planes

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FARE INCREASE NECESSARY FOR AIRLINES

Diapers, Diamonds Used in Bombers

A purchasing agent who fills requisitions for diamonds, diapers, pipe tobacco, wooden marbles and leg makeup, does so, not in a movie or television studio, as you might expect, but at an aircraft factory.

The diamonds, it turns out, are for grinding wheels employed in tooling; diapers, it seems, are dandy lint-free cloths for cleaning bomb-sight lenses on a giant jet bomber; the pipe tobacco is used in smoke generators to test ventilating systems; wooden marbles—some 3,800,000 of them—are utilized in metal-bonding to equalize vacuum and to apply pressure to uneven tool surfaces; and the leg makeup is applied to employees' hands, not legs, for photographic purposes to provide the necessary contrast.

Other novel requisitions which the purchasing agent can fill without so much as a raised eyebrow include: ink droppers, chloroform, fingerprint remover and acid neutralizer, grain alcohol, helium, stop watches and window socks.

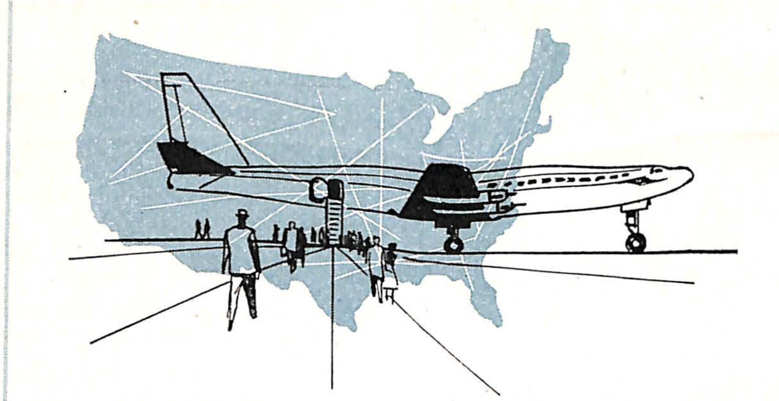
Their uses: ink droppers are brought into action to fill pyrometers in heat treat areas; chloroform and helium aid in servicing and repairing aircraft flight instruments; fingerprint remover and acid neutralizer are used on unplated parts to prevent corrosion due to handling; grain alcohol is provided for laboratory tests; the stop watches are employed in various service tests on bomber components, and the "window socks" of the type worn by shop window decorators, are worn by maintenance men walking on top of the bomber. They prevent surface scratches.

These requests for "oddball" items point up the complexities in fabricating a modern heavy jet bomber—a machine so intricate that wooden marbles, leg makeup, diamonds and diapers all go into producing it.

Long Look

World's longest periscope has been constructed by a U. S. aircraft engine manufacturer and is installed at AEC's National Reactor Testing Station, Idaho Falls, Ida., to aid development work on a nuclear aircraft. The 90-foot aluminum tube with intricate mirror and lens system permits atomic workers to sit safely behind heavy shielding while watching test of a nuclear reactor.

AIR TRAVELING AMERICA



The Civil Aeronautics Administration predicts that by 1970, 118 million passengers a year will be flying U. S. domestic airlines, compared with 42 million in 1956. On overseas routes, the agency states that U. S. International Airlines transported approximately 4 million in 1956 and predicts an annual passenger volume rise to more than 11 million by 1970. The ever-increasing dependability, speed and luxury of American-built aircraft and engines has established the United States as the world's leader in commercial air power. 'PLANES'

Testing Machine Exerts 1.2 Million-Pound Force or Compresses Egg without Crushing Shell

A $175,000 machine, strong enough to exert a force of 1.2 million pounds and delicate enough to compress an egg without crushing its shell, now enables research engineers at a southern aircraft plant to make extensive strength evaluation of military cargo planes, thereby insuring maximum performance and greater service life for the aircraft.

The mammoth universal testing machine, weighing 90 tons and standing a lofty 35 feet above floor level, is capable of applying tension or compression loads up to 1.2 million pounds, and measuring them with a precision comparable to that of a chemical balance.

Large aircraft parts, such as wing panels 25 feet long by 10 feet wide by any depth can be pushed in compression, pulled in tension, bent in flexure or loaded in many ways to simulate service conditions. The most modern electronic equipment in the aircraft plant's engineering research laboratory will be used with the new machine for reading hundreds of channels of strain gage output at rapid rates.

Although primary use of the new testing machine will be for aircraft structural members and components, it will be made available to government and private concerns requiring tests in the plus-million-pound range.

Before installing the machine, it was necessary for the construction contractor to remove 1,000 cubic yards of earth, erect 8.5 tons of steel, and pour 200 cubic yards of concrete to build an underground foundation 26 feet wide, 30 feet long and 16 feet deep. The walls vary in thickness from 24 to 48 inches.

Such painstaking tasks are routine in the aircraft industry's constant search for better ways of testing the component parts that go into building American air superiority.

Piston Power Gain

Piston engines may soon be in a competitive position with turboprop powerplants by using a new anti-knock compound developed by the Ethyl Corporation. The compound, which is an organic derivative of manganese, has been tested by a major aircraft engine manufacturer. New reciprocating engines could use this improved fuel to increase power 20 per cent and put piston airliners in the 400-mph. class.

Rising Costs Cut Profits Sharply

By Stuart G. Tipton
President, Air Transport Association

Little more than a year from today, a four-engine turbojet transport bearing the insignia of an American flag carrier will speed down the runway of a West Coast aircraft company and our scheduled air transport industry will enter the era of commercial turbojet transportation.

The transition from piston to turbojet power is the most significant move the airlines have made in their already intensive equipment programs since they became organized and regulated under the Civil Aeronautics Act in 1938.

Behind the simple action of the pilot who pushes forward the throttle is a dramatic story of the technical, economic and managerial teamwork of this nation's air transport and manufacturing industries.

A transport plane manufactured in 1938 was capable of carrying 28 passengers over relatively short stages at an average speed of about 160 miles per hour. A coast-to-coast flight required about 20 hours. The new turbojets will carry up to 150 passengers at a speed of 600 miles-per-hour from Los Angeles to New York in 4 hours and 27 minutes, and the flight is made non-stop in pressurized comfort far above the weather. No other form of transportation even approaches these tremendous increases in service to passengers, air mail users and cargo shippers.

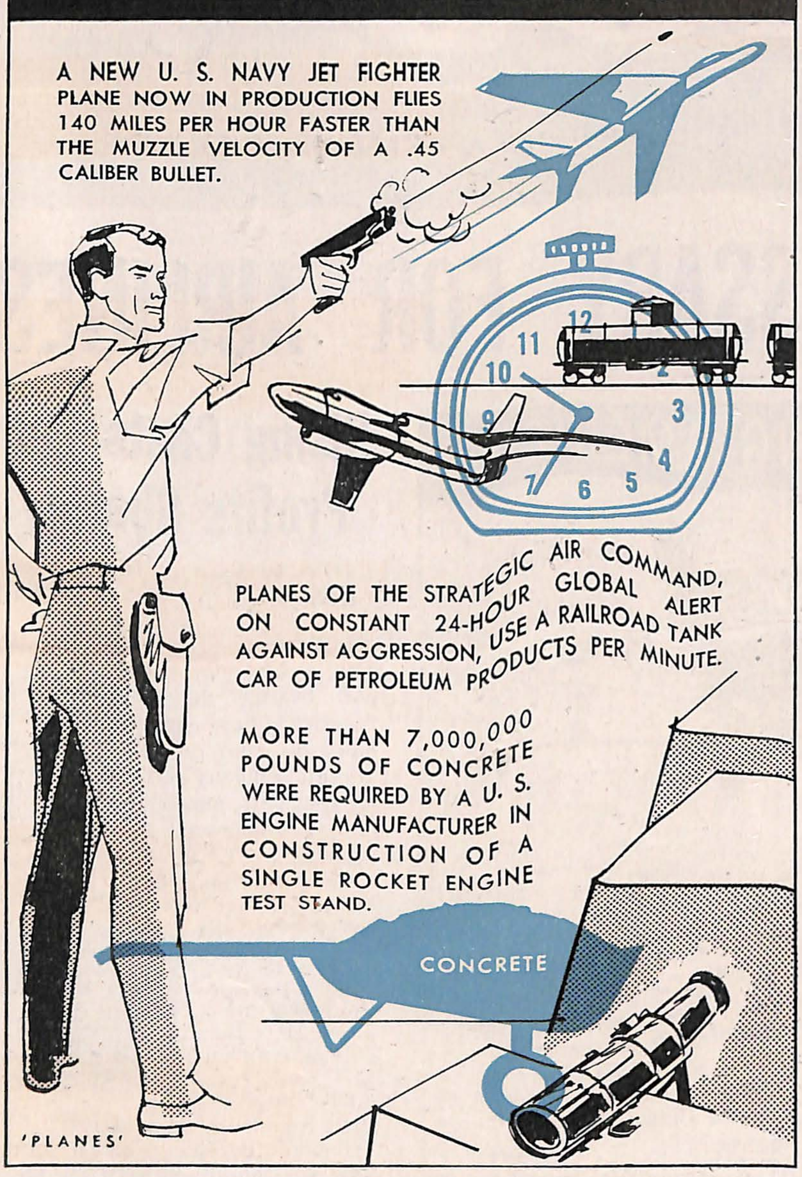
In the face of these accomplishments in service there exists a truly amazing anomaly: The average airline fare is less today than in 1938. A study by the Air Transport Association shows that the average airline fare in 1938 was 5.32 cents per passenger mile and in 1957 the average fare is 5.28 cents.

In the entire common carrier system only the airlines today charge less than they did in 1938. First class rail fares have increased 50 per cent, rail coach fares are up 33 per cent and bus fares have gained 27 per cent.

The ability of our airlines to hold

(See FARES, Page 7)

Plane Views



Teaching Aid Book Tells Civil Aviation Story

For educators eager to provide students with learning experiences from our world of flight, the National Aviation Education Council has published the booklet *Social Studies Teaching Aids For a Stronger America.*

Prepared as part of the Illinois Curriculum Program—Aviation Education Project, the booklet is one of a series which secondary school teachers may use as instructional aids for aviation education.

Social Studies Teaching Aids undertakes to create in the student a comprehension of how civil aviation strengthens the nation and its manifold social and economic effects; the relationship of air power to national security; and the potentials of air transportation for building international understanding and world peace. The booklet enables the student to become an intelligent consumer of air transportation services and to probe the history and development of various aspects of aviation and related areas, such as, air mail, air age legislation, subsidies and transportation, and world trade policy.

Each section is divided into topics. The topics "Aircraft at Work" and "The Airport" are sub-divided further so that teachers may readily locate activity suggestions for the more specific aspects of these topics. For example, the agricultural uses of aviation are considered in one group of activities listed under "Aircraft at Work"; air freight, in another group; business flying, in another; and so on.

Specific resource materials are suggested for most of the activities. They are listed either under the heading "Annotated References" immediately following an activity, or are included within the text which describes the activity.

Social Studies Teaching Aids may be obtained by writing to Dr. Evan Evans, Executive Director, National Aviation Education Council, 1025 Connecticut Ave., N.W., Washington 6, D. C. Cost for a single copy is $1.00; 2-99 copies—80 cents each; 100 or more copies—75 cents each.

NOTE: Other instructional booklets published by NAEC are: *Science Teaching Aids For A Stronger America*—75 cents per copy; *Mathematics Teaching Aids For A Stronger America*—75 cents per copy; and *English Teaching Aids For A Stronger America*—75 cents per copy.

PLANES

Planes is published by the Aircraft Industries Association of America, Inc., the national trade association of the manufacturers of military, transport, and personal aircraft, helicopters, flying missiles and their accessories, instruments and components.

The purpose of *Planes* is to:
Foster a better public understanding of Air Power and the requirements essential to preservation of American leadership in the air;
Illustrate and explain the special problems of the aircraft industry and its vital role in our national security.

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ALL MATERIAL MAY BE REPRODUCED — MATS OF ALL CHARTS ARE AVAILABLE FREE

Material Progress

Progress in the development of superior air power is made through a broad assault along the entire front of the physical sciences. Advancements in one area of aeronautics, such as engines, must be paralleled by accomplishments in aerodynamics, electronics and components if the full advantage of the engine development is to be realized. Modern aircraft and missiles are not a haphazard arrangement of parts; they are fully integrated systems with each part dependent on the proper functioning of another part. Failure of a simple fuel pump gasket could cause a missile to fail in its mission just as much as the failure of its complex guidance system.

With all the diverse and unique requirements of modern aeronautics, there is one common area that intimately affects the progress of all; availability of materials.

Materials are the single greatest limiting factor in the development of air power. Only a few years ago, aircraft designers spoke of the ideal material as being of extreme light weight and great strength. Aluminum met the major part of this requirement. Much more than light weight and strength is needed for tomorrow's aircraft and missiles.

Metals of tomorrow must retain their properties and strength across a temperature spectrum ranging from 100 degrees below zero up to thousands of degrees Fahrenheit. They must withstand the gravity forces that would crush most conventional metals, resist corrosion and remain unaffected by nuclear radiation. Finally, they must be easy to fabricate. An engineer with a flair for reducing the heat engendered in high speed flight to common terms estimates that during five minutes of combat flying at Mach 2 (twice the speed of sound) a fighter plane will pick up heat equivalent to that produced by 45,000 furnaces blazing away in a space about the size of your living room.

Missile designers are thinking in terms of temperatures up to 10,000 degrees Fahrenheit. Couple this temperature requirement with the fact that tungsten and carbon turn to liquid or gas at 7,000 degrees and you will have an idea of part of the problem that metallurgists are up against.

The seemingly hopeless job of discovering metals that will meet the ever-burgeoning requirements of high-speed flight hasn't discouraged researchers. Their programs are yielding results. Titanium, once an expensive "wonder" metal, today is widely used in the manufacture of aircraft and missiles. Many metallurgists believe that the full potential of this new metal, which combines light weight and high strength, has not been realized. Bonding techniques—the gluing together of metal skins with a glass fiber honeycomb material—has boosted strength and increased heat resistance. Combinations of ceramics and metals, called cermets, show great promise. They appear to be particularly applicable to gas turbine engines where great heat is generated as the gases are spewed from the engines. Major advances in molybdenum, columbium, chromium and nickel also appear likely.

Research directed at turning up new knowledge and techniques is usually expensive; and it is always a gamble. Blind alleys are more familiar than the broad avenue of success. But no all-out scientific attack on a particular problem has ever failed. The research and development programs of the aircraft industry will find a solution to aerodynamic heating just as it has solved a host of other knotty problems.

ECONOMICS of the U.S. AIRCRAFT INDUSTRY

SELIG ALTSCHUL is an independent aviation consultant and has been engaged in economic research and investment analysis for nearly twenty years. He is a graduate of Northwestern University, and he served two different terms as Chief Analyst for the Civil Aeronautics Board; from 1942 to 1943 and from 1945 to 1946. Mr. Altschul established his own aviation consulting practice in New York in 1947, specializing in independent analyses, and preparing reports and evaluations for separate aircraft companies and airlines. He served as a financial consultant to the Congressional Aviation Policy Board in 1947-48, for the Department of Commerce in 1949, and the Senate Interstate and Foreign Commerce Committee in 1951. He also conducted the Task Force Study of MATS as a consultant.

By SELIG ALTSCHUL

THE aircraft manufacturing industry is a many-dimensioned thing. It means all things to all people. Yet, ironically, it is perhaps the least understood of all major industrial groups in the United States.

Air power, in its fullest context, is far more than a symbol of security to the United States. It has become the deterrent to aggression against the free world. The aircraft industry in the United States makes this air power a living force and by so doing, in effect, helps underwrite the peace of the world.

This vital mission in life places the aircraft industry in a special category of its own. Then, too, the nature of air power is constantly changing and the characteristics of the aircraft group must adjust to anticipate new requirements.

As a consequence, development and support of air power is dependent upon an industry which has been forced to evolve in a manner differing from the traditional pattern followed by most enterprises in the United States. The economic equation of demand and supply, for example, cannot always be the controlling factor in aircraft managerial determinations. Shifting to commercial markets of a non-aviation nature cannot salvage the fortunes of an airplane company in the ebb tide of aircraft orders.

Following the end of World War II, with a sharp curtailment of aircraft procurement, a number of airframe companies did, in fact, attempt entering other fields. Diversification was sought in such activities as manufacturing washing machines and other appliances, phonograph cabinets, gasoline engines, truck bodies, rowboats, plastics, motor scooters, artificial limbs and caskets. Virtually all of these attempts in the commercial vineyards were abandoned after incurring substantial losses.

For one thing, manufacturing facilities geared for airframe assembly have limited utility for other production on an efficient and economical basis. Far more importantly, it takes years to forge a going aviation organization in being. This comprises more than managerial talent, it includes designers, engineers and scientists whose knowledge of aerodynamics and related fields has been assimilated in the crucible of aviation experience. While the aircraft industry complex could not exist without this reservoir of specialized technical talent, it nevertheless represents a collection of abilities which cannot be acquired in other industries and, once attained, are of limited value elsewhere. The aircraft industry is highly specialized. Once evolved into a group entity, a basic aircraft enterprise loses its flexibility to enter other fields of commercial endeavor.

THE aircraft industry is thus forced to live in a world of its own. But what sort of world is it? When life was relatively simple in the industry, the group's evolution tended toward specialization of the manufacturing processes into four main categories. They are:

1. Airframe builders
2. Engine builders
3. Propeller manufacturers
4. Parts, equipment and accessories

By and large, these separate divisions still prevail but their boundaries are by no means sacrosanct, and even now ripples of change may effect waves of adjustments in many areas.

The aircraft industry, as above constituted, has submitted to a whole series of transitions in the past. Its development led from aggregate sales of less than $1.8 billion in 1949 to almost $9.5 billion for 1956. It is an industry which has had to tailor its organizational structure largely to meet military requirements. Commercial orders, while more important for a number of individual companies, have, in recent years, not exceeded 10 to 15% of total industry sales in the aggregate.

The relative economic contributions of each of the four major aircraft categories, as measured by 1956 results, are summarized in Table No. I.

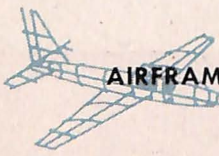
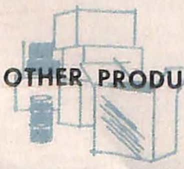
There are, however, ferments of change. For example, up until very recently there were but about five major engine builders. They devoted their main efforts in building major powerplants, either of the piston variety or in the newer turbo-prop and jet types. More recently, an entire new breed of engines—rockets and ramjets—have appeared and are likely to grow in importance. This has attracted newer, specialized entries to the field.

Moreover, in the broad grouping of aircraft parts, accessories and equipment, are included the various electronic controls which have been assuming mounting importance in recent years. An entire host of new companies, large and small, previously without any formal identification with the aircraft industry, have appeared and are making their influence felt.

TABLE NO. I

AIRCRAFT INDUSTRY DATA

Selected Measures for 1956

	SALES (Millions)	EMPLOYMENT* (Thousands)	FLOOR SPACE# (Millions)
 AIRFRAME	$5,554	512.0	101.5
 AIRCRAFT ENGINES	2,035	165.2	34.1
 AIRCRAFT PROPELLERS	136	16.1	2.8
 OTHER PRODUCTS	1,771	110.8	NA

NOTES:
*—MONTHLY AVERAGE FOR YEAR
#—IN SQUARE FEET AT DECEMBER 31, 1956
NA—NOT AVAILABLE

SOURCE:
AIRCRAFT INDUSTRIES ASSOCIATION
MUNITIONS BOARD, OFFICE OF AIRCRAFT PROGRAMS
DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS
DEPARTMENT OF LABOR, BUREAU OF LABOR STATISTICS

PLANES

THERE are no accurate figures available as to the full measure of military electronic equipment sales volume, employment and facilities devoted to its service. Many manufacturers in this activity are also in basic fields which they used as a springboard to become interested in electronics. They include companies in electrical equipment, automotive products, heating and ventilation devices and commercial radio and TV. One reliable estimate has placed military electronic spending by the Department of Defense at more than $15.1 billion for the six and one-half years through December 31, 1956. More than $5.5 billion of this amount is estimated to have gone directly into aircraft, another $4.4 billion into electronics and communications, and $1.8 billion for guided missiles.

The portents are clear, as will be noted, that expenditures and activities in guided missiles and supporting electronics are due for substantial growth in the years ahead. And with this growth will come far-reaching changes and adjustments within the framework of the aircraft industry as now constituted.

Certainly, there can be no doubt as to the impact of the aircraft group upon the nation's economy. For almost a year now, the aircraft industry has remained as the largest manufacturing employer in the United States. At the end of March, 1957, there were some 889,200 men and women employed by the manufacturers of aircraft, aircraft engines, aircraft systems and components. This exceeded the automotive industry (by 75,000 employees) which formerly consistently led the nation as the leading employer but is now in second place in this respect. Aircraft employment, which paid an estimated $4.8 billion in salaries and wages during 1956, now represents almost five per cent of the country's total manufacturing employment.

BUT still the full extent of the aircraft industry's wider impact in the nation's economy must remain unmeasured. There are literally thousands of enterprises outside of the ken of the aircraft industry which are fed a steady stream of orders for parts and components to be assembled into airframes and engines. Were this stream of aircraft orders to dry up, many of these enterprises, a good many in the small business category, would find themselves in difficult straits. There is virtually no facet of American industry which remains unaffected by the business volumes fed into the aircraft production machines.

A brand new airplane, whether military or commercial transport, emerging on the runway just off the production line, epitomizes one of the longest, most complicated and far-flung manufacturing efforts of our time. Airplanes are not stamped out of the production line as are beverage bottle caps. In terms of organization and management an airplane is a system. The aircraft manufacturer is given a basic job and starts to work. He often does not produce the aluminum, make the powerful engines; the landing gear; electronic communications equipment that make up the airplane or guided missile. Yet he manufactures them. The skill involved is in his ability to make these thousands of intricate elements work together to accomplish a specific task. This is the unique qualification of the aircraft manufacturer. Each of the major components

TABLE NO. II

INDUSTRIAL RESEARCH AND DEVELOPMENT COST AND PERSONNEL 1953

(Latest Year for which Data Available)
by Major Industries

	RESEARCH & DEVELOPMENT COST		NUMBER OF SCIENTISTS & ENGINEERS	
	TOTAL (Millions)	%	ALL TYPES	R & D ONLY
All Industries	3,699.4	100.0	553,800	157,300
Electrical Equipment	778.3	21.0	61,000	28,800
Aircraft and Parts	758.0	20.5	48,500	27,600
Chemicals & Allied Products	361.1	9.8	62,700	21,500
Machinery	318.9	8.6	60,300	16,300
Prof. & Scientific Instruments	171.7	4.6	18,800	9,100
Petro Products & Extraction	145.9	3.9	38,500	6,800
Telecommunications & Radio Broadcasting	113.0	3.1	28,600	3,700
Fabricated Metal Products and Ordnance	103.3	2.8	21,900	4,600
All Others	949.2	25.7	213,500	38,900

'PLANES'

of the aircraft is itself the product of an assembly process. The engine plant, for example, purchases from other producers fuel, air and hydraulic systems along with other parts and accessories. There is, in consequence, a virtual host of manufacturing companies supplying the industry with a vast miscellany of products ranging from prosaic nuts and bolts to instruments of great precision and from windshield wipers to diverse armaments.

NO section of the United States has failed to benefit by the economic activities set in motion by aircraft production. For example, a recent compilation by the Office of Assistant Secretary of Defense (Supply & Logistics) places the net value of procurement actions for supplies, services and construction for the Air Force alone, for the period July 1950 through March 1957, at $62.7 billion. The bulk of these funds may be assumed to be supporting aircraft and related procurement. While the distribution by states logically shows the largest concentration where the major airframe and engine builders are located, there are substantial awards in areas not generally identified with aircraft manufacture.

The rapid rate of technological advances in the aeronautical art has dictated that an abnormally high percentage of aircraft industry's revenues be devoted to research and development. An analysis for 1953, the latest year for which data is available, reveals research and development expenditures by major industries and is shown in Table No. II. For that year, the aircraft group spent 20.5% of the entire research and development outlays for all industries. This was exceeded slightly by the electrical equipment group with 21% of the total and which may be considered as harboring substantial electronic activity finding an ultimate home in the aircraft field. The aircraft research expenditures represented 12% of the industry's total dollar sales for 1953 compared with 2% for the all-industry average.

While the aircraft industry sponsors and finances major research activities with its own funds, the bulk of research and development projects are dependent upon Government support. Expenditure in this activity continues unabated and is mounting to new peaks. For example, each breakthrough in a specific field, such as the development of engines of various types with more powerful thrust, in turn increases the difficulty and the need for solution of problems in other fields while creating new scientific challenges. The emergence of missiles as a major factor brought into being a new family of problems in need of solutions.

The results of these research and development activities are not always immediately discernible. But they represent one of the best assurances for the United States' maintaining technological leadership in the years ahead.

In the face of these ever-mounting demands being made upon it, the aircraft industry is being confronted with a ceiling on military appropriations which together with the changing technological art is leading to a radical transition in the character of the business.

THE Administration appears determined to confine total military expenditures to around $38 billion a year as part of its plan for a balanced budget. Of this amount, aircraft and related items, including guided missiles, are to receive new appropriations of around $8 billion a year. But the distribution of these funds now promises to flow in channels entirely different from those of past patterns.

The Air Force, which is scheduled to receive the bulk of aircraft "and related items" procurement money has blue-printed its future spending plans. This trend is summarized in Table No. III, which shows the transition in aircraft spending habits for the Air Force from 1956 to 1961. It can be seen that manned aircraft is scheduled to drop by 50%, from $4 billion to $2 billion. Missiles, of course, are forging ahead, expecting to increase from the $500 million level of 1956 to over $2.8 billion for 1961. The gain in electronics will almost double to $1.3 billion for 1961, but a large portion here may be regarded as more directly related to missile activity. Jet engine deliveries are due for a sharp drop, about 40%, from $1.5 billion to $.9 billion.

ACTUALLY, the consequences of this decline are more acute than indicated. Ramjets, bypass jets and rockets with liquid and solid propellants, will figure prominently in future engine deliveries. And many of these newer powerplants will come from companies not formerly in the jet engine field.

And while faced with the threat of having their volume of activity cut in half within two years, the airframe and engine builders, and other elements in the industry will have a continuing need for additional capital to pay for new facilities and related equipment.

The Air Force has indicated that of the 40 million sq. ft. of facilities out of the available 60 million sq. ft. now utilized by U.S. Air Force contractors, only 20 million sq. ft. will be needed less than two years hence. It is indicated that of the projected 70 million sq. ft. to be available, a staggering 50 million sq. ft. face prospects of remaining fallow.

This harsh fact on facilities is mitigated by the fact that it does not take into account the substantial floor space required for the manufacture of Navy and Army aircraft or civil aircraft.

Nevertheless, within the industry, expansion projects continue at an unabounded pace. This would appear surprising in view of the stated surplus of facilities, both Government-owned and industry-financed. Huge expenditures have already been made for facilities and there will be a continuing need for capital outlays for additional plants and equipment.

For perspective, it is interesting to note that U.S. Air Force-owned facilities for contractors, as of January 1, 1956, represented an investment of $2.1 billion.

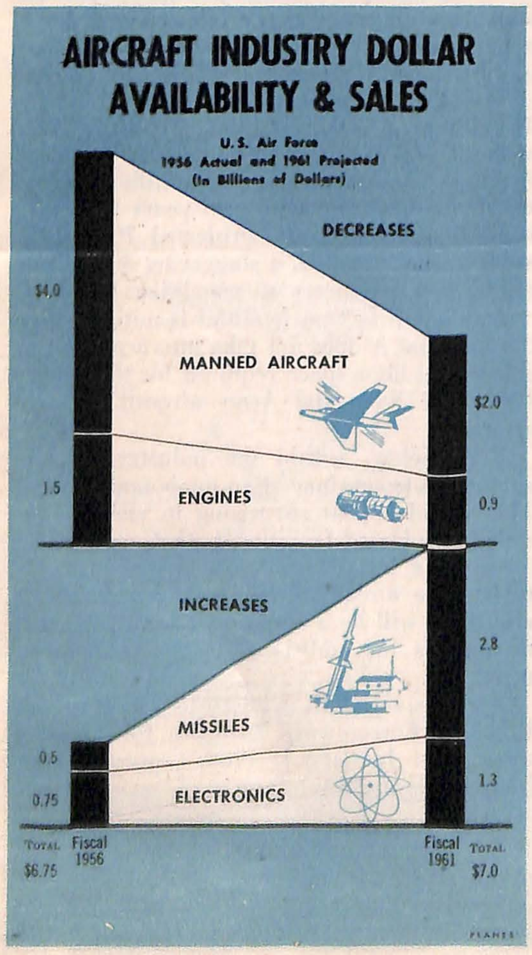
Why the never-ending need for more and more capital expenditures? The simple truth of the matter remains that demands on the aircraft industry are creating a material transition in physical and personnel requirements. The changing complexion of the military services such as the planned shift from manned aircraft to guided missiles, means far-reaching changes in the required facilities to meet new product demands.

A wide variety of electronics, assuming a greater role in complete weapons systems, are moving up very rapidly in taking a larger percentage of the aircraft procurement dollar. The character of engines powering aircraft and other weapons are submitting to vast changes. Nuclear adaptations to the military art, and ultimately to commercial aviation, require new facilities and supporting equipment completely unrelated to anything seen in the past.

Government-owned facilities used by the aircraft industry generally have little value other than for the specific purpose intended.

For example, an airframe assembly floor was designed for the specific purpose of facilitating production of airplanes as efficient as possible within the abilities of the management in charge. Conversion to a highly specialized electronics operation which relatively takes far less space with entirely different layouts, is not a simple or inexpensive procedure. (This is to say nothing of the attendant requirement for an entirely different complex of personnel.) Moreover, an airframe company cannot close down its assembly floors or even reduce their size proportionately to meet reduced airplane production orders. Smaller unit orders, of course, increase the cost of the airplanes but this becomes a factor beyond the control of the services and the industry in view of lower appropriations available.

In recently seeking Congressional approval of funds for facility expansion, an Air Force official justified his requests by a series of examples, a few of which follow:



"New development facilities will be required for programs such as aircraft nuclear, liquid rocket, and ramjet engines, the initial development of these engines, improvement in their reliability and their production acceptance testing require facilities which were previously non-existent and have no commercial application. "The interdependence of subsystems upon precise displacements is forcing watchmaker precision for larger, rugged components, such as zero backlash gear trains . . . this is an area warranting Government financing."

To the limit of their resources the individual aircraft companies are also expending substantial sums for expansion. In hearings held last year before a Congressional subcommittee, there were repeated accounts of these privately-financed programs.

Very recently in accomplishing some public financing, an aircraft company declared that it will need about $20 million for new facilities and equipment. Of this amount, "about one-half is expected to be spent for machinery and equipment, and the balance for construction of laboratory and test facilities . . . Significant among these new facilities are a high speed wind tunnel, a high temperature fluid test laboratory and a rocket engine test facility."

THE full extent of projected capital expenditures is difficult to ascertain. Circumstances and needs constantly change. However, a Congressional subcommittee noted that, as of 1956, the 12 leading airframe manufacturers planned to spend $350 million of their own money for new plants, equipment and research. In addition, principal powerplant producers were represented as earmarking over $200 million for expansion during the next five years. To this must be added the spending plans of one of the largest manufacturers, a builder of engines, helicopters and propellers. It is known that capital expenditures for this firm amounted to over $105.6 million for the past five years. Further, another $90 million was authorized, of which $60 million is expected to be expended in 1957.

It is clear that the aircraft industry will have a continuing need for substantial sums to conduct its costly and vital programs. This money can be forthcoming from only three main sources:

1. Earnings and other internally generated funds such as depreciation and non-cash charges.
2. New capital in the form of additional equity, long-term and short-term debt.
3. Government assistance.

Profitability of operations remains the key not only to developing current earnings but attracting new capital as well. To the extent that industry can finance its operations on its own there will be less demands made on the Government for assistance. Certainly, the Government will be called upon to finance directly a wide segment of highly specialized programs. But there are wide areas where industry can do the job best on its own. For example, each company may be expected to know best its own technical and production potentials. For a Government agency to make all such decisions would seriously restrict freedom to explore and improvise technological advances.

While earnings for the industry, as a whole, have improved somewhat in recent years, obviously, in themselves they are inadequate to meet the projected need for capital assets. Earnings are essential to attract equity capital to the industry. Without sufficient equity, it becomes extremely difficult, if not impossible, to obtain the required loans of a short or long-term nature.

The aircraft group is in constant competition with other industries that also need capital, but whose earning power is uninhibited by the artificial restraints and special peculiarities found in aircraft development and production. Moreover, these other industries have far better histories of earnings and stability, plus some attractive dividend records. This condition becomes even more acute in the tight money market now prevailing.

INCIDENTALLY, it is most significant that after extensive hearings and examinations, a Congressional subcommittee investigating aircraft profits of a group of 12 major airframe companies for the period 1952-1955, concluded that:

> "*. . . on the evidence, that there has been no showing that, on the average, the profits allowed, are excessive.*"

Aircraft profitability deserves measurement on a different basis from that applied generally to most other industries. For example, the complexity of aircraft and missile production must be considered in appraising the reasonableness of earnings. Few other industries are required to concentrate so speculatively on the development of so limited type of revolutionary products over as long a period of time without reasonable assurance that the products will ultimately be purchased. The cycle of a new type supersonic aircraft or missile, from conception to prototype may consume years, during which hangs a doubt as to whether the product will ever reach production. Were not technological uncertainties present, there remain changes in Government requirement, development of a competitive product and failures in deliveries of major components, all of which can render the most creative effort completely profitless.

And when an aircraft enterprise successfully runs the gauntlet and completes a production run, there is no assurance that it may retain the profits realized in this work. This is after submitting to price-redetermination on contracts and which is presumed to set a fair cost to the Government and provide a reasonable profit for the company. There remains the delayed reaction of renegotiation a few years later. This is a judgment factor and it is frequently a frustrating experience for aircraft management to contend with this unknown in their fiscal affairs and which appears to be beyond their control. Yet, it is this threat of second-guessing by the renegotiation authorities which has frequently discouraged vital investment support for the industry.

No one questions the need of a balanced fiscal budget and eliminating waste and unnecessary Government expenditures. The high cost of aircraft and weapons systems will always remain a source of concern to the Congress and military services. But the fact remains that aircraft and missiles, by their nature, are enormously expensive due to their revolutionary designs and intricate construction. If the industry is to fulfill its destiny in the jet-atomic-electronic age, it must attract the best available brains and facilities. It must be able to compete with other industries for the people and money to make this possible.

Fares Today Are Lower than 1938 as Services Show Great Gains

(*Continued from page 1*)

the price line in a maelstrom of inflation is a tribute to the teamwork of our air transport and aircraft manufacturing leaders. Commercial transport manufacturers have developed and produced planes that can attract more passengers and carry more passengers at economical rates.

The U. S. aircraft industry has produced a succession of two- and four-engine piston aircraft that set the standard for performance and earning power throughout the world. This is proven by the fact that 85 per cent of the aircraft flown by the world's airlines are built in America. There are no tricks of foreign exchange or national preference in this record. American aircraft were chosen for no more complicated reason than they are the best transport aircraft obtainable.

Today it is possible to make a coast-to-coast flight in eight hours in the latest four-engine planes. There is a substantial backlog of orders for piston transport aircraft scheduled for delivery to U. S. and foreign airlines after the first jets enter service. The domestic trunklines alone this year will take delivery of 136 new planes, and 113 will be the latest four-engine types. This portion of the modernization program alone will be an eight per cent increase in the present airline fleet.

The airlines have aggressively sold the benefits of air travel to the public, have instituted the most modern managerial practices to keep costs down and service up.

But as we approach the era of jet transportation, the airlines find themselves trapped at the point of diminishing returns. Business booms and profits sag. Last year the gross revenues of the scheduled air transport industry increased by 11 per cent over the previous year, but the net income declined by 10 per cent. The profit margin has steadily declined over the last seven consecutive quarters since the third quarter of 1955. The profit margin before taxes in the past 21 months has slipped from 12.11 cents on the dollar to 5.76 cents.

The reasons are simple: Everything involved in running an airline has gone up—wages, parts, fuel, cost of aircraft—while the fare has remained the same.

The airlines today are seeking a modest increase to offset part of these rising costs. The Civil Aeronautics Board recently denied an immediate increase sought by seven of the twelve trunkline carriers. The CAB's General Passenger Fare Investigation, however, is continuing, and hearings will be held this fall. The investigation will reach the CAB for decision sometime next year.

Failure to grant this minimal relief to the airlines can only delay the full realization of the commercial jet program. This conclusion is inescapable. Our domestic carriers today are committed to spend $2 billion for jet airliners. Loans, depreciation accruals and funds on hand will meet $1.4 billion of this bill, leaving $600 million to be provided in the next three years by earnings or additional investment. The expansion of our economy has put a strain on credit resources. Even companies with good earnings records are encountering difficulties in finding new capital, and airline stock prices have declined 30 to 40 per cent from the peak two years ago, while Dow Jones industrial averages have risen 16 per cent.

An investment banker, William Barclay Harding, a specialist in aviation securities who examines the earnings with clinical precision and objectivity, recently said: "The earnings record of the airlines in recent months puts them in a particularly disadvantageous position. More than anything else, the airlines need better earnings. In the long run, capital can be attracted only by earnings."

There is no question that the new aircraft produced by our manufacturers will earn their way. For example, if a new jet airliner is used for only 450 trips a year it would be able to carry more than 60,000 passengers across the Atlantic. This nearly equals the number of passengers carried in the same period by the SS United States, and that vessel cost $70 million when it was built four years ago. The increased comfort and performance of jet aircraft will certainly attract more passengers. But the fares must be adequate to insure earnings that will close the $600 million gap.

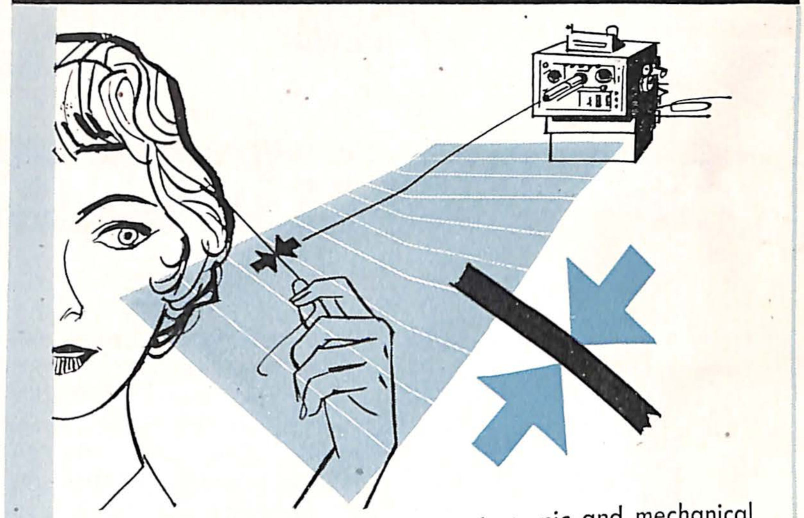
The economic safety of our vital air transport industry is anchored by an adequate fare structure. In turn, the manufacturing industry needs the commercial aircraft sales made to U. S. carriers if it is to retain its position of leadership in the world aircraft market, and build the commercial business that forms a cushion when military orders are curtailed.

There is a substantial bonus for hard-pressed taxpayers in the turbojet re-equipment program of the airlines. Most of these aircraft become part of the Civil Reserve Air Fleet.

The language of the Civil Aeronautics Act is clear in defining the responsibilities of the Civil Aeronautics Board. The Board is charged with the "encouragement and development of an air transportation system properly adapted to the present and future needs of the foreign and domestic commerce of the United States, of the Postal Service, and of the national defenses . . . and foster sound economic conditions in such transportation."

Permitting the air transport industry to lose its dynamic momentum through negative interpretation in the administration of this policy would be a foolhardy, dangerous gamble with a vital national asset.

PRECISE PERFORMANCE



Instruments used to check the electronic and mechanical systems in modern aircraft and missiles can measure the width of a hair at a distance equal to the length of a football field. The aircraft industry has pioneered the use of precision manufacturing and testing techniques to insure that modern weapons can fulfill their mission.

'PLANES'

Modern Missile Techniques Outlined to President by Navy Lieutenant—111 Years Ago

The young Navy Lieutenant thought our naval forces ought to have more modern weapons, but nobody was willing to listen to him. So he wrote a letter to the President of the United States, telling the Chief Executive he had exploded missiles electrically by remote control.

Lt. Henry Moor, USN, also set forth the advantages he felt could be gained through underwater explosions, air bursts and proximity-fuse-type blasts, according to the Armed Forces Press Service. The young Navy officer said he had turned mortar shells into missiles by using an electric switch to trigger the blasts. He claimed to have exploded five missiles attached to 1,500 foot wires successfully.

Such missiles, he said, would provide striking power "to fly over the deck of a ship, to attack the enemy on their own coast, destroy the shipping in their harbors, ascend their rivers and penetrate into the heart of their country."

The amazing thing about Lt. Moor's letter to the President is that it was dated May 10, 1846, and the President it was addressed to was James K. Polk.

Missile Assembly Needs Room Within Room

An idea of the delicacy of assembling tiny missile components can be gained from the fact that a particle of dust sized between 60 and 100 millionths of an inch, lodged in a minute ultra-precision missile part could cause as much friction as a handful of sand thrown into a ball bearing assembly of conventional size.

To cope with such problems on the microcosmic scale, an aircraft and missiles components firm is currently building a room within a room for missile subassembly. Three-sided glass "steri-shield" canopies will cover the work in progress, with room enough beneath them for a worker's hands to assemble miniature missile parts. The partitions and wall crevices are to be sealed with tape to prevent impure air from seeping from the outer to the inner room, and a bank of filters governing air pumped into the inner room will remove 99.9 per cent of the dust.

Ventilated Treads Used To Keep Tires Cool For High-Speed Landing

Modern jet fighters and interceptors take off and land at very high speeds, sometimes above 200 miles-per-hour, and the tires on their landing gear consequently take a rugged beating.

A new, cooler-running jet aircraft tire, however, survives up to three times as many high-speed landings and takeoffs than conventional tires designed for use on jet aircraft. Key to the tire's improved performance is a ventilated tread design effective under extreme loads on operations at speeds above 200 miles-per-hour.

The new tread pattern permits heat to flow uniformly from the tire while spacious grooves between its ribs circulate cooling air to eliminate formation of localized "hot spots." This permits equal distribution of tread rubber in tires designed for modern jet aircraft for the first time, according to the manufacturer.

New Fuel Boosts Range

Boron high energy fuels which are expected to be available to the military in substantial quantity by 1959 will boost the range of current jet aircraft by approximately 40 per cent. Present turbojet engines will have to be modified to burn the fuel.

AROUND THE WORLD IN 48 HOURS

FLYING around the world in 48 hours, which will be possible when America's new turbojet transports enter airline service, poses problems of a sort that never concerned Phileas Fogg, hero of "Around the World in 80 Days."

Travelers will operate on two times—Stomach Time and Zone Time. For example, a traveler departing from the West Coast Friday at 4:00 p.m. local time on an eastbound jet flight around the world would find himself in Karachi, Pakistan, about 24 hours later, but the Karachi clock and calendar would tell him that it was 3:40 a.m., Sunday. His stomach would insist that it was close to dinner time, but the clock would be equally insistent that it was approaching time for breakfast of the following day.

The airlines are well aware of these problems and carefully plan their flights and meal service to eliminate such conflicts whenever possible. But the long-distance traveler simply must stomach his problems.

The timetable shown here illustrates the differences in Stomach Time and Zone Time encountered in around-the-world flights in opposite directions.

A passenger flying east from the West Coast would arrive in Paris at noon local time although his stomach would be telling him it was 3:10 a.m. It gets even more complicated as the flight continues east. The traveler's Saturday would last only 13 hours, and Sunday would be divided by Monday. By the time he departed Tokyo it would be Monday, but Sunday would pop up again when he crosses the International Dateline and arrives back at his original point of departure.

The westbound flight is equally amazing. The swift jet transport would be traveling with the sun and only an hour's time would be consumed every few thousand miles. If he departed westbound at 4:00 p.m. West Coast time, passing the International Dateline would cut Saturday in half, but his Sunday would then be 40 hours long. The eastbound passenger would see the sun rise three times in 48 hours, but the westbound passenger would have only one morning during the entire trip.

Progress of the aircraft industry in designing faster, more comfortable aircraft may one day find aircraft flying at the same speed of the sun and time will stand still.

JET TRANSPORT

Around-the-World Timetable

AIA

EASTBOUND			WESTBOUND		
STOMACH TIME (SAN FRANCISCO)		ZONE TIME	STOMACH TIME (SAN FRANCISCO)		ZONE TIME
4:00 pm Friday	Lv San Francisco	4:00 pm Friday	4:00 pm Friday	Lv San Francisco	4:00 pm Friday
8:12 pm	Ar New York	11:12 pm	1:10 am Saturday	Ar Tokyo	6:10 pm Saturday
9:00 pm	Lv New York	Midnight	5:00 am	Lv Tokyo	10:00 pm
3:10 am Saturday	Ar Paris	12:10 pm Saturday	10:09 am	Ar Saigon	2:09 am Sunday
7:00 am	Lv Paris	4:00 pm	11:00 am	Lv Saigon	3:00 am
10:55 am	Ar Beirut	8:55 pm	4:18 pm	Ar Karachi	4:18 am
Noon	Lv Beirut	10:00 pm	5:00 pm	Lv Karachi	5:00 am
3:40 pm	Ar Karachi	3:40 am Sunday	8:40 pm	Ar Beirut	6:40 am
5:00 pm	Lv Karachi	5:00 am	9:30 pm	Lv Beirut	7:30 am
10:18 pm	Ar Saigon	2:18 pm	1:25 am Sunday	Ar Paris	10:25 am
11:30 pm	Lv Saigon	3:30 pm	9:00 am	Lv Paris	6:00 pm
4:50 am Sunday	Ar Tokyo	9:55 pm	3:10 pm	Ar New York	6:10 pm
7:00 am	Lv Tokyo	Midnight	7:30 pm	Lv New York	10:30 pm
4:10 pm	Ar San Francisco	4:10 pm Sunday	11:42 pm	Ar San Francisco	11:42 pm

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