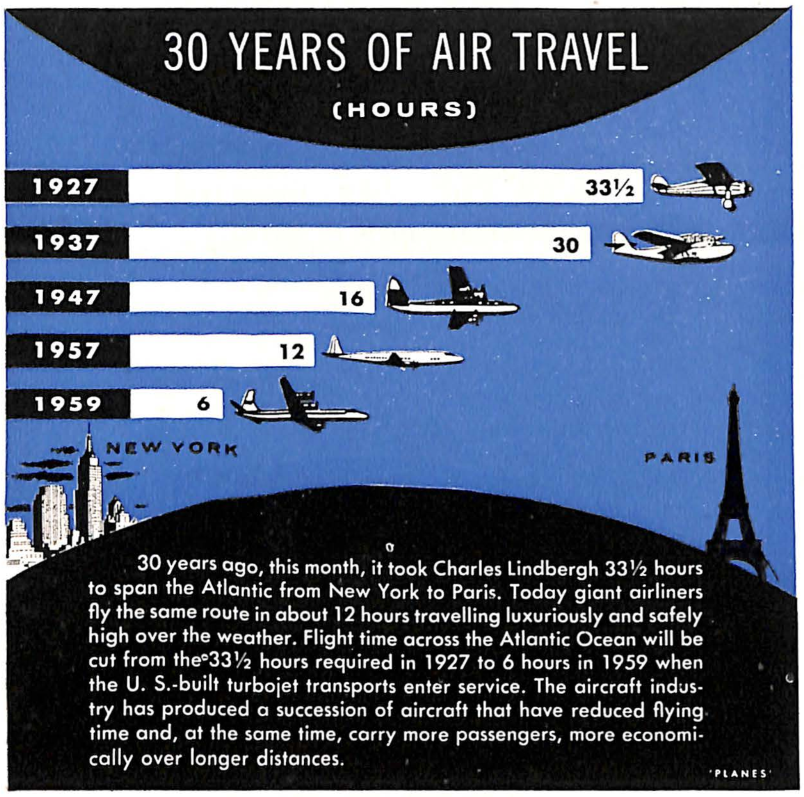
AIA

planes

May 29, 1957
Vol. 13, No. 5

OFFICIAL PUBLICATION OF THE AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA

AIRLIFT IS KEY TO LOGISTICS ECONOMY



30 years ago, this month, it took Charles Lindbergh 33½ hours to span the Atlantic from New York to Paris. Today giant airliners fly the same route in about 12 hours travelling luxuriously and safely high over the weather. Flight time across the Atlantic Ocean will be cut from the 33½ hours required in 1927 to 6 hours in 1959 when the U. S.-built turbojet transports enter service. The aircraft industry has produced a succession of aircraft that have reduced flying time and, at the same time, carry more passengers, more economically over longer distances.

Air Force Reports Air Transportation Saved $9.8 Billion on High Value Items

By I. C. Peterson
Director, Technical Service, Aircraft Industries Association

Military air transport, one of this nation's most strategic resources is, for the most part, an enigma to the general public and an absolute logisical necessity to the Army, Navy and Air Force.

To the general public, military air transport simply implies fast and "luxurious" transportation of personnel from one base to another either here in the United States or to any of the military's far flung installations on the other side of the world.

While air transport may be considered luxurious in comparison to surface travel, the reason for increasing air transport of military personnel, reduced to its common denominator (excluding war emergency), is the cost factor.

Civil air carriers, for example, under contract to the government to move personnel in excess of the military "space available" air transport, alone, in 1955 produced a net gain to the government of more than $9,000,000 in terms of per diem pay saved in rapid transport. The savings in man-hours productive time amounted to 20,165,301. These are savings in time and money to reckon with. Military air transport equivalents are not available but it is safe to say that they would be even more dramatic since they carry the bulk of personnel transported.

However, the savings effected in the air transport of military personnel is only a fractional part of military air logistics. For example, the Air Force determines that out of 725,000 inventory items, a scant *two per cent* of them account for 40 per cent of the money value. At the same time, most of these high unit cost items share some other common characteristics — low bulk weight, critical production lead time and susceptibility to damage in transit. Airlifting these items, military experience has shown, provides a fast, safe, distribution system with an added premium of reducing a large inventory requirement for items in transit to, or stored at, forward areas.

In this connection, the Air Force recently reported that airlifting high value cargo had already saved $9,800,000,000—a figure exceeding the total outlay for aircraft *and* missiles for *all* the armed services in the 1958 military budget. Thus, by concentrating on air transport of high dollar-value items, air logistics more than pays for itself.

Military air transport has made a significant contribution to the peace

(See *TRUE GLOBAL*, Page 7)

Planes Are Built to Hair's Breadth

"Splitting hairs" may not be a social attribute, but it is a *must* in the manufacture of today's supersonic aircraft.

Building one long-range intercontinental bomber, for example, is like manufacturing about 1,000,000 high quality wrist watches. Most measurements are made in thousandths of an inch. A variation of only .005 inch thickness on the wing skin could add 275 pounds of weight to the plane. In the machining of the wing stiffeners alone, a deviation of .005 inch thickness could add 110 pounds of weight to the plane.

A hair's breadth makes a critical difference in an airplane with several thousand square feet of wing area, because it is directly connected with the range and speed capacity of the airplane.

Bolt and rivet fit on the bomber must be precise. The holes for the four basic bolts used to hold each two-engine nacelle strut to the wing can vary only .0016 inch and the bolts can vary only .0011 inch.

In spite of the fact that a fuselage section is larger than a railroad boxcar, it must conform to close-tolerance requirements and join accurately with other sections, built in other factories. Tolerances are .020 inch.

Even the thickness of each coat of paint on the airplane is measured and controlled. A protective coating (paint, varnish, lacquer, anodizing, plating) must be thick enough to do its job, but no thicker, as additional thickness adds weight. In consequence, some coatings are as thin as .00004 inch.

As manufacturing processes are continually improved, new methods bring new requirements in precision. The strength of U. S. defense can lie in the delicacy employed by the U. S. aircraft mnufacturer.

New Magnesium-Thorium Alloys Offer Solution to 'Heat Barrier' Caused by High Speeds

Already, the aircraft industry has overcome two formidable barriers in its history of conquest of the air—the gravity barrier and the sound barrier. Work is now under way on a third—the "heat barrier."

But just as the first two barriers were toppled through patience and the resources of science, so also is the conquest of the heat barrier inevitable. That it is being surmounted is a tribute in part to the development of high-temperature magnesium-thorium alloys.

These new materials combine magnesium's traditional light weight and strength with the ability to withstand the temperatures which confront today's supersonic aircraft.

Just what is the heat barrier? Simply this: as an aircraft, a missile, or a rocket—no matter how functional its design—blazes through relatively dense air at speeds above 1,000 miles per hour terrific friction occurs along its surfaces. The friction generates intense heat within a layer adjoining the surface of the aircraft or missile.

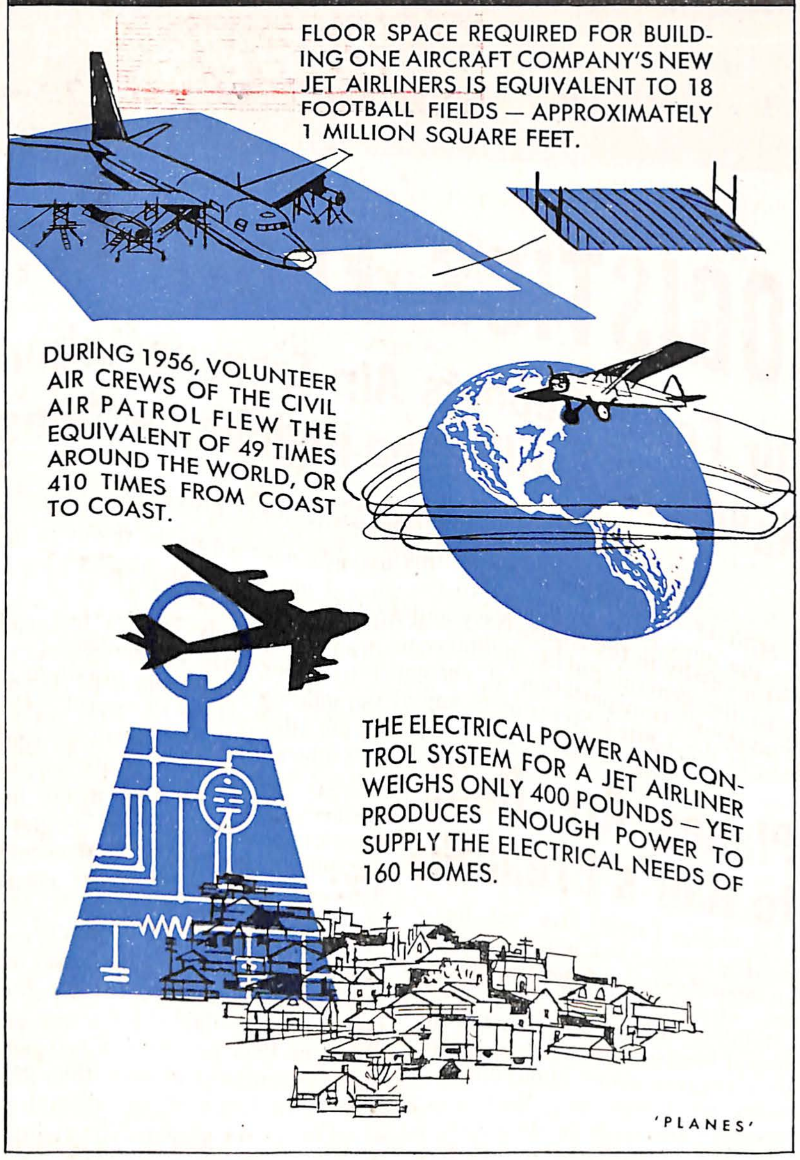
The fact that air temperature decreases rapidly as altitudes increase does not help. Materials with built-in heat resistance are necessary.

Two of these new high temperature sheet alloys seem certain to fill a critical void in the nation's defense needs that can best be described this way: aluminum is satisfactory in the low temperature range, and while several metallic alloys resist high temperatures well, none but magnesium offers the weight savings so paramount to top performance. To put it another way, titanium and some stainless steel alloys are impervious to extremely high temperatures, but their relatively heavy weight is an impediment to maximum performance.

The virtue of the new magnesium-thorium alloys is that they combine a superior strength-to-weight ratio with excellent heat resistance. They are ideally suited to the "middle temperature range" of about 350-750 degrees encountered by most aircraft and missiles which fly at more than 1,000 but less than 2,200 miles per hour.

When—not if—the heat barrier is smashed, it will be due to the brilliant research and development efforts of the men and women of America's aircraft industry, who continually face up to—and overcome—many such barriers.

Plane Views



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.

Publication Office: 610 Shoreham Building, Washington 5, D. C.
New York Office: 150 East 42nd Street, New York 17, New York.
Los Angeles Office: 7660 Beverly Boulevard, Los Angeles 36, California.

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

Air Progress

At 7:52 a.m., May 20, 1927, a tiny heavily laden, high-wing monoplane waddled down the runway and finally climbed slowly into the air over Roosevelt Field, New York—bound for Paris. The plane weighed 5,000 pounds fully loaded, and its pilot, a young chap named Charles A. Lindbergh, flew the 3,600 miles to Paris without stopping.

The plane's 225 horsepower engine spun the propeller 1,700 to 1,800 times a minute continuously without fault for thirty-three and one-half hours. But the public's adulation was centered only on the slim pilot; the vehicle which made his flight possible got scant attention. As a matter of fact, one day the designer of the engine was asked how the public could overlook the part the powerplant played in Lindbergh's exploit. He answered: "Who remembers the name of Paul Revere's horse?" Perhaps it was prophetic that the public should stop worrying about the reliability of the airplane and airplane engines and begin to take them for granted.

In 1956, the scheduled airlines carried their 300,000,000th passenger. Behind this statistic is a far more significant fact than the number itself. It took 24 years for the airlines to carry the first 100,000,000 passengers but only a little over two years to hit the 300,000,000 mark. Of equal statistical, and perhaps historical, interest is the fact that United States scheduled airlines today are carrying 65 per cent of all passengers travelling between the U. S. and foreign countries. In fact, these airlines fly more than 61 per cent of the entire free world's passenger traffic.

Speeds during the last three decades have increased markedly. In the time it took an air traveller in 1938 to go from New York to Chicago, today's passenger can fly all the way from New York to Denver. In 1959, when the luxurious turbojet and turboprop-powered transports join the airlines, he'll make it all the way to Los Angeles in the same air travel time.

The biggest of today's four piston-engined airliners can carry five times as many passengers as the twin-engined airliners of 1938. Passenger-wise, all of today's airliners could provide seats for every man, woman and child in a city of 80,000 population. At the same time, they could carry 3,116 tons of mail, express and freight.

Safety, too, perhaps, has been a most significant factor in building this nation's confidence in air travel. In the ten years from 1947, airline accident fatality rates have shown a drop of almost 80 per cent. Moreover, safety record comparisions show that air travel is, in fact, five times safer than riding in your own automobile.

All of this is, of course, a tribute to efficient management of the scheduled airlines, and to the fine quality of the transport aircraft produced by the U. S. aircraft industry. The transportation achievements of the past few years have been made possible only through the intelligent cooperative efforts of both the aircraft manufacturers and the airlines.

Today, the aircraft industry represents a blend of many technologies. There is hardly a science or a craft upon which it does not draw. Its manufacturing skills have been sifted from generation after generation of inventive men of science and engineering concerned only with building a better, more useful product.

The trend continues toward more complete and highly perfected tooling and methods of manufacture to meet the demands of the advanced designs of aircraft, their engines and equipment. The genius of the aircraft industry has provided the airplane pilot with a wealth of mechanical and electronic aids in order to simplify and ease the pilot's task of flight control and to insure the safety, comfort and well being of his passengers.

Turboprop Engines To Power Ship

Some time this Summer a strange looking ship should be making a test cruise in the coastal waters off the southeastern United States. The vessel—an ex-Liberty ship—will be propelled not by customary ship's engine, but by four aircraft turboprop engines mounted on 40 millimeter gun mounts placed in pairs fore and aft on the deck.

If all goes well, the ship, with all propellers generating 20,000 horsepower, will move majestically through the waves at a speed of eight knots.

This is "Project Dumbo," which got its start last January in the Navy's Bureau of Ships. Since aviation engineering was definitely involved, the Navy's Bureau of Aeronautics was also called in on Project Dumbo.

Representatives of aircraft engine and propeller companies also took part in the novel idea of propelling a seagoing vessel by aerial means.

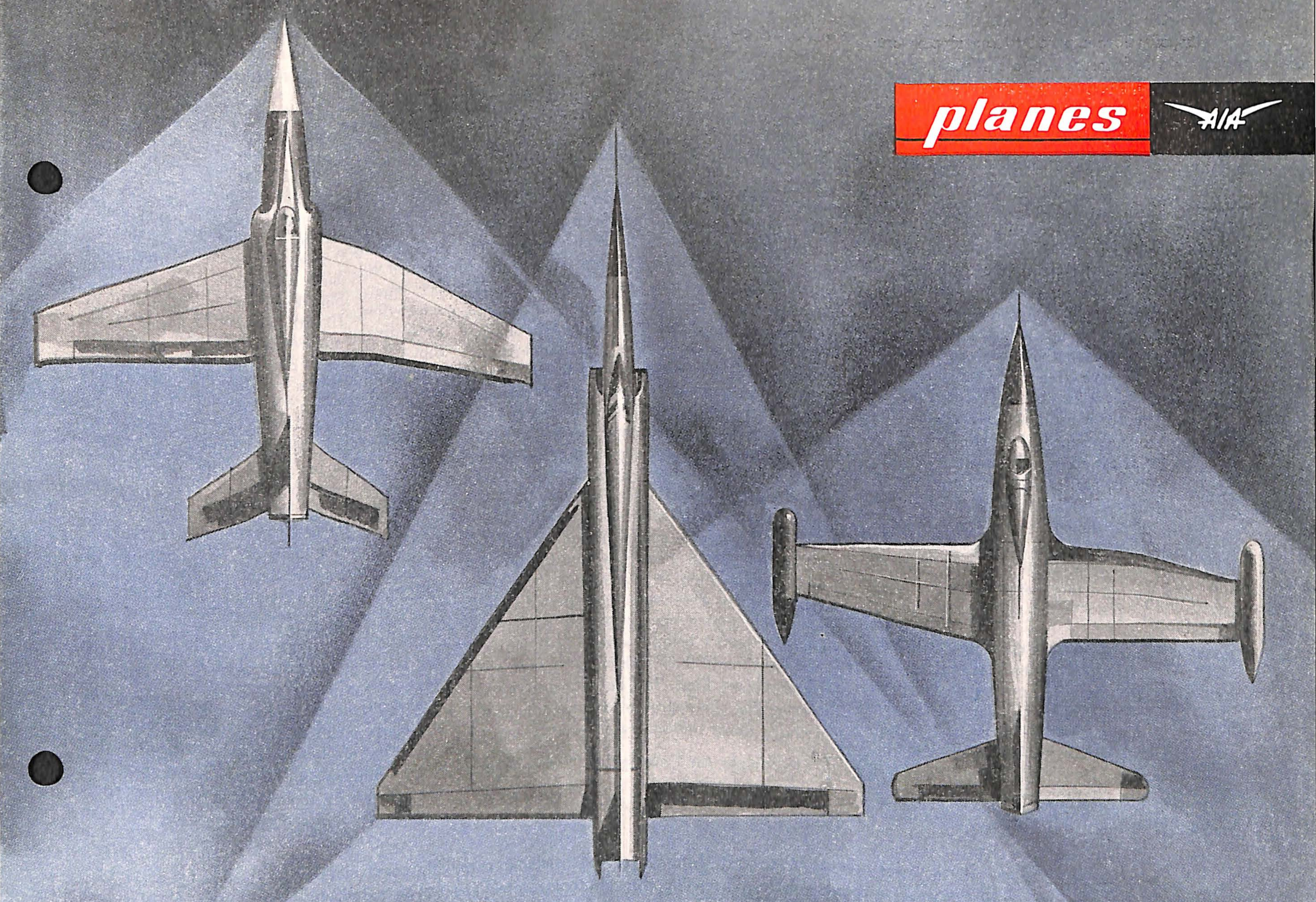
The moral of the story is obvious. If you have a problem in propulsion, bring it to the aircraft industry, which probably knows more about propulsion than any other industry.

AIR QUOTE

"By word and deed the Soviets are challenging us in aviation. They are building more aircraft than we. They are training more aeronautical engineers and scientists that we. Perhaps most significant, there are incontestable indications that they are overcoming our greatest advantage and are closing the technological gap. Vigorous research and development programs are the key to technological supremacy. We must redouble our efforts to maintain our technological lead.

"We will never start a war. I am convinced that the Soviets will not start a premeditated all-out war until they are satisfied they have established technological superiority and believe they can win.

"What we do now will determine our deterrent power tomorrow. Every dollar spent on fundamental research and development to gain leadership in weapons technology today will, in the long run, save many more dollars and possibly many lives."—*Dr. J. H. Doolittle, Chairman, National Advisory Committee for Aeronautics, February 21, 1957.*



Sonic Boom

By Senator Barry M. Goldwater

SENATOR BARRY M. GOLDWATER, of Arizona, is a colonel in the U. S. Air Force Reserve, and the only member of the U. S. Senate who is a qualified jet pilot. He has flown most of the supersonic fighters in the Air Force inventory. Senator Goldwater joined the Air Force in 1941 and during World War II served in the Far East with the Air Transport Command flying supplies and personnel across the Himalaya mountains from India to China. He attended Staunton Military Academy and the University of Arizona. Sen. Goldwater was elected to the City Council of Phoenix in 1949 and re-elected in 1951. He was elected to the U. S. Senate in November 1952. He is a member of the American Legion and the Veterans of Foreign Wars. Sen. Goldwater is Chairman of the Board of Goldwaters, of Phoenix.

A NEW sound of air power progress will become more apparent as America opens its doors to the summer season, and more supersonic aircraft are delivered to the military services. This sound is the sonic boom—man-made thunder. It is one of the most widely misunderstood phenomena of high-speed flight, and has been blamed for damage that couldn't have been inflicted by an atomic bomb.

The U. S. Air Force recently reported some initial findings of a study of sonic booms to find out how they are caused, the damage they can do and, even more important, the damage they cannot do. The study was made by scientists and structural engineers of the Wright Air Development Center, largely based on investigations of claims from citizens who thought, correctly in a few cases and incorrectly in most cases, that their homes had been damaged by the sonic boom.

The researchers found out many things, but it should be a matter of relief to the citizenry that the study proved the sonic boom, from usual operating altitudes:

Cannot crack foundation walls or pavement.

Cannot crack plaster walls installed according to most building codes.

Cannot cause roofs to buckle or crack.

Cannot do any structural damage, but under some circumstances can damage glass panes and improperly installed doors.

There is nothing mysterious about the sonic boom. In fact, muleskinners in my state of Arizona once created booms of a minor variety when they cracked their whips over the teams. The tip of the whip actually exceeds the speed of sound and causes the characteristic sharp crack.

Basically, sound is wave lengths of various pressures hitting the ear, and they result from any surge of energy. The strong arm of the muleskinner provides the energy that creates the crack of the whip. The wave lengths can be compared to the ripples created by a rock tossed into a still pond. Ordinary conversation is a series of pressure wavelets pulsating against the ear like ripples of water slapping the shore of the pond.

AN explosion is no more than a very strong pressure wave created by a sudden release of energy. These strong waves of pressure are known as shock waves because of their intensity.

The sonic boom can also be explained by this established law of sound. Shock waves are not visible except under laboratory conditions where highly specialized photographic equipment can catch their distinctive shape. If the shock wave created by a supersonic aircraft in flight were visible, it would resemble a shallow dish as it attaches to the airplane at the exact speed of sound. The speed of sound varies according to altitude and temperature. At sea level, it is 760 miles per hour, and at 40,000 feet the speed of sound is 660 miles per hour.

When the plane exceeds the speed of sound, the waves are swept back from the nose at sharp angles until they form the cone shape of a funnel. Here is the making of a sonic boom.

The shock wave travels through space, but, unlike the ripples of water that it basically resembles, there are only one or two ripples. This wave, which has been formed by the tremendous energy of the aircraft flying at supersonic speed, reaches the ground at the speed of sound. However, the shock wave is obstructed by anything it comes against— trees, buildings, automobiles — anything it touches. The power it possesses is constantly dissipated as it passes through the air. It is robbed of its energy by the friction it creates in its passage through the air and on the ground. Guided missiles create a sonic boom as they move through the air, as do aircraft capable of supersonic flight during climb. But this sonic boom never reaches anyone's ears since it dissolves in its upward flight.

However, when the increase in pressure occurs at the eardrum, we have a sound. Anyone in the path of the cone's high pressure air will hear the sound as the cone passes over him. The aircraft dragging the cone along is travelling at a very high rate of speed, and, since the high pressure is concentrated in a very small volume, this sound is a sharp crack which sounds much like a thunderclap.

This, essentially, is all there is to the cause of the sonic boom. It is man-made thunder with the aircraft playing the role of an electrical discharge or lightning.

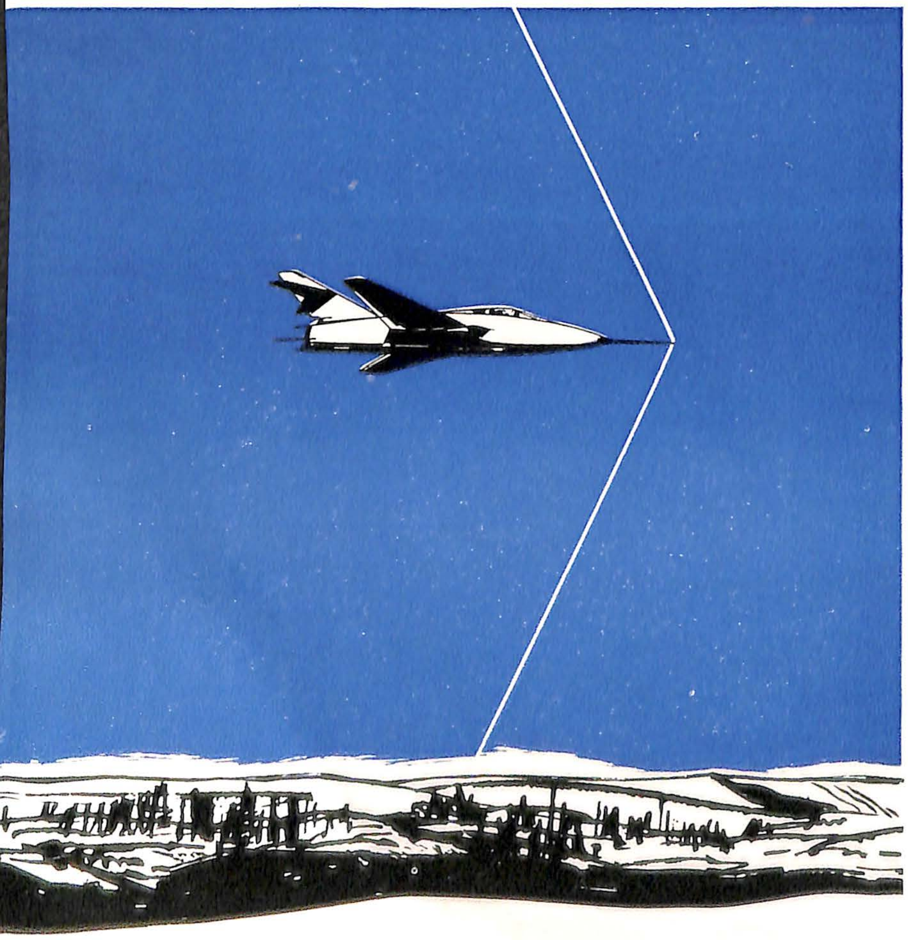
A loud thunderclap can generate a pressure of about a half-pound per square foot, and a loud sound from a boiler factory will produce a pressure of about one pound per square foot. The noise of a sudden thunderclap will startle or frighten people while the boiler room noise, which is continuous, will do neither, simply because it is expected. Reducing the analogy even further, a person shouting "boo!" behind a man will startle him more than a "boo!" shouted by someone he sees before him. It's only fair to note, however, that the degree of surprise depends on who is doing the booing.

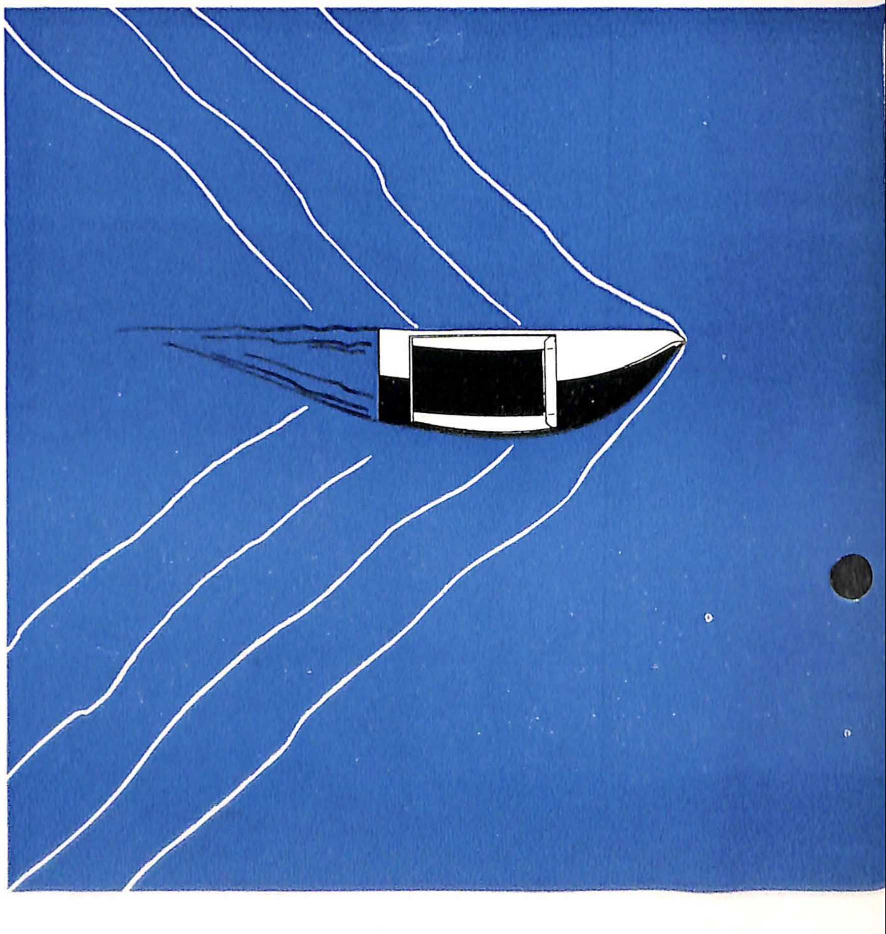
THE Wright Air Development Center engineers and scientists made a thorough investigation of representative cases of the damages alleged to have been caused by the boom. They had a substantial background of experience in shock waves caused by explosions to draw upon in arriving at their conclusions.

FIRST, the engineers and scientists observing the effect of shock waves generated by atomic explosions never detected structural damage to the flimsiest structures at pressures less than 70 pounds per square foot. In tests where aircraft have dived from 35,000 feet, exceeded the speed of sound, and then pulled out at 25,000 feet, the pressure of the wave created has been no greater than 5 pounds per square foot. Even when the aircraft descended to 10,000 feet before pull-out, the pressure did not reach 10 pounds per square foot. Supersonic operations are rarely performed at altitudes less than 20,000 feet since the pilot requires this altitude as a safety factor for recovery from the dive. The Air Force even carried its recording instruments to a mountain top to obtain a pressure reading. They registered an aircraft flying at supersonic speed 280 feet away and the maximum reading was 33 pounds per square foot. The jet pilots I know are much too wise to attempt supersonic flight at an altitude of 280 feet except for the most urgent operational reasons.

Air Force regulations also state that sonic and supersonic speeds during straight and level flight will be commenced and terminated at altitudes above 30,000 feet over land areas, and above 10,000 feet over water areas. Sonic booms are not intentionally performed during tactical missions, and when training programs require speeds that could produce a sonic boom, the flight must be conducted over

Shock waves created by aircraft flying faster than sound are roughly comparable to the waves created by a boat speeding through the water. The wavelets follow to nose of boat just as the shock waves do.





specially designated areas under close supervision. These regulations governing training missions are also applied by the aircraft industry in conducting test flights of new aircraft.

BY simple arithmetic, the pressure produced by the usual sonic boom is less than one-twentieth the pressure required to cause structural damage to a flimsy structure. The behavior of homes and industrial buildings of brick, block and frame construction tested by nuclear explosions reveals that it takes pressure on the order of 150 to 300 pounds per square foot to cause damage ranging from plaster cracks to wall and roof cracks.

The WADC engineers made a calculation study of a wood stud wall with a plaster inside surface. The walls were between eight and ten feet in height and constructed from 2 by 4 studs. Suppose we overlook the strength contributed by the sheathing, siding and plaster and assume that the stud takes all the load. On a single stud the load is about 67 pounds. The maximum tension in the stud at the middle is 200 pounds per square inch of stud.

Most building codes require that the stud be fastened to the plate by three 12-penny nails. These nails provide the shear resistance. The shear strength of the nails is about 300 pounds and the tensile strength of the wood is at least 1,000 pounds per square inch. Building authorities say that in order to prevent plaster cracks, the deflection at the middle of the beam should not exceed 1/360th of the span length.

As long as a ten-foot stud does not bend more than one-third of an inch at the middle from its normal position, the wall plaster will not crack. By calculation, the deflection of our wall stud under the heaviest load imposed by a sonic boom would be only 30 per cent of the deflection required to crack the plaster.

Calculations of this kind can be extended to various elements of the house—roofs, side walls and porches. The sonic boom falls far short of causing sufficient load to crack plaster, floors, roofs and walls. The force exerted by the boom is like a giant giving the whole house a very light and very quick touch.

So far the structure has been discussed as if it had no openings. Now let's take a look at the windows and doors. The sash and frame of a window, of course, are more than strong enough to withstand the relatively minute force of the boom.

The window glass is another matter. Glass, in one sense, is a strong material, but it is brittle compared to other building materials when used in thin sheets. The methods by which it is manufactured are apt to produce internal "lock-up" stresses. In addition, the glass may be bent ever so slightly when it is installed. Thus a light, sharp blow can shatter a glass pane.

I do not want to imply that a sonic boom will always break windows. Ordinary window glass, properly installed, will break at pressures of 18 to 70 pounds per square foot, a much greater force than the boom produces. In fact, the Air Force, in a recent demonstration, directed sonic booms at a large plate of glass held in a frame. Five successive sonic booms failed to shatter the glass and only when the glass was loosened in its frame did the boom cause it to shatter.

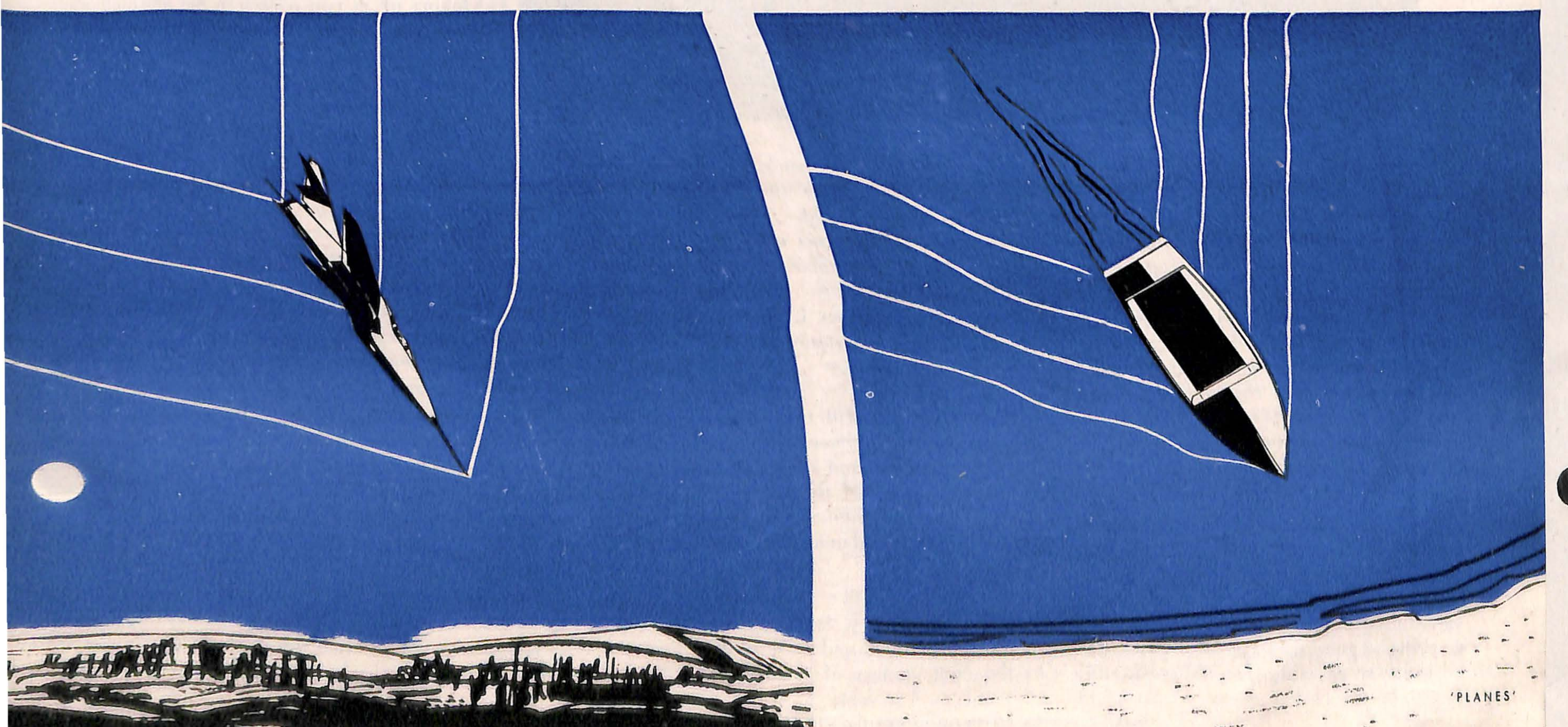
DOORS, with the exception of their glass area, are strong enough to resist boom forces. The weak points are the lock and hinges. If a lock is loose fitting, the impact of the boom may be sufficient to jar the opening and cause the door to slam against the wall. Under this condition, or if the door is slightly ajar, the hinges might pull loose or cause a split in the door jamb.

BRICKS, plaster and mortar do not have any measurable ability to "creep" or move along its surface. When laid up into walls or ceilings, they also get locked up stresses which are caused by curing of the mortar or plaster, shrinkage due to the drying out of mortar or plaster and the effect of expansion and contraction between hot summer and cold winter temperatures.

These materials have very little "give" or resilience. They stand these force combinations indefinitely or fail after one or two seasonal cycles. If the boom forces were appropriate, brick, block or plaster stressed near the point of failure by a combination of locked up or seasonal forces might be overloaded; but since the boom force on a structural element is far less than a good stiff windstorm or, in most cases, less than that of a healthy boy jumping on the floor, it is difficult to see how a wall could remain poised just at the point of failure for any length of time without being tipped in or broken by other more frequent forces.

Ground vibrations are another matter subject to misunderstanding for very good reasons. For example, it was reported to the Air Force that structures were shaken violently and the ground was jumping up and down an inch or two when large aircraft flew overhead. Even the scientists sent to investigate the matter admitted to this feeling. Yet, measuring devices with the most sensitive

The nose of the supersonic aircraft directs the course of the shock wave created by its speed. When the plane's speed drops below the speed of sound, the shock waves continue in the direction the plane was travelling.



instruments available indicated no movement, but slamming a screen door drove the measuring device completely off the scale.

The scientists found that we get false perceptions of movement because the sense organs in the skin only require pressures measured in a millionth part per square inch to cause a sensation of movement. It is difficult for anyone to believe there is no vibration, but the most exacting scientific tests have proven there is none.

THE sonic boom will not cause ground vibrations that could damage basement walls, floors or concrete walks and driveways. Investigations of nuclear explosions which produce many times the pressure of a sonic boom show that there is very little effect on the ground near the point of impact or on pavements, pipes, or foundation footings.

The question then arises as to why structural damage is claimed after a sonic boom. Basically, this is because the home owner, after hearing a sonic boom, is certain that the noise must have caused some damage. He makes a careful inspection of his home, probably the first time he has gone over the house looking for damage in several years. And, of course, he finds crack after crack. The immediate conclusion is that the boom caused the wall and ceiling cracks. The owner is convinced that the cracks did not exist before the boom occurred. This is a completely natural reaction. The cracks hadn't been detected before simply because the householder had never looked carefully for them.

A simple test will prove this point. Take a flashlight and go over your walls and ceilings. You will find numerous cracks that you didn't know existed. It is also possible to check whether the cracks are recent or not. Where the plaster has parted, the edges of the rupture will be gray or weathered on an old crack and the plaster will be white on a recent crack.

The Air Force has a dual responsibility on damage claims. It is the policy of the Air Force to make prompt payments for damage caused by its operations. At the same time, the Air Force has a tremendous obligation to the taxpayers to expend each dollar appropriated in a proper manner. The great bulk of the claims received are from people who are honestly convinced that the damage was caused by Air Force operations. The Air Force completely respects the right of the citizen to claim this damage, and a thorough investigation is made. But the scientific knowledge acquired by their investigations of what a sonic boom can do and cannot do must be considered in denying or approving the claim. This is evidence that cannot be ignored.

There are, of course, cases where the claims are patently ridiculous. During a recent demonstration, several sonic booms were deliberately made. One man's residence was located thirteen miles from the airport where the boom was directed. The atomic bombs dropped on Hiroshima and Nagasaki did not cause damage to Japanese residences beyond an eight-mile radius. This fact, however, didn't stop the owner from claiming damage from a sonic boom at almost twice the damage limit of an A-bomb.

A sonic boom created by an aircraft diving from 35,000 feet to 25,000 feet—produces a pressure of about 5 pounds per square foot on the ground. Supersonic operations are rarely carried out at altitudes lower than 20,000 feet. The shock waves generated by an atomic explosion have not caused damage to the flimsiest structure when the pressure is less than 70 pounds per square foot. This is 65 pounds more than the pressure usually caused by a sonic boom.

PLANES

ANOTHER man with two business establishments and a house located in a triangle seven, five and two-and-a-half miles apart, with the closest corner of the three buildings located four miles from the airport, promptly put in a claim for damage on all three buildings.

The Air Force, like all government agencies in a democracy, is highly responsive to the demands of the public it serves. Protests to the commanders of air bases across the nation and to the Pentagon are given prompt attention and remedial action is sought. In many cases, a simple fix is possible; in other cases, the Air Force cannot eliminate the cause of the protest without serious damage to operations.

IT is difficult to readily identify the aircraft causing a sonic boom. This is due to the high altitudes where most supersonic operations are conducted, and a sonic boom created at high altitude may be heard 20 to 30 miles away from the path of the plane. Atmospheric conditions play a significant part in the propagation of these sound waves.

Although Air Defense Identification Zones are in existence, aircraft operating within them, once identified as friendly, receive no further attention. These zones are established to identify aircraft entering the zone from an outside point.

Absolute identification of the aircraft causing the sonic boom is further complicated by the fact that, except for certain required position reports en route, a jet aircraft may not be known to be in a designated area at a certain time.

The Air Force now has under consideration the development of an instrument that would automatically record the time, position and flight direction of a plane when it exceeds the speed of sound. Such an instrument will be vital in fixing the responsibility for any damage a boom may cause.

The noise created by turbojet engines is a thorny problem in the relations between the Air Force and the citizens of cities they defend. But the Air Force started an intensive program of public education on jet noise.

Community leaders were invited to nearby air bases for tours; they talked to the commanders and the pilots of the jet aircraft. Landing patterns were re-arranged so that the least inhabited areas were in the flight path. The Air Force explained that a jet taking off at two o'clock in the morning was not prompted by the desire of a pilot to get his flying time. An unidentified plane had been reported and the jet was ordered to make an interception.

Once these points were explained, the complaints on jet noise dropped. In fact, jet noise complaints apparently reached their peak last year and the Air Force estimates that fewer complaints will be received this year despite a growing number of aircraft entering service equipped with high-thrust jets. The noise of the jet planes still exists and will continue to exist for many years, but the annoyance has been lessened through public understanding.

Public appreciation of cause and effect, of necessities that far outweigh inconveniences is an invaluable national asset. Certainly we would not want to equip our Air Force with supersonic aircraft and then forbid the pilots to fly at these speeds. Pilots must know the performance capabilities of their aircraft if they are to be employed some day against the enemy.

The sonic boom is a new noise that we must accept as part of freedom's price.

True Global Mobility for Combat Forces Requires Long-Range Transports

(*Continued from page 1*)

and security of the free world. It was the means of winning the first battle of the cold war with Russia—the Berlin Airlift. Thousands of people were kept alive by air-delivered food, fuel, and medicine. Freedom was maintained by air transport alone. Military air transport won this cold war.

Military air logistics became even more significant in the next scene of battle against Communist aggression—Korea. The logistical airlift of forces, ammunition and supply, in the first year, far surpassed the Berlin record.

Today, the most pressing need for military air logistic operation is for a long-range air transport that can provide real global mobility to the combat forces. Such a transport must be capable of flying non-stop from the United States to overseas areas *avoiding* the use of en route refueling bases. En route stops are time consuming and expensive—and, bases of this type would be extremely vulnerable to enemy action in the event of war.

While a number of transports have been designed primarily for military operations, examination of the present military air logistics fleet reveals that the bulk of the fleet are passenger-type aircraft. In the main these planes were built to commercial airline specifications, then were modified to meet military necessity.

It requires eight and one-half years between the decision to build a modernized air logistics plane and the time when a new cargo and personnel carrier is delivered to the military services. Therefore, if this country does not step up modernization of its logistics transport fleet now, there won't be any adequate airlift to meet military needs and strategy ten years from now.

A Senate Armed Services Subcommittee report put it this way: "The United States has insufficient airlift capacity to maintain mobility of the current U. S. Army and to enable the latter to meet overseas commitments, nor do plans include provisions for adequate airlift."

The Air Force now has a requirement for a new giant transport for which, unfortunately, it does not have the funds with which to put the plane into production. This completely modern transport could carry a payload of 100,000 pounds nearly 4,000 miles at 460 miles an hour. Such a plane could well launch a new era of air logistics for *commercial* aviation as well as in military air operations.

If an emergency arose and the Defense Department found it necessary to move a single division of troops and their combat equipment 3,500 nautical miles, it would require 340 of our present air transports—four days—and a direct operating cost of $8,900,000. And to do it, present aircraft could not perform the mission at all if intermediate bases were not available.

The same mission could be accomplished by 130 of the 100,000-pound, 460 mile-an-hour transports for $6,500,000—a saving of $3.4 million plus less ground maintenance for the fewer number of planes; fewer flight crews; faster mobilization; and speedier deployment.

Consider materiel: When supplies for overseas bases can be delivered in a few days (and it can take up to 100 days by ship), huge stocks of items which may never be used need not be warehoused at our outlying bases, but can be delivered from the zone of the interior on demand. Huge savings can thus be realized in inventories.

Consider manpower: Through modernized airlift, fully equipped divisions can be delivered in concentrated force overnight to any trouble spot from the zone of the interior. We will have tremendously more effective manpower with smaller numbers at greatly reduced cost.

In addition, the quicker supply of spare parts will keep a greater proportion of our equipment overseas combat ready. Also, by decreasing the stockpiles of critical and expensive materiel at our bases, modernized airlift will eliminate the danger that surprise attacks would wipe out important segments of our military power.

If the Air Force Budget, currently under Congressional scrutiny, could be augmented to enable it to continue plans to modernize its air transport services, it would be able to quadruple the productivity of logistic aircraft within the next three years. In three years, our capability to transport men and materiel throughout the world on intercontinental missions, measured on the basis of speed—often the difference between victory and defeat—could be doubled.

Heavy Breathing Weighs Less These Days

A new type of personal oxygen system for crews of high altitude aircraft which weighs just a fraction of conventional oxygen systems, has been developed by the aircraft industry.

Liquid oxygen, the weight-saving innovation, represents the most compact method of storing and carrying oxygen, and results in a weight saving of approximately 75 per cent over systems using natural oxygen.

This system, which converts liquid oxygen to gaseous oxygen as the crew member needs it, consists of a small insulated tank for the liquid oxygen surrounded by a coil of uninsulated tubing which transforms the liquid oxygen into the usable gaseous state.

The oxygen system is so compact that a single low pressure unit, weighing only 55 pounds when filled, replaces eight high pressure oxygen cylinders weighing a total of 176 pounds.

AUSTRAILIAN CIVIL AVIATION LEADER VISITS U. S. — Donald G. Anderson (center), Director General of Civil Aviation for Australia, confers with Orval R. Cook (left), President of the Aircraft Industries Association, and James T. Pyle, Civil Aeronautics Administrator. Mr. Anderson told a meeting of the Export Committee of AIA that Australia buys American-built aircraft because "we want to buy the best in aeronautical equipment and know the high quality of American workmanship."

New High Energy Fuels Yield Greater Speed, Payload, Less Weight

Super high energy fuel for aircraft and missiles is being developed for the Navy by the Armour Research Foundation of Illinois Institute of Technology. A combination of boron, carbon and hydrogen, the new fuel is expected to extend the range of an aircraft, reduce the weight of its airframe, increase the payload and improve both speed and climb. It can also be effectively used at altitudes where ordinary fuels will not burn. Research on the new high energy fuel has reached the point where a $38,000,000 high energy fuel plant is now under construction.

Versatile 'Copter Takes Over Tugboat Job

To the helicopter's long list of achievements in versatility, one more can now be added—its ability to operate as a flying tugboat.

In a recent series of tests off San Diego, conducted in cooperation with the U. S. Navy Amphibious Base, a military helicopter successfully demonstrated its potential capability in salvaging surface vessels and landing craft.

Here are some of the feats performed by the helicopter during the tests:

An LVT (Landing Vehicle, Tank) was deliberately immobilized on the beach, but the helicopter tugged it out of its sandy trap, into the water and onto a "safe" beach.

A two-and-a-half ton amphibian "Duck" was pulled off shore with ease during a simulated invasion maneuver.

The helicopter maneuvered to shore and anchored a 200-foot pontoon causeway, then hauled an LCU (Landing Craft, Utility) laden with caterpillar tractors on and off a surf-washed beach.

The whirlybird towed a 3,000-ton LST (Landing Ship, Tank) at five knots, about half the LST's normal cruising speed. The ship was found to be more maneuverable under tow by helicopter than it is under its own power.

Boy from City Finds 'Farmer's Wings'

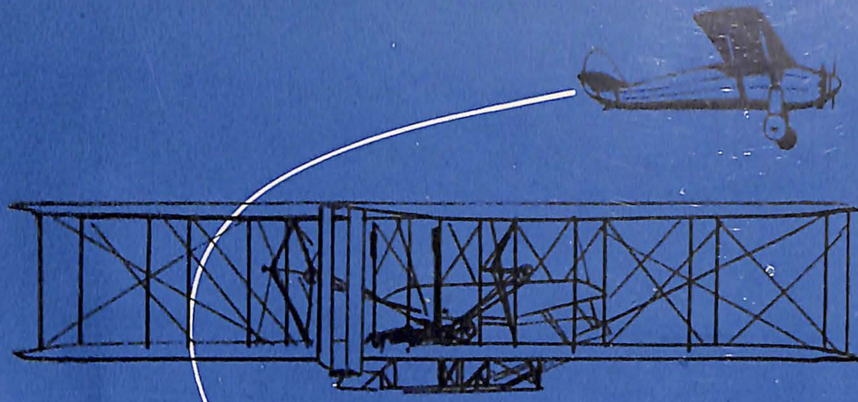
For the sly parent bent on giving junior a dose of painless instruction, we recommend *The Farmer's Wings*, an exciting adventure story of a city boy who spends his summer vacation on a farm.

This is one of several booklets published by the National Aviation Education Council, a non-profit organization dedicated to increasing the student's comprehension of aviation and its relation to the varied pursuits of American life.

The Farmer's Wings opens a whole new world to any city child who thinks of the farm as a simple, rustic place comprised of tired horses led to watering troughs, or an elemental dependence on chance for a successful crop. Children will share with Bob, the city boy who visits his country cousin, the thrilling revelation of modern farm life, and the integral part played by the plane in operating a large farm.

Every day is an aviation adventure for Bob, from the time he lands at the Wichita airport, where he is flown to the farm in his uncle's "puddle jumper," until he is back at school in Chicago, regaling his classmates with his summer experiences. These include: watching the process of aerial photography from the cockpit of the plane itself, observing aerial spraying and dusting first hand, and going "fence riding" with a modern cowboy, who flies along the fence to locate breaks in the wire, as well as stray cattle.

Richly illustrated with sketches and actual photographs, this four-color booklet for 10 to 14-year-olds may be obtained by sending 50 cents to the National Aviation Education Council, 1025 Connecticut Ave., N. W., Washington 6, D. C.



The biplane with straight, square wings used by the Wright Brothers in 1903, was the type most popular in aircraft produced in the following 30 years. The biplane eventually gave way to the monoplane which permits greater speed.

The straight wing is familiar in subsonic aircraft but it is used in advanced supersonic flight too. Among its advantages is structural simplicity.

The swept wing moderates the heavy drag increase when the airfoil reaches the speed of sound and compresses the air into shock waves.

shape of flight

Many things determine the performance of an airplane, but one of the most important is the shape of the wing. This is why the shape of the wing or airfoil always has been the subject of intensive research and development by the aircraft industry. A wing design that performs efficiently at low speed might be incapable of supersonic speed, so aerodynamic scientists are constantly seeking the compromises necessary to satisfy the requirements of widely varying speeds. The objective is to produce designs that obtain maximum lift, low drag and good performance over a wide range of speeds, for low landing speeds and high cruising and, at the same time, for top speeds into the supersonic for military tactical operations.

One condition must be present for the wing to produce lift. The air pressure above the wing must be less than the pressure below it. The result of the difference between upper and lower pressures is the upward force of lift. Thrust produced by the engine or propeller moves the wing forward to produce enough difference in pressure to equal or exceed the weight of the plane.

Because of the exacting requirements of shape and size, the search for new aircraft designs involves huge expenditures for wind tunnels and other laboratory devices, for computers to solve elaborate problems of mathematics, for staffs of scientists, engineers and technicians, and finally for prototypes of the aircraft for flight testing.

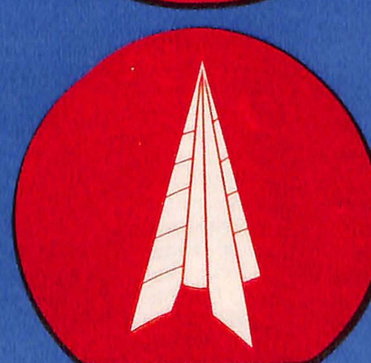
The aircraft industry, working in close cooperation with such basic research agencies as the National Advisory Committee for Aeronautics, has met the challenge of supersonic flight, and is now preparing greater advances for the air world of tomorrow—a world that will see speeds far above the supersonic and altitudes well beyond the limits of the earth's atmosphere.

Aviation's history has been written in the characteristic shapes of aerodynamics. Shown here are some notable shapes of past and present, including the first powered airplane, the shapes for transonic and supersonic flight, and one shape being investigated for flight faster than five times the speed of sound—more than 3500 miles an hour.

This profile or cross-section of a typical subsonic wing reveals a rounded leading edge, a curved upper surface and a trailing edge tapered to a sharp point. The air flow divides at the leading edge, part of the air flowing over the top and part passing below. Traveling a longer distance above the wing, the air moves faster than that moving below the wing. The increased speed serves to decrease pressure, and thus produce lift. More than two-thirds of the lifting action occurs on the top surface.

Supersonic flight has created the need for extremely thin wings. Some of the newest American aircraft have wings comparatively as thin as razor blades. The progression toward thin wings has introduced a host of problems for designers and manufacturers. Extremely thin wings usually are milled from solid pieces of metal to provide great strength. The tremendous power of modern turbojet and rocket engines has made supersonic and hypersonic flight possible. This power brought about the demand for new airfoils, new shapes of flight.

The delta wing has the advantages of good stability, structural simplicity and room for storage of fuel and payload within itself. Like other shapes, it is adaptable to aircraft of many types.



Now under intensive study are the shapes for rocket-powered aircraft capable of speeds in the hypersonic zone, or more than five times the speed of sound. One example of this type resembles the familiar "planes" built by schoolboys from tablet paper. This glider would be hurled to the outer limits of the earth's atmosphere by powerful rocket motors and then would glide long distances at hypersonic speeds before landing like the conventional airplane.

AIA