FLYING SAFETY

UNITED STATES AIR FORCE

SEPTEMBER 1953

THE HONORABLE HAROLD E. TALBOTT
Secretary of the Air Force
"AIRPOWER"

DEPARTMENT OF THE AIR FORCE
WASHINGTON

OFFICE OF THE SECRETARY

MEMORANDUM FOR MAJOR GENERAL VICTOR E. BERTRANDIAS,
Deputy Inspector General, USAF

Your organization has made a realistic and aggressive approach to the problem of accident prevention. This work has resulted in greater safety for our men and has additionally saved money and equipment. These savings have in turn enhanced our overall management efficiency and economy of operation.

Please pass along my commendation and my sincere wishes for your continuing success to all who are participating with you in your essential work.

H. E. Talbott
Secretary of the Air Force

Mr. Talbott has long been associated with the aviation industry, having served as President of the Dayton-Wright Airplane Company, as Chairman of the Board of North American Aviation Company and as a Director of Chrysler Corporation. During World War II, he was director of aircraft production, War Production Board. Mr. Talbott served as a Major in the U. S. Signal Corps, Aviation Section, during World War I.

Memorandum For All USAF Flying Personnel:

The commendation of the Honorable Secretary of the Air Force, Mr. Harold E. Talbott, applies to each member of each command of the United States Air Force who has contributed to the basic concept of accident prevention. Your application of the accident prevention program throughout the Air Force has achieved greater safety while increasing the effectiveness of our combat operations and training and has reflected efficiency in our management and supervision.

Your efforts and those of the Directorate of Flight Safety Research with its continuing and aggressive accident prevention program have brought about a lowered accident rate in the Air Force, with savings of many millions of dollars and valuable personnel.

Victor E. Bertrandias
Deputy Inspector General, USAF.

Department of the Air Force
The Inspector General USAF
Major General Victor E. Bertrandias,
Deputy Inspector General

★ ★ ★

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FLYING SAFETY

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The Accident Board sometimes finds a few errors by the instructor. Turn to page 6.

"our growing

By Brig. Gen. Thomas L. Bryan, Comdr., 1800th AACS Wing, MATS Tinker AFB, Oklahoma

ONE of the responsibilities of the 1800th AACS Wing is to install and operate the military navigational aids and air traffic control systems for the Air Force within the continental limits of the United States.

These facilities include control towers, approach control, GCA and DF stations plus all the necessary ranges, beacons and various navigational aids needed to support the air traffic control system.

In addition, AACS is responsible for the support, in a communications sense, of all strategic and tactical missions of the Air Force. AACS fits into the national air traffic control picture for the military pilot in the same way that the Civil Aeronautics Administration and the commercial

Since the advent of jet aircraft, the air traffic control people have been faced with many new and complex problems.

jet traffic control problem . . ."

Weather, Emergencies and Equipment Failure Add to the Complexities of Any Air Movement Situation

airlines communications systems fit into the civilian aviation picture. In the continental United States, AACS is responsible for terminal control of military air traffic. Overseas, AACS acts as the control agency for en route and terminal air traffic, as well as performing the "company" communications missions.

Our air traffic control job has always been a difficult one because of the varied situations that develop within any air movement situation due to weather, emergencies and possible failure of ground and airborne equipment. With the advent of the jet airplane, the air traffic control people were faced with a new and even more complex problem. Conventional aircraft posed many control difficulties, not the least of which was the Berlin airlift. This situation was finally whipped by assuming complete control of all air movement factors. Pilots were told how to take off, when to take off, how fast to fly, what kind of approach to make and how to taxi at the end of the run. Because of the traffic, and the split-second timing vital to the success of the lift, many of the pilots' prerogatives were shifted to AACS.

With the present situation involving "mixed" traffic . . . jets, heavy transports, slow aircraft and large bombers interspersed, it may be that a modified "Berlin" system is the ultimate answer.

Stop and consider some of the differences in the characteristics of jet and conventional aircraft, some of which border on the fantastic, and all of which affect, in some way, the air traffic control problem. These differences include rate of climb, rate of descent, high cruising speeds and high altitudes. These factors are almost the exact opposite of those of conventional aircraft. Other factors are higher takeoff speeds and landing speeds, higher fuel consumption (for instance, in one type of jet, 100 gallons of fuel means five minutes' flying time at 1000 feet, but 35 minutes' flying time at 45,000 feet), weather conditions and alternate airports. Due to the critical problem of fuel load versus fuel consumption, sometimes two and even three alternates must be planned for jets.

Another important factor is the critical range of jet aircraft. Tactical personnel must plan missions that take a bare minimum of fuel reserve in order to realize full utilization of such aircraft in tactical missions. In some cases, an unplanned go around could mean trouble.

Straight-In Approach

In the opinion of AACS, the easiest method of letting down into an airport is the straight-in approach from altitude. This is especially true in the case of pilots flying "hot" airplanes under IFR conditions, where the minimum number of turns is required. In addition, this method is the most economical. Standardizing such an approach is difficult, but AACS is striving toward a simplified method, taking into consideration locations of navigational aids and airspace restrictions.

Not the least of the controller's problems in relation to a straight-in approach is that of approach over metropolitan areas such as New York. For example, how can a jet be cleared for a straight-in approach from 40,000 feet, 60 miles out from destination, if that airport should happen to be New York, Cleveland, San Francisco or Kansas City? How would the other traffic in the area be handled? What if contact with the jet should be lost, after he had been cleared down through the assigned altitude of practically every airplane in the area? This is why the progress is slow and tedious.

The big problem, and the most unsolvable, is that of sufficient airspace in the United States. If sufficient airspace were available, key navigational aids could be installed around a given airport at an adequate distance to allow jet aircraft to start descent from 40,000 feet, and let down straight into landing. Naturally, the expense of such a system would be prohibitive. The obvious answer to this problem would be the establishment of specific air corridors or areas for jet aircraft, and other areas for conventional aircraft. This method has been employed, but the system will not work in the area of terminal airports, where routes are at a premium.

Another problem that poses itself is the limitations of our present navigational facilities at high altitudes. Definite difficulties can be foreseen at altitudes above 40,000 feet. For example, what is the width of the cone of a low frequency range station at 40,000 feet and above? Would the pattern of a fan marker placed ten miles out from the range station "Z" marker interfere or overlap the "Z" marker pattern? Does the configuration of the range leg remain the same at high altitudes? How does VOR work at such altitudes? AACS has all these problems under careful evaluation at present. All possibilities are being exploited, and these possibilities may dictate a resurvey and relocation of many of our facilities.

There is no magic formula that will solve all of the difficulties in the field of air traffic control, but AACS is moving in the right direction.

The immediate steps toward solution of the problem are those of developing and establishing radar and radar systems to aid the controller in handling air traffic. Until all the new "gimmicks" are installed, the best method is the wise employment of the systems now in use.

AACS is in the process of establishing approximately 50 radar air traffic control centers in the United States. These centers are composed of terminal radar capable of high altitude coverage to approximately 20,000 feet with horizontal coverage of approximately 40 miles radius, and precision radar capable of handling two or more airplanes on the final approach simultaneously. Long range radar is being installed in some locations, capable of high altitude coverage, and a radial coverage up to 200 miles. All of this radar equipment is consolidated within a single room, allowing centralized control of the entire system.

AACS believes that radar is best used as the *primary* means of approach control. This belief is based on the need for simplifying the work of the jet pilot. This does not mean that radar itself is a complete system. Only by proper placement and utilization of all facilities in the area can an efficient system be accomplished. However, radar does simplify the entire picture.

With the proper radar system, a jet can be picked up 40 miles away at altitude, and brought to a landing without utilizing any other navigational aid. But there is a limit to the number of aircraft that one operator can control. Because of this, a combination of navigational aids is used, in order to provide the widest safety factor as a backup.

It is planned to use automatic ILAS and GCA in conjunction with our RATC centers to speed up approaches and reduce the work load on the precision radar operators.

ILAS has been found invaluable in the event of radar failure in that the pilot can divert his attention to working the ILAS, and continue his approach normally.

Radar is not infallible, but it's still the best instrument at hand.

One problem that besets radar control of jet aircraft is the small reflecting surface of the jet. Jets are difficult to see on the radar, and they travel at high speeds, making tracking difficult. One solution to this problem is an airborne responder that intensifies or increases the size of the blip. Care must be exercised in controlling aircraft equipped with a responder at long range and at great altitude, because the fact that the aircraft can be seen on the scope sometimes lends false security to the observer, in that other non-equipped aircraft are in the same area, but not on the scope.

Looking into the future, here is a rundown on some of the systems that are in the mill.

AGCA vs. ILAS

An old saying "differences of opinion make for horse races" has been around for a long while. Back around 5000 B.C., Ug, who had always dragged his wife along by the hair, disagreed with Pog, who favored dragging his wife by one foot. Both methods gained the same end, that of getting the missus to the point of termination, albeit slightly ground weary. During the middle years of aviation, many beers and much wind were expended in furthering or refuting the theory of control surface action in a vertical bank (if you are in a vertical bank, does the elevator act as a rudder, or vice versa?). Today, there is much hangar-yak centering around the comparative value of ground controlled approach (GCA) and instrument landing approach system (ILAS). Both are used by the Air Force. Note the term "approach." Neither of these systems is a blind landing system — yet. Blind landings, however, are the goal of both these systems, which are still in the process of development, and which still depend to a great extent on lighting design and runway length.

Automatic GCA and automatic ILAS are refinements of the respective systems. Both are aimed at completely automatic approaches and much progress has been made in each system. No doubt when both are perfected there will still exist the same old argument as to which system is best. I, for one, plan to wait and see, while urging the development and utilization of both systems.

Brig. Gen. Thomas L. Bryan

General Bryan ranks as one of the top electronics experts in the Air Force. A veteran of 24 years service, he has been engaged in communications work since 1942, when he commanded the Radar School at Boca Raton, Florida.

During the War, he was Communications Officer, 5th Air Force, and then became Chief of the Operations Section, Electronics Division, Headquarters, Wright Field, Ohio. He was a Technical Observer at both the Bikini and Eniwetok Atom Bomb tests from 1946 to 1948.

Prior to assuming command of the 1800th AACS Wing, General Bryan commanded the 10th Air Div. (Def.) in Alaska.

Pictorial Computer

The CAA Technical Development and Evaluation Center is presently working with a new computer which is capable of plotting an aircraft's track over a given map area. The equipment can be mounted on the instrument panel of the aircraft or, in the portable version, can be placed in the pilot's lap. The pictorial computer utilizes information from the distance measuring equipment and the omnirange receiver and continuously indicates on a chart the position of the aircraft with respect to the omnirange station. This type of equipment may well be one of the answers to the jet navigational problem when the equipment is perfected.

These new systems or aids will probably prove very useful in the future and are adapted to inclusion into our present systems. I believe completely automatic flying and automatic systems are not too far away; however, we can and should do everything possible to refine and modify our present systems to meet our more immediate needs until we do change to this automatic status.

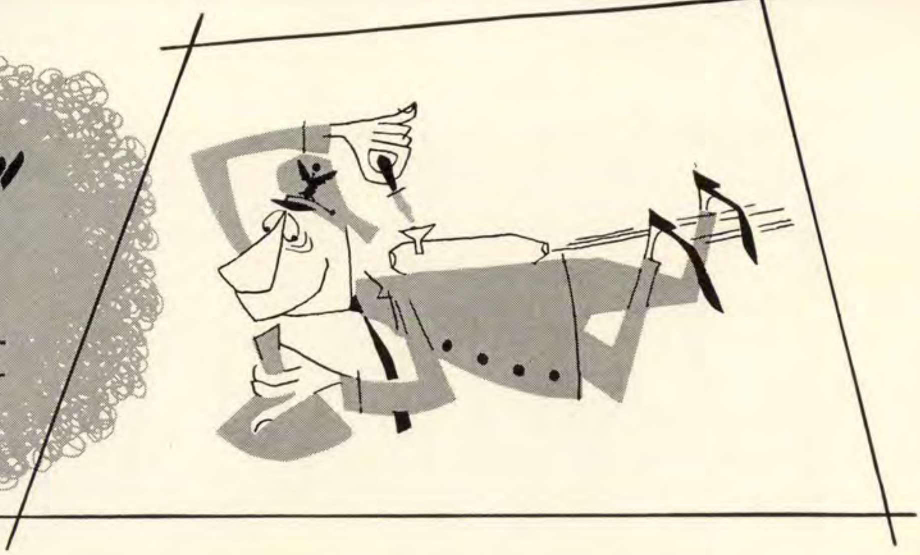
We in the Air Force are extremely distressed by the increasing numbers of mid-air collisions. Today's modern airplanes with all their knobs, handles, levers, gages, dials, hydraulic systems, electrical systems, etc., are masterpieces of ingenuity and genius. Their increasing speeds are virtually changing the meaning of space — space as the old pilots knew it 20 or 30 years ago. There was a time when the pilot had nothing to do but crank 'er up, point 'er into the wind, and he was airborne. He could take off, fly around for a spell and land in almost any cow pasture, never having to touch anything in the cockpit except the stick, rudder and throttle. He had a lot of free time to look around.

AACS is doing everything it possibly can to solve air traffic control problems. AACS works constantly with CAA and other agencies in attempting to devise streamlined, safe air traffic control procedures which will benefit all concerned.

Any ideas you may have on this subject will be welcome. We can progress in this field only if all agencies work together and pool their "know how" in this business whenever the opportunity arises. ●

"Home, James!"

All-Weather jet pilots of the 68th Fighter-Interceptor Squadron have found a new soup-cutter—



By 2nd Lt. Dick Myers, RO, 68th Ftr.-Intcp. Squadron, APO 929-2

LET'S QUOTE: "Air Navigation, by definition, is the art of determining the position of an aircraft at any time and directing the aircraft from one position to another."

This is the first sentence in the Introduction of Air Force Manual 51-43. The manual is titled "Air Navigation for Pilots." It is a standard reference work for almost all of the Air Force's rated officers. It goes on to outline the fine points of getting from "here" to "there," using all of the standard instruments and aids encountered in the AF's aircraft.

Air Defense pilots are extremely conscious of instrument techniques, and log a high percentage of time in the "night" or "weather" categories. Being IFR-minded, they know the importance of using all available facilities as cross-checks. Good "Flying Safety" dictates that the pilot utilize all his available information in "spotting" himself in the air.

In line with this doctrine, pilots of the 68th are depending more and more on a new source of information in addition to the commonly accepted radio aids. This "new" source is actually an old member of the Air Defense team, the Radar Observer. Strapped in the two-place fighter behind the pilot, the RO's specific duty is to search for the unidentified target on his radar screen, plot the track of the bogey, and swing the interceptor around into "collision course," using a rapid-fire series of commands to the pilot for speed changes and turns. Now, the RO's of the Lightning Lancer Squadron are not only lining up gunsights on bogeys, but pinpointing the positions of their own aircraft as well, utilizing the limited-function radar set.

Radar Check

When used for a navigation assist, this short-range radar is most often employed as a check on the normal Radio-Beacon facilities. This technique is made possible by the fact that most of the flights are over water, which shows up on the radar screen as an area of "no return." This blank area is broken up by distinctive shoreline patterns and numerous small islands, each possessing its own individual shape, and represented by a glowing "ground-return" indication. The result? A moving, electronic "map" of the immediate area, elongated and misshapen, but quite adequate for navigation if watched carefully.

One of the first tricks a new RO is taught by the "old hands" in the squadron is the identification of "Horseshoe Island," a tiny but unmistakeable half-moon of an island just off the coast. Another is "Pear Shape," farther out, and appropriately named. These little islands are picked up by the RO's in aircraft approaching at altitude, and plotted to verify the pilot's ADF approach to the letdown point. Should the radio compass show any skittish tendencies in heavy weather, the pilot can always ride in on a "null." But sighting the "point" on radar is foolproof. So all the pilot has to do is line up with the "pip" and come on in. Nice. It works every time.

Here's number 626, inbound in the soup after a routine armed-patrol mission up the Japan Sea. The GCI controller on the ground has steered the crew in, and obtained clearance for the ADF letdown. GCA is alerted and waiting, and 626 is approaching the high cone. Let's plug into the interphone. Over the high-pitched whine of the turbine, the breathing of the tandem crew sounds a steady "Sss . . . Sss . . . Sss. . . ."

Pilot: *"Got anything yet?"*

RO: *"Not yet. Wait a minute—Here comes Pear-Shape. I should read more, soon."*

Pilot: *"Roger. What ETA over the homer?"*

RO: *"About 20 more seconds. Now I have Horseshoe — it's sliding to the port side. Correct five degrees. Now three more, and we're lined up. Five seconds, now, Ready—Hack!"*

626 pops out speed brakes, and pitches into its steep descent outbound. More spot-checks on the scope. Looks OK. On the inbound leg, should the birddog cut out at any point, the aircraft can be jockeyed into position for a GCA by a few more words from the RO. The Observer in 626 is still merely monitoring the usual ADF, but in case of need for it, he has his own landmarked letdown, and can take over from the radio compass and direct the descent at any time.

The beauty of it is that in time of an actual air attack these men won't be hampered by loss of radio aids. The system not only provides a *positive* reference to the field, but a simultaneous search for other traffic that may be unknown to the Control in the area or hostile to our installations. Practice is accomplished on clear days for safety's sake, and the "Scope Dope Letdown" coincides nicely with the compass indications. After a dozen or so "dry runs," an RO has it pretty well grooved, and knows just how the letdown will look, day or night, VFR or IFR. It looks as though these boys will continue to use "all they've got" in weather. No confusion. No collisions. No sweat. ●

you

CAN'T EXCUSE the teacher!

If an IP fails in his responsibilities, he is planting the seeds for an accident.

Accident Board Findings:

"Primary cause of accident attributed to failure of the instructor pilot to maintain proper spacing in the pattern and to his failure to clear the aircraft properly on final."

Accident Board Findings:

"Primary cause of the accident is that instructor pilot misjudged distance and altitude, failed to check clearance on the glidepath, and planned his approach improperly."

Accident Board Findings:

"This accident was caused by the failure of the instructor pilot to keep a safe margin of airspeed on final, although warned that strong gust conditions prevailed on the runway."

Each of the above quotations are taken from a report of a major accident. They are conclusions reached by Aircraft Accident Investigating Boards concerning the causes of the three accidents.

Unfortunately, these are but a few of the many accidents which occurred during 1952 and the first quarter of 1953. Actually, there were 128 major and 102 minor accidents during this period in which instructor pilot error played a major role.

An instructor pilot has a special responsibility not shared by others. His job may be to teach all phases of flight maneuvers to unrated students. It may be to increase and maintain proficiency in currently rated pilots, in a specific aircraft.

In either case, a fundamental part

This T-6 was piled up because the IP let the student "go too long" without correction; cockpit confusion caused the C-45 accident.

of this teaching is to instill safe flying habits in his student, both by example and by instruction. If he fails in either respect, he is laying the foundation for an accident.

An instructor pilot must exercise good judgment in dealing with his student in many diverse ways. A student pilot picks up and retains his instructor's flying habits. If these are careless or dangerous, they will be magnified by the student's inexperience and lack of technique.

By riding the controls too heavily and by questioning the judgment of the student too frequently an instructor pilot can destroy the student's confidence. On the other hand, by allowing the student too much leeway, he may be inviting an accident. An IP's job is to maintain the proper balance between the two extremes.

When instructing a rated pilot, an IP faces a different problem. He knows his student has the basic knowledge and ability to fly the aircraft. However, his experience level can cover a wide range, and considerable instruction may be necessary for him to become proficient.

In cases where the student's experience in an aircraft type is limited, an IP must be careful not to take too much for granted. Too little supervision and instruction and too much leeway and carelessness can lead to extremes in trouble.

To illustrate what happens when an IP fails to do his job properly, take a look at some accidents involving IP error.

An aviation cadet flying a T-6, with an IP in the rear seat, hit a tree while on final approach, substantially damaging the aircraft. The IP admitted that he had allowed his student to make an excessively wide base leg and a long, low approach without correction.

The student got so low and slow that neither pilot was able to see a 40-foot tree some distance from the end of the runway, until right on top of it. The IP then jerked back on the controls and gave it full throttle, too late. The aircraft mushed into the tree, recovered and hit on the over-run.

Accident causes were listed as misjudged distance and altitude, failure to clear flight path for obstacles on low approach and improper planning by the instructor pilot.

A T-33 received major damage when an IP allowed his student to flare out too soon and too high in strong gust conditions. The student started flareout a considerable distance from the end of the runway but the instructor pilot made no correction. They were warned by mobile control that strong gust conditions prevailed and instructed to hold sufficient airspeed to compensate for the gusts. The aircraft hit 100 feet short of the runway and tore off the gear and buckled both wings.

This accident, brought about by an IP's late corrective action, resulted in the loss of an SA-16. Mission was a short field check-out.

Accident causes were listed as failure of the IP to hold a sufficient airspeed and failure to make corrections in time to compensate for the student's poor pattern.

A B-25 was washed out in a similar accident. In this case, the instructor pilot stated that he had taken over the controls on several previous landings when it became evident that the student was going to land short.

The IP stated, "I decided that I would let him go ahead on the next landing and, if necessary, I would talk him down." The B-25 was leveled off high, stalled and hit extremely hard on approach end of the over-run. The IP had advanced full throttle just as the plane hit but was many seconds late. The fuselage was buckled, one engine torn loose, gear damaged and the IP's windshield completely shattered.

Another accident caused by an IP's late corrective action resulted in the loss of an SA-16.

In this instance the student was being checked out in short field, JATO takeoffs. After rolling a short distance down the strip, the student pulled the amphibian off in an extremely nose-high attitude, at a low airspeed. As the nose came off, the tail skid contacted the runway and dragged for several hundred feet. After becoming airborne the pilot maintained the nose-high attitude until one wing partially stalled.

Attempting to get his wing up, the pilot retarded the power on one engine. Up to this time in the flight the IP had made no attempt to correct the student's obvious mistakes. Finally, seeing that the student was unable to get the wing up, he took over the controls, cut power completely on the engine and managed to level the wings momentarily.

As the instructor pilot reapplied power, the other wing dropped and dragged on the ground and they were off through the boondocks. The aircraft hit, sheared the gear, tore up a wing and damaged the hull. In spite of the deep marks where the tail dragged on the runway, the IP stated, "The takeoff looked normal to me, all the way. I couldn't believe it when the wing dropped."

High on the list of accident causes

attributable to instructor pilots is that of poor briefing and inadequate explanation of intended maneuvers. No student can be blamed for an accident that occurred because he wasn't told how to perform a maneuver or procedure. True, if the instructor's explanation isn't clear, he should ask questions. But often, if something is omitted, the student has no way of knowing that his briefing is incomplete.

A typical example of this is the IP who "forgot" to brief one of two students he was checking out in a C-45. Both students were scheduled for the flight and were to switch off in the left seat.

Somehow the instructor pilot neglected to inform his second student just who would be responsible for throttles and gear on a go-around. On the first landing the pilot touched down, skipped and ballooned up about five feet. He then applied partial power to ease back down to the runway, but the IP, assuming the student was going around, had started to retract the gear.

As the aircraft settled, the IP poured on the coal in a futile attempt to stay airborne but both props hit the runway and the plane bellied in.

The student stated that he was under the impression that the IP would handle the power for a go-around. He said that after recovering from the bounce he had cut the power, intending to make a normal landing. Board findings were that the instructor pilot had failed to brief the student adequately and the resultant cockpit confusion was responsible for the accident.

Overestimating a student's ability, combined with carelessness, caused one IP to eject from his tail-less F-84. Fortunately, the student was able to get his badly damaged plane home.

The student was being checked out on his first acrobatics ride in an F-84. He had limited jet experience, with very little time in an F-84. After running through a series of confidence maneuvers the student was instructed to do a loop.

The instructor pilot in the chase plane moved in close as the student pulled up into the beginning of the maneuver. At the top, the IP noted that his airspeed had fallen off very low and instructed his student to tighten up the loop. At this time he lost sight of the student but continued on around although he knew he was in danger of over-running the lead ship. As they came through the horizon the chase plane's tail was sheared and the plane went out of control in an inverted spin.

The accident board decided that the accident could have been avoided if the IP had been more aware of his student's limited experience and had kept his aircraft in sight by remaining farther out and away.

Another accident in which the IP over-estimated his student's ability ended with a severely damaged B-47.

The student had trouble maintaining proper approach speed and used poor technique on his roundout. He then overcontrolled and made abrupt, rough movements attempting to get the aircraft in a landing attitude. The IP made no correction and did not take over the controls until after the plane stalled in, short of the over-run. After initial impact the plane bounced up to the runway and the IP was able to recover.

During the investigation, the IP commented, "His progress had been satisfactory and I thought he was doing okay on this landing. When I realized that we were going to hit short, it was too late."

Perhaps the best example of what can happen when an IP neglects his duties is that of a recent T-33 crash.

After entering the pattern the student flew erratically on his downwind and base legs. The instructor followed him through on the controls, while giving instruction over the interphone. Testimony during the accident investigation revealed that the student was not briefed properly on cockpit procedures, had failed to use a landing checklist and didn't know the base SOP for a landing check.

Under these conditions, trouble was inevitable. The student moved the gear handle toward the down position but not far enough to activate the system. The situation now became critical as the IP neglected to cut the throttle for a horn check and didn't bother to look at the gear warning lights for a safe indication.

Instead, he switched to VHF and called in gear down and locked as he turned on final. Mobile control made several calls to warn the pilot that his gear was up. They finally shot a flare to send the plane around. Despite the warnings the aircraft came on in and made a very smooth landing—on the belly.

Another major accident cause is the failure of many IP's to look around and keep themselves cleared at all times. This hazard is especially true in the traffic pattern and on instrument training flights. In this type of accident, the IP's failure to look around often ends in a collision with another aircraft, frequently with fatal results.

Two such accidents this year caused the loss of three T-33's and one F-80, with three fatalities.

In one, involving two T-33's, an IP entered the pattern behind a three-ship formation. The number three man lagged behind his flight and the IP cut inside of him on the base leg. Both rolled out on final at approximately the same time, with the solo student slightly lower and ahead of the dual airplane.

Mobile control warned both planes that they were closing rapidly and finally sent the number three man around. As he pulled up on the go-around, his aircraft collided with the dual plane, who had continued his approach, and both crashed and were totally destroyed.

Witnesses to the crash testified that at no time did the dual airplane deviate from its course and that it was obvious that the IP did not have the other aircraft in sight, in spite of the warnings from the mobile control.

In the other accident, a T-33 and an F-80 were demolished when the T-33 landed on top of other aircraft.

As the two planes turned on final, the T-33, who was number two in the pattern, started to overtake the F-80. Both planes were sent around but the student in the F-80 reported he was low in fuel and would have to land. The IP in the number two plane did not acknowledge the transmission and continued on final. Just as the F-80 touched down, the second aircraft landed on top of him and the two interlocked airplanes careened down the runway. Amazingly enough, no one was injured but both aircraft were a total loss.

Every kind of aircraft from jet bombers to liaison planes and helicopters figured in accidents involving instructor pilot error in the 15-months period surveyed. In almost every instance the accident could have been averted entirely if the instructor pilot concerned had performed his duty properly. Be sure that you, as an IP, don't end up as a statistic through neglect and carelessness. ●

"I'll come where you're to—"

By Major James T. Butts, Base Air Operations Officer, Ernest Harmon AFB, NEAC.

UP IN THE NORTH COUNTRY, the "Newfies" have a provincialism, used in advising those who are lost, to wit, "Stay where you're at, and I'll come where you're to." Pilots departing Harmon AFB, after using the "easy-dial" NOTAM system in use there, can say: "I'll come where you're to, safely, that is!"

Every pilot is familiar with the hassle involved in checking NOTAMS at many bases. In too many instances, the NOTAM file is placed on top of the dispatch desk, and that intelligent soul who is eager to learn all about route information is forced to climb over a gaggle of pilots filing clearances, two line-taxi drivers, and eight sailors looking for a ride to Canarsie or Cucamonga.

Assuming he can finally get in position to pull open a few NOTAM drawers, the Searcher for the Truth must then interpret the "cable-ese" of the TWX's therein. This operation, in itself, is no child's play. Assuming, of course, that the NOTAM file has been kept up to date.

This problem has been licked at Harmon by the manufacture of a revolving NOTAM Route Board which looks very much like a large wall-sized computer. The board is the brainchild of Captain Robert W. Givens, Route Briefing Officer, and Airmen C. S. Dodge, L. R. Cundall, and D. J. Anderson, radio operators in the briefing section.

The circular board provides quick, efficient and practical briefing of routes and facilities and insures knowledge of usable airfields along the various proposed routes out of Harmon AFB.

This 'Wheel of Fortune' board provides a briefing of routes, airfield facilities.

The circular board is the outcome of the realization that too few pilots were showing interest in late NOTAMS. Those who *were* interested placed an extra load on dispatch and briefing personnel who were charged with giving pilots all available information. This had to be done verbally, and when operations was busy, some confusion resulted.

The briefing section went to work on designing some sort of visual presentation that would be easy to operate, and that would present complete information. After considering numerous gadgets such as a Colt '45', a curvaceous blonde, or a Newfoundland lobster nibbling on a pilot's ear, the section finally came up with the idea of this rotary information board.

It was discovered that it would be very easy to design a NOTAM wheel in the form of a ship's steering wheel, and arrange it so information at destination and along proposed routes always appeared at the top of the wheel, in a small window for easy reading. In another window all necessary information is shown on available alternates.

The rotating board was manufactured locally, and the NOTAMS are typed on a four by eight inch card, inserted behind the windows. Cards can be replaced or corrected very easily. In front of the revolving wheel is a stationary wheel that serves as a cover, and identifies the board.

In addition to this NOTAM board, a memorandum NOTAM summary is given to all pilots for information while in flight.

Since the board was completed, all pilots have shown great interest in NOTAMS . . . and can say, without fear of contradiction, "Stay where you're at, and I'll come where you're to . . . SAFELY!" ●

Finding Facility Facts

By Lt. Col. Robert L. Van Ausdall,

Senior Air Inst., 104th ANG Ftr. Sq.,

Harbor Field, Maryland

THE author, a senior pilot with 3500 flying hours, has been flying fighters most of his Air Force career. During IFR flights in F-51 aircraft he always had trouble with "paper work" in the cockpit. Maps, letdown books, E-6-B computers and Radio Facility Charts always seemed to be cluttering up the few inches of space left in the cockpit, so he decided to analyze and study his available aids with a view to saving time in locating the information he needed. This article is an outcome of his study of the US edition of the Radio Facility Charts and it is presented with the hope that not only other fighter pilots but all users will learn some new facts that will save them valuable time and help promote safety through more intelligent use of the charts.

★ ★ ★ ★

BEFORE you put this down and say to yourself, "I've used Radio Facility Charts for years, why should I read anything about it?", answer these "True-False" questions:

1. Approximate reception distance of each radio range can be estimated quickly in the Radio Facility Charts by looking at the end of the range leg.
2. A radio range which is shown with an extended leg can be received farther away on that leg.
3. All mileage in the charts is statute, mainly because ATC does not accept nautical miles for IFR flight plan information.
4. An airport symbol which is outlined with a square box means that station possesses either UHF/DF or VHF/DF.
5. All bearings on radio range legs are true bearings.
6. When the frequency of a radio facility is underlined on any of the pages of the Radio Facility Charts, that facility is without voice.

You should get all these answers right, but check for correctness at the end of this story.

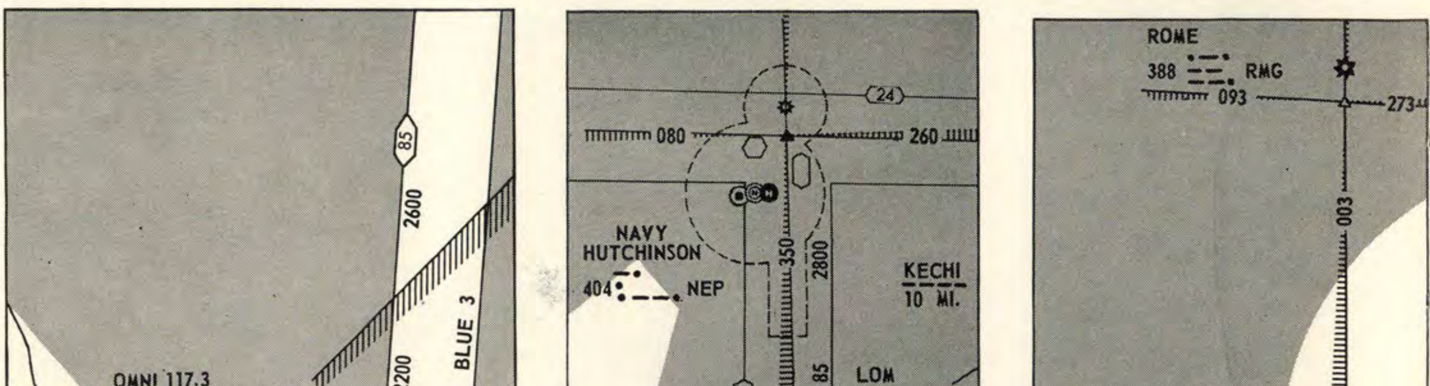
The above questions refer to only six of the hundreds of aids offered by the Radio Facility Charts. If you missed one of these or even had to guess on one, better read the article. It will only take you 16 minutes. All of these aids when understood and quickly recognized can save much time and trouble and will consequently promote flying safety.

It's in the Book

Let me give you an example. Last month during an instrument check, the pilot I was checking made five calls to "Dover (Delaware) Radio" trying to give a position report. In addition to all the written information opposite Dover showing that its range has no Air/Ground Voice, the frequency is underlined on the page next to Dover's range and call sign. (The page which he had spread open

Extended range leg can denote change in minimum en route altitude (A) or reporting point intersection (B) or both (C).

(A) (B) (C)



on his lap.) A quick glance at any range frequency in the book will reveal the same information.

If the range frequency is not underlined, it has voice. If it is underlined, it does not have voice.

Examples of the three different ranges can be seen on the Los Angeles blow-up page (103B in the current edition) of the Radio Facility Charts. Los Angeles Range is strong. Its range ends *point out*. It can be received farther away.

Burbank Range has the indented end. It is very weak. About 25 miles.

Riverside is an example of the in-between or 50-mile reception range. Its end is cut off diagonally.

If you can remember that the pointed-out range can be received farther away and the indented range, only when in close, the remaining one has to be medium strength. This will be very helpful to you if you are one of the group who has never before paid any attention to the legend page of the Radio Facility Charts.

Radio Range legs have their magnetic headings printed within their confines. Don't mess around trying to add or subtract variation. It's done for you in the magnetic heading.

Mileage in the Radio Facility Charts is *not* statute. All mileage is nautical. Also, all facilities listed in the book operate 24 hours per day unless stated differently in the "Remarks" column.

An extended range leg may mean one of two things or both but certainly *not* that the reception is better in that direction. It can denote a change in minimum en route instrument altitude (Fig. A) or reporting point intersection (Fig. B) or both (Fig. C).

Whatever the type of airport, UHF/DF or VHF/DF is available if the Radio Facility Charts show that airport's symbol with a square box around it.

The "Remarks" column will show which Air Force bases have pilot-to-forecaster service available as well as the hours and frequency for contact. This is for use in urgent necessities or emergencies only, but certainly it is wise to know where to find the information.

The USAF has available for use seven different Radio Facility Charts issued by various USAF Aeronautical Chart and Information Offices. The one referred to in this article is the U.S. Low and Medium Frequency Edition. All editions are identified by color which is usually as follows:

White book with black lettering—U.S. Low & Medium Frequency Edition
White book with blue lettering—U.S. VOR Edition
Yellow book—Pacific Edition
Red book—N. Atlantic and E. Canada Edition
Gray book — W. Canada & Alaska Edition
Blue book—Caribbean & S. America Edition
Green book—Europe Edition

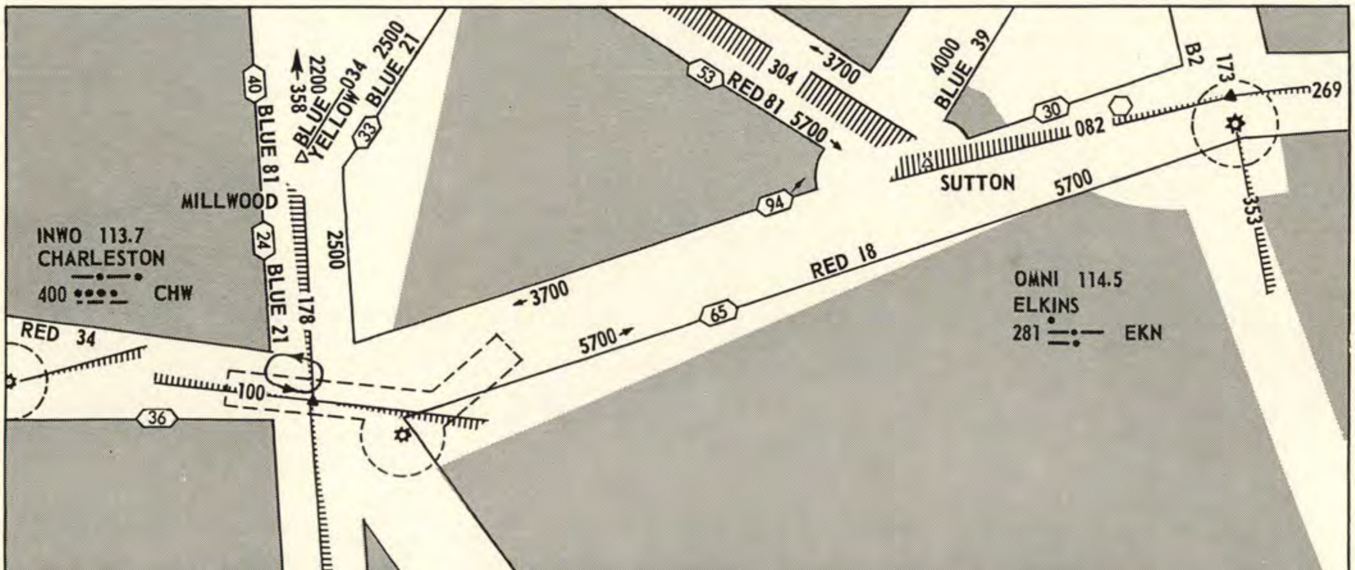
Other portions of the world, such as Africa, the Middle East, etc., are covered by the Royal Air Force and the Royal Australian Air Force in Radio Facility Charts utilized by the USAF.

Although a standardized presentation is anticipated in the near future between NATO countries and our own, there will always be some minor discrepancies in the way information is presented. Whatever edition you now utilize, study it prior to the day you're in the soup.

The U.S. Edition is printed every two weeks. It is most important for station commanders to inspect the entries covering facilities under their control in *each* edition to verify the correctness of the listings. However, should the commander or his representative miss an error, any person noting the error should report it for correction. The correct procedure for reporting errors is shown in paragraph 5b, page 1 of the U.S. edition. I recently called a USAF tower for a practice DF steer. They advised me that their DF equipment had been removed six months previously. After I told them that the current U.S. Radio Facility Charts showed their station to possess VHF/DF, they admitted ignorance of the fact but assured me a correction would be made immediately. Out of date information

If an aircraft is not equipped to receive all navigational aids, the rule is to fly highest given minimum en route altitude.

(D)



in the charts could result in serious accidents. It is everyone's duty to keep the information current.

Did you ever wonder why some civil airways carry two listed minimum en route altitudes for the same segment, such as Figure D?

Minimum altitudes are based on all radio navigational aids including radio ranges, radio beacons, VHF omni ranges, VHF VAR ranges and fan markers. In cases where an aircraft is not equipped to receive *all* navigational aids, the aircraft is required to fly at the highest given minimum en route altitude. In such cases two minimum altitudes are shown for an airway segment and the altitude applicable will be shown on the right hand side of the airway for the direction of the flight concerned.

What altitude should you request for an IFR flight?

Remember, that as a general rule, on green and red airways, eastbound flights should be conducted at *ODD* thousand foot levels, westbound at *EVEN* thousand foot levels, and on amber and blue airways, northbound flights should be conducted at *ODD* thousand foot levels, southbound at *EVEN* thousand foot levels. Outside control airways and control zones with visibility less than three miles, aircraft must be flown on the quadrantal Course System. (Magnetic.)

0 to 89 inclusive—odd thousand.

90 to 179 inclusive—odd thousands plus 500.

180 to 269 inclusive—even thousands.

270 to 359 inclusive—even thousands plus 500.

Have you ever tried to receive a radio range which should be on a certain frequency only to find another on that frequency? If you don't recognize the identification, turn to the page in your Facilities Book listing "Range Station and H Facility Index by Identification." You can find all ranges listed here by their identification and by so doing you will probably learn that your radio dial is slightly off frequency. More important, if you are lost and can get only one or two strong ranges, use this quick system to identify which station you are receiving.

SBMRAZ, BVOR. Would this apparent "gobbledegook" listed under "Class Power" of a Radio Facility throw you? Reference to the Radio Class Code Legend on page 4 of the book deciphers this as follows:

Low Frequency Range

S—Simultaneous transmission of range signals and voice.

B—Scheduled Weather Broadcast.

MRA—Range (Adcock, vertical radiators), power 50 to 150 watts.

Z—VHF station location marker.

VOR

B—Scheduled Weather Broadcast.

VOR—VHF omnidirectional range.

Your book contains other important information. You can find:

• The effective distance for VHF Radio Facilities depending on your altitude.

• The voice calls to each facility.

• The scheduled weather broadcast times for CAA, USAF, Navy and Canadian stations.

• VHF and UHF channelization and which service is normally set up for each channel.

Every page contains the elevation of each station and facility on that page, its call or identification, the class and power of the station, the magnetic bearing and distance from facility to field, the frequencies that are received and those which are used for transmissions, who operates the facility and all remarks which could possibly help the pilot. Among the types of remarks are such things as where to expect unreliable or "bent" range legs, interference, multiples, splits and fading of ranges and when facility will be closed down for maintenance. Whenever such information is changed between issues of the Facility Charts, NOTAMS are used to supplement this "Remarks" column.

Each and every map page in the book has two scales: one for nautical and one for statute miles. Each map page also has a note at the bottom advising where the ADIZ procedures and areas are to be found in the book. It is to be noted that the pages are not all of the same scale. Most blowup pages cover an area of about 65 to 95 nautical miles. The majority of the pages cover 125 by 140 nautical miles, while some few pages of areas where there is little information to be presented have areas of approximately 250 by 375 nautical miles.

The center page of the book contains a map of the United States with mileages between larger cities on airways. Flight Service Center locations and their telephone numbers, as well as Flight Service Area boundaries, are presented here, too.

In the rear of each book are pages listing current Airspace Restricted Areas, their number, name and state, effective altitude, time used, using agency and the pages of the facility charts where these areas can be found. "D" numbers represent Danger Areas, and "W," Warning Areas. Flights are prohibited over these areas while they are in use. "P" areas are Air Space Reservations and flight is prohibited at all altitudes and at all times.

In addition to the DF box around each airport symbol as mentioned earlier, all the DF stations in the United States are listed alphabetically in each book, usually somewhere near pages 150-152.

Radar Air Traffic Control Facilities and Procedures (including GCA) of both Air Force and Navy are likewise listed alphabetically on a series of pages following the DF page. With these pages is a definition of GCA. Air Surveillance Radar (ASR) and Precision Approach Radar (PAR). Weather minimums, GCA runways and hours of operation for each Radar Facility are listed here.

A most important part of the Radio Facility Charts in planning flights prior to submitting flight plans is the information starting at approximately page 165, entitled "Directory of Aerodromes." It is here that reference should be made to determine the type of field, the length of its longest runway and whether or not it is hard top. It lists also the type of fuel (if any) which is available, the night lighting, and the very important remarks column, giving latest information on oxygen, maintenance, jet assist starting units, whether or not official orders are required or whether the base is a foreign clearing station, etc. This section, plus NOTAMS, plus weather decides your destination prior to any flight.

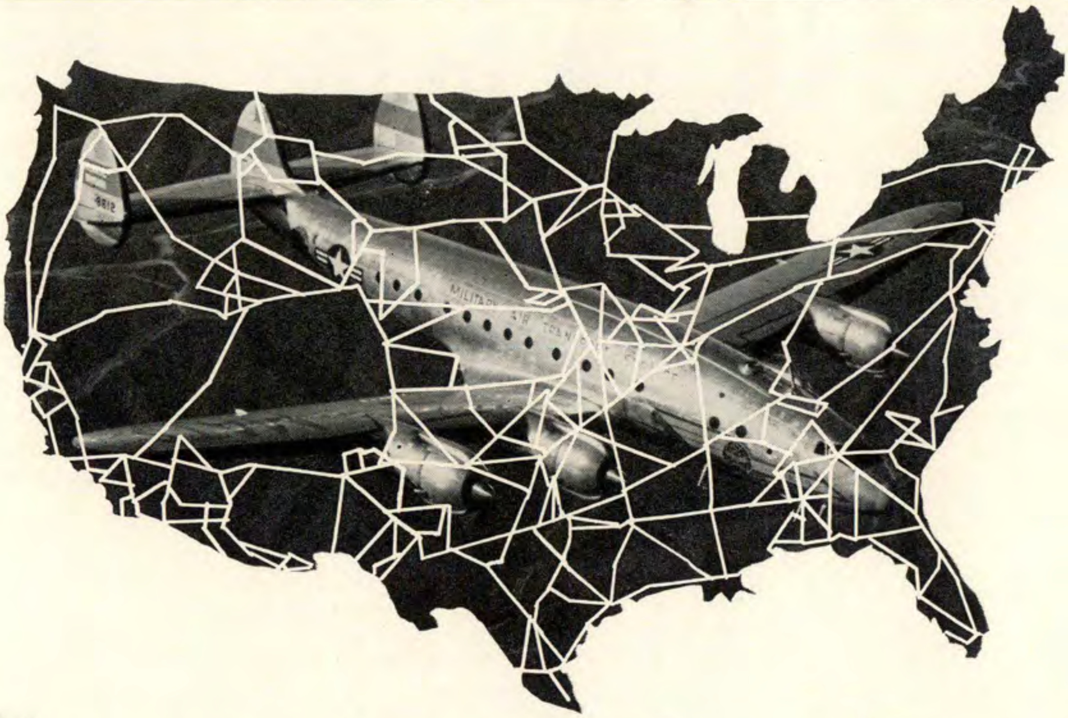
A section headed "Special Notices" near the very end of the U.S. Radio Facility Charts includes:

• Requirements for clearance to and from the Washington, D.C., area.

• Emergency Radar Interceptor Procedures.

• Minimum and en route altitudes.

• Conversion from statute miles to nautical miles.



The following from the legend page of the Radio Facility Charts should also be known by all users:

P/333 **Designates prohibited areas.**

D/333 **Designates danger areas.**

W/333 **Designates warning areas.**

Designates ADIX zones.

(A) **An Air Force Field.**

(H) **Non-directional homing beacon.**

133 **Indicates nautical mileage on civil airways between all reporting points and/or LF/VAR radio ranges and homing beacons.**

8000 **Minimum en route altitudes are shown within civil airways.**

Range legs are reproduced in the book in three ways:

1. **RA and RL Ranges: Reception approximately 100 miles.**
2. **MRA and MRL Ranges: Reception approximately 50 miles.**
3. **ML Ranges: Reception approximately 25 miles.**

Note the difference in their ends. This tells you something, or it should. And if it hasn't told you anything in the past, I hope it will in the future. Number 1 identifies RA and RL Ranges. The end points out. This should henceforth indicate to you that this range has better reception than the other two (in fact, approximately 100 miles).

Number 2 identifies MRA and MRL Ranges. It has a plain cut-off end and it has an *average* reception of 50 miles.

Number 3 identifies ML Ranges. Its reception is quite *weak*. Usually about 25 miles.

• Procedure for entering the New York Area.

• Fuel servicing for Naval and Army Installations.

• Restrictions in the use of AF fields and facilities.

This page ought to be studied by each pilot with the arrival of each new Facility Chart for changes and new notices.

Designated mountainous areas and Air Defense Identification Zones are presented in map form with coordinates and ADIZ names.

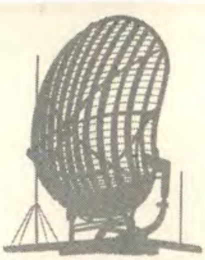
The back cover lists one of your most important in-flight sections of the book. The types of flight plans, how to change them in flight, position report procedures, emergency procedures and ADIZ procedures and allowable tolerances.

The outside back cover not only shows a map of where each area may be found, but also contains time zone boundaries and variation lines.

We have gone from front to back, in the Facility Charts. A few readers may have known all of this information but most of you probably learned a few facts. If you are in this category, stop by operations and pick up a copy of the latest Radio Facility Charts. Leaf through it and find examples of the items that are new to you since reading this. And then, above all, use your knowledge on the next flight and try to help promote safety through a better, more efficient use of your Radio Facility Charts. ●

Answers to "True" and "False" questions on page 10.

1. True	**4. True**
2. False	**5. False**
3. False	**6. True**



GCA in big "K"

By Major Geoffrey Cheadle, 1993 AACS Mobile Comm. Sq.

THE writers of AFM 51-38, "The Theory of Instrument Flying," hit the nail on the head when they said, "The application of radar devices to the fields of instrument flight and air traffic control is apparently without foreseeable limit."

Over here in Korea the use of GCI and GCA radar has more than substantiated the above statement, while in Japan the Tokyo Radar Air Traffic Control Center has done the same. This has reversed the usual situation in which pilots are inclined to over-estimate the service inherent in a navigational aid. Now they are tending to be unaware of the *capabilities* of radar in air traffic control.

As an example, the following typical incident happened recently at one of our forward air bases.

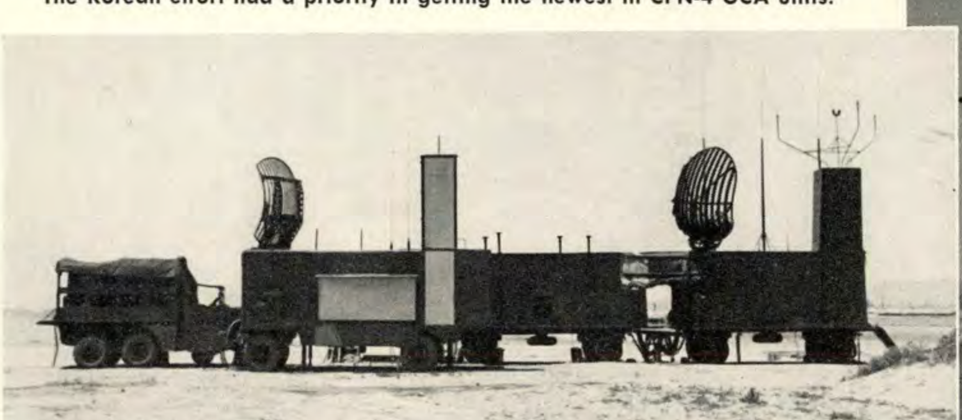
A B-29 was coming back south from a mission and was reporting low on fuel. He was being vectored under instrument conditions by a GCI radar station toward the nearest suitable base. At an altitude of 12,000 feet, approximately 25 miles out, the aircraft was picked up on the air base GCA scopes. GCA informed the pilot that they had him in good radar contact and would bring him on in if GCI would release him. The pilot refused, saying that GCA could not possibly have him on their scopes at that range and altitude, so he would continue on in under GCI control to a lower altitude at shorter range. Finally, a GCA approach and landing was made without incident. No danger was involved—this time. However, the GCI station was tied up controlling the B-29 when it was not really necessary, and should an emergency have occurred at lower altitude, the transfer of control between GCI and GCA might have occurred at a very undesirable time.

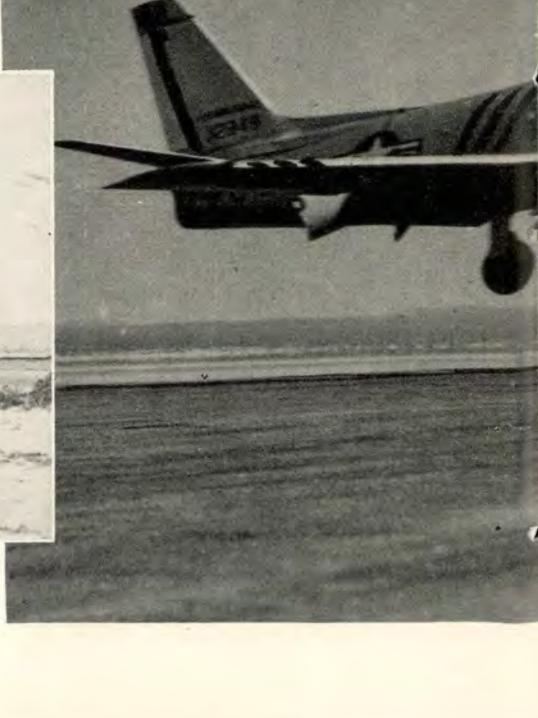
There are doubtless numerous pilots who would have had the same mental reservations about GCA as this B-29 pilot. After all, the current written instrument examination still sticks to the 25-mile and 6,000-feet limitations on GCA. The answer is that newer types of radar have been developed and are being used wherever available. The new GCA unit is the AN/CPN-4. The older unit still giving good service at most Air Force bases is the AN/MPN-1. The CPN-4 was developed to overcome certain limitations of the MPN-1, while at the same time realizing extra capabilities inherent in radar air traffic control. The big brothers of the CPN-4 are the AN/FPN-16, the AN/CPN-18 and others. These are units designed for radar air traffic control of a large area, such as the entire Washington, D. C., or Tokyo airport. A technical description of these systems for pilot use is more subject matter for the Instrument Flying Manuals (Hint!). Here, let's point out the extra service which can be given by the CPN-4 GCA unit.

The Korean effort has had a priority in getting CPN-4's. Consequently, three forward air bases here have them. At these bases they have been used to control all types of traffic, whether administrative or tactical, conventional or jet. It might be mentioned that having CPN-4's in Korea has highlighted the supply and maintenance problems which come up in keeping such an intricate and sensitive instrument operational in a combat theater. On the other hand, Korea has been an ideal proving ground for this new equipment. Nowhere else is the variety so great or are the emergencies so numerous.

We have used GCA in controlling air traffic at altitudes up to 35,000 feet and at distances up to 40 miles.

The Korean effort had a priority in getting the newest in CPN-4 GCA units.





[*These extreme altitudes can be obtained by proper use of antenna tilt; however, when high altitude coverage is used, some loss in coverage at very low altitudes may be experienced.*] Even the CPN-4 tech orders are not up to date on these capabilities. This long range aspect alone has accounted for literally dozens of recorded "saves" of battle-damaged aircraft or aircraft returning low on fuel. For one thing great versatility is possible in the approach track of an aircraft. Given proper radar identification, GCA can bring a jet aircraft in from GCI control onto the final approach. This was done in an emergency recently, when an F-86 reporting low on fuel was brought straight in from up North to a successful landing under instrument conditions. The pilot in this case had confidence in GCI and GCA. It was fortunate that he was not required to maneuver on the way in, because he flamed out one quarter of a mile short of the runway, just close enough to coast in safely. Saved: One F-86.

The CPN-4 also differs from the MPN-1 in scope presentation characteristics. The MPN-1 has three separate scopes: one for PPI search, one for glidepath, and one for azimuth. This requires a change of control during every run from the search controller to the final controller. It also limits the number of aircraft on final approach to one at a time. In the CPN-4 there are three bays of two scopes each. Each bay has all the capabilities of an entire MPN-1. Each has a PPI scope and an "AZ-EL" scope, the latter giving a combined presentation of glide-path and azimuth. Only one controller is needed to take an aircraft all the way through the pattern down to a landing. This incidentally confuses some pilots, who are expecting the usual transfer of control.

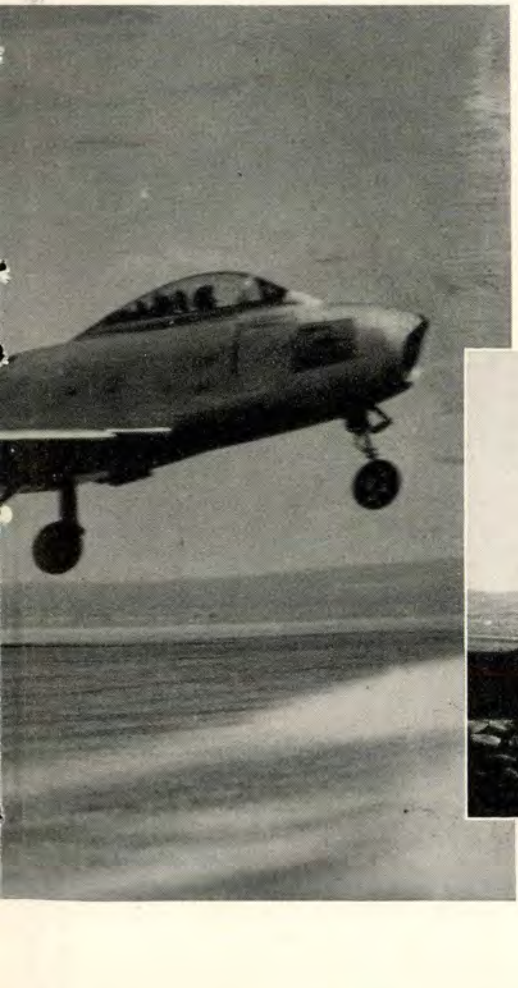
With three-bay operation, multiple approaches are easily accomplished. Theoretically, a constant stream of aircraft can be controlled to a landing with only one mile separation on the final approach, with an aircraft landing every half-minute or so. The advantage of this in a combat theater is obvious. Jets cannot wait around very long after a mission.

The CPN-4 has two other features to facilitate radar identification and control. The first is the AN/GRA-7 VHF/DF. This is a built-in direction-finder which throws out a strobe line on the scope to any aircraft transmitting on the frequency to which it is tuned. This provides instant radar identification (positive identification is a must at all times) without necessity of special flight maneuvers, radio fixes, etc. The second feature referred to is MTI (Moving Target Indicator). As the name implies, this device can be used to reduce in intensity all radar echoes not from moving objects. It effectively erases ground-clutter as an obstacle to full-time radar tracking of an aircraft.

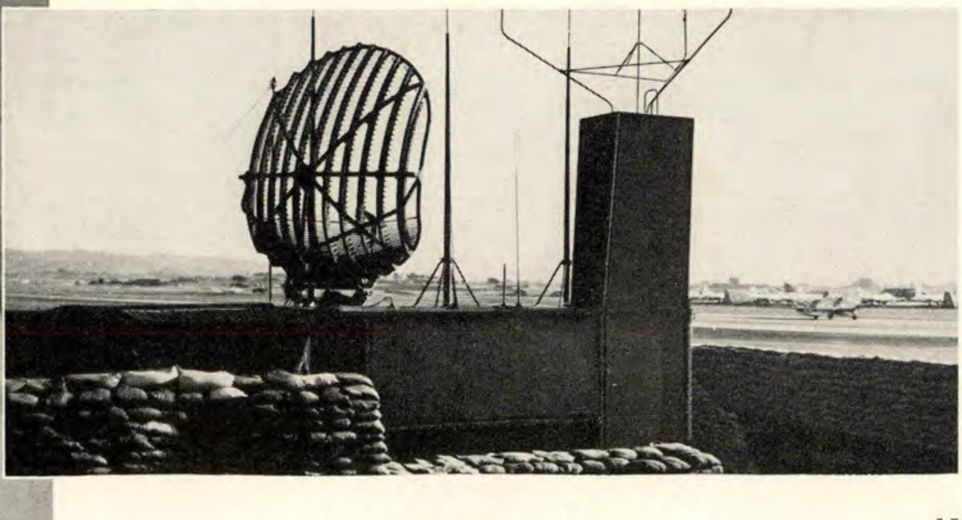
Apart from new devices the CPN-4 has what the MPN-1 has, and then some. For instance, each bay in the CPN-4 has an eight-channel VHF set instead of the four-channel sets of the MPN-1. That makes 24 VHF channels available. In tactical operations where a multiplicity of VHF channels are used, this is a blessing. The larger scope faces of the CPN-4 make PPI approaches easier and more accurate. Since PPI approaches are being used more and more to provide landing into the wind or when the precision system is out, the larger scopes come in extremely handy.

Air Surveillance Radar (ASR), sometimes non-technically referred to as "PPI" is an apparatus that can direct an aircraft to any selected runway or sea lane. The ground controller furnishes traffic direction and information for surveillance (or PPI) approaches by reference to a radar scope that shows the range and azimuth of approaching aircraft. The pilot must control his descent based on his indicated altitude in relation to the glide angle desired and the distance from the runway as furnished by the controller. The pilot must keep in mind that elevation data is not available to the GCA operator, but the controller will advise the pilot of the indicated altitude at which he should be flying at any given range from touchdown. (Radio Facility Charts, Europe, 1 July 1953.)

The moral of this story is that it is almost as bad for pilots to sell a navigational aid short as to over-estimate it. Let's be aware that some GCA's may be able to do things for us that we hadn't thought of. Including saving our necks. Ed. ●



From GCI control, GCA brings in an F-86 to a safe touchdown.



WING FLAPS

FACT vs FABLE

THE pilot of today's modern aircraft usually is well trained to perform the motions required for safe flight under normal operating conditions. It is unfortunate, however, that in certain abnormal flight conditions a lack of technical understanding of the many complex installations under his command sometimes does result in an accident. It is even more unfortunate when the accident results from lack of technical understanding of such a common and uncomplicated installation as the wing flaps.

Technically speaking, the wing flap installation is a simple mechanism. Usually controlled by a simple switch or handle in the cockpit, it can be extended and retracted at any time during flight. There is nothing complicated about it . . . no knobs or levers to operate in proper sequence . . . yet, the improper actuation of this system has resulted in many accidents. The faulty use of this system in such cases is traceable to lack of technical understanding regarding the wing flap installation. Mechanically, the installation was capable of perfect operation.

Despite its basic simplicity, the wing flap is associated with a line of fallacy and folklore that will stretch from Kittyhawk to San Diego. Most of the misimpressions regarding wing flaps are directly traceable to the pilots themselves.

The wing flap was designed some 20 years ago to accomplish one purpose: to reduce speed at takeoff and landing. That's all. No fantastic performance claims such as increased lift for increased gross weights, higher rates of climb, steeper angles of climb, or any of numerous other claims. Just lower takeoff and landing speed.

Why lower takeoff and landing speeds?

The need for lower takeoff and landing speeds was a direct result of our prime objective in aircraft design—speed. To achieve the speeds of our modern aircraft, a reduction in airplane drag was necessary. This was accomplished largely by altering the design of the wing to reduce the induced and profile drag of the wing.

In most instances, this has resulted in higher wing-loading weight over wing area ratio. In general, however, the reduction of wing drag was accomplished by increasing the aspect ratio, decreasing the wing area, and reducing the thickness of the

wing profile. The aspect ratio is obtained by dividing the square of the wing span by the wing area.

$$AR = \frac{WS^2}{WA}$$

As wing design was advanced to achieve higher cruising speeds, speeds for takeoff and landing also increased. It became evident that a wing designed for high performance flight would not be suitable for such low speeds as those desired during takeoff and landing. Many auxiliary installations such as the wing slot, variable camber, telescoping wings and other "aids" were devised and discarded due to their complexities or cumbersome weight. The ultimate design was the wing flap.

On today's modern aircraft there are many adaptations of the wing flap installation, including the plain flap, the split flap, the slotted flap and the Fowler flap. The object of the flap is to alter wing camber and/or increase the wing area, thereby assisting the wing to produce the necessary lift at a lower airspeed. An increase of the convexity of the entire wing or the wing upper surface will change the camber of the wing. The plain flap, the split flap and the slotted flap operate to alter wing camber only, whereas the Fowler flap alters the wing camber while effectively increasing the wing area. In the retracted position, the wing flap conforms to the basic wing, and therefore does not contribute to airplane drag. In its extended position it alters wing camber and/or effectively increases the wing area, making it possible to accomplish flight at low airspeeds. It is retracted for normal climb and cruising flight and extended for takeoff and landing.

The wing produces lift to offset the weight of the airplane at all times during unstalled flight. The minimum speed at which the wing is able to

By George E. Putness, Service Engr.,
San Diego Division,
Consolidated Vultee Aircraft Corp.

On high speed aircraft, the wing flap is the answer to safe takeoffs and landings.

produce lift equal to the weight of the airplane is usually referred to as the *stall speed*. The capability of the wing to produce lift is usually discussed in terms of *coefficient of lift*, a non-dimensional value. Since the wing produces lift only to counteract the weight of the airplane, it is not possible to express the capabilities of a particular airfoil section in terms of pounds of lift. The value would change as the airplane weight changed. The term *coefficient of lift*, being non-dimensional, expresses the true lift capabilities of the wing, regardless of airplane weight, and can be used in conjunction with airplane weight to determine the minimum speed at which lift equal to weight will be obtained.

$$C_L = \frac{L}{qS}$$

Where: L = *lift in pounds*
q = *dynamic pressure in pounds per square foot*
S = *wing area in square feet*

However, since lift is equal to airplane weight in unaccelerated flight, the formula can be simplified for everyday use to determine the wing CL or airplane stall speed for a known CL.

$$C_L = \frac{W}{.00256 \, x \, V^2 \, xS}$$

Where: W = *airplane gross weight in pounds.*
V = *airplane indicated airspeed in mph.*
S = *airplane wing area in square feet.*
.00256 = *represents a constant required to utilize airplane indicated airspeed in mph.*

A wing that produces a low takeoff or landing speed is considered to have a high maximum coefficient-of-lift value. Conversely, a wing with a high takeoff or landing speed is considered to have a low maximum coefficient-of-lift value. Wings with a minimum of induced and profile drag, permitting high cruising speeds, usually are of a low maximum coefficient-of-lift value.

In order to achieve an increase in the coefficient of lift without sacrificing the desirable low-drag characteristics, it became necessary to provide a supplemental installation. The wing flap is this installation. Observe the relationship of the modern wing and wing flap to an out-dated wing design.

Retracted Position

In the retracted position, the flap conforms to the wing contour; in the extended position, the wing area has been effectively increased and the wing camber has been altered to achieve similarity to a high-lift coefficient, low speed wing.

Since the installation of wing flaps and their operation in the extended position results in a similarity to the airfoil section used earlier and since discarded due to high drag, it also is to be expected that the increase in lift coefficient is accompanied by an increase in airplane wing drag. Operation of the airplane with wing flaps extended in any position results in increased airplane drag and decreased airplane performance.

Why Decreased Airplane Performance With Wing Flaps Extended?

The airplane power plant must produce thrust equal to the airplane drag to maintain unaccelerated level flight at any airspeed. Increasing airplane speed requires increasing amounts of thrust until the maximum level flight speed is attained, using the maximum thrust available.

To produce a rate of climb at a given airspeed, the thrust available from the power plant must be greater than the thrust required for unaccelerated level flight at that airspeed. This difference between the thrust required due to airplane drag and the thrust available as limited by the capability of the power plant is defined as *excess thrust*, since it can be used for added airplane performance.

The greater the value of excess thrust, the greater the airplane performance at a given airspeed. However, since the thrust available is limited by the power plant installation, any increase in airplane drag will require a greater thrust, thereby resulting in decreased performance through a lesser value of excess thrust. The extension of wing flaps to any position increases airplane drag and reduces airplane performance.

An airplane can go only so fast for

a given power and wing flap condition. If climb is desired, speed must be sacrificed and if speed is desired, climb must be sacrificed. Either climb or speed can be obtained, but it is not possible to have a maximum of both at the same time.

Why install wing flaps if performance is decreased?

Wing flaps are used during takeoff to achieve a low takeoff speed, resulting in a shorter ground run. Lower speeds result in decreased airplane wear and increased safety through a lesser deceleration distance if the pilot decides to abort the takeoff.

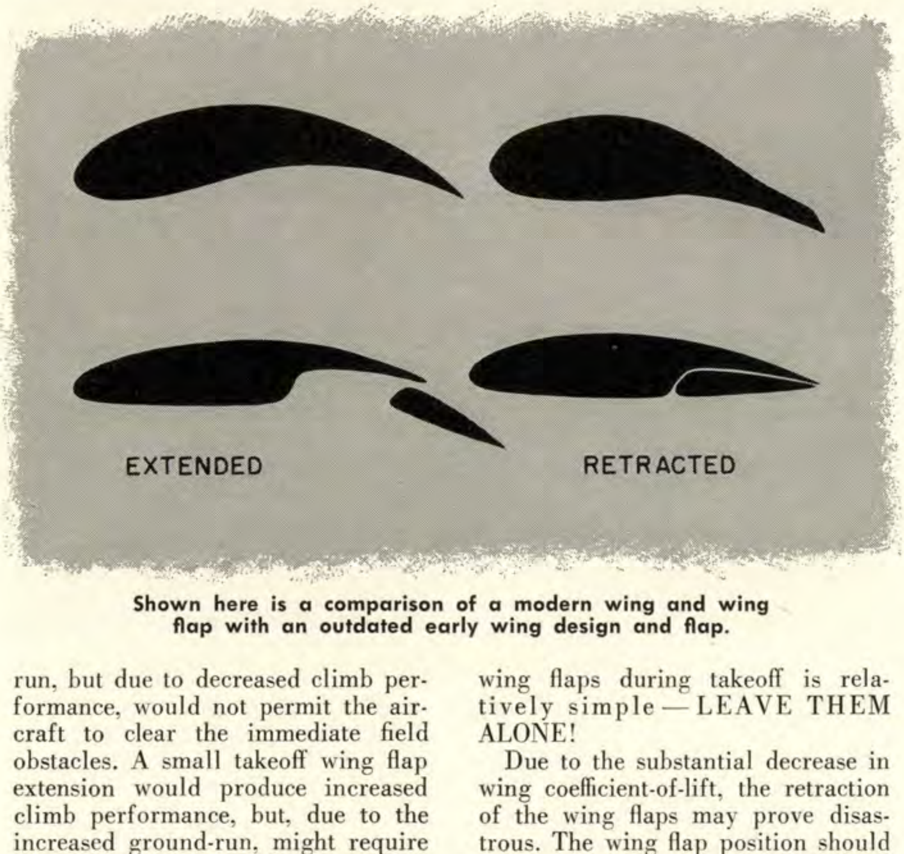
The takeoff wing flap position usually is selected on the basis of ground run and obstacle clearance flight. A large takeoff wing flap extension would produce a short ground run, but due to decreased climb performance, would not permit the aircraft to clear the immediate field obstacles. A small takeoff wing flap extension would produce increased climb performance, but, due to the increased ground-run, might require more than the available runway for takeoff. The optimum wing flap position usually is that which produces the shortest horizontal ground run to clear existing obstacles.

However, the optimum takeoff flap position for multi-engine aircraft with all engines operating may not be the optimum flap position following an engine failure or partial power loss. This is due to the loss of climb performance resulting from the partial loss of total thrust available. The resultant rate-of-climb under a partial power-loss condition may not be sufficient for safe clearance of immediate obstacles. In the consideration of continued safe flight under emergency takeoff conditions, the selection of the takeoff flap position should be based on an adequate rate-of-climb after takeoff with a partial loss of total thrust available.

Flaps for Landing

It is necessary at this point to state that on some aircraft the wing flap is used only for landing. This is a result of the wing and flap design, which does not produce a sufficient decrease in the takeoff speed to justify the decreased climb performance with wing flap extended.

The best method of operation of wing flaps during takeoff is relatively simple — LEAVE THEM ALONE!



Shown here is a comparison of a modern wing and wing flap with an outdated early wing design and flap.

Due to the substantial decrease in wing coefficient-of-lift, the retraction of the wing flaps may prove disastrous. The wing flap position should not be altered during takeoff until two details have been accomplished:

- *All immediate obstacles have been cleared and the airplane has reached a safe altitude.*
- *Airplane nose high attitude has been decreased and airplane speed allowed to increase to the "flaps-retracted" climb speed.*

The airplane rate-of-climb will be reduced during the period of acceleration to the flaps-retracted climb speed, because the total thrust available can be used for acceleration or climb but not for a maximum of both, simultaneously. In some instances, the wing flaps may be retracted in increments, using the rule-of-thumb of one degree for each one mile-per-hour increase in airspeed above the particular flap position climb speed.

However, the wing flaps should never be retracted without first allowing the airplane to accelerate to a safe speed. At low airspeeds, the flaps are depended upon to sustain flight. If flaps are retracted at low airspeeds, the airplane may stall and lose altitude. Until the airplane rate-of-climb can be sacrificed to allow acceleration to the flaps-up climb speed and maximum rate-of-climb, a better rate-of-climb is obtained with flaps.

The wing flap position during landing is usually fully extended, since in this position the airplane can sustain flight at the minimum speed possible, and can approach the landing in the steepest angle of descent.

Why a steep angle of descent and minimum speed for landing?

The steeper the angle of descent during landing approach, the less horizontal distance will be required for the descent to touchdown. This means that where obstacles are in the immediate vicinity of the runway, a greater portion of the runway will be available for the landing roll.

The lower the speed for landing, the less distance will be required for the deceleration roll, thereby permitting landings on relatively short runways. The low landing speed also reduces tire and brake wear.

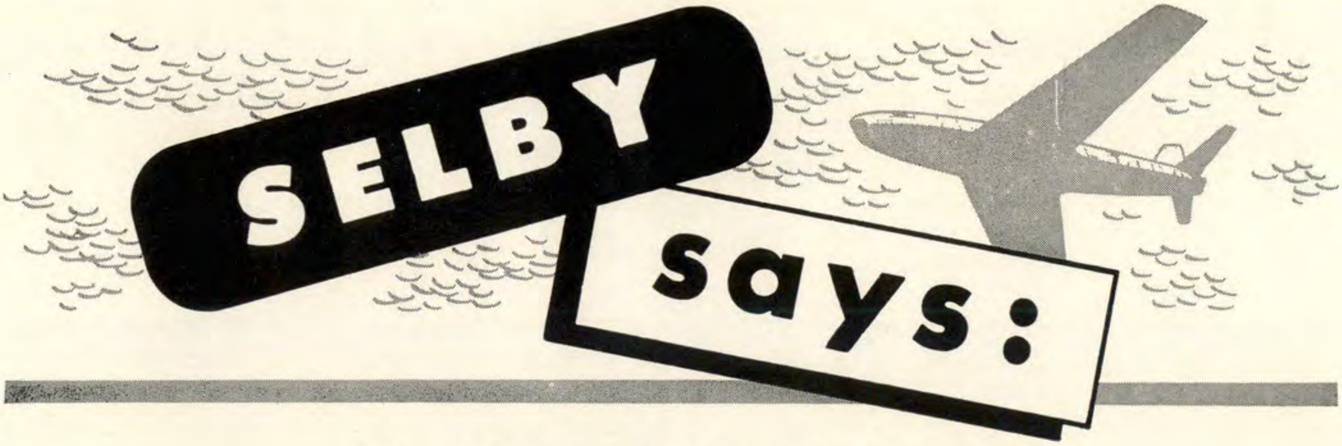
The extension of wing flaps to the fully extended position for landing should not be accomplished until it is certain that the landing can be completed. Otherwise the increased airplane drag, due to the wing flap position, and a partial loss in total thrust available, may not allow a wave-off and go-around.

In summation, we can state that the wing flap mechanism is installed to provide low takeoff and landing speeds, thereby resulting in short ground distances for takeoff and landing. After takeoff and acceleration to a safe flaps-retracted speed, the flaps should be retracted and further use restricted to the approach for landing and landing. Any extension of the wing flaps during normal climb or cruising will result in loss of performance, and therefore should not be attempted. ●

WELL DONE!

To the pilots and crews of the Fifth Air Force, *FLYING SAFETY* extends a particularly hearty "*Well Done*" for the outstanding role they played in the Korean action.

And a "*Well Done*" to the men who stayed on the ground, that the pilots and crews could safely accomplish the mission of the United States Air Force.



Our weather experts know their business as you will see after reading this article.

WEATHER OBSERVATIONS and the LANDING PILOT

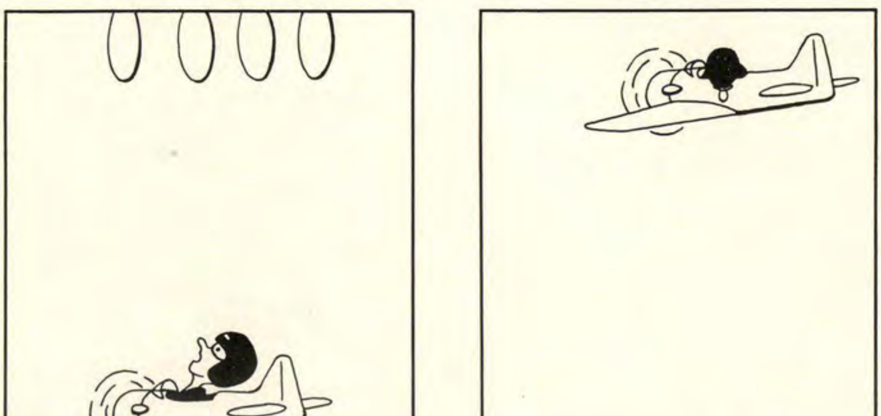
By Operational Analysis Division, Headquarters, Air Weather Service

"It's all in the point of view" . . . but regardless of how you look at a cow, it's the end result of an ice-cold glass of milk and a rare beefsteak that counts. (See "Slant Range Visibility," FLYING SAFETY MAGAZINE, *May, 1953.) I wonder what Air Research and Development Command has to say about "built-in windshield obscuration."*

Selby

"IT'S ALL IN THE POINT OF VIEW."

High cow. **Low cow.**



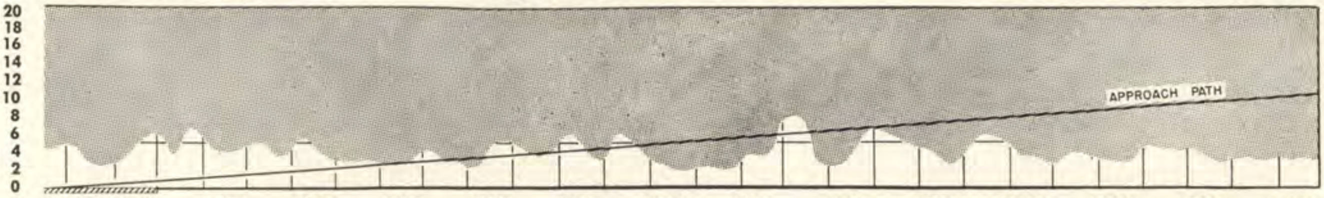
THE Old-Timer was sitting on his porch, rocking gently. "You know," he said, "what you see and how you figure what things look like depends a lot on where you are. Ever look up at the under-side of a cow? Craziest thing you ever saw! But stand off and watch it, and it's a mighty nice-looking critter!" *(See cartoon, "It's All in the Point of View!")*

Remember the times when you, a pilot, came in to land during bad weather, and ran into ceiling and visibility conditions that were "different" from the weather report given you by the tower? You're a reasonable man, you know the weather people, like them . . . but this was too much. You can understand why the weather men will occasionally "bust" *forecasts.* After all, there's plenty they still don't understand about what makes the weather tick. But this business of *observations* is different . . . seems as how the weather guys can't even tell what weather they've got *right now!*

Incidents like the above have occurred with increasing frequency over the last five years. Why? . . . we suspect it's because the operating margins for landing aircraft have been shaved thinner and thinner. In the old days, if the pilot could see the airport from altitude, he landed . . . if he couldn't, he didn't. Now, how-

Fig. 1. Cloud Base Contours

(COURTESY U.S. WEATHER BUREAU)



ever, instrument landing aids can bring the pilot blind to a minimum altitude, by which time he must have transitioned to visual reference. The requirements of an all-weather Air Force and the ticklish business of landing high-speed jets in bad weather have increased the pressure on the weather observer to more precisely report landing ceiling and visibility conditions.

The cry of "Report what the landing pilot will see!" has become increasingly popular. Another one the weather man hears is "Don't give me gobbledegook . . . just tell me at what point on my glide path I can see the runway!" This is not easy to do.

Campaign Started

In view of the heat generated on this subject (there's been some light, too), Air Weather Service has started a campaign to bring AF personnel up-to-date on where the weather man stands with respect to this problem. Some questions of interest to flying personnel are:

☆ How well can the weather people actually determine the ceiling and visibility conditions that the landing pilot will encounter?

☆ What are the weather people doing to improve their capabilities in this direction?

☆ Are there any tricks-of-the-trade that pilots can use to get around the difficulties created by the weather man's limitations in this direction?

Let's tackle the first question . . .

How far you can see through the atmosphere depends on four factors:

- The properties of the atmosphere itself. For example, presence of condensed water vapor in the form of clouds, occurrence of dust particles, and so on.
- The amount and distribution of light; "how much" and where's it coming from?
- The kind of objects at which, or for which, you are looking. You can't tell how far you can see unless you're looking at something!
- Your visual ability. And in the pilot's case, this includes the extent to which his vision is hindered by poor cockpit and windshield design and other structural characteristics of the aircraft.

The first two factors above are *meteorological*, and it is the weather man's job to measure and report them. He does this by sight, or, what is much better, by a combination of sight and weather-measuring instruments. The ceilometer, which measures the height of a cloud base over a point, and the transmissometer, which measures the transmissivity of the atmosphere between two points (this is a new piece of gear about which you'll be hearing more shortly), are examples of weather-measuring instruments that help the observer. For the rest of this discussion, when we refer to the weather man's observations, we mean his visual observations *aided in so far as possible by instruments.*

Now it is important to note that the last two of the four factors above are of a *psycho-physiological* nature . . . (so help us, that's what the doc told us!). Stripped of mumbo-jumbo, this means that these factors depend on *who* is doing the looking and *what* he's looking at. And brother, these last two factors present a big headache to the weather man.

Weather Reporting Factors

Factors that keep the weather man from reporting to the pilot just what he will encounter on final approach:

☆ Weather observer can't get a visibility measurement along the glide path; nothing to sight on. Even if he could, the measurement would differ from the pilot's visual range because of opposite direction of sighting.

☆ Pilot's vision is affected by his landing speed (particularly when precipitation is occurring) and by the structural characteristics of his aircraft. On the other hand, the weather observer and his meteorological instrument are stationary, and his vision is not restricted by an enclosure.

☆ When ceiling- and visibility-measuring instruments are not available, the weather observer's estimate of ceiling and visibility can vary between wide limits.

☆ Rapid variation in ceilings and visibilities are possible during bad weather. This changeable character is apparent from point to point at an airport and from minute to minute at one point. This variation is particularly great during on-and-off precipitation.

Differences

Let's talk now about the differences between the weather man's and the pilot's estimate of ceiling and visibility . . . first, the differences due to meteorological factors. Often the base of clouds in the approach zone is ragged and uneven. This means that as the cloud ceiling moves over different observing points, measurements of its height may vary considerably from moment to moment and point to point. Similarly, smoke, fog, and haze concentrations vary over an area as large as an air base.

When weather conditions approach landing or takeoff minimums, *such variations in ceiling and visibility* are often of greater operational importance than the ceiling and visibility values themselves.

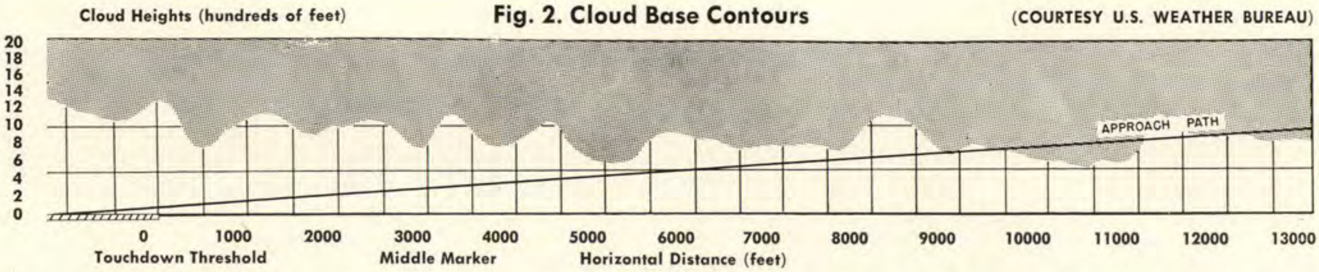
Here are examples that illustrate how great these variations can be:

1. In a joint CAA-CAB-U.S. Weather Bureau-Air Transport Association test at the Washington National Airport, Washington, D. C., August 1949 to March 1950, ceiling and visibility observations were taken simultaneously from the terminal building and from a runway site about 3,000 feet away.

RESULTS: Ceiling observations between the two points varied 100 feet or more in 61 per cent of the observations and 300 feet or more

Fig. 2. Cloud Base Contours

(COURTESY U.S. WEATHER BUREAU)



in 12 per cent of the observations. Visibility observations varied by ⅛ mile or more in 70 per cent of the observations and by ½ mile or more in 25 per cent of the observations!

2. A similar test was conducted by Air Weather Service at Manston, England, in March and April 1952. The base weather station and the runway observing site were about ⅝ mile apart.

RESULTS: During the time the field was below VFR by reason of the base weather station observation being below 1,000 and/or 3, *about 20 per cent* of that time the runway site reported *above* VFR landing conditions. Furthermore, during the time the field was below GCA minimums because the weather station observation was below 300 and/or ½, *about 6 per cent* of that time the runway site reported *above* GCA minimums.

The conclusion is striking . . . ceiling and visibility measurements during bad weather depend a lot on where the observer or the observing equipment stands! It is worth noting, too, that on a GCA run, the aircraft is more than two miles away from touchdown when it's at 500 feet altitude.

3. Figures 1, 2 and 3 come from a recent test made by the U.S. Weather Bureau in a project sponsored by the Air Navigation Development Board. The cloud height measurements were made with a rotating-beam ceilometer, which can record a measurement every 24 seconds. The instrument was located at a fixed point, and the time variation in cloud height translated to a space variation for illustrative purposes.

These figures illustrate the "in-and-out" characteristics of an approach during low, variable ceilings. In Fig. 1, for example, the glide path would be "in" clouds 7500 feet from threshold, "out" at 5200 feet, "in" at 4900 feet, and so on, until final break-out about 2500 feet from threshold.

The implication of this data is clear. Under bad weather conditions, ceilings and visibilities can vary markedly over fairly short intervals of space and time.

Now what about the difference between the weather observer's and pilot's estimate of ceiling and visibility, due to psycho-physiological factors? Here, we are mainly concerned with how far the pilot expects to see obliquely from the cockpit and down the glide path.

Ceiling and visibility vary as much for the pilot as they do for the weather man on the ground . . . the pilot is just moving too fast to notice it. The incoming pilot is primarily concerned with seeing details in terrain or objects of recognition near the runway. His ability to pick out these objects is determined mainly by "object contrast," which means how much the object differs from and stands out from its background. When his windshield is swept by rain or snow or coated with ice, the pilot may not be able to see objects 100 feet away although the actual visibility may be as much as three miles. Furthermore, when he is tired or unfamiliar with the landing field, his ability to see some object on the ground and to know his distance from it is greatly reduced.

The human weather observer isn't perfect, either. We know from recent experiments, for example, that several weather observers can differ by several hundred feet in their estimate of a ceiling height that was made without measuring instruments. The "human equation" influences the observer's estimate as well as the pilot's.

What Can Be Done?

So much for the factors affecting the observer's ability to see and the pilot's ability to see. . . . Is it any wonder they often report different ceiling and visibility values? Well, you'll ask, what can be done about these difficulties? . . . you've got to fly . . . you can't tell the "old man," "Sorry, Chief, count me out. The whole area's reporting ragged ceilings near minimums, and since the weather observer can't give me an on-the-button reading, I think I'll stay in the sack today!"

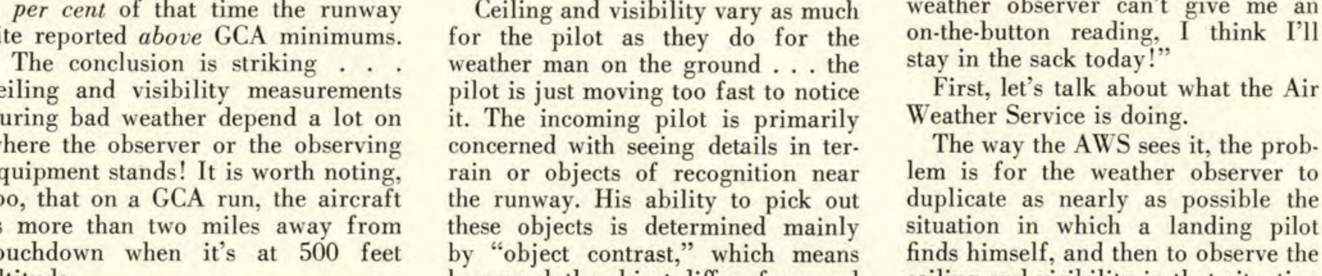
First, let's talk about what the Air Weather Service is doing.

The way the AWS sees it, the problem is for the weather observer to duplicate as nearly as possible the situation in which a landing pilot finds himself, and then to observe the ceiling and visibility in that situation in which a landing pilot finds himself, and then to observe the ceiling and visibility in that situation.

At present, at air bases where the base commander concurs in the need, a weather observer stations himself near touchdown when the weather is bad. He observes visibility down-runway and out into the approach zone and also the height of cloud base. The purpose is to minimize as much as possible the spatial and time varia-

Fig. 3. Cloud Base Contours

(COURTESY U.S. WEATHER BUREAU)



Slant Range Visibility

A word here about "slant range visibility," a term used to describe how far the pilot can see down the glide path. The value of such a measurement is obvious . . . If a pilot is landing at 120 mph and his slant range visibility is two miles, then he'll see touchdown one minute before he gets there . . . at least that's what the formula says.

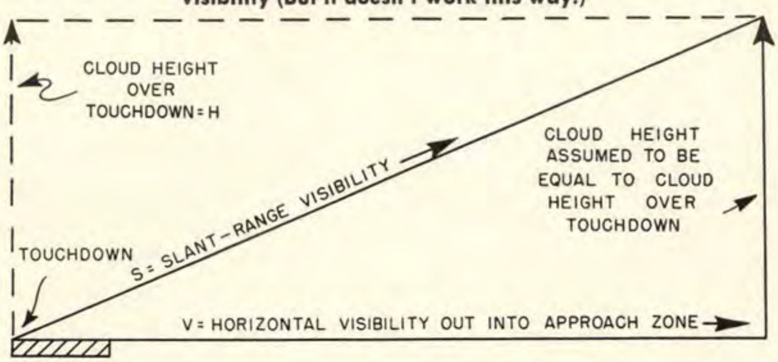
In the beginning, the mathematicians decided the simplest way to get slant range visibility was to measure the ceiling height at touchdown and the horizontal visibility in the approach zone, and compute the slant visibility using the trigonometry shown in Fig. 4.

The one fact that shoots holes in such calculations of slant range visibility is that the physical properties of the atmosphere within the glide path are often different from the physical properties of the atmosphere where we're measuring cloud height and visibility.

Such indirect measurement of slant range visibility, that is, where measurements of other visual ranges are made and the slant visibility computed from them, hasn't given us the answer.

How about *direct* measurement of slant range visibility? Well, we might suspend, in the approach zone, targets to sight on. The British have tried mooring balloons near glide path to give the observer on the ground something to look at. They've also experimented with firing rockets aloft to provide sighting targets. The operational hazards involved, however, are considerable. We would guess that if a gadget is ever made to measure this thing directly, it'll be a type of light extinction meter such as a photographer might use to give him the proper lens opening and shutter speed for a picture.

Figure 4. $S^2 = H^2 + V^2$. "Mathematical" computation of slant range visibility (But it doesn't work this way!)



tions in ceilings and visibilities discussed before.

In addition, AWS is carrying out a long range program aimed at taking ceiling and visibility observations by electronic instruments (like the ceilometer and transmissometer) located on the ground in the approach zone near touchdown. Remember, however, that we cannot suspend the instrument on the glide path; we cannot skid the recording instrument down a 2½° glide toward touchdown to simulate the experience of the landing aircraft, and we cannot adjust the instrument to take into account pilot fatigue, pilot familiarity with the terminal area, and other psycho-physiological factors.

In short, there are angles to this problem that the weather man can never solve.

Another thing AWS is doing is monitoring closely the attempts to solve this problem by such U. S. agencies as the NACA, CAA, ANDB, Weather Bureau and by foreign meteorological services. Let's not kid ourselves . . . this problem has most of the world's weather services and flying organizations hopping. The first Air Navigation Conference of the International Civil Aviation Organization was held in Montreal in February and March 1953. *The first item* on the agenda was slant visibility measurements and measurements of height of base of cloud in the vicinity of airdromes.

The conference decided that pilots landing in bad weather needed the following information:

☆ Altitude at which they would "break out" in the approach zone.

☆ Slant range visibility down the glide path and obliquely in other directions from the cockpit.

☆ Horizontal visibility down the runway.

☆ Prevailing visibility in the terminal area.

The meeting further concluded that, of these requirements, only the last two could be satisfied right now by any of the world's weather services.

American airmen have a reputation for ingenuity. Is there anything the pilot can do to make up for these limitations of weather observations? At the risk of being told to get back into the weather station where we belong, here are a few suggestions:

☆ First and foremost, recognize the limitations of observations of ceiling and visibility when they are used to estimate what the landing pilot will see. Remember, whether the observer is at the base weather station or standing in the approach zone, he *never tries to give you a bum steer* on terminal weather conditions. We're not asking you to learn weather observing, but simply to recognize the limitations involved.

☆ When you hear such terms as "indefinite," "variable," "obscured" used to describe a weather observation, be on guard for unexpected ceilings and visibilities. When a weather man reports "Indefinite ceiling, 1500 feet, obscured, 2½ miles visibility in light snow," the words that should ring a warning bell are "indefinite" and "obscured!" "Indefinite" means "not definite," "variable" means "changing" . . . so heads-up flying is in order.

☆ Recognize how very changeable the approach zone and runway ceilings and visibilities can be in bum weather. And this rapid fluctuation is greater the worse the weather. When you hear "2000 and 4 in light fog," or "1200 and 2 in rain," just remember that at some place in the approach pattern, *where the observer or measuring instrument is not located,* the ceiling and visibility can be a lot worse. ●

Stop IN TIME!

IT isn't the landing roll that hurts—it's the sudden stop at the end of a runway that does the damage. And avoiding this sudden conflict with Newton's law by bringing an airplane to a stop before the end of the runway is reached after landing is a problem that confronts some pilots every day.

This is particularly true during periods of limited visibility, or when runways are short, wet or icy. At these times a pilot should know the best way to stop the landing roll short of retracting the gear or removing a section of Farmer Brown's fence.

Despite the fact that the majority of airfields have adequate runways and clear approaches, a great many pilots, according to stacks of accident reports, just can't seem to make it onto the first third of a runway.

Take the case of the Gooney Bird pilot who was determined to touch the gear on the first few feet of the runway and landed ever so short—the plane stalled out and landed hard enough to knock most of the gear off.

Causes of landing accidents include water on the runway, snow, crosswind and the pilot's inability to maintain directional control. In the majority of the accidents where weather factors were listed, the pilots concerned failed to maintain control because they counted on the brakes to hold. Braking action on wet or snow-covered runways frequently aggravates a skid rather than stopping it.

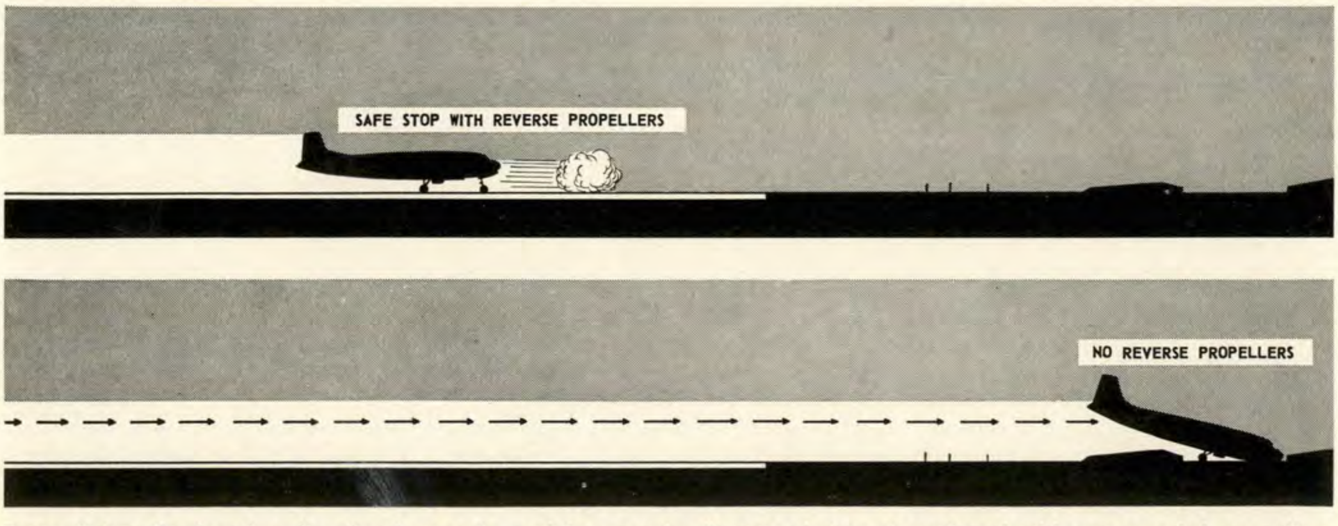
Some landing incidents and accidents have been caused by a cushion of water under the tires which, it is claimed, largely nullifies good braking action.

Every landing on wet or snow-covered runways presents an individual problem and the pilot should be doubly alert for the unusual that could happen. Some problems are common to all slick-surface landings—such as landing straight ahead without drifting and maintaining directional control with the rudders as long as possible.

Braking action can be even more treacherous when only patches of water or ice remain on a runway. Under these circumstances if brakes are applied when the wheels are on a slick spot they will have little effect, and if they're still being held when a dry spot is reached, the brakes may grab and veer the plane sharply. Of course, any power used for directional control will increase the landing roll.

A few landing-roll accidents can always be chalked up to "touch and go" practice. During practice landings in some types of airplanes it may be necessary to retract the flaps before breaking ground on subsequent takeoffs. Again, under some circumstances due to weather, field conditions and type of aircraft, flaps should be retracted soon after landing. Except for these, some general precautions may be followed:

• During the landing roll do not attempt to raise flaps. Wait until you have turned off the active runway.



Power is best for keeping directional control — and for stopping if your airplane is equipped with reverse pitch propellers. The brakes, when used to slow the landing roll on slippery surfaces, should always be applied gently and cautiously. Right, a B-47 stops with aid of a drag chute. At light landing weights chute is not needed in a careful approach to long runways.

• Look at flap control lever before moving it.

• On take off, retract the gear only after you're sure safe flying speed is attained.

Power is the best method of keeping directional control. Brakes, if used during the landing roll, should be applied gently and cautiously. On airplanes equipped with reverse pitch props, reversal is the safest and most efficient means of rapid deceleration on slippery surfaces.

The drag 'chute used in slowing the landing roll of the really hot stuff—like the B-47—is an effective and comparatively late wrinkle. In this type of aircraft, the safest landing is one in which the rear gear touches first. This allows an adequate flare and prevents a bounce.

At light landing weights with runway lengths ten to twelve thousand feet, the drag 'chute is not needed if the approach has been carefully planned. Using the drag 'chute produces a 300 per cent increase in the drag of the aircraft. It is most effective at the higher speeds.

Training Planes

Among training aircraft, the T-6 stays out in front—in the landing accident picture. Most of the T-6 landing errors come about as failures to follow the correct techniques. This is often based upon the pilot's lack of familiarity with the airplane and his apprehension over landing.

A fast glide in the T-6 will frequently cause the round-out to be delayed too long. This, in turn, necessitates an abrupt round-out which will cause floating and ballooning. Landing from this type of approach will usually be main gear first, and such a round-out may result in failure to hold drift correction. The drift is difficult to notice in such a tail-high attitude.

The degree of flaps to be used is a controversial matter and based primarily upon personal experience and opinion rather than on a hard and fast SOP. However, the normal landing for a T-6 calls for full-flaps. With a crosswind, the flaps should not be used to the extent that the slip method of drift correction cannot be used to control the drift.

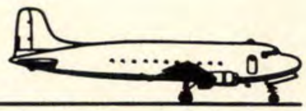
Weight of the airplane is a factor, since a lighter airplane will have less weight on the wheels if angle of attack on landing is not reduced. Thus, skidding might occur with lightly loaded planes at lower speeds than would occur on heavier loaded airplanes. A heavily loaded airplane has increased landing speed and kinetic energy and, consequently, will require more braking action. Reducing the angle of attack and fast retraction of flaps will be of assistance in this case also.

The higher the airport, the higher the landing groundspeed, even though the stalling airspeed is the same. Faster landings mean more kinetic energy must be dissipated.

The effect of CG is only in relation to how much weight is on the main gear for braking action. The worst

Everything which goes up has gotta come down

And if it's an airplane it should come down safely



Reverse pitch props are a real boon when it comes to stopping the landing roll of a heavy airplane like the B-36.

conditions are a forward CG on tricycle gear and a rear CG on tailwheel airplanes.

One of the most important items in estimating the distance required for landing is the coefficient of friction. For example, the coefficient of free-roll friction on rough concrete is approximately .05 and is increased by proper use of brakes to approximately .70 for wet and .80 for dry pavement. In other words, by proper application of brakes, a pilot can almost lock the wheels but still let them roll so that they aren't skidding. In this manner, stopping of the airplane is facilitated 14 times faster for wet runways and about 16 times faster for dry pavement.

Items of importance which can change required landing distances by as much as 100 per cent under the worst landing conditions include: Landing speed slow, within safe limits; weight on the wheels—for maximum efficiency of brake, reduce aerodynamic lift.

Remember: Altitude of airport—increases landing ground speed. Wind velocity and direction — may aid or hinder slowdown, depending on use. Up-slope landing is an important aid, down-slope landing a detriment, high temperatures cause excessive landing roll.

The pilot should keep in mind that reducing the angle of attack quickly on landing and retracting the flaps reduces the aerodynamic drag as well as the lift. This causes more wear on the brakes in order to get the benefits of a shorter stopping distance. In ordinary landings where emergency stopping is not a factor, it would be better to use the aerodynamic drag available (flaps and high angle of attack) when conditions are favorable.

Here are some suggested aerodynamic techniques which should help you make safer landing rolls:

• Reduce the lift of the wings; retract the flaps immediately on contacting the ground; decrease the angle of attack by keeping the tail high on airplanes with tailwheels and by putting the nosewheel on the ground quickly on tricycle gear aircraft. Research has indicated that increasing the weight on the main gear is more important for quick stopping than the aerodynamic braking of flaps and a high angle of attack.

• After touchdown, approach the point of incipient skid when braking an airplane, but don't skid the tires. The maximum effective use of the brakes is accomplished in this way.

• Your touchdown speed is important and, when the runway is wet or slippery, the lowest speeds consistent with a safe approach are the best landing technique.

As usual, those words "pilot error" top the list of landing accident causes. Cold, statistical facts show that the odds are better than two to one that if you have an accident it will happen while you're making an approach or landing. Don't relax during this final phase of your flight. Be forewarned and forearmed and look to your own technique for bringing a plane to a safe stop while still *on* the runway. ●

Average Stopping Distance with Reverse Thrust Propellers

(Ground roll distance in feet from point of touch down to stop)

Airplane	Max. Wgt. (lbs.)	Touch Down Speed (MPH) Ave.	Brakes Only	Reverse Props Only	Emergency Stop Full Brakes & Props (Ave.)
C-46	45,000	90	2500'-3000'	1800'-2000'	900'
C-54	87,000	100	1500'-1700'	1400'-1600'	1000'
C-82	60,000	100	1150'-1250'	1800'-1900'	850'
C-121	93,000	100	1600'-1700'	1500'-1600'	1000'

CROSS FEED

LETTERS TO THE EDITOR

One Full, the Other Empty!

During Flying Safety Meetings conducted by this command, the question has come up as to what action to take in F-94-B type aircraft when one of the drop tanks has failed to feed and it will not jettison.

Based on the known experience of pilots who have made landings in the configuration of one drop tank empty, and the other containing approximately half fuel, it is believed that it would not be possible to keep the aircraft straight after rudder control had been lost if a landing were made with one tank full and the other empty.

We will appreciate any information and recommendations your headquarters has on this subject.

Capt. Stanley K. Haggerty
Hq. 10th Air Div. (Def.)
APO 942.

How about some comments from the field?—Ed.

* * * * *

Flying Safety Record?

As there is a certain tendency within the human race to "blow your own horn," we are coming in with this little plug. In the conventional section here at the USAF Instrument Pilot Instructor School, we have compiled over 50,000 B-25 flying hours without a pilot error accident. In fact, the only incidents during this period resulted from slight structural damage caused by hail and lightning.

This achievement may be particularly significant as this flying was accomplished under any and all weather conditions. Until restricted recently by AFR 60-16 we had no weather cancellations or postponements during this period. Incidentally, the airframes of our aircraft average 5,484 hours each. It can be easily seen that these B-25's are no longer kids.

Maj. Terry R. Barton
3550th F. T. Squadron
Moody AFB, Ga.

RAF Looks for Flying Safety

I have been the USAF Exchange Officer here at the RAF Control Fighter establishment for the past two years. One of the units on the station is the Fighter Command Instrument Training Squadron, comparable to our instrument school at Moody.

During the course of my tour the people of the Instrument Training Squadron have been most interested in obtaining every copy of FLYING SAFETY, as many of your features tie in closely with their operation.

Maj. Jackson Saunders, USAF
Air Exch. (OAA)
RAF Sta. West Raynham
Norfolk (U.K.)

* * * * *

More Anent Le Rhone

In Cross Feed of the June issue of FLYING SAFETY, you very properly removed the Gnome from the Spad but you install it in the Nieuport where, I am afraid, it does not belong. Some of us youngsters in No. 60 Squadron, Royal Flying Corps, in 1916-17 were very proud of the Nieuport Scout which had the Le Rhone, nine cylinder, 110 H.P. rotary.

My real reason for venturing this comment is to take the opportunity of expressing my high regard for the quality of the material you publish and to mention that FLYING SAFETY is studied with interest at these Headquarters.

R. C. Kean
Inspector of Accidents
Accidents Investigation Br.
Royal Australian Air Force

At last an Old Hand to the rescue. Our two previous advisors on this technical problem were paternal gleams when Mr. Kean was flying Scouts—Ed.

You Wuz Right, Baby!

I just read the first article in your July issue, "Hit by Hail," and was looking at the picture of the wing that was supposed to be on a C-47.

I would like to say that if that aircraft is a C-47 they have certainly modified the old "Gooney Bird" since last I worked on one, as I never saw a single strut landing gear or wheel well doors on the old girl. The plane in the picture looks like a C-46 to me. Am I right?

I want to say Thank You for your fine magazine.

T/Sgt. Walter Jones
3585th Maint. Sqdn.
Gary AFB, Texas

The Sergeant is so right. Our cutline writer has just received 100 lashes with an old pitot cover.—Ed.

* * * * *

What? No Screwdriver?

What ever became of the lowly screwdriver? Nothing is more aggravating to a fighter pilot who has baggage, down lock pins, form 1, etc., stuffed in every nook and cranny, than to arrive at an air base and find the alert crew sans a screwdriver.

Aircraft manufacturers are finding more and more uses for Dzus fasteners and to date no substitute for the "Dzus opener" or screwdriver has been found. Coins, dog tags, keys, etc., may accomplish the task but also damage the fasteners and harass the individual attempting to use them.

I, for one, believe that in addition to the sharp-looking white coveralls, various arrival and servicing forms for pilots to fill out, an "alert" alert crew should have at least one screwdriver available to aid a pilot in debarking his aircraft.

Capt. Robert A. Garrison
FSO, Hq. 4706th Defense Wg.
O'Hare Internat'l Arpt., Ill.

Keep Current

NEWS AND VIEWS

• **Stuck to the Pavement** — The F-86 jockey was taking off number two in an 18-ship formation. As he hit 110 knots, he tried to pull off, but she just rolled and rolled. Take-off was aborted, tire blown. Inspection revealed that the pilot had not checked the clearance of his oxygen hose and G-suit connection in relation to stick travel. The O hose and the G-suit connections were crossed in such a manner that the stick could not be pulled back far enough to get the nosewheel off the ground. A thorough cockpit check would have precluded that hairy "near-accident."

• **Soup's on!** — Recently an over-water C-97 flight with 65 passengers aboard encountered an over-speed condition on all four turbo superchargers. Fortunately, the manifold pressure was brought under control and the aircraft landed safely.

The over-speed condition was the result of a short in the electrical circuit, caused by coffee spilled on the turbo over-ride switches. Previous to this incident, various C-97 airplanes have suffered various communications failure and mechanical malfunctions caused by coffee, fruit juices, soups, and other liquids being spilled on the control switches.

Careless food handling is not only unsanitary but downright dangerous. Watch your table manners, and if you gotta eat, please be neat!

• **Jet GCA's** — Captain Robert E. Eager, 3200th Fighter Test Squadron, APG, Eglin AFB, has come up with a new GCA procedure for jet fighters. Squadron members have tried it out many times on all USAF jet fighters, with the exception of the F-89, while running GCA flight tests.

The procedure is designed to allow a pilot to fly his GCA pattern at one throttle setting and eliminates remembering various power settings for different configurations. Weight changes are compensated for automatically.

In describing the pattern, Eager emphasized that the secret was to set up the proper power setting as a pilot enters the GCA run.

· Set the power up for maximum allowable airspeed with a gear down configuration.

· Put the speed brakes out on the downwind leg. (This is equivalent to having the gear down.)

· While turning on the base leg, drop the gear. Use combination of gear and speed brakes to lose altitude to that desired on base leg. (Retract speed brake 200 feet above desired level off altitude.)

· Roll into turn on final and drop wing flaps to the number of degrees needed to maintain desired final approach airspeed.

· Set up rate of descent and open speed brakes. Approach airspeed can be varied slightly to maintain a constant rate of descent.

The procedure has worked so well that it is now being taught in the instrument instruction section of the 3200th Squadron.

• **Globemaster Pioneers** — The Sixth Air Transport Squadron, currently stationed at Brookley Air Force Base, Alabama, recently was commended for chalking up an enviable flying safety record.

Flying the C-74, the prototype of the C-124, the Sixth is pointing toward a two-year accident-free safety record. The only Air Force unit utilizing the C-74, the Sixth has recorded no fatalities involving aircraft since the single-deck Globemaster was put into service in 1947.

In addition to the no-fatality accomplishment, the Sixth has flown some 72,000 hours with only four flying accidents during the entire six-year period of operation.

Capt. Marvin E. Fouche, Flying Safety Officer, reports that the crews flew nearly two-and-a-half million miles during the fiscal year 1953, carrying 20,454 passengers, and transporting 18,985,911 pounds of cargo and mail. The aircraft in the squadron have averaged 6,600 hours.

The Sixth has served mostly on long overseas flights into the Near and Middle East and was on continuous duty during the Berlin Airlift. More recently, the unit has seen extensive service in support of the Korean conflict, in addition to transporting SAC units to overseas points.

Major General V. E. Bertrandias, Deputy Inspector General, USAF, gets first hand information from Colonel Francis S. Gabreski, the Air Force's leading ace, prior to a familiarization flight in a T-33 jet trainer at Norton Air Force Base, California.

Mr. Lewis is the former Vice-President of Curtiss-Wright Corporation. From 1934 to 1947 he was responsible for directing Lockheed Aircraft Corporation's purchases, outside production, and subcontracting. From 1947 to 1950, Mr. Lewis was with Canadair, Ltd.

As Assistant Secretary in charge of Air Force Materiel matters, including production and procurement, Mr. Lewis is eminently qualified.

"NEVER ENDING EFFORT..."

"Flying safety must be a never ending effort by everyone in the air and on the ground.

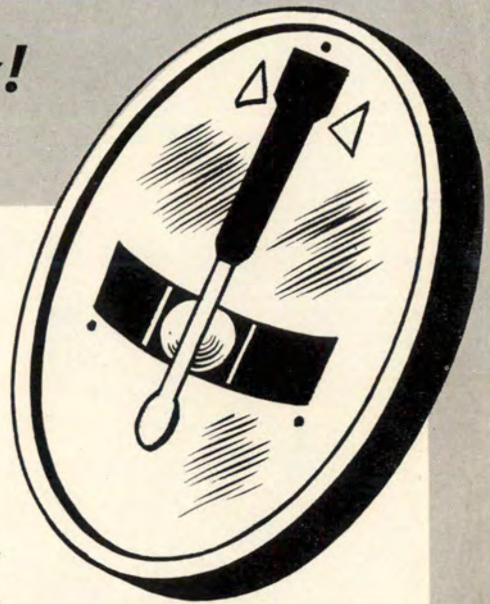
"Our expanding Air Force has placed an abnormal financial burden upon the economy of the nation. Military and commercial genius have banded together to provide us with the best possible aircraft and allied equipment.

"Maximum utilization of this equipment can only be obtained through safety consciousness and safe practices."

Roger Lewis

Assistant Secretary of the Air Force

Know Your True Airspeed vs. Bank!



TAS 150 MPH

Approximately 20 degrees of bank necessary for a standard rate turn.

TAS 250 MPH

31 degrees of bank required for a standard rate turn.

TAS 400 MPH

At this TAS, standard rate turn requires 44 degrees of bank.

TRUE airspeed (indicated airspeed corrected for installation error, temperature and pressure) controls the degree of bank required for a given rate of turn. The illustrations at the left show that, on instruments, standard rate turns at a true airspeed above 250 MPH are impractical because of the steepness of the bank. Also, it should be remembered that indicated airspeed is not a good indication of the bank required to maintain a standard rate turn. For example: On a standard day at 2,000 feet, with an airspeed of 220 MPH, a standard rate turn requires 27 degrees of bank. At 30,000 feet on a standard day and with the same indicated airspeed it requires 41 degrees of bank to maintain a standard rate turn.

BE SMART, FLY SMART WITH FLYING SAFETY!

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