



Apr. 29, 1957

Vol. 13, No. 4

# planes

OFFICIAL PUBLICATION OF THE AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA

★ All material may be reproduced with or without credit.  
★ Mats of all charts available free.

## GENERAL AVIATION TO DOUBLE FLIGHT HOURS

### Aviation Exports Exceed \$1 Billion

U. S. aviation exports in 1956 exceeded \$1 billion for the first time since World War II.

Total exports reached \$1,044,487,000 in 1956 compared with \$728,514,000 in 1955, an increase of more than 43 per cent. This is the greatest growth in aviation exports the industry has ever registered.

This substantial increase is a testimonial for the quality and effectiveness of U. S.-built military aircraft and the earning power of our commercial planes.

In terms of economic importance to the country and the industry, this represents an advance from 8.6 per cent of U. S. gross aviation production value in 1955 to 11 per cent in 1956 or, stated in terms of manpower utilization, an employment for export production of approximately 88,451 workers throughout 1956 as contrasted with 63,486 in the previous year.

A notable increase was in new commercial transport aircraft weighing more than 3,000 pounds. This category increased from 95 to 151 units, a gain of 59 per cent, and in value from \$81,145,000 to \$132,798,000, an increase of 64 per cent.

Utility, personal and liaison aircraft gained 28 per cent in the number of units and about 50 per cent in value.

### Synthetic 'Glowworm' Lights Plane Doors

Development of a "light that never fails" has been announced by the Air Materiel Command. The light, which will glow in the dark for more than five years, is slated for use in illuminating entrance and escape hatch door handles on a long-range jet bomber.

The light source is a small piece of Strontium-90, a specially treated metal which is safe-sealed in a transparent plastic button. It glows continuously and, in the event of a night emergency involving a possible power failure, the synthetic "glowworm" would guide crew members safely to escape hatches.

Another possible use for the syn- (See LIGHT, Page 8)

### Facilities Planning Group Predicts 20 Million Hours Annually in 1976 by 90,000 Aircraft

By George E. Haddaway, Publisher, Flight Magazine  
General Chairman, General Aviation Facilities Planning Group.

More than 65,000 privately-owned aircraft of the nation are being flown today by some 200,000 pilots more than 10,000,000 hours annually. By 1976, the general aviation fleet should reach to at least 90,000 aircraft flying 20,000,000 hours annually.

This is the conservative prediction of the General Aviation Facilities Planning Group, comprised of eleven national aviation organizations, made in a report to Edward P. Curtis, Special Assistant to the President of the United States for Aviation Facilities Planning.

The report culminates an eleven-month study of the current significance of general aviation, and projects the vast potential of this facet of the national economy through 1976. While drawing no conclusions, it holds promise of an inevitably positive effect for the expansion and improvement of aviation facilities

throughout the nation.

While the report does not statistically record the spectacular, recent growth of general aviation in the United States, during the calendar year 1956 alone, general aviation showed a 52 per cent gain both in unit production and in dollar volume over 1955—a total of 6,738 aircraft with a retail value of \$135,000,000 in 1956 as compared to only 4,434 aircraft valued at \$92,000,000 (retail) in 1955.

Agricultural aviation also has shown an amazing growth. Today, one in every seven cultivated acres in the U. S., along with millions of acres of forest land, were seeded or treated in 1955 by some form of aerial chemical application.

In the interests of maintaining a conservative base for projecting future growth trends, the General Aviation Facilities Planning Group (See GENERAL, Page 8)



### Computers Test New Aircraft

Earthbound "test pilots" who "fly" electronic computing machines are making great strides in the aircraft industry's never-ending search for planes which will fly farther and faster safely.

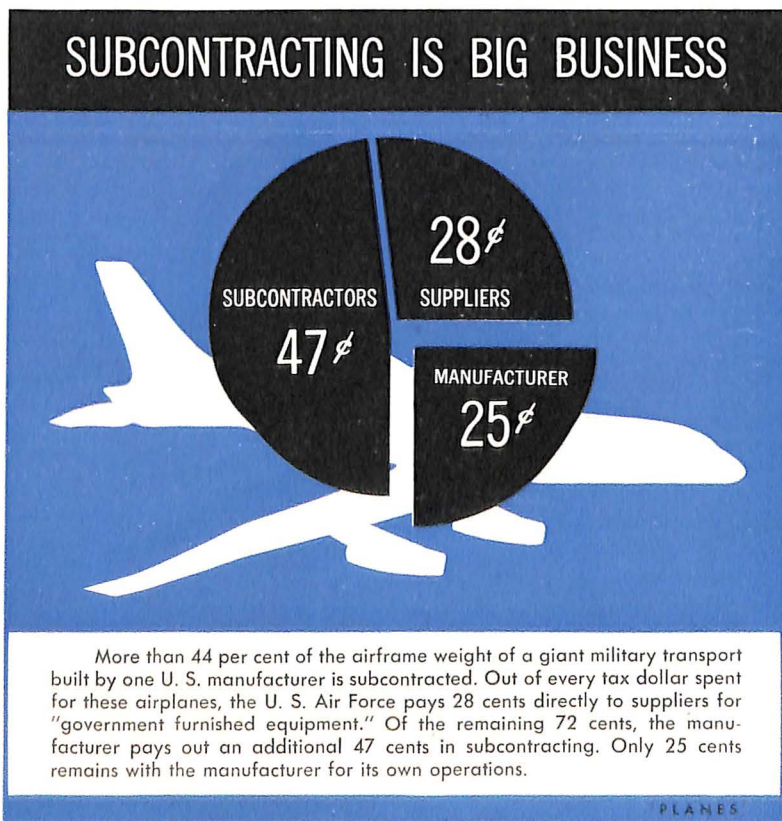
The computers can not only simulate actual flight conditions which would be met by a prototype, but they can tell aeronautical engineers as well where to look for flaws in design. Analog computers make it possible for engineers to test fly an airplane or missile without even building a model of it.

Computers are capable of solving a wide range of problems in computation, simulation or testing, and doing so at lightning quick electronic speed. Engineers at one aircraft plant recently took a problem from preliminary design engineers, which, it was estimated, would have required one full week of work to solve by using a slide rule. One day was spent in translating the problem into the mathematical language employed by the computer. The problem itself was then solved by the analog computer—in just 60 seconds!

Use of electronic devices are drastically changing the necessarily slow and costly process of designing new or improved aircraft, building models, laboriously testing them in wind tunnels, revising the design, and re-testing the models over and over again.

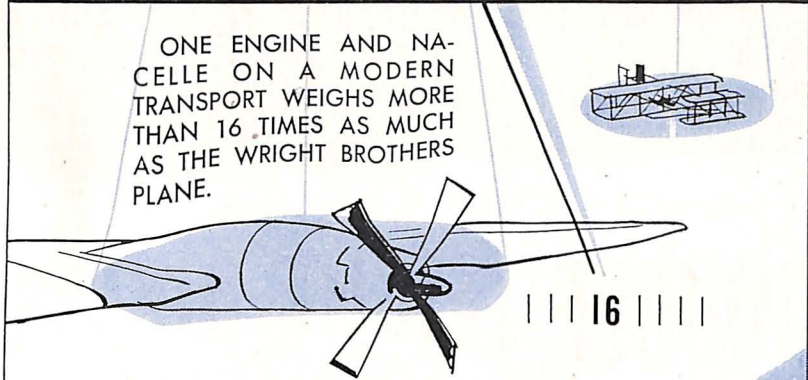
Instead, "paper airplanes" are put through simulated flights on the computer, and the results are recorded on graphs. From the recorded results, engineers can make necessary changes to avoid many pitfalls which otherwise would have to be solved by trial and error methods in wind tunnels or experimental flight.

Subsequently, when models, prototypes and production models are built, they are of a much improved design and represent the choice of best results from simulated testing. As one "paper test pilot" puts it: "I've walked away from a lot of computer 'crashes.' We can afford to be wrong in a computer flight, but a test pilot in the air has to be right all the time."



## Plane Views

ONE ENGINE AND NACELLE ON A MODERN TRANSPORT WEIGHS MORE THAN 16 TIMES AS MUCH AS THE WRIGHT BROTHERS PLANE.



MORE THAN 500,000 RIVETS, BOLTS AND FASTENERS ARE REQUIRED IN THE MANUFACTURE OF A GIANT NEW BOMBER.



A NEW TACTICAL JET BOMBER USES APPROXIMATELY 1,345 POUNDS OF STAINLESS STEEL—ENOUGH TO MANUFACTURE MORE THAN 89,600 KITCHEN PARING KNIVES.



'PLANES'

## Helicopter Will Play Key Role In Prehistoric Treasure Hunt

A prehistoric treasure hunt will begin shortly with the aid of some very modern machines—a helicopter, a giant vacuum cleaner and the world's longest single-span aerial freight tramway.

Source of treasure—the Grand Canyon, which holds an estimated 100,000 tons of the valuable mineral bat guano. As fertilizer and as a source for the ingredients of modern medicines, the huge deposit of guano is worth at least \$10 million, and is estimated by archeologists to date back as far as 60 million years.

The cavern containing the valuable deposit, its entrance situated about 600 feet up the precipitous canyon wall above the Colorado River, was discovered in the 1930's, but it was not until recently that a method of removing the guano economically was devised.

Through the use of the versatile helicopter, an aerial tramway is being erected from the mouth of the cave to the canyon rim 1½ miles across the river gorge. Already completed is the spectacular stringing by helicopter of 11,500 feet of 1/8-inch construction cable. This is the

first of four cables which will be drawn across the 2911-foot deep gorge before the permanent 1½-inch track cable is suspended from three giant towers which will support the tramway cable over its 9400-foot route from loading to discharge terminals. The entire cable stringing operation will take about a month.

Previous attempts to remove guano by barge were unsuccessful because of the Colorado River's treacherous currents and sand bars. Since there is no road or trail to the bottom of the Canyon in the vicinity of the bat cave, all equipment, personnel and supplies used have been flown in since the tramway project was begun last August.

The guano will be picked up by a vacuum and carried about 1000 feet through a 10-inch pipe to a bag house where air and guano are separated. The guano then drops into loading bins of the lower tramway terminal where it is diverted into the tramway bucket. The developers plan to limit withdrawal of the product to 10,000 tons a year, unless further exploration uncovers additional deposits.

## 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

## Unnecessary Handicap

By Orval R. Cook

President, Aircraft Industries Association

The shift in air power emphasis from manned bombers and fighters to guided missiles, which becomes more pronounced each year, has spawned a succession of problems—technical, strategic and economic.

Missiles have astounding operational characteristics. They may guide themselves to targets, 5,000 miles from the launching site, leaving and re-entering the earth's atmosphere, and seek out and destroy hostile aircraft flying at supersonic speeds at very high altitudes.

But each gain in technology that makes possible these great performance characteristics has been hard-won and costly. Missile development requires the acquisition of new knowledge, new techniques.

The investment in facilities to develop and produce missiles is high. For example, the industry to date has invested more than \$100 million of its earnings in new test installations and plant expansion for the ballistic missile program alone, and additional large expenditures are scheduled.

Last year, the aircraft industry plowed back 60 per cent of its earnings in new facilities and tooling, the highest percentage of profit re-investment of any major manufacturing industry. In addition, twelve of the major airframe companies last year borrowed more than \$275 million to help meet current financial needs, a four-fold increase in borrowing over the previous year.

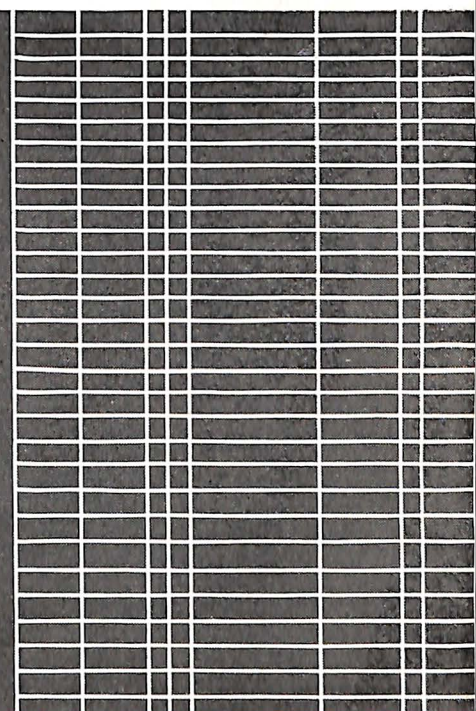
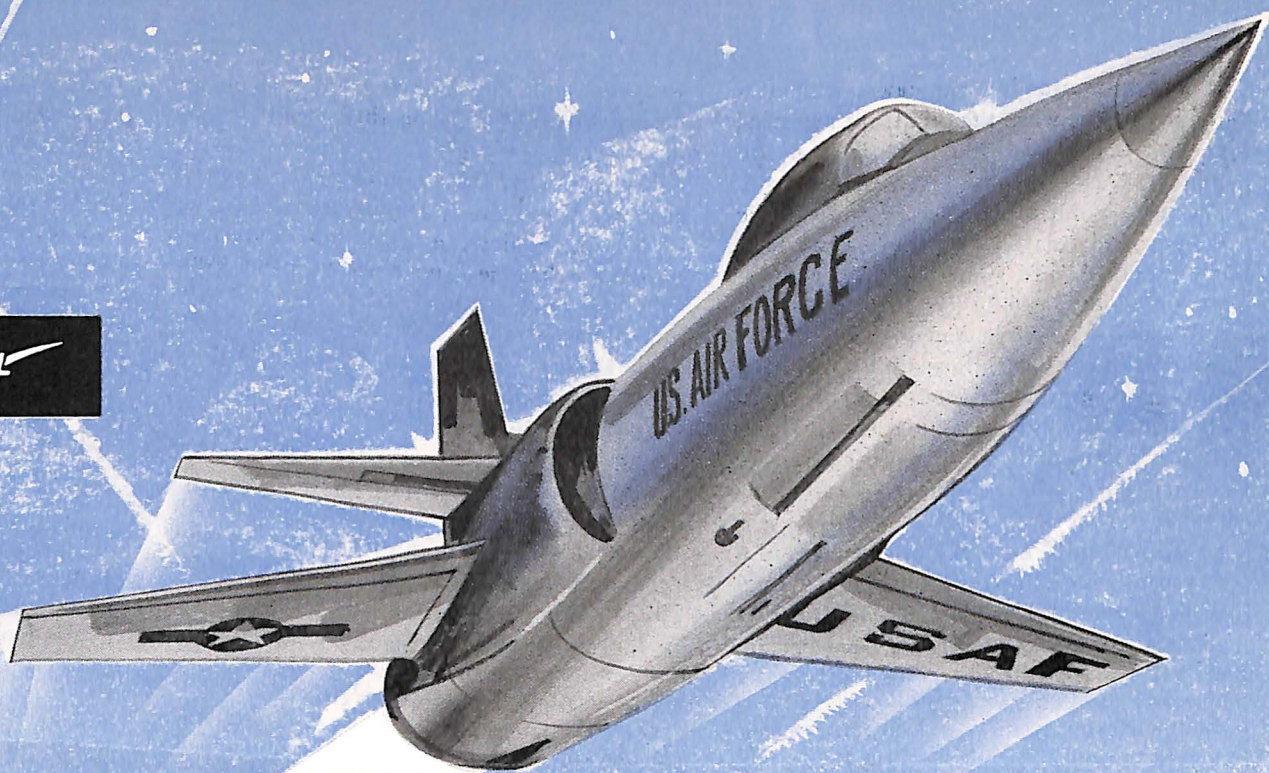
The goal of the aircraft industry is to produce something more than an effective aerial weapon; the weapon must be economically as well as technically feasible. It is not only necessary to bring the highest order of management to bear on cost reduction, it is also necessary to take advantage of contract techniques that provide an incentive for efficient operations.

Today's contracts are usually based on an incentive system that benefits both the Government and the manufacturer. A target price is first negotiated which includes a reasonable estimated profit. Then the manufacturer faces the challenge of producing the product for less than the target cost. If he fails, the actual profit is cut. If he succeeds, the savings in cost are divided on an average ratio of 85 to 15—the government retains 85 per cent of the savings and the manufacturer receives 15 per cent. The military services work intimately with the contractor during the life of the contract and know the management skills involved in reducing the costs. The final price paid is carefully weighed by the military services and adjustments made according to performance.

Despite this close and continuous re-examination of contracts, the manufacturer is required to re-open the contracts as much as four years later for another review of performance and earnings. The principles involved in renegotiation are, of course, debatable. But there are no debatable factors in the burden that latent renegotiation places on the manufacturer. The ability of a company to invest its earnings in new facilities and projects is severely hampered since such programs must be planned on a long-range basis. A company cannot precisely determine the total earnings in 1953 until as late as 1957. Earnings in a current year must be used to make up refunds claimed on contracts performed years previously, forming a barrier to sound corporate planning.

Decisive, efficient investments in facilities, tooling and materials are necessary for the success of the guided missile program and it should not suffer from this unnecessary handicap.

planes



GEN. BENJAMIN W. CHIDLAW (USAF-



Ret.) was the first commander-in-chief of the Continental Air Defense Command, the first joint service command ever organized within the U. S. in peacetime. A pilot since 1924, Gen. Chidlaw monitored and directed the development of the original jet engine and jet airplane in 1939, as Chief of the Experimental Engineering Branch of the Materiel Division. During World War II, Gen. Chidlaw was deputy commanding general of the 12th Tactical Air Command, commander of the 22nd Tactical Air Command and commander of the Mediterranean Allied Tactical Air Forces. In 1945, he became deputy commanding general of the Air Technical Service Command (later designated the Air Materiel Command) and AMC commander in 1949. Joining the Air Defense Command in 1951, Gen. Chidlaw was named commanding general, ADC, and CONAD commander in 1954. He is now Vice President of Thompson Products, Inc., Cleveland.

## Noisy Angels

ON almost any clear day, when ceiling and visibility are unlimited, the citizens of big cities look aloft and see a gossamer of vapor trails being traced across the sky. Be it week day or weekend, work day or holiday, invisible fingers play this giant game of tic-tac-toe. But what the citizen doesn't know is that, even when lowering clouds shroud the earth, this great game goes on six or seven miles up.

To understand it is to sleep better, for those "X's" against the heavens are the contrails of the Continental Air Defense Command crossing those of the Strategic Air Command—the latter the fox, the former the hound. The planes are frequently too high to be seen,

but they are there—constantly exercising—with SAC's bombers trying to slip through to "target" and CONAD's fighters trying to intercept.

If we were at war, we would fervently hope that we might never see such trails, for it could mean that an enemy has slipped through the great invisible air defense wall that encircles this country from the Arctic Circle to blue water of Atlantic and Pacific far from our continental shores. That wall has been built by CONAD to identify friend and foe, and to insure that no aggressor sneaks through with lethal load to strike at our heartland.

Here is how it works.

It was an unusually clear dawn, without a cloud in the sky, when the thin trails appeared high over Canada. Most of America was still asleep.

An alert ground observer picked up the telephone and relayed the information to a filter center. Almost simultaneously, a radar operator spotted a blip on his radarscope. He also picked up a telephone.

Moments later, the information was being plotted and evaluated thousands of miles away, at the Colorado headquarters of CONAD, the Continental Air Defense Command, by wide-awake military officers of all three services.

At an Air Force base, the urgent notes of a warning horn broke up a boring gin rummy game. Interceptor pilots, already wearing flight gear, dropped their cards, snatched up their helmets and started toward their fighter planes at a dead run.

In the North Atlantic, an aircraft carrier prepared to send three planes aloft to identify the aircraft responsible for the vapor trails.

At a suburban outpost near a great metropolitan center, an Army anti-aircraft team took the hurried preparations necessary to launching its deadly missiles.

Most of America was still asleep.

weapons and the intercontinental bombers needed to carry them on their death-dealing missions.

Because CONAD—a unique joint command encompassing literally hundreds of thousands of soldiers, sailors, airmen and civilians—recognizes that the danger will never be over, most of America can afford to sleep, safe in the knowledge that CONAD's defensive umbrella strives to protect it from the lethal rain of enemy bombers.

The threat to America which CONAD was established to meet is a very real one. A look at a polar projection map graphically demonstrates just how real. Soviet bombers taking off from Murmansk or Eastern Siberia could strike targets *anywhere* within the continental United States. No spot in the U. S. is as much as 4,500 miles away from Soviet bases, yet the Soviets possess bombers capable of striking targets that far away or farther.

CONAD's mission is simple to state, but unbelievably complex to carry out: "Defend the United States against air attack."

Physically, CONAD consists of three strings of radar networks—the Pine Tree, Mid-Canada and DEW lines—plus the so-called "Texas Towers" at sea, airborne early warning radar aircraft, Naval picket ships, Navy fighter

rockets, radar, sophisticated communications equipment, weapons systems, components and spare parts—and nearly all of them, on which the defense of America rests, are fabricated by the aircraft industry.

And its responsibility to produce adequate quantities of superior weapons and equipment by the aircraft industry makes the industry itself an integral part of CONAD's far-flung defense network.

No one knows better the need for continuing emphasis on reliability for CONAD equipment than a high officer of the Air Materiel Command.

"Perfectionism," this officer declares, "is mandatory if we are to protect the nation."

While great strides have been made, particularly during the last five years, to "close the chinks" in the aerial fortress, the job is far from complete. The ultimate air defense system, when completely installed, though exceedingly complex is virtually "automatic" once it is pressed into service.

For example, to put a fighter into the air at the proper time, it is necessary to bring into play an extensive radar network capable of determining altitude, speed, direction and numbers of attacking aircraft. This intelligence must be instantaneously and continuously transmitted to a combat control center and correlated through electronic computers, with similar intelligence from other sectors of the net.

The scramble order to the fighter squadron must be automatically transmitted giving time, direction and course setting. Within the airplane, when airborne, automatic pilot and flight controls take over. These must continue to receive correctional inputs based on later radar observations from the control center.

These automatic control and navigation systems, through the use of airborne computers, must integrate, correlate and feed back data on air speed, altitude, ground speed, magnetic and radio compass readings, altitude of the plane and distance traveled or time.

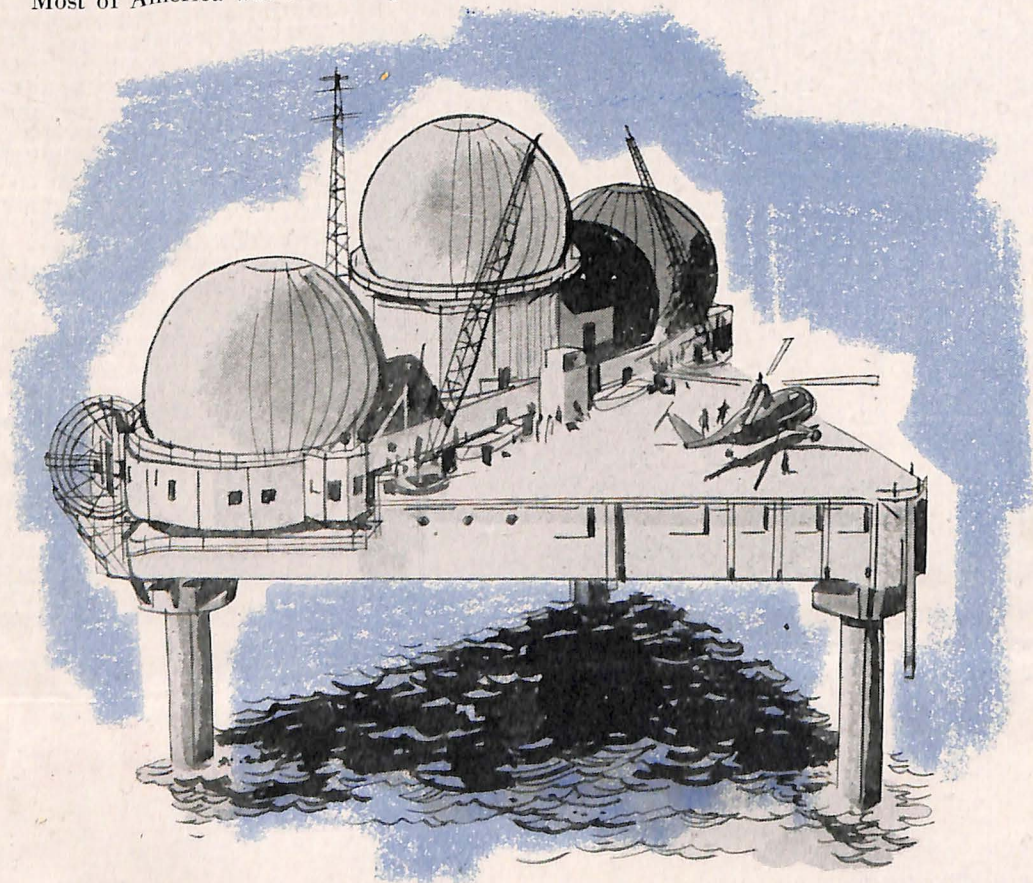
Flying at speeds from 1,000 to 2,000 miles an hour, on a course calculated to intercept the attacker—at ranges up to 1,000 miles, the slightest error or angular deflection in course will lead to a mission abort.

Nor is this all. The fighter must carry its own radar search which comes into play when approaching the zone of intercept. This system must take over the flight control and navigation job.

At the pilot's command the radar must lock on to the target and assume direction of the fire control system for delivery of the kill projectiles. All of this must happen automatically in an extremely short period of time and with no opportunity for second guessing or equipment failure if we are to kill the target.

Failure to intercept and destroy now has lethal penalties attached of unimaginable orders of magnitude. Literally, whole cities and their environs making up our national potential for survival are vulnerable.

This emphasis on reliability is reflected twofold in building CONAD'S warning net—reliability in equipment, and reliability in personnel.



The Air Force interceptor pilots, in their swept-wing supersonic fighters, made the initial contact. Fortunately, these vapor trails did not mean trouble. They had been made by an Air France transatlantic airliner, whose pilot had been blown off his course by high winds.

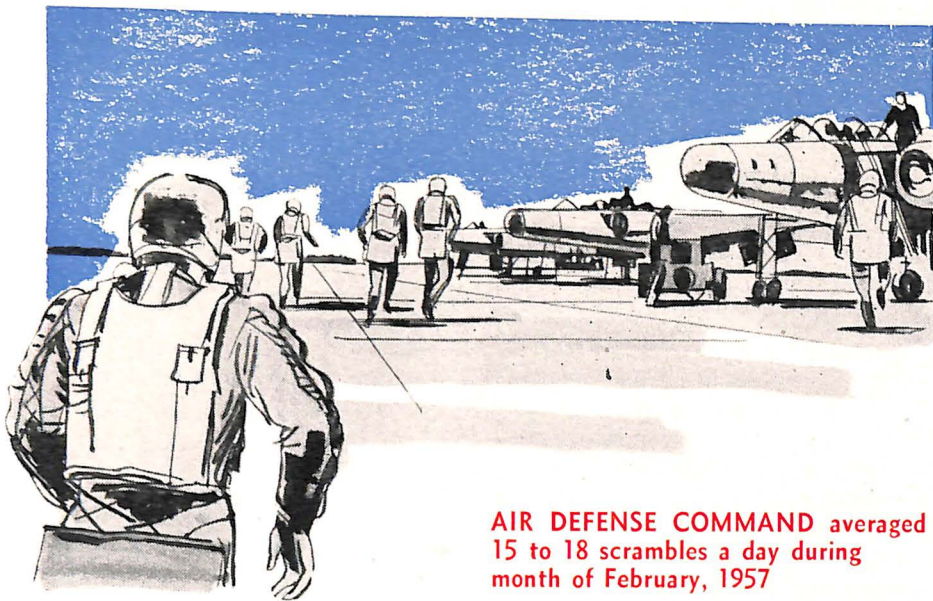
The news was quickly relayed to the fighters' home base, and word swiftly passed to CONAD. Everyone concerned breathed a sigh of relief. All hands relaxed, but no one considered that the danger was over.

The danger will never be over so long as potential aggressor nations maintain nuclear

squadrons, Army Nike installations, the entire Air Force Air Defense Command, the Ground Observer Corps, and one of the most elaborate communications networks ever devised by the mind of man.

PHYSICALLY also, CONAD consists of nearly 1,000,000 people, both in and out of uniform, completely dedicated to the proposition that "It can't happen here" so long as they maintain their vigilance.

In actuality, CONAD also consists of the equipment which makes the whole defensive structure operate. Such things as airplanes, engines, weapons, including missiles and



**AIR DEFENSE COMMAND averaged 15 to 18 scrambles a day during month of February, 1957**

**R**ELIABILITY of equipment for the nation's armed services is an old story to the aircraft industry, but one which is always under emphasis. Literally millions of dollars and man-hours are spent by industry to perfect new weapons, new techniques of fabrication, new materials, and new areas of flight. Parts are now gauged as accurately as there are gauges to measure them. All this is done in the name of reliability.

Translated into action, this means CONAD with its radar screen 10,000 miles long around an area of 3,000,000 square miles, and between 10 to 12 miles high. Moreover, this screen must be as nearly hole-proof, leak-proof and bomber-proof as it is possible to build within the envelope of resources and manpower made available to CONAD for its air defense task.

Besides the radar screen, CONAD also possesses Atlantic and Pacific seaward extensions of the warning network. This work is carried out by "Barrier Atlantic" and its Pacific counterpart—a conglomeration of radar-bearing picket ships and planes, designed, in the words of Admiral Jerauld Wright, Commander-in-chief, Atlantic Fleet, "to keep the guys from making an end run" around our northern warning ring. "If you have a hole in your detection system or are wide open at the flanks, you have nothing at all," he adds.

**A**MONG the more unusual features of CONAD's hemisphere-wide defenses are the "Texas Towers" anchored to the bottom of the sea off the Atlantic coast. Serving as radar stations and weather observatories, the "Texas Towers," named after oil-drilling rigs of similar design, are manned around-the-clock, seven days a week, to prevent a sneak attack on America's coast.

Personnel aboard these "Texas Towers" are rotated every 30 days, to prevent them from getting "island fever." All possible means are taken, as well, to keep the crews' morale high during a stay on these tiny outposts.

Each of these "Texas Towers" costs approximately \$1,000,000 minus the equipment it carries. Supply and transfer of crews is carried out chiefly by helicopter.

Helicopters have also been extensively used

to supply the Mid-Canada radar line, and the DEW line (Distant Early Warning line) is supplied by giant cargo transport aircraft.

Many of the DEW line radome stations are located north of the Arctic Circle. Crews here, too, are rotated often for morale purposes. While the exact locations of the 55-foot DEW line radomes are a military secret, it has been announced that a westward extension is under construction from northern Alaska to the tip of the Aleutian Islands. From here, the network will connect with seaborne and airborne radar operating in the Pacific out of Hawaii and Midway Island.

The "nerve center" of CONAD is located at Ent Air Force Base, in Colorado Springs, in the shadow of Pike's Peak. Here, the four phases of CONAD's mission are plotted: Detection, identification, interception and destruction.

Every day, "unknowns" are plotted on the gigantic plexiglass board, showing direction, altitude and numbers. With as many aircraft as are crossing America's skies today, it seems manifest that some of them will stray off their assigned airspace, thus becoming "unknowns." It is then necessary to scramble fighters to have a look at them.

At Ent, there is a single purpose among the staff—defend America. This dedication of all concerned transcends service loyalties, no matter whether they wear the Air Force blue,

the Navy blue or the Army OD. This is a unique outfit—the only joint command operating inside the continental limits of the United States in peacetime. There is no time for petty jealousies. The assignment is too specific, too all-inclusive. These men know they must work together always as a team if their common mission is to be accomplished.

The air of dedication to the task of keeping CONAD's umbrella on high is apparent in talking to any of the men on the staff, which is now commanded by Gen. Earle E. Partridge.

Since the outbreak of the Suez Canal crisis, CONAD headquarters has been on "increased intelligence" status — every unknown is double checked by interceptors, to make doubly sure that America is not under surveillance or attack.

An idea of the kind of job CONAD performs, day and night, can be gleaned from the bare announcement that the Air Defense Command averaged from 15 to 18 scrambles a day during the month of February, 1957.

**I**N order to scramble, the interceptors involved, many of them now supersonic; need to get to fighting altitude—50,000 feet—fast. If the "unknown" ever turns out to be hostile, it is imperative to America's safety that the interceptor make its kill before the deadly eggs of the aggressors can be laid on an American metropolis.

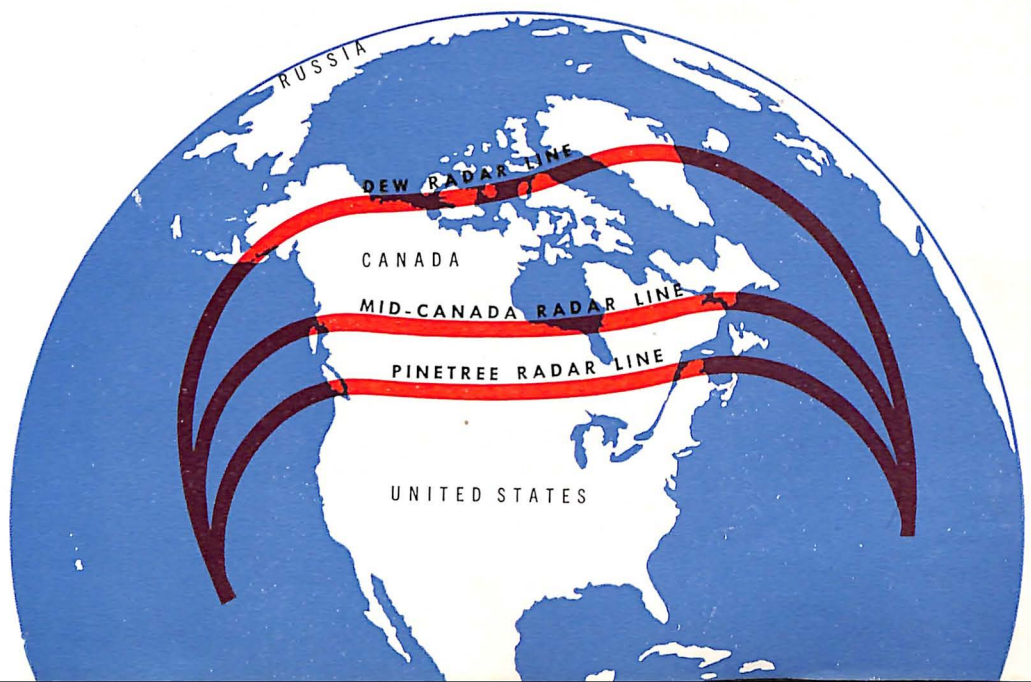
Some of the modern day "century series" interceptors used for this purpose are capable of reaching 50,000 feet in near vertical flight at supersonic speeds. But in order to do so, they create noise, because of the tremendous engine thrust.

Jet noise over airbases has become a problem to some communities, a problem which has been exaggerated in magnitude. Actually, the sound of jets—so long as they are ours—represents the sound of freedom, a comforting sound.

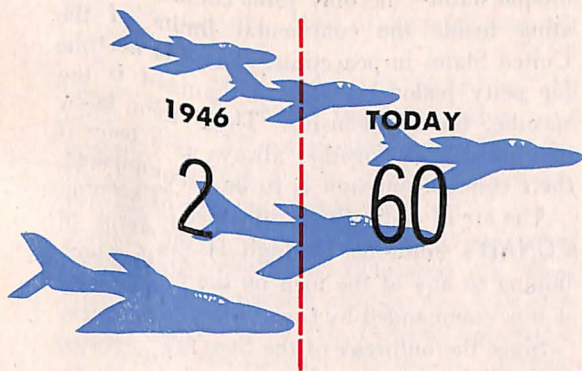
While there may be some sleep lost by a few of the citizens around an interceptor base due to jet noise, the sound is infinitely more assuring than the scream of a Russian nuclear bomb.

There have been suggestions that it might be more pleasant for all concerned if the Air Force were to move its interceptor bases to remote locations, far away from the cities.

In theory, this is an ideal solution. But



## FIGHTER SQUADRONS



when it is considered that the interceptors are there to protect the cities, it becomes obvious that they had best be located within the defense arc of the cities they are to protect. The jets would perform a poor job of protecting New York City, for instance, if they were based in rural upstate New York, where, conceded, they would awaken far fewer people during a midnight scramble. Moreover, to build a new system of remote bases, set up supply lines, housing and facilities would take billions of dollars of the hard-pressed taxpayers' money.

Also, as any municipal planning board is already aware, there is rarely such thing as an isolated airfield, no matter how far out of town an airport is located, the town seems to find a way of growing out toward the airport, and, eventually, engulfing it.

**W**ORK is under way, by the aircraft industry, to perfect jet noise suppressors, but the power loss entailed makes current suppressors a poor investment for military aircraft. Commercial airliners may eventually accept such a loss for our public comfort, but a military plane must have every ounce of power of its engines.

For the time being, at least, military jet noise is something the citizens will have to learn to live with. At best, it is a bargain price to pay for the assurance that we won't hear an atomic explosion.

One interceptor base commander who had been plagued by indignant telephone calls—mostly from mothers whose children had been awakened by the jets—developed an excellent system for creating good will in place of the indignation. He made appointments with each mother who called, and sent out the pilots who had been responsible for interrupted naps to call on them—in full uniform.

When the interceptor pilots, most of whom are fathers themselves, explained the necessity of their missions, the mothers who had complained were unanimously won over, and Junior's nap seemed a bit less important in the scheme of things.

One of the major "selling points" of CONAD is its relatively small cost to the taxpayer in terms of protection. Brig. Gen. Kenneth H. Gibson, whose 8th Air Division operates the Air Force fleet of long-range airborne early warning radar picket planes off both our coasts, recently described the aircraft with their protruding radomes as "a technological achievement that is a major step toward pushing any enemy threat back over the oceans

and away from our shores."

America's progress in the concept of aerial defense in a little more than a decade is remarkable. CONAD today is a highly efficient team of experts—both human and mechanical—which stands as a co-equal deterrent with our nuclear warfare potential.

But on March 27, 1946, when the Air Defense Command was first formed, it seemed more of an invitation to aerial attack than a deterrent. Already, the "cold war" with the Soviet Union was under way, and the realization that we might some day come under attack led military planners to begin, falteringly, a system of defending the continental United States against aerial bombardment.

When organized, ADC was allocated what amounted to four poorly manned and equipped radar squadrons and two equally deficient fighter squadrons. By 1950, when the Korean War broke out, all doubts over the need for a permanent radar network were dispelled. Work has gone on ever since toward buttressing our northern and seaward frontiers against assault. Today, the Air Defense Command contributes more than 60 squadrons to aerial defense.

Work continues, too, on the proficiency of manpower and weapons which make up the CONAD concept. Because of the revolutionary nature of the electronic systems in operation today, the pilot of a modern interceptor is no longer a lone gladiator flying to do battle with another lone gladiator in an enemy plane. Now, the man on the ground has become just as important as the man in the air.

At Vincent Air Force Base, Yuma, Arizona, as much advanced training is given to ground control intercept radar controllers as is given to interceptor pilots in rocket firing proficiency tests. Such tests are mandatory for all ADC fighter squadrons once a year.

The GCI controller must have an understanding of meteorology, air navigation, air

tactics, and the performance limitations of the aircraft he directs. He must give air crews the speed and altitude of the target being tracked on the radarscope. Once the interceptor has left the ground, GCI takes over.

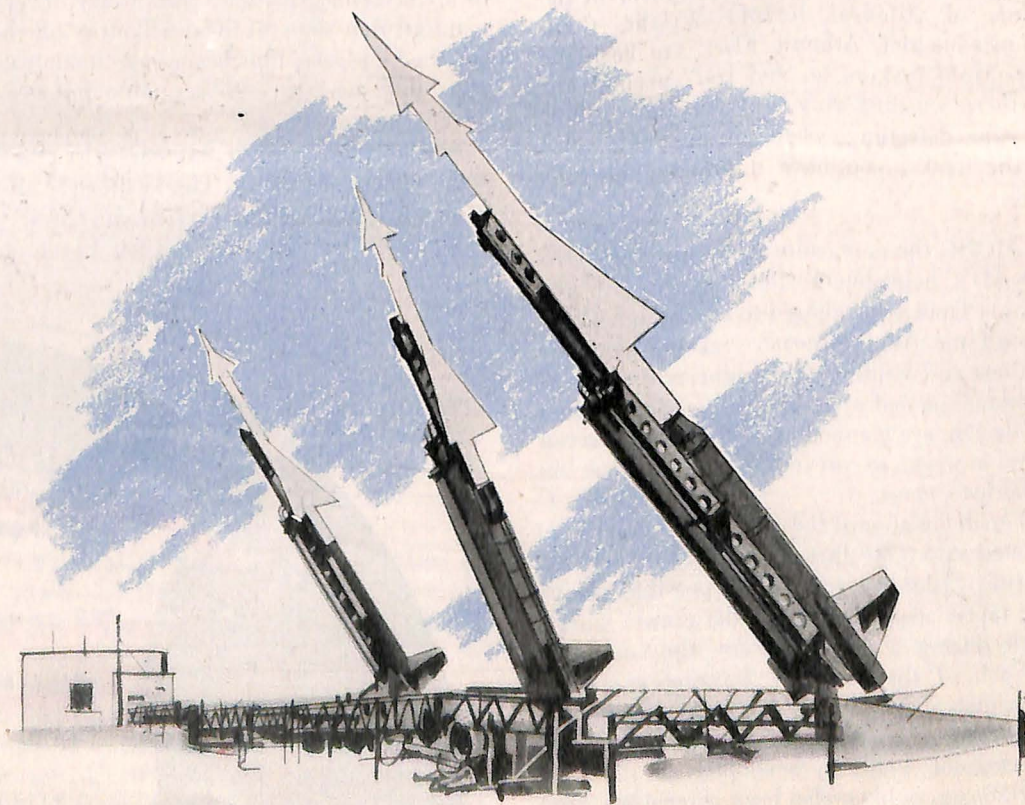
Although the interceptor may be miles above him, the ground controller is primarily responsible for the kill. When he has directed the interceptor to a point in the sky where it will intercept the "unknown," airborne radar and automatic fire control devices "lock" onto the enemy, and deadly air-to-air missiles are fired with uncanny accuracy even before the interceptor pilot may make any visual contact.

**T**HE result of such performances by the men of CONAD, backed up by the men and women of the aircraft industry, who have perfected these ultra-modern tools of aerial defense in depth, is that you can sleep better at night, knowing that some of your fellow Americans are wide awake, and ready to overwhelm any aggressor bent on reducing the United States to a rubble heap.

Neither the military nor the aircraft industry is yet satisfied with the defensive weapons that make up CONAD. Higher, faster and deadlier aircraft and missiles are on the drawing boards or in preliminary planning stages. As quickly as they can be phased into our defensive network, they will be. But until these weapons and communications systems are built, we must continually strive to keep present day equipment and weapons in top operating condition.

We must also back up the military components of CONAD by creating public understanding of problems created by the very necessary business of defense.

If our defenses are strong enough, no aggressor will dare to strike us. President Eisenhower has stated that "a surprise enemy attack would find us with increasing readiness to resist attack and retaliate with devastating effect."



## Ghost Airliners Fly Real Routes

Ghost airliners are crossing the Atlantic between New York and London every day. Ten times a week, other ghost airliners make the 1,864-mile hop between New York and Caracas, Venezuela.

While the airplanes are imaginary, the schedules they fly are real and the data compiled from their operation is accurate. The ghost flights are part of one airline's program to prepare for actual flights with a new jet transport which will go into service next year.

A plan is made for each imaginary flight as carefully as if an actual jet-powered transport were about to take off with its load of passengers and mail. Factors considered are storms, temperatures and winds throughout the atmosphere up to 53,000 feet.

Weather conditions at a flight's destination also affect its schedule. A ghost plane may need to be diverted to an alternate landing field if its original destination is closed down by fog.

The ghost flights are managed by some of the most practical persons ever engaged in make-believe—pilots, operations engineers, meteorologists and airplane dispatchers at New York and Miami offices of the airline. When these experts fly a ghost jet plane, it takes the same course, altitude, speed and time as if it were the real McCoy.

A primary reason for the ghost flights is that the new jetliner on order will make it possible to take full advantage of the world's wind currents, particularly the so-called "jet stream" which can add appreciably to a jetliner's speed and range by pushing it between 100 and 150 miles per hour faster than the jet would normally cruise.

When the new jets come into actual operation, the data amassed under the ghost flight procedures will be of inestimable help in reaching new heights of passenger comfort, safety and speed—major goals of the U. S. aircraft industry.

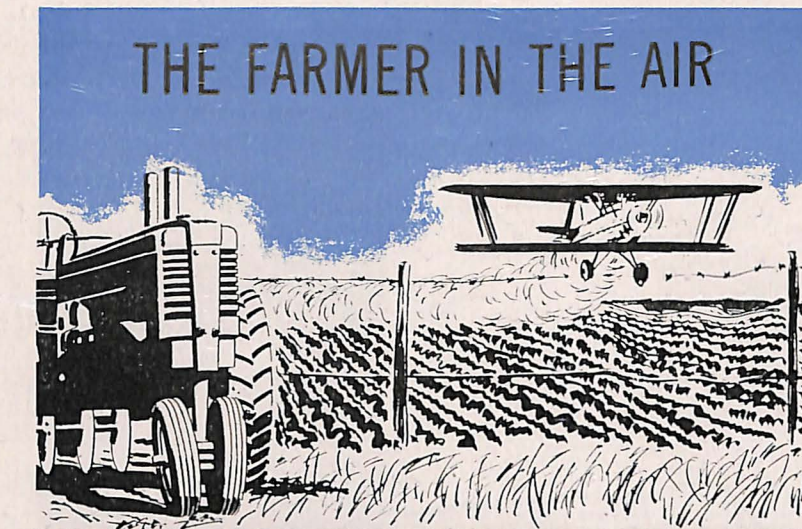
## Difficult Design Standards Are Routine In Aircraft Industry

Difficult standards are just about normal for the aircraft industry. For example, a recent assignment given to engineers of two U. S. aircraft companies had the following requirements:

Build a cylindrical house 100 feet long and 11 feet wide, with seating facilities for 91 persons. Install radiant heating in floors and walls. Provide a cooling, heating and ventilation system that is draft-free and uniform from floor to ceiling throughout.

Devise automatic controls to maintain steady interior temperature when outside it may range from -65 degrees F. to 120 degrees F.

Make the temperature controls sense any change in three separate locations and turn on heaters or coolers as indicated for passenger



The aircraft is both transportation and a tool of the farmer or rancher. Besides its ability to provide quick transportation to remote places on the farm and ranch, the plane is used for erosion control, fence patrol, dusting, spraying and many other purposes. The U. S. Department of Agriculture has estimated that aircraft have added as much as \$3 billion annually to farm income.

'PLANES'

## 'Cat Eye' Light Amplifier Makes Night Scenes Bright as Day

One of America's great aircraft industry electronics manufacturers has built a light amplifying device so delicate and yet so powerful that it can see a scene at night and reproduce it with daylight brightness, even when the human eye can see nothing.

Termed the "Cat Eye" by the Air Force, for whom it was built, the photographic light amplifier developed for fast night-flying military reconnaissance aircraft is also expected to prove a great boon to the sciences of astronomy and television.

Conventional photographs of planets and other heavenly bodies taken with even the best cameras are not considered to be completely accurate. This is because heat and cold in the atmospheric envelope sur-

rounding the earth causes "tremors" in these air masses. As a result the light reflected from distant objects in space being photographed is deflected first one way and then in another. An example is the shimmering of starlight seen on a clear night. This shimmer causes photographs to blur, since conventional photographic techniques require exposures of several seconds for Mars, and even longer periods for more distant planets.

But with the powerful new Cat Eye light amplifier, it is expected that pictures of Mars may be made in a few thousandths of a second, thereby photographing "between" the tremors in the atmosphere.

To the human eye, light appears to be steady and continuous. Actually it is composed of many separate photons, each of which is a separate small train of light waves. The human eye detects only about one photon in twenty—enough to see by daylight or lamplight.

In comparison, the photographic light amplifier collects and converts photons much more efficiently than the human eye. It is able to amplify the useful total of light emanation by several hundred million times.

The device works on principles similar to television. In use, it presents a cathode tube image not unlike a television picture. In fact, the Air Force says, it will probably have a profound effect on television broadcasting since the sensitivity of this optical amplifying technique is more than 1,000 times greater than a standard television camera.

The device will become an invaluable tool to Air Force aerial reconnaissance since it will enable fast, high-flying reconnaissance aircraft to take night time photographs with daytime clarity.

## 'Office Shortages' Same in Plane

With the emphasis on continued development of faster, more powerful aircraft, the aircraft industry and the U. S. Air Force have become very critical of unused "office" space.

In this case, the office space is that used by U. S. military pilots in new, high-speed aircraft. If you've ever had the opportunity of looking into the cockpit, or office, of one of this nation's sleek new fighters, you'll wonder how they could be made much more compact.

Yet in an effort to obtain maximum use of crew space, USAF's Air Research and Development Command has come up with an adjustable model cockpit to enable industry-military engineers teams to determine quickly the best and most efficient pilot-office design before time and money are invested in a hand-made prototype.

When a particular instrument and control arrangement is chosen, pilots, dressed in pressure suits and other special clothing, try it out to determine if the controls can be easily seen as well as conveniently reached and operated. If the arrangement is unsatisfactory, changes can be quickly made. Then the manufacturer is more readily able to build a detailed model. This results in saving production time and taxpayers' dollars, more safety for the pilot and a better, more efficient combat aircraft.

## Missile Performance Evaluated by Radar

A revolutionary instrumentation radar system which makes possible for the first time immediate evaluation of the performance of guided missiles has been developed by the aircraft industry.

Representing ten years of advanced research and development, the system is the first precision radar designed specifically for guided missile range instrumentation.

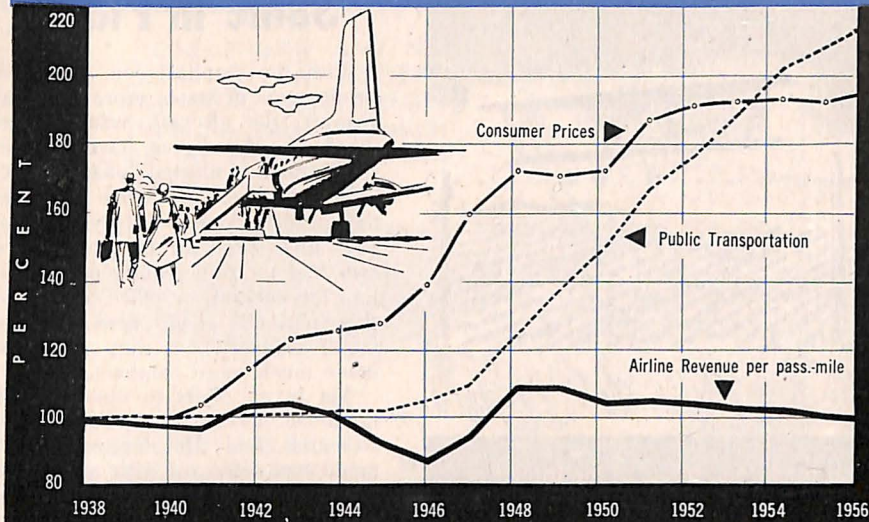
It is capable of tracking with accuracy over extended ranges, in darkness, through clouds, and under any atmospheric conditions—and to yield data that can be reduced almost instantly to final form.

Prior to development of the radar instrumentation system, data reduction methods required months for computation.

The instrumentation radar will be used to track missile and aircraft targets with and without beacon transponders, and to produce spherical coordinate data outputs of high accuracy, which will provide an instantaneous record of the trajectory of the targets. It also can be assigned to plot performance of satellite, drone, and other free-space moving targets.

Designed for installation as a fixed station, the radar will be housed in an enclosure specifically designed for it. The antenna pedestal will be mounted on a tower, detached from the enclosure in order to minimize the possibility of vibrations being transmitted to the tower.

## ECONOMY IN AIR TRAVEL



The airline passenger in 1956 paid less per mile for his ride than he did in 1938. While consumer prices in general went up, from the 1938 index of 100, to 192.7 in 1956 and public transportation as a whole went up to 212.6, airline revenue per passenger mile dropped to 99.6. This remarkable record in travel economy has been due to efficient airlines operations and the skill and experience of the U. S. aircraft industry in building faster, larger, safer and more luxurious airliners.

## Math Teaching Aid Offered

In line with their program of integrating aviation in the school curriculum, the Materials of Instruction Committee of the National Aviation Education Council has recently published the booklet, *Mathematics Teaching Aids for a Stronger America*.

Prepared as part of The Illinois Curriculum Program—Aviation Education Project, this booklet will enable mathematics teachers to greatly enrich their study programs by creating in the student an awareness of the various applications of mathematics to aviation. It is one of a series which secondary school teachers may use as instructional aids for aviation education.



The booklet is arranged into two main divisions. Part I gives illustrations of some of the uses to which aviation materials and aviation data can be put in teaching a selected group of the topics of mathematics. These topics are: Measurement; Fractions, Decimals, and Percent; Graphs; Angles and Triangles; Circles and Spheres; Formulas; Ratio, Proportion, and Similarity; Indirect Measurement and Numerical Trigonometry; and Equations.

Illustrations of aviation application to these topics are outlined, together with suggestions for classroom activities. A group of sample problems are presented involving use of the principles and skills of the topic being taught, followed by a listing of mathematics textbooks and aviation materials which will serve the teacher in dealing with these problems.

Part II presents three study guides concerning the relationship of mathematics to aeronautics, aerial navigation, and the consumer of aviation goods and services. Following the guides is a brief listing of suggested pupil activities, and a bibliography which lists a variety of teaching and learning aids pertinent to the subject.

*Mathematics Teaching Aids* will encourage a pupil's interest in learning mathematical skills and concepts, by showing these to be both functional and indispensable to air progress. Copies of this booklet 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 is 75 cents.

## Light Source Will Last More Than Five Years

(Continued from page 1)

thetic "lightning bugs," according to AMC spokesmen, might be their adaptation as wing-tip markers.

Attention to details as minute as providing light sources for escape hatch door handles is another reason why today's aircraft are among the most reliable forms of transportation ever devised.

## General Aircraft Output Up 52 Per Cent In Year; Piston Engine Will Be Power Plant Mainstay

(Continued from page 1)

did not take into account any so-called "major scientific breakthroughs." However, many competent observers, when interviewed, believe that new materials, along with aerodynamics developments such as Boundary Layer Control, Short Take-Off and Landing, and Vertical Take-Off and Landing, and new powerplants and fuels, can affect the nature and capability of civil aircraft more rapidly than the study presented to Mr. Curtis indicates.

Here are some of the outstanding facts turned up in the course of the Planning Group's report: 1. *Many airplanes in the 1976 fleet will be powered by piston engine powerplants not materially different from current models.* Today's reciprocating airplane powerplants are examples of highly refined U. S. aircraft industry machinery design. The rate of improvement in terms of fuel economy, performance efficiency and weight reduction has just about reached its peak although a modest rate of improvement will continue for a number of years. There will be an increased use of fuel injection; an increase in the number of engines equipped with superchargers; and in the application of controllable variable pitch propellers.

2. Turbojet and turboprop powered aircraft will join the general aviation fleet during the next five years but because of the cost factors, the numbers of this type of aircraft by 1976 will be "modest" the Group reports. However, there will be a continuous growth in the proportion of turboprop-powered aircraft produced, and in twenty years a large number of this class of new airplanes will be turboprop.

3. Cruising speeds of aircraft will continue to increase to a 1976 maximum in the magnitude of 600 miles per hour for turbojet-powered planes and 400 miles per hour for turboprop-powered planes. The minimum cruising speed of the piston-engined plane of 1976 will likely be in the magnitude of 230 miles per hour.

The business aircraft fleet, in its normal operation in 1976 will supply about one-quarter of all *first class* (scheduled airline and railroad included) business transportation at ranges of from 100 to 1,000 miles.

Some additional perspective in this economic picture serves to emphasize the restricting factors on private individual plane ownership. A 1954 survey put the median income of potential aircraft owners at \$25,000. There are only about 300,000 families in the United States today, with incomes of this size. Unfortunately, the survey concluded, the heads of about two-thirds of these families are over 45 and at a point where personal interest and aptitude in flying levels out. Nevertheless, by 1976, it is estimated that there will be an approximate 350,000 persons in the \$25,000-income category and that in 1976 one-tenth of these families will own its own plane.

While the general aviation fleet is scattered throughout the nation, there is a marked tendency for airplanes to be owned and based in geographic areas where there are concentrations of people.

Aircraft of the general aviation fleet will make approximately 588,000 take-offs and landings during a single peak day of the week in 1976 (contrast this to the approximate 15,125 take-offs and landings of the scheduled airliners *alone* each day in 1954). Operations of general aviation in the 1976 Chicago area alone are estimated to reach approximately 18,000 per day; in Los Angeles, 29,000; New York, 19,500; Dallas, 7,500; and in Miami, 6,500.

As can easily be seen, the use of aircraft for business purposes promises to continue to increase dramatically during the next 20-year period. These business planes will be increasingly in the high performance categories and their accommodation by 1976 will pose an airport and facilities requirement of considerable proportion.

While the future growth expected in general aviation promises to be

spectacular, it is already very sizeable, its present flying hours—10,000,000—exceeding those of the airlines three times. The report also discloses that the bulk of current general aviation is for business and agricultural purposes, with non-business uses accounting for only 20 per cent.

Because of the growth of general aviation, particularly for business purposes, the nation's aviation facilities are important to it just as they are to commercial airliners and military aircraft.

An interesting finding about numbers of airports disclosed in this privately financed analysis is that government figures on the larger airports with runways of 3,500 feet or longer were found to be quite accurate. But the figures concerned with the smaller airports were not. The report indicates that there are, in reality only about 4,000 publicly used airports as compared with the approximate 7,000 recorded by the government. For example, many small airports still listed on government records were found to be no longer in existence. Of these 4,000, more than half have runway lengths exceeding 2,300 feet.

Of greatest interest in the airport facilities study is the finding that the largest percentage of general aviation does not need large airports. The same holds true in maneuvering space for take-off and landing. At the same time, an important deduction resulting from the study is the need for flexibility in the traffic control system of the future.

An airplane is only so useful as there are available and convenient places to land. As the numbers of areas which are readily accessible to general aviation increase, so too does the utility of a given aircraft. Many sections of the nation are still inaccessible by air. In the interests of the national welfare—social, economic and common security—all America should be able to travel to one another in the quickest, safest and most economical way—by aircraft.