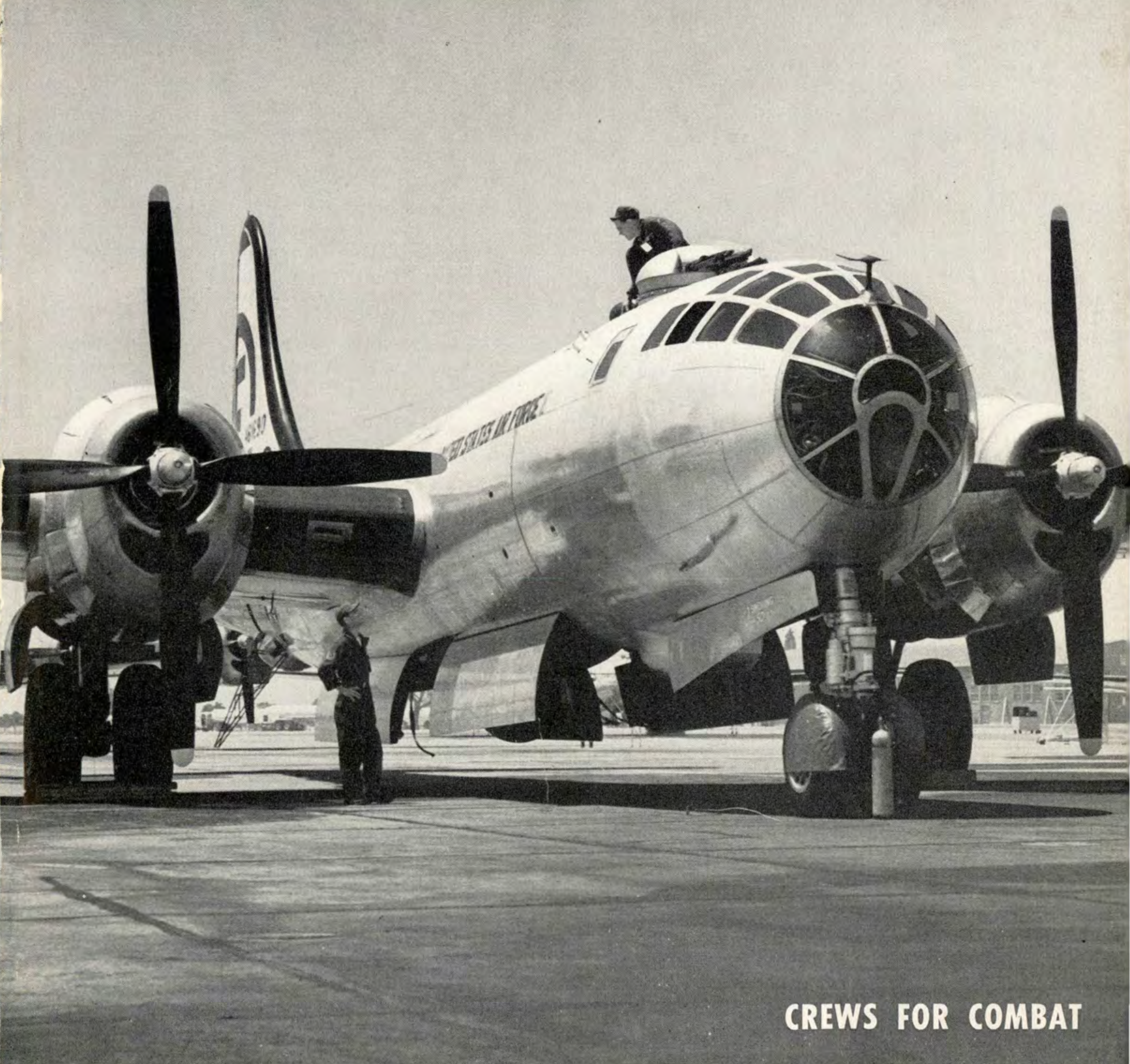
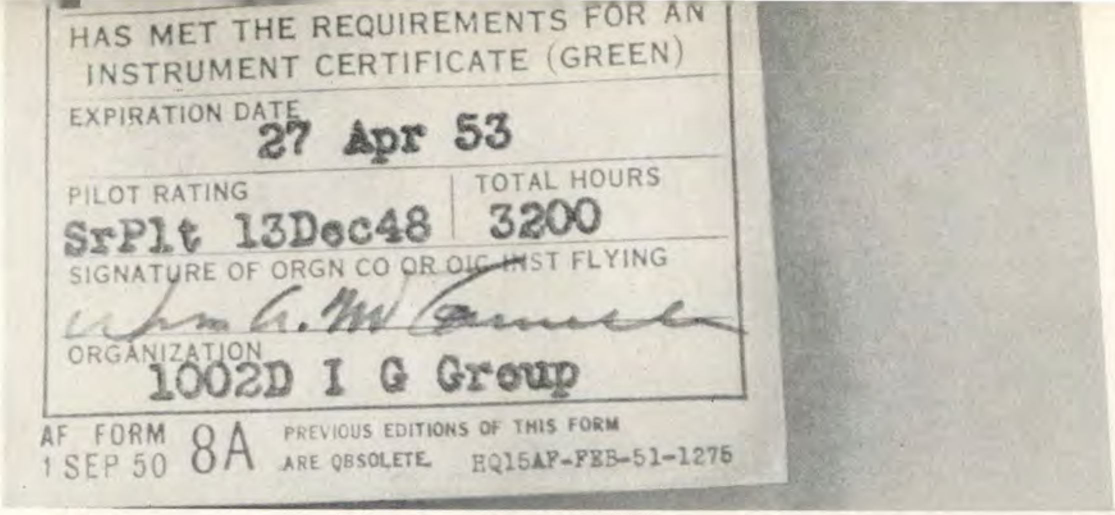
FLYING SAFETY

THE INSPECTOR GENERAL · U. S. AIR FORCE



CREWS FOR COMBAT

JULY 1952


HAS MET THE REQUIREMENTS FOR AN
INSTRUMENT CERTIFICATE (GREEN)
EXPIRATION DATE 27 Apr 53
PILOT RATING SrPlt 13Dec48
TOTAL HOURS 3200
SIGNATURE OF ORGN CO OR OIC INST FLYING
ORGANIZATION 1002D I G Group
AF FORM 8A 1 SEP 50 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. HQ15AF-FEB-51-1275

THE GREEN CARD

MORE THAN just a few accidents have occurred recently during IFR low approaches at bases where the weather was below GCA minimums. The green card holder is doing his share in furnishing the statistics.

Some green ticket holders have ventured where Angels fear to tread, and they've come out second best. Granted, a few of the green holders are making spectacular IFR low approaches and hair-raising safe landings in almost zero-zero weather with nothing more than a radio range, but these aren't the jockeys we are talking about — not yet. We are talking about the guy who dragged his landing gear through the trees on his second pass at the field — about the pilot who tried and lost, who flew into the ground and cart-wheeled himself and his crew into bold-face type across the front page of the newspapers — and so it goes — some are getting home for that dinner, a few aren't so lucky.

The old timers in the Air Force are getting worried now about all the slack which they've given to the pilot with the AF Form 8A. Right now they're hassling over the pros and cons of paragraph 38a of AFR 60-16. This paragraph states that there are no landing or take-off minimums for the green card pilot.

Any green card holder may attempt a landing at his own discretion when the weather is below minimums. Some of the powers that be want to re-establish landing minimums for the pilot with the green ticket, others say no. Both sides have their good points.

Most people seem to agree that the pilot with the experience and years behind him to earn a green card deserves the right to think and act on his own authority during the clinch. It's to the best interests of the Air Force to recognize excellence — to give to the one who earns it, a green card plus clearance authority, and Senior and Command Pilot wings.

An important factor to consider in this squabble is the type of aircraft in which the pilot received his instrument check. It has been pointed out by some that the pilot who obtained his green card in a B-29 should not be allowed to exert his green card authority in an F-80.

Whatever the outcome of this hassle, everyone agrees that IFR low approach ACCIDENTS "have to go."

With all of this talk of minimums for the green card pilot an accompanying headache enters into the picture. What effect would this have on our plans for an all-weather Air Force?

Regardless of the decision made, the green ticket holder must be made to realize that the day of safe zero-zero landings hasn't arrived yet — not with our present equipment. In the meanwhile, good, sound pilot judgment should be based on consideration of the limitations of present day equipment. To our knowledge, no blind landing system has been installed at any airdrome — anywhere. GCA is not a blind landing system.

Think it over — slow down and think it over before you stick that green card in the windshield for that low, low approach. The Air Force can't afford to lose you or the aircraft. "Fly Smart." It's better to get home late to the wife and kids, or sweetheart, than *not* to get home at all — ever.

THIS MONTH

Once again, the "West Point of the Air" becomes a busy Crew Combat Training Base. The Air Training Command has done it again, adapting itself versatily to the task of switching from cadet training to combat crew training almost overnight at Randolph AFB. Beginning on page two is the story of "Crews For Combat."

YESTERDAY AND TODAY

"Voice of the People," beginning on page 12 reflects the public opinion of yesterday and today in regard to aviation. If you read closely, you'll see that, basically, the public feels as it did 44 years ago—indicating, perhaps, a serious mistake on the part of aviation—that of progressing without systematically educating the public in the importance of aviation and its vital role in our economy and welfare today.

MAKE YOURSELF KNOWN!

Herewith, we make a special offer to print your name in FLYING SAFETY magazine for all the Air Force to see.

The eligibility rules are simple: (1) Select a subject which you believe to be of importance or special interest concerning flight safety; (2) Write 500 to 2500 words on the subject you have selected; (3) Gather any pertinent photographs, add captions or identifying information (note: photos are not necessary, though helpful); (4) put the results in an envelope and mail to the Editor, FLYING SAFETY Magazine, Office of The Inspector General, USAF, Norton AFB, California. Your contribution will be judged by the editor and staff and if found worthy of publication, will be printed *with your byline*. And lest you fear that your writing style may be slightly lacking in certain ways, we hasten to assure you that any required editing and polishing will be done by the magazine staff. So get on the bandwagon—mail your contribution soon.

THE COVER

Two crewmen of the 22nd Bomb Wing readying a Superfort for an afternoon mission.

FLYING SAFETY

DEPARTMENT OF THE AIR FORCE
THE INSPECTOR GENERAL, USAF

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The printing of this publication has been approved by the Director of the Bureau of the Budget, June 4, 1951.

Facts, testimony and conclusions of aircraft accidents printed herein have been extracted from USAF Forms 14, and may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious.

No payment can be made for manuscripts submitted for publication in FLYING SAFETY magazine. Contributions are welcome as are comments and criticisms. Address all correspondence to the Editor, FLYING SAFETY magazine, Deputy Inspector General, USAF, Norton Air Force Base, San Bernardino, California. The Editor reserves the right to make any editorial changes in manuscripts which he believes will improve the material without altering the intended meaning.

Crews for Combat

A Rigid Training Schedule Which Involves Much More Hard Work Than Glory Insures That Our Superfort Teams Are Topnotch

IT MAY SURPRISE the good people of Texas to learn that Fort Worth has been bombed about 4000 times in the last 20 months. It is equally certain the majority in neighboring Arkansas have been blissfully unaware that the Westinghouse plant at Little Rock has been clobbered on 2000 occasions during the same period.

Patients in the Army's Fitzsimmons General Hospital near Denver hardly have realized that the buildings which shelter them are beaten up almost daily and this is to inform Oklahomans that their State penitentiary at McAlester has been wiped out hundreds of times.

The raids have been mounted by B-29 Superforts from Randolph Air Force Base, storied "West Point of the Air," and fortunately for the citizenry, have been make believe.

These superforts are the property of Air Training Command's Crew Training Air Force and specifically of the 3510th Crew Combat Training Wing. The wing's designation tells why it exists: to train 11-man crews for medium bombardment in the B-29.

This B-29 program, like many other Air Training Command activities, traces its origin to the Communist invasion of South Korea. It was apparent immediately that B-29 strength in FEAF must be stored up and a qualified replacement source established. Training Command set up the Randolph project to meet these goals in August, 1950.

Three months are required to produce the 11-man combat crew. Those responsible for the program like to think of it as essentially an assembly line function. You take 11 men from a variety of sources, put them together, and three months later you deliver a combat team. What occurs in this quarter-year to produce what Training Command's CG, Lt. General Robert Harper, terms "crews highly proficient in the use of military aircraft as combat weapons?"

The three months are split into two phases—one of 30 days transition, the other a 60-day crew combat train-

ing period. Only five-elevenths of the eventual team are concerned with the transition phase. The fraction is composed of aircraft commander, co-pilot, flight engineer and right and left scanner-gunners.

This nucleus is brought together in the 3513th Transition Squadron where the five are introduced to the remainder of the crew and the task of fashioning a B-29 crew begins. This business of introductions is no joke. Except for the scanners, youngsters in the Air Force and freshly graduated from Gunnery School at Lowry AFB, it is unlikely that any has met before.

The truth of this is understood more easily by consideration of the sources from which the persons stem. Until very recently virtually all aircraft commanders were recallees, War II four-engine men, many of whom hadn't been in a flying machine for five or six years. Co-pilots usually are new graduates of a Training Command multi-engine school such as that at Vance AFB in Oklahoma. The flight engineer is a product of the school for his specialty at Chanute AFB. The gunners hail from Lowry.

Transition is guided by a three-man instructor crew—IP, flight engineer and gunner. Instructor crews carry a double load, each being responsible for two training crews. Some idea of the hours they put in may be gleaned from the information that 11 of them totaled more than 8000 flying hours in a year.

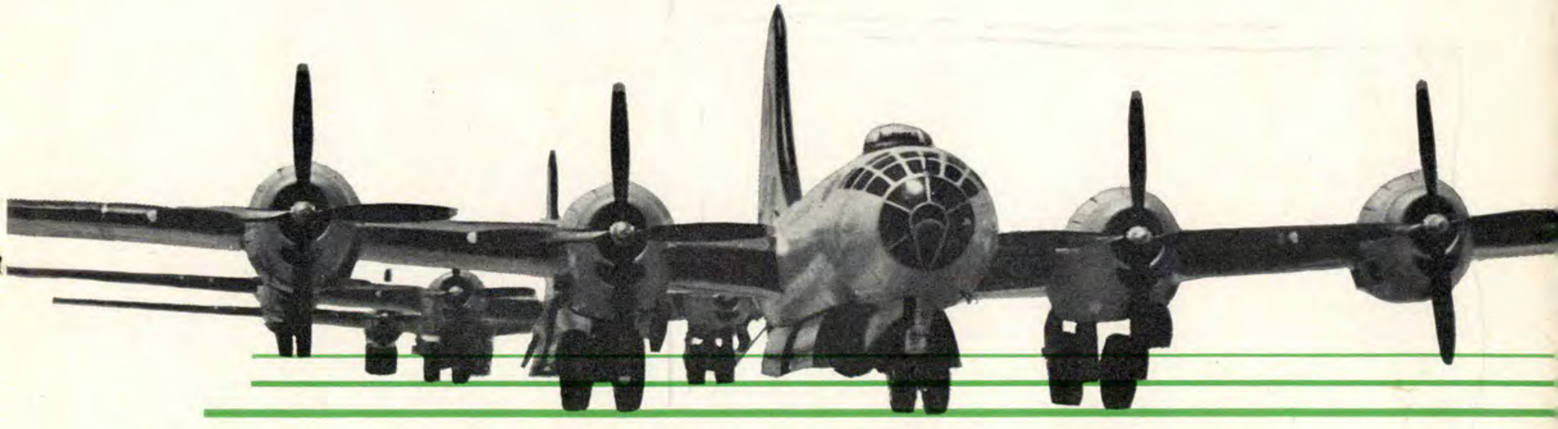
The transition phase is designed to produce maximum familiarity with the equipment in a minimum time. The five-man, or "short" crew picks up about 40 hours of flying time, approximately half on instruments. A crew will make about 40 landings, eight of them at night, and 12 GCA's; 36 takeoffs, nine on instruments and eight after dark; three and two-engine landings, aural null and range letdowns, half-flap and no-flap landings. For the statistically-minded, this kind of flying produced in the last year for the 3513th Squadron some 29,000 hours in which 48,000 landings were accomplished.

There is neither gunnery nor bombing during transition. It is a time for becoming acquainted with the Superfort, particularly for the aircraft commander. This key individual owns either a minimum of 1500 hours of which 1000 comprise four-engine time, or has 1000 hours of which 500 were logged in B-29s.

When a crew is not flying during transition, it can be found in one of a number of classrooms. Academic training covers B-29 indoctrination and orientation, emergency procedures, communications and long sessions with Link and Curtis P-2 trainers.

At transition's end, the "short" crew is fleshed out with the six additional members. The bombardier, radar observer and navigator almost certainly will be War II veterans, recalled and given refresher training—the bombardier at Connally, radar observer at Mather and navigator at Ellington. The radio operator will come from the school at Keesler, and Lowry will provide both tail gunner and central fire control gunner.

The crew having been assembled, there follows a 10-day "stand-down" period. Everyone gets introduced all over again. Crew orientation and discipline are scheduled, as is bomb team training in the classroom with the ultrasonic equipment. Four missions, each lasting four hours, are set up in this trainer for the team—aircraft commander, co-pilot, navigator, bombardier and radar observer. One, aimed at cross-training, places each at another's job. The practical idea is to get the bomb team



functioning as a unit before it ever gets into the air.

Veteran instructors, including 39 Korea returnees, oversee the 60-day combat training phase conducted in the 3514th and 3515th Squadrons. Eight simulated combat missions are flown, each lasting from seven to 14 hours.

Every mission covers a three-day cycle. Crews are briefed the first day. This begins with a general briefing covering routes, targets, weather, etc. Two hours of target study follow, the crew members of the aircraft scheduled for the mission gathering in a room according to specialty. All navigators work out their problems together, radar observers collect in another room, bombardiers in still another, and so forth.

The mission is flown the second day and several targets are covered. Some, like the Matagorda bombing range, are actually hit with 100-pound practice bombs. Others, like the Cotton Compress building in Oklahoma City, are located by radar. In this type of mission a radar bomb scoring team on the ground tracks the B-29 on its run and determined accuracy when the aircraft signals "bombs away."

The day following each mission is given over to critiques at which mock bombing results are evaluated and instructors offer tips for improvement.

In the 14-hour mission the student-operated Superforts leave Randolph around midnight for Brownsville, Texas, where they turn out across the Gulf of Mexico for the Florida coast. Just west of Florida, the bombers climb to altitude and strike targets along the peninsula. Mock fighter intercepts are flown from Jacksonville Naval Air Station. The Superforts "bomb" Tampa, then stream out across the Gulf again for Texas and a daylight landing at Randolph.

During the combat training phase, the bombardier will make both visual drops and radar bomb scoring runs. Each gunner will complete three malfunction missions and a similar number in which he will "fire" gun camera film at intercepting fighters. Navigators accomplish at least 16 hours of celestial navigation. And to continue stress on instrument flying, aircraft commanders spend at least two hours of each mission on the gages.

To keep this program in high gear constantly—and safely—requires excellent maintenance and safety consciousness. Both are present in marked degree at the long-time Texas training center.

Good maintenance gives an extra margin of safety.

Crew orientation and discipline are stressed in the program.

Flying day and night, through all kinds of weather, the Superforts pile up about 7000 hours each month and have logged in excess of 100,000 hours since the program began. Just last April one Superfort flew 218 hours and the month before another registered 197 hours.

Current maintenance proficiency did not come easily and it stays where it is primarily because crews work in three shifts, around the clock, six days a week.

From the time Randolph was conceived in 1928, when 2300 acres of land were turned over to the government, the base has been associated with cadet training. Once before, in the period between 1944 and VJ-Day, B-29s were Randolph's major interest. But war's end found the Texas installation returning to its traditional role of a cadet alma mater. At the time the B-29 project was launched almost two years ago, Randolph was back in the pilot training business and the flight line was equipped exclusively with the venerable T-6.

Colonel Samuel Gershon, director of maintenance for the B-29 program and an officer who has had a long association with the Superfort, recalls that maintenance in the early days suffered because "the men were not familiar with the equipment and many were afraid of it."

The Colonel, intensely loyal to the aircraft, took the lead in dispelling old wives' tales of the terror built into the Superfort. "It's a fine airplane," he says, "and better now than when first off the production line. Modifications have made it safer and sturdier in every way."

His B-29 knowledge, buttressed by insistence that the aircraft be operated without deviation from established rules, contributed much to creating present high performance levels. Brig. General J. H. Davies, commanding the B-29 program, declares flatly that "we have the best maintenance in the Air Force."

The General, who was in the Philippines on Pearl Harbor Day and later at Australia where he took command of the old Third Bomb Group, believes that Randolph's maintenance, by keeping the program running without interruption and safely, has "made a considerable

Three months of teamwork both on the ground and in the air, go into the making of a combat ready B-29 Crew.

contribution to the buildup of our air strength at a time when it is so necessary."

The Flying Safety end of the program is guided from Wing level by General Eisenhower's former pilot, Capt. Edward B. Devon. The Captain was assigned to fly General "Ike" when the latter was Chief of Staff following the war. During that fracas, Captain Devon first flew 31 missions out of England in 93rd Bomb Group B-24s and later was assigned to Air Transport Command for duty on the Pacific run out of Hamilton Field.

Before taking over the Flying Safety job, Captain Devon spent a full year as an instructor in the B-29s and consequently was grounded thoroughly in the Randolph tenet that makes safety an equal partner with proficiency.

Safety is an integral part of all briefings and target studies. Here, safety SOPs are discussed in minute detail —altitude reserved from CAA, discipline on bombing ranges, headings—everything that combines to make up the mission. "Good planning, attention to detail and procedures, and the kind of maintenance that creates confidence in the equipment might be termed our safety program," Captain Devon says.

The Aircraft Commander of the Honor Crew in Class 52-E, Major Woodrow Jack of Amorita, Oklahoma, agrees that the safety record stems from following established procedures and from confidence in the maintenance.

"Actually," says the major, "this 29 we're flying now is practically a different airplane from the one we flew during the war. Modifications have made it a lot safer. And the maintenance here keeps it that way." An Oklahoma school teacher until recalled a year ago, Major Jack says, "Safety consciousness begins as soon as a crew member starts the transition phase and never lets up. Our instructors keep safety in front of us at all times. We practice emergency procedures constantly and any detail that contributes to safety is never overlooked."

Major Jack is one of several recallees in his crew. The navigator, Lt. Lawrence D. Wiggins, War II veteran of B-29 missions over Japan, was recalled last December. Major Gordon A. Buhrman, bombardier, who also served in B-29s with the 315th Wing in the Pacific, was called back last September; and Major Joseph J. O'Hara, Jr., radar observer, who flew his wartime missions in the ETO with the 306th Bomb Wing of Eighth Air Force, was summoned last November

Lt. James L. Humphreys, co-pilot, went to Randolph and the crew directly from multi-engine training at Vance. The flight engineer, S/Sgt. Charles M. Escue, came to the Air Force by way of the Navy. He was a radio-gunner in the last war, flying from the carrier Enterprise.

Virtually all crews go to SAC upon graduation and are shipped to FEAF to press home the B-29 strikes in the Korean campaign. If Major Jack's team follows the established route, the experience of taking an active part in the shooting war there will not be new to Sgt. Escue. The Florence, Ala., native completed 78 missions in B-26s of the Third Bomb Group before he was sent to flight engineer's school.

Randolph's program is evaluated on the spot in the combat zone by Training Command liaison officers. Colonel Colin E. Anderson, wing operations and training officer and veteran of 29 missions over Korea with the 19th Bomb Group, points out that Randolph began to stress bombing of bridges and tactical targets immediately after the B-29s were called upon for operations of this kind in Korea.

This is in keeping with Randolph's avowed purpose of turning out combat-ready B-29 air crews. "We tailor our program," says General Davies, "to accomplish the mission."

So long as there is a need to deliver combat-ready crews to SAC, B-29s from Randolph will be making their simulated bomb runs on the Port of Houston's grain elevator and Sweetwater's little red schoolhouse. In an address at Randolph three months ago, General Harper explained the compelling "why" of the project.

"There is a reason for this program of training here," he said, "a very important one. It is a matter of our survival, the survival of this country—its ideals, its principles, its freedom."

It is axiomatic that strength deters aggression and to this end the training program at Randolph makes a considerable contribution to the muscular development of the nation's air power.

The Bird Dog

Here's a Refresher on the ADF for Those Who Might Be a Little More Than Rusty—

THE RADIO COMPASS, or bird dog as it is known in Air Force lingo, is a pretty handy gadget to have around on any VFR or IFR navigational flights. It helps a pilot get where he wants to go, quickly and efficiently. But it is wise to remember, as stated in the Theory of Instrument Flying Manual, that, "The radio compass is a valuable *aid* to air navigation." The pilot who is unfamiliar with all phases of radio compass procedures may find himself in serious trouble if he depends solely on the automatic feature of the compass.

Too many pilots and aircraft have been lost because someone placed all his reliance in a set that was malfunctioning or not fully understood and utilized.

Recently, a jet pilot was forced to make an emergency landing on an unused strip because he followed the needle as it homed on a gigantic thunderhead. His ETA had run out sometime previously and he admitted he had gradually turned off his plotted course but he still persisted in following the compass, though an error was obvious. He was lucky the strip was there; others don't always have this luck. Other conditions that may affect the radio compass and cause errors of from ten to one hundred eighty degrees include mountain effect, inter-station interference, heavy static in the air, pulsing of the indicator needle, coastal reflection and night effect. A brief review of the entire compass may be of some value in helping the pilot determine how he can safely use the compass if the automatic feature is not functioning.

In tuning in and operating the sets there are several facts that may be of interest to those who have not been in contact with a radio compass for some time. The sets should be tuned in on the Antenna position, which acts as an ordinary range receiver, rather than the Compass position to avoid rotating the loop as various stations are passed. It is best to tune the set in to maximum reception by a combination of the tuning meter, which shows maximum deflection upon getting maximum signal strength, and by ear as the tuning meter is affected by interference and static. Remember that on the Loop position, the loop antenna only is used, and must be rotated manually by using the left-right switch. For tuning in an area of heavy interference the Loop position will also give the best static-free reception.

Radio ranges, both Loop and Adcock, non-directional beacons, standard broadcast stations, control towers, using 200 to 600 kcs and other aircrafts' liaison transmitters using 200 to 600 kcs are all possible to receive on the radio compass. In picking a station the pilot should consider the proximity of the station to the field, the power of the station, and, where possible, choose a station that transmits a constant carrier wave. In this connection it is better to choose an Adcock range over a Loop range as the strongest signal transmitted over an Adcock range comes from the center tower which is non-directional.

Orientation, after the set is tuned in and placed on

Compass position, is, of course, automatic since the indicator needle always indicates the relative bearing of the station. However, after determining direction to the station, several easy calculations are possible to show the approximate time and distance to the station.

To get the approximate time from the station first get your indicator needle center on the zero index. Then turn to either a 90 degree or a 270 degree reading, note the time and fly a constant magnetic heading. Fly this heading until you get a change on the indicator of from 5 to 20 degrees. Always fly at least a 5 degree change. Note the exact time elapsed to fly through your degree change and apply it to the following formula:

$$\frac{60 \text{ x Minutes between bearing change}}{\text{Degrees of Bearing change}}$$

This formula gives you a reasonably accurate time from station reading. It can be simplified further if definite 5, 10, 15 or 20 degree changes are made.

- For 5 degrees: 12 x T = Minutes from station
- For 10 degrees: 6 x T = Minutes from station
- For 15 degrees: 4 x T = Minutes from station
- For 20 degrees: 3 x T = Minutes from station

For example, if it took you two minutes to get a five degree change on the indicator you would use 12 x 2 = 24 minutes from the station.

To get the distance from the station in miles use the formula $\frac{\text{TAS x T}}{\text{Degree of bearing change}}$. Thus, if the TAS is 250 MPH and it takes two minutes to effect a five degree change on the indicator the formula reads $\frac{250 \text{ x } 2}{5}$ or $\frac{500}{5}$ for a distance from the station of 100 miles.

If the pilot intends to home in on the station it is merely necessary for him to keep the indicator "zeroed," always remembering that if he allows it to wander or deviate he can get considerably off course and consume more time before arrival. A five degree error ten minutes from the station can put the aircraft considerably off course, though it would be only minor when one minute from the station.

Homing does not allow for crosswinds and consequently an aircraft homing in on a station frequently describes a semi-circular or curved path over the ground. Naturally, it is always desirable to utilize the aircraft fully and to track in on a straight course. Under certain conditions it may be vital, particularly in rough, high terrain or when fuel is low.

TRACKING INBOUND

When tracking inbound the directional gyro is used as the primary directional source, the indicator needle is used to determine deviation from the track.

To determine drift and correction to hold a desired track, fly a predetermined gyro heading, starting with the radio compass indicator on "O." The indicator needle will deviate in the direction of the wind. Thus, if the crosswind is from the right, the needle will deflect to the *right* of "O," if the wind is from the left, the needle will be to the left of the "O" marker. Hold this gyro heading till a definite deviation of the needle occurs; the rate of deviation will give an indication of the wind velocity, particularly when far from the station. An initial corrective turn is made in the direction of the needle, depending upon the distance from the station. A 30 degree turn should be maximum except in extreme cases. The aircraft will be back on track when the indicator needle has moved to the opposite side of "O" the same number of degrees as was made in the gyro turn. As an example, if the aircraft is flying a gyro heading of 270 degrees and the indicator needle is on 10 degrees, make a correction to the right for a definite number of degrees, for example, 30 degrees until the needle has swung to the opposite side of "O" to a bearing that corresponds with the number of degrees in the gyro turn. The gyro heading now might read 300 degrees and the relative bearing of the needle might be 30 degrees to the left of "0" or on the 330 degree marker.

After this initial turn that puts the aircraft back on the track, reduce wind correction gradually, holding enough to keep the aircraft on track. As long as the needle deviates from "O" the same number of degrees and in the opposite direction from the applied drift correction, the aircraft will stay on track.

Remember, a small angle of drift far out from the station may mean a strong wind and a great distance of actual drift but a 30 degree initial correction, applied as soon as drift is evident, will be sufficient to compensate for a cross wind up to one-half the actual airspeed of the aircraft.

TRACKING OUTBOUND

When tracking outbound use the 180 degree marker in the same manner that you used the "O" marker to track inbound. The indicator needle still indicates the direction of the wind but now, when a correction is made, the needle moves further away from the 180 degree marker, or in the direction of the turn. Again, when the needle points to a position which is the same number of degrees away from the 180 degree position as the degrees used in the corrective turn on the gyro, the aircraft is back on course. After an initial corrective turn has been made and the aircraft is back on track, additional turns are made as needed to keep the aircraft on the track and to compensate for the drift. By keeping the same number of degrees from the 180 degree position on the indicator as those used in the corrective turns the aircraft can be held on track.

AURAL NULL

Aural null procedures are primarily of an emergency nature in radio compass procedures. The emergency occurs usually after the loss of the sensing antenna or when some other factor renders the automatic feature of the compass inoperative.

The aural null or minimum signal position only occurs when the "hole" of the loop is perpendicular, or directly facing the station. The width of the null, that is the number of degrees through which the loop may be rotated and still receive a minimum signal, is determined by the audio control. To widen the null, decrease volume; to narrow the range of the null increase volume. The null will be relatively wide, even with full volume, if the aircraft is a considerable distance from the station, as its width is then determined by the distance and the power output of the station.

It is first necessary to solve the 180 degree ambiguity in the loop when working an aural null problem. First, fix the null in a nose position and then turn 90 degrees so that the null is then in a wing tip position. Fly a constant heading on the directional gyro until the null has moved at least five degrees. If, in order to hold the station, the loop must be moved to the left, the station is to the left of the aircraft. If the loop is moved to the right, then the station is to the right. While solving the 180 degree ambiguity it is possible to work out the time-distance, using the formulas mentioned above.

Once the ambiguity has been solved always keep the indicator needle pointed toward the station so as to be oriented throughout the aural null procedure. After turning to the station, it is possible to home in, keeping the needle indicator pointed to the nose null. In case of a crosswind it will be necessary to make small corrective turns into the wind to keep the nose on null position.

If a crosswind is evident it is desirable to track inbound in much the same manner as used for the automatic radio compass. Hold the aircraft on a nose null position, then set up a constant heading on the directional gyro until the null moves left or right. If the null moves left, the aircraft is drifting to the right; if the null moves right, the aircraft is drifting to the left. Correct back toward the track. Once again, a 30 degree correction is ample for winds up to one half the aircraft's airspeed. The null moves opposite to the direction of the turn. Hold the correction until the null has moved the same number of degrees in the opposite direction as the turn. Apply additional correction as needed; as long as the null is the same number of degrees from "O" as the applied correction on the gyro, the aircraft is on track.

Keep the *null width constant* at all times with your volume control; this is especially important as you near the station to assure recognition of station passage. An indication that the aircraft is close to the station is the rapidity with which the volume must be turned down in order to keep the null at a constant width.

At the actual station passage the null will be lost for a short time if the aircraft passes *directly* over the station. If the aircraft is to one side of the station it is possible to follow the null around to the tail. When the pilot is *sure* that he is within one minute of the station he may rotate the loop to a maximum signal position, or wing tip null and maintain a constant direction. When this is used there will be a surge in volume followed by a signal fadeout as the station is passed. Keep the volume low when following this method. Another indication of station passage is a widening of the null as the signal strength decreases, without a manual volume change. This widening will depend on the type and power output of the station. Another good method to check for station passage is to turn right or left 30 degrees off the track heading and follow the null. If it moves closer to the "O" indication the station has been passed, if it moves away from the "O" indication, the station is ahead.

In tracking outbound, the 180 degree marker on the indicator is used. Here, however, when correcting toward the track, the null moves away from the 180 degree marker. When the null moves back to the same number of degrees off the tail or 180 degree marker as the applied correction, the aircraft is again on track, and will stay there as long as the additional corrections remain equal from the marker and in the turns.

In summation, the old bird dog is a good friend for any pilot to have, but to get the best from him, you've got to know him well.

NEW LOOK IN LINKS

Scheduled for delivery to SAC, USAF is getting one of the first jet bomber simulators — the B-47B — which has been test "flown" by pilots from WADC's Flight Test Division, SAC and Air Training Command following inspection tests by USAF engineers; the bomber simulator does virtually everything its airplane counterpart does except leave the ground.

The B-47B trainer differs from the other trainers now being used in the same manner that one type of airplane will differ from another. Because it has controls and attitudes they do not have, several new conditions had to be simulated for the B-47.

One characteristic of the airplane, for instance, is a tendency to float just before touchdown and it is necessary for the pilot to nose the plane down to a landing.

In the trainer, the same floating tendency is simulated.

Other characteristics simulated are the use of the drag chute, in-flight refueling, jet assisted takeoff, and the 14 circuit breakers controlling the electrical power in the airplane.

These are controls for setting up VOR, VHF, and low frequency radio stations; setting up and changing field elevation; changing the CG; and varied other conditions that duplicate actual flight. Sixty-five different potentially hazardous conditions may be realistically set up in the simulator to afford crew training for emergencies.

For night or adverse weather "flights," the pilots are separated from the instructor by a blackout curtain. This curtain is left open for routine practice work.

Other type flight training simulators now under construction for the USAF include mock-ups for the B-36D, the C-124A and the C-97A cargo planes.

Those HIGH-LEVEL winds

By Captain Doyne Sartor,
Air Weather Service

Compressibility And Temperature Play an Important Part in Your High Altitude Flight

THE INCREASING frequency of high-level flights is bringing up many new questions for the weather forecaster to answer. At high altitudes (20,000 feet and above), are headwinds stronger than tailwinds? Are these high-level headwinds more effective in reducing the ground speed of jets than tailwinds are in increasing it? Are actual high-level winds generally stronger than forecasts and ground observations indicate?

The answer to all these questions would seem to be an obvious "no"—yet the experiences of many pilots have attributed an erratic behavior to the winds and created doubt as to the ability of the forecaster to provide accurate high-level wind forecasts. The following discussion will attempt to explore some of the factors which may affect the apparent inaccuracy of high-level wind forecasts.

The weather officer began receiving new and unusual comments concerning his wind forecasts almost immediately after high-level flights became routine. One pilot told his weather officer that on the outbound leg of a high-altitude round-robin flight he encountered a strong headwind. After making a 180° turn and heading back for the base, he said he again encountered a headwind instead of the expected tailwind. Other pilots quite frequently reported headwinds on the order, for example, of 100 knots instead of the 50 knots which had been forecast. At some bases the forecasters found that pilots were adding 20 to 40 per cent to the wind speeds forecast for high altitudes.

The comments of most pilots concerned either a predominance of headwinds or unusually strong headwinds; seldom was any mention made of discrepancies in the forecasts of winds which acted upon a pilot's aircraft as tailwinds. This was undoubtedly due to the adverse effect of headwinds on a flight, making it only the headwinds that pilots remember and talk about to the forecaster. Further investigation of these apparent wind-forecast discrepancies was indicated, and the USAF Air Weather Service initiated a project to obtain actual high-level wind speeds by tracking aircraft with radar.

The first measurements, made by tracking jet aircraft of the 33rd Fighter Interceptor Wing with radar of the Massachusetts Institute of Technology, seemed at first to confirm the pilots' comments. The surprising result was that the computed wind for aircraft flying into the wind was nearly twice that obtained when the aircraft flew with the wind.

Following the MIT runs, a continuing project was set up in which an aircraft control and warning unit tracked the jets of the 33rd, and a large number of carefully made wind runs were obtained from March through September of 1951. Computations of the actual winds affecting single

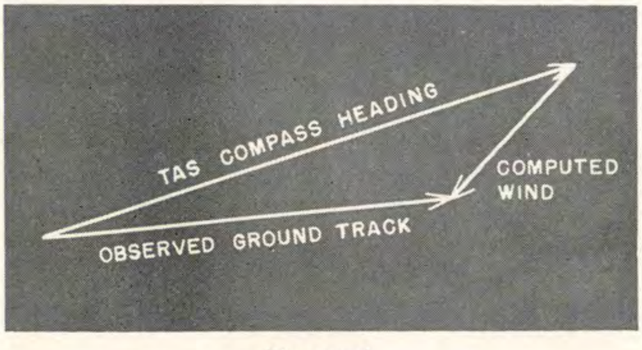


Diagram 1.

legs of these runs were made in the usual manner illustrated by Diagram 1: by subtracting the true airspeed and the heading vector from the ground track vector. These results also bore out the comments of pilots: headwinds averaged greater speeds than tailwinds and headwinds were in the majority.

A further refinement was added as a result of these single-leg findings and an attempt was made to obtain as many wind runs as possible with four equally timed legs, each on a heading differing by 90° from the preceding leg. Each leg was flown at the same altitude and indicated airspeed.

When the ground tracks of the four legs (Diagram 2) are plotted as vectors, one on the tail of the other, a line drawn to connect the starting point of the run with the terminal point represents the wind which has acted on the flight for the total duration of all the legs. Timing of each leg was begun only after the aircraft had settled down to a constant speed after making the turn onto each new leg.

Examination of results obtained from these four-legged runs showed a possible influence of the E6B computer on apparent discrepancies between wind speeds forecasted and those experienced. For this type of run the

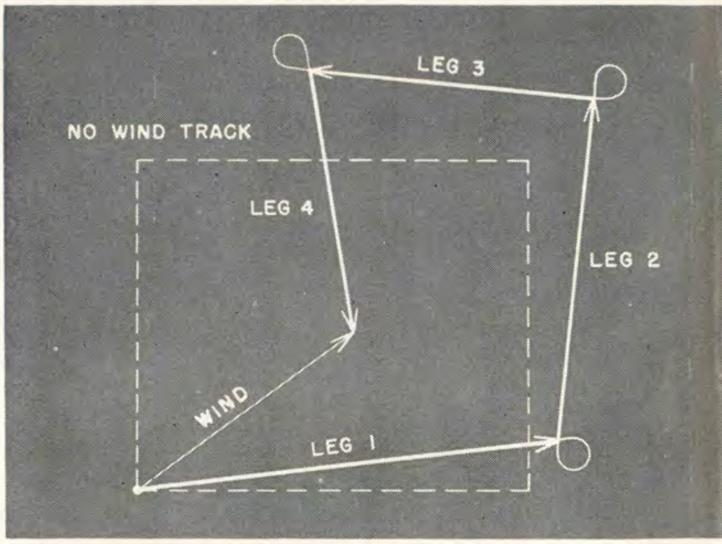


Diagram 2.

wind was obtained without reference to True Air Speed computations or compass heading information from the pilot. Furthermore, when a run consists of four legs, it is possible to check the accuracy with which the wind is obtained.

If actual TAS's are generally lower than those computed by the E6B, this difference alone could account for the reported wind discrepancies. The fact that no correction for the compressibility of air is incorporated into the E6B is believed to be a major factor responsible for these differences, since the application of a correction for compressibility brought computed TAS's into reasonably close agreement with those observed. A glance at the table of compressibility corrections for E6B-computed TAS's will clarify the effect of compressibility on

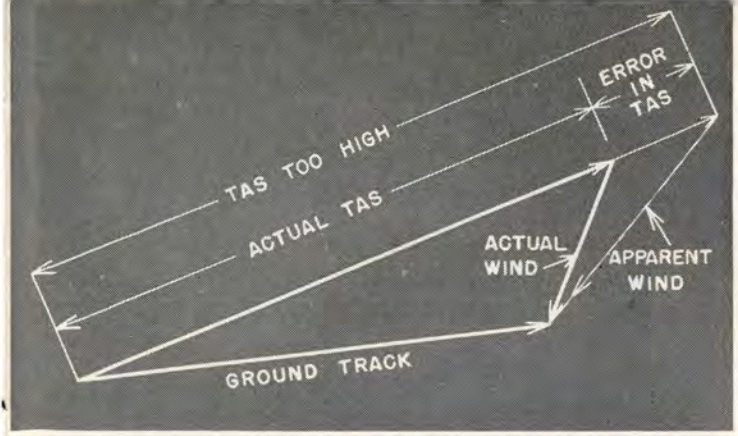


Diagram 3.

airspeed computations at high speeds and altitudes.

Another factor which can be expected to create frequent errors in TAS computations is the practice of using the indicated free air temperature instead of the actual free air temperature. Due to air friction on the bulb of an outside thermometer and a temperature rise in compressed air, the indicated free air temperature is always considerably higher in a fast-flying aircraft than the actual free air temperature. Aircraft that have no free air temperature gage are much safer in this respect, since the pilot is obliged to obtain his free air temperatures from radiosonde observations and forecasts available in the weather station.

Free air temperatures should always be obtained from this source, whether the computations are being made during the flight or prior to takeoff. Using a temperature reading which is too high will always increase the value of a computed TAS, to a degree which can be determined by an inspection of any airspeed computer.

Although occasional large errors do appear in high-level wind forecasts, because of the smaller amount of data available as the altitude increases, they have a random effect on flight planning when applied to a large number of flights over an extended period of time. Obviously, wind forecasts would not indicate a headwind component consistently too small, since a given wind is a headwind or a tailwind only in terms of an aircraft's course.

The effect of a TAS computed to be too high can be visualized in Diagram 3. Here, the correct TAS, the ground track and the actual wind are given as heavy black vectors. If the TAS is estimated too high (as shown by the thin line vector extending beyond the correct TAS vector), the pilot is led to believe that the wind he is experiencing has a much stronger headwind component than is actually the case.

This will always be the case at high altitudes and speeds when the too-high indicated free air temperature is used and when no correction is made for air compressibility. Since exclusive use of the old E6B computer does not permit a correction for compressibility and since there is no ready means of correcting the indicated free air temperature for compressional heating, it is reasonable to assume that many of the reported wind forecast errors are in reality due to these navigational errors.

Pilots who have had experience in the use of flight planning techniques for their particular aircraft as described in the appropriate technical order and in the article on Jet Flight Planning in the January, 1952, FLYING SAFETY Magazine, report no such difficulty with wind forecasts. The danger is, however, that unless it is understood how navigational errors have affected wind forecast verifications, confidence in wind observations and forecasts may not return with improved navigational computations.

It should be emphasized that when apparent discrepancies are noted between forecast winds and those computed by navigational procedures, due consideration should be given to inaccuracies in True Air Speed computations, true headings and positions over checkpoints.

More and more the science of "Aerologation," or "Wind Navigation" is coming to the fore as meteorologists learn about the movements and velocities of wind streams at high altitudes.

As a result of their experience with charts on a daily basis in different parts of the world plus knowledge from research, thinking relative to the distribution of wind patterns at high levels is evolving somewhat along the following lines:

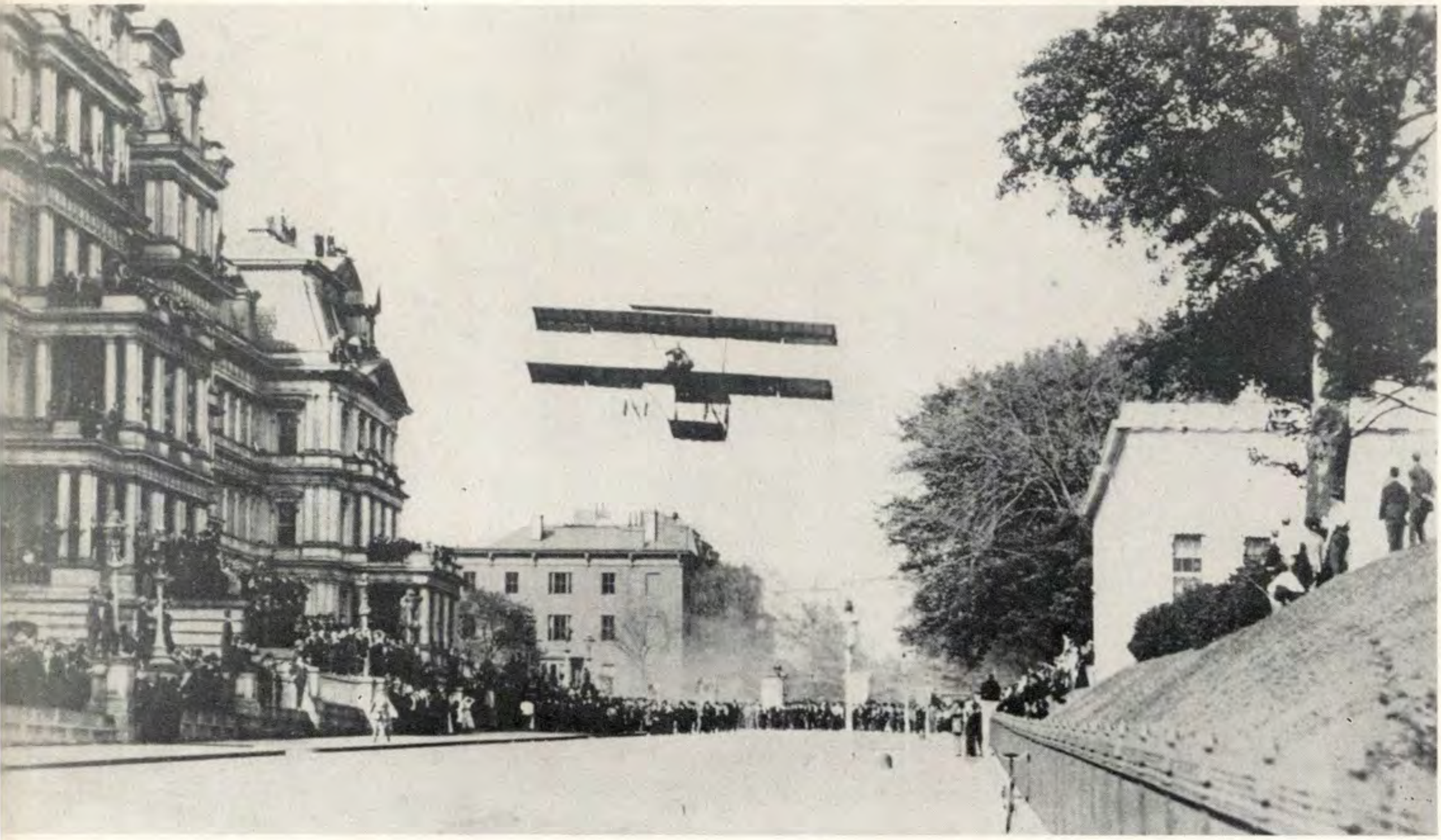
- **When abnormally strong west winds occur, they are likely to be abnormally strong at all levels from about 10,000 feet up to the tropopause.**
- **West wind speeds normally increase with height up to the tropopause (39,000 feet in January and 52,000 feet in July on an average).**
- **West wind speeds of 225 mph are not exceptional at the tropopause in winter through the mid latitudes.**
- **The two windiest areas in the northern hemisphere aloft are the east coast of the United States and the northeast coast of Asia in winter.**
- **Tapering off of west wind speeds in the lower stratosphere is gradual.**
- **Excessively strong west winds have a tendency to occur as "jet streams" extending almost perpendicularly from about 10,000 feet up to the tropopause but having a relatively narrow latitudinal width.**

COMPRESSIBILITY FACTOR TABLE

Press. Alt. Feet	Calibrated Airspeed-Knots 200	250	300	350	400	450	500	550
10,000	1.0	1.0	.99	.99	.98	.98	.97	.97
20,000	.99	.98	.97	.97	.96	.95	.94	.93
30,000	.97	.96	.95	.94	.92	.91	.90	.89
40,000	.96	.94	.92	.90	.88	.87	.87	.86
50,000	.93	.90	.87	.86	.84	.84	.84	.84

(Multiply the correction factor from the above table by the TAS obtained with your computer to get TAS corrected for compressibility. Result will be a good approximation.)

VOICE OF THE PEOPLE



How the Citizen Ultimately Accepts Aviation Depends Upon the Pilot of Today . . .

"NO FLYING MACHINE or airship shall travel on any street of this town within 10 feet of the surface at all, or within 20 feet at a rate of speed of more than 8 miles per hour, 50 feet at 15 miles an hour, 100 feet at 25 miles an hour, 200 feet at 50 miles an hour, and any airship traveling at a speed of 100 miles per hour shall stay at a height of not less than 500 feet."

That is one of the highlights of an ordinance passed in a southern city in the year 1908, just five years after the Wright Brothers made their first flight. Another provision of the ordinance prohibited throwing or otherwise ejecting any substance, fluid or solid within the town, while another made it unlawful for an aircraft to collide with, break, destroy, deface or damage in any way, telephone wires and poles, public buildings or public property within the town. It was further decreed that all balloons or airships should be equipped with bells, whistles or horns, brakes, lights, flying belts, artificial wings and "other safety apparatus."

It would be interesting to know if and how this law was enforced. It would also be very interesting to know what incident or series of incidents only five years after Kitty Hawk could have aroused the local lawmakers sufficiently to cause them to pass the ordinance. Chances are that the cause of the concern was much similar, in a modified form, to the series of accidents and incidents which have only very recently brought about storms of protest from the public and demands for legislation aimed at the control of air traffic for the protection of persons on the ground.

Since the end of World War II, aviation agencies, both military and civilian, periodically have been swamped with complaints from irate citizens about low flying, noisy aircraft. In many cases, it is only the noise that is objectionable, while in others, witness the Newark Airport dilemma of a short time back, the complaints are primarily concerned with danger to residents who live in the vicinity of the airport.

Regardless of the reasons, public opinion is a powerful force, and it is certainly to the advantage of aviation, whether civilian or military, to do all possible to avoid unfavorable reactions of the populace. Already, some cities have passed or are about to pass legislation which could seriously hamper flying activities.

When a law is passed which prohibits flights below 1000 feet anywhere over a city limit regardless of whether or not it is a populated area, it may require that the takeoff or landing pattern of a nearby airport be revised. Seldom can pattern revisions work to the best interests of safety. In most cases, the pattern is already being flown as safely as possible.

What are some of the specific complaints which are received by the Air Force? Here are some excerpts from letters actually received:

"The many planes . . . are an almost constant menace . . . since they must drop to low altitudes over thickly populated areas as they take off and land at the military airfields."

"Commercial and especially military planes are a nuisance in that they interfere with ordinary conversation, radio reception, church services, school instruction . . ."

"——— is a potential disaster area because of the operations of jet bombers which constantly fly over the city at low altitudes and with deafening roars."

"As it is now, the slow accelerating jets, taking off downwind, are pulling off the runway in a climbing 90-degree turn, which brings them over an area where there are many small farms, with homes located close together."

To members of the Air Force, some of these complaints may seem rather unreasonable. In other cases, however, particularly those involving noise, the objections may at times be well founded. In any case, the very great number of complaints which reached authorities subsequent to the recent series of disasters near Newark, N. J., prompted the formation of the President's Airport Commission, more popularly known as the Doolittle Committee, to make a detailed study of airport facilities, both civil and military, their location as to convenience and utility, and the problems they may present as to noise and possible danger. The findings of this commission will undoubtedly be much publicized and much contested. But there are certain actions that the Air Force and its members can take without awaiting the results of the study.

Pilots alone can do much to lessen the national concern over aircraft operations in populous areas. They can, first of all, avoid flying over such areas whenever possible. The straight line approach to an airfield often takes the plane over built-up areas at relatively low altitudes. In many cases, a slightly more circuitous route which would avoid population centers would serve just as well. When such a route can be used without endangering the flight, it should be used. Another way in which pilots can help to lessen the fears of people on the ground is to reduce power as soon after takeoff as possible when flying from fields located in or near populated areas. Granted, the only result is a reduction of the noise, but noise has been found to be one of the major sources of complaint. It not only is a nuisance, but also is instrumental in developing fears that a plane is about to crash.

Flying supervisors should study their local traffic patterns and determine if any changes can be made which will reduce the nuisance or hazard to personnel on the ground without adversely affecting the safety of the airplane and its occupants. One complaint received in Air Force headquarters was accompanied by a suggested solution which involved only a three-degree turn to the right after takeoff. Seldom would this increase the danger to the aircraft, and its acceptance might do much to improve relations with local citizens.

Commanders should insist upon strict compliance with established traffic pattern altitudes to prevent low approaches over congested areas. Also whenever wind conditions, runway length, aircraft load and performance characteristics permit, a runway should be used for landings and takeoffs which will minimize the risk to surrounding residents in the event of a crash. Along this same line, instrument runways and procedures which avoid heavily populated areas should be developed whenever possible.

Many complaints by citizens could undoubtedly be resolved in the Air Force's favor through an aggressive public relations program aimed at presenting the Air Force side of the problem. At some Air Force bases, civilian complaints have been withdrawn after the situation was fully explained in a cooperative fashion.

Regardless of whether or not you as an individual think complaints about noise and low flying are justified, it is your duty and responsibility to do whatever you can within the limits of safety to correct the situation which causes the complaints. The mission of the USAF is to protect the American people who support it. This includes protecting their peace of mind as well as their lives and property.

Glenn Curtiss at Rheims, France, 1909.

Food For Flying...

Proper Training Diets Are As Important to the Pilot as They Are to the Athlete

PRACTICALLY every college and pro football team has a training table, as do most of the baseball clubs while they are conditioning for their scheduled clashes.

Air Force pilots preparing for combat have a much more serious and rigorous schedule facing them, with their lives dependent upon the outcome, yet very little has been done in the Air Force to give the fly-boys a "training table" type of diet.

At Nellis Air Force Base, Nevada, one of the first steps has been made toward a training table for pilots. It is believed by flight surgeons that this effort to feed the pilot the food he needs will have a direct bearing on the accident rate at this base.

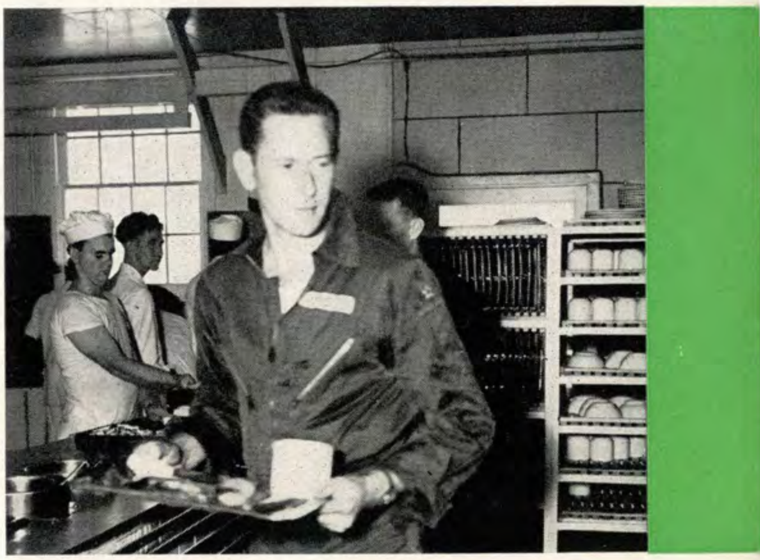
Flight surgeons for years have been appalled at the careless manner in which our intrepid airmen have treated their eating habits. A great many pilots, they've maintained, have given little or no thought to their body needs and by recklessly throwing hot dogs, cokes and coffee down their palates day after day, they're inviting a poor health condition with resultant accident potential.

How many pilots on a rigid flying schedule will go to the trouble of getting out of their flying togs and into a uniform, and head for an officers' mess which is across the field when they know that they have to fly again within an hour? Not too many jockeys are eating properly as a result.

Captains Grimmer and Compton, flight surgeons, and Captain Lee, the food specialist at Nellis, have taken steps to provide a pilot's mess near the flight line where pilots can "come as you are." This experiment in "good eating" is proving to be a boon to the busy fly-jockeys who are preparing to do battle with Joe's team in Korea.

Each pilot is encouraged to eat at least two meals at the training table—breakfast and lunch. The mess is restricted to flight line personnel only and there's no waiting in line. Special attention is given to diets with

Above, two weary pilots freshen with "punch bowl special."
Upper right, two pilots enter their exclusive dining hall.
Center, a pilot goes through with "no delay en route."
At lower right are a few of the boys "shooting the breeze" and relaxing before taking off for another flight.



non-gas forming foods for the boys who fly at high altitude.

It's a well-known fact that the pilot is a highly active individual who dislikes taxi and takeoff delays. When the pilot is ready to eat here in his own private mess, he gets immediate service with no delays, and he has time to relax a little after the meal, pull a pack of cigarettes out of his flying suit and "shoot the breeze" for a little while. A few minutes of relaxation after a good meal makes for a nice break in the middle of a busy day.

In addition to watching the pilot's diet, the hard-working flight surgeons have worked out a plan to induce the pilots to consume the needed salt which they need to keep going during the hot weather. During the hot summer months, salt is lost from the body at a terrific rate, particularly in the dry heat conditions at Nellis.

The old salt tablet is a good stand-by, but no one has ever made it tasty. On the flight line, Flight Surgeon Grimmer has introduced the needed salt in an easy to drink "Punch Bowl Special"—a vegetable or fruit juice spiked with a high salt content to be taken by the pilot upon return from his flight. This replenishes the salt loss of the body during periods of heavy perspiration.

The reaction to the "training table" is proving to be highly gratifying to the hard-working flight surgeons. It looks like the start of what could be a trend to keep our pilots healthy and accident-free.

Mobile Control

Adequate Supervision Spells Safety—Improperly Operated, a Control Unit Can Mean Accidents—

A SAFETY MEASURE, when misused, may create a greater hazard than the original condition it was intended to rectify. A pilot may be lulled into a false sense of security merely by the presence of some special device designed to contribute to his safety which, if improperly employed, actually presents great accident potentialities.

One such device, the Mobile Control Unit, has been successfully used in the past in the prevention of traffic and landing accidents. Today, in some instances, bases utilizing a Mobile Control Unit are permitting operating procedures which have resulted in serious accidents.

A series of landing accidents, attributable, at least in part, to lack of proper control procedures by mobile controllers was climaxed recently by two collisions during flareout for landing. Each crash involved a T-33 and an F-80; with all four aircraft sustaining major damage. In both instances, control unit personnel were aware that a collision was inevitable but transmissions to the aircraft involved were ineffective. The radio calls were made in such general terms as, "T-33 on final, go around," because the identification of the individual aircraft was unknown. Failure to identify the aircraft was due to the number of planes in the pattern and to the practice at this base of allowing aircraft to enter the initial approach, make their break and land without radio clearance.

This late type unit is fully equipped as a rolling "tower."

While mobile control problems will differ from base to base under different operational conditions, there are certain basic rules and practices that should be followed under all circumstances.

The mobile units should be manned by rated personnel, qualified by experience and technical know-how to supervise takeoffs and landings. Controllers should be selected from among the base instructor pilots, check pilots, flight leaders and operations people on a full-time or rotating basis and not be assigned the job as an extra duty. The controllers must be able to control all movement in the traffic pattern and maintain spacing within safety limitations. Aggressive and immediate action must be taken as soon as an unsafe act is observed; aircraft in close proximity to another and those making a poor approach should be sent around before the danger of an accident becomes acute. Care should be taken to insure that all mobile unit personnel are fully checked out in all equipment so that prompt remedial action can be taken to avoid an accident.

Additional recommendations have been made by the Directorate of Flight Safety Research for fighter bases with extensive training programs.

Traffic control procedures should be established that require all aircraft to receive clearance from the tower prior to entry onto the initial approach with a mandatory call to the control unit on the break and on base leg. This will enable the mobile controller to establish positive identity of all aircraft in the pattern. In formation flights clearance may be obtained by the flight leader for not more than four aircraft. If the formation breaks up, it then becomes the individual pilot's responsibility to obtain a landing clearance.

Entry to the initial approach should be made over a definite, easily identifiable point. This will prevent some flights from making their entries at a considerable distance from the end of the runway and consequently being cut out by other flights which have entered at a closer point. The 45-degree bank onto the initial makes it im-

possible for a pilot to observe other aircraft which have established their entry farther out.

Fighter bases should establish and enforce a safe minimum linear separation between aircraft in the pattern.

There should be an adequate number of qualified personnel in the mobile unit at all times, commensurate with the amount of traffic handled daily at the base. Fields at which an extensive training program is conducted need a minimum of two highly skilled controllers to handle adequately the flow of traffic.

Where possible, flying periods should be scheduled in such a manner as to preclude having more aircraft in the pattern at one time than can be effectively controlled by mobile unit personnel. Both the accidents previously cited occurred when approximately 70 aircraft were attempting to enter the traffic pattern during a 15-minute landing period.

A final recommendation was made that student pilots be required to maintain a minimum of 60 per cent engine RPM until landing is assured. This recommendation is due to the slow acceleration of the F-80 and T-33 from 0 to 60 per cent RPM and the number of go-arounds observed to have been made by student trainees.

In essence, the Mobile Control Unit, when used properly, has proven to be a positive factor in reducing landing accidents at fighter bases. Equally important is the fact that misuse or haphazard operation of the unit will increase the accident-potentials of a base.

At an Eastern base a mobile controller monitors the takeoff of a Sabre jet. The controlier also stands by to clear incoming traffic.

No matter what it looks like — if it is equipped with a radio and parked in the right place — it's mobile control.

Illusions

By Major G. E. Schafer
and Capt. R. T. Gallagher
Hqs., Air Training Command

Seeing Is Not Always Believing—When in Doubt, Read the Gages

WHEN IT COMES to creating illusions, Blackstone, the magician, is a master. He doesn't, however, have a monopoly of the art. The art of flying can produce more illusions than Blackstone, or any of his fellow magicians, ever dreamed of. Blackstone must rely solely on optical illusions, but the pilot has at his command a wide variety of illusionary materials. Optical illusion is just one item in his bag of tricks.

In addition to optical illusion, the pilot is subjected to illusions resulting from functions of his inner ear, from his muscle sense, and from a combination of these.

Every pilot knows that such illusions occur; nearly every pilot has experienced them. There is an abundance of material concerning sensory illusions. The average pilot is briefed on them by his instructor, by flight surgeons, and by physiologists. He reads pamphlets, technical orders and periodicals about illusions. His head swims from the hundreds of information sources. More than anything, he is confused by the multitude of terms applied to the illusions. It is obvious that most of the literature on the subject is written for the researcher or scientist rather than for the pilot.

The pilot reacts to this confusion in a number of undesirable ways. He may decide the subject is too mysterious and dismiss it entirely. He may develop an over-consciousness of it and bring on illusions he never would have suffered ordinarily. He may decide the subject is too complex to study and therefore he will take a chance that it won't happen to him.

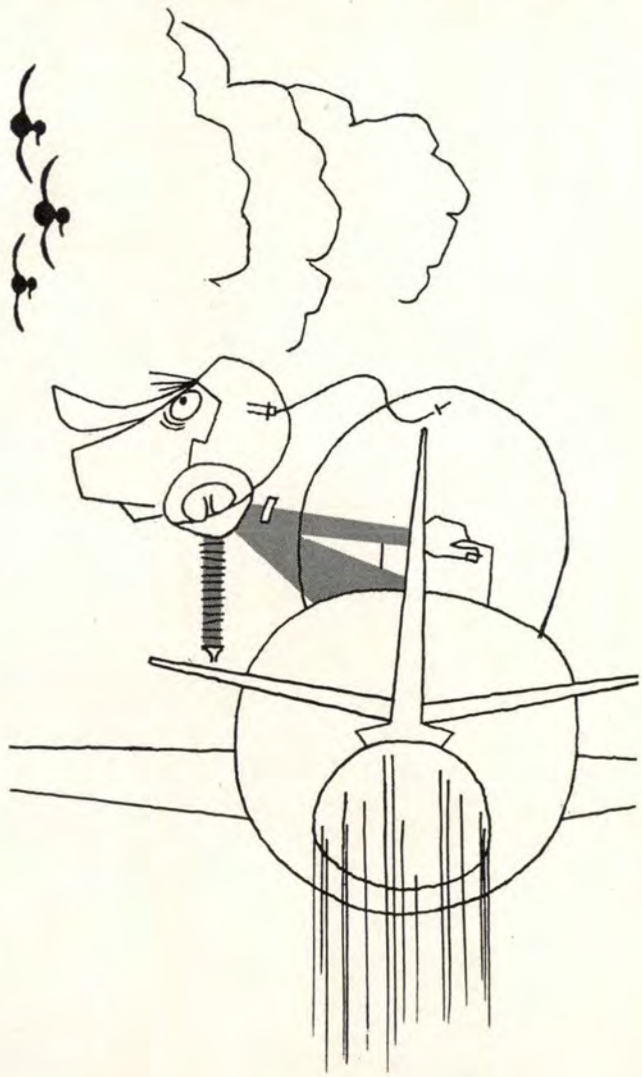
Because of the existing confusion, human nature stepped in and developed a common term to cover all these slightly mysterious happenings. The term brought forth was "vertigo."

Vertigo is difficult to define. Generally, we think of it as "a dizziness or a blurring of vision." If this is true, consideration of many of our past flight disturbances reminds us that no "dizziness" took place. Usually, the disturbance was "confusion." We thought a wing was up but actually it was down. We thought we were turning to the left but actually we were straight and level. We were confused. So we explain this confusion by saying, "I suffered vertigo."

Too often the term vertigo is used by pilots to explain any unusual experience encountered while flying. The danger in this practice is we can become complacent about the illusions we've suffered and we assume that it is just one of those things the human body must endure.

The truth is most of the illusions are not vertigo and need not be suffered. They can be prevented. If they do occur, they can be abolished. The way to prevent sensory illusions is a strict adherence to air discipline.

An understanding of the causes of sensory illusions can assist in encouraging air discipline. Some of these illu-



sions and the fact of their occurrence can be shown in past aircraft accidents:

• The pilot of a T-6, making a night flight over a waterfront area, reported to a nearby air base that his fuel supply was low and requested permission to land. After receiving landing clearance, the pilot began a let-down and the T-6 broke clear of a thin overcast at 2,000 feet. Sighting what appeared to be the runway, he set up a tight pattern and landed his plane . . . on a waterfront pier. The plane hit an obstruction and cartwheeled down the pier. The pilot had mistaken the parallel lights of the pier for runway lights.

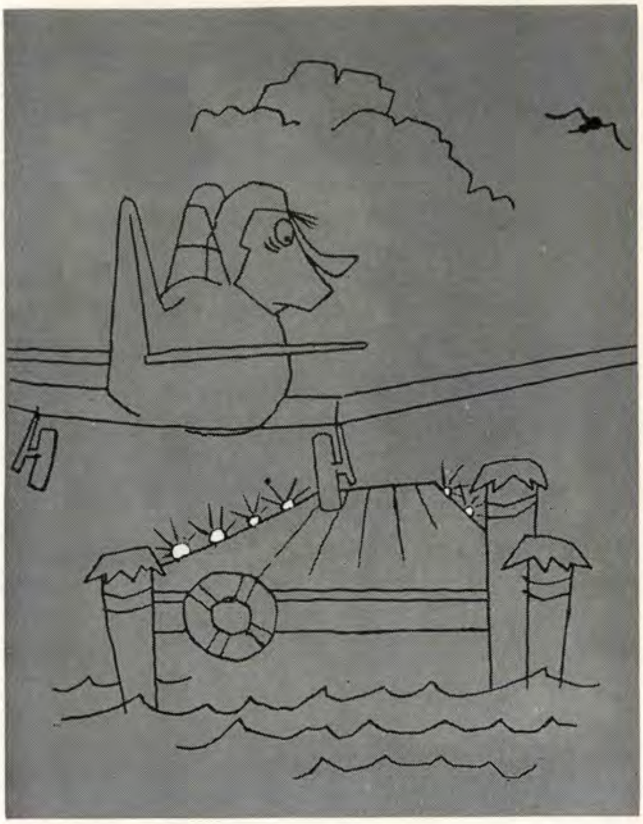
• A flight of two F-51's making a night flight had a mid-air collision. The wing man who was using the wing navigational light of his leader as a reference point thought that the leader peeled off and he followed through, only to collide with the leader. Fortunately, only minor damage resulted and both were able to land safely.

• The pilot of an F-80 in his first solo acrobatic mission lost his visual orientation at the top of his third executed loop and went into a spin to the right. He recovered but then thought he was in a spin to the left. He eventually bailed out.

Many more of these illusions can be cited from near accidents and from occurrences in every day flight, and just as many are explained away by the loose term "vertigo." Usually this explanation is technically erroneous. Vertigo is a medical term which is defined as a dizziness or giddiness or a swimming of the head. This is actually a symptom and is not a definite entity in itself. Vertigo can be experienced on the ground as the result of certain diseases. Vertigo can, in a few instances, be experienced by flyers as a result of sensory illusions that are the result of flight. However, to help clarify the occurrence of these illusions, the reasons for their existence and the basic causes must be understood. This will not only remove their mystery but will also remove the term "vertigo" which further confuses the problem. This knowledge will make the pilot more aware and more alert and can result in better and safer flying.

The inadequacies of the sense of balance cause these illusions. Your sense of balance, without which you wouldn't be able to stand on your own two feet—much less fly—is really made up of three senses. When the three work together and send coordinated messages to your brain you know where you are and exactly what position your body is taking. If they don't work together in the air, and your brain gets conflicting messages, you develop a sensory illusion. In other words, your body tells you that you are in an attitude different from your actual attitude. In flight, such circumstances can result in accidents. Remember one thing: your body was designed to be on the ground, to move and change direction of movement slowly. It was not designed for rapid speeds and rapid changes of direction.

One of the three senses of balance referred to is visual.



Your eyes tell you where you are in relation to other things around you. In maintaining balance, they are probably of greatest importance.

A second sense of balance is derived from your inner ears. They contain something that looks like a pretzel but which actually is a very sensitive instrument of balance. The "pretzel" is made up of three semi-circular canals, each placed in a different plane, containing a special liquid. Even the slightest movement of your head causes this liquid to move in the opposite direction and vibrate tiny nerve hairs lining the inside of the canal. This vibration sends messages to your brain which tell you where you are in relation to gravity. For example, if you spin around, it tells you that you are spinning, or if you tilt, it tells you that you are tilting. But the messages can often play dirty tricks on you if they are not coordinated with what you see with your eyes. That's one of the reasons why you must use your instruments instead of relying on your senses.

The last of these three balance senses is your muscle sense which comes from changes in pressure and tension on your tendons, ligaments, muscles and joints. With it, you feel what position you are in. It enables you to fly by the "seat of your pants" if such an art actually exists. But muscle sense registers all movements as if they were up or down. Again, you need your eyes to tell you reliably certain movements of your body.

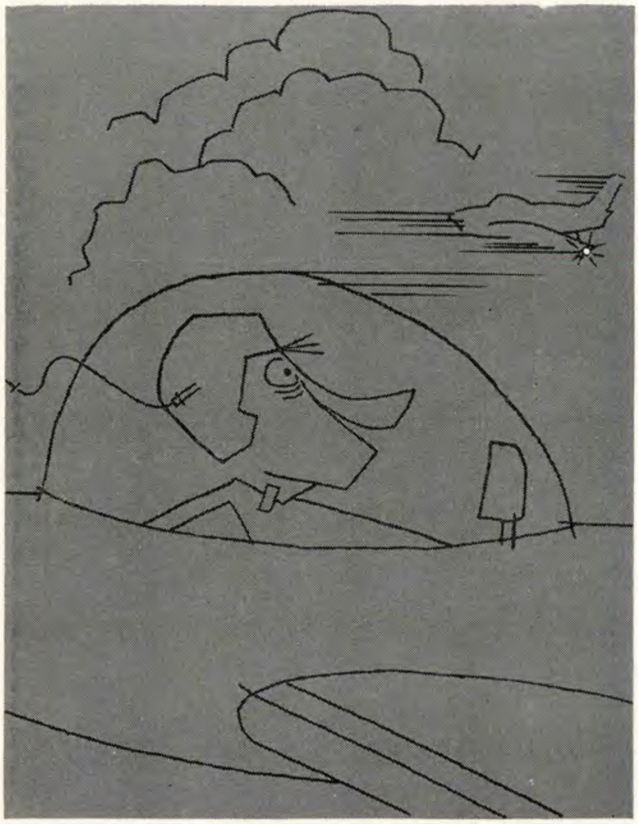
In discussing these sensory illusions, we can place them in three broad categories in relationship to our sense of balance. That is, we can discuss those illusions that are due primarily to our eyes, those that are due to our inner ears, or those that are due to a mixture that involves our eyes, inner ears, and muscle sense.

VISUAL ILLUSIONS

A number of illusions are considered to be the result of a misinterpretation of visual cues. Each has its own name and its own set of characteristics.

AUTOKINETIC PHENOMENON—This illusion can be described as consisting of the apparent movement of a light which is fixed against a uniform background, when other visual cues are lacking. In other words, when a pilot stares at a fixed light on a dark night, he may believe that the light moves or peels off when actually the light hasn't moved. This illusion can be so pronounced that a wingman following the light of his wing leader will peel off possibly into his wing leader's aircraft. This phenomenon is experienced by all normal persons and is very difficult to abolish. It is thought that the sensation of movement of this light is the result of fatigue of the muscles of the eye. This illusion can be very easily demonstrated if one will stare constantly at a small fixed light in a completely dark room. It will be noticed that in approximately ten seconds the light apparently moves.

RELATIVE MOTION—Although there are several illusions that might be listed under relative motion, the motion of a wingman transposed into the motion of the flight leader is a common example of this type of illusion. A similar effect can be noticed in travel by railroad.



When passing a stationary train in another train close by, one senses the illusion of motion of the stationary train. Naturally, this type of illusion can become dangerous in formation flying.

FALSE HORIZONS FORMED BY CLOUD BANKS—In flying with no reference to the actual horizon, cloud banks that are inclined are often misinterpreted as being horizontal. This false impression can be strong enough to force the pilot to change the attitude of his plane.

CONFUSION OF LIGHTS—This type of situation involves an error in interpreting the meaning of lights, or a light, as a consequence of their isolation, or the different appearance of lighted objects at night as compared to land marks in the daytime. Lights at night form a major part of the visual field, and the possibilities of misinterpreting their significance are frequent.

SIZE SPACE RELATION ILLUSION—Conditions that result in poor space orientation such as flying over water, flying over desert terrain, or night flying in which inadequate reference knowledge is present, may result in illusions especially dangerous during landing, gunnery, low level navigation, and formation flying.

INNER EAR ILLUSIONS

This illusion results from the inadequacy of our inner ear sense. The inner ear apparatus (the "pretzel") has a threshold for "tilt" and "pitch" and movements under this threshold are not perceived.

LEANS OF THE SAME DIRECTION—During instrument flying, if attention is not focused on the instruments and if the plane should roll suddenly to the left and then recover very slowly, the pilot will feel that the plane is still tilted to the left when actually it is straight and level. The slow recovery is not recorded on the inner ear.

LEANS OF THE OPPOSITE DIRECTION — Under the same conditions as above, if the plane slowly leans to the right, the pilot does not perceive the tilt, but considers the plane to be straight and level. Then as the plane recovers rapidly, the pilot perceives this motion but believes that it occurred from the level position. Consequently, he considers the plane tilted to the left when it is actually level.

PITCH — Illusions of pitch have the same mechanisms as the "leans" but are not experienced as commonly.

MIXED ILLUSIONS—Although most of the so-called sensory illusions are not clearly defined as to cause, this group is definitely related to mixed cues from the senses of equilibrium and results in mixed illusions. Under this heading, we can have two broad categories.

One of these categories consists of illusions that are the result of false sensations from mixture of the eyes and inner ears (oculo-gyral). An example is the "Graveyard Spin." This is in reality a sensation of reversal of motion. A rotary motion which is discontinued gives the sensation of rotation in the opposite direction. So, the pilot who does not have a good visual reference on a recovery from a spin to the left feels the false sensation of spinning in the opposite direction and attempts to correct this, causing the plane to go back into the original spin. Probably everyone has experienced this same sensation as a child. In childhood days when one would spin around very rapidly in an attempt to become dizzy, it was noticed that on cessation of the spin the world appeared to be moving in the opposite direction from the original spin.

Another example of illusions which stem from false sensations of the eyes and inner ears is known as the Coriolis reaction. A special type of angular acceleration which is important in aviation is that which occurs when an active movement of the head is made in a plane at right angles to a plane of passive rotation—the so-called Coriolis acceleration. This may take place, for example, during a spin if the pilot should meanwhile move his head up or down. If the head is moved (turned) downward during a left hand spin, the resultant sensation is of rotation to the left and downward, and the falling reaction is to the right and downward. When present, the Coriolis reaction usually produces marked vertigo and is especially dangerous in aviation for that reason.

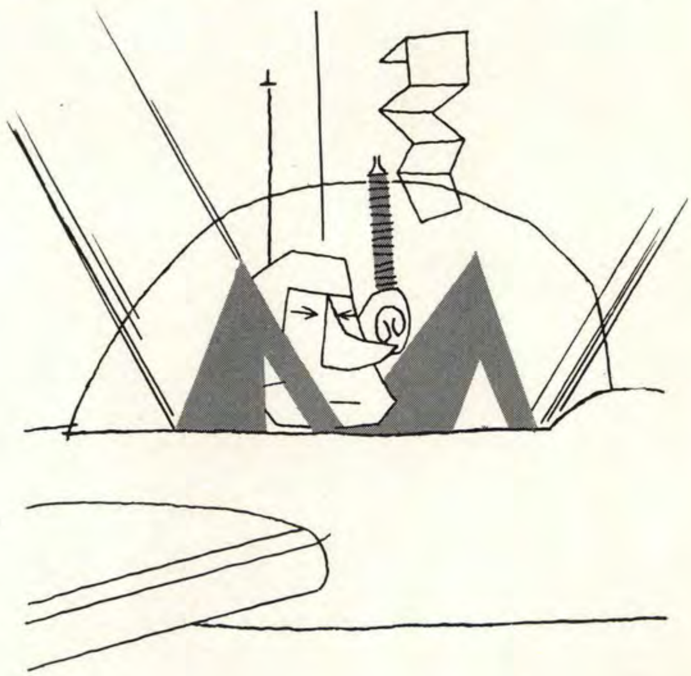
A third example is the sensation of turning during straight and level flight. The most disturbing effect in instrument flying is the sensation of turning which occurs even during horizontal flight or during the most perfect turn and may produce the illusion of rotation about all three axes. This illusion of rotation is particularly convincing in instrument flying because of the working together of the eyes with the organ of equilibrium in the ear, which is failing to give the corrective picture, thus leading to the impression of turning being not only felt, but seen. This is probably the most important contribution to the explanation of the astonishing and suddenly occurring cases of dizziness of pilots during instrument flying. Such illusions of turning arise especially on account of the numerous small disturbances of an aircraft about its three axes, particularly when the flight is made in bumpy air. All the accompanying sensations are worked upon by the inner ear to produce false and disturbing sensations of rotation. In part these rotations are sensed, and in part they do not come to consciousness. As the sensations of turning overlap each other and other sensations are added, a qualitative and quantitative estimate of movements is finally made which is quite false. Such illusions of rotation may also arise when the aircraft is in horizontal flight, as, for example, when, on account of airscrew torque, the aircraft deviates slowly and unnoticed from its course and is then pulled back again by small movements of the rudder.

The physiological cause for these illusions lies in the currents in the fluid of the semi-circular canals of the ear. The fluid, during the slow phase of turning, is carried with the movement of the canals themselves, but in the false phase (when the correction is made) the fluid lags behind the movement on account of its inertia. The sensory hairs are thus affected only by the movement in one direction and thus set up the sensation of a continuous rotation.

The second category of mixed illusions is based on false sensations as the result of stimulation (oculogravic). For example, in the absence of visual cues, G forces which are present in various maneuvers do not give adequate stimulus to differentiate the type of maneuver; consequently, the pilot may interpret the G forces of one maneuver as originating from an entirely different maneuver. Examples are:

- Sensation of Climbing While Banking: The resultant G forces of a coordinated turn may produce the sensation of climbing.

- Sensation of Diving While Recovering from a Turn: The reduction of G forces noticed on recovery from a



turn produce the same sensation as the reduction of G forces noticed in a dive and may be interpreted as such.

• Sensation of Diving Following Recovery from a Dive: In the pull-out from a dive, certain G forces are imposed on the body which are reduced following the pull-out. This reduction tends to give the same sensations as are experienced in a dive and consequently may be interpreted as originating from a dive.

• Sensation of Opposite Tilt During a Skid: In a perfect turn, when the ground or horizon cannot be seen, the angle of bank cannot be sensed because the resultant of gravity and centrifugal force must fall at right angles to the transverse axis.

In instrument flying, the deviation of the resultant, and with it, of the angle-of-bank indicator, may be sensed as an inclination of the aircraft to the side of the deviation. If in instrument flying the aircraft skids during a turn on account of not having been given adequate bank, then the resultant no longer falls at right angles to the transverse axis. Thus the sensation is that of tilt of the aircraft opposed to the true one.

Primarily, the pilot should be vitally interested in the attitude of his airplane and should devote considerable mental effort in keeping himself aware of it at all times. During contact flight the pilot relies upon visual clues for orientation. These cues are augmented to a limited extent by sensations arising from the control stick or wheel pressures. Even a short strip of horizon is sufficient to give him the position of the nose and his angle of bank. These control-pressure sensations should not be confused with his muscle sensations of lateral balance which serve as monitoring stimuli for inducing the appropriate rudder responses. Even under conditions of good visibility, the average pilot refers frequently to his flight instruments. The altimeter, airspeed indicator, the rate-of-climb indicator, and the turn-and-bank indicator, all provide information which can be interpreted in terms of attitude.

When outside visual references are eliminated because of darkness, fog, or other conditions, the pilot who has not been trained to fly by instruments attempts to interpret his muscle sensations and inner ear sensations of balance in terms of attitude, particularly in reference to the angle of bank. If he would take time out to consider the problem, he would realize that the only sensations which are different in a perfectly coordinated turn and in level flight lie in the increased G-load and that these sensations can give an erroneous impression of the true attitude.

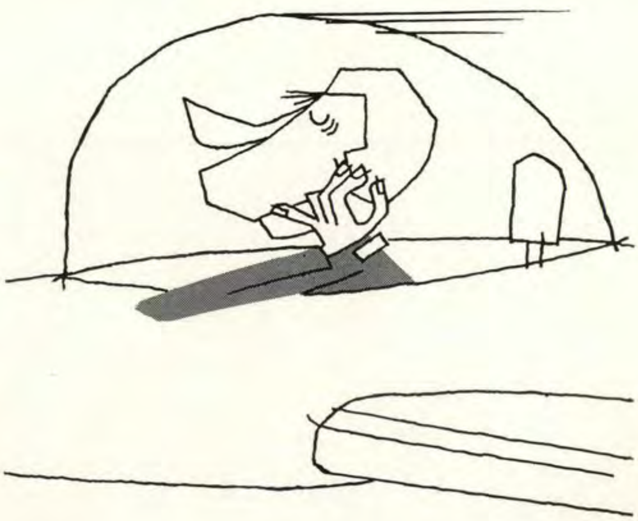
When flying on instruments using the primary group — needle, ball, and airspeed — the pilot interprets the deviation of the needle from center as angle of bank, the ball as the state of lateral balance, and airspeed indications as nose position in relation to the horizon. Of these three, only the information provided by the position of the ball is duplicated by his muscle sensation of balance which he uses ordinarily to detect the tendency to slip or skid. Thus, he gets his attitude information from two sources: angle of bank from the needle of the turn and bank indicator, and pitch angle from the airspeed indicator.

The most serious cases of sensory illusions can probably be traced to the difficulty that the average pilot encounters when attempting to transpose the rate of turn reading, as indicated by the displacement of his needle in the turn-and-bank indicator, into fixed values as expressed in terms of the angle of bank.

The addition of an artificial horizon to the primary flying group of instruments represents a large forward step in eliminating the basic cause of sensory illusions. All the pilot needs to do is to fly the miniature airplane in the instrument in reference to the horizontal bar. Even the student will quickly perceive that the miniature airplane responds to the flight controls in relation to the horizontal bar in the same manner as his airplane performs in relation to the real horizon. Most artificial horizons include an inclinometer, similar to the one in a turn-and-bank indicator, for good measure, but the information provided by the ball is also available to the pilot through his sense of balance.

It can be seen that most of the mixed or inner ear illusions can be traced to attempts by the pilot to read into his muscle sensations information which *cannot* be provided by them. A realization by the pilot that it is impossible for him to differentiate between turns and level flight or climbs and glides, will eliminate one of the main reasons for the sensory illusions. It should then be relatively simple for him to learn to interpret the reading of the needle and airspeed indicator in terms of attitude, or to master the simpler problem of deriving the same information from the horizontal bar of the artificial horizon.

It is known that many of the sensory illusions are so strong that it is difficult to cast away the illusion in favor of the information gained from the instruments. However, if the pilot is made aware of these illusions and the reasons for their occurrence, he will have a better inclination to believe his instruments at all times.



SAVE THAT ALTITUDE !

"MAYDAY, MAYDAY!"

"Kingston tower, this is AF256, Flameout four miles southeast of the field—can't reach runway—making emergency landing. Over."

The pilot who made this transmission was flying an F-86 on a local VFR flight. Cause of the flameout was fuel starvation.

The pilot had been airborne approximately one hour and ten minutes when he made the crash landing. He landed wheels-up in a pasture in the vicinity of the downwind leg, with empty main tanks and full drop tanks. He escaped uninjured from the landing; however, the aircraft received substantial damage.

Why did this occur?

Here are some of the facts:

- The pilot had a total of four hours and twenty minutes previous time in the F-86.
- This was his first flight with drop tanks on the aircraft.
- He was given a briefing and starting procedures were supervised; however, nothing was said about the drop tank operation during this briefing.
- The pilot forgot to turn on the drop tank pressure switch at 5,000 feet, according to a squadron SOP.
- He was re-entering traffic pattern early because he had noticed excessive fluctuation of the fuel gauge.
- He made a descent and entered on initial approach at *normal* altitude, 1500 feet.

The above facts tell the story, don't they? The question arises—why didn't the pilot plan for an emergency landing, knowing that the possibility existed?

This pilot did not inform the tower of any difficulty prior to the time of flameout. As a matter of fact, when he entered on his first initial approach, he made a 360-degree turn because of excessive traffic in the pattern in front of him. The flameout occurred on his *second* initial approach at 1500 feet.

If the pilot had declared an emergency when he first became aware of an impending emergency and preserved altitude until arrival over the field, he might have averted this accident by making a basic circular descent over the runway (see "Project Flameout," FLYING SAFETY magazine, August, 1951).

Many pilots, through poor planning, have lost altitude prematurely and crashed in the traffic pattern when the anticipated emergency actually occurred. Recent trends have been to disregard the basic rule of preserving altitude and to plan an emergency approach. Force of habit has caused pilots to initiate normal traffic pattern procedures, even when emergencies arise.

- Declare your anticipated emergency
- Alert proper personnel when facilities permit
- Have the pattern cleared of all traffic
- Plan direction of landing.

Plan your flight from the time of a non-bailout emergency so as to anticipate power failure.

Plane Boners

When Your Thinking Lags Behind—Accidents Happen

PILOT ERROR is always present in high percentage in any study of causes of Air Force accidents. Some are errors in judgment, some are attributable to poor pilot technique, some are compounded by other circumstances such as weather and materiel failure, others can be traced to broken regulations but many result from just plain lack of thinking and carelessness. Some of the accidents outlined below verge on ludicrous, others are tragic but all may be used as an example to prevent their repetition.

After making a thorough external check the pilot and copilot of a gooney bird climbed into the cockpit, leaving the crew chief to stand fireguard. After checking the hydraulic pressure, the pilot notified the crew chief that he could pull the pins and stand by for firing the right engine. Upon rechecking the cockpit the pilot noticed that the hydraulic pressure was considerably higher than normal (the crew had neglected to spread the gear and heat expansion had occurred) and decided to bleed the pressure down to a more acceptable figure. His method of reducing the pressure was decidedly unique. Very calmly he disengaged the safety latch, pulled it up and then raised the gear handle. His method worked insofar as lowering the pressure is concerned; unfortunately he also raised the gear. He stated that he noticed the left wing dropping and quickly put the gear back down and locked it but not before the wing had partially buckled and the landing gear and wheel well were substantially damaged.

This man was an experienced C-47 pilot and knew the correct procedure for relieving pressure on the lines. In his own words, "I considered the action to be taken to relieve the build up, which was to put the gear handle down and then return it to neutral, and then I carefully unlatched the gear and raised the gear handle to the up position, allowing the aircraft to settle to the ground." He knew what he wanted to do but was so occupied with other things that he automatically followed an entirely different procedure, *without thinking*.

Another outstanding example of not thinking, combined with carelessness, took place when an instructor and student made a forced landing in a B-25. The student was taking an instrument check and was homing in on the station when the instructor noticed a serious malfunction of the right engine. He ordered the student to feather and carefully followed him through in all phases of the procedure. The student was still flying the plane while the instructor tried to ascertain exactly what the trouble was. The IP noticed that the airspeed was fluctuating and that the aircraft was losing altitude rapidly. Taking over from the student he attempted to stabilize the airspeed and check the rate of descent but was unable to get sufficient power from the good engine. The entire single engine procedure was gone through several times completely but nothing they attempted seemed to add any power to the left engine. Finally, the instructor notified the field that he would be forced to make a crash landing several miles short of the base. A pattern was set up and the plane was put down in a plowed field, resulting in severe damage to the aircraft but without serious injury to the crew.

Examination of the B-25 after the crash showed that the left fuel shut-off valve was closed and the right shut-off valve was still open. The Accident Investigating Board determined that the student, while running through his single engine procedure had actually closed the wrong fuel shut-off valve and consequently the left engine was gradually losing power due to fuel starvation and had been wind-milling through most of the descent. Testimony of the student revealed that he was unsure as to which valve he had pulled and that the instructor had not checked carefully the possibility of fuel starvation of the good engine.

In an instance of fuel mismanagement a B-29 was totally demolished when it crashed and burned a few miles short of its destination. The accident occurred on

a maximum effort, long range navigation flight. The fuel consumption computations of the crew were in error by about two hours and were compounded by the crew chief's failure to utilize the fuel carried in the center wing tank.

The crew assumed the gages to be in error and figured they had enough fuel to make the last part of the flight and still return to their base. Actually, according to their own figures they would have had barely enough fuel to make the base and yet when all four engines quit due to lack of fuel the center tank still had 1100 gallons remaining. The crew chief failed to open the center tank shut off valve which allows the fuel to flow from the center tank; the crew in figuring fuel consumption attributed the apparent discrepancy between their computations and the gages to an error in the gages themselves.

Heavy damage to another C-47 took place as the direct result of improper procedure in using the landing gear latch.

In this case, after the gear had been dropped on the downwind leg the warning horn continued to blow after the throttles were pulled back although the green warning lights were on and the gear seemed to be fully extended. The gear safety latch would not go into positive lock position and the decision was made to land with it in the spring lock position.

After landing and ground checking the locks the crew chief was able to force the latch into the locked position. The aircraft was taxied to the runway and run up with the horn still blowing. During the run-up the right gear collapsed, allowing the right prop to excavate several king-sized divots from the hardtop. Result of this accident was a costly repair bill and extreme embarrassment for a crew that really knew better.

As a final horrendous example let's look at the case of the T-7 pilot, who with his passenger logged some unscheduled time in a chute. This fly-boy tried to stretch his range just a few miles beyond limits while flying at high RPM settings. He preferred to re-fuel at his destination rather than to schedule a fuel stop that would allow him to make the last leg of his trip without sweat.

His fuel consumption figures should have brought him to his destination with a half hour's reserve but while still many long country miles from that point he started to run dry on one tank after another. When the engines first coughed, he switched tanks and called in that he was proceeding to an alternate base close by but when the engines cut out again after a few minutes he realized he had delayed his decision too long. His departure from the plane was expedited by his knowledge that engines refuse to perform when running on fumes. The aircraft was damaged beyond economical repair.

Many other examples of heads up thinking could be mentioned when discussing pilot error accidents. Outstanding examples would be the two jockeys who taxied their respective T-6's head on into each other from opposite ends of a taxi strip, the B-26 driver who had to go around and forgot to drop his gear on the second approach, or the F-80 pilot who admired the surrounding scenery so much that he didn't notice he had landed on another plane till they had both crunched to a halt.

But all these examples together make just one pertinent point; that when in an airplane the man at the controls must think ahead and react to his thinking.

CROSS FEED

DEAD HEAD — I am enclosing a brief description of a freak incident which may be of interest to others. I have 3500 hours of flying time and have been an instructor pilot in C-47 aircraft for the past five years, but I have never had both spark plugs go out simultaneously in the master cylinder in any type of aircraft.

On 20 February, Captain Joe B. Patterson and I took off on a local training flight from Brize Norton, England, in a C-47. At the end of three hours we made one full-stop landing and were on the downwind for a second, when our right engine began to backfire at approximately three-second intervals. There was no appreciable loss of power and no excessive vibration. The backfire became less frequent on the base leg. However, the right cylinder head temperature began dropping rapidly, and the reading on final approach was 100° C. By the time we touched down, the backfiring had ceased entirely.

Subsequent investigation by the aircraft maintenance officer revealed that the number one cylinder was completely dead. Neither spark plug was operative. Whether both plugs became defective simultaneously, or whether one had been out prior to this flight could not be determined.

This incident is worthy of notice because it demonstrates the possibility of having a dead cylinder, with no more indication at the time than a few sputtering backfires which might easily be mistaken for carburetor ice. Had the dead head been any other but the one from which the cylinder head temperature was derived, there would have been no continuing indication of the malfunction.

—Maj. Verden McQueen
7503rd Air Support Wg
APO 147, c/o PM, N. Y.

MATHER SAFETY RECORD —This is being written, not to take anything away from Mather AFB or any of Mather's well qualified and energetic personnel (some of whom are friends of mine), but to try to find out the facts.

We, at Ellington AFB, are also proud of our accident record even though it is not without blemishes here and there. Our average flying time per year is approximately 90,000 hours, or about 7500 hours per month, and a great part of it is done in some of the worst weather imaginable.

The April copy of FLYING SAFETY infers that Mather had no accidents in 58 months, up to January. Personal knowledge, combined with printed matter published by FLYING SAFETY, indicates that five major accidents occurred during this time.

—Capt. Edward H. Risher
Box 923, Ellington AFB
Houston, Texas

We're caught! Our slip-up was made when we failed to verify statistics given to us by certain people at Mather.—Ed.

CAMEL BURGERS — I am enclosing an excerpt from an article in the Tripolitanian English newspaper, the *Sunday Ghibli.*

"One unusual accident between a low flying plane and two camels was recorded. The pilot and passengers in the plane were unhurt but the aircraft lost its under-carriage."

The incident referred to did not concern an American aircraft, but serves to further emphasize the fact that the accident potential is not limited by the circumstances of time, location, or any other factor, but can appear in an endless variety of ways. In this particular instance, the pilot thought that he was safe in doing a little buzzing because he was over an uninhabited and remote desert area. The falaciousness of his conclusion was only too obvious when the inevitable occurred.

We would like to compliment you on the "Jabber Jaw" article in the February 1952, issue. May we suggest that a similar article be included a minimum of once each six months? Repetition of the printed word might cause a little more understanding by the offenders themselves, and if your article can reduce the practice even by a small amount, a great service has been done to the flying profession.

—Maj. Charles A. Roberts
1261st Air Transport Sq
APO 231, c/o PM, N. Y.

Yes, but what happened to the camels?—Ed.

FUEL SAMPLES — I have just finished reading "Keep It Clean," in your April 1952 issue. Servicing of all our aircraft is done by the National Iranian Oil Co., at the airport in Teheran. In addition to all "normal" precautions, the local oil company manager has instituted the following system:

Before the hose is put into any tank on the aircraft, a pint jar is filled with the gasoline with which the plane is being serviced. The aircraft commander or aerial engineer is given the bottles after refueling is completed and must sign that he has inspected the fuel and it appears free of water and dirt. The bottles are then placed in a metal container much like a "coke" case, labeled with the date, the aircraft number, and placed in a storage place made especially for the containers, and kept for seven days. After seven days, the bottles are emptied, cleaned, and reused for other aircraft.

This system allows the aircraft commander to assure himself that the gas delivered was free of visual contamination and by checking the color that the proper grade was issued. If any malfunction of the engine develops on the next flight, a sample is available for analysis.

This seems to be a good system to follow, in addition to all other precautions taken. Admittedly it requires more work but I think it assures us of better fuel. Is it feasible to have such a procedure in the USAF?

—Col. Francis L. Grable
USAF Sec. U.S. Mil Mission
Teheran, Iran

The suggestion will be passed on to the powers that be.—Ed.

ANOTHER F-86 SAVED—The members of the 4th Fighter-Interceptor Wing would like to thank you for your article, "Mother of Invention," on page 28 of the March issue of FLYING SAFETY.

Your article undoubtedly saved us an F-86 a few days ago. The F-86 had taken off on a combat mission and the pilot noticed that his gear warning light stayed on. When he put the gear back down, he noticed that the nose wheel was cocked 90 degrees off. Crash facilities were alerted and the pilot made several touch and go landings in an effort to jar the gear around to its proper position. The pilot's fuel supply was getting to a critical point when two officers standing by happened to remember your article. Foam from two crash trucks was sprayed on the runway and the pilot came in for a perfect and uneventful landing.

Thanks again. At present the plane is back at its job of battling MIGS over North Korea.

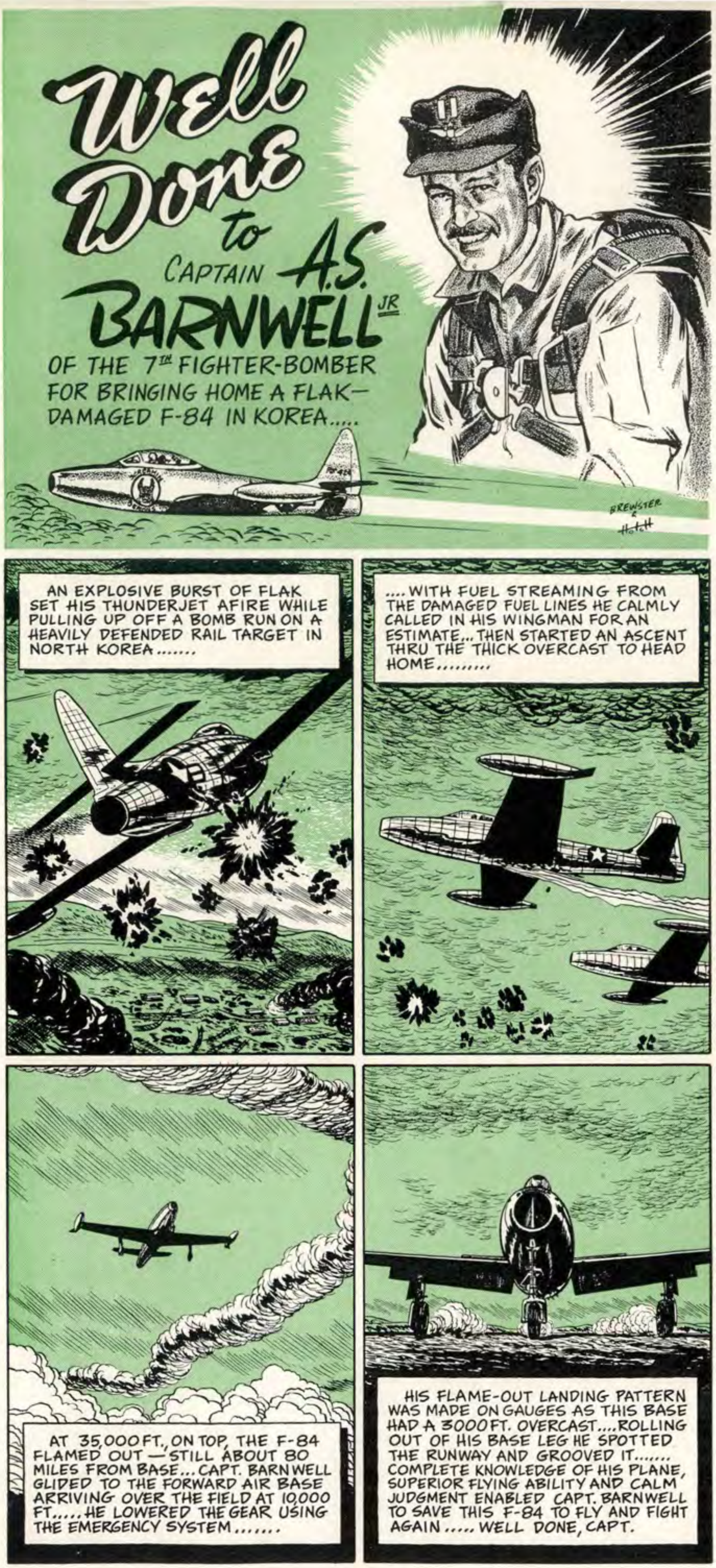
—Maj. Robert T. Alder
Flying Safety Officer
4th Fighter-Int. Wing

This makes a known total of three F-86's saved by this method, two of them prompted by the article, "Mother of Invention."—Ed.

EYE FOR BEAUTY—First and foremost you and your staff deserve plaudits for continually publishing one of the outstanding magazines of the aviation world. FLYING SAFETY has for many years now been publishing timely articles in a readable, easily remembered style. . . . Along with our enthusiasm for the written articles we are understandably interested in the picture on the inside of your back cover. Since the picture "Ten Tall Men" was shown over here, we have wanted to see more of Mari Blanchard. We would appreciate seeing as much of her as the law will allow.

—Maj. Clyde G. Miller
Spokesman for at least Ten Tall Men of the 67th Tac Recon Wing

Thanks from all the staff. The boys went all out to grace FLYING SAFETY *with an elegant picture of Miss Blanchard. She adorns the inside back cover this month very nicely—Ed.*



CONTRAILS

COLLISION WARNINGS — There's something new in research every day. Now they have developed a collision warning radar set which gives a pilot a constant picture of everything within two hundred miles of his plane, whether mountains, other aircraft, or thunderstorms. The radar unit weighs 250 pounds, installed, and is pressurized for operation at 50,000 feet altitude. Radar signals can be transmitted in a pencil-like beam for obstacle detection and general search, or in a vertical fan for mapping and navigation. A recent test of the equipment in a USAF C-97 flying at 17,000 feet altitude picked up the Azores at 195 miles, with excellent definition.

Only recently a Flight Safety survey of Air Force mid-air collisions during a 14-month period revealed that the cost of aircraft damage alone equalled the cost of two squadrons of F-86 jet fighters.

SALUTE TO AIRLIFT SAFETY — While C-46's flew overhead in formation, Brig. Gen. Chester E. McCarty, commander of the 315th Air Division, recently presented an award, the division Flying Safety Pennant, to the 437th Troop Carrier Wing for safety in the Korean airlift.

In commending the officers and airmen Gen. McCarty reviewed their record of nearly 1500 sorties in one month on the Korean airlift carrying a variety of high priority cargo for frontline troops as well as evacuation missions. "Your careful flying, excellent aircraft maintenance and high morale have all contributed to the extremely good record of only two minor flying accidents during the month . . . and in neither of these accidents was anyone injured," the general said.

NEWS FOR THE WEATHERMAN — A new "rawin" (radio wind) system designed to gather more accurate facts about wind direction and wind speed has been developed by the Signal Corps. The new system consists of a mobile automatic tracking radio direction finder and a new type radiosonde which, besides being a radio transmitter, carries a thermometer, hygrometer, barometer, and a device for measuring humidity. Other advanced features of the new set permit its use in areas 60 degrees below zero and in steaming tropics and arid deserts.

LOOKING BACKWARD

The CAA Technical Development and Evaluation Center at Indianapolis has come up with a transparent streamlined plastic bubble for light aircraft which includes a mirror. This is mounted in the cockpit canopy, above and ahead of the pilot.

Extensive flight tests have proved its effectiveness. Small aircraft can be seen at a quarter-mile rearward distance. In fact, practically all of the sky above and to the rear of the airplane can be scanned.

NO FUEL PROBLEMS!

"Say, Sarge, lemme have three ounces of U-235, and check the tires."

Air Force pilots in the future might be saying that, according to latest developments in the NEPA program. That's Nuclear Energy for the Propulsion of Aircraft .General Vandenberg, Air Force Chief of Staff, has stated that atomic flight is closer than most persons realize.

Atomic-powered airplanes, which, conceivably, might beat the clock—fly around the world at local midnight —and complete the circuit 80 times on one pound of fuel, are currently being developed.

Details are veiled by a "top secret" classification, but the NEPA program has now progressed well beyond the theoretical phase.

The far-reaching implications of an atomic airplane, besides its range and speed, are that it could stay aloft for many days; could fly at maximum speed at a given altitude for its entire mission. This is all predicated on the relatively low fuel supply which would be required.

MODERNIZED 36's

B-36 modernzation for the Air Force is being continued at Convair's Fort Worth, Texas Division, where production B-36's are coming off the assembly line. Arrival of the last B-36 will be paralleled by delivery to Fort Worth of that plant's first Air Force operational plane to be modernized. B-36 production and modernization will thus be carried on simultaneously at Fort Worth.

Mari Blanchard, Columbia Pictures

SITTING PRETTY!

You will be sitting pretty, too, if you—

- **Know your airplane and its limitations**
- **Know yourself and your limitations**
- **Know and abide by all flying safety rules**

A MEMBER OF THE TEAM

He's seldom seen and seldom praised, but he's always there — on the job for your safety.

LOOK SMART ★ THINK SMART ★ FLY SMART

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