Flying Safety

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IN THIS ISSUE: **WIBAC** page 14

RESTRICTED

TEST PILOT

What makes an Air Force test pilot?

Experience . . . reliability . . . efficiency . . . alertness . . . technical background, sure. But there's something else, too. That something else is a unique Air Force school presently located at Wright-Patterson . . . the Experimental Test Pilot School of the Air Materiel Command's Flight Test Division.

It's a school made up of a handful of classrooms and a dozen airplanes. But it's a school staffed by top-notch civilian and military instructors and attended by specially picked young Air Force pilots . . . a school with a rough and tough curriculum that, in courses of only a few months duration, turns out the men with the answers—the experimental test pilots of the USAF. These pictures show high-lights of this specialized training that—in the last analysis—is what makes an Air Force test pilot.

In their course of training, students run complete flight tests on four aircraft: the C-45, T-6, F-51 and F-80—to qualify them for flight research in newer USAF planes. First of these is the C-45 in which an instructor can go along. In the top photo, Capt. J. R. Amann, deputy chief of the school, gives 1st Lt. Richard L. Dennen pre-flight instruction in the C-45. Note knee board, the test pilot trademark, used for recording data in flight.

Performance Section of the school lasts three months. Stability and control studies are five months in duration. In both courses, classroom work is timed to coincide with tests that are actually being flown by the students. Thus, in theory and in practice they learn the business of flight testing. Robert B. Allan, stability and control instructor, is shown in the center photo illustrating a problem in aerodynamics.

Last plane to be flight tested in the course is the famed F-80 Shooting Star. In the bottom picture, Lieutenant Dennen gets a send-off from two of the Flight Test Division's top pilots—Capt. Charles E. Yeager (right), first man to fly faster than the speed of sound, and Maj. Leonard Wiehrdt, former school chief, and now chief of the Division's Accelerated Service Test Operations Section. Both are former students of the Test Pilot School.

SAFETY AND SECURITY

By

THE SECRETARY of the AIR FORCE

WORLD WAR II imposed a tremendous task on the Air Force. Almost overnight there had to be created from the nucleus of a few hundred airplanes and a few thousand men, airpower superior to that of our enemies. Along with the expansion of the Air Force, there occurred an acceleration of the Flying Safety program. The effectiveness of the Air Force was at stake, but so was economy of operations. Aircraft and personnel had to be saved for other missions.

Despite the severe difficulties imposed by wartime expansion, the AAF was notably successful in lowering its accident rates throughout the second World War, and in the post war years the USAF rate has been further reduced. This low accident rate is a tribute to the attention given the program by all concerned—pilots, aircrew, maintenance personnel and commanders.

Today we are once more building a great Air Force. It is my intention that in spite of this build-up, the Air Force continue to maintain its program for accident prevention without retrenchment, and that we reduce accident losses to a minimum.

Primarily, the purpose of our defense establishment is to have in being and ready for immediate action in any theater a force so strong, so well trained and so ready for immediate action that it will stop aggression. Every accident that occurs impairs the readiness of the Air Force to fulfill its mission. I wish, therefore, to call the attention of all personnel to the fact that accident prevention is not only an integral part of operational efficiency but a contribution to national security.

Thomas K. Finletter

AFTER THE CRASH ---A JIGSAW JOB

Just a Few Pieces of Aircraft Wreckage Can Tell a Big Story to Accident Investigators

The search for clues in aircraft wreckage takes investigators to mountains and jungles.

AT FIRST GLANCE, draining a swamp or riding a horse for six hours seems hardly the way to conduct an aircraft accident investigation. But such is life among the Directorate of Flight Safety Research's aircraft accident investigators.

These gents are the puzzle solvers of the USAF. Given a hole in the ground, some old scrap metal and broken branches from surrounding trees, they can tell you within an ace the speed and attitude of a plane before it became a bid for your wife's pie plate. Frequently, these investigators of major and mysterious crashes around the country have little more than a hole in the ground plugged with hunks of metal resembling splintered beer cans to go on. But with their experience and with the help of USAF engineers, aircraft manufacturers' engineers and pilot groups, they can usually reconstruct the crash and determine the causes.

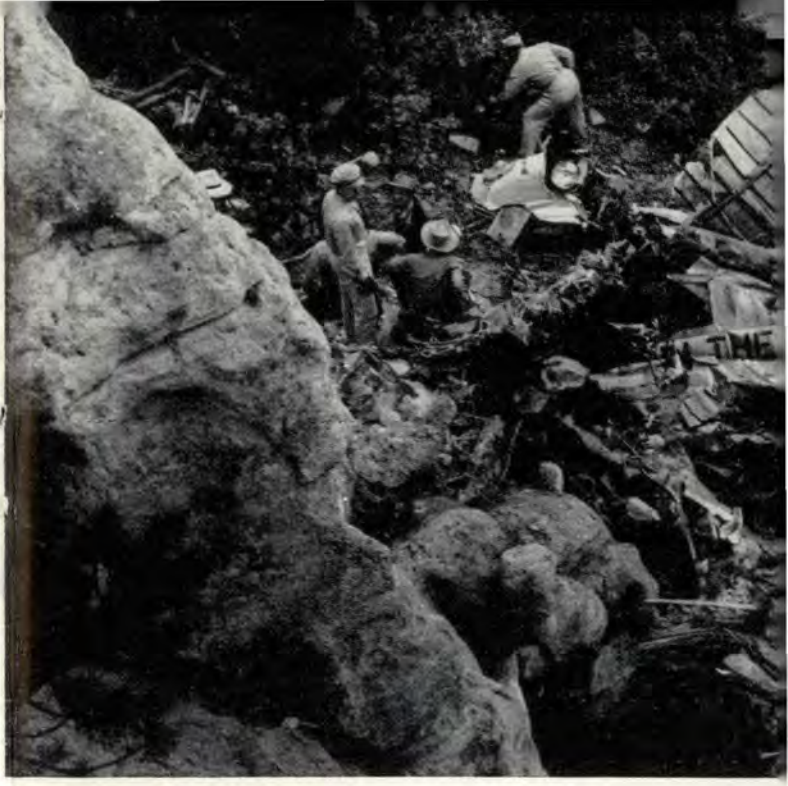
In the process they have some pretty unusual, occasionally hair raising, and quite often amusing experiences, which, of course, are not limited to these investigators. Any Base Flight Safety Officer who has investigated accidents has probably had one or more unusual experiences or found himself in a situation which couldn't be called routine. The difference is that with Flight Safety Research investigators such things are more or less routine.

There was the investigating team which got lost in the woods without a compass or landmark while looking for scattered pieces of the wreckage of a B-45. Luckily, the opinion poll was reliable. The majority ruled and the team got out of the woods on the first try. But on the way, they almost got in the way of a bear in headlong flight, being chased by a pack of baying hounds. They also scared several deer which would have been a more welcome sight at another season of the year.

Last summer, a B-50 crashed into a remote and rugged piece of western real estate and the ensuing investigation brought first hand information of the still wild west to one of the accident analysts. He still has saddle sores, takes his meals from the mantel, and his legs automatically bow at sight of a horse. The wreckage of the plane was spotted from the air. It rested at an altitude of between 5,000 and 7,000 feet, miles from roads or any form of civilization, in a rocky, hilly area with steep bluffs and cliffs barring the most logical approach.

To get to the scene of the crash, the investigator landed at an auxiliary field, took a two-hour ride in a jeep, covering only ten miles in the second hour, then rode a horse for six hours and walked another hour. The horse, particularly, made him certain that he was a city boy at heart with a deep-seated feeling against the life of a cowboy. He was definitely bronc-busted.

But this wasn't the end of the hardships. The B-50 wreckage was scattered over a wide area and all the pieces had to be gathered together or inspected so that the cause of the accident could definitely be determined. The team of which this investigator was a member spent a full week combing the cactus and mesquite for clues to the accident cause. This involved brushes with rattlesnakes, pulling cactus needles out of one man's hand with a pair of pliers, climbing cliffs and junior size mountains Swiss style (using ropes), sleeping in sleeping bags under the stars, cooking over campfires and being supplied by air. A lot of these modern conveniences the frontiersman didn't have. But it was close enough to the real thing to more than suit our boy.



No matter how high on a mountain an Air Force plane crashes, invest

Finally the ground search was given up as a lost cause and a helicopter flew in to lend a hand. This made things much easier and the investigator was soon able to spot from the 'copter the missing parts which told the story.

The B-50 accident had, contrary to the previous belief, been caused by a propeller blade breaking off in flight. And in arriving at this conclusion, more than being able to hang onto a horse or avoid a rattlesnake was involved. Engineering know-how and the ability to interpret the meaning of a certain type of metal break, a certain twist of the broken edge, plus a few other things, was necessary.

Before packing up his bags and taking off on an accident investigation, the Flight Safety Research investigator runs a short survey within the Directorate. He digests the causes and results of similar types of accidents of the past and in general fortifies himself with a last minute briefing on matters which, from analysis of the preliminary accident report, he believes may be pertinent to the accident. And after he returns from the investigation, the report he turns in is used in compiling various types of data for use in the accident prevention program. The experience he gains helps him in later investigations, and the fact that his experience is made available to others, helps other investigators.

Usually, an investigating party consists of anywhere from four to ten persons. Included are personnel from the nearest Air Force Base, which is charged with the normal investigation, representatives of the Directorate of Flight Safety Research, and occasionally engineering personnel from the aircraft factory which manufactured the airplane involved in the accident. Every angle, every possible cause, is studied thoroughly. Past experience, a as possible, the investigator ties all these parts into the accident story. Such things as disintegration in flight do not necessarily point to an explosion or fire. An airplane in flight, particularly in a dive or excessive speed is a highly-stressed structure. Failure at its weakest point may cause instantaneous disintegration with a noise like an explosion. Fire may follow structural failure as fuel vapors escape.

Investigators have frequently used the procedure of reassembling the wreckage to find the cause or to prove a theory when faced with a difficult accident problem. In one case an airplane crashed soon after takeoff under circumstances which indicated defective aileron controls. The wreckage was burned and badly scattered, with the aileron control system demolished and the cables cut and twisted. All parts of the system were recovered and reassembled to look like the original structure. Investigators went so far as to match individual wires in each strand of cable. When the reconstructed system was operated, it proved that the controls had been installed to give opposite action than that which was intended. As a result of this evidence, the control system was redesigned to eliminate the possibility of an error in reassembly after overhaul.

Once in a while, there is a pleasant side to the grim business of chasing down accident clues. A plane crashed on the estate of a wealthy merchantman and the investigators received royal treatment during their stay. Another time, an F-51 crashed in the city park at the home town of an investigator while he was on the last day of a leave. No time was lost by the Directorate in assigning him to the case, and his stay at home was prolonged several days while he investigated the accident, but his time was spent in work instead of play.

In spite of all efforts at investigation, there are still many accidents which have never been solved. Pilots, crews and mechanics can do a lot to help cut down the rising rate of accidents due to causes unknown, by reporting bugs and malfunctions in flight—before an accident occurs to make an investigation necessary.

-tings on a crashed F-84 (front spar tip left, rear spart right). Was tank t the tank dropped down, then swung nose out, and that the rear socket e front one failed in flight.

No One Can Contribute More to Safe Flight on the Gages Than the Individual Pilot

By Col. H. C. Munson
Chief, Facilities Branch
Directorate of Flight Safety Research

IT IS OFTEN SAID the best trained pilots in the world are Air Force pilots. One would have reason to believe this as a true statement if for no other reason than the vast sums of money expended for equipment, facilities, and personnel in training programs. Aviation has become a sound activity with an unlimited progressive future, and well trained pilots are the core of this progress. There is no other business depending so much on the ability of an individual as aviation depends on the pilot.

Yet, a serious situation is developing in the Air Force by almost daily, unnecessary crashes. In numerous cases these crashes are the result of careless flight planning, inadequate briefing, poor supervision and unsound judgment by both pilots and operational personnel. The result of these deficiencies are bailouts, crashes, and needless fatal accidents.

A large number of these accidents indicate a weakness in the instrument flying proficiency of Air Force pilots. There is no phase of flying training in which so much money has been expended, as there has been in instrument flying training programs. The result of this expenditure has produced highly qualified instrument pilots, many of whom can be rated as experts. Since the end of World War II these highly qualified instrument pilots have spread throughout the Air Force creating a valuable asset to all commanders in that their services can be utilized in the training and supervision of less experienced personnel and thereby raise the standard of all concerned in the art of instrument flight. However, facts and figures show that responsible people in many cases are overlooking the opportunities presented to build up their commands into highly efficient flying organizations.

In further improving the instrument training program, proper use should be made of all the instrument training facilities as well as instrument instructors. Too often aircraft designated for training purposes are not available and are being used on missions which deprive any training program of their availability. Synthetic trainers too often are out of order and not used to their fullest extent. No instrument training device can be more helpful in developing a sound knowledge of instruments than the synthetic trainers now available to almost all flying personnel. In addition these same trainers offer one of the best means for qualifying pilots to maintain their proficiency in the basic orientation problems of instrument procedures. It is a sound test for any pilot to prove to himself, in a synthetic trainer, that he maintains the techniques he has acquired through an extensive training period. All pilots should take pride in the skill with which they demonstrate their ability.

No flying organization regardless of its capabilities can function to a high degree of usefulness to the Air Force without the most efficient operations supervision. From the highest command down, the delegated authority of Air Force operations is one of the most responsible duties. There are indications that the full responsibilities of these duties are not always assumed by the individuals to whom they are assigned. Careless and complacent operations supervision is contributing to a needlessly high accident rate. By careful and helpful consideration of flight planning and briefing, many potential accidents can be prevented. Not only should departing flights be given careful screening, incoming flights should be monitored and given whatever aid would be necessary if an unforeseen hazardous conditions arises.

There are many other ways that operations can contribute to safe flight, such as constant watchfulness of field conditions, snow removal, marking of hazards, and obstructions. Almost daily throughout the Air Force accidents are created by neglect on the part of some one responsible for airport maintenance.

No one can contribute more to flying safety than the individual pilot, with proper training and supervision. By his determination to use sound judgment and efficient flight planning on all flights, the valuable equipment with which he is entrusted to fly can be utilized to its maximum degree. The result will be the strengthening of the overall efficiency, economy and combat readiness of the Air Force.

Use Instrument Trainers . . .

Use Flight Simulators . . .

and Instrument Mock-ups

THE WEATHER

Much of a pilot's training is devoted to study of the weather, but not all make the most practical use of this knowledge. To properly plan a flight and make use of the weather station, the pilot should use a planned procedure. If the steps shown here are followed the most pertinent information regarding the weather can be obtained in a logical manner. Of course, you can vary the procedure to fit the particular flight, so long as you get all the information available. Check weather from destination to alternate with the same care as the original route.

1. The first objects to attract the pilot's attention are the synoptic maps. Information on these maps gives him an overall picure of the trend—he sees the direction and speed of movement of fronts and pressure systems. Synoptic maps, prepared every six hours, are separate pictures of the surface weather. The pilot can learn to analyze the intensity of storms and determine with the forecaster whether the conditions are likely to improve or become worse in the region of the flight. Also compare the synoptic with the prognostic charts put on the wire by Air Weather Service.

4. At the same time the pilot checks winds aloft, he also needs to know all the information available on the upper air. Adiabatic charts are nothing more than vertical soundings of the atmosphere showing pressure in millibars and the temperature and humidity at various levels over a particular station. From these upper air charts amount or severity of turbulence and icing can be predicted. By combining factors of humidity and stability the type of clouds can be told. By locating the most stable air, flight can be made with minimum discomfort and fatigue.

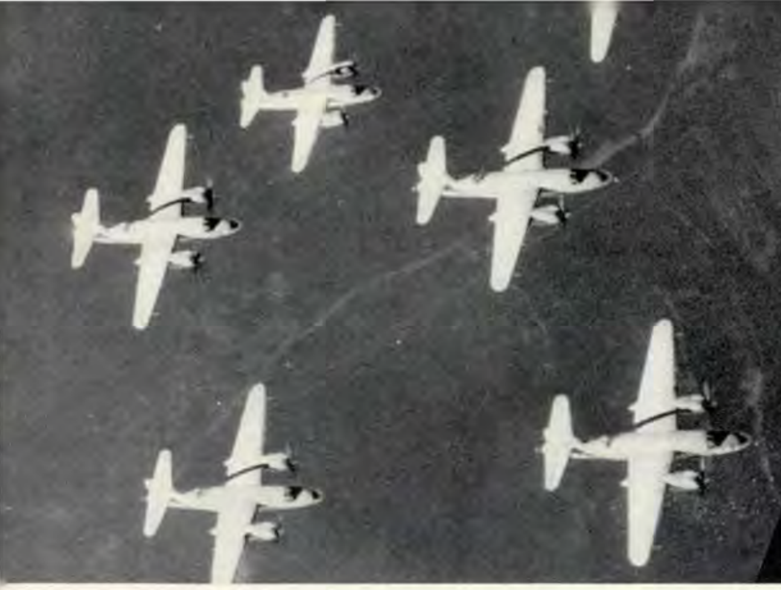
5. Pilot reports furnish additional details of weather to be expected en route. Locations of fronts, thunderstorms, turbulence, precipitation and icing levels can be more accurately pinpointed with the aid of PIREPS. It is also a good idea to look up other pilots in operations who may have just come through the weather you are going to fly. CAA weather bureau forecasts for routes and regions give concise reviews of the synoptic situation, predict frontal movements, types of clouds and extent of sky cover and give an eight-hour further outlook.

2. The seemingly confused mass of teletype sheets in the weather station are actually well arranged to simplify the work of the pilot and forecaster. Color codes help locate stations on circuits. From teletype reports the pilot can determine present conditions along the route. By comparing previous reports with the latest, plus the information gained from the synoptic maps, the pilot can visualize the weather to be expected at the time of arrival . . . ceiling lowering from 2,000 to 1,000 feet in one hour might indicate that the field will be below minimum at E.T.A.

3. In checking winds aloft, the pilot can choose the most favorable flight altitude for fuel consumption and make adjustments for plotting the course to be flown with regard to drift and E.T.A. Final selection of altitude to be flown requires consideration of turbulence and icing levels and the performance capabilities of the aircraft—oxygen supply, etc. Since some stations do not draw winds aloft charts, each pilot should be able to read winds aloft sequences from the teletype.

6. If the weather situation compels—that is, if there are several fronts, icing, turbulence, the pilot should ask the forecaster to draw up a form 23A. This gives a cross sectional picture of the weather for the entire flight. In any case, the pilot should have in his own mind the weather en route wih its relationship to terrain. Accurate information on free air temperatures for certain altitudes will enable the pilot to compute true airspeed before takeoff, a factor that must be known by Air Traffic Control for safe spacing on airways.

7. The forecaster is in the weather station to assist the pilot in getting the weather information he needs. Don't hesitate to consult him on any question. No pilot or forecaster can choose the safest route through weather by using only one source of information in the weather station. Only after you have checked the weather by following a logical plan, is it time to have the WX man fill in the weather portion of your flight clearance form. Remember to find out as much about your alternate as you do about your original destination.



the Silver Fleet

FROM NEW GUINEA TO KOREA

WHEN AN ORGANIZATION can receive orders, prepare for and move to a far distant land and perform a combat mission all within nine days, it is indicative of the high order of training and efficiency of the unit. To have an abort rate of less than 1.5, to drop over 6,000 tons of bombs in 835 missions and have only one accident—and that due to mechanical failure—is a record to be well proud of. That is part of the story of the 22nd, one of the five medium bombardment groups that participated in the strategic bombing of North Korea.

Strategic Air Command pilots and crew members all receive standard training and at the start of hostilities all are equally prepared, insofar as type of training is concerned. True, some have more experience, thus making them more efficient than others, but in the over-all picture, all are "tarred with the same brush."

The safe operation of a bomb group is a mixture of morale and tradition, of leadership and training. On 1 February 1940, the 22nd Bombardment Group (M) was activated at Mitchel Field, New York. Using B-26's, B-25's and later B-24's, the unit fought from Australia to Okinawa during World War II. During this period, it received two Presidential Citations and eleven battle honors. The famed Silver Fleet was well known to the enemies of the USA. The Group was deactivated from the latter part of 1945 until 6 June 1946, when it was reactivated and equipped with B-29's.

The group returned to the United States shortly thereafter, and, in the rush to get the show on the road for home, the group might have returned minus the ground crews. But foresight on the part of commanders saw to it that the key personnel of the ground crews were trained in the duties of flight crews and they flew right along in the B-29's, thus saving for the group the highly trained maintenance personnel.

From this period until 4 July 1950, the group participated in the regular SAC training program. Training in the SAC Mobility Plan was the order of the day, including two overseas training missions in the United Kingdom.

On 4 July 1950, Col. James V. Edmoundson, Commanding Officer of the 22nd, received orders to proceed to the Far East. Spending the Fourth of July in last minute preparations and final pre-flight safety checks, the group proceeded to Kadena Air Force Base, Okinawa. On July 13th, the group, with 98 per cent of its B-29's, participated in the first combat mission.

Although Kadena was a fairly well equipped bomber base when the 22nd moved in, there were certain contrasts in maintenance there and maintenance at March AFB which is the home of the 22nd. The main interest became maintenance, and personnel were more productive at Kadena, and under combat pressure actually performed better than at March.

Under the supervision of Maj. William Lemme, Group Flying Safety Officer; Capt. Ernest J. Saliba, 2nd Bomb Squadron; Maj. Louis Lamm, 19th Bomb Squadron, and Capt. Harold Timmerman, 33rd Bomb Squadron, the flying safety program was carried out with the same efficiency as was maintained while flying within continental United States. Their constant vigilance kept all personnel safety-conscious and contributed to the group's excellent record. One example of this was the wearing of flak suits on all missions regardless of whether or not flak was expected.

Maj. Edward M. Nichols, maintenance control officer for the group, had many difficulties to overcome. For example, the 19th and 307th Bomb Groups were already assigned there prior to the arrival of the 22nd on Kadena so that by the time the planes of the 22nd arrived they were parked so far away from the base shops that they naturally performed most of their own maintenance. Being assigned little-used parking areas made matters difficult, because of the mud and inaccessibility of heavy equipment. In addition to these headaches, some of the planes of the 22nd were among the first B-29's to fly over the hump in the CBI during the last war. Col. R. W. Hawley, director of maintenance and supply for the 22nd Bombardment Wing, claims, however, that with proper maintenance the amount of time on an airframe has no bearing on the wear-out rate of the aircraft. Keep them in the air and the airframe will last longer than if it is parked and forgotten, is the theory.

Master Sergeants Gernand, Sands and Edge, line chiefs of the group, had nothing but praise for the work of their men while in the field. Adverse conditions challenged the men and they rose to meet them. That they were successful is attested to by the fact that from the time the group left March AFB until it returned, 10,664 hours were flown, with only one accident.

After returning to March, the group went right on with training in order to remain on the alert for any future eventuality. Each plane was to receive a thorough inspection to get back into combat readiness. Major inspections were slated at the maintenance docks. There would be such things as checking corrosion caused by the damp climate and complying with new tech orders written while the group were away. All control surfaces were to be rejuvenated and all over-age accessories replaced. In addition, all de-icer boots were to be replaced. As can be seen, in order to maintain a group at combat readiness, it's a seven-day week.

That the combat-readiness type of training conducted by SAC is basically sound is indicated in remarks made by Maj. Gen. Emmett O'Donnell, Jr., Commander of SAC's 15th Air Force and of the Far East Bomber Command: "Insofar as strategic bombing is concerned, we in the field are making no recommendations based on this campaign for changes in procurement, training or general planning for any future strategic air war."

General O'Donnell commended the 22nd for the manner in which the group met the requirements demanded of it since the first day of operations: "Your combat flying time is the highest in the command, despite the fact that your living and operating conditions have been the most difficult." He wrote, "Your aircraft utilization rate is as high as any I have ever seen, your bombing accurate, and your reports rendered promptly and fully."

In having a part in the destruction of the North Korean strategic targets, the 22nd Bombardment Group (M) lived up to the mission assigned to it by the Strategic Air Command and the 15th Air Force: "To conduct long range bombardment operations in any part of the world at any time, either independently or in cooperation with land and sea forces."

CRASH LANDINGS

IT MIGHT SOUND a bit incongruous for this publication to dub as "Mal Function" a pilot who lands gear-up while in a state of mental lethargy, and then in a subsequent issue of *Flying Safety,* give a Well Done and praise galore to a pilot, who, in an emergency, makes an intentional gear-up landing, thereby saving the crew and doing little damage to the aircraft. Yet, that greatest teacher of them all, Experience, has proven that emergency landings, other than on airport runways, are, with minor exceptions, safest performed wheels up.

Jet fighters, bombers, cargo planes and trainers, have all been set down with the gear-up on sod, in plowed fields and on other reasonably smooth terrain with a surprising lack of damage.

Jet jockeys have walked away from wheels-up landings, with a touchdown indication as high as 200 knots, and have written their own reports while enjoying good health. A study of fuselage protection on jet fighters has shown that a high percentage of the cockpits remained intact even though the rest of the plane was scattered over a country-sized acre. If you do have to crash land, the more you have studied and simulated emergency procedures the better your chance of survival.

Vital points to remember on a fighter belly-landing are: Keep the airplane under control. Fly a pattern best adapted to the emergency field you have selected and keep airspeed appropriate for fuel load. Be positive your shoulder harness is *locked,* safety belt fastened (tight). Open or jettison canopy (where it can be done without ejecting the seat), cut switches and fuel and make a normal stall landing, maintaining directional control with rudder as long as possible.

Get clear of the aircraft as soon as you can and stay clear until the engine cools and fire hazard is past.

Basically, the bomber is handled with much the same safety technique as the fighter, though necessarily somewhat more involved, to accomplish an emergency wheels-up landing successfully. It is in this situation that the value of real teamwork and split-second timing makes the difference between success or failure.

First of all, each man on the crew should know his crash landing position as shown in tech orders. In most instances they are the same stations as in water ditchings.

If time allows, the pilot should select the most suitable field and make his approach much the same as in ditching, with the aircraft, if possible, headed into the wind. Also, if time permits, the pressure in the oxygen system should be relieved to reduce possibility of an explosion and fire. This is expedited by each crewmember turning his valve to the emergency oxygen position.

Pressure in the hydraulic system should be relieved if possible, in all wheels-up landings. Fire extinguishers should be set for engines nearest the fuselage. Also, feather inboard engines if possible, to eliminate chances of a prop tearing loose and sawing through the fuselage. Bomb bay tanks and bombs should be salvoed and fuel drained from the auxiliary power unit before touchdown, if time permits. At least turn this unit off. Open all emergency exits except bomb bay doors, stow or jettison as much loose equipment as possible because such objects may become lethal projectiles in a crash landing.

To illustrate the value of knowing proper procedures, we can use two B-29 crash landing accounts, selected from accident reports, to determine the procedures actually used by crews who have crash landed without fatalities.

A B-29 departing from an AF base encountered excessive manifold pressure on numbers two, three and four engines, resulting in engine fires in numbers two and three engines. The bomber had gained approximately 200 feet of altitude at the time of the emergency and the aircraft commander elected to make a crash landing straight ahead in the most suitable field available.

The weight at the time of takeoff was 95,574 pounds with 2600 gallons of fuel. The indicated airspeed at the time of the emergency was 160 mph.

As the aircraft neared the ground, the aircraft commander proceeded to lower full flaps and again warn crewmembers to be in crash landing positions. The plane landed in a field four and one-half miles from takeoff in a tail low attitude, bounced over a 150-foot gulley, touched again, and came to rest 1200 feet from point of initial impact.

The number three engine was torn loose when the aircraft struck a slight depression in the ground after sliding approximately 675 feet. The flight engineer shut off the main switch (crash bar) just before contact with the ground and as many other switches as possible during the time the aircraft was sliding along.

After three unsuccessful attempts to open the flight engineer's hatch, all members in the front pressurized compartment scheduled for exit through the hatch abandoned the aircraft through either the pilot's or the copilot's windows. All members in the rear pressurized compartment escaped either through the rear entry door or the escape hatch near the auxiliary power unit.

Insufficient time existed during the emergency to use the fire-in-flight procedure, or remove escape hatches, but due to a well executed crash procedure and an orderly abandonment, all personnel escaped uninjured.

The crew of another B-29, while flying a photographic mission, became lost. When the fuel supply ran low and darkness approached, the pilot decided to crash land on an iced lake. A normal traffic pattern was made and all crewmembers were warned to take proper crash positions. The approach was made at 125 to 130 mph, with full flaps down. As the round-out was started, the engineer was ordered to cut all switches. Following the main impact, the aircraft slid for approximately 800 feet and did not deviate more than five degrees from the direction of touchdown. The landing was smooth and the only sensation experienced by the crew was that of deceleration. The aircraft was immediately evacuated along with all emergency equipment.

In this wheels-up landing, a normal pattern was used as complete power enabled the pilot to retain "everyday" conditions. A flap setting of 25° was used on the downwind leg. The airspeed was kept at pattern requirements (160 on downwind, 125-130 on the final) with the power settings of 2400 rpm and enough manifold pressure to do the job.

Just prior to impact the engineer cut the bar switch and the navigator, bracing himself next to the engineer, put the mixture controls into the OFF position as the engineer cut the "tank selector" switches. The pilot kept his crew informed by interphone so that they knew the expected moment of impact and every member was properly set for the crash. Touchdown was made tail low to relieve the main section of the fuselage from the initial shock.

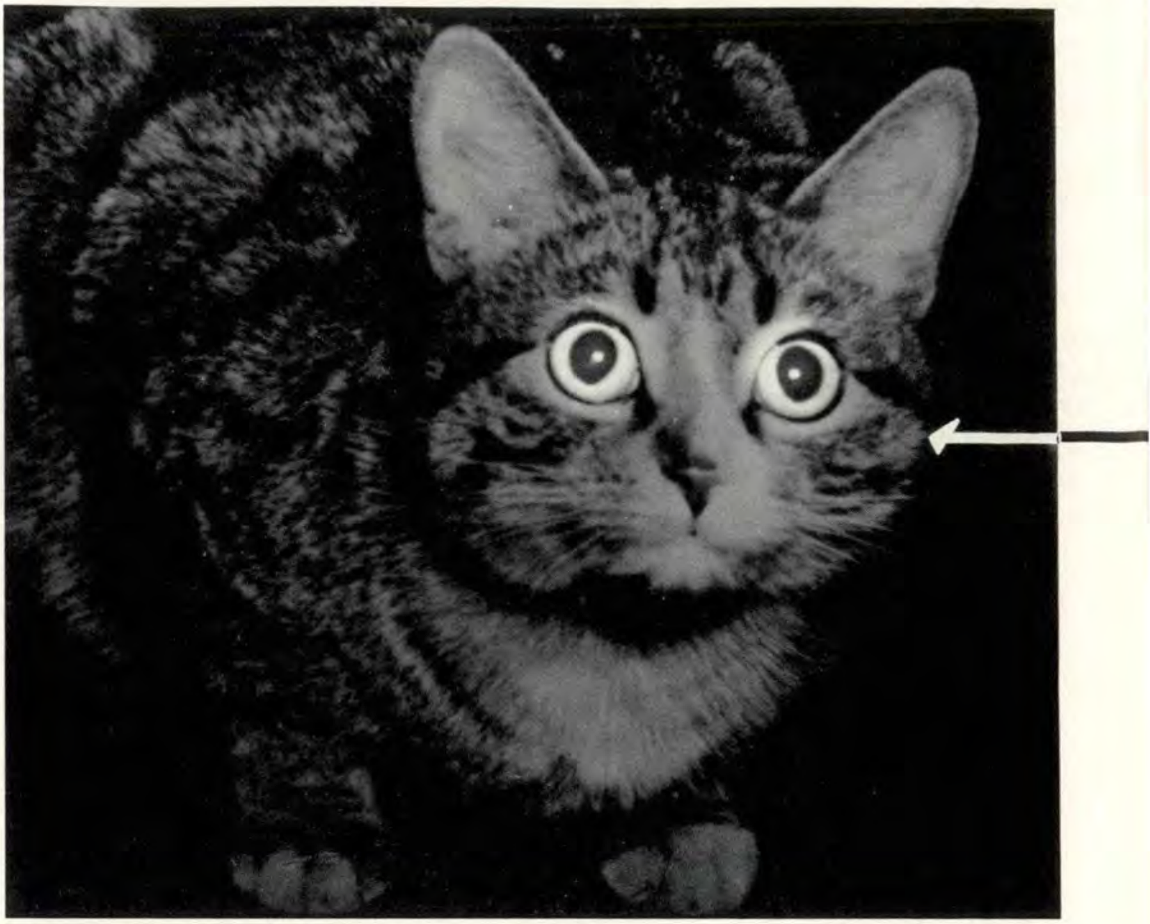
This is an instance where a gear-up crash landing was inevitable and the decision was made while there was still enough fuel on board to retain powered control. This also allowed the pilot more choice of landing terrain.

Points to keep in mind in cargo types, is to make sure passengers have fastened their seat belts and know their exits, and jettison cargo if time and altitude permits. Lose cargo narrows your chances of walking away.

These are, admittedly, brief tips on crash landing. But they are tips evolved from procedures that have saved lives. Tech orders for your plane will give you more complete details.

• • •

Studies of aircraft crash landings lead to improvements in procedures and equipment. Fire after a crash is a hazard that the USAF and other agencies are working to eliminate. Of a total of 525 fires after crashes (all types of crashes, not crash landings exclusively), during a recent 30-months period, there were 91 attributed to either fuel and electrical spark origin, oil on hot metal, friction, or ignition of the hydraulic fluid. Recommendations have been made by the Directorate of Flight Safety Research that an inertia switch be devised which will automatically, at the time of impact, de-energize the electrical circuit, shut off all flammable fluid systems, and discharge fire extinguishers in the engine nacelles.



REPUTEDLY, THE CAT is a pretty sharp critter when it comes to spotting things at night—like mice, for instance. For that matter, the owl also has an enviable reputation along these lines—maybe it's just because both have better dark-adapted eyes, thereby constituting an occupational hazard to nocturnal mice.

On the other hand, bats and pilots, particularly bats, have never been any great shakes at seeing in dark BOQ's or while airborne. Both utilize radar—high-frequency squeaks from the bat and the pilot uses man-made mechanical sets working more or less on the same principle.

Every pilot and crewmember has undoubtedly heard vaguely about night vision, and could ask a lot of questions about it. What is night vision? How well can you see with it? What can be done to improve vision at night? What is night blindness? Does eating carrots and vitamin A help night vision? These are some of the common queries, and here are some of the answers.

Night vision in some respects is virtually 180-degrees different from daylight vision. With daylight vision you can read books, judge colors, look at pictures, and recognize friends. With night vision none of these things can be done, and you cannot see details. But you can see in *almost* total darkness with it, and here is where night vision is most valuable in night operations.

Country people know and use dim vision very well. They use it in walking along the roads, crossing fields, hunting possums, finding the cabin in the cotton, and in general, getting about on dark nights. But this night vision cannot be used at a moment's notice; the eyes have to work down to it gradually.

The eyes are fantastically sensitive to the smallest amount of light after they have been dark adapted for half an hour. With completely adapted eyes it is possible to see a candle flame 12 miles away, or the flare of a match 25 miles away on a clear night. Under ordinary ground conditions it is neither the sensitivity of the eye nor the distance which limits the visibility of lights; it's the curvature of the earth and the haze and mist or the smog, that obscures them.

Your capacities for seeing in the daylight and at night are not evenly distributed. The arrangements for daylight vision are most concentrated in the very center, so that when you look at something directly you use only day vision. This is fine for most purposes, but as a result, the center of the vision is practically blind in very dim illumination. Under such conditions you cannot see anything at all if you look at it directly.

It is really the margin of your vision that is arranged for night seeing. You do poorly with this part of the eye during the day; for example, as you read these lines you will notice that only that part of the page is sharp which you are looking at directly; everything else is fuzzy.

In night operations you must be content with this crude vision. Consequently, direction markers should be painted in large simple forms. Arrows should be exaggerated, the tip being many times wider than the shaft. Color contrast between lettering and background on signs and placards should be as great as possible.

Color has a peculiarity which is of first-rate importance in seeing at night. This concerns the different degrees of brightness of various colors, and is best shown with red and blue. This holds true for red and blue lights. Tests have been made where a blue and red light were matched in brightness and a dense screen then placed in front of the two lights so as to cut their intensity equally down to a small fraction. The difference was that the blue light was hundreds of times brighter than the red.

This proves that by reason of its greater night brightness than red light, blue has a bad effect on night vision. Complete dark adaptation is not easily acquired; it takes approximately half an hour and it cannot be hurried—but it can be quickly lost. Seeing a bright light will destroy the adaptation and the eye will have to go through the course of adaptation again. The extent to which dark adaptation is destroyed, and the speed of its recovery depends on the duration of the exposure to light and on the brightness of the light as it appears to night vision.

Since blue light—and for that matter green light—is so much brighter to night vision than an equally useful amount of red light, the use of blue light or green light for seeing any detail will always expose the night vision to greater effect than red light, and the eye dark adaptation will be destroyed accordingly. This holds for looking at the instrument dials in the cockpit of the plane. The best light for illuminating these is red light just bright enough to make them visible. If they are illuminated with any other color of light, the dark adaptation will be spoiled more than if red light were used.

Unfortunately, the cockpits of all planes are not yet illuminated in this way, and it is important to keep the brightness as low as possible, so that when you look out into the night you will be able to see adequately. Here, another point may be stressed. The plane's windshield and side windows should be kept clean. Dirt and scratches cause reflections or "ghosts" in the field of vision which act like fog and glare to reduce the dark adaptation of the eye.

Night vision also has a relation to vitamin A, which is a cure for night blindness. The reason you need vitamin A is that it enters into the formation of a substance called visual purple, which is responsible for the great sensitivity to light of night vision. Night blindness is the inability to see in low illuminations even after prolonged dark adaptaton. When it occurs in groups of people, it is because they have been deprived for a long time of green vegetables and butter.

Recovery from night blindness caused by vitamin A deficiency is slow and is to be reckoned in weeks and months rather than hours and days. It is vitally important to the pilot never to get in such a condition. He should eat green and yellow vegetables whenever possible, because his life may depend on this some night. Lack of sleep and rest, and indulgence in too much alcohol will make night vision poor for several days. Also, lack of oxygen on night flights can affect vision and depth perception to the point that the pilot may be unable to make a safe landing.

Foresight *for night sight*

As guides for visual behavior during night operations this information adds up to some simple rules. If you learn them and realize what they mean in terms of night vision, you need have no fears about getting around in the dark or while flying at night. You have a couple of the most sensitive light-detecting instruments in existence. All that is required for their best operation is that you know how to use them.

1. It takes time to achieve complete dark adaptation. When leaving a brightly-lit operations room, don't rush into the black night for a fast takeoff. If you do, you will see nothing and will endanger yourself and others. Go slowly. Wait at least ten minutes after leaving bright illumination; wait longer if you can.

2. Once outside for awhile, do not light a last minute cigarette. Never strike a match or use a lighter to damage your dark adaptation already acquired.

3. Learn to use the visual periphery. Pay attention to what you can pick up out of the corner of your eye. This requires practice but you can become adept at it.

4. When extra light is needed in the cockpit to check instruments or maps, use only a weak red light. Put red cellophane, or red glass over your flashlight.

5. Watch your diet so that it does not fall below normal vitamin A requirements. Use oxygen, as required for safe flight.

Remember to take no chances on your night vision. Its good condition may mean the difference between a safe or a dangerous flight by night—and good sight is a tool of survival if you are forced to bail out or evade capture at night.

WIBAC TESTS THE STRATOJET

Air Force Crews Are Wringing Out the B-47 To Match Its Performance With Safe Procedures

ENGINEERS AND TEST PILOTS can iron out the big bugs in a new airplane before it is delivered to Air Force units, but it takes many hours of operation under varying conditions to exterminate the little bugs that can gang up to delay training, cause missions to abort, and give crews a tough time in emergencies.

You could call Project Wibac a clinic for the careful examination of the B-47 to find out everything that can be learned about the new beauty before she makes her debut in the bomb groups.

Wibac is what the Boeing people call their plant at Wichita—*WI*chita, *B*oeing *A*irplane *C*ompany. And the Air Force found it a handy name to dub the unit sent to Kansas under the command jurisdiction of the Air Proving Ground to perform operational suitability tests on the Stratojet.

As Project Officer for Wibac, Col. Paul W. Tibbets, Jr., is chief clinician, and if there was a glass door to his office there wouldn't be room to paint the names of the specialists associated with him. They are officers and airmen from Air Proving Ground, Strategic Air Command, Training Command, and Air Materiel Command.

Actually, Colonel Tibbets and his staff don't make their examinations in an office. They make them on the flight line and in the air, which is where you find out how it goes with mechanics and flight crews. After that you can go back to the office for consultation with the specialists and come up with a remedy for whatever ailment you have diagnosed.

Major General S. R. Brentnall, as Special Assistant to the Chief of Staff for the B-47 program, works directly with Project Wibac personnel to expedite decisions which facilitate the operational testing of the Stratojet.

Project Wibac is a new and accelerated method of combining all the various performance and equipment tests required on a new airplane into one project. It is located right at the Boeing plant in a new concept to deliver the airplane direct from the manufacturer to the user and take advantage of the company's facilities, engineers and test pilots, all close at hand. This way maintenance fixes can be made immediately. You can even go so far as to say that if some difficulty develops in flight, not covered in the handbook of operating instructions, you can punch the mike button, talk to the man who made the part that's acting up, get his advice and make an emergency adjustment. Sort of a UR by two-way VHF.

When the Stratojet goes into operation in group strength, Project Wibac should have the answers to the questions flight and ground crews will ask about it. How do you fly and service the airplane? And of more far-reaching importance will be the solution of problems facing major commanders on how effective the fast bomber will be when operated by Air Force personnel. Here are some of the questions Wibac will answer:

How safe is the airplane? Can Air Force pilots and crews operate it safely and how much transition time will be required to check out the pilot and crew? Strategic Air Command and the Air Training Command are both closely watching this phase of the accelerated tests and have officers connected with Wibac for this purpose. Lt. Col. Richard C. Neeley is ATRC Liaison Officer and Major Robert T. Robinson is the SAC Liaison Officer.

Until you have tested a basic airplane and its equipment through all sorts of flights and field operating conditions, it is pretty difficult to work out tables of organization and equipment that will be needed by bomb groups who will fly the airplane.

There are thousands of questions that have to be answered before a group receives delivery on a new type plane. You have to know how many maintenance people will be needed; how many parachute riggers; engine mechanics, hydraulic mechanics; supply people will have to know how many generators the group will need in a month's operation, how many fuses and tires, how many landings will the drag chute stand? It is essentially a job of finding out what maintenance and repairs can be made in the field and what will have to be fixed at depots or the factory.

That's the job of Project Wibac—to wring the B-47 out and get the answers so that operating units will know ahead of time the basic requirements for training, operations, maintenance and supply.

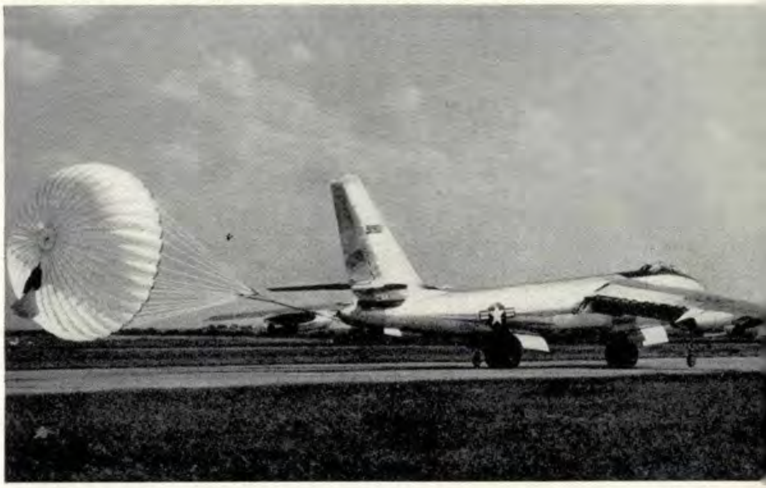
Warrant Officer Albert B. Sherman, a SAC engineering officer, is a member of the project, and he has 60 hand-picked airmen, mostly from MacDill and Eglin Air Force Bases, who will become a trained nucleus of experienced B-47 mechanics. Even though Project Wibac's Operations and Maintenance set-up is right across the street from final assembly at the Boeing plant, they are flying and servicing the airplane just as any squadron or group would do at an AF base.

Not all of the testing is to be done at Wichita. Project Wibac crews will fly B-47's to Eglin for bombing missions and other tests in connection with the airplane's armament, and to Wright-Patterson for tests in conjunction with the All-Weather Flying Division of AMC. Thus, at the same time the pilots and mechanics are learning what it takes to keep the airplane operational, the Unit will also be solving the problems of bombing and instrument flight techniques.

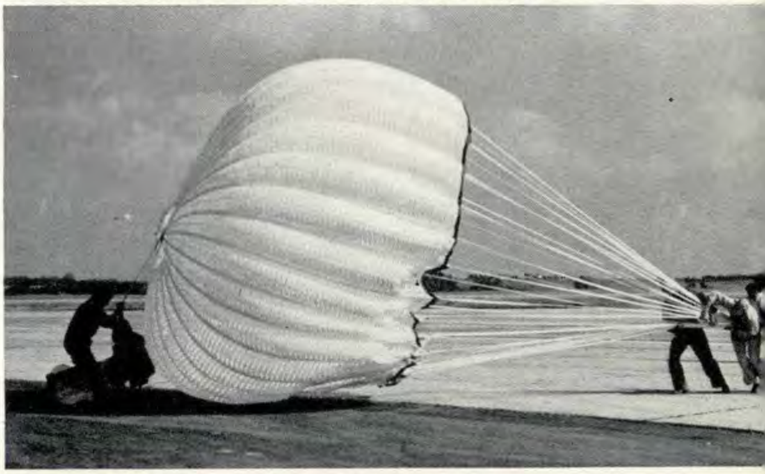
All these flights will give most valuable clues to the Supply people. Major John A. Hykes, Project Supply Officer, says that it will be possible to determine repetitions of breakdowns. This means, for example, if generators average 60 hours before they give trouble, it will become SOP to replace them at 55 hours, before they breakdown. This idea is carried into all equipment and parts of the airplane.

From the start of the B-47 design, the Boeing service equipment people, the men who go out in the field with the bomber groups as trouble-shooters, used all of their ingenuity in simplifying tools and servicing procedures. While the Boeing B-29 Super-fortress requires 140 special tools and items of equipment for maintenance work and ground handling, such tools and special equipment have been trimmed to 87 for the Stratojet. Development of the new tools and equipment took advantage of previous experiences of servicing airplanes in various extremes of climate and airfield conditions. Along with this effort to give the GI mechanic special tools to make his job easier and allow fewer chances for maintenance errors, the Stratojet tools are built largely of aluminum alloy so that the plane can carry them with it wherever it goes. Even the tow bar can be quickly broken into sections for transport aboard the plane. This Boeing-developed equipment which has received plaudits from AMC engineers will be given thorough workouts by the

Either pilot can deploy 32-foot ribbon-type drag 'chute.



After B-47 decelerates, 'chute can be jettisoned or spilled.

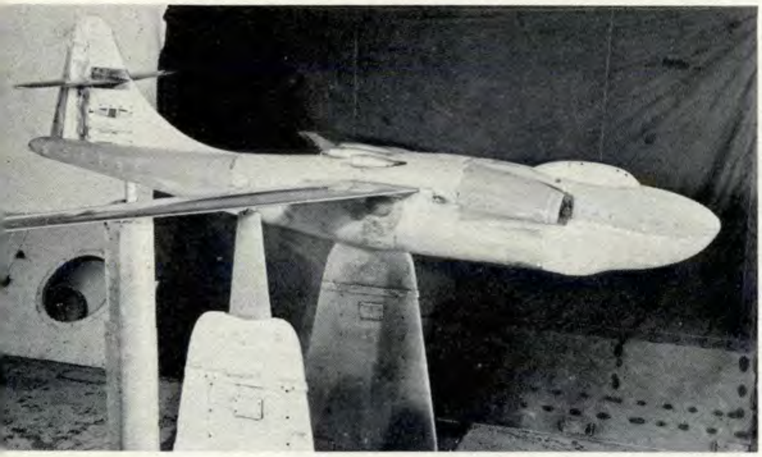


Crew retrieves, repacks, reinstalls 'chute in 90 man minutes.

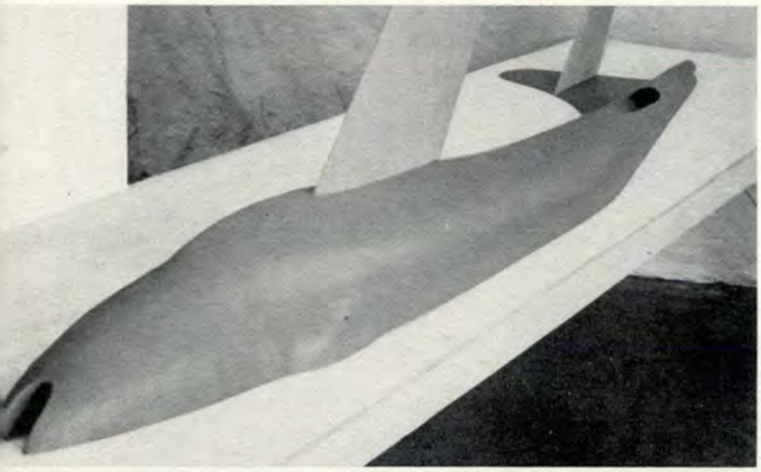
Wibac ground crews so that, again, when the plane is in operation by Air Force groups, the most simplified maintenance will be the standard.

The first question the average Air Force pilot asks a Project Wibac pilot when they meet is "What's it like to fly the B-47?" or, "What kind of a pilot does it take to fly the B-47?"

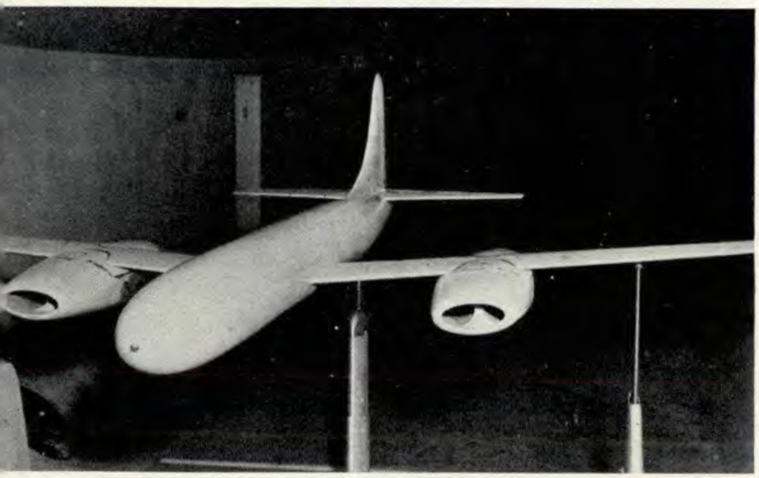
To keep wing thin, early B-47 design had engines in fuselage.



Further development in 1945 added a jet engine in the tail.



This design gave way to swept wings and underslung nacelles.



To answer the latter, Colonel Tibbets will say first of all the pilot has to have the bombing concept—that is the primary purpose of the B-47—to get the bombs on the target. All the months of the flight crews' training, all of the airplane and the crew positions were created for that purpose. Unless a man feels and knows this concept, he will not make a good B-47 pilot, is the way Colonel Tibbets, who piloted the B-29 delivering the first atom bomb to Japan, feels about it.

Secondly, Project Wibac pilots and Boeing test pilots will tell you that the best plane for transition before you fly the B-47 is another jet airplane, a jet fighter. The B-47 has six throttles, yes. But as a fast jet calling for precise flight planning and quick thinking, it is right down a jet fighter pilot's alley. In the B-47 you have three people doing the job heretofore in bombers done by six or eight and doing it in a plane going twice as fast. The pilot is the aerial engineer as well as the aircraft commander. The copilot is also the gunner, while the man in the nose wears four hats: navigator, bombardier, radar man and radio operator.

For a six-engine airplane, the B-47 cockpit has been amazingly simplified. This, of course, is largely because jet engines require fewer instruments than reciprocating engines driving propellers. Controls including the wheel column as well as rudder pedals are adjustable. Pilot's seats also can be adjusted in the B models. So the cockpit will be comfortable for almost any size pilot. At least so far as the physical size of a pilot is concerned, you can't exclude a short man or a tall man when you are saying who is best qualified to fly in the cockpit of the B-47.

No part of the airplane or its equipment will be overlooked by Project Wibac in the tests. According to Major Robinson, they are even going so far as to thoroughly evaluate a pilot's performance handbook, a convenient publication designed to fit in a coverall pocket. This handbook prepared by Boeing is an aid in flight planning; it gives a pilot ready information on takeoff distances with and without ATO and provides a quick reference for emergency procedures. The handbook assists a pilot in working out complete mission problems including fuel consumption under various conditions such as operation on four or five engines. The B-47's J-47 engines offer six-engine safety, and Project pilots have flown the plane on four engines and have simulated three-engine operation.

Project Wibac personnel are enthusiastic about the B-47 Stratojet. While it is too early for all the answers, they think that the airplane can be kept operational with fewer difficulties than have been encountered in other bombers.

M/Sgt. Jack Brown, one of the Wibac maintenance men with years of experience in working on other USAF planes, thinks that after personnel are trained on the B-47, we will be able to do the job with fewer maintenance men than are required on the B-29. "I believe," he said, "this is another honey—a work horse, and like the B-17, it ought to be around a long time."

STRATOJET PERFORMANCE

Wibac Pilots Comment on The B-47's Flight Characteristics

Pilots who have flown the B-47 compare the feel of its controls with that of the much smaller B-26. With the control boost on, you can practically fly it with your finger tips and coordination is easy.

Right away you may ask, "How does it fly *without* power operated boost on the controls?"

If boost is lost at high speed, naturally as in any jet the thing to do is try to stay under control—that is, don't try large maneuvers but keep the plane going straight, and slow it down below 300 knots where it can be flown and controlled throughout almost any maneuver, manually. Test pilots have taken the B-47 off and landed it manually, at the maximum center of gravity limit both fore and aft.

The hydraulic power boost system on the surface controls is used to reduce the control forces necessary and to prevent control surface reversal as well as flutter. This gives the B-47, which is in the 125,000-pound class, flight characteristics greatly improved over former bomber type airplanes to a point where it can best be described as flying like a fighter.

Lack of propeller slip stream over the wing and the lack of torque results in almost identical power on and power off stalling speeds and attitudes. For this same reason the trim of the airplane does not change much even with an outboard engine shut down. At the same time, because of the lack of propeller drag, power off, it takes the B-47 longer to decelerate. This keeps the pilot on his toes in landing. He has to calculate carefully his correct final approach speed, considering fuel load, center of gravity, elevation of field and atmospheric conditions. This approach speed has to be within five knots of the correct speed for the given conditions and touch down is made at only three to five knots slower than the minimum approach speed. The airplane floats on roundout if it is held off. The best landings in the B-47 are made with both of the tandem main gears touching the runway simultaneously.

Tex Johnson, Boeing's Chief Test Pilot at Wichita, who works closely with Project Wibac, has shot enough landings in the B-47 to know what happens when you touch down either on the front main gear first or rear gear first. Touching down rear gear first is not so bad if the front gear is very near the runway. However, if the front wheels are more than three feet off the ground when the rear gear touches, the front wheels will slam down hard. A regular "jackrabbit" bounce may develop if the front gear touches down first.

The B-47 landings are made safer by two new developments. First, is the drag chute. The deceleration afforded by this chute while not abrupt, is positive, and could be compared to the sensation you get riding in a "shoot the chutes" at an amusement park when the boat hits the water. The drag chute is open and acting on the airplane within three seconds after the pilot pulls the control handle.

What happens if the parachute opens during the flare-out? This would immediately steepen the angle of approach. If it is opened after the flare-out while the airplane is still floating, there is a tendency for the airplane to drop. Thus the SOP for use of the chute is to deploy it on touchdown.

Boeing's anti-skid brake allows the pilot to tromp full on the brakes immediately on touch down and hold full pressure throughout the landing roll without skidding the tires. As in any airplane, however, the brakes are ineffective until the airplane is slowed down sufficiently for weight on the wheels to allow effective braking. In the B-47, this is at about 80 knots. A combination of drag chute and automatic anti-skid brakes has brought the B-47 to a stop within 2300 feet.

There is a possibility that someone might make a mistake and pull the

What looks like the jaws of a gator below actually is a double photograph of the B-47 wing undergoing static load tests at the Boeing plant. The same wing section is shown as it was forced up and down from the center line (arrow) under hydraulic pressure of test rig. In flight, the wings may flex as much as 13 feet at the tips. The 116-foot span gets strength from a thick, tapered skin. Lower photo shows the 35° swept-back wing as it is lowered into place on a new B-47B fuselage during final assembly at the Boeing plant in Wichita. J-47 engines are already in the nacelles at right and these compact power packages are quickly fitted to the wings.

parachute release in flight, but the plane wouldn't nose dive in, if this occurred, according to Project Wibac and Boeing pilots. The linkage connecting the chute to the airplane is designed to fail at speeds above 180 knots and it is possible that the parachute itself would fail first, at higher speeds. In case the chute should be accidentally opened when not desired, the whole affair could be quickly jettisoned by the pilot pulling a red lever in the cockpit.

Practicing stalls give Wibac pilots a lot of information on the Stratojet's performance. According to Major Robinson, SAC Liaison Officer, engine rpm has no effect on stall characteristics or speeds. The stall warning is adequate and comes about 10 knots more or less prior to the stall, depending upon how fast you have entered the stall attitude. Best attitude for practice stalls is similar to the landing attitude with a pay-off at about one knot per second. This gives a moderate climb angle and eliminates the severe buffeting that will appear at steep stall entry angles. The initial stall warning can best be described as a nibble which increases progressively to moderate buffeting at the stall.

"It is a lot like catching fish," is the way Major Robert Celetto, SAC pilot, describes it. "First you feel a nibble and if you wait a little while you get moderate tugging." This buffeting builds up to a series of vertical bounces and just prior to a complete stall, a slight pitch-up will occur, but this pitch-up isn't sufficient to require you to jam the stick forward. All you have to do is release a slight amount of back pressure on the elevator control. B-47 pilots use pretty much standard control techniques for executing and recovering from stalls. Roll due to yaw is nonexistent and stalls out of turns can be executed without abnormal roll if the turn is well coordinated. Of course if you went into a stall in an uncoordinated turn, you would get some roll but you have sufficient lateral control to recover.

As a safety measure in practicing stalls in the B-47, an altitude of 20,000 feet is advised. To recover from a stall requires at least 2500 feet of altitude, which doesn't leave much room for carelessness at low altitudes.

Buffeting (the term used to describe the aerodynamic effects on the airplane due to flow separation of the air foils) can occur under low indicated airspeed near the stall range, in accelerated flight with a positive G acceleration and at high speed or mach number. While this situation will not be new to experienced jet pilots, it can cause trouble if a pilot is not aware of all the factors that cause buffeting.

Since the spread between low and high speed buffeting varies with altitude — the maximum spread occurs at sea level — the spread decreases as you go up until the low and high buffeting speeds become the same. This means that the indicated stall speed increases with altitude. The airplane's weight also affects this. For example: At a gross weight of 130,000 pounds and an altitude of 30,000 feet the spread between low and high speed buffeting is 70 knots. Under these conditions if you are cruising at a .79 mach, buffeting will occur at positive acceleration of 1.2 G's.

When a pilot checks out in a B-47 he devotes much time to studying the curves on performance charts relating speeds, altitudes and weights so that he will know the various situations where high speed buffeting could occur on different flights and on long missions with gross weight and altitude changes.

While flights through thunderstorms are not advised this early in the game in the B-47, it is not always possible to avoid flight through severe turbulence. Project Wibac, in its various tests in Kansas, Florida and Ohio, should supplement information on flights through turbulence already furnished by Boeing test pilots and engineers. Power settings and pitch attitude are the basis for safe flight through turbulent air in a jet bomber. If these are established before entering the storm and adhered to throughout the storm, the airspeed will be constant regardless of any erroneous readings of the airspeed indicator. Test flights have shown that a heavy rain can decrease the indicated airspeed by as much as 60 knots by partially blocking the pitot tube pressure head.

The time-proven Air Force admonition of "Don't chase the airspeed indicator in turbulent air," is even more applicable in the B-47, where it could result in extreme airplane attitudes. If sudden gusts were to occur, when the airplane was in a nose high attitude, a stall might easily result.

The wing flaps of a B-47, designed to provide high lift and low drag and operate with the minimum of pilot attention, offer a safety factor which bomber pilots will cheer.

Flaps are designed to go down in a hurry—in approximately 20 seconds—but they have slow retraction, requiring about 40 seconds. This slow retraction allows the airplane time to accelerate before the flaps reach the full "Up" position. All the pilot has to do is put the flap control switch in "Up" position and the flaps will automatically be milked up, avoiding the sinking point.

The left elevator trim tab and the wing slats operate with the flaps. Slats on the leading edge of the wing retract during the first 25 per cent of wing flap movement and the elevator trim tab adjusts for trim as the flaps come up.

A big help for control at low speeds are the flaperons. The outward flap on each wing operates as a conventional flap with an additional feature that it will rotate upwards to assist aileron action. The flaperon works when the flaps are fully extended and when you rotate an aileron upward from six degrees to its maximum up position, the corresponding flaperon will move up from its full down position of 35° until it is only 10° down. If the aileron boost system fails the flaperons will operate only as conventional flaps.

The location of the engines in external cells is considered a safety factor in event of engine fire. Fire in flight is unlikely to destroy or seriously damage the wing. Fuel and oil can be shut off from the engine cells to stop the flow to the fire until extinguished, but even if some failure prevented closing the valves, Boeing engineers believe that the engines would burn off their mounts and leave the wing intact.

Fuel is carried in the fuselage and the cells have a system for replacing fuel fumes with carbon dioxide as the fuel is used. Then as an added safety measure, the compartments containing these cells are vented to admit the outside air.

The B-47 pilot will have a fistful of safety built right into the bomber's throttles. Throttle quadrants are marked "cut off" at the aft end of the throttle movement; "idle" at approximately the idling position, and "open" at the forward end. The throttle can't be advanced from "cut off" until the pilot lifts and releases the throttle knobs. Likewise, in reducing power, the throttles stop at approximately the 35 per cent rpm position and can not be further reduced until the throttle knobs are released. Takeoff can not be made with the control surfaces locked because the throttles will not advance beyond 52 per cent rpm when the surface lock lever is in locked position. In addition to the principal function of throttles—that of maintaining the desired rpm—the fuel, oil, hydraulic warning and ignition systems are partially controlled by microswitches which are actuated by throttle movement.

The control surface lock lever is located on the pilot's control stand. Rudder and ailerons are locked in neutral and elevators are locked full down, but they can't be locked if any throttle is open beyond 52 per cent rpm.

With crew comfort being a major factor in long range missions, B-47 engineers have utilized latest improvements in pressurization and air temperature controls. From 5,000 to 24,000 feet, a 5,000-feet altitude pressure is maintained in the cabin, while above 24,000 feet, a 6.55 pound per square inch differential pressure can be maintained. The noise level is low in the cockpit as well as in the nose. Vibration is at a minimum—so lacking, in fact, that instrument panel vibrators have been provided to supply sufficient vibration to prevent the indicator pointers from sticking. The flexible wings also contribute to crew comfort in that they absorb many of the "bumps" caused by gusty air.

The 18 solid fuel ATO units, nine recessed in each side of the B-47 fuselage, supply additional thrust of 1,000 pounds each when it is desired to shorten takeoff distance. These, added to the power of the six General Electric J-47 turbo-jets, each rated at 5,200 pounds thrust, accelerate the Stratojet to a spectacular takeoff. Maximum takeoff weight in the present design is 185,000 pounds. In the photo at left the bicycle landing gear can be seen starting to retract into the wheel wells. Outriggers already have retracted. ATO units are fired simultaneously and burn continuously until fuel is exhausted.

"POLICE THE AREA"

THAT'S THE BEST WAY TO PREVENT COSTLY DAMAGE TO JET ENGINES

A JET ENGINE, like a vacuum cleaner, will suck up anything and everything that it can get near its mouth. But, unlike a vacuum cleaner, it has no special compartment in which to store the junk it swallows. The trash feeds right into the mechanism.

At some bases using jet aircraft, very little trouble is experienced in this regard, while at other stations as many as two or three engine changes may be necessary every month, solely because of damage resulting from various foreign objects entering the jet air intakes.

If these were isolated cases, there would be little cause for alarm over the situation. That they are not isolated is attested by the fact that in a recent three-months period, 60 jet engine changes were made necessary in the USAF by damage from such various items as pieces of paper, rags, pebbles, tools, hats, gloves, safety wire, etc. These objects were sucked into the intakes, left in the ducts by careless maintenance personnel, and, in some cases kicked up from the ramp or runway by other airplanes.

Regardless of how the objects got into the engines, the fact remains that, during the 90-day period studied, two jet engines had to be replaced every three days because of this. As a matter of interest all Air Force jets included in the study were operating from established bases and under no particular stress. In wartime, when airfield conditions are not so good or where the press of operations overshadows other concerns, the cost of this problem could undoubtedly become unbearable. It could materially curtail the mission of the Air Force—unless, of course, something were done to prevent such a situation.

And something can be done. The problem is with us now, so why not start the action now? Aside from saving two-thirds of an engine each day, action now would start the habit and provide a basis for the action which is even more vital in combat operations.

Before attempting to diagnose a cure, however, let's look into the jet intake a bit. How do all these various objects get into jet engines? Probably the most common is a result of the suction or vacuum effect which accompanies the operation of any jet engine. The jet engine has to suck air into the intake to keep operating. But it has no way of rejecting pieces of foreign matter which might be sucked in along with the air. As a rule, only lighter objects such as paper or small pieces of wood will be sucked up off the ramp or runway. The answer, of course, is to keep ramps, taxiways and runways clean. This has always been a must in the Air Force. With jets, it is a double must. "Policing the Area" is a fundamental military chore which now takes on a new meaning.

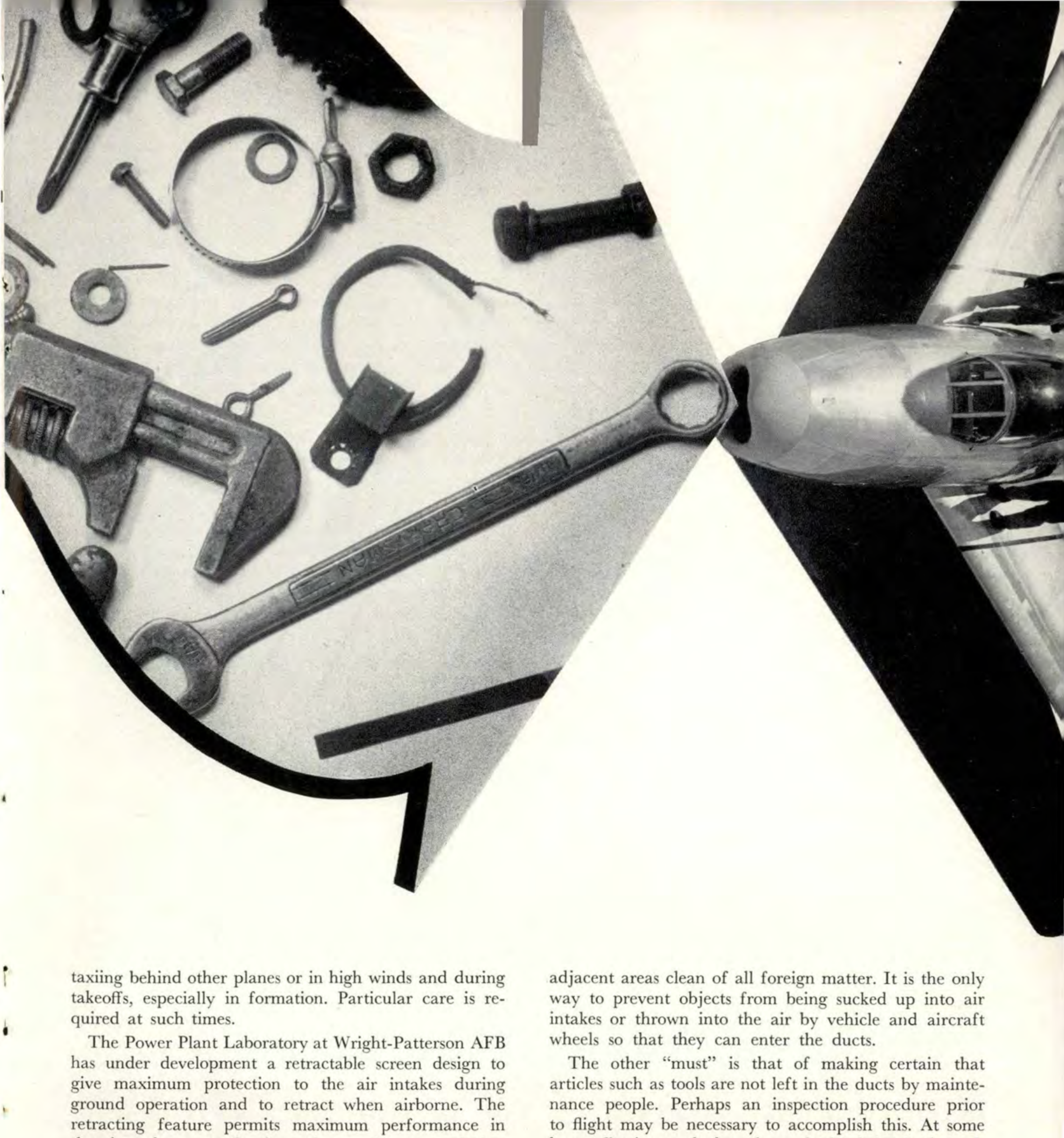
Heavier objects such as rocks, bolts and pieces of metal are not likely to be sucked up from the ramp, but they get into the air intakes, just the same. They get there by being kicked up into the air by tires of a towing tug or by the nosewheel of the airplane. Such happenings have actually been observed. Just another argument for keeping paved areas clean.

Occasionally, a screw-driver, a pair of pliers or some other tool gets into the engine and causes its failure. These aren't sucked up or kicked up from the runway. Invariably, they were left in the air duct by maintenance personnel. The remedy is obvious.

There are other ways, of course, that various things can get into and damage jet engines. In general, they are not so easily corrected; however, they account for a comparatively minor portion of the difficulty. Some of them are pieces of the plane itself, such as screws or nuts, being lost and entering the air intakes, debris entering the ducts during strafing passes, and cartridges and links being dropped by other planes in formation.

Of those ways in which foreign matter enters jet engines, the most common is that of lightweight items being "sucked" up from ramps and runways. Pieces of paper, grass, weeds, leaves, rags, gun plugs and other lighter objects are most often found on air inlet screens. The frequency with which matter is picked up varies inversely with the height of the air duct above the ground. For example: the F-84 and F-86 which have higher ducts have many more hours flown per article reported than do such low duct planes as the F-80 and F-94. This only means that the matter of keeping taxi and take-off areas clean is more pressing, the closer the intake is to the ground.

The most critical times for foreign matter to enter the jet intake ducts are during engine runups, when



taxiing behind other planes or in high winds and during takeoffs, especially in formation. Particular care is required at such times.

The Power Plant Laboratory at Wright-Patterson AFB has under development a retractable screen design to give maximum protection to the air intakes during ground operation and to retract when airborne. The retracting feature permits maximum performance in the air and prevents ice formation on the screen during flight. However, there is still considerable development work to be done on this screen and some time will elapse thereafter before production begins. It does represent Air Force recognition that the problem is important and something is being done about it.

For the present and until the screen is perfected and installed, other preventive measures are necessary. Most important is keeping ramps, taxiways, runways and adjacent areas clean of all foreign matter. It is the only way to prevent objects from being sucked up into air intakes or thrown into the air by vehicle and aircraft wheels so that they can enter the ducts.

The other "must" is that of making certain that articles such as tools are not left in the ducts by maintenance people. Perhaps an inspection procedure prior to flight may be necessary to accomplish this. At some bases effective results have been obtained simply through appealing to the integrity and sense of responsibility of maintenance personnel.

Jet engine damage by foreign matter costs the Air Force hundreds of thousands of dollars a year, to say nothing of the reduction in effectiveness and ability to accomplish the mission. It will take the coordinated efforts of installations personnel, maintenance, crewmembers and supervisors to lick the problem.

FLIGHT *Attitude*

FREQUENTLY, THE QUESTION is asked, Why has the Air Force provided electrically-operated rather than vacuum-driven flight instruments in new aircraft? Reviewing the highlights of the research and developmental phase of these instruments will reveal some interesting factors relative to the reliability of the two methods of operating gyros—vacuum and electricity.

Directional gyros and artificial horizons were initially installed in Air Force aircraft around 1930. These instruments were driven by vacuum obtained by Venturi tubes. Except under icing, the Venturi tubes were fairly satisfactory for the slow speeds and low altitudes typical of flying in those days.

During the airmail operations by the Army Air Corps in 1934, all mail service aircraft were ordered to be equipped with flight indicators and directional gyros which were to be operated by engine driven vacuum pumps. For a time, however, Venturi tubes continued to be installed as an alternate in the event of vacuum pump failure. As better vacuum pumps were developed, the Venturi tubes were deleted. On multi-engine aircraft an alternate source of vacuum was obtained by requiring two vacuum pumps and providing the pilot with a selector valve.

In the period just prior to World War II, electrically-driven gyroscopes were developed for use in bank and turn indicators. The electrical bank and turn indicator development was initiated to obtain the following:

(a) A more uniform rate of rotation of the gyro wheel;

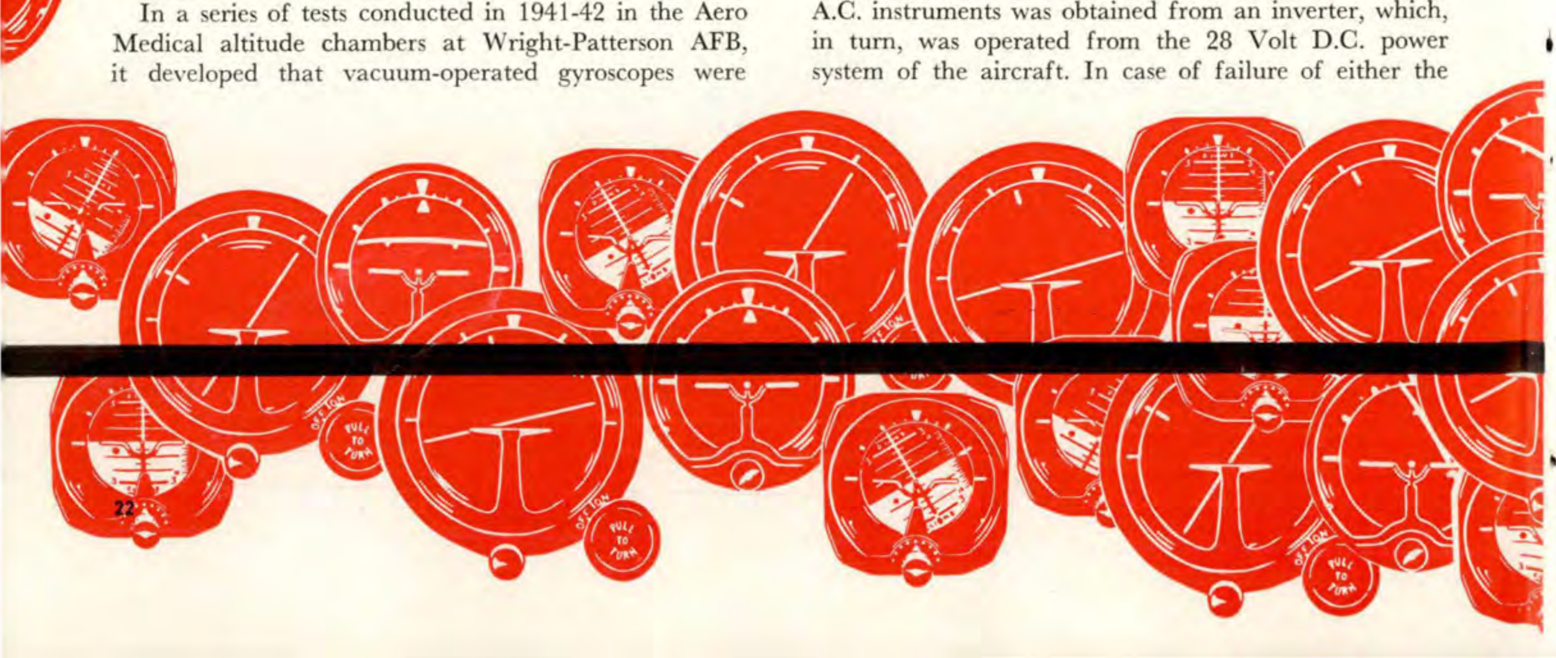
(b) An instrument that could be operated directly from the batteries in event of a complete vacuum pump failure;

(c) An instrument that would operate satisfactorily at high altitudes and low temperatures.

In a series of tests conducted in 1941-42 in the Aero Medical altitude chambers at Wright-Patterson AFB, it developed that vacuum-operated gyroscopes were erratic above 30,000 feet. The rotor speed of the vacuum-operated gyroscopes varied greatly from the designed speed obtained at sea level, thus affecting the instrument's sensitivity. This condition was partially alleviated by the design of a vacuum regulating valve, which was adjusted to secure the required vacuum and rate of air flow for the flight instruments. Equally important were the results of a series of low temperature tests which indicated that vacuum-driven gyroscopes are not completely reliable at ambient temperatures below —35°F.

The first successful electric bank and turn indicator, The Type C-1, was designed to operate directly from the battery on 28 Volts D.C., and required approximately .5 ampre current. The gyro in this instrument was maintained at a constant speed of 11,500 rpm. Furthermore, this gyroscope operated successfully at altitudes exceeding 40,000 feet, and also operated successfully at extremely low temperatures (—65°F.). This instrument was procured in large quantities and installed in numerous World War II aircraft. The directional gyro and flight indicators in the majority of World War II aircraft were vacuum-operated. Thus, in the event of failure of all vacuum pumps on the aircraft, the pilot could return to base by using the electrically-driven turn and bank indicator and the needle-ball-airspeed type of instrument flying.

Early in 1944, the Type C-1 turn indicator and the Type E-1 flight indicator were put into production and installed in a few production aircraft, primarily B-29's. These instruments were designed to operate on 3-phase, 400-cycle A.C. voltage. During this period, it was standard practice to provide the pilot with vacuum-operated flight instruments, and the copilot with electrically-operated flight instruments. The electric power for the A.C. instruments was obtained from an inverter, which, in turn, was operated from the 28 Volt D.C. power system of the aircraft. In case of failure of either the



THE ULTIMATE GOAL IS A FULLY DEPENDABLE EASY TO READ GYRO FOR USAF PILOTS

By David V. Stockman, Assistant Chief, Instrument & Navigation Branch, Equipment Laboratory
Engineering Div., Hq AMC

electrical or the vacuum system, this installation provided an alternate source.

The global operations of the USAF during World War II disclosed a number of deficiencies in vacuum-operated instruments. In the CBI Theatre, for instance, when the aircraft came down over the "hump "to a warm and humid airfield, the vacuum-operated instruments sometimes became faulty. The basic reason for such failures was the moisture condensation within the instruments. In Alaska, if aircraft were exposed overnight to temperatures below —35°F., the vacuum-operated instruments, in many cases, would not start without preheating. When jet aircraft became operational they were not equipped with vacuum pumps. The air-operated instruments in the jets were driven by pressure that was bled from the cabin pressurization system.

From the above conditions, the need for hermetically sealed instruments is quite obvious. Such a design will not only eliminate the problems of condensation and humidity, but also the adverse effects of sand, dust, salt-fog, fungus, and other environmental nuisances. Combat experience also proved that the inherent bank limits of 100° and pitch limits of 60° in the vacuum-operated gyroscopes were inadequate for all-weather fighter operations.

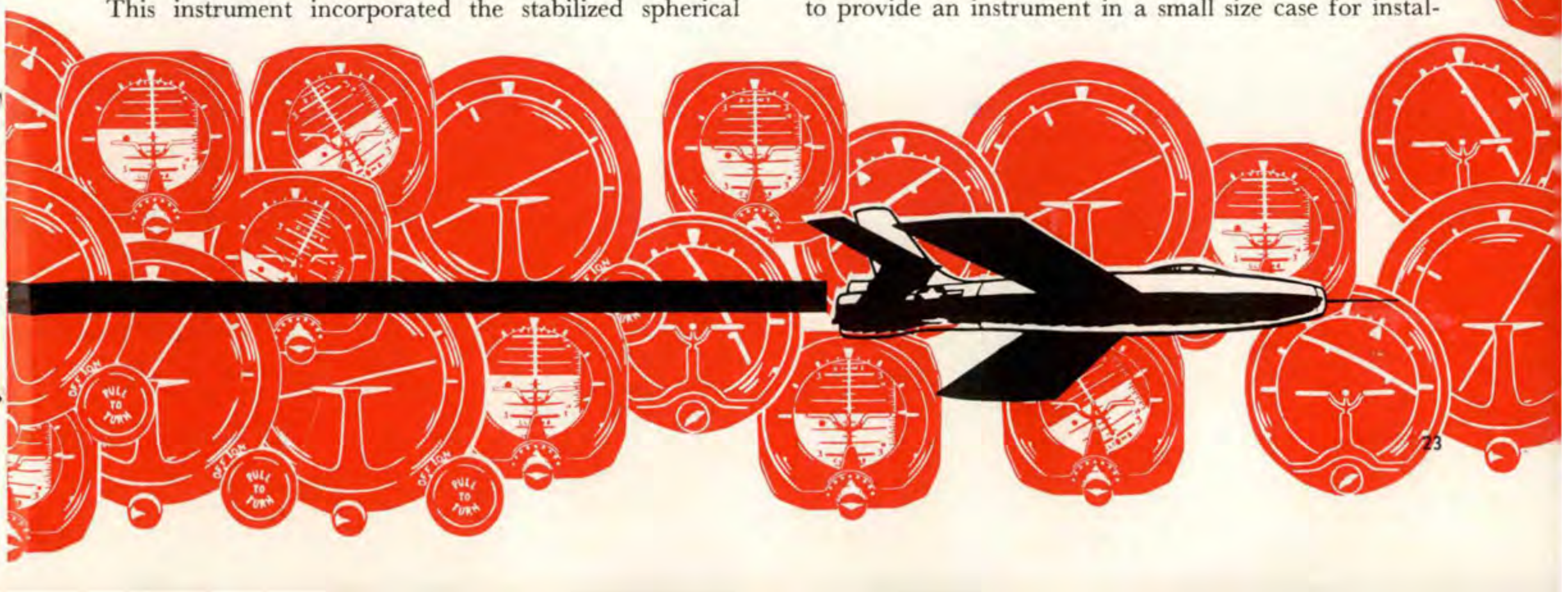
Consequently, a requirement was established for a non-tumbling universal attitude indicator. Initial developments of the universal attitude indicator included an attempt to design a satisfactory vacuum-operated, universally gimbaled gyroscope. The difficulties involved in piping clean air to drive the gyros through universally mounted gimbals were numerous. Therefore, all development efforts were concentrated on an electrically-operated universal attitude gyro.

The first instrument to be developed and placed into production was a large-size attitude gyro, Type J-1. This instrument incorporated the stabilized spherical type presentation in which the upper hemisphere of the ball was painted black and the lower half yellow with "DIVE" printed on the black portion and "CLIMB" on the yellow.

The first production installation of this instrument was in the F-80B aircraft. During extensive service use, several major deficiencies were disclosed. The first deficiency was in presentation. The presentation in which the miniature airplane is flown "TO" the sphere in bank and "FROM" the sphere in pitch, was found to be confusing, especially when quick interpretation was required.

A second major deficiency of the instrument concerns what is known as "turn error." Although turn error has been present in all flight indicators, including the vacuum operated designs, the importance of this factor was not fully realized until the advent of the Type J-1 attitude gyro and jet aircraft. Briefly stated, turn error is caused by the inherent pendulosity of the gyro and its erection mechanism. It is desirable to have a low erection rate in a gyro erecting mechanism. In turns the pendulosity of the gyro and the erection mechanism causes precessional forces which produce both pitch and bank errors during turns. Due to high true airspeed, this condition is accentuated in jet aircraft. Results from flight tests have indicated that the turn error present in the Type J-1 attitude gyro is too dangerous for instrument flying in jet aircraft. To give gyro engineers due credit, it must be recognized that no laboratory means were or are at hand by which turn error can be measured. At the present time, the best known method to determine turn error is by actual flight test.

The next attitude gyro to be put into production was the Type J-3. This instrument was identical in presentation with the Type J-1, but had improved turn error characteristics. The Type J-3 was designed primarily to provide an instrument in a small size case for instal-



lation in aircraft where instrument panel space was at a premium.

In an effort to correct the presentation deficiencies in the Type J-1 and J-3 instruments, a horizon bar was added to the gimbal axis of the Type J-3 instrument and the sphere was painted black, with the exception of yellow circles at the top and bottom of the sphere. The modified instrument was called the Type A-1 and is being installed in many current production aircraft. The type A-1 has the conventional horizon bar indication up to pitch angles of $\pm 27°$, at which time the horizon bar ceases to move and the sphere can be flown throughout $360°$. This instrument has essentially the same turn error as the Type J-3.

The Type A-1 instrument has a slow initial erection rate and, under certain conditions, requires as much as 13 minutes to erect. It should be recognized at this point that the USAF has a requirement for getting fighter aircraft into the air on scramble takeoffs in one minute or less. To meet this requirement, a new type instrument, the Type J-8, was developed and is currently in production for fighter aircraft. This instrument has essentially the same operating characteristics as the Type A-1, but with the addition of a manual caging feature which will permit the pilot to cage the gyro instantly. This instrument is operational and suitable for takeoff within thirty seconds after the power is turned on.

In an effort to eliminate turn error, the USAF has developed two new vertical gyros. The Lear Type B-1 indicator with the K-4 control is now in production. This instrument has the vertical gyro together with amplifying circuits and a rate gyro erection switching system in a "black box." The pilot's indicator on the panel is servoed from the remotely located black box. This instrument has a large size dial, the same presentation as the Type A-1, meets all the required environmental demands and has a greatly reduced turn error. It is currently scheduled for B-47, B-36 and F-80D type aircraft.

The second development is the Type J-9 which is a case-contained large size vertical gyro with a rate gyro erection switching mechanism built into the indicator case. This instrument is presently in the service test stage and, when fully developed, will provide an instrument with normal presentation, with greatly reduced turn error, and with a manual caging knob to provide quick erection for scramble takeoffs.

Thus far, no mention has been made of electrical system deficiencies. From the unsatisfactory reports received by Air Material Command, the large majority indicates that failures of electrical gyro instruments have occurred because of deficiencies in the electrical system and not because of deficiencies in the instrument itself. To improve this condition, more efficient inverters have been developed.

In the Air Force today, it is standard practice to operate the gyro flight instruments from the main inverter and, in event of power failure, to switch either automatically or manually to a spare inverter. On certain large aircraft, a third very small inverter is installed which will operate only one set of flight instruments. This system is only used in the event of loss of the primary power system. Miscellaneous troubles in the instruments themselves have been, for the most part, discovered and corrected. No development work on vacuum-operated instruments has been undertaken by the USAF since 1945. All gyro instruments now in production or undergoing development are electrically-operated.

The development engineers at AMC welcome information on any new technique or methods that may aid the progress of USAF gyro development. Equally welcome is any information that may constructively alter existing conclusions.

Gyro horizon development is based on the requirement for a non-tumbling universal attitude indicator that will eliminate turn error and operate in various extremes of climate. The instruments shown below are among those discussed in this article. The J-8 is currently in production for fighter aircraft.

KEEPING CURRENT

Air War Maneuvers—More than 1,000 planes took part in the nine-day Exercise Emperor, greatest air war maneuvers since World War II, over the British Isles. The exercise was designed to test the air defenses of the North Atlantic Treaty and Brussels Treaty nations. Bomber squadrons of the USAF's Third Air Division, USAF jet fighters, and British, French, Belgian, Dutch, Danish and Norwegian aircraft participated in the exercise.

• • •

Medical Research—Aeromedicine Panel of the Scientific Advisory Board is making a survey of medical research facilities in the Air Force. The group, headed by Dr. W. Randolph Lovelace, recently visited Edwards AFB, Muroc, California, to interview test pilots, to study cockpit arrangements in new aircraft and to inspect the Human Deceleration Project. A demonstration run for the panel was the first decelerator run in which the subject wore a back parachute pack.

• • •

Filmed at 600 mph—Moving pictures from a jet-plane cockpit are clear and steady — the camera mounting device was built in four hours at a cost of 90 cents, by flight personnel at Andrews AFB. The camera mount proved useful in Korea, where it brought back a front-seat view of actual air attacks on the enemy. Some of this film was used in the Department of Defense release "Your Air Force in Action," a 15-minute short shown on TV and newsreel screens.

• • •

Two for the Smithsonian—Two more airplanes which have outlived their military usefulness are to be preserved as a tribute to the records they made in post-World War II aviation. They are the B-50 Superfortress "Lucky Lady II," which made the first non-stop round-the-world flight in history in March, 1949, and the first Boeing Stratofreighter, an XC-97 which set a transcontinental speed record for transports by flying from Seattle, Washington, to Washington, D. C., in six hours and four minutes, in January, 1945.

The "Lucky Lady" will fly no more because of an accident three months ago. She "bellied-in" after a take-off power failure and was considered too badly damaged to put in the air again. The Air Force removed her wings, stripped one side of her fuselage of its aluminum and substituted plexiglass and cut her in half so that she can be transported on two-flat-bed trailers. She will travel throughout the country as part of the Air Force Exhibit Unit, whose educational traveling road show already includes two "wingless wonder" B-29's. After she has outlived her usefulness to the Exhibit Unit, she is scheduled to take her place for posterity beside the "Spirit of St. Louis" and the Wright brothers' "Flyer" in the Smithsonian Institution or one of its annexes.

• • •

200-hour Extension—The time normally allowed before changing engines has been extended for one of MATS' Boeing C-97A Stratofreighters. AMC approved the extension for one of the Stratofreighters assigned to the 1274th Air Transport squadron of MATS' Continental Division at Kelly AFB, Texas.

The authorization will permit the Squadron to put 1,000 hours, instead of the normal 800 hours, on each of the big transport's four Pratt & Whitney Wasp Major engines, before they are removed for inspection and overhaul.

Under normal operating conditions, such extensions for engines are not unusual. But ever since this airplane was delivered from the Boeing plant, it has been used exclusively for transition flying in the USAF Heavy Transport Training School, operated by the Continental Division.

• • •

Better Lights Sought—When 500-mile-an-hour jet planes approach each other at night, what lights must they carry to give ample advance warning? "Adaptable Annie" is helping foresighted aviation men in government and industry find the answers to questions like these before the problems are faced in daily operations.

"Adaptable Annie" is a 15-year-old Boeing 247 airplane, which the Civil Aeronautics Administration operates experimentally at its Indianapolis Technical Development and Evaluation Center. It is being used in a continuing program for development of more effective aircraft lighting, in which two Douglas DC-3's, owned by CAA and United Air Lines, and an Air Force helicopter, also participate from time to time.

"Adaptable Annie" is lit up like a Christmas tree, in the current phase of the test program. It carries five tail lights with red, yellow, lunar white, and clear cover glasses and six fuselage lights. To top off the effect, three sweep-beam high-intensity lights, similar to the type used on fire engines, are mounted on the leading edges of the wingtips and on the tail of the fuselage. The high-intensity beams are visible at 20 to 30 miles distance, and thus allow more than the one-minute considered as a minimum safe warning for planes closing at 500 miles an hour each.

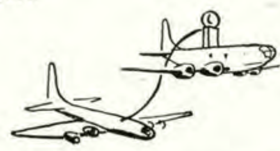
As a result of tests made with "Adaptable Annie," it was agreed that present flasher systems should be changed to provide for flashing wingtip and fuselage lights at the rate of 80 per minute, with alternate flashing of red and white tail lights at the rate of 40 per minute. United Air Lines plans to modify its entire fleet accordingly.

• • •

Briefly Noted—A New Automatic Distress Signal Operated by the flip of a switch has been developed which will automatically re-tune a plane's transmitter to an emergency channel and transmit the plane's call sign, plus a series of SOS signals. Signals that will assist direction equipment to locate the aircraft are automatically sent if a plane crashes. The keyer weighs only four and one-half pounds . . . Perrin AFB will conduct flight evaluation of a cross-wind landing gear installed on six T-6 airplanes.

• • •

Stratofreighter Doubles as Tanker—The new Boeing C-97 Stratofreighter can be utilized either as a Flying boom type aerial refueling tanker, or, in its normal capacity, as a 300-mph troop-and-cargo transport.



The double-deck Stratofreighter, already known for its work as a flying ambulance, ferrying war-wounded from the Far East to the United States, can now be easily converted to a tanker. Like the Boeing KB-29P Flying Boom tankers already in service, the KC-97A can make mid-air refueling contacts with the B-50D.

Operation of the fuel pumps and accessory flight refueling gear is controlled by a special flight engineer's panel in the control cabin. The boom operator's station and base of the boom itself are underslung beneath the fuselage at approximately the point where the upper and lower lobe of the double deck transport meet. A bracket beneath the tail of the KC-97A holds the after end of the boom in a retracted position so that the boom does not protrude as far behind the tanker as in the case of the KB-29P.

With tanker equipment removed, the KC-97's can carry either 135 combat-equipped troops, 83 litter patients with their medical supplies and attendants, or up to 68,000 pounds of freight which could include jeeps, trucks or artillery weapons.

Boeing Stratofreighters, used as troop transports, hospital airplanes and cargo carriers, are now in use by MATS, SAC and other USAF units.

2 TO GO

Flying proficiency, judgment and skill paid off heavily in flying safety dividends recently when a sharp pilot, 1st Lt. James P. Siberell of the 1268th Air Transport Squadron, MATS Pacific Division, backed by the close teamwork of his crew, saved a C-54 for the Pacific Airlift.

Carrying crated aircraft engines and spare parts to Midway Island, the heavily loaded plane took off from Haneda Air Base, Japan. The ceiling was 500 feet, with visibility cut to one mile by rain. Routine checks and procedures before takeoff had indicated everything normal on the C-54.

After climbing into the overcast, Lieutenant Siberell homed in on a radio beacon and continued to climb to 1200 feet. Without warning, the No. 1 engine began to lose oil rapidly, and the oil temperature shot up. The propeller was immediately feathered; three engine emergency procedures were initiated, and the plane was turned back toward the field.

While in the turn, it was observed that the plane was losing altitude at the rate of 200 feet per minute, so the second pilot was requested to notify Haneda to prepare for an emergency downwind landing.

Back on the homing beacon, Lieutenant Siberell called for more power on the remaining engines; just then, No. 3 began to cut out. The rate of descent increased to 300 feet per minute, and the flight engineer was directed to attempt to keep No. 3 functioning and to increase the output on No. 2 and 4. At this point, according to Lieutenant Siberell, "the aircraft was difficult to handle and we were still on solid instruments."

They broke out of the overcast at 500 feet, into a light rain that hid the runway location. The pilot put the plane into a left turn to cut across the arc of coastline, heading for the place he knew the runway to be.

The rudder pedals were banging against my feet," Lieutenant Siberell reported, "indicating a loss of rudder control. I didn't think we'd make the field."

He directed his crew, except for the second pilot and flight engineer, to go to the rear end of the plane. Right aileron was necessary to hold up the aircraft as it made a left turn, but still the plane skidded right, in the direction of some storage tanks.

They finally leveled off three-fourths of a mile from the end of the now visible runway, with airspeed reduced to 120 mph and a 250-foot altitude being whittled away at 200 feet per minute. With 100 feet left they began to set down on the strip, flaps full down, two and one-half engines working, and landing gear dropping into position. There was a 15-knot tailwind and the strip surface was wet and slippery. They touched down, braked, and No. 3 engine cut out completely halfway through the landing roll.

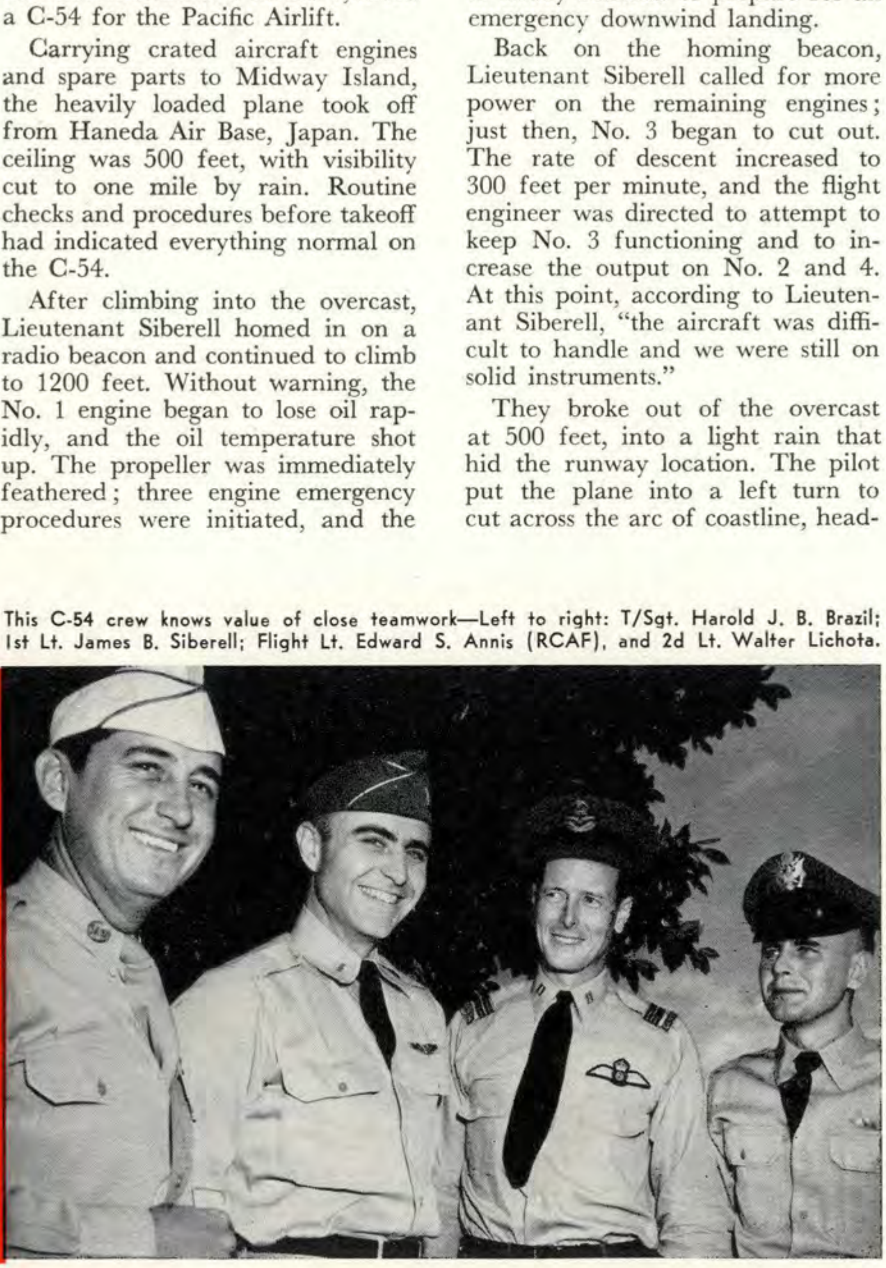
They had been airborne for seven and one-half minutes. It had been three and a-half minutes from the beginning of their trouble to the safe landing.

"We were very lucky," Lieutenant Siberell reported.

With Lieutenant Sibrell as aircrew were 2nd Lt. Walter G. Lichota, Second Pilot; Flight Lt. Edward S. Annis (RCAF), Navigator; T/Sgt Howard D. Brazil, Flight Engineer; S/Sgt Arthur Hudson, Radio Operator, and Cpl. Clifford S. Hurd, Flight Attendant.

"Full credit should go to T/Sgt Brazil," states the pilot's report, "for his coolness and initiative in performing the duties of flight engineer."

This C-54 crew knows value of close teamwork—Left to right: T/Sgt. Harold J. B. Brazil; 1st Lt. James B. Siberell; Flight Lt. Edward S. Annis (RCAF), and 2d Lt. Walter Lichota.



DECOMPRESSION SICKNESS

If you keep physically fit—and use oxygen properly—you can avoid discomforts of bends

By Maj. William B. Westfall, USAF

Before the advent of aircraft which performed routinely above 25,000 feet, decompression sickness was of little interest to airmen. Today, with flights at altitudes around 40,000 feet a common practice, it is important that crew members be aware of the symptoms and the treatment of decompression sickness.

Decompression sickness is not synonymous with hypoxia. The former is caused by lowered barometric pressure; the latter by lack of oxygen. Effects of lowered pressure may be evident at 18,000 feet but usually an altitude of at least 25,000 feet must be reached before the symptoms are noted. If a flier is going from ground level to high altitude, the external pressure of one atmosphere can be reduced to one-half, or perhaps even one third of its ground-level value.

The earliest symptoms commonly appear in the skin. One or more of the following may be present: numbness, tingling, itching, hot or cold flashes.

The occurrence of "bends" is the most common symptom. This is pain in the bones and joints. The pain may appear in one joint only or may involve several joints. It is usually progressive, tending to pass in a few minutes from a merely noticeable sensation to an unendurable ache or a sharp, stabbing pain. Movement and massage make the pain worse!

The "chokes" is another common symptom. A burning sensation in the windpipe and lungs, resembling the distress experienced after hard running, being aggravated by deep breathing. Before long, the victim experiences feelings of suffocation, and a constriction of the chest. An afflicted individual may tear off his oxygen mask even though warned that this may rapidly lead to unconsciousness from hypoxia. Chokes are relieved more slowly than the bends and may be followed by considerable fatigue or even collapse at ground level.

Defects in the field of vision may vary all the way from small blind spots to blindness. Vision difficulties ordinarily bother the flier only a few minutes and may be accompanied by headache.

Decompression sickness occurs because the body has difficulty in eliminating nitrogen, which is chemically inert and remains idly dissolved in the body fluids. The body can dissolve only about one liter of nitrogen at ground level. At high altitude, this same ground-level liter of nitrogen cannot remain in solution. The excess must go somewhere, so it comes out in the blood in the form of bubbles. The bubbles cause the "chokes" when they block the blood flow in the tiny capillaries in the lungs. The bubbles in the joints cause the "bends."

The only treatment for decompression sickness is descent to lower altitudes. Symptoms usually disappear or are markedly alleviated by descent to about 25,000 feet. Relief comes because the exisitng nitrogen bubbles are compressed to a smaller size. Return to the higher altitude on the same flight is not recommended because bubbles will expand again and symptoms will immediately return to their original intensity. The flight surgeon should be notified following flights in which symptoms of decompression sickness are experienced. Collapse has been known to occur several hours after reaching ground level.

Decompression sickness in non-pressurized aircraft can best be guarded against by breathing 100 per cent oxygen before high altitude flight. Breathing 100 per cent oxygen for 30 to 45 minutes greatly reduces the likelihood of bends. Part of this may be done on the ground and the remainder completed during ascent. Once bubbles begin to form, nitrogen is eliminated with difficulty so that denitrogenation must be carried out below 20-25,000 feet. Denitrogenation requires that pure oxygen be breathed. The automix on the demand regulator must be turned to the *Off* position at ground level to make this possible.

It has been found that the less one exercises during flight, the more likely he is to avoid the bends. It is also recommended that exertion immediately before or after high altitude missions be kept to a minimum. Fat fliers are much more susceptible to decompression sickness than are thin men, for fat contains about five times as much nitrogen as blood. Fat has the smallest blood vessel volume of any tissue. At high altitudes, fatty tissues have the most nitrogen gas but the poorest means for carrying it away to the lungs where it can be blown off. Denitrogenation of fatty tissues tends to be a relatively prolonged and difficult process. The importance of staying physically fit is obvious.

We also say WELL DONE to WAF Corporal Helen Lee Pawlak, of March AFB. While she was on duty as a control tower operator she spotted an F-86 on final approach with wheels still up. The pilot had previously given a "gear down and locked" call to the tower. She informed the pilot and visually followed the plane until he corrected the deficiency, lowered the gear and landed. She is the model for this month's safety reminder on the opposite page.

Flying Safety

RESTRICTED

DEPARTMENT OF THE AIR FORCE
THE INSPECTOR GENERAL, USAF

Major General Victor E. Bertrandias
Deputy Inspector General
For Technical Inspection and
Flight Safety Research

DIRECTORATE OF
FLIGHT SAFETY RESEARCH

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CONTENTS

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C O N T R O L

ON THE GROUND
----AND IN THE AIR
EQUALS SAFETY IN FLIGHT

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