and we can improve on nature by reclamation, irrigation and flood control projects. Then we can have both virgin wilderness, plus greenbelt areas and forests where we can harvest our timber on a true sustained yield basis.

One of the real steps in this direction has been the Public Land Law Review Commission, which is to report in June 1970. It is to come up with recommendations as to how we can best use the public lands we have left.

In general, I believe the problems connected with resources should be kept in one department. In Interior, we have both natural resources and human resources. We have all the Indian problems — Indian, Eskimo and Aleut.

The government has become a crutch to the Indian, and we must allow our Indian citizens to make more of their own decisions concerning education, for example. We should allow them not only to make decisions as to what they think is best, but allow them the privilege of making mistakes, so they'll learn by those mistakes. We have got to have more communication between those in the Bureau of Indian Affairs, and those on the reservations.

In some way we're going to have to "cut the cord," so to speak, and encourage the Indian to become more involved, more independent.

It is not only in connection with our responsibilities for our Indian citizens, of course, that we are dealing with human problems. In handling all of our missions we must focus not on just the resource — but on what the resource can mean to us in building a better life for the people of our country and of the world.

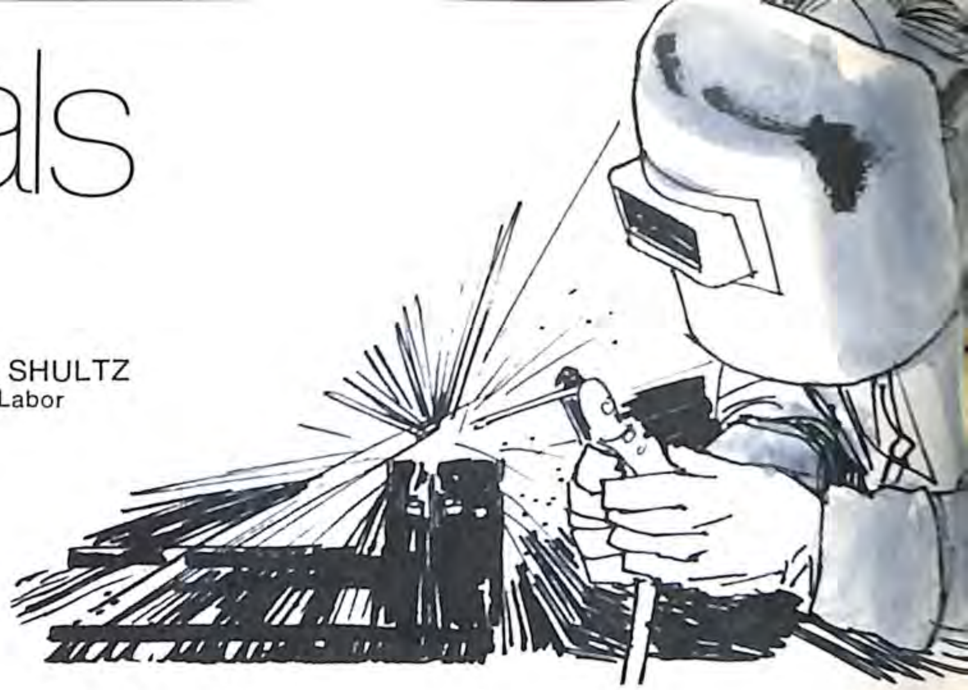
As President Nixon has said, together we have damaged the environment and together we can improve it.

We are working to meet the urgent resource challenges of the seventies with the conviction that what is required is a strategy of quality for the future to match the strategy of quantity of the past.

Our natural resources are the base on which life itself depends. Our stewardship — the care we take of this natural wealth and beauty — will be reflected in the overall quality of our lives.

Labor Goals

By GEORGE P. SHULTZ
Secretary of Labor



'One of our primary goals is the expansion and re-direction of our manpower programs to balance the employers' urgent need for workers with the job needs of men and women who lack the education and training to assume these jobs.'

The goals of the U. S. Department of Labor today are far wider in scope than those defined by its original charter, which called simply for serving the "wage-earners of America."

Today the Department's mission is much more complex. The people it is dedicated to serve include not only current wage-earners, but those who, through deprivation and lack of education, have never been prepared for the world of work.

The Department has become a major force in shaping the nation's economic policy and in planning to facilitate the human adjustments that will follow de-escalation of Vietnam hostilities.

One of our primary goals is the expansion and re-direction of our manpower programs to balance the employers' urgent need for workers with the job needs of men and women who lack the education and training to assume those jobs.

We look at this task in terms of building bridges; bridges that will lead from welfare rolls to the world of work; bridges that will span the gap between the classroom and a specific place in business or industry; bridges that will carry offenders from the courts or the prisons into jobs that restore their self-esteem and keep them in the community and away from further offenses; bridges that will ease the transition of displaced farm and rural workers to new occupations in smaller urban communities.

Among our challenges is the salvation of the human resources now lost to the nation in the group known as the "hard-core" unemployed, and the removal of these people from the nation's welfare rolls. We hope to do this through a variety of manpower programs. One is the Job Opportunities in the Business Sector program operated in conjunction with the National Alliance of Businessmen (for which 5,200 jobs have already been pledged by the aerospace industry).

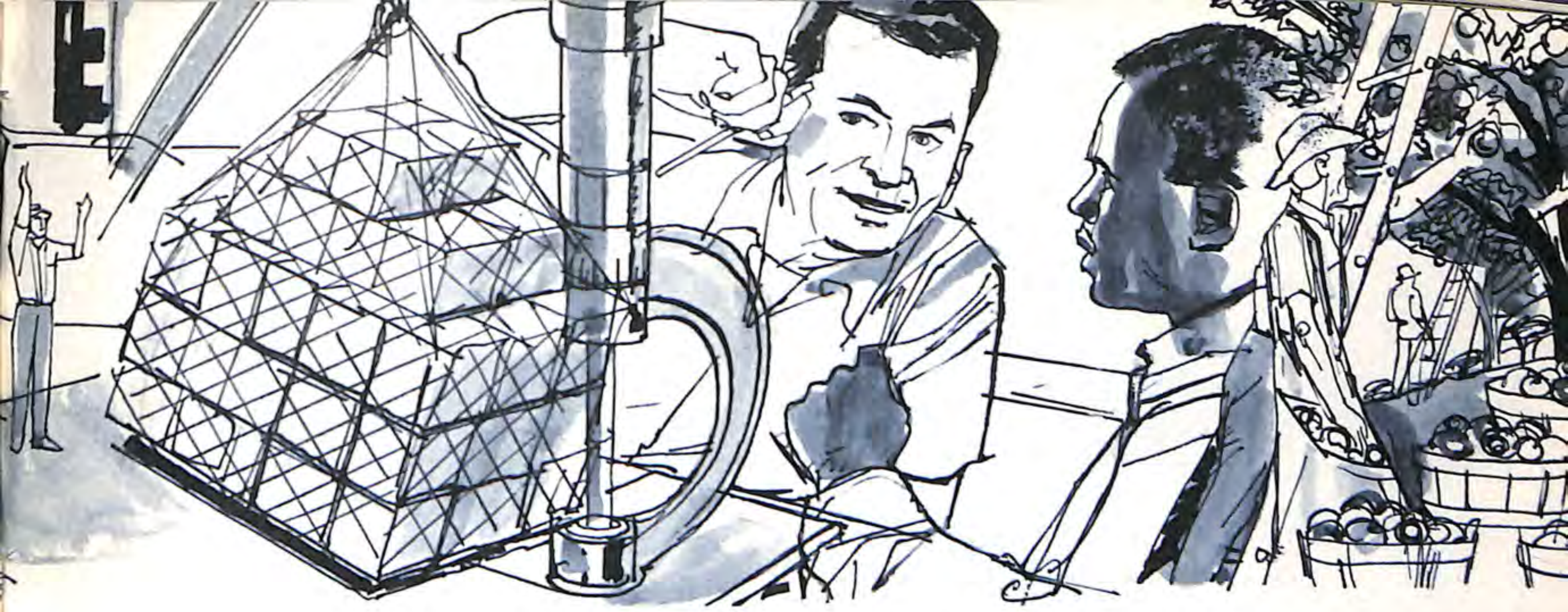
To provide the necessary incentive to move workers off the welfare rolls, legislation has been proposed which will allow welfare recipients to retain a larger portion of their earned income than previously permitted, and will gradually phase them off welfare as their income level rises.

Another challenge is the reduction of teen-age unemployment which is shockingly high for a nation with our resources. Much of this problem can be attributed to the failure of our society to prepare youngsters to make the transition from school to work. We are, therefore, drafting legislation which, in cooperation with the Department of Health, Education, and Welfare, would expand cooperative education concepts so that our youngsters could be trained for specific jobs while still enrolled in school.

Another effort in which we place great hope is the attempt to salvage, through job training, men and women who have run afoul of the law. Although it has been proven that the "repeater" rate can be drastically cut through job training while in prison, only two percent of the inmates in our prisons and reformatories are now receiving such training. The Labor Department goal is to place prisoner rehabilitation on a full-program basis, a move we believe should prove highly effective in breaking the poverty-crime cycle.

The Labor Department also has plans to provide job training, counseling, and assistance in relocating to some of the 14 million rural residents now living in poverty.

To provide better coordination of manpower programs and improved service to the disadvantaged, we have proposed a comprehensive Manpower Training Act. This would channel federal money to "umbrella" agencies in the States and metropolitan areas and provide flexibility to deal with their problems in their own way.



To render better service to worker and employer alike, we plan to streamline the operation of the public employment service. We have already begun the automation of this operation and hope to have a fully-automated nationwide man-job matching system within the next five years.

The Department of Labor's second major goal is to improve the welfare of the worker and his family.

Of foremost importance in this area is the matter of safety in the workplace. From 1961 through 1968, 112,000 Americans were killed while at work — 14,000 a year. Each year, more than two million workers are disabled, temporarily or permanently, from on-the-job accidents. Our new technology has brought with it new hazards and new diseases; in recent years, the accident trend has turned upward.

The Department has therefore proposed a workplace Health and Safety Bill to improve safety and health practices and conditions on the job. It will contain measures designed to motivate employers to provide their own programs, and to stimulate their employees to work safely and with regard for health.

We also hope to broaden the scope of Workmen's Compensation coverage, which now leaves 13 million workers and their families completely unprotected against loss of earnings resulting from injury or death.

In keeping with our belief that any worker is entitled to live in dignity, we shall encourage the States to increase maximum benefits, which now average less than half of a worker's weekly wage.

We have already sent to Congress draft legislation to carry out the President's recommendations for improving the Federal-State unemployment insurance program. This bill would extend unemployment insurance protection to nearly five million additional workers, including those working for small employers, those employed on larger farms and in border-line agricultural activities, and salesmen and delivery tradesmen.

The new law is designed to assure that payment is made only to those whom the unemployment compensation system is designed to protect, and to remove unreasonable restrictions such as the denying of payments to those who are receiving job training. It also contains a trigger mechanism intended to protect the economy from sharp declines in personal income due to unemployment.

A third goal of the Labor Department is to ensure the realization of equal employment opportunity. As federal procurement contracts provide one of the most effective means of achieving this, we intend to strengthen the operation of the Office of Federal Contract Compliance.

In the field of industrial relations, the Department's goal is to encourage the parties in labor disputes to settle their own affairs without the intervention of the office of the Secretary of Labor or the White House. The Department intends to maintain a policy of restraint and low visibility and to see that the Federal Mediation and Conciliation Service, an independent agency, is utilized when assistance is required in resolving a dispute.

We are also developing guidelines as an aid to policymakers in deciding which situations should be defined as "national emergency" disputes, and are studying the possibility of several lines of action in coping with them. In addition, we are studying the problem of strikes in the public sector, which raise critical questions relating to health, safety, and welfare.

In the area of farm labor, I have recommended to the Congress that the right of farm workers to organize be guaranteed by the National Labor Relations Act, with the provision that a three-member Farm Labor Relations Board be established as a separate entity. My recommendation points out the need for adapting that Act to the agricultural setting and for guaranteeing the protection of farmers against secondary boycotts.

These, then, are some of the goals for the Department of Labor. It is our hope that the realization of these goals will not only make for a better life for the members of our working force, but will also enhance the welfare of the nation and all its citizens, who are in fact dependent upon the productivity of the American worker.

Transportation Goals

BY JOHN A. VOLPE
Secretary of Transportation

'In short, we are working to evolve a transportation system that will best serve the economic, social and defense needs of the nation.'

Transportation decisions affect all of our other national goals — our competitive position abroad, our agricultural and economic sufficiency at home, our social welfare, national defense, even the conservation of our natural resources and our explorations in space. Transport is equally important to that other side of man's life — his leisure. This very pervasiveness can augment the complexity of its planning. And the time element now requires that we plan right the first time.

Purpose, goals, objectives are synonymous. The purpose of the Department of Transportation is spelled out in the enabling legislation passed by Congress in 1966. In May 1968, at the end of its first full year of operation, the Department issued a pamphlet listing its "Goals and Objectives." It was noted then that these were subject to revision to meet the dynamic changes in the transportation picture. This brief article will discuss a few of the primary goals as we now see them and our steps toward accomplishing them.

The long-range, overriding goal is *to see developed a balanced national transportation system in which the inherent advantages of each medium of transport are efficiently employed to meet the total demand, using private enterprise to the maximum extent feasible.*

Ideally, plans would be formulated at the national level, free from political and partisan pressures, and implemented in the private sector with governments at various levels participating as needed.

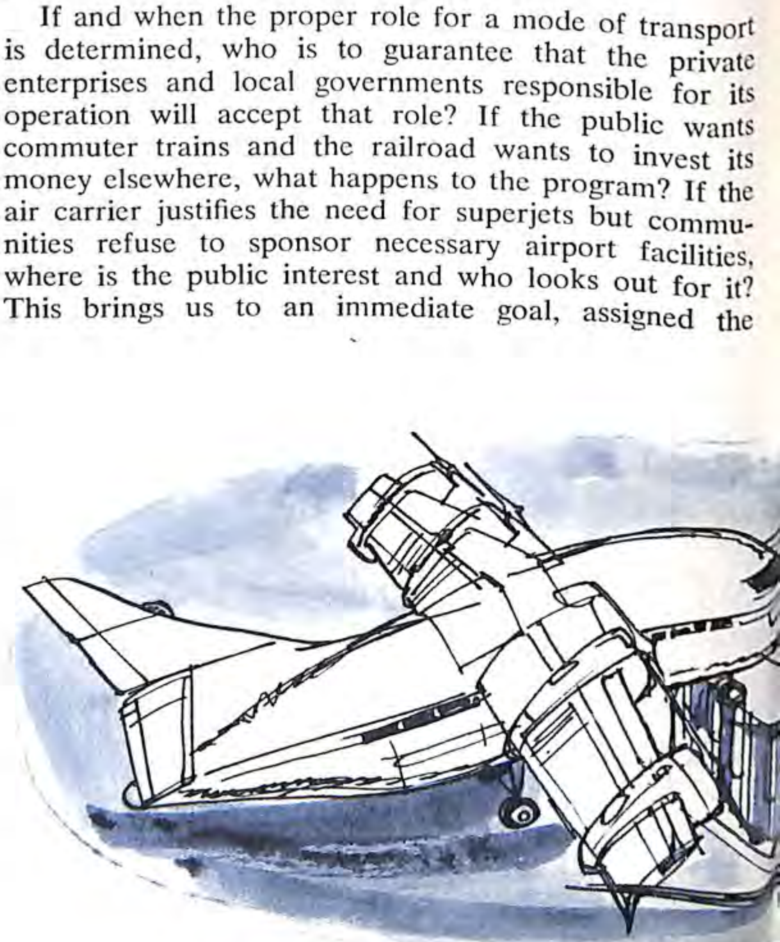
Aerospace engineers have dramatized the effectiveness of the systems approach in decision-making. It may offer the best hope for programming a balanced transportation system and keeping it flexible to accommodate changing requirements and new technologies.

In an economic environment of free enterprise, where the profit motive understandably leads to stiff competition, the "inherent advantages" of truck and rail transport, for instance, may vary with the promoter. And the advantages of one era — low cost, availability — may shrink or disappear in a succeeding period when speed or convenience becomes a dominant requirement of the shipper or traveler.

The systems approach is now being tested in the Northeast Corridor Transportation Project (NECTP) and, on a smaller scale, in the Center City Transportation Project. The high-speed Metroliner and Turbo Train experiments are only part of the forecasting and analysis process in the Corridor. The other project will design and implement improved center city transportation systems for 26 cities, analyzing common problems and solutions, and make results available to other cities.

These and other endeavors are hindered by significant gaps, fragmentation and incompatibilities in our transportation data base. In May 1969 the Department proposed to Congress initiation of a five-year program for meeting the critical transportation information needs of industry and government at national, state and local levels. Once the machinery is functioning and the data base established it can be kept current at nominal cost. Such a project can pay for itself many times over in pointing the way to avoid planning errors.

If and when the proper role for a mode of transport is determined, who is to guarantee that the private enterprises and local governments responsible for its operation will accept that role? If the public wants commuter trains and the railroad wants to invest its money elsewhere, what happens to the program? If the air carrier justifies the need for superjets but communities refuse to sponsor necessary airport facilities, where is the public interest and who looks out for it? This brings us to an immediate goal, assigned the



Secretary of Transportation by President Nixon:

To define a National Transportation Policy.

This task, now under way, involves among other things the updating of the 1961 "Doyle Report" on National Transportation Policy.* It must consider transportation both as a service and as a power to make things happen. And it must give the nation the political decision-making machinery to keep pace with and control the influence of technological advances, even though this quite possibly will necessitate administrative, legislative, and regulatory adjustments.

Once a national transportation policy is defined and adopted it will be necessary *to structure new programs and perhaps restructure some existing programs to conform to that policy.*

Some goals are constant. We can never fulfill them to our complete satisfaction. One is *to improve safety on all modes — to minimize injury and the loss of life and property in transportation-related accidents.*

FAA Administrator John H. Shaffer recently told employees, "I am concerned first and foremost about the safety of the airways, and the welfare of the people we depend upon to assure that safety." We have recommended to Congress legislation proposing expenditures of $12 billion over the next 10 years to operate, maintain and expand the airways system. That is a considerable sum — more than $3 million daily from now through 1980. And almost every dollar spent in the FAA program directly or indirectly affects the safety of the airway user. We anticipate a need for 10,000 more engineers and technicians by 1979, most of them to be produced from FAA training programs. We must replace outdated equipment, expand inadequate facilities, take full advantage of automation, and encourage research into new means to reduce congestion and assure safety.

Highway fatalities run more than a thousand a week. We are carefully analyzing the causes of serious accidents, seeking new cures. We are finding ways to get the right kind of emergency aid to the injured in time to save lives. Vehicles, tires, accessories are being manufactured to higher safety standards. New breakaway signs and posts are saving lives in roadside accidents. Highways are being upgraded. Several systems are being tested to control the merging maneuver on high-volume urban freeways, a major source of accidents. By prescribing national standards we are encouraging state and local governments to upgrade such programs as motor vehicle inspection, driver licensing, driver education, implied consent laws and chemical testing of drunken drivers, traffic control devices, and clearer signs and route markings.

Small-boat accidents, transportation of hazardous materials, pipeline safety, rail safety and railroad grade crossing elimination are all receiving priority attention.

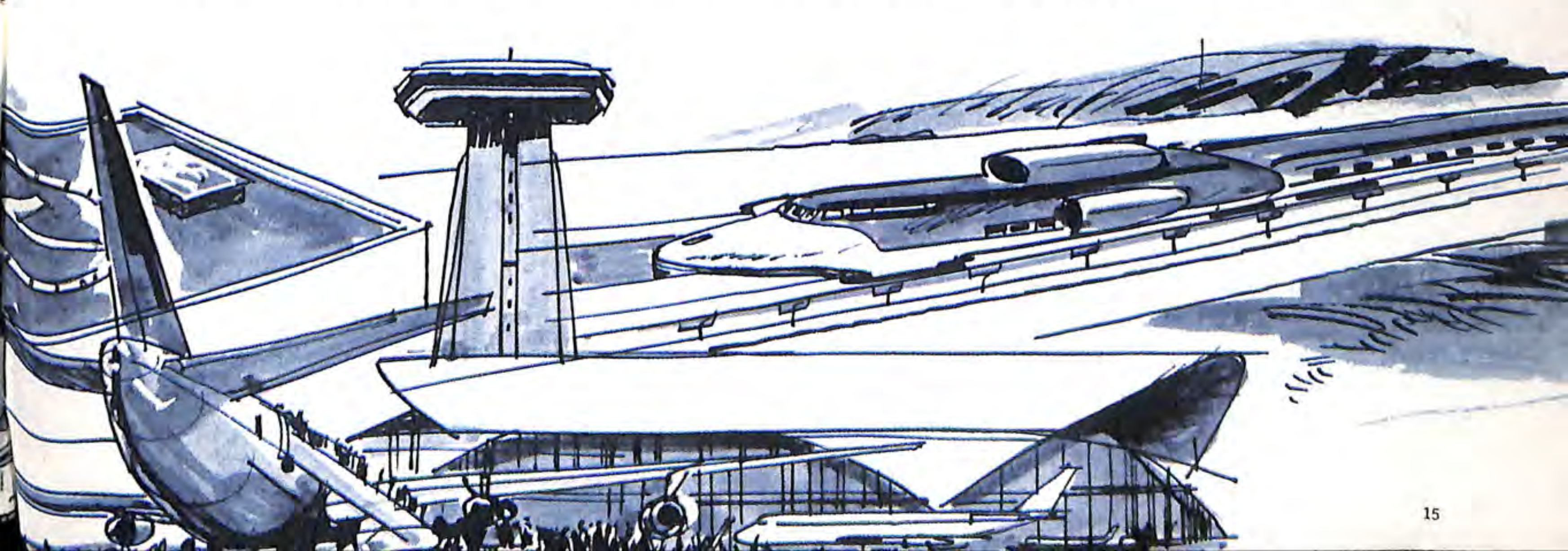
Particularly in areas such as safety and commuter services, where private performance does not always meet public needs, the Department is encouraged *to stimulate technological advances in transportation.*

Looking ahead to tomorrow's traffic crush in our metropolitan corridors, we are exploring the feasibility of trains in tubes, tracked air cushion vehicles, high-speed trains, and V/STOL services. Dial-a-bus and other computerized systems are being tested to find public transit services that will be acceptable to more riders and that will reach the urban dwellers not now adequately served. Federal Highway Administration experimentation with the Electronic Route Guidance System may prove a first step toward highway automation. The Coast Guard is checking the potential of an amphibious air cushion vehicle. We are seeking a breakthrough in tunneling techniques that will make it economically feasible to carry more traffic and transportation-related facilities underground. This is directly related to the need *to improve the impact of transportation facilities and services on the environment.*

Every project of the Department must now give positive consideration to its effect upon the quality of life and to upgrading that quality wherever possible. We are experimenting with pollution-free propulsion plants for buses and with means to control and reduce aircraft noise. New highways are being routed to preserve natural, historic, and cultural resources. Where a neighborhood must be disrupted, every effort is made to put it back together in an improved fashion. Ecology is finally getting equal billing with technology.

In short, we are working to evolve a transportation system that will best serve the economic, social and defense needs of the nation.

** Special Study Group on Transportation Policies in the United States. National Transportation Policy. Preliminary draft of a report prepared for the Committee on Interstate and Foreign Commerce, United States Senate, pursuant to S. Res. 29, 151, and 244 of the 86th Congress. Washington, U.S. Government Printing Office, 1961.*



Urban Council Goals

BY DR. DANIEL P. MOYNIHAN
Assistant to the President for Urban Affairs

'The administration of many of the government's most important urban programs have been consolidated and strengthened.'

The Council for Urban Affairs, established by President Nixon on January 23, 1969, as the first official act of his Administration, was given the mandate to "advise and assist" the President "in the development of a national urban policy, having regard both to immediate and to long-range concerns, and to priorities among them."

America is an urban nation. This is not to say, however, that most Americans live in big cities. The 1970 census will show that the majority of Americans in metropolitan areas now live in the suburbs, and that a great many live in urban settlements of modest size. But we are not the less an urban people for these reasons, and it is not less true that our most serious domestic problems are urban in nature. The extraordinary migration of rural Southern Negroes to the inner cities of the North, and the post-war population explosion which has placed such impossible pressures on municipal governments and driven many whites to the suburbs seeking relief — these and other urban developments have profoundly altered the conditions of our lives and the tasks which our government is called upon to perform.

The 1960's have been in many ways an "urban decade," a period when the problems associated with city life have called forth vastly increased activities at all levels of government. It has been at the federal level that this expansion has been most evident. The years between the Presidential elections of 1960 and 1968 saw an increase in the number of federal domestic programs from 45 to 435.

And yet there has been during the same period a steady erosion in our faith in government's capacity to do what it says it will do. With the unveiling of each new government program, it seemed, we had increasing less confidence that any will produce worthwhile results or a higher degree of social satisfaction.

Hence the issue arises as to whether the demands of the time must not be met in terms of *policy* as well as programs. Policy, in the federal government, is essentially the goals and intentions of the President as transmuted by the Congress and effected in the operation of the executive agencies. It is far more than the sum of the many diverse programs that the government operates. As the President said when he signed the Executive Order creating the Council for Urban Affairs, "The American national government has responded to urban concerns in a haphazard, fragmented, and often woefully shortsighted manner . . . What we have never had is a policy: coherent, consistent positions as to what the national government would hope to see happen; what it will encourage; what it will discourage."

A national urban policy means many things: Elimination of conflicts and inconsistencies between the scores of programs addressed to similar urban problems; a sense of what is more important and what is less so, and the establishment of priorities among them. And, perhaps most of all, a heightened sensitivity to "hidden" urban policies — those coincidental effects of almost all government programs, be they aimed specifically at urban problems or not, which have profound effects on the lives, employment, and well-being of those living in metropolitan areas.

As a result of the work of the Council for Urban Affairs, under the Chairmanship of President Nixon, a number of important steps have been taken toward a national urban policy. The administration of many of the government's most important urban programs have been consolidated and strengthened. The first major reorganization of the regional structure of the federal government has begun. Proposals have been submitted to the Congress that will replace our inhumane and socially destructive welfare system, begin a revenue sharing policy that will restore fiscal vitality to our state and local governments, and establish the first efforts by the federal government to deal with the consequences of population growth and movement.

Having a national urban policy is no more a guarantor of success than having one in foreign affairs. But it is a precondition of success, and a precondition also of restoring coherence to the domestic undertakings of our government and a higher degree of confidence in its capacities.

AIA MANUFACTURING MEMBERS

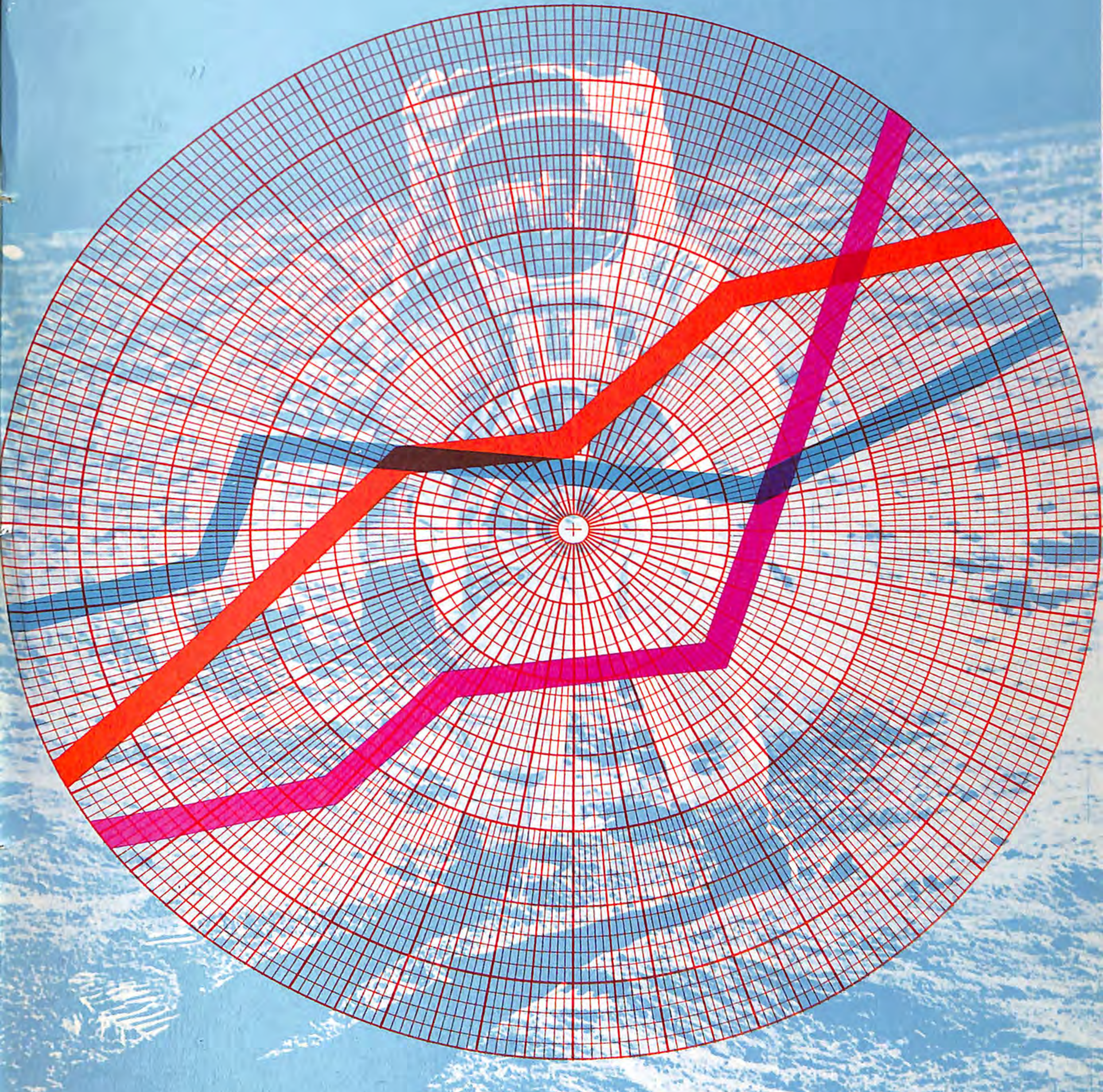
Abex Corporation
Aerodex, Inc.
Aerojet-General Corporation
Aeronca, Inc.
Aeronutronic Division, Philco-Ford Corporation
Amphenol Connector Division
  The Bunker-Ramo Corp.
Avco Corporation
Beech Aircraft Corporation
Bell Aerospace Corporation
The Bendix Corporation
The Boeing Company
Cessna Aircraft Company
Chandler Evans, Inc.
  Control Systems Division of
  Colt Industries, Inc.
Continental Motors Corporation
Curtiss-Wright Corporation
Fairchild Hiller Corporation
The Garrett Corporation
General Dynamics Corporation
General Electric Company
  Defense Electronics Division
  Aircraft Engine Division
  Missile & Space Division
  Defense Programs Division
General Motors Corporation
  Allison Division
The B. F. Goodrich Company
Goodyear Aerospace Corporation
Grumman Aerospace Corporation
  A Subsidiary of Grumman Corporation
Gyrodyne Company of America, Inc.
Harvey Aluminum, Inc.
Hercules Incorporated
Honeywell Inc.
Hughes Aircraft Company
IBM Corporation
  Federal Systems Division
International Telephone and Telegraph Corporation
  Defense-Space Group
    ITT Aerospace/Optical Division
    ITT Avionics Division
    ITT Defense Communications Division
Kaiser Aerospace & Electronics Corporation
Kaman Corporation
Kollsman Instrument Corporation
Lear Jet Industries, Inc.
Lear Siegler, Inc.
Ling-Temco-Vought, Inc.
Lockheed Aircraft Corporation
The Marquardt Company
Martin Marietta Corporation
McDonnell Douglas Corp.
Menasco Manufacturing Company
North American Rockwell Corporation
Northrop Corporation
Pacific Airmotive Corporation
Piper Aircraft Corporation
Pneumo Dynamics Corporation
RCA
  Defense Electronic Products
Rohr Corporation
Ryan Aeronautical Company
Singer-General Precision, Inc.
  A Subsidiary of the Singer Co.
Solar, Division of International
  Harvester Co.
Sperry Rand Corporation
  Sperry Gyroscope Division
  Sperry Systems Management Division
  Sperry Flight Systems Division
  Vickers Division
Sundstrand Aviation, Division of
  Sundstrand Corporation
Thiokol Chemical Corporation
TRW Inc.
Twin Industries Corp.
  Division of the Wheelabrator Corp.
United Aircraft Corporation
Universal Oil Products Company
Westinghouse Electric Corporation
  Aerospace Electrical Division
  Aerospace Division
  Astronuclear Laboratory

AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W., Washington, D. C. 20036

RETURN REQUESTED

aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • WINTER 1970

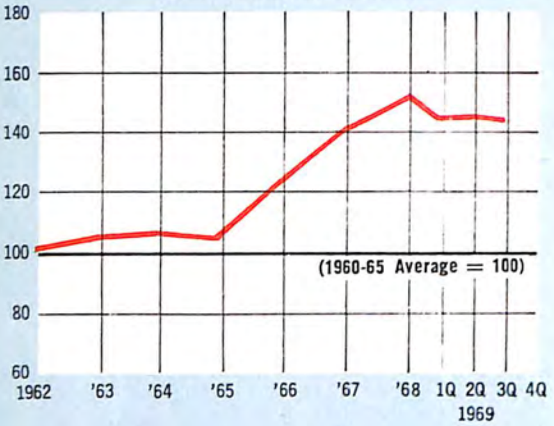


AEROSPACE INDUSTRY: 1969 REVIEW AND FORECAST

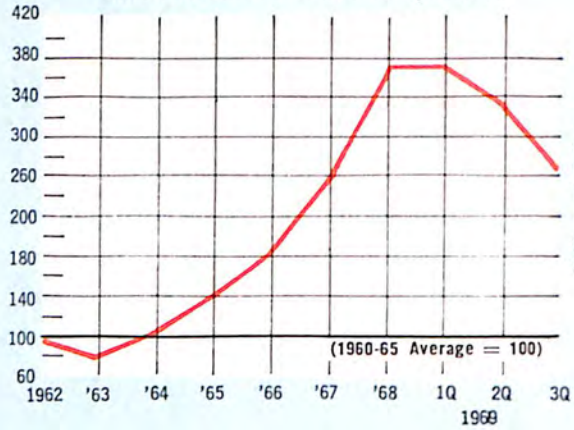
AEROSPACE ECONOMIC INDICATORS

CURRENT

Total Aerospace Sales

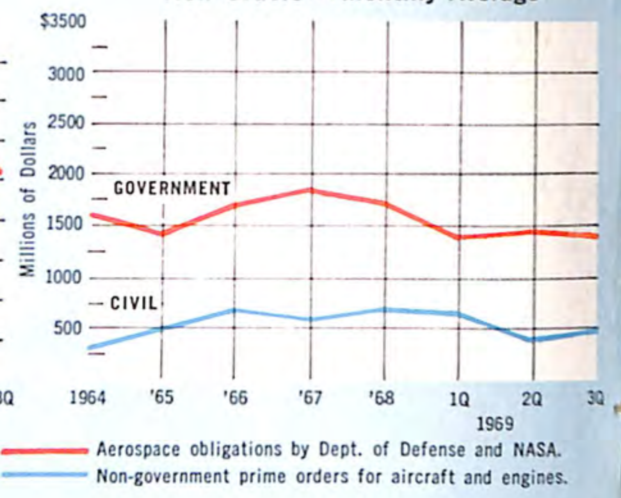


Value of Civil Aircraft Shipments



OUTLOOK

New Orders — Monthly Average



ITEM	UNIT	PERIOD	AVERAGE 1960-65 *	LATEST PERIOD SHOWN	SAME PERIOD YEAR AGO	PRECEDING PERIOD †	LATEST PERIOD
AEROSPACE SALES: Total	Billion $	Annual Rate	19.4	Quarter Ending Sept. 30 1969	29.4	28.1	27.8[E]
	Billion $	Quarterly	4.8		7.0	7.1	6.2
DEPARTMENT OF DEFENSE							
Aerospace obligations: Total	Million $	Monthly	1,151	Sept. 1969	2,161	1,104	1,304
Aircraft	Million $	Monthly	601	Sept. 1969	1,173	660	723
Missiles & Space	Million $	Monthly	550	Sept. 1969	988	444	581
Aerospace expenditures: Total	Million $	Monthly	1,067	Sept. 1969	1,298	1,325	1,265
Aircraft	Million $	Monthly	561	Sept. 1969	868	872	714
Missiles & Space	Million $	Monthly	506	Sept. 1969	430	453	551
Aerospace Military Prime Contract Awards: TOTAL	Million $	Monthly	920✠	Sept. 1969	1,971	1,079	1,098
Aircraft	Million $	Monthly	447	Sept. 1969	1,156	629	689
Missiles & Space	Million $	Monthly	473	Sept. 1969	815	450	409
NASA RESEARCH AND DEVELOPMENT							
Obligations	Million $	Monthly	215	Oct. 1969	368	270	284
Expenditures	Million $	Monthly	130	Oct. 1969	330	246	285
UTILITY AIRCRAFT SALES							
Units	Number	Monthly	692	Nov. 1969	1,008	1,192	722
Value	Million $	Monthly	15	Nov. 1969	35	36	31
BACKLOG (60 Aerospace Mfrs.): Total	Billion $	Quarterly	15.3#	Quarter Ending Sept. 30 1969	31.5	29.4	29.2[E]
U.S. Government	Billion $	Quarterly	11.6		17.3	15.0	14.9
Nongoverment	Billion $	Quarterly	3.7		14.2	14.4	14.3
EXPORTS							
Total (Including military)	Million $	Monthly	110	Sept. 1969	254	300	157
New Commercial Transports	Million $	Monthly	24	Sept. 1969	112	69	29
New Utility Aircraft	Million $	Monthly	2	Sept. 1969	7	8	8
PROFITS				Quarter Ending Sept. 30 1969			
Aerospace — Based on Sales	Percent	Quarterly	2.3		3.4	3.0	3.0[E]
All Manufacturing — Based on Sales	Percent	Quarterly	4.8		4.9	5.1	4.6[E]
EMPLOYMENT: Total	Thousands	Monthly	1,132	Sept. 1969	1,416	1,344	1,347[E]
Aircraft	Thousands	Monthly	469	Sept. 1969	629	591	597
Missiles & Space	Thousands	Monthly	496	Sept. 1969	609	577	576
AVERAGE HOURLY EARNINGS, PRODUCTION WORKERS	Dollars	Monthly	2.92	Sept. 1969	3.70	3.96	3.99[E]

R Revised
E Estimate
* 1960-65 average is computed by dividing total year data by 12 or 4 to yield monthly or quarterly averages.
† Preceding period refers to month or quarter preceding latest period shown.
# Averages for 1961-65.
✠ Averages for fiscal years 1960-1965.