APRIL 1954

FLYING SAFETY

UNITED STATES AIR FORCE

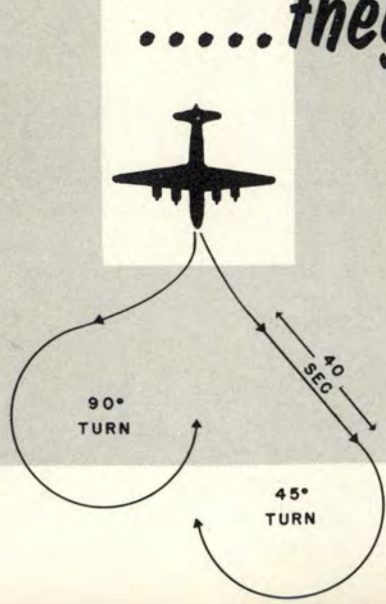
The VOLSCAN Story . . . page 2

They crossed the field

.....they double-crossed it

.....they triple-crossed it....

and still they lost it.



MORAL : PRACTICE LOW VISIBILITY APPROACHES

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FLYING SAFETY

VOLUME TEN
NUMBER FOUR

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Cover: Interlocking steps in the Volscan system.

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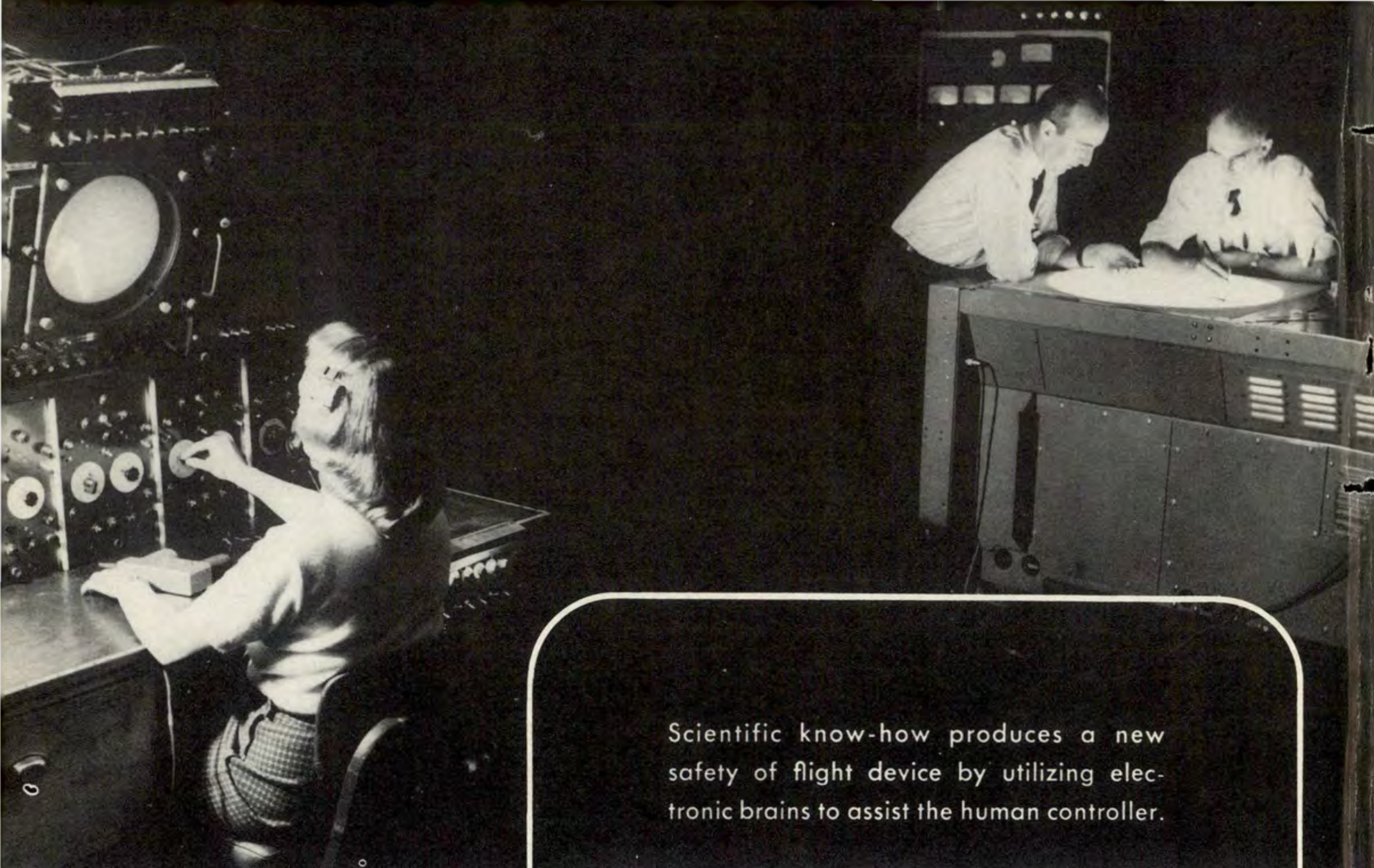
USAF PUBLICATION 62-1

In answer to many requests, Rex Riley appears on page 17. If you know of an accident or incident that would make a good Rex Riley, send it along. Include an outline, date and location. If your recommendation is used, Steve Hotch will send you his original artwork.



Scientific know-how produces a new safety of flight device by utilizing electronic brains to assist the human controller.

Operators chart progress of incoming aircraft.

VOLSCAN

An Electronic Traffic Controller

A TYPICAL news release called it "a revolutionary electronic device for controlling incoming planes at busy air bases. Not radar; rather a combination of electronic tracking and computing units which are capable of automatic control of all planes approaching an airport." That was our introduction to VOLSCAN.

We decided that if this gimmick was half as good as the advertising, the Air Force was well on the way toward solving a knotty problem. Consequently, we packed up our long-johns, overshoes and coonskin coat and headed for Boston, home of the new seeing-eye wonder.

January on the east coast can be chilly. In fact, it's downright cold — but any sacrifice for the readers of *Flying Safety*.

In a well-guarded underground bunker at Fort Dawes, near the entrance of Boston Harbor, we watched VOLSCAN in operation. It was contacting and guiding Air Force planes during test runs in the Greater Boston area. It was a startling demonstration, to say the least.

To an old GCA rider-inner, this system is an eye-opener in every sense of the word. VOLSCAN, developed in secrecy over the past five years, is an automatic system for bringing aircraft into an approach gate at precise intervals of as little as 30 seconds, where the aircraft is taken over by GCA for the final landing.

Thousands of test flights in everything from B-29s to F-86s have indicated conclusively that we're on the right track. If nothing else, VOLSCAN represents a definite step toward licking the stack-up problem and feeding existing landing systems. *Flying Safety* does not claim this is the final answer, but it's by far the best system we've seen to date.

This electronic system automatically does the job of the human traffic controller and with greater accuracy.

Traffic control personnel today are often forced to delay planes for long periods of time because of traffic saturation and stacking. The VOLSCAN system will do much to eliminate these problems, as will be described later.

Let us give you a quick picture of the unit itself before we launch into some of the technical details. You may as well read this report too, for sooner or later you, as an Air Force pilot, will be exposed to VOLSCAN.

The first VOLSCAN unit to be constructed is located on a cold and bleak island overlooking the tossing gray Atlantic. There is little in evidence to mark the site except a conventional radar truck. This bright yellow unit perches on a small windswept hill, its rotating antenna flashing at precise intervals as it twirls in the early morning mists. Outwardly the antenna somewhat resembles that of the familiar AN/CPN-18, which is now standard search radar equipment at many Air Force bases, but in this particular case is mounted on a truck rather than a fixed site.

However, several hundred yards away in an underground bunker are two rooms. One, illuminated only by dim red lights, contains the main control console and radar scope. Here, too, we find a large flat radar display panel also used for recording the performance of aircraft under control.

The other room contains the various electronic devices which make up VOLSCAN's electronic brain — glowing tubes, clacking relays and fast spinning gears. Inasmuch as this was our first glimpse of an electrical brain, we felt a bit shocked. Complex, yes. But still a very compact unit and not as awesome as we'd contemplated.

VOLSCAN is capable of controlling an entire area from one site. Thus, while we watched, aircraft were "fed" into several bases.

When the incoming aircraft were about 60 miles from Boston, they were seen by VOLSCAN's "eyes" — the radar — and their radar echoes appeared on the circular screen of the scopes in the bunker. The screen gives a map-like picture of the entire control area and the planes appear as tiny yellow dots moving across it.

Meanwhile, the planes have told VOLSCAN's "ears"—that is, the traffic operator — to which airport they are bound. The next move is for the operator to point a VOLSCAN Light Gun at the aircraft's signal on the scope. Instantly, a small square of yellow light, called a tracking gate, surrounds the radar blip. Each plane scheduled to land or under VOLSCAN control is inclosed by one of these gates.

As each aircraft's signal moves, the little tracking gate follows it, sorting out its data from that of all other planes and memorizing its position and velocity. These gates are produced by automatic tracking-while-scanning devices called "Antracs," which are VOLSCAN's memory cells. Even if the radar echo fades out, they will continue to move in accordance with their memory of the aircraft's past performance, thus predicting where the plane will appear when the fade has passed.

Just so that you'll get a better picture of this tracking gate, envision a radar blip surrounded by a square or oblong of light about a half inch in length looking something like this:

Remember, even if the blip fades momentarily, the little old gate keeps chugging right along across the screen. This is Antrac hard at work. Its electric memory is working up a storm and sure enough, even after a bad fade, the blip will appear again in the middle of the gate, right where it belongs.

Once the gate is tracking the aircraft's signal, the traffic operator pushes a button that starts VOLSCAN's cortex operating. This device, which is the reasoning and calculating section of the unit's brain, is called Datac. As an electronic traffic manager, it considers the plane's relationship to the airport and to all other traffic under control, and automatically selects a schedule that will permit it to arrive as early as possible at the approach gate and still prohibit a collision with other aircraft.

Safe arrival is the primary consideration and speed of arrival is secondary. Once it has selected the schedule, Datac continuously calculates control orders for the planes, consisting of headings to fly, altitudes, airspeed and the usual instructions such as reduce airspeed, lower landing gear and complete cockpit check.

Datac does not confine the aircraft to an artificial railroad-track type of path in the sky. Instead, it uses the plane's ability to maneuver and achieves its precise timing by changing the aircraft's heading so that it will fly a path just long enough to bring it to the final approach gate within nine seconds of its scheduled arrival.

Since data link (automatic coupling) is not yet available to all air-

The Light Gun places a small, yellow square, called a tracking gate, around aircraft radar blip.

The path of each approaching aircraft is traced.

craft, VOLSCAN now uses relay men, who merely read Datac's orders over a voice radio channel to the point. In this case, no apparatus is required in the aircraft except that which it normally carries. Eventually it is planned that such instructions will be fed directly into the automatic pilot, thus making this system truly automatic, with the pilot acting only as a monitor.

Too Many Aircraft

When a major base is recovering its aircraft after a combat operation, the number of planes in the area can become prohibitively large, especially if there are other air bases in the area. The same problem exists around heavily congested areas where air traffic saturation is acute.

The mass of targets on the scope and the speed at which they are moving create a situation that can exceed the ability of even the most experienced controller using a manual system. He must identify each of these elusive blips, remember its identity while it weaves across the scope, guess at its distance, its speed, its heading, its possible arrival time and issue orders in hope of sliding it into a gap in the evolving pattern. And always hanging over him is the danger of rapidly diminishing fuel in jet aircraft at low altitude.

As we all know, a jet needs a great many gallons of fuel for a single go-around or if it encounters a traffic delay after dropping down to approach altitude. Therefore, once a jet starts its descent, it must be considered committed to land.

Under these conditions the visual estimation of distances from a PPI cannot be permitted except at very low traffic densities when large gaps can be left between aircraft to compensate for possible human errors in estimation. Therefore, automatic computation is the answer to the problem. This must be coupled with automatic retention of identity.

A Closed Loop System

VOLSCAN is an automatic computation and control system. It is not solely radar.

Many Air Force bases are now being equipped with the AN/CPN-18 air traffic control and search radar. These can be connected to VOLSCAN, reporting to it periodically the position of all aircraft in the area.

At the expense of appearing repetitious let us enumerate the advantages of this new system. VOLSCAN includes automatic tracking-while-scanning channels called Antracs. At the control console an Antrac is assigned to each aircraft in the control area. Functioning as an automatic plotter, the Antrac isolates that aircraft's blip, follows its path and continuously reports its exact position to the computer. A channel of the VOLSCAN computer called Datac automatically selects a scheduled arrival time for the aircraft and calculates heading and altitude orders which will make good this schedule. Thus Datac is an automatic controller.

The Datac control orders are relayed to the aircraft by voice or, as noted previously, eventually will be sent automatically by Data Linkage for display on the Zero Reader or injection into the auto-pilot through a coupler.

As the airplane responds to the control orders, the radar reports all changes in its position, thus completing the loop. This closed loop control results in very precise management.

The heart of the VOLSCAN system is the Datac computer. This portion of the unit always selects for an aircraft the earliest possible time of arrival which does not conflict with aircraft already scheduled. Where such a schedule is possible, Datac issues a control order which heads the aircraft along the shortest possible path to the final turn circle, or a longer gradual curve, to establish time separation.

In case there is a conflict with another schedule, Datac selects the earliest later 30-second interval which has no reservation. Datac then orders the pilot to take a heading which is offset from the tangent path heading. Thus, as the aircraft progresses along this longer path, it is being delayed. As delay time drops, the magnitude of heading offset gradually reduces until finally, when the delay has all been taken, the aircraft, now on time, is on a tangent path.

In this way, by controlling aircraft headings, delays are gradually used up, and the aircraft are delivered to the entry gate with precise timing.

If this latter bit of information threw you for a loss, just look over the diagram entitled "VOLSCAN Heading Control." You'll note that each inbound flight path varies slightly. The aircraft closer to the entry gate are flying straighter paths. Those farther out are following greater curves. End result: they all arrive at the gate on time and properly spaced.

VOLSCAN can deliver aircraft to a final approach entry gate at the following rates — Jets: 120 aircraft per hour. Conventional: 100 aircraft per hour. The rate for mixed aircraft is lower than either type separately since aircraft must not pass one another either along the common landing path or in the funnel immediately preceding it.

Adaptable and Flexible

VOLSCAN has been designed to integrate with existing and proposed USAF equipment. It does not require separate radar; it can be connected directly to any AN/CPN-18 unit. VOLSCAN can feed either GCA or ILAS with equal ease. It can function also without any final landing aid if weather conditions permit a minimum of 1000 feet and two miles visibility. These are arbitrary minimums established for test purposes only.

The tracking and computing equipment that make up VOLSCAN may be utilized in building, block fashion, to meet the needs of any particular installation. For example:

To achieve a traffic rate of 60 aircraft per hour with simultaneous automatic control of seven aircraft requires one Traffic Console and seven Antrac-Datac channels. If the traffic at this base increases, one additional console and seven additional channels can be added easily to give the full rate of 120 aircraft per hour with 14 planes under simultaneous automatic control. Thus the system can grow with the base.

Furthermore, one VOLSCAN channel contains only 60 tubes. Since a VOLSCAN air base installation consists principally of a number of such channels, it is not necessary to provide too many spares; each is a spare for the other. Therefore, maintenance is reduced to servicing a small number of simple circuits repeated many times—a far easier problem than most electronic installations.

We hope that we've made VOLSCAN's operation fairly clear to the uninitiated. We know that it sounds somewhat complex, but one visit to a control center or one in-flight utilization of the system will make a believer out of any skeptic.

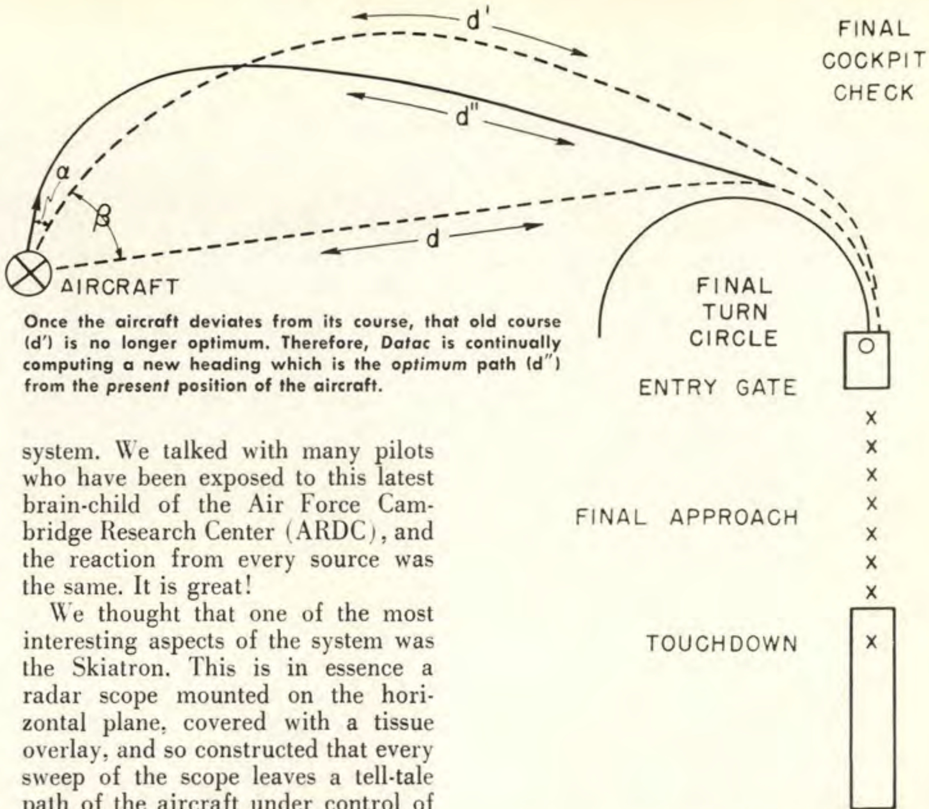
We had a long chat with Captain Bob Deiz, who has flown hundreds of runs, day and night and in all types of weather, on the VOLSCAN system. He's enthusiastic about the whole project and reports that it requires no special training — any pilot with a valid instrument card is qualified to fly it. There are no complicated holding procedures over a radio fix or on a beam leg. The approach to line-up with the runway is a smooth turn and gradual steady descent. The entire run from the beginning to GCA touchdown is a carefully polished, integrated operation.

Captain Deiz has a favorite story about VOLSCAN that we feel is worth passing on:

"To illustrate the need for the VOLSCAN system," he began, "one morning I took off with a 300-foot ceiling and proceeded to the VOLSCAN practice area. In one hour and 45 minutes I had made four VOLSCAN letdowns to VFR, in one case breaking through the ceiling at less than 100 feet. On leaving the practice area, I could not get a definite altitude assignment to the home station range, but was assigned 500 feet on top, which put me at 9000 feet.

"Arriving over the range I was notified that since I was eighth in order, my approach time would be one hour and 20 minutes later. During the period of holding, three jet aircraft arrived over the range and were placed ahead of all other traffic. It was not until one hour and 45 minutes after I reported over the high cone that I was able to land. VOLSCAN, 32 miles from there under the same weather conditions, could have landed all 11 of the various types of aircraft in less than 12 minutes."

Captain Deiz's story is typical of those who have flown the VOLSCAN system. We talked with many pilots who have been exposed to this latest brain-child of the Air Force Cambridge Research Center (ARDC), and the reaction from every source was the same. It is great!



Once the aircraft deviates from its course, that old course (d') is no longer optimum. Therefore, *Datac* is continually computing a new heading which is the *optimum* path (d") from the *present* position of the aircraft.

We thought that one of the most interesting aspects of the system was the Skiatron. This is in essence a radar scope mounted on the horizontal plane, covered with a tissue overlay, and so constructed that every sweep of the scope leaves a tell-tale path of the aircraft under control of the console operator. The Skiatron operators can chart the progress of incoming planes and, by following the various flight paths, insure that there is no danger of collision. Every airplane under control leaves a purple trail visible on the tissue-covered viewing face of the scope, and the operators can actually "see" where every airplane is at any given moment. By tracing the flight-path trails with pencil, it is possible later to analyze all runs for accuracy and comparison purposes.

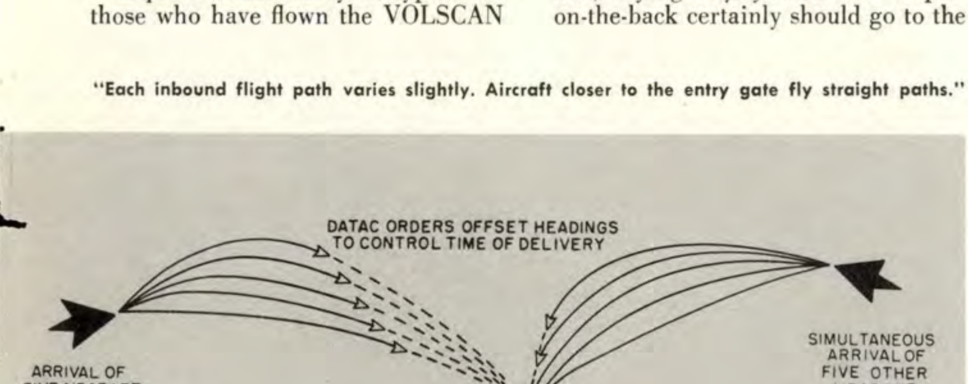
Just to give credit where credit is due, *Flying Safety* feels that a pat-on-the-back certainly should go to the project scientist who spark-plugged VOLSCAN. The entire project has been under the direction of Benjamin F. Greene, Jr. This genial giant of a man (a mere 240 pounder) is known to everyone as "Ben." He's a likeable, energetic sort of a guy who is completely wrapped up in his work and has spent the past five years in the development of VOLSCAN. We found that it didn't matter if one was wearing stars on the collar or stripes on the sleeve, Ben would launch forth into long and detailed discussion of VOLSCAN's possibilities at the first question. And, his answers are both interesting and understandable.

We do not wish to imply that VOLSCAN is any one man's brain-child. It certainly isn't. Cambridge is staffed with many brilliant electronic specialists, and they all had a part in the development of this new system. Basically, however, VOLSCAN isn't new. These experts have merely taken existing know-how and strung it together in the form of a new unit.

You can already see that this system, if adopted, can lead to drastic changes in present Airway Traffic Control procedures. *Flying Safety* will endeavor to keep its readers posted on all new development. If new ATC procedures finally become a reality, we shall bring them to you just as quickly as possible.

Remember the name VOLSCAN. We feel certain that you'll be hearing it used with increasing frequency. ●

"Each inbound flight path varies slightly. Aircraft closer to the entry gate fly straight paths."



DITCHING

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THE Coast Guard, because of its long experience in landing seaplanes in rough water — both on rescue operations and in controlled tests — has always maintained a vital interest in ditching problems. As a result, we have developed certain procedures which now are accepted universally as standard by seaplane pilots. In most respects the landing of a seaplane and the ditching of a land plane at sea are similar, and these procedures can be applied to both. A study of numerous reports of ditchings by aircraft tends to confirm this.

Only a few years ago most pilots faced with a ditching situation simply turned into the wind and splashed in, often with rather drastic results. Today our pilots make a careful analysis of the sea and swell systems before selecting a landing heading; for in most cases the swell system, not the wind, is the governing factor.

A proper selection of landing heading may well be the difference between a smooth, easy ditching and a disastrous crash. Many pilots consider a night ditching to be a rather hopeless situation, but with proper procedures it is far from hopeless.

In a controlled ditching, even under very adverse conditions, the probability is that no one will be seriously injured on impact. Some may be lost evacuating the aircraft if panic is allowed to develop or the crew is not properly indoctrinated in evacuation procedures, but even this loss can be cut down with proper training. Once evacuation of the aircraft is accomplished, and with proper use of survival gear, rescue is virtually assured.

All this, however, depends upon a successful ditching, which in turn is dependent on the ability of the pilot to evaluate the sea and select a proper ditch heading. Considerable material on sea evaluation and day ditching has been presented in the past; therefore, this article will cover ditching under night and instrument conditions.

We may assume that a night ditching will occur when the distressed aircraft is alone, under escort of another aircraft or near a surface vessel. If the distress was reported promptly, the escort aircraft summoned will be a search and rescue aircraft, dispatched with necessary equipment. We can further assume that if the pilot has any choice in the matter, he will elect to ditch beside an ocean-station vessel which is trained and equipped to handle a ditching aircraft.

First let us examine a situation wherein the distressed pilot is by himself. To accomplish a successful ditching he must have information on sea condition and winds in order to select a suitable ditch heading.

If trouble occurs shortly after darkness, he may have a good idea of his best ditch heading from having observed the sea during daylight. We encourage our pilots to study the sea constantly during daylight hours and mentally select the heading they would choose if they had to sit down. This is not only good practice for seaplane rescue pilots, but it is good insurance for any pilot flying over the water. The chances are, however, that a pilot has not the slightest conception of the sea conditions if he has been flying at altitude and in darkness. He then must get the information on sea conditions from someone else, or he must see them for himself by flare illumination or perhaps by moonlight. Fortunately many ships at sea, and of course the weather ships, send in frequent weather reports including the sea conditions; this information can be obtained through the controlling Air Traffic Control Center. If they do not have it immediately available, they should be able to obtain it from the Rescue Coordination Center.

In a recent case, off the California coast, a pilot on a cargo flight lost two engines and realized that he would

This is the first of two articles dealing with ditching under night and instrument conditions.

by L/Cdr. John W. Waters, Jr.
U.S. Coast Guard

be forced to ditch at night some 300 miles off shore. He requested a sea condition forecast. This was given by the Rescue Coordination Center on the basis of the best information available. The pilot set the DC-4 down in a beautiful night ditch without benefit of illumination. All personnel evacuated the aircraft and were picked up shortly thereafter.

It is apparent, however, that a sea forecast, based on scattered ship reports and under changing weather conditions, is subject to error. It would be far better if the pilot of the distressed plane could look at the sea himself.

In our search for a method to accomplish this, we assumed that our distressed plane would have only two flares available; this is the allowance usually carried by military aircraft (other than SAR types) and certain commercial operators. We also assumed that if the plane were in a ditching situation, its ability to maneuver would be restricted. The flares used were 600,000 candle-power aircraft parachute flares, Mk. 5, which have a burning time of three minutes.

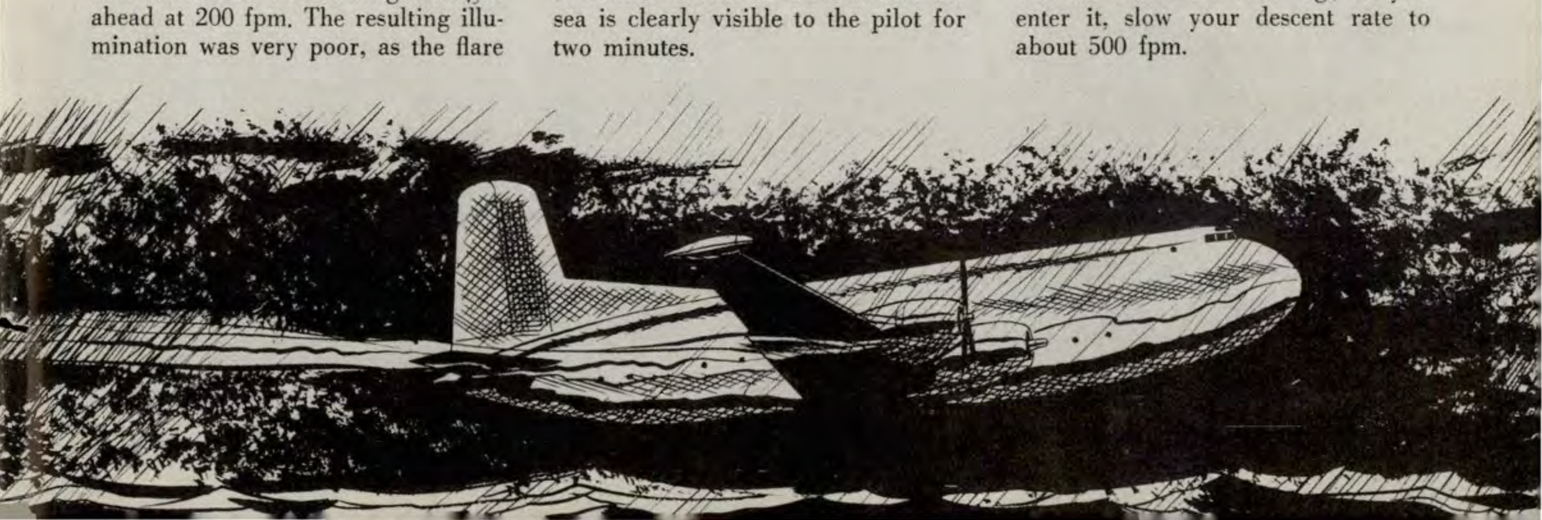
To reduce maneuvering requirements, we tried dropping the flare at 2500 feet and descending straight ahead at 200 fpm. The resulting illumination was very poor, as the flare was astern and the water is only lighted between the observer and the flare.

We next tried dropping the flare at 2500 feet and circling the flare in a fairly tight descending turn. The water could be seen fairly well, but this method met with some objection from pilots who pointed out that it is difficult to evaluate the sea accurately when in a constant turn. Control of a crippled aircraft in such a turn was also pointed out as an additional handicap. With a low wing aircraft, the wing also tends to block vision in a constant turn.

The method finally settled on was a modification of one which was recommended by Coast Guard units in the Pacific. This consists of dropping a flare at 3000 feet, set to ignite 300 feet below the aircraft. After the flare is dropped, the plane is held on course for 10 seconds and then turned 90 degrees left, losing 300 feet in the turn. After rolling out of the turn, course is held for 30 seconds, then a turn of 180 degrees to the left is made, losing 600 feet in the turn. The flare is then dead ahead. The plane will pass the flare about 40 seconds after rolling out of the turn. The entire procedure takes two minutes and 50 seconds and the sea is clearly visible to the pilot for two minutes.

Only two turns are needed, both descending: this allows for a safe margin of airspeed even with a crippled aircraft. If the aircraft is capable of climbing again, the pilot can judge the sea better by descending below 2100 feet. A word of caution on passing the flare: the flare always looks closer than it is, but to play safe pass it to the side. Look down at the water, not directly at the flare. After passing the flare, shift back to instruments.

After the sea condition has been determined, choose your ditching heading. Then take up a heading 90 degrees to the left of the ditch heading, altitude still 2100 feet, and get set to ditch. Cockpit check should be made and all preparations for ditch completed. When ready, drop the second flare and remain on the heading for 10 seconds, commencing descent at 1500 fpm. At the end of the 10 seconds, turn 90 degrees to the left, still descending at 1500 fpm. When this is completed, you will be on the reciprocal of the landing heading or the downwind leg. Hold this leg for 30 seconds, continuing the descent. At the end of this 30-second leg, turn 180 degrees to the left. This turn might well be called the base leg; as you enter it, slow your descent rate to about 500 fpm.



From this point on, the approach will be by visual reference. As you approach the water, slow your rate of descent further and roll out of the 180-degree turn at about 200-300 feet, with the flare 40 seconds ahead. Ditch straight ahead by the light of the flare.

It cannot be emphasized too strongly that the pilot must touch down before reaching the flare. If the plane is held off the water too long, it will overshoot and pass from the area of good illumination into darkness, with results which can be imagined. The best touchdown point is about 400 yards short of the flare. There must be no hesitation in getting the plane down to the water. Landing lights may be used at the pilot's discretion, but are not recommended as they are of little help and produce a blinding glare.

It should be noted also that a rapid descent in the early stages of the letdown will allow a gradual descent near the end with less chance of inadvertently flying into the water. We recommend left turns, because the aircraft commander is usually in the left seat, and this allows him to observe the sea during the entire approach.

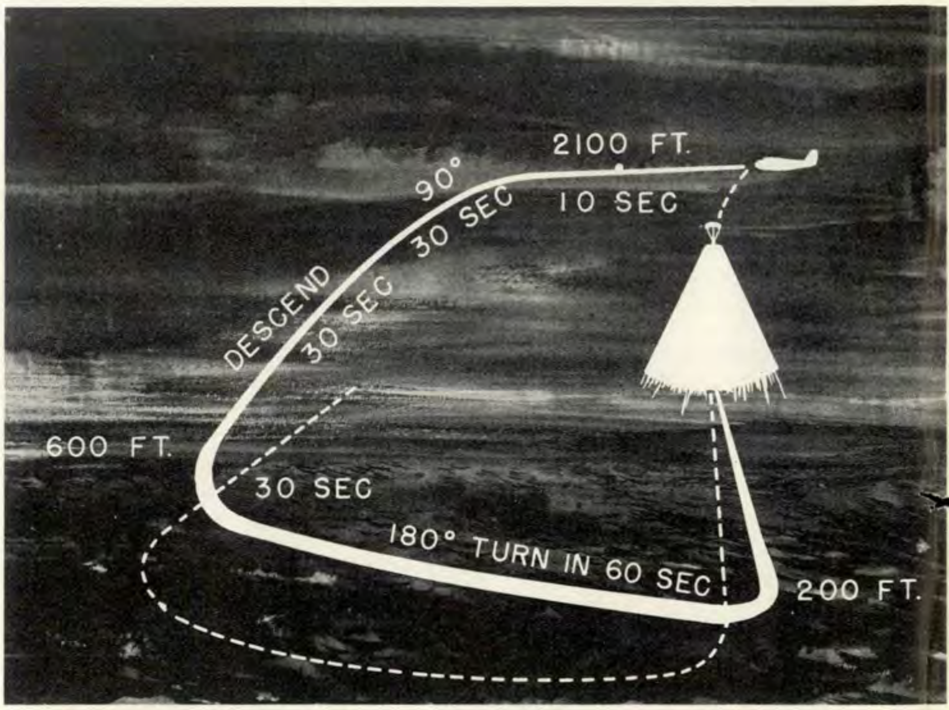
If the pilot of a distressed aircraft is fortunate he may have an escort with him at the time he ditches. This escort may be any commercial or military aircraft that happens to be in the vicinity, or it may be a search and rescue aircraft with special equipment.

In order to find the most suitable way for an escorting aircraft to assist a distressed craft to ditch at night, a series of tests were conducted off Bermuda using one of our aircraft as the escort and another as the distressed plane. From these tests we derived a method which we consider simple, easy to explain and effective.

After intercept, the escort takes station one mile astern and 500 feet above the distressed plane. This provides good radar reception, for visual contact is very difficult to maintain at night or in clouds when the aircraft is ahead of the escort. From this position, the escort can commence his illumination plan at any time it becomes necessary.

If ditching becomes imminent, the escort remains one mile astern but does not descend below 3000 feet. The altitude of the crippled plane is immaterial as long as the plane is below 2000. The escort requests the distressed aircraft to execute a 360-degree turn, rolling out on the original heading. The distressed aircraft commences the turn, giving a mark at the time of turn. The escort continues on course, and as it passes the point where the distressed plane rolled into the turn, releases two parachute flares and a smoke float. When the cripple has completed about 100 degrees of the turn, the flare will light, and the surface of the sea will be visible during the remaining 90 seconds of the turn. This time should be used to evaluate the sea and select a ditch heading. After completing the 360-degree turn, the distressed aircraft rolls out on the original heading; the escort aircraft ditch heading, dropping a flare and a smoke float as it starts the turn. This is primarily to mark the turn point for the crippled plane, but it also gives the cripple an additional minute to look at the sea. As the crippled plane reaches this flare, it turns onto the selected ditch heading also. The rescue aircraft is three miles ahead when the turn is completed.

At this time the distressed aircraft can commence descent for ditching. When the distressed plane calls for illumination (usually at about 300 feet



Recommended procedure when aircraft is ditched under its own flares.

is now about three miles ahead. (During the entire operation, the escort transmits signals on a homing frequency of 514 kc, and the distressed aircraft, by tuning the ADF to this frequency, will always know where his escort is.) The escort aircraft is now in a position to commence illumination when called for; and if the present heading is suitable for ditching, no further turns will be necessary. The probability is, however, that the pilot of the distressed plane will select another heading for ditching. In this case, he advises the rescue plane.

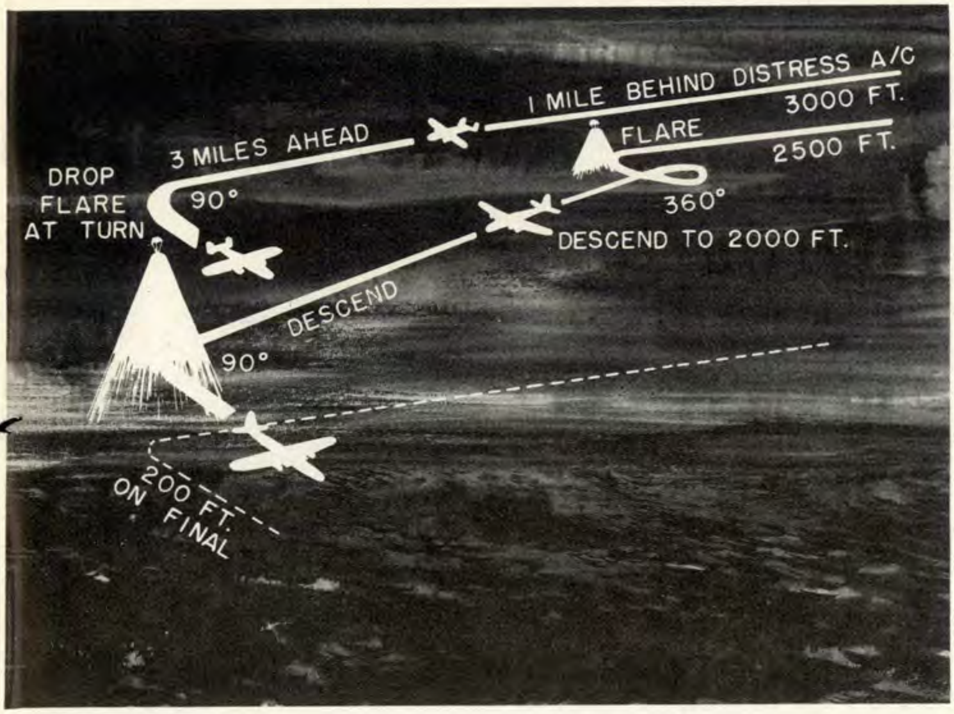
The rescue plane then turns to the altitude), the escort drops a line of five flares at 1000-yard intervals. With each flare a smoke float is dropped. The first flare will ignite two and a half miles ahead of the distressed aircraft, and all five will be burning when it is one mile out. The illumination totaling three million candlepower is excellent, and the distressed aircraft can ditch under conditions approaching daylight.

The escort aircraft, after dropping the fifth flare, turns rapidly to the left and parallels the flares on the reciprocal of the ditch heading. From this position the pilot can watch the distressed plane ditch and observe the impact point with reference to the string of smoke floats. Immediately after the ditching, the escort continues around in a race track pattern and drops a string of five more flares. There are now 10 flares, totaling six million candlepower, illuminating the scene while the ditched plane is being evacuated.

After dropping the second five flares, the escort commences a rapid descending turn to the left, passing under the flares and over the survivors

In discussion with a number of experienced airmen, both military and commercial, who have actually flown through this procedure, I have encountered only one objection. They believe the rescue plane pilot should make the sea evaluation and select the ditch heading, rather than the distressed pilot. Their reason for this belief is the general inexperience of the average land plane pilot in sea evaluation. We have agreed to modify the procedure to allow the rescue pilot to evaluate the sea. This is accomplished

Recommended procedure when ditching area is illuminated by escort aircraft.



at an altitude of 100 feet, dropping both bomb bays of survival and flotation equipment a few feet upwind. This drop will occur about four minutes after ditching, when all survivors should be out of the plane and still well grouped. Single flare drops are continued until all survivors are in rafts. We have thus provided for sea evaluation, illumination for ditching and evacuation of the aircraft, flotation and survival gear for survivors and a guard over the survivors until surface rescue units arrive, or until daylight when on open sea landing can be made by the rescue seaplane.

by having the rescue aircraft execute a 360-degree turn for sea evaluation when dropping the first flare. The distressed aircraft will then be required to make two 360-degree turns instead of one, as the rescue aircraft must still move out ahead the required distance.

The more satisfactory solution, of course, is to have every pilot who regularly flies the ocean familiar with sea evaluation procedures and selection of ditch heading. In the procedure just discussed we have assumed the escort to be an SAR plane. But suppose the escort is a commercial aircraft which happened to be in the vicinity at the time. This has happened on several occasions.

If the escort has parachute flares, it can use a modification of this procedure knowing that it will have only two flares. One of these should be used for sea evaluation and the other for final ditching. If the escort has no flares, it can assist by dropping down low and estimating the sea by whatever light is available. Use of landing lights is, however, a hazardous and doubtful procedure, and not to be undertaken lightly. Once the distressed aircraft has ditched, the aircraft must fix the position and remain on top as long as possible, dropping available survival gear.

There is one other possibility if two or more SAR planes are en route to intercept. The plane nearest the distressed unit will continue and complete the intercept, while the other SAR plane evaluates the sea by means of flares and advises the distressed plane of the best ditch heading.

The question will probably arise as to the effectiveness of this procedure during conditions of low ceilings and reduced visibility. To be frank it is only fair, but still far better than no illumination at all. In clear weather the flare is normally dropped at 3000 feet. It ignites at 2700 feet. If there is a low ceiling, this procedure must be modified; otherwise the illumination from the flare will be dissipated long before the flare drops below the base of the cloud. With a ceiling of 600 feet, for example, we would wish the flare to burn out at 400 feet, or 200 feet below the base of the clouds. This is accomplished by dropping at 2100 feet instead of 3000. While it burns only about 15 seconds below the cloud base, it will give off considerable illumination while still in the cloud, due to diffusion of the light.

It is not recommended that the flare burn below 400 feet in any case, due to the blinding effect and danger of igniting gasoline on the water after ditch. In this connection you may object to the smoke floats we drop as a potential fire hazard because of the open flame. Tests show that flares drift away from the smoke floats. If a ditching is made under the flares, you will be clear of the smoke floats, which, however, will be invaluable as a reference for the impact point. In this article, I have been referring to the U. S. Navy Mk. 5 parachute flare. If a different model is used, procedures must be modified as necessary to fit the performance of the flare. ●

PLANNED for the PILOT

The Zero Reader — How it works and how to use it.

By George Huss
Field Service Engineering
Sperry Gyroscope Company

MILITARY pilots are, as a rule, expected to participate in the most exact kind of flying. There is little or no room for error. Aircraft speeds are faster. Performance is higher. Missions are more complex. A pilot handles more information. But less time is available to receive, interpret and use this information.

Concepts that simplify this information problem are much sought after. The problem is almost as old as the instrument panel. Many attempts have been made to meet this challenge and almost as many new instrument concepts have ended up in the museum.

Two approaches have been common. One has been to design indications that make it easier for the pilot to visualize his flight path. Another has been to combine indications to gain more efficient presentation and to save panel space. Both are based on presenting existing facts about actual attitude and position of the aircraft to the pilot. After visualizing his flight path he must decide what to do.

Now, a new concept has been introduced. It tells the pilot what to do — how to move the stick to attain and hold the desired flight path.

This principle originated in the Zero Reader Flight Director developed by the Sperry Gyroscope Company in 1948. It has proved thoroughly successful in the worst of weather flown by the Air Transport Association, Sperry flight research aircraft, and the USAF All-Weather Flying Division. Today this basic instrument is being employed both as a flight instrument and as a low-approach instrument in many types of aircraft, particularly in USAF interceptors.

The flight director tells the pilot how to accomplish something that has not yet occurred. It directs him into the desired flight path. This is how it works:

The flight director combines information from the basic flight and navigation instruments; yaw from the directional gyro, heading from the compass, roll and pitch from the vertical gyro or gyro horizon, altimeter data and the radio navigation information of the localizer, glideslope and VOR. From this, it computes the control information necessary to direct the pilot into the desired flight path. This information is presented on a simple two-element indicator that tells the pilot directly how to move the controls to reach and maintain this path.

Operational Principles

Except for controlling speed by application of power or speed brakes, control of the aircraft can be reduced to two elements; turning right or left and nosing up or down. This is true of all phases of flight, including precise instrument flying, air traffic control, radar interception and instrument approaches and landings.

This principle is fundamental to operation of the flight director. The indicator gives only two instructions: Fly Right or Left and Fly Up or Down.

The pilot finds that as soon as he has moved the controls enough to give the amount of pitch or bank computed by the flight director, the indicator zeros immediately. As long as he moves the stick to hold the indicator on zero, his airplane will turn neatly into the desired climb, heading, track or other desired flight path without any overshoot. It will hold the plane on the path as long as the indicator is zeroed. Further, if diversions cause him to stray from the desired path, simply moving the stick to zero the instrument again will promptly bring him back.

The revolutionary feature of the flight director is that the pilot is provided with an indication that permits him to fly and navigate the airplane manually with a degree of accuracy, precision and ease that approaches the performance of automatic control. Hunting and overshooting of the desired flight path are eliminated.

In the past, the pilot flying manually has been obliged to consider the values of five different elements of flight and navigation information: altitude, heading, pitch and bank attitude, localizer deviation and glideslope deviation. He has had to take these values, some or all of which may at any one time be in continuous change, weigh them against one another, and calculate the necessary movements of the controls. These calculations have had to include the rate at which the actual flight position and attitude approached the desired conditions so that anticipatory movements of the controls could be made. The flight director makes all of these calculations automatically. No anticipation is necessary. The pilot merely follows the indicated pitch and bank commands directly as they occur.

Evolution of the flight director to meet special requirements of different aircraft operations has produced three versions for use in military aircraft. Type A-2 is the one in principle use today. This consists of four major components: indicator, selector switch, control and radio rate unit. The A-2 indicator is a panel-mounted instrument which combines the indicator element and the heading selector of an earlier commercial version. This indicator has two distinct advantages. Heading information is presented on a large, easily read dial, built around the indicator element, and the combination precludes mounting the heading selector in an inconvenient cockpit location.

The selector switch can be mounted in any location that is easily accessible to the pilot during flight. The control and radio rate unit are usually inclosed in a remote section of the aircraft.

The sensing of the indicator is such that the pilot always flies the center of the indicator toward the bars. For example, if the horizontal bar is two marks above center, the pilot raises the nose of the aircraft by back pressure on the stick or control column until the bar returns to zero. If the vertical bar is displaced to the right the pilot banks the aircraft to the right.

It is important to note here that the indicator can read zero on both the horizontal and vertical bars, and yet the aircraft will not necessarily be level laterally or longitudinally. This is because the instrument does not give any fundamental data as to what the aircraft is doing. It only

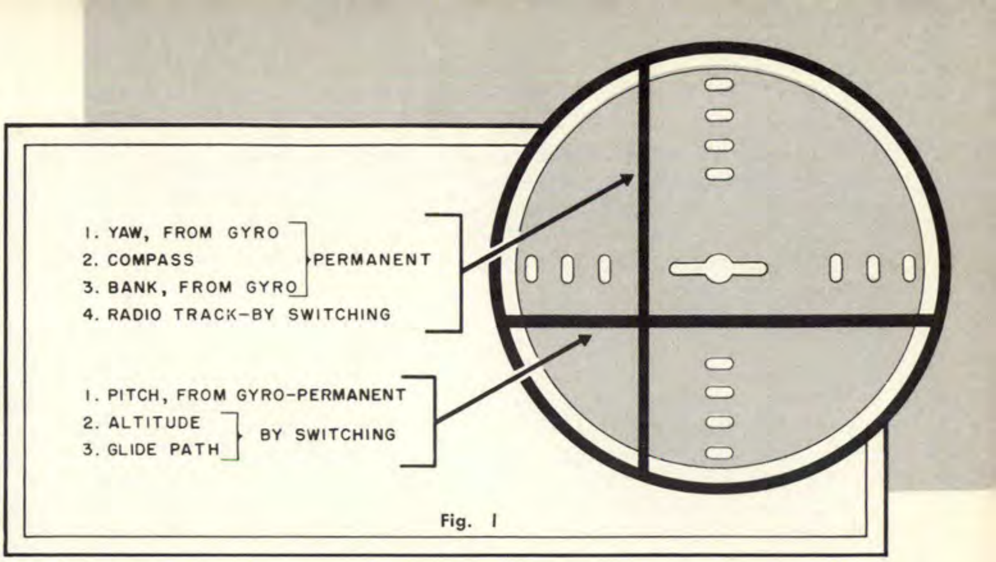


Fig. 1

indicates to the pilot that he is flying according to some pre-selected plan.

Control Limits

To what extent will the flight director allow you to change the attitude of the aircraft and still remain on zero? This has all been precomputed within the control unit of the flight director system. The limits have been determined from actual flight test data taken under the most adverse weather conditions by both the All Weather Flying Division of the Air Force and the Sperry Flight Research Department. The limits chosen were approximately 30 degrees of roll for jet aircraft and approximately 25 dgerees for transport aircraft. The pitch limits are 10 degrees for both jets and transports.

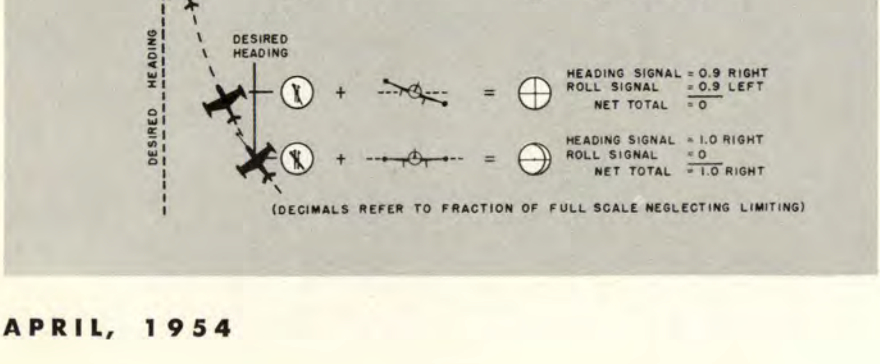
Operational simplicity of the flight director is presented in Figure 2, which shows how to turn to a new heading. Assume that a takeoff has been made on a runway heading of 250 degrees and the desired heading after takeoff is 160 degrees. After the aircraft becomes airborne, gear and flaps retracted and a minimum safe altitude attained, set the desired heading on the flight director. This causes the vertical bar of the indicator to deflect to the left. This vertical bar deflection tells the pilot to Fly Left! As the aircraft begins to bank, the needle begins to return to center or zero. When the vertical bar returns to zero, no further bank is required. The bank angle is in the neighborhood of 25 to 30 degrees, as determined by monitoring the gyro horizon.

When the airplane begins to approach the desired heading, the needle begins to move slightly to the right, indicating that the bank should be decreased sufficiently to return the needle to zero. Nearing the desired heading, the heading signal demand diminishes; therefore, the computed bank angle also diminishes. A computed presentation of this type results in a smooth, pre-planned and ever decreasing turn to a new heading.

Throughout this maneuver no anticipation of the instrument is required of the pilot. There is no lag or lead. The turn is completed exactly at the point planned as the flight director is relieving the pilot of a series of mental computations.

The flight director system does not replace any of the conventional instruments normally mounted on the aircraft panel. It does, however, relegate these instruments to a standby or monitoring system. The flight director reduces the required instrument scanning time to a minimum. The pilot has more time to attend to radar, navigation, gunnery, bombing, fuel scheduling or any other problem

Fig. 2. This illustrates the proper way to use the Zero Reader to turn to a new desired heading.



necessary to accomplish the mission. Fundamentally the flight director is a flight instrument. It is designed to make accurate instrument flying easier and more feasible for pilots under the most adverse weather conditions

Flight Director Versatility

The versatility of the flight director is such that many uses can be made of it. Excluding the more special applications, the following are some of the common or conventional uses for the flight director:

- Instrument takeoff.
- Turn to initial GCI heading and transition to best climb speed.
- Climb and transition to level flight.
- Expediting turns made to new headings.
- Descent and transition to level flight.
- Accurately maintaining altitude.
- Flying VOR radials.
- ILAS approaches.
- GCA approaches.
- VOR and L/MF range approaches.
- ADF approaches.

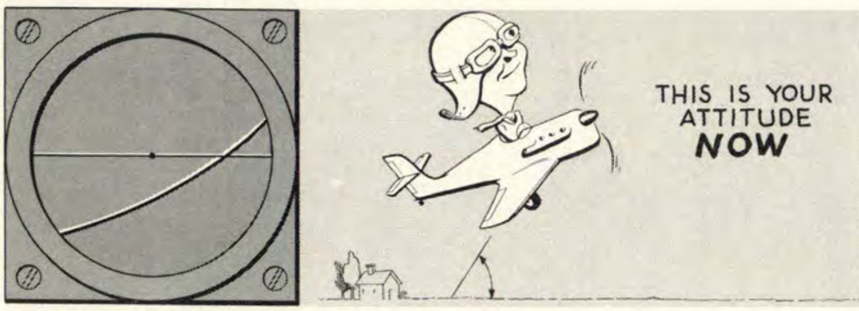
It is beyond the scope of this article to go into detailed procedures of all these uses, even though the flight director can be used to equal advantage in each. The following ILAS approach can serve as an interesting example of how the flight director can enable the pilot to succeed under adverse weather conditions. This example deliberately avoids what is considered a standard ILAS approach to emphasize the versatility of the flight director. It points out how an approach procedure can be adapted to fit traffic or geographical problems that may exist in any location.

Assume that a jet aircraft is returning from a mission in which the fuel supply is nearly exhausted. The aircraft is at an altitude of 25,000 feet and there is a solid overcast from 20,000 feet to 500 feet. The pilot is flying a heading of 240 degrees, homing on the middle marker of the ILAS system by means of ADF and is cleared for approach. The flight director is set to 240 degrees, the selector switch set to FLIGHT INSTRUMENTS and the altitude control is on.

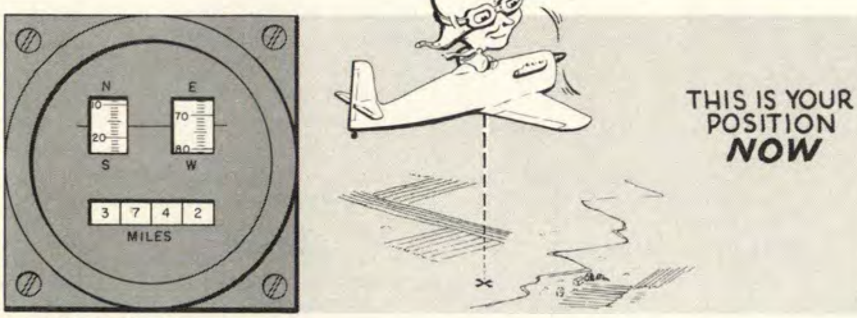
Referring to Figure 3, note that from A to B is approximately 15 miles. While flying from A to B the pilot is concentrating upon his radio, map, fuel scheduling and checking altitude while maintaining attitude. From B to C the pilot wants to maintain the exact heading that he had been flying prior to arrival at point B. During this time he is tuning his ADF to the LOM frequency. He desires a radio bearing to the outer marker which will give him an intercept angle with his present heading at some point beyond the outer marker where he can start a standard rate turn to the right to intercept the beam edge. Also, during this phase of the approach the pilot is concentrating upon any configuration changes of the aircraft, any additional radio tuning that may be required, watching his fuel supply and making his letdown.

Descent and Approach

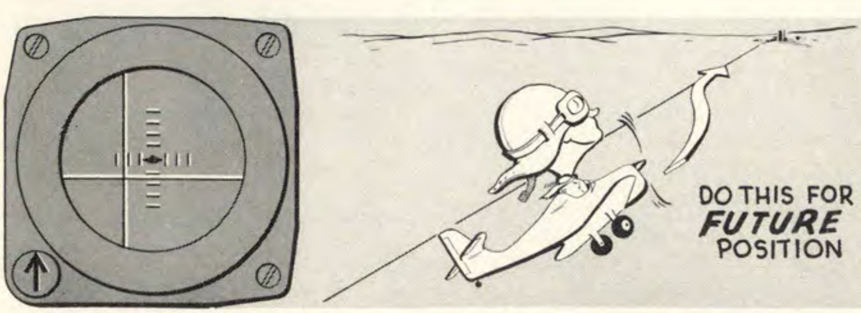
The descent is accomplished by setting the desired nose-down angle in on the pitch attitude trim knob of the indicator and then zeroing the horizontal bar. The pilot now intersects



FLIGHT INSTRUMENT

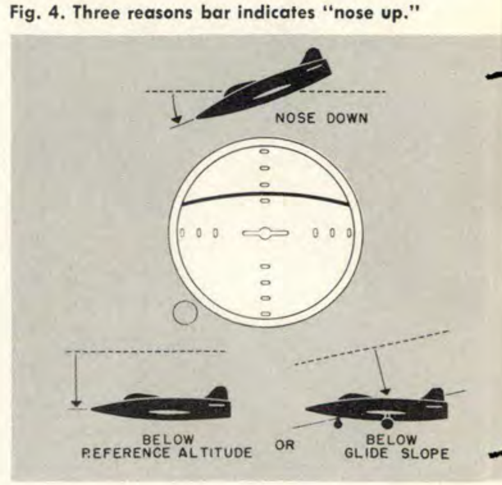


NAVIGATION INSTRUMENT



FLIGHT DIRECTOR

Fig. 4. Three reasons bar indicates "nose up."



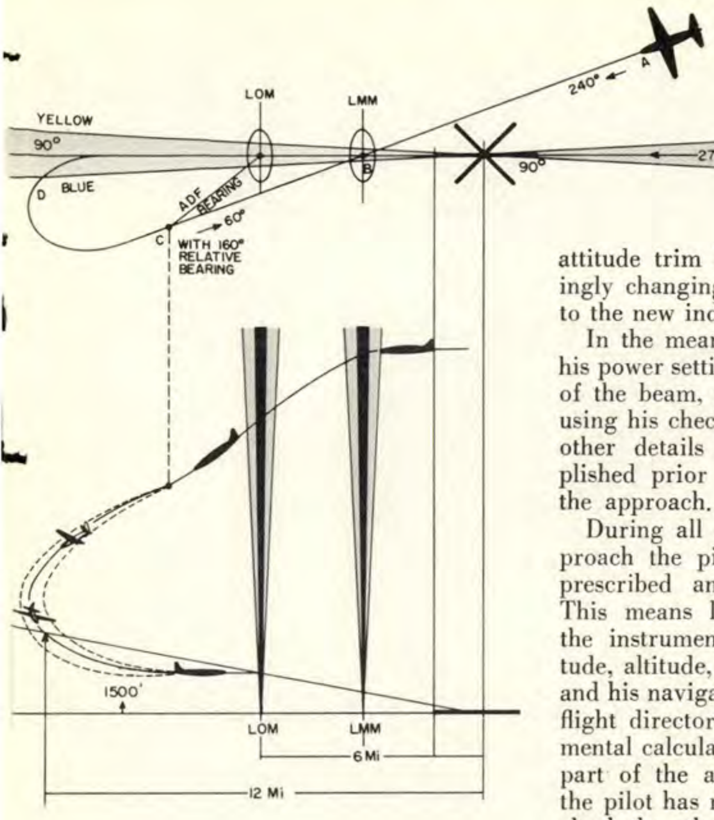
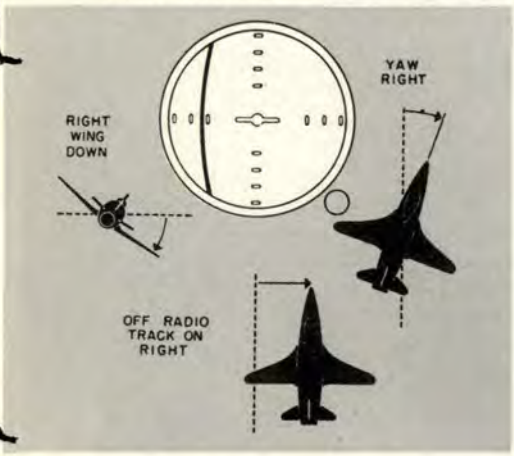


Fig. 3. A diagram of flight described in text.

his radio bearing to the LOM at point C and immediately starts a standard rate turn to the right. After initiating this turn, the pilot inserts a heading of 60 degrees on the flight director and flies the bars to zero. This means that the pilot is turning with a bank of 30 degrees and still descending at the rate he initially established. If he desires to change the rate of descent he can do so by increasing or decreasing the position of the horizontal bar with the pitch attitude trim knob, and correspondingly changing the pitch to conform to the new indication.

Fig. 5. Reasons bar indicates "turn right."



In the meantime, the pilot adjusts his power settings, listens for the edge of the beam, makes his final checks using his checklist and attends to the other details that must be accomplished prior to the final phase of the approach.

During all of this part of the approach the pilot has time for only prescribed and mandatory actions. This means less time for scanning the instrument panel to check attitude, altitude, rate of climb, heading and his navigational instruments. The flight director alleviates most of the mental calculations necessary for this part of the approach, which means the pilot has more time to accurately check the other requirements to complete his approach successfully.

At point *D* the pilot intersects the edge of the localizer beam. Immediately, he inserts the runway heading of 90 degrees on the flight director and couples to the localizer by turning the selector switch to Blue Right. Also, he watches his altimeter to determine the final approach altitude at which he must intercept the glide path. Once the altitude has been reached, he simply turns the altitude control on and reduces airspeed to gear and flap speed before reaching the outer marker. The descent signal inserted previously no longer is operative because the altitude signal has taken over.

The aircraft now approaches the glide slope as noted by the movement of the glide slope needle on the deviation indicator. When the needle of the deviation indicator reaches on course the selector switch is turned to APPROACH. The aircraft is now coupled through the flight director to both the localizer and the glide slope. The pilot concentrates upon keeping both the vertical and horizontal bars on zero, while monitoring the primary instruments.

As the approach continues, the localizer and glide slope deviation will be approximately on course. At the outer marker gear and flaps are extended and the aircraft is slowed to final approach speed. Drift on final can be estimated from the tower's reported surface wind. Correct the approach heading of 90 degrees for this drift. For example, if a crosswind of 10 knots exists and an approach speed of 120 knots is used, the estimated drift will be five degrees. Set the heading selector to either 85 degrees or 95 degrees, depending upon whether the drift is left or right. Computations for drift should be made prior to arriving at the middle marker. In the type A-2 flight director this drift correction is taken care of by the radio rate unit automatically when the selector switch is turned to APPROACH.

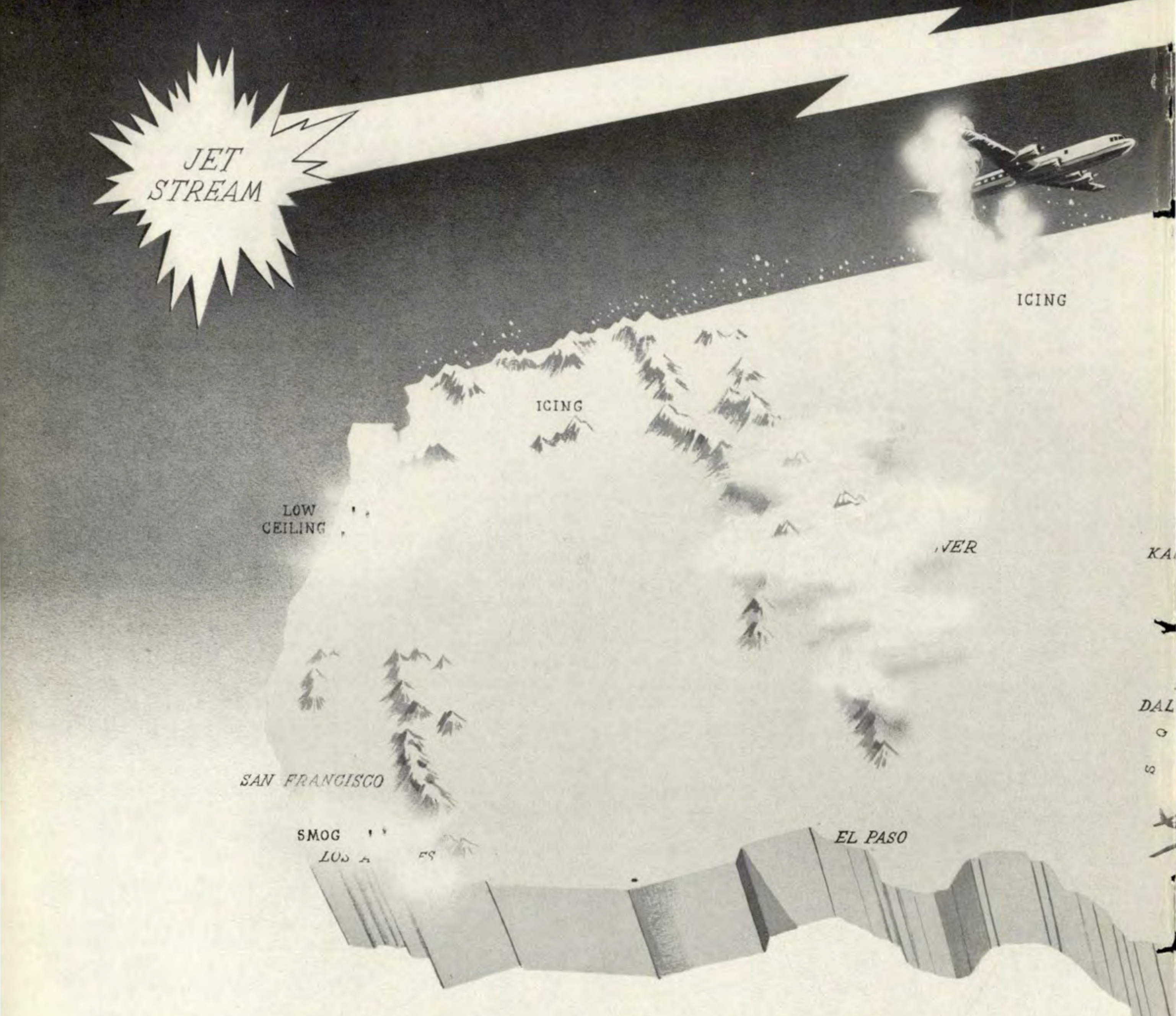
Somewhere near the middle marker the aircraft will break into the clear and the pilot will see he is lined up with the runway and ready to land. This type of approach may seem unorthodox but it is hoped that from this you will be able to derive some basic ideas for using the flight director for many types of approaches.

As experience is gained daily with the flight director, its value in all-weather flying and high altitude flying becomes more evident. In addition to the applications cited, it is being used for many special applications such as formation flying and accurate pitch references for bore sighting. Pilots like its simplicity, ease of operation, reliability and the ease with which they can adapt themselves to its use. In particular it aids precise maneuvers on instruments and permits aircraft to line up and land on the first approach. As illustrated, this is particularly desirable when the aircraft is short of fuel and arrives under low visibility conditions.

The examples throughout this article seem to indicate that the flight director is better suited for the jet aircraft, but this is not intended. Actually the flight director is installed in many types of transport aircraft, both military and commercial.

Reports from our field engineers indicate that the flight director is also being used for many special applications. They also report that pilots who have used this equipment like it. We are naturally encouraged by reports like this from the field, because we feel flight directors are here to stay. On one count alone — their contribution to flight safety on IFR — they've made a lot of friends among USAF pilots. ●

Spring FLYING HA



This represents the first of a series of climatological briefs on the four main seasonal weather phases. The summary which appears in this issue covers in general terms the spring weather for the United States and will be followed by briefs on summer, autumn and winter weather at the advent of each season.

In addition, eight other articles are scheduled throughout the year, highlighting single weather factors of timely importance for the given month.

These articles are being prepared for FLYING SAFETY Magazine by the little-publicized Directorate of Climatology, Headquarters Air Weather Service, under the supervision of Dr. Woodrow C. Jacobs, Director.

The "book" says that climatology is the study of the collective state of the atmosphere at a given place or over a given area within a specified period of time. During World War II the need for such a meteorological agency, capable of attacking a climatic problem, evaluating the data and providing an answer, was recognized. Today, the Directorate of Climatology is the source for all long range weather needs and other weather data for both the Air Force and the Army.

ZARDS

By Capt Richard C. Burriss, Hq AWS
Capt Robert W. Sanderson, Hq AWS

Art Work by: S/Sgt. R. C. Guy, Hq MATS

The Directorate has sources of weather information, both specific and general, almost beyond imagining. A case in point is the total of almost two hundred million cards containing weather observation data filed in the U. S. Weather Bureau-Air Force-Navy punch card library.

Many climatological requests for problem solutions are received both in the field and by Hq Air Weather Service. If the solution is beyond the capability of the field station it is forwarded to Headquarters. In general, there are three types of requests: (1) A solution to a specific problem such as the most suitable location for a GCA unit; (2) An analytical-descriptive study to indicate weather conditions affecting certain operations, plans or decisions such as weather conditions affecting helicopter flights over the North Atlantic; (3) A quantitative description of certain weather conditions or atmospheric events such as mean heights of the tropopause and associated phenomena.

The information on the following page includes an explanation of the weather map and a brief rundown on the types of accidents most prevalent during the spring months.

THIS map indicates the major spring weather hazards and the areas in which they are most commonly observed. Under certain conditions these hazards could occur anywhere in the country at some time during the season.

During March, April and May, the weather over the United States is characterized by atmospheric instability, particularly over the Middle West and Southeast portions. A steady progression of cold fronts with accompanying squall lines sweep across the Mississippi Valley and into the Atlantic Coastal States.

A sharp increase in thunderstorm and tornado activity is noted in the spring. In March the area of maximum tornado occurrence is roughly a circle about 600 miles in diameter centered over northwestern Mississippi. This zone moves northwestward in April and becomes most intense in May when it is centered in eastern Kansas.

From 1916 through 1952 over 6,000 tornadoes were reported; more than half of these occurred during the three spring months. Kansas leads in number of tornado reports, while Iowa holds the championship for number of tornadoes per unit of area. Oklahoma runs both a close race.

About half of the reported tornadoes begin between 1400 and 2000 LST, and 82 per cent are observed between noon and midnight.

Thunderstorm activity is centered in the same areas but is much more widespread. Most thunderstorms form along fronts, but late in May the air-mass-type storm appears over the states bordering the Gulf of Mexico.

Low ceilings and visibilities are most frequent along the East Coast north of Washington, D. C., along the coast of Southern California, along the Washington-Oregon coast, over Southeastern Texas, over the eastern edge of the Rockies and over the extreme western portion of the Great Plains. In addition, certain industrial smoke areas, such as Chicago and Pittsburgh, have a relatively high frequency of restricted visibility.

Except in frontal zones and thunderstorms, icing is encountered most frequently over the states bordering Canada and the Great Lakes. The zone from 5,000 to 10,000 feet presents the greatest possibility of dangerous ice accumulation on aircraft.

The jet stream loses strength during the spring and begins a northward migration. It is encountered most generally over the southern half of the country at levels above 30,000 feet.

The preceding information gives a picture of the various types of weather phenomena which may be expected during March, April and May. Let's examine these conditions in terms of weather contributing to accidents.

The Directorate of Flight Safety Research has made an exhaustive study of accidents that were, in part at least, attributable to weather during these three months. This study covers a period of the past five years. Certain facts are particularly outstanding, and in general they are as follows:

An average of 17 aircraft per month during the reporting period were involved in accidents where weather was a contributing cause.

One phase of flight that came in for a large share of such accidents was the landing. Most of this could be attributed to strong, gusty cross-winds. Groundloops, nose-ups, dragging wings and loss of directional control all enter the picture. These figures alone indicate that a much more aggressive program is necessary on the part of commanders to insure greater pilot proficiency. After all, these are the windy months of spring and cross-wind techniques could well be a topic at the next flying safety meeting.

The in-flight phase of the study indicates that many aircraft have received extensive damage from hail while flying through thunderstorms and in some instances pilots have lost control and crashed while attempting flight through such adverse conditions.

Several cases are on record of pilots becoming lost during instrument conditions, resulting in fuel exhaustion and ultimate abandonment of the aircraft or landing on unsuitable terrain.

The following is a typical example of an accident where weather entered the picture and helped set the stage for a crash:

One day in May a flight of four F-80s departed a midwestern air base on a navigational training and weather penetration mission.

The aircraft became airborne early in the afternoon but were delayed in join-up for several minutes while the No. 3 man cycled and recycled a sticking landing gear. Finally, the four planes got into formation and proceeded on course.

At 3500 feet the flight entered clouds. Precipitation static made reception of the climb-out range leg impossible and the flight leader switched his compass to the loop position. He was then able to locate the null.

Visibility in the clouds was good and the flight continued in normal formation, position reports being made on channel "C." The flight leader reported passing 4000, 6000 and 8000 feet and received acknowledgment from approach control.

At approximately 9500 feet the leader turned 45 degrees to the left to position the flight for a procedure turn. Standard climb was maintained and at this time heavy rain was encountered with severe turbulence.

During a 180-degree turn to the right the flight leader was unable to check the positions of the rest of the flight since he was concentrating on his instruments and heavy rain had covered the windshield and canopy.

This was the last time the leader saw his wingmen until back on the ground. Here he found his No. 2 man. Number 3 apparently experienced vertigo and lost control of the aircraft. It went almost straight in. Number 4 definitely experienced vertigo when he lost contact with the aircraft ahead and then attempted the transition to instrument flying. The plane entered a spin from which he was unable to recover. He bailed out at 8000 feet.

These men had been briefed adequately on expected weather. The experience level should not have been a factor in the loss of two aircraft. Perhaps it can best be attributed to the vast difference between flying in fairly thin clouds and in actual weather. Rain and turbulence suddenly teamed up to call the shot.

Before either pilot could make the transition to the gages, both planes were thrown into unusual positions. After that, interpretation of the instruments seems to have become an impossibility.

Don't let old man weather sneak in a Sunday punch on you. The monthly rundown of projected weather in *Flying Safety* will never serve as a forecast but it will alert you to the type of weather you may logically expect to encounter. ●

CARBON MONOXIDE POISONING SYMPTOMS

Tightness across the forehead with slight headache. Headache with throbbing temples. Severe headache with dizziness, weakness, nausea, poor vision, vomiting and collapse.

LIGHTNING

DURING 1953, the Directorate of Flight Safety Research received 25 reports of lightning damage to USAF aircraft. In all instances these planes were in flight when the strikes occurred. It is interesting to note that no injury to personnel was incurred.

Although this article is not intended primarily to pinpoint lighning damage, it is worth noting that in almost every reported incident the general pattern of strike damage was identical in all types of aircraft.

In fighter aircraft it appears that the Radome acts as a lighning rod and in cargo type planes the loop antenna appears to be very attractive to stray bolts of lightning. One other particularly vulnerable point on all types of aircraft is a wingtip.

Recently we received an incident report from Alaska that tends to bear out a theory we've been considering for quite some time. Let's see what you think of it.

The aircraft was flying at 7000 feet MSL on an IFR clearance. Terrain altitude varied from 500 to 2000 feet above sea level, and as far as the crew was concerned, this was strictly a routine flight.

At assigned altitude the gooney bird was for the most part on top of a cloud layer, but occasionally the pilot found it necessary to fly through towering cumulus clouds that were building up in the area.

The pilot estimated the tops to be about 12,000 feet but inasmuch as the plane was running through each one in short order, he thought it unnecessary to alter course or request an altitude change.

At a point where the terrain was approximately 2000 feet, the aircraft was struck by lightning. The plane was traveling through a fairly high cumulus cloud and the trailing antennae was extended at the time of the strike.

The antennae acted as a conductor for the bolt which went steaming up through the plane, knocked the liaison radio set out of commission and finally discharged through the tail cone.

Damage was confined to the trailing wire antennae and liaison radio set, and a small hole was burned in the tail cone. Now, here's the gimmick of this story. The aircraft's magnetic compass was found to be as much as 30 degrees off on some headings after the lightning strike.

Peculiarly enough, among the strikes reported through 1953 this was the only one where lightning went galloping up the trailing antennae, and there only two organizations reported magnetic compass problems as a result of lightning damage.

However, it cannot be assumed that these two lightning strikes were the only ones to affect magnetic compasses. On the contrary, it can be safely assumed that in every instance some magnetic disturbance resulted.

Considering how easily the magnets in a compass can be thrown off, let's ponder on the possibilities in the following incident:

An F-94B was on a routine proficiency flight over the sea of Japan. Altitude was 22,000 feet when the crew started to encounter thunderstorm activity. These storms were in all stages . . . cumulus clouds developing, genuinely mature and dissipating. The thunderstorms were surrounded by cirro-stratus type clouds, all of which extended to about 35,000 feet.

At first moderate turbulence was encountered. Then without warning the plane was struck by a bolt of lightning. It hit the nose of the aircraft with a blinding flash that was clearly discernable to both pilot and radar observer. A smoky odor was noticed in the cockpit but no actual smoke could be seen.

The pilot immediately cranked around in a 180-degree turn (still the best maneuver in the business). Within the next five minutes the plane was struck at least two more times. The bolts hit somewhere on the wings, ran all over the aircraft and were discharged at the external tank tips.

There was heavy precipitation in the form of rain when these strikes were incurred. Neither hail, ice nor St. Elmo's fire was encountered; but apparently this does not prove too much, for many lightning strikes have been reported when no precipitation was present.

About the time the F-94 received the last wallop from nature, the artificial horizon started to precess to the right and the pilot had to resort to partial panel flying until the plane broke out into the clear momentarily. In between cloud build-ups he cut in the spare inverter, the instrument was recaged, and it then started to function normally.

The airborne radar was at first reported inoperative by the radar observer but about 10 minutes later it started doing business again and they finally got the plane back home.

A postflight check revealed that the radar dome had a six-inch hole, the trailing cone of the left tiptank had been punctured and the servo tab for the left elevator had fused spots all over it.

Although not specifically mentioned, we'll take a few bets that the magnetic compass was really off after this little caper. There was enough voltage sizzling through the '94 to upset the best of magnets!

Here's another one to consider:

A senior pilot was wheeling along over the rolling hills of Indiana in a B-26 just about a year ago. The pilot was working his way through a cold front when he tangled with a bit of lightning. He was quite surprised, for it was snowing heavily at the time, and the free-air temperature was registering in the neighborhood of 15 degrees plus. It shouldn't have happened, but it did.

There were two flashes of lightning. The first was off the right wing and apparently did no damage. The second flash, or bolt, struck the lower left gun barrel sleeve and completely disintegrated the barrel cover. Next, it jumped into the cockpit and danced around long enough to render the radio compass inoperative (except on 'ANT'), and finally it slammed into the magnetic compass which promptly spun like a dervish and thereafter was 25 degrees in error.

Of course there's one thing about a lightning strike. You don't have time to duck. It's about on par with diving into a slit-trench after you hear some gunfire!

In still another incident an SA-16 started playing footsie with a typical Pacific typhoon. Needless to say, this wasn't from choice. But, as all of us know, sometimes such deals become a "must" from necessity alone. In any event, after getting slammed around between Okinawa and Luzon, the crew was mighty relieved to break out into some VFR conditions which unfortunately didn't last long.

They had been in the clear only a short while when a cumulo-nimbus type cloud was encountered. Because it was dark at the time, its presence was noted only because of a single flash of lightning that occurred in front of the aircraft but not particularly close. In a matter of moments, however, they were in a real ripper of a storm.

As the aircraft proceeded closer to the center of the storm, St. Elmo's fire was noticed on the free air temperature gage and jumping out in front of the plane. Heavy rain was encountered at this time accompanied by a very rapid increase in the intensity of static electricity on and around the aircraft. The scanners reported very heavy St. Elmo's fire all around the plane, and at the same time personnel in the cockpit noticed the whole plexiglas nose was blue with static discharges.

At this moment there was a brilliant flash of light which seemed to come from all directions. The right scanner reported that it came from his side of the aircraft and the left scanner reported that it came from his side of the plane. The pilot was under the impression that it had struck the right wing, while the aircraft commander felt certain that the plane had suffered a lightning strike from the left side.

Falling back on the safest course of action, the pilot swung the SA-16 around in a 180-degree turn and scooted out of the area. Total damage was two badly scorched wing-tips.

We sincerely wonder what happened to the magnetic compass!

Getting away from all-metal aircraft for a moment, the Editor recalls a day, years ago, when he ran into a bit of a storm while flying an old cabin Waco equipped with floats. During the brief fiasco, while attempting to fly basic instruments, lightning got into the act and danced the plane all over the sky. Fortunately, it was all over in a few moments, and much to the relief of three passengers and the pilot the battered biplane broke out in the clear, none the worse for wear except for a completely crazy compass.

Ever try to swing a compass while the crate's on floats?

Consider the fact that relatively small metal objects can throw a compass off. Place a pair of sun glasses or a screwdriver near the case, and in many instances you'll observe the card starting to swing erratically. Imagine then the possibilities of sudden demagnetization when a bolt of lightning starts tickling the magnets of a compass.

A good wrinkle to file away for future reference involves careful planning before a possible thunderstorm area is entered. Set the gyro compass just before penetration, and remember that if the plane should receive a hit, the gyro will be fairly accurate even if the magnetic compass is knocked out of the picture. Even in a relatively rough show the gyro probably won't precess excessively and will give you a sort of a yardstick for checking the magnetic compass for induced error.

In winding up this little story we'd like to suggest that maintenance and operations officers give a bit of serious thought to this lightning strike problem. Sooner or later, one or more of your planes will get involved in just such situations as we have described. When that sort of thing happens, FLYING SAFETY strongly urges that you make certain the magnetic compass is swung before releasing the plane for flight again. It's mighty cheap insurance.

To Play It Safe

- Avoid flight through cumulonimbus clouds, at levels where the temperature is between $+15°$ and $-10°$F, for high potential gradients and consequently disruptive charges can be expected.
- Avoid flight in the immediate vicinity of cumulonimbus clouds, especially when they have given manifestations of thunderstorm activity. It is preferable to keep at least 2500 feet or more away from them.
- Avoid flight through moderate or heavy rain and/or snow, sleet, hail or ice crystals, especially at levels where the temperature is from 20° to 40°F, particularly if the precipitation is from cumuliform clouds.
- If the precipitation static and/or corona discharge (St. Elmo's fire) is moderate to severe, and there is evidence from the temperature, cloud, and precipitation conditions that the airplane is in a zone of strong potential gradient between oppositely charged regions, reduce speed.
- Then seek a lower level where temperatures above 40°F prevail, or leave the given cloud and precipitation conditions. The tendency for precipitation-static sounds to increase rapidly in intensity should be regarded as precursory signs that a discharge is imminent. ●

A variety of aircraft are flown by company pilots on test flights, making a comprehensive safety program necessary.

Here is the way one manufacturer handles his flying program . . .

the SAFE way

Flying programs in the aviation industry often have much in common with USAF operations. The fine flying safety records compiled by various manufacturers reflect their interest and concern with flight safety. FLYING SAFETY Magazine takes a look at a typical example of how one company operates its flight safety program.

★ ★ ★

TAKE a big operation, add complex aircraft, mix in many flying hours and you have a flying safety problem. The Aircraft Operations and Flight Test Division at Hughes Aircraft Company has this problem whipped.

Led by Colonel C. A. Shoop, ANG, this division has compiled the envious record of four years of flying without an accident. This record was made in spite of the fact that the unit operates many different types of aircraft under test conditions.

The mission of the pilots of the division is to test and prove the various electronics and radar equipment produced at the company. Each pilot must have a working knowledge of the many phases of radar engineering. After each flight he makes his report to and works closely with the project engineer or physicist who developed the equipment.

The safety record was made in the face of some difficult situations. Up until a year ago the aircraft were operated off a sod runway that at times more resembled a quagmire after a session with the infamous California liquid sunshine. Even now the new concrete strip does not have a taxiway and aircraft must taxi in the same area where others are landing and taking off.

The pilots, who are all ex-service flyers, stay current in two jets each, as well as the conventional aircraft. This of course makes for a proficiency problem as new or different types and models are being tested all the time. It is a matter of keeping on top of the workload; and diligent, conscientious work and practice by all individuals concerned. At present, F-94s, F-89s, F-86s, B-45s, B-25s, T-29s, C-47s and C-45s are used for the tests. In the offing are the -100 series of aircraft.

This calls for considerable technical skill and knowledge from the maintenance and engineering personnel as well as the pilots. To keep ahead of this problem, a plan was devised and is in operation. Representatives from the company sit in on the development of any new types of aircraft scheduled to appear for tests. For instance, people from the division are sitting in on the production of the F-102 which will come to the company for installation of electronics and radar equipment. Also, if a new model of an aircraft is scheduled to appear, personnel are sent to the respective company for thorough briefing on any new developments.

It is pretty hard to put a finger on any one thing that is the key to the success of this operation. However, if any one thing is the answer, it is probably the supervision of Colonel Shoop. For here is supervision at its best. He asserts that no matter how far advanced aircraft become in the missile stage, the pilot will always be a vital part of flying. What's more, not just as a pusher of buttons; for good flying technique, "the old seat-of-the pants," will always make the difference.

Though chief of the division, he

The old sod runway in use until last year...

is also an integral part of it. Shoop is a firm believer in staying close to the operation in order to understand better the problems which arise. He monitors most landings and takeoffs. personally. In his office he has a radio receiver and can tune in on all transmissions of the aircraft. He is in direct contact with the tower and can relay messages to a pilot if the situation demands.

This, of course, is invaluable if any emergency should arise. Colonel Shoop's position can be compared to that of the squadron commander. He feels personally responsible for the safety of his men as well as the aircraft. Knowing the value of safety, he says, "The lack of accidents at Hughes for the past five years has accounted for the expeditious development and production of advanced electronics systems with a tremendous saving in dollars and manpower to the company and the military services."

There is an interesting sidelight on the last accident of the division. Colonel Shoop was in a Bravo-25 and when it came time to put the gear down, the nosegear failed to extend. All emergency procedures were tried to no avail. The decision was made to land and try to keep the nose up long enough for some people on the ground to hold the tail down. Colonel Shoop

... replaced by new 7000-ft. concrete runway.

made an excellent landing but the tail-holders-to-be could not catch up with the aircraft. The landing was such a good one and the damage, under the circumstances, so little that the Colonel received a letter of commendation. If you've got to have an accident, that's the way to have it. However, these people don't believe you have to have any accidents. Since the B-25 incident they have had a spotless four years to prove it.

A weekly flying safety meeting is SOP. These meetings serve as a review of new procedures, a briefing on what is to come, a comparison of notes between pilots, an opportunity for any type of instruction thought necessary and many other pertinent features. This gathering is not a dreaded occurrence or a chance to catch up with some sleep. It is looked forward to as one other thing which will allow the pilot to do his job better and safer. Also, any time something hot comes up, special meetings are held. This unit has found, as have many others, that training films are invaluable for learning new techniques and certainly add to the flying safety meeting if up-to-date and apropos.

Not only do they follow the requirements of the Civil Aeronautics Administration, but the regulations and SOPs of the USAF as well. No marginal flights are attempted. If it looks unsafe, they just don't do it. Standard air traffic control procedures are used.

Of course, new equipment usually means new operating procedures. After extensive testing and proving these are written up by the division to insure that the using activity has thorough knowledge of the new system.

The people in the division from the mechanic to the chief are proud, and justly so, of their safety record. This is reflected in each effort and one can sense the confidence in each individual to do his job efficiently and safely. Colonel Shoop sums it up:

"The Aircraft Operations and Flight Test safety record at Hughes Aircraft is accounted for by a combination of factors. Personnel are selected carefully from competent military-trained and experienced people. Considerable attention is given to such things as personality, temperament and ability to work with others. The safety is due also to an efficient aircraft maintenance and inspection system.

"In the final analysis, the high safety record is the result of the methods employed in the conduct of our electronics flight test program, such as careful flight planning and precision flight patterns which are designed to obtain desired test results with the maximum allowable flight safety that can be obtained in any flight test operation." ●

Supervisor of Safety

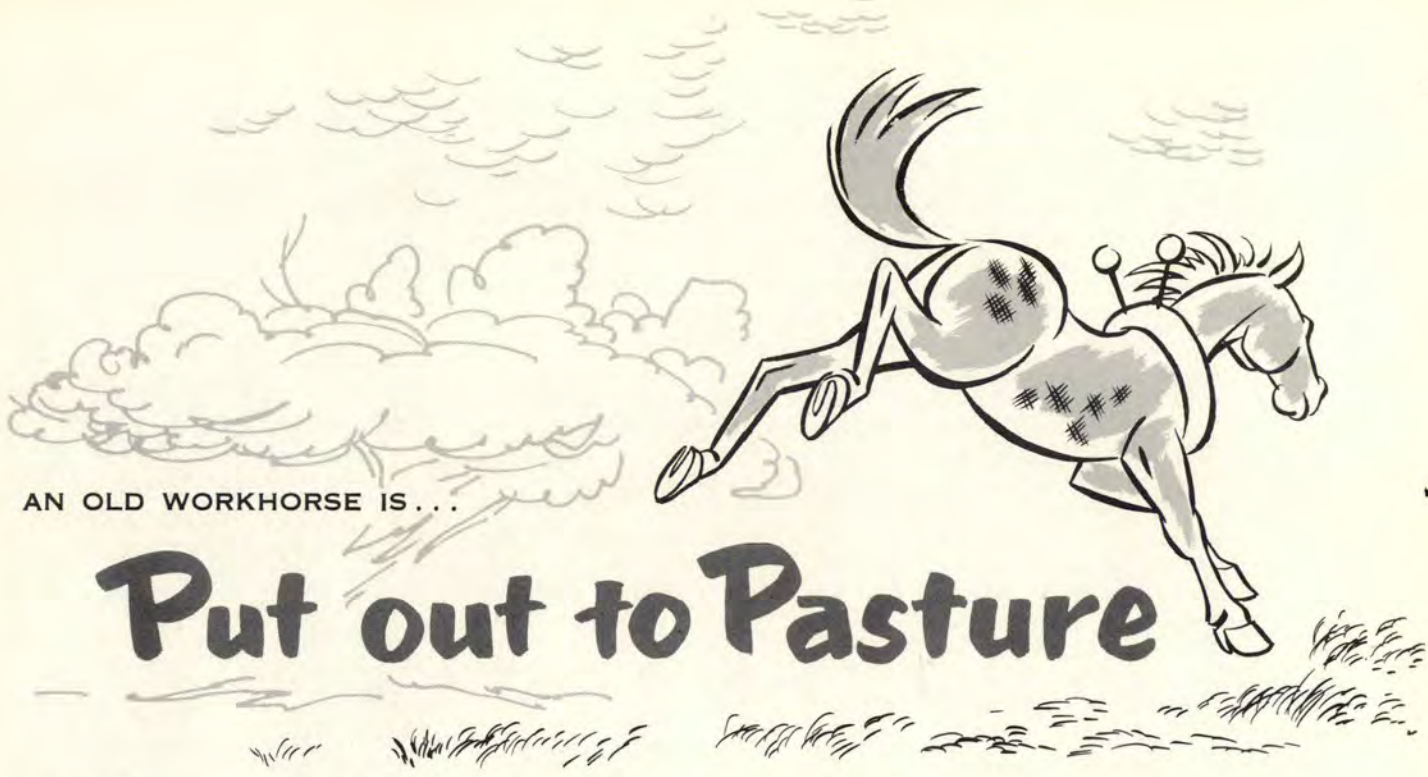
Col. Clarence A. Shoop, ANG, started flying in 1930 as a cadet at March Field. He joined the California Air National Guard in 1933 and was called to active duty prior to World War II. He took part in the experimental test flying of the P-38.

Colonel Shoop was one of the first pilots in this country to fly jet aircraft, flying the XP-59, first jet airplane to fly in the U. S., the XP-80 and many other experimental aircraft. He has 12 years of experience test flying many types of aircraft and equipment.

Serving overseas with the 55th Fighter Group, 8th Air Force, he took command of the 7th Photo Recon Group D-Day -1. His group flew many missions and was considered one of the top-ranking photo recon groups in the ETO.

On his return to the U. S., Colonel Shoop was assigned to the Command of the Muroc Flight Test Base where he was instrumental in the program of development for that base and the numerous projects undergoing tests there.

Colonel Shoop is presently the commanding officer of the 146th Fighter Wing, ANG, Van Nuys, California.



AN OLD WORKHORSE IS . . .

Put out to Pasture

ONE of the real "old timers" of jet-powered flight, the XB-43, was retired from service recently at the Air Research and Development Command's Air Force Flight Test Center, Edwards AFB, California. The nation's first jet bomber will spend the rest of her days at the National Air Museum of the Smithsonian Institute.

When the Douglas XB-43 was delivered to the Air Force Flight Test Center in 1947, its unique feature was unknown. Designed as a light bomber, it was destined to a future in research leading to improvements in modern jet engines and related equipment. Its arrival and flight tests were greeted with the heraldry and acclaim that is due a "first" in aviation, as the XB-43 was the nation's first jet bomber.

The aircraft was put through a series of rigorous tests to determine its possibilities as a tactical bomber. It measured up to the contractor's estimated performance, and in many ways exceeded these expectations. However, further tests demonstrated that in certain characteristics the aircraft was unstable. The flights were brought to an end. The XB-43 became one of the many stepping stones in the road toward improved aircraft designs, a rejected airplane.

After its rejection, the XB-43 stepped into another role. Unlike the other experimental aircraft, the plane was not scrapped or salvaged for usable parts. It became a flying test stand for jet engines.

With the two engine mounts located in the fuselage behind the pilot's compartment, one standard J-35 engine was removed and replaced with a test engine. Takeoffs and landings were performed with both engines. However, during high altitude operations, the J-35 engine was shut off or throttled back and tests performed on the other engine. Or, while maintaining altitude on the J-35 engine, full time could be devoted to studying the characteristics of the test engine with its modifications.

The kick-off to these experiments occurred in 1948. They have since proved to be of great value in the design of engines now in use in such Air Force planes as the North American F-86, North American B-45, Boeing B-47 and the Martin B-51. These tests can be credited with saving the lives of many pilots as well as reducing the cost of experimental flights.

A few of the tests performed with the XB-43 are as follows:

• Determination of J-47 minimum safe lube oil flow. It was believed at one time that many of the engine failures were caused by the reduction in the flow of lube oil in the jet engine. A J-47 engine was installed in one of the XB-43's engine mounts. Several hours were spent on the ground running up the engine before it was taken into the air. The first tests started at 10,000 feet with the engine running at full power and with full oil flow. This altitude, power and oil flow were held for 30 minutes. The pilot then turned, gained more altitude, reduced the oil flow a fraction and held his position for another 30 minutes. These tests continued over a period of weeks until an altitude of 40,000 feet had been reached and the oil flow reduced below minimum. Several facts were proved during the three months these tests were performed. One of the major results was a recommendation to aircraft manufacturers on the future design of pressurized oil tanks. Further, safe limits for the oil flow were set. At no time did engine failures result during the operations.

• Another test involved the replacement of the normal electric starter with a small gas turbine compressor and air turbine starter. Extensive experiments resulted in the U. S. Navy's adoption of the new gas compressor for many of their turbo-prop aircraft. As in previous tests, extensive ground run-ups were made before the plane was taken to altitude for the experimental operations.

• Special regulators to facilitate the high altitude starting of the J-47 engine were tested. Since the XB-43 could perform safely on only one engine, this type of test could be performed without endangering the life of the pilot. Recommendations designed to improve the starting characteristics of jet engines were passed along to the contractors after many altitude restarts.

• Main engine regulators and emergency regulators were put through experimental flights. The tests resulted in modifications and design changes.

• Ignition tests and tests on different ignitor plugs resulted in proposed changes.

• Temperature limiting control tests were performed. These were designed to limit the engine to the maximum operating temperature and relieve the pilot of the adjustments he would have to make under some altitude conditions. This would enable the pilot to devote more time to actual flying in combat or while on a bombing mission. The tests proved that the controls were unsatisfactory. A new control has been designed and future tests have been planned.

It has been stated that the XB-43, long out of date as a combat type plane, was the "most flown" aircraft at the Air Force Flight Test Center. Since most of the aircraft at the Center are of experimental type, this claim is probably true. To date, 230 hours and 50 minutes of flying time have been logged. The bulk of this time has been devoted to experimental work, with the exception of about 20 hours when the aircraft was used during the filming of the motion picture "Jet Pilot."

The majority of the experimental flights have been done by Major Arthur Murray and Captain James S. Nash, test pilots of the Air Force Flight Test Center.

Closely associated with the pilots in keeping the XB-43 in commission is M/Sgt Bernard A. Fahey. When parts were needed to perform necessary maintenance on the aircraft, it was Sergeant Fahey's responsibility as crew chief to obtain the replacements. Since the plane did not go into production and many of the parts required were not available through Douglas Aircraft Corporation or normal Air Force supply channels, the Sergeant was frequently required to handmake suitable substitutes.

The nickname of "Versatile II" has been assigned the XB-43. "The Frog" and "The Grasshopper" are other labels given the plane by the Edwards flight line mechanics. Living up to its official nickname, the XB-43 had a secondary responsibility as photographic plane. A specially designed nose section was installed, giving a photographer the advantage of shooting pictures from almost any desired angle.

The "X" will never be erased from the title of the XB-43, and it will never be "officially" counted among the U. S. Air Force aircraft, but Versatile II can look back on its history as a flying test stand at the AFFTC with pride. Aircraft engines and components tested in the XB-43 play an important part in the performance of "active duty" aircraft in today's (and tomorrow's) Air Force.●

Crew members prepare to fly USAF's first jet bomber to the National Air Museum for retirement.

". . . the XB-43, long out of date as a combat type plane, was the 'most flown' aircraft at the Air Force Flight Test Center, Edwards AFB."

Keep Current

Correct Radio Transmissions—Incidents and accidents continue to occur because of unwarranted or misunderstood radio transmissions at crucial moments.

On one flight of two F-86s, during a normal takeoff, the wingman called the leader while rolling down the runway at 100 knots IAS, "Blank one, your left tiptank cap is loose." Blank one had a slight fuel siphoning condition. To Blank one (and the Mobile Control Officer) this statement was heard, "Blank one, your left tiptank is loose." Blank one aborted the takeoff, but could not stop the aircraft until it was off the end of the overrun of the 7350-foot runway. Although no damage was incurred, this type of incident could easily result in major damage to an aircraft.

In another incident, a radio transmission was correctly sent but incorrectly read by another member of the flight. This was a routine, formation flight of four F-86s. The flight leader thought he heard a transmission stating that he was on fire. He jettisoned his canopy and tried to eject. His seat mechanism failed and he rode the hot seat in successfully.

In reality the radio message had stated that the number three aircraft was on fire and this pilot ejected successfully. Granted the pilot should have checked for the fire more carefully, it is easy to see how this misunderstanding could have cost the USAF one each F-86.

These are only two examples of incidents caused by careless transmissions. Who is to know how many accidents possibly could be attributed to it. Far be it for anyone to say that the radio is not a vital and important part of the aircraft and any flight. The problem is that the wrong word at the wrong time can make a harmless situation critical.

Use your radio, use it right . . . think before you speak.

★ ★ ★

Planned Safety—Basic concepts of flying safety were put into use recently during the successful movement of the 318th Fighter-Interceptor Squadron from McChord AFB, Washington, to Thule AFB, Greenland. The flight, involving F-94s and T-33s, required 24 days, 11 hops and 5477 miles for completion.

Needless to say, extensive flight planning was necessary for the operation. All flight plans were prepared, checked and filed until needed. Fuel consumption charts were compiled from technical orders and checked for accuracy by test flights. A complete set of maps was drawn up for each crew. The flight courses, proposed landing fields, with alternates, and emergency strips were studied by each crew member until all pertinent details were thoroughly familiar.

Each crew flew a training flight which duplicated in mileage the longest leg of the actual Arctic flight. An exact count of fuel consumption, oxygen requirements and aircraft performance was kept.

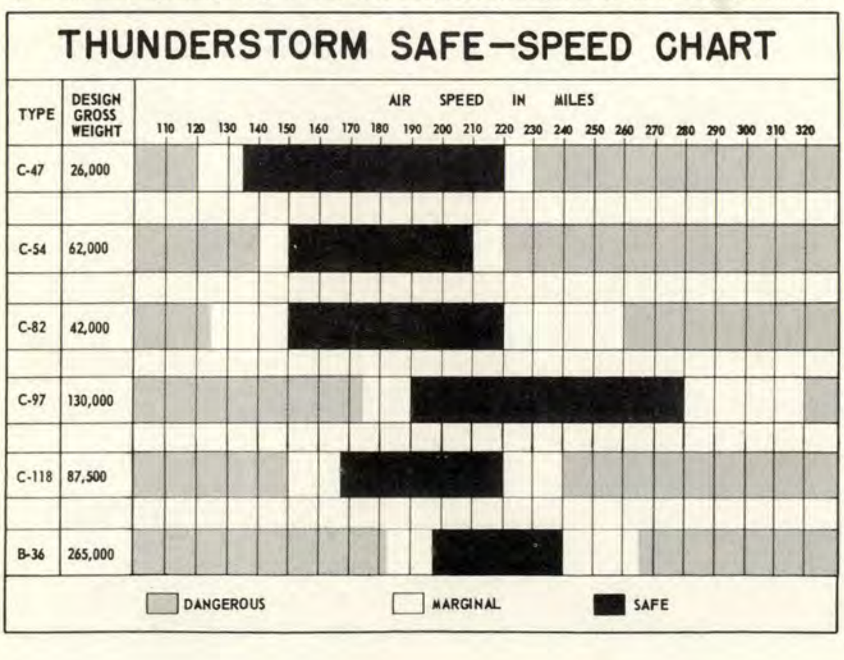
The first leg was 460 nautical miles from McChord to Great Falls, Montana. Before this flight and every flight, extensive briefings were held. All details of each phase of the flight were discussed and all emergency procedures covered.

Arrival at Great Falls was accomplished without incident and a short critique was held. This covered happenings along the way and the general condition of all the aircraft. The maintenance crew, who had accompanied the flight in two C-54s, then went over the aircraft.

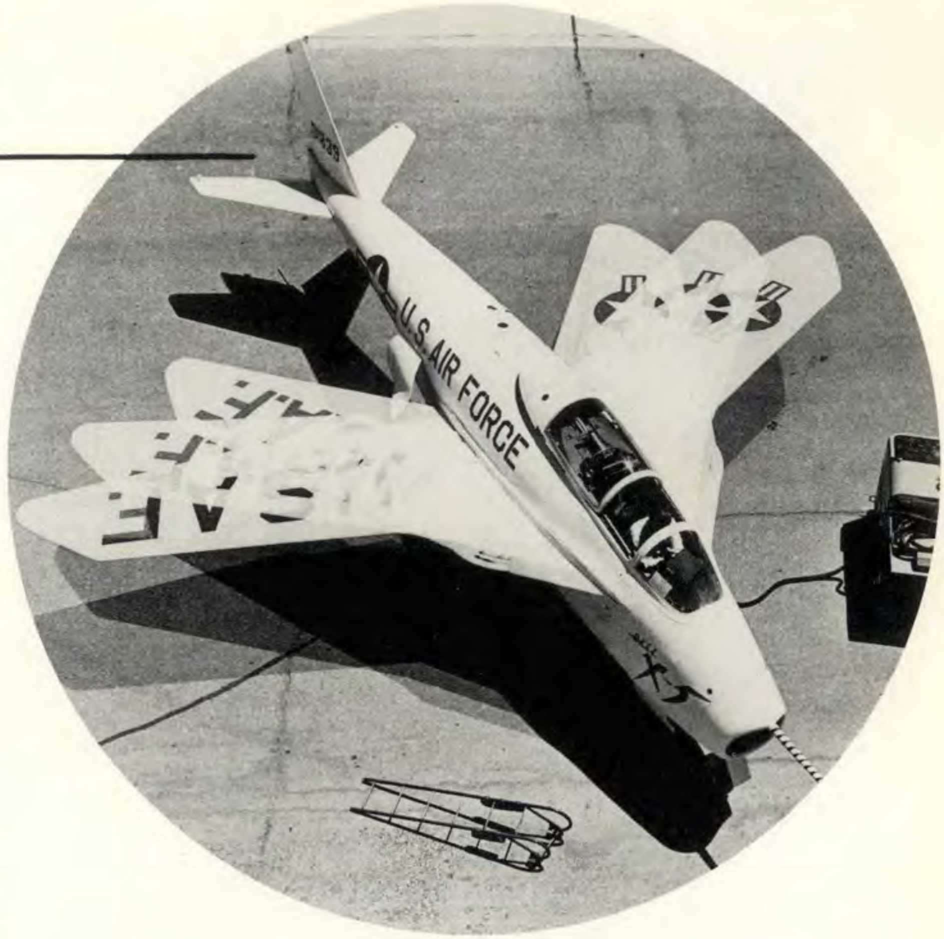
Two incidents occurred during the subsequent three hops which took the flight to the Greater Pittsburgh Air Terminal. A float valve on one of the '94s stuck open on takeoff at Great Falls. By the time it was shaken loose, sufficient fuel had been lost to necessitate a landing. After refueling, the aircraft joined the squadron at the next stop. The second incident occurred when one of the '94s blew a tire on landing, but no damage was suffered.

On the leg from Dow AFB, Maine, to Harmon AFB, Newfoundland, water which had collected in the throttle linkage control boxes of several of the aircraft, froze at altitude. Therefore, one power setting had to be maintained throughout the flight.

Chart shows dangerous, marginal and safe airspeeds for flight in areas of thunderstorm activity.



An illustration of the variable wing sweep of the Bell X-5 which can be changed from 20 to 60 degrees while the aircraft is in flight.



All linkages thawed out upon descent, and the cause was eliminated by cutting a drain in the bottom of the control box.

There were no alternate landing fields from Goose Bay northward. Navigational aids were few and far between. Landmarks as checkpoints were not reliable to a group not familiar with the area. Homer beacons were provided by aircraft orbiting given points along the flight and transmitting a given wave signal.

The squadron was weathered in at Sondestrom AFB, Greenland, for a few days giving the maintenance personnel a chance to give the aircraft a thorough check. The final hop was to Thule and was the second longest of the flight. Although the weather cleared, headwinds were forecast which would run the F-94s close on fuel. As T-33s have a slightly longer cruising range, one was sent out to check the effects of the wind. The report back was favorable and the final leg to Thule was completed without a hitch.

There is nothing particularly phenomenal about this flight. However, it serves to illustrate a joint effort in accomplishing the mission and in flying safety.

★ ★ ★

The Pressure Demand Oxygen Mask — Question: When difficulty is experienced exhaling from a pressure demand oxygen mask, the probable source of trouble is:

a. The exhalation valve.

b. An inlet valve.

Recently this question was posed to a group of ten experienced pilots on a short oxygen equipment quiz. Only one of the ten knew the correct answer. And he alone knew how to correct such a difficulty.

Of course, the right answer to the question is choice (b). The exhalation difficulties with the pressure mask are in the inlet valves.

If at any time during exhalation the inlet valves do not provide a positive seal, breathing out will be very difficult. To simulate the lack of a positive seal, remove one of the inlet valves and try to exhale. Air may be blown out around the edge of the mask but not through the exhalation valve.

Several factors may prevent a positive inlet valve seal:

- If the rubber portion of the valve is warped, or if dirt is caught underneath, it won't seat properly.
- If the plastic base for the valve is not completely inserted in its receptacle, there can be no seal.
- On some small and medium masks, the microphone port may be pressed against the inlet valve structure and cause a leak between the rubber portion of the mask and the plastic base for the inlet valve.

Of these factors, the first is the most common and keeping the mask and particularly the inlet valves clean will eliminate most exhalation difficulties. Should an inlet valve become warped, it should be replaced. Of course, care must be taken to check for proper insertion of the inlet valve into the mask. In the third instance, however, the source of trouble may easily escape detection. Binding between the microphone port and the inlet valve has occurred primarily on small masks and occasionally on medium sizes. The remedy is to insert an additional rubber gasket around the plastic base of the inlet valve so that a tighter fit is provided between the mask proper and the inlet valve base.

It can be seen that if one of the inlet valves leaks or does not seat properly on exhalation, the force of exhalation is not only exerted on top of the exhalation valve, but is vented back through the inlet valve into the mask oxygen hose and then through the exhalation valve extension up to the underside of the exhalation valve. Consequently, with equal pressures present on both the top and bottom of this valve, the springs operate to keep the valve shut, and exhalation must take place by blowing the mask loose from the face.

Take the time to disassemble your mask and see how it works. When you have trouble exhaling, you should then have little difficulty locating the source of trouble.

Totem Pole Climbers

"Our aircraft accident rate can be lowered in 1954 if we make a concerted effort to continually seek out better preventive methods and daily emphasize flying safety."

General Curtis E. LeMay

IF YOU land at a Strategic Air Command base one bright May morning and hang around a few hours, you're likely to find yourself thinking about checklists. A billboard outside Flight Operations will warn, "You might forget the checklist but the aircraft won't." The base newspaper you pick up in the coffee shop will catch your attention with a "Fly Safe" column – about checklists. Driving back to operations, maybe you'll pass a series of rhyming signs – selling checklists. Wandering down the hall to the weather forecaster's office, you might pass the monthly flying safety meeting in full swing – checklists again.

By this time, if you're a stranger around here, you'll probably decide that SAC has checklists on the mind this spring. But the crews of the Strategic Air Command know that all this is just part of the Safe Aircraft Campaign for '54. And that the primary topic for May is checklists.

When you visit this base in June and catch a sign

Nuts and bolts
Lying loose
Can blow a tire
And cook your goose.
Ramp clean?

you'll know that, before you're airborne again, you'll be exposed to a good many reminders about airdrome hazards, the prime subject for June. In July it will be takeoff and landing data cards, in August maintenance. And so on through the year.

This Safe Aircraft Campaign is designed to reduce SAC's aircraft accident rate for the fifth successive year. As carefully and elaborately worked out as a New York agency's plans to launch a new toothpaste, the Safe Aircraft Campaign for '54 is designed to sell just one thing — flying safety. Through a combination of "advertising," special awards and development of a competitive spirit among bases, SAC hopes to keep safety in flight uppermost in the mind of each individual in the command.

The campaign, and it has many ramifications, was organized by the Flying Safety Division at SAC headquarters, Offutt AFB. To see how it was being implemented down at wing level, *Flying Safety* paid a visit to the 320th Bombardment Wing at March Air Force Base.

The 320th's Flying Safety Officer is Captain Loyd A. Coats. A B-47 aircraft commander, Captain Coats has been Wing Flying Safety Officer for about 18 months. It's a full-time job. Here are some of the things that he and every other flying safety officer in the command are doing to make 1954 SAC's best safety year.

Special Awards

In the command perhaps the most exclusive group as of the first of this year were the 16 crewmembers belonging to the Heads Up Flying Club. Organized by SAC in 1953, it is composed of flying personnel who averted an aircraft accident by an outstanding feat of airmanship or demonstration of judgment. When the flying safety officer knows of an individual he believes qualified for membership, he brings the facts to the attention of the commander, who in turn recommends the individual for membership in the club.

With membership goes a certificate of achievement from General Curtis E. LeMay, SAC Commander, a miniature model of the aircraft involved and a set of identification tags for flying clothes, proclaiming the wearer a "heads up" flyer.

At the time of our visit, the 320th Bomb Wing was preparing to recommend a captain of the 441st Bomb Squadron for membership. An observer on a B-47, the captain prevented an accident by his quick thinking. The aircraft was rolling down the runway for takeoff and had passed the unstick speed or point of no return when the bomb-bay doors fell open. Airspeed immediately dropped. Reacting instantly, he flicked the switch to close the doors. As soon as the drag was removed, airspeed began to increase again and the B-47 labored into the air to complete a successful takeoff. Had the observer hesitated a moment, had his attention wavered a few seconds from the warning lights, the bomber might well have crashed.

His name will be forwarded through channels of command to SAC headquarters, where his eligibility for the title of Heads Up crewmember will be determined.

Although Heads Up Flying Club nominations are made only when a special performance warrants it, every SAC organization is required to nominate a crew of the month (or pilot in the case of fighter organizations) and a maintenance man of the month from among its personnel. Nominations of the various organizations on a base compete to be the base's candidate when the contest reaches command level.

When *Flying Safety* visited the 320th Bomb Wing, they had just recommended a B-47 crew for the February award. These men had utilized their flying time so well and accomplished requirements of such high quality that they were declared combat ready one month ahead of schedule. On the wing simulated mission their run was better than the scored practice or record run of any other crew in the squadron, including combat ready crews. Their outstanding run had been made in spite of a tone malfunction and other difficulties. Should the crew become SAC's combat crew of the month, their picture and a story of their contribution to flying safety will appear in the command's magazine *Combat Crew*, and they will receive an achievement certificate from General LeMay.

The same awards are presented to the maintenance man of the month, who is chosen in a similar manner.

As the campaign guide points out, "The tremendous work accomplished day in and day out by maintenance crewmembers plays a vital part in the prevention of accidents. Any flying safety program failing to recognize this fact is only a flying safety program in part."

Typical of the 320th's nominees in the maintenance field is a staff sergeant of the 807th Operations Squadron, the wing's candidate for January. The C-45 this sergeant crews completed 50 hours of flight between periodic inspections without a single discrepancy.

When he was chosen as the wing's candidate for maintenance man of the month, his picture, together with a brief write-up of his qualifications, was posted on March AFB's three flying safety bulletin boards. This serves a double purpose: "advertising" for the safety program and an incentive to other maintenance men to equal or better the performance. Each month, the wing nominee at March receives a letter of appreciation from the base commander.

Advertising

Advertising — keeping the "product" in everyone's mind — pays off. Realizing this, the Safe Aircraft Campaign calls for billboards, *Burma Shave*-type signs and other outdoor displays. The campaign manual offers the flying safety officer suggestions for his outdoor advertising. Around SAC bases this year, you'll see signs like:

You'll always be right
If you remember preflight.

and

The scanner said, "The flaps are up."
The pilot said, "They're down."
St. Peter said, "You're welcome boys,
But you should have gone around!"

Brief and pointed, they get the message across. Perhaps better than ordinary written material.

In addition to displays like this, on every Strategic Air Command base you'll find a brightly painted totem pole which focuses attention on the command's year-long safety program. The names of the first four bases appearing on the totem pole are changed each month to reflect

current standings. It's every base's goal to be "high man on the totem pole." (Taking into account number of hours flown, an adjustment factor for the type aircraft operated and penalties for accidents, the bases are ranked each month and the base of the month given a permanent award in the form of a trophy. The base of the year also receives a trophy.)

Along with this outside "advertising" goes newspaper publicity. At March AFB, the *Beacon* carries a front page column on flying safety each month. Sometimes these are locally written, sometimes they are the monthly press releases issued by command headquarters. These columns tie in with the special theme for the month.

And along with newspaper publicity, some SAC bases have used radio programs with great success. For instance, Ramey AFB has used a weekly broadcast, "Rex Riley the Third." A flying hillbilly, whose job is saving Air Force dollars through accident prevention, narrates the program. People around Ramey might think Rex Riley III is pretty corny, but they listen to him. The program has been outstanding in instilling safety consciousness among Ramey personnel. Davis-Monthan, Ellsworth, Offutt and Forbes have all used radio successfully in their flying safety programs.

Although television is a more complicated media than radio, and audience-wise a more limited one, TV also has been used successfully in SAC's safety campaign. On five occasions, Flying Safety Division personnel have appeared on local and national television shows to discuss safety in flight. A network telecast also, of course, helps the civilian population understand that an intense safety program saves tax dollars.

Other Campaign Devices

Flying safety meetings are familiar to all USAF flying personnel. At a SAC base attendance is mandatory at one squadron level meeting a month and one wing level meeting a month. The theme of the month is discussed at these meetings, as well as special local and seasonal problems. At March, Captain Coats attempts to keep his wing meetings lively by arranging for guest speakers and demonstrations by attached organizations such as the Air-Sea Rescue people. Articles from SAC's *Combat Crew*, *Flying Safety* magazine and the *Aircraft Accident* and *Maintenance Review* are used as material for flying safety meetings, as well as information brought to the flying safety officer's attention through the SAC incident report.

These incident reports are of considerable importance in the safety campaign. As one of the campaign slogans says, "Want to know about accidents? Ask the pilot who had one." But you can learn a lot, too, from the man who *almost* had one. From this idea was born the incident report.

Every aircrew member has experienced a near-accident, or he has had a complaint about some equipment or a procedure which he believes could cause an accident. By using the incident report he can tell his experience or make his complaint. In the Strategic Air Command these reports may be submitted anonymously if the individual desires. The report is submitted to the flying safety officer, who refers it for investigation, and also prepares copies which eventually wind up at every other base of the command. In this way, each base takes advantage of the experience of the others.

Once special awards and publicity have been taken care of, there remain the special local problems which affect safety of flight. These are handled at March AFB by the Flying Safety Committee, which meets monthly.

The committee is composed of commanders, principal staff officers and representatives of special organizations such as AACS and Installations. Each unit submits to the base flying safety officer topics or problems on which they wish action taken. The base flying safety officer has these matters investigated and chooses the most important for the agenda of the committee's monthly meeting.

When the committee convenes, it is able to deal with problems quickly since commanders are present and can immediately order appropriate staff officers to take necessary action or appoint a sub-committee to make further investigation. At the next monthly meeting, commanders go over the old business to insure that all problems have been dealt with and adequate action taken. March has found that through this committee local flying safety problems are dealt with quickly and efficiently.

By now, although this has been only an outline, you can see that the

Safe Aircraft Campaign for '54 is a big operation. Expensive to implement, you say? Not so expensive as just one major aircraft accident. Successful? The accident rates computed at the end of the year will answer that. But the command's steadily decreasing rate the last few years has proved the worth of past campaigns.

Flying safety is a reflection of high proficiency in all phases of flying. It is the measurable result of an attitude of mind shared by pilots, crewmembers and maintenance men alike. An attitude of mind that combines discipline with knowledge. The Strategic Air Command mission frequently involves the assuming of calculated risks. But good flying safety habits mean precision, efficiency and reliability. And those qualities enhance the prospects of a successful mission.●

spring

summer

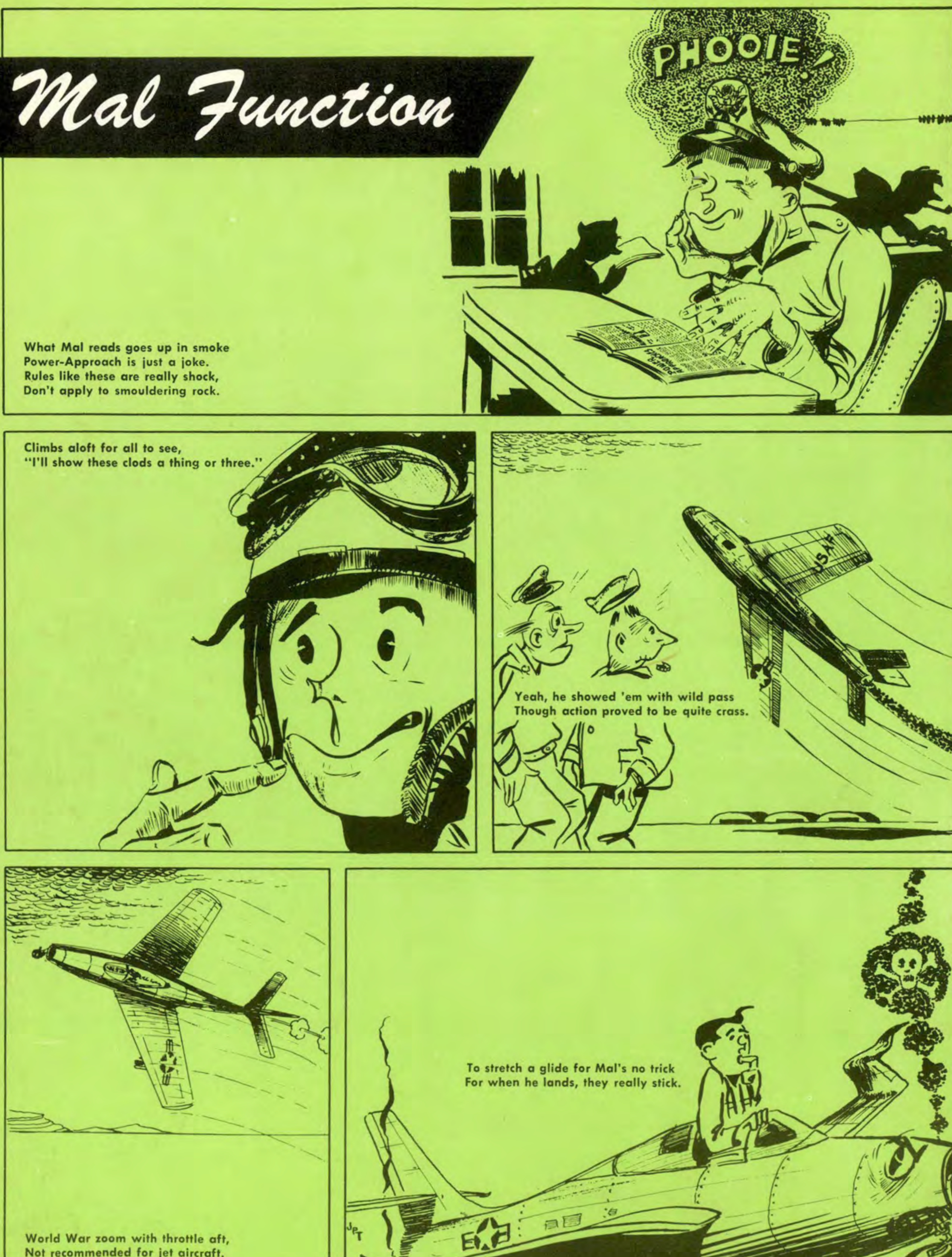
Every season has its hazards and, as every flyboy knows, advance briefing always pays off. Early storm warnings are a must!

See this month's centerspread for the first of a new series of seasonal flight hazards. The Directorate of Climatology, AWS, will keep you posted through the medium of FLYING SAFETY.

fall

winter

Mal Function



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