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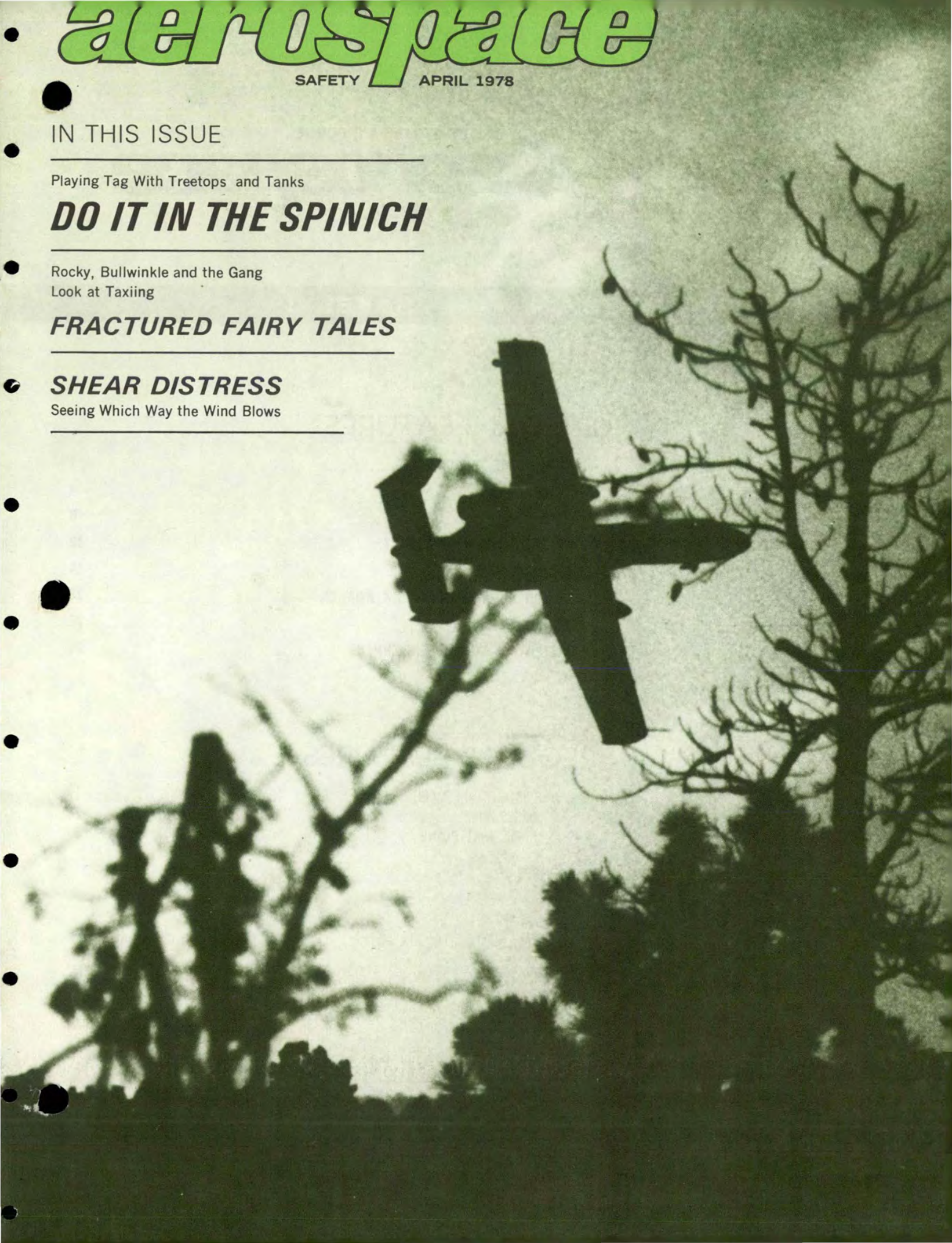
SAFETY APRIL 1978



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UNITED STATES AIR FORCE

aerospace SAFETY

THE MISSION - - - - - - SAFELY!

SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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APRIL 1978 AFRP 127-2 VOLUME 35 NUMBER 4

DEFINITION: SPINACH—
A potherb of the goosefoot family

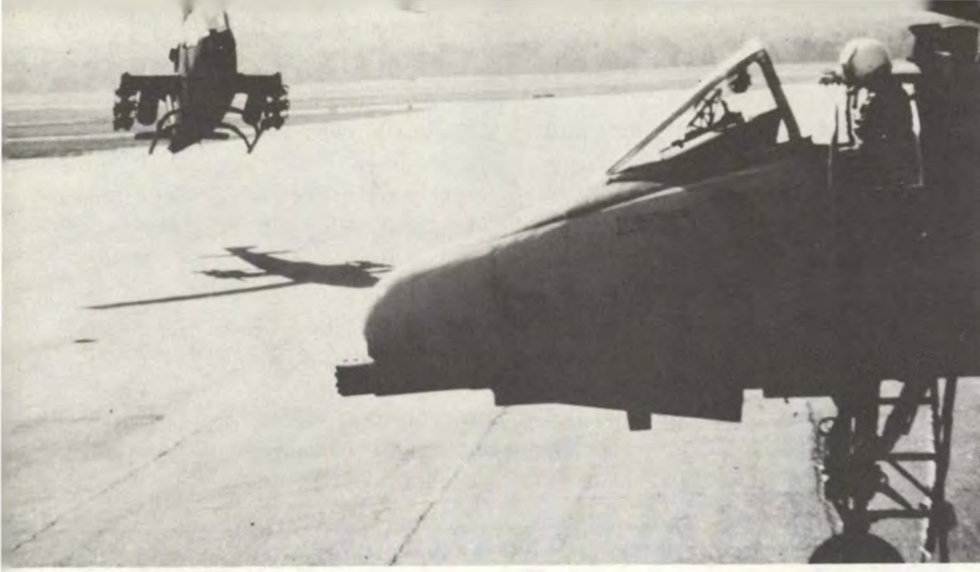
SPINICH—
Tactical Shrubbery

Dynamic integrated training and tactics development scenarios such as Red Flag and JAWS (Joint Attack Weapons System) are today's methodology to increase readiness and defeat the threat.

The "Spinich" is defined as that airspace from ground level to 300 feet AGL. A helicopter operating in this space owns that area from the treetops (spinich) down, while an attack fixed-wing aircraft (such as the A-10) owns that portion from the "spinich tops" upward. If the target terrain does not include tactical shrubbery, then survivability is reduced due to inability to use terrain masking (hiding in the shrubs). While using this technique, a qualified helicopter jock can fly around trees with "minimum" blade clearance on both sides. Similarly, an A-10 pilot can sustain altitudes of 100 feet AGL or lower.

MAJOR TONY HELBLING, Jr. • Directorate of Aerospace Safety

DO IT IN THE SPINICH



DO IT IN THE SPINICH continued

This joint scenario is the epitome of demanding flying resulting in lots of sweat and adrenalin flow! If a midair situation is sensed by a helicopter or attack aircraft, the chopper "takes it down" while the A-10 goes up.

In order to properly train and qualify aircrews, the pilots are exposed to a repetitive series of low altitude missions and successfully demonstrate proficiency at increasing levels of difficulty (sustained periods of low altitude-close clearance maneuvering). With this methodology, our pilot is trained for the maximum degree of low level proficiency (given increased readiness as the prime driver).

When the "balloon goes up" and the tanks of the Warsaw Pact rum-

ble into friendly territory, we aren't going to have time to prepare or polish up on low altitude tactics. When you fly an A-10 with a wing span of 57 feet, at a sustained altitude of 100 feet AGL and below, you had better have your priorities sorted out *before* you break into that 5G turn. You just don't have time to learn that degree of proficiency on a short notice basis.

Our job as operations supervisors is to ensure that our training programs do this. For instance, does our lead-in training program complement the primary role of the follow-on combat aircraft? What type of low altitude lead-in training do we need? Should an A-10 pilot candidate be learning the same basic maneuvering techniques as a crop duster? (Minimum distraction techniques and eyeballs out of the cockpit.)

In dynamic, integrated joint weapons scenarios, when fixed-wing aircraft are working within a few meters of helicopters, there is little room for error. The slightest distraction or lack of in-flight priorities can result in a real bad scene for both Army and Air Force aircrews.

When we look at realistic training such as "Red Flag," we see a slight increase of aircrew/aircraft losses as compared to previous loss history over several years. More dramatically, we see a substantial increase of realistic training which is realized by the higher proficiency level of increasingly demanding training tasks such as "pop-up" attacks, and reattacks.

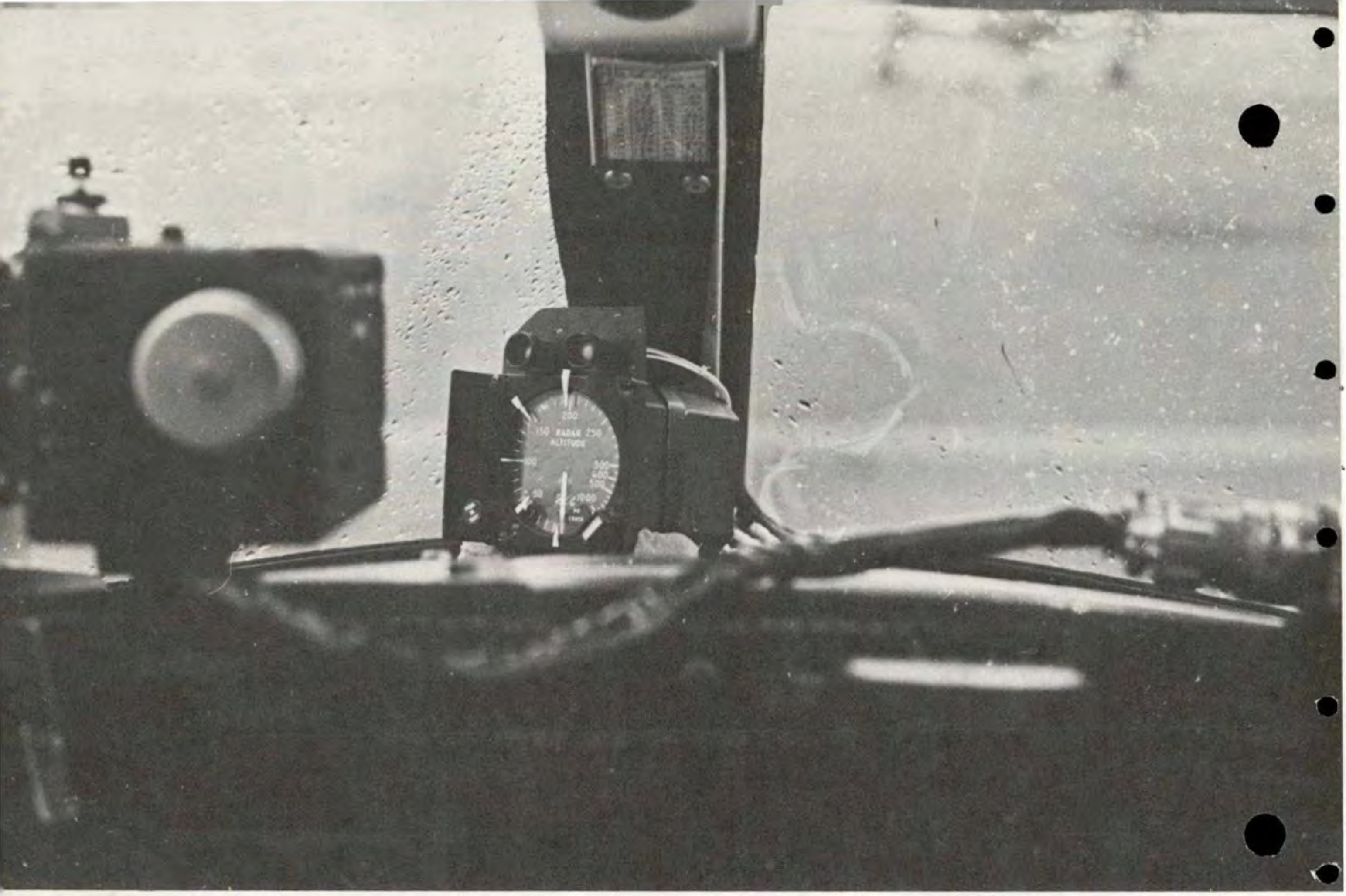
When we assess an aircraft loss on an "each case basis," we have to apply all the preventive measures we can *short* of interfering with our readiness goal.

At the year's end, when we analyze the annual statistics and compare losses versus training/readiness gains, we can justify our losses provided we have done all in our power to eliminate training deficiencies and bolster our training programs.

Previous theories of accident prevention such as:

- raising minimum altitudes,
- eliminating formation landings,
- reducing ACM/DCM exposure

just won't "hack it," given the requirement of increased readiness. ★



Runway Condition

CMSgt GEORGE M. HORN • Air Weather Service, Scott AFB IL

With its engines running and windshield wipers wiping, a T-39 waited for takeoff clearance while a series of rainshowers wet isolated portions of the airdrome. A curious passenger inquired about the delay. The pilot responded, "We are waiting for the weather people to get out there and declare the runway dry." He continued to explain that the T-39 needs a dry runway before it can take off on a runway shortened by construction. Since the curious passenger was a "weather people," he knew that responsibility for determining the runway condition does not reside in the weather shack. He wondered how much of the aviation community was confused about how runway condition is determined and disseminated.

An informal poll showed that many pilots were unaware of how runway condition was derived, let alone relayed to the cockpit. This is understandable considering that runway condition is only one element of many occupying a pilot's mind before making a takeoff or landing decision. However, since the aircraft's contact with the runway surface is one of the more important aspects of flight, runway condition is of more than passing significance; pilots should know how it is determined as well as how it is passed through the inevitable channels to the user.

Before we discuss where "runway condition" comes from, we should review what it is. "Runway condition" is composed of two separate elements: "Runway Surface Condition" (RSC) and "Runway Condition Reading" (RCR). RSC tells you what's on the runway (water, snow, ice, slush) while RCR (a number from 02 to 26) provides an index to the relative braking efficiency of the runway surface which is ice or snow covered.

The chief of airfield management is tasked (by AFR 55-48) to determine both values (RSC and RCR) and disseminate them to local agencies such as the tower, RAPCON, and command posts. Base Operations also passes RSC and RCR, in coded form, to the base weather station for transmission on longline weather communications networks and subsequent use in aircrew weather briefings. In certain situations Base Operations may use the local weather dissemination system (usually an autowriter) to relay runway condition to agencies with drops on that system.

Runway condition is determined by personal inspection either by Base Operations people or the Supervisor of Flying (SOF). RSC is determined visually. Determining RCR takes a little more effort and occasionally some daring. A device called a "James Brake Decelerometer" or similar equipment is mounted in a "ground aerospace vehicle" (usually a truck), and the driver, after attaining the required tech order directed speed, attempts a stop on the portions of the runway in question. The average maximum locked wheel deceleration rate without the vehicle coming to a complete stop is the number reported as the RCR. The better the coefficient of friction, the higher the decelerometer reading. A dry runway should coax a "26" from the needle, for example, while a sheet of ice will get more response from the driver than from the decelerometer. The runway inspector checks out the entire length to determine a representative value and also inspects ramps and taxiways.

When all the data have been acquired, the decelerometer operator passes it to Base Operations. Base Operations then relays the information for the runways, ramps, and taxiways around the base for immediate use. From that dissemination, the base weather station transmits only the conditions of the runway (in coded form) as part of the weather observation and uses the information in local aircrew briefings. When base weather is advised of a change to the existing runway condition, they transmit it as a special weather observation and subsequently include it as a remark in each succeeding hourly weather observation. In this way, it is transmitted to all other USAF bases and used by weather forecasters there as an important part of the flight weather briefings they provide.

As written on your weather briefing form, runway condition may look like these examples: "WR//" means that the runway is wet. Note that an RCR is *never* included with a wet runway report; joint USAF and NASA tests have shown that RCRs determined on wet runways are invalid and should not be used to predict stopping distances. RCRs determined on other surfaces, however, can be used as reasonably accurate stopping distance estimators. "IRO5P WET" means that there is patchy ice on the runway, the remainder is wet, and the RCR in the ice covered areas is 05. "LSRO8P DRY" means that there is loose snow in patches, remainder dry, with an RCR of 08. The addition of the remark "SANDED" tells you that the engineers have provided some sand for your braking convenience.

Runway Condition Reading (RCR) is measured by James brake decelerometer when surface is covered with ice or snow but not for a wet runway report.

An encoded runway condition of "RCRNR" means that Base Operations is closed and no one is available to determine or disseminate a runway condition. Since weather observers at such bases have been instructed to transmit this remark whenever the runway is anything but dry, you may assume some sort of precipitation or ice to be present whenever you see it. By comparing the RCRNR report to the reported weather observation, a rough assumption of actual runway condition can be made.

At some Army airfields and Air National Guard bases, decelerometers are not used and RCRs are not reported. At some of these bases, RSC is still reported, but RCR is replaced by slashes and ICAO braking action remark is added, e.g., "PSR// BA MEDIUM." This, so far, is how runway condition is determined and disseminated today. To take a brief look down the road (or runway), there's a strong possibility that runway condition will follow the inevitable move towards automation. There are systems available and operational today that transmit real time *runway surface condition* data from sensors buried in the runway surface to digital readouts in Base Operations. It is possible to totally automate these systems for instant, hands off, local dissemination and longline transmission. However, a totally automated runway condition is still a problem in that there is no provision for providing an automated RCR.

Runway condition is significant to all aircraft operations except perhaps VTOLs and helicopters. It's important that pilots know how it's derived, relayed, and applied to individual aircraft characteristics. For further information, see AFR 55-48, Chapter 5, or stop in for a chat with your friendly chief of airfield management, SOF, or weather person. ★

Q. In discussing crosswind corrections in the holding pattern, AFM 51-37 refers to double and triple drift corrections. Exactly how do you apply these techniques?

A. The method most frequently used to correct for crosswinds in the holding pattern is to steepen the downwind turns and shallow turns into wind 1° for each degree of drift correction required to maintain the inbound/outbound track. These bank corrections should be made from either the bank angle necessary for a standard rate turn or 30°, whichever is the smaller. The procedure can be depicted as in Figure 1.

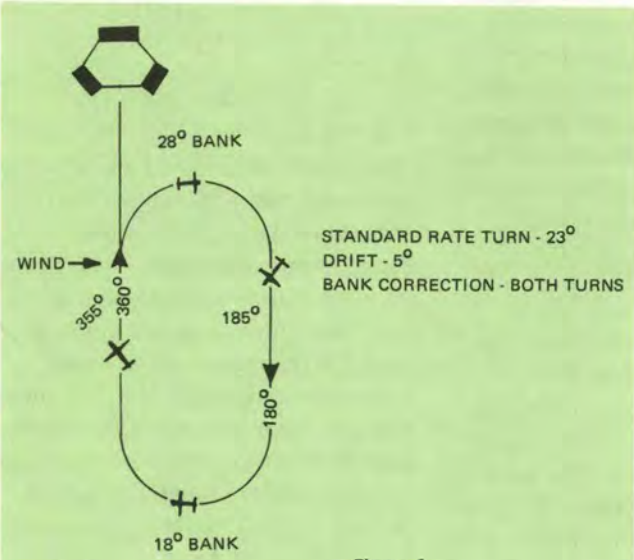


Figure 1

However, if the aircraft's true airspeed is in excess of 210 knots, the bank angle for a standard rate turn becomes greater than 30°. In this case, the pilot should use 30° of bank as the reference bank angle for making corrections. Notice, he now cannot steepen his downwind turn. Since he cannot compensate for the wind's effects during this turn, the aircraft will be flown wide, and merely shallowing the turn into the wind will not place the aircraft on the inbound course. The use of a double drift correction on the outbound leg, as shown in Figure 2, is a method that will correct this problem.

In a situation where the required drift is large enough (greater than 15°), the pilot may not be able

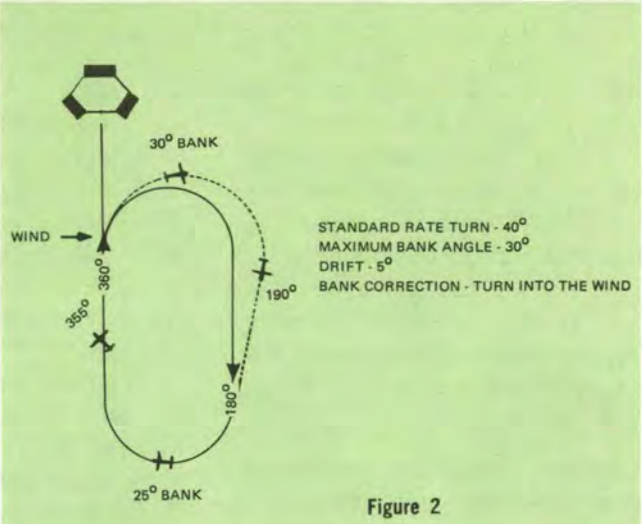


Figure 2

to shallow the turn into the wind sufficiently to place the aircraft on its inbound track. Use of the triple drift method on the outbound leg can be employed in this situation. This method, which is illustrated in Figure 3, has an added advantage in that 30° of bank is used for all turns.

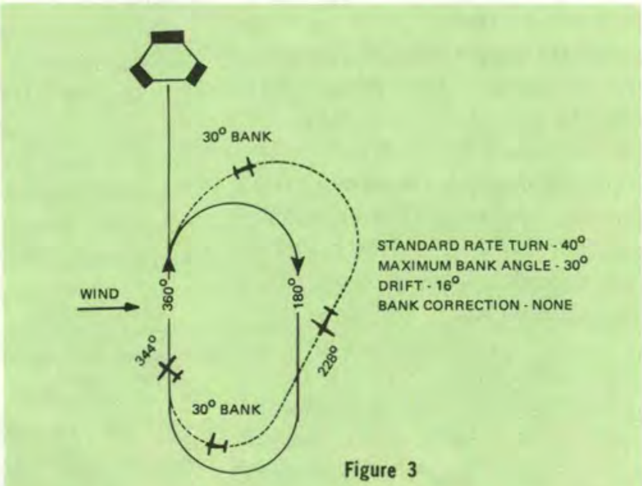


Figure 3

POINT TO PONDER—THE INSTRUMENT TAKEOFF

Most pilots would agree that the takeoff is one of the most critical phases of flight. It is even more so when poor weather dictates the necessity for performing an Instrument Takeoff (ITO). Since the Air Force has lost several aircraft in recent years during instrument takeoffs, perhaps a brief review of ITO techniques is in order.

When can the pilot anticipate an ITO? Certain weather conditions will, of course, necessitate an ITO but weather alone may not be the determining factor. Night takeoffs over water or desolate areas may require the mental preparation necessary for an ITO. Aircraft configuration and performance in certain aircraft (a heavyweight KC-135 for example) require the precise pitch attitude and airspeed control that are associated with an ITO.

Preparing for the ITO begins long before the actual takeoff. A thorough study of all available SIDs, approach plates, obstacles, NOTAMs and weather conditions should be accomplished when the possibility exists that an ITO will be flown. The study of SIDs and terrain might indicate a certain climb gradient must be maintained to clear obstacles. If the climb gradient can be maintained normally, is it possible after the loss of an engine? Always check approach plates and NOTAMs for available back-up procedures in case an emergency return is required. If a formation flight is planned, every flight member should review emergency return and lost wingman procedures. A detailed study of the weather conditions is perhaps the most important aspect of the pre-flight preparations. The pilot must mentally prepare himself to anticipate the visual to instrument changeover.

The actual performance of the ITO begins in the chocks. A thorough instrument cockpit check might prevent a surprise later. In multi-place aircraft, the pilot performing the takeoff should brief applicable crew members to monitor appropriate performance instruments during the ITO. A review of aircraft flight manual procedures for takeoffs might be advisable. The ITO is accomplished by reference to both visual and instrument cues. In the initial stage, the takeoff is almost completely a visual maneuver. As visual references deteriorate, more reference must be made to the cockpit instruments. The weather conditions present will dictate how rapidly the changeover must occur. The changeover will be readily apparent to the pilot, for example, in low ceiling/low visibility conditions (e.g., precipitation, fog, etc.) or high ceiling/low visibility situations (e.g., ground fog, smoke, haze, etc.). The low ceiling/high visibility conditions associated with the low stratus clouds, for example, may, however, catch the pilot off guard if he is not mentally prepared for them. Although the actual takeoff will be completely visual, the pilot must prepare himself for a sudden entry into complete instrument flight conditions shortly after getting airborne.

With proper planning, the takeoff itself should be easy. If your aircraft has a flight director system, setting the heading set marker to the runway heading will provide an easy to use display for maintaining runway heading and wings level attitude after airborne. It will not correct for wind drift, however. Therefore, if your takeoff clearance is to maintain runway heading, the intent is to maintain a ground track out the extended runway centerlne. To accomplish this, drift correction should be applied to correct for known winds. Another technique for maintaining centerline is to use a localizer course if available on the takeoff or opposite runway. This will provide a reference to the runway centerline provided the appropriate ILS front course is set in the course selector window. The Course Deviation Indicator/Course Indicator will remain directional under these conditions but beware, as the bank steering bar may not be reliable in some flight director systems.

The ITO is not, in itself, a difficult maneuver. Without adequate preparation and forethought, however, it can lead to unexpected and sometimes disastrous results. The next time you contemplate flying an ITO, try applying some of the techniques that have been discussed here. If they are properly applied, you will probably find yourself safely airborne every time.

As mentioned in our last approach article, the USAFIFC is in the process of closing down. In case you missed reading the March "IFC Approach" article, it stated that the USAFIFC will be closing on 30 June 1978. Until that time, most of your instrument related questions can still be answered there. For TERPS call AUTOVON 487-4274. For pilot procedures/directives call AUTOVON 487-4276. For questions on FLIP call AUTOVON 487-4884. The responsibility for AFM 51-37, AFR 60-16 and AFP 60-19 has been relocated in a section at HQ ATC. Questions on these publications can be answered at AUTOVON 487-5835. ★

SHEAR DISTRESS

MAJOR JOHN E. RICHARDSON
Directorate of Aerospace Safety

"TANGO 21: *You are cleared for an ILS approach to Runway 30. Current Offutt weather—800 scattered, 3,000 broken, visibility 3 miles in light rain, moderate to heavy thunderstorms 10 miles north of field, winds 310 at 10. The last two aircraft on the approach reported turbulence and possible wind shear just prior to the middle marker."*

The aircraft starts down the ILS glide path. The pilot makes a slight correction and the pitch and bank steering bars on the ADI center. A glance at the airspeed shows it to be right on computed final approach speed. As the aircraft approaches decision height, the pilot notices that the airspeed is dropping off. At the same time, the pitch steering bar indicates that the aircraft is dropping below glide path. The pilot adds power and raises the nose as turbulence shakes the aircraft.

This pilot is faced with a fairly common problem. The question now is how to handle the situation. The more we study wind shear, the more we learn about the phenomenon and develop methods to combat its effects.

What is wind shear? Basically, it is a result of a change in direction and/or velocity of wind.

An aircraft is affected by this change because the aircraft motion relative to the ground is also changed by the wind. At altitude this is usually not a problem, except for the turbulence associated with a shear plane. There is usually enough altitude and airspeed to compensate for the changes. However, the situation may become critical in the traffic pattern or on takeoff. The safety margin could be too thin. It is possible for the wind shear to exceed the pilot's capabilities or performance of the aircraft.

We can discuss performance capabilities in terms of available energy. Changes in energy cause changes in aircraft position and speed. In unaccelerated flight an aircraft maintains a certain energy level, balanced against the surrounding atmosphere. If this balance is disturbed, by a wind shear, for example, some compensation must be made. Events in an aircraft are dynamic, and the aircrew is continually reacting to the changing flight conditions.

Changes in wind velocity or direction are part of these dynamic conditions. The crew perceives the need for a change in aircraft energy levels through the instruments and makes changes. The applied corrections are not, however, instantaneous, and as a result, the reactions of the crew or aircraft may not be sufficient.

HEAD WIND

Using the situation we had at the beginning of this article, let's trace three hypothetical wind shear encounters. These are cases where the shear is the result of a decreasing head wind. In such a case, there is a transient loss of airspeed and lift. This causes the aircraft to descend. The pilot must compensate for this loss of lift. The critical factor is that of sufficient altitude to complete the recovery. In Figure 1, the shear occurs at an altitude high enough for the pilot to complete the recovery (just past final approach fix, for example).

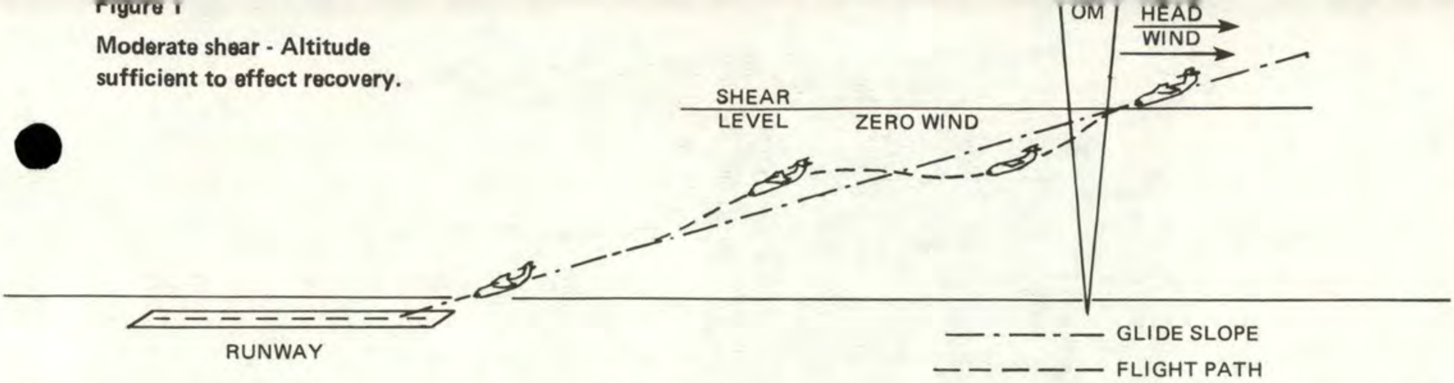
As the aircraft passes through the shear level, airspeed and lift are lost. The aircraft starts to sink and drops below the glide path. The pilot sees this as a deviation and corrects with increased pitch and power. Very often the correction is too great and the aircraft overshoots the desired airspeed and glide path. However, there is sufficient altitude to correct and the aircraft lands safety.

Let's consider a case where the wind shear occurs farther down the glide path. Reaction time becomes more critical. Again, the initial reaction of the aircraft to the shear and the pilot's correction are the same. However, if the pilot overcorrects and the aircraft goes above the glide slope and airspeed increases, there is insufficient altitude and/or time to correct, and the aircraft may land long and hot.

The third case is the most critical. The wind shear is of sufficient magnitude or the altitude of occurrence is too low to effect a recovery, and the aircraft lands short.

Figure 1

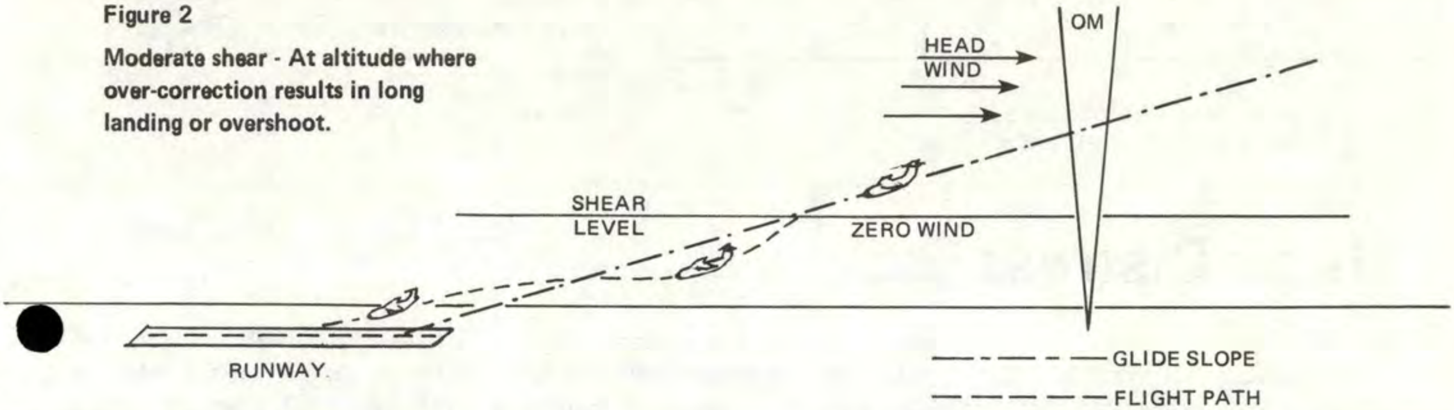
Moderate shear - Altitude sufficient to effect recovery.



- Loss of indicated air speed is equivalent to shear value.
- Lift is lost, aircraft pitches down, drops below glide slope.
- Pilot applies power to regain speed, pulls the nose up and climbs back to the glide slope.
- Probably overshoots the glide slope and target air speed but recovers and lands without difficulty.

Figure 2

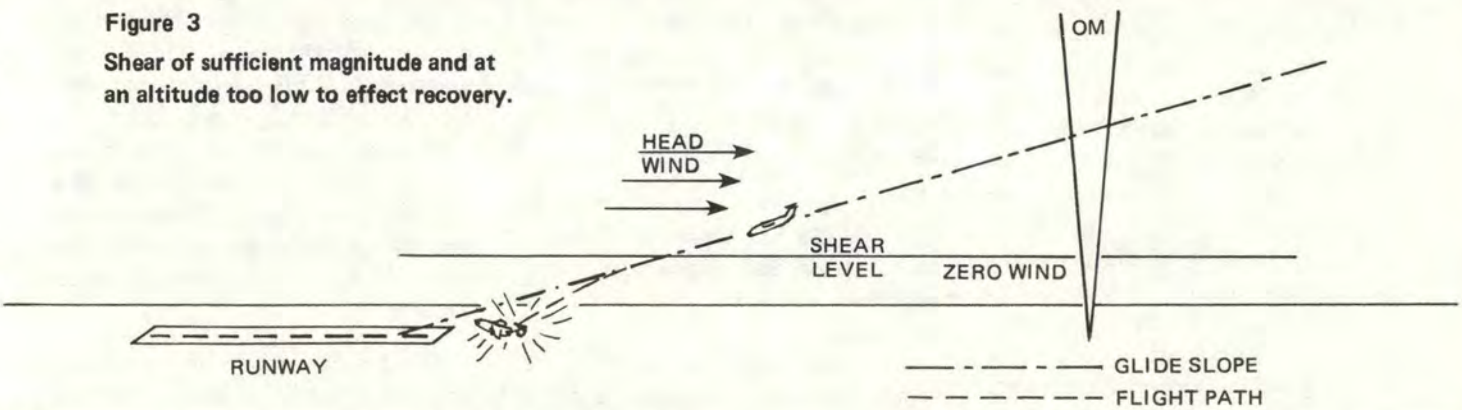
Moderate shear - At altitude where over-correction results in long landing or overshoot.



- Loss of indicated air speed is equivalent to shear value.
- Lift is lost, aircraft pitches down, drops below glide slope.
- Pilot applies the power to regain speed, pulls the nose up to climb back to the glide slope. Nose up trim may have been used.
- When airspeed is regained, thrust required is *less* than required for the previously existing head wind.
- Thrust is not reduced as quickly as required, nose-up trim compounds the problem, airplane is climbed back above glide slope.
- Airplane lands long and fast.

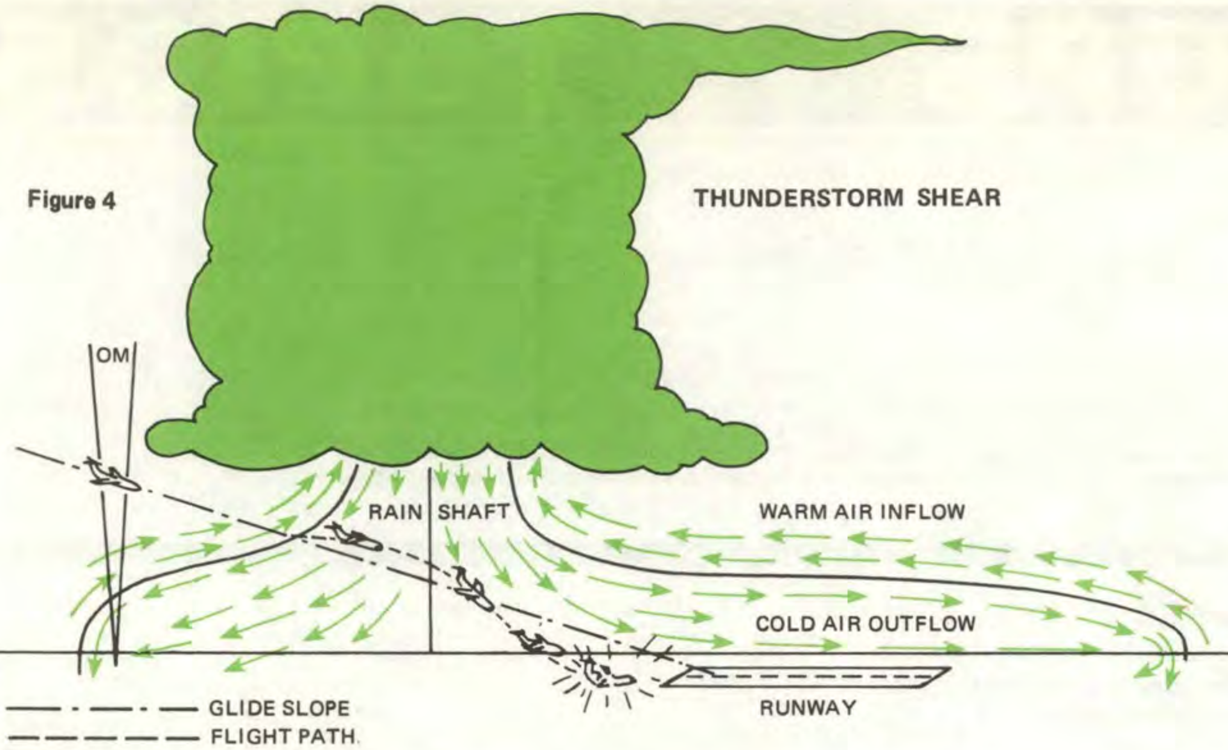
Figure 3

Shear of sufficient magnitude and at an altitude too low to effect recovery.



- Loss of air speed is equivalent to shear value.
- Lift is lost, aircraft pitches down, drops below glide slope.
- Pilot applies the power to regain air speed, pulls nose up to climb back to glide slope, engine spool-up requires time.
- Aircraft is in high drag configuration, altitude critical, increase in angle of attack produces only a slight or momentary increase in lift accompanied by a tremendous increase in drag as the maximum value of the lift/drag ratio is exceeded. The result is a momentary arrest of the descent with decreasing air speed followed by a large increase in an already high descent rate.
- Pilot's only hope is to pull on the yoke and push on the throttles.
- Pilot action is too late, aircraft crashes short of the runway.

Figure 4



Shear Distress continued

TAIL WIND

A decreasing tail wind has the opposite effect. When the aircraft crosses the shear and loses the tail wind, lift increases and the aircraft climbs above glide path. As in the case of a head wind, the pilot's reaction can mean an overcorrection and transition to below glide path. Once again, recovery is dependent on altitude above the ground.

Wind shear is not the simple matter it was once thought to be. The asumptions that an airplane flying into a decreasing head wind will land short while one flying into a decreasing tail wind will land long are too simplistic. Other factors are involved. Regardless of the complexities of wind shear, there are a few actions which will prove helpful. The first requirement is an awareness. If you, the aircrew, are aware of the presence of wind shear, you will be better able to cope with it. Your reaction time will be reduced due to mental preparation. The pilot's perception of a deviation from glide path or airspeed is affected by knowledge of the shear. If the pilot is aware of the possibility of overcorrection, overshoots become a bit less likely.

Airspeed and power are two other factors. A few knots extra (the Dash One gust factor except in a tail wind) makes it a lot easier to control the aircraft. Changes in configuration (flaps, speed brakes, etc.), when available, can mean higher power settings and better response times to overcome surprises caused by shear.

If such options are available to you, a little pre-approach planning as to speed and configuration can pay high dividends when you suspect wind shear.

The most common reason for a wind shear encounter turning into a mishap is a pilot attempting to salvage a bad approach. Therefore, mentally be prepared to initiate a go-around if it doesn't look right.

THUNDERSTORMS

One other part of the subject of wind shear which should concern pilots is thunderstorms. The effects of the severe winds in a thunderstorm are well documented. In at least two cases, a military trainer on one occasion and a civil jet on another, the direct cause of a crash was wind shear associated with a thunderstorm.

The best advice for flying in or near thunderstorms is DON'T! The guidance in AFR 60-16 is very specific and definitely worth following. The capabilities of *any* aircraft can be exceeded by the "gust front" of a moderate or severe thunderstorm, and the positions of such gusts are unpredictable because they move so rapidly.

Wind shear is one of the "occupational hazards" of flying. We cannot avoid it. At best, we can only hope to learn about wind shear and be prepared to cope with it when it occurs. ★

OPS TOPICS

DO YOU SMELL BURNT TOAST?

A B-52 crew experienced a strange physiological incident. On climbout, the lower compartment crew members, while on normal oxygen, reported a burnt toast odor. The entire crew went on 100 percent oxygen, but as the climb continued, the fumes became stronger and some crew members reported dizziness, light-headedness, tingling hands and feet, and eye irritation. The pilot initiated an immediate descent and selected ram air on the air conditioning system. The fumes dissipated by 10,000 MSL. Post flight inspection revealed two bird nests lodged deep in the precooler heat exchanger. The nests blocked the flow of ram air, causing the precooler to overheat. Hot air also entered the catalytic filter, causing the filter element to overheat and to emit burnt toast smelling fumes. It is thought that the epoxy glue, used as a filter adhesive, when overheated may emit fumes which are irritating to the eyes. Beware of any strange odor. Select 100 percent oxygen and watch for hypoxia symptoms.

TO STALL OR NOT TO STALL

A short note for C-9 pilots. For those of you who missed the NTSB report on the November 1976 Texas International DC-9 crash at Stapleton International, it is summarized here:

As the DC-9 passed through rotation speed and at a point just prior to lifting off the runway, it received a stall warning which triggered two actions in the cockpit:

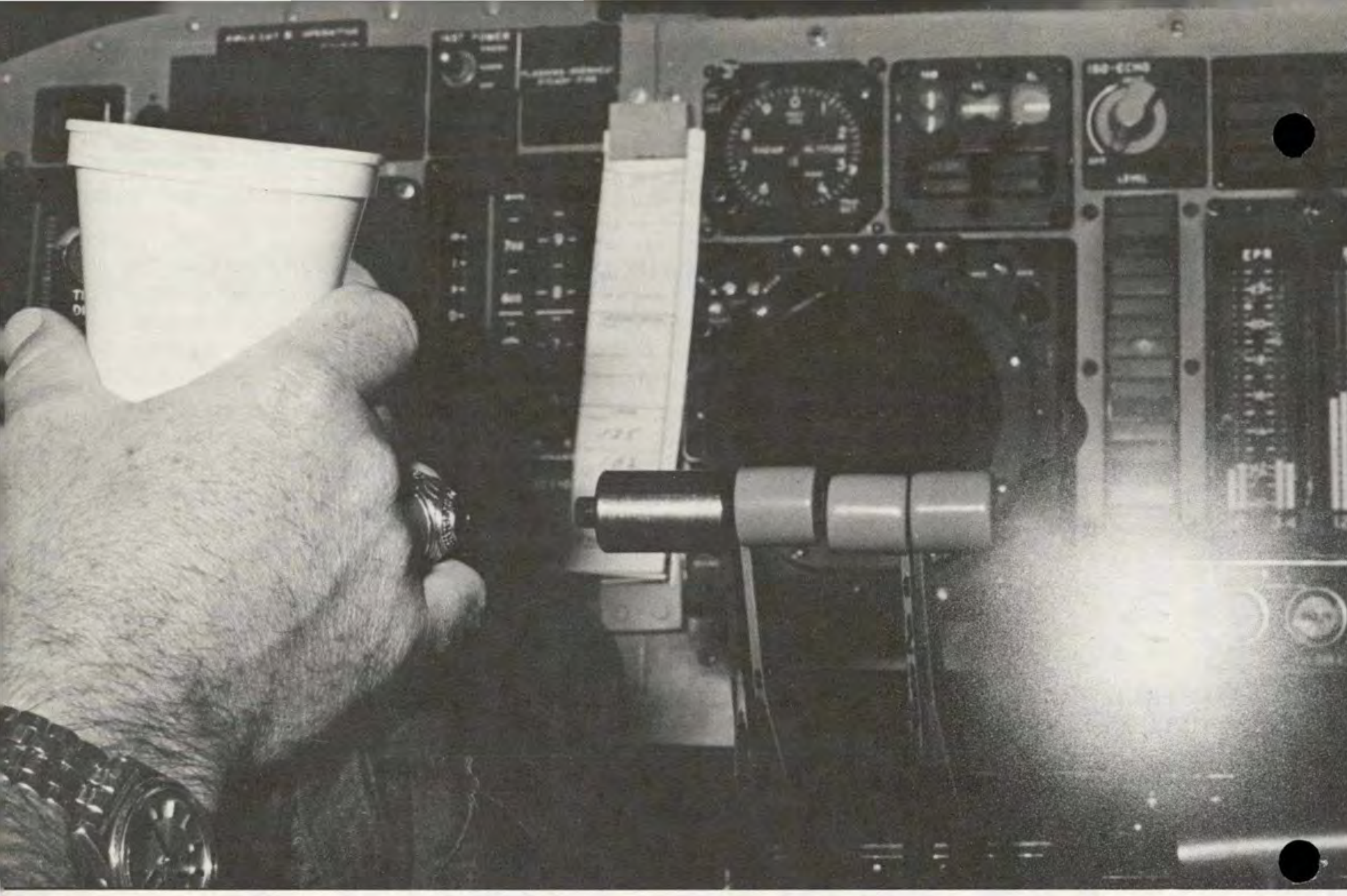
1. The pilot's control column began to shake.
2. The stall warning sound was emitted.

The pilot decided to abort the takeoff, but the jet overran the runway, struck several approach light stanchions, caught fire and burned, resulting in injury to 14 persons and substantial aircraft damage.

The board held that the decision to reject the takeoff, "Although not consistent with standard operating procedures and training, was reasonable in this instant case, based on the unusual circumstances . . . , the minimal time available for decision, and . . . a potentially catastrophic situation." The board further stated that the stall warning was due to a malfunction in the stall warning system.

COMMUNICATION

An F-111 was scheduled for a Fuze Test mission carrying munitions only on the external stations. A write-up in the AFTO 781-A stated "do not operate weapons bay doors in normal or auxiliary modes (operate manually only)." However, the before exterior inspection checklist says to check the weapons bay door control switch to ensure its position agrees with the position of the weapons bay door. The copilot, following this checklist, placed the weapons bay door control switch to closed and placed the auxiliary control switch to normal. Just after engine start, a loud pop was heard, and the crew chief observed hydraulic fluid streaming from the aft edge of the weapons bay. Investigation revealed both doors were overdriven to the closed position, and the aft lips on both left doors were cracked. Although the investigation is not yet complete, it is obvious that once again that old demon, communication breakdown, reared its ugly head. Somewhere in the travel of information from 781 (or Maintenance) to pilot to copilot and back to pilot, vital communication was lost. ★



The Automatic Complacency

A man-machine problem faces the pilot in his role as a programmer and supervisor in an environment that provides automatic systems to do the work but where the redundancy concept requires the pilot to be in a "continuous loop" function. How to cope with the problem is discussed in the following presentation at a Flight Safety Foundation seminar for pilots by Captain K. E. Ternhem of SAS:

In our role as pilots in an environment that provides technology to do the work for us automatically but not always intelligently, and without qualified interface between the individual systems, we have a problem. We are faced with a man-machine interface problem we might call "automatic complacency."

To combat the problem, it must always be borne in mind that the machine, be it even the most complex computer, is but a tool, designed to aid the man in performing certain specific tasks. The machine cannot think for us and it cannot work outside its rigidly defined performance envelope. It cannot even be complacent. Consequently, there is every reason for the man not to let these tools work on their own and without knowing their weak spots and the limits of their capabilities.

For example, the autothrottle and the autopilot normally perform their specific assignments very well but neither system knows much of what the other is doing or plans to do, and neither system knows much about operation limitations (with some exceptions, e.g., on the DC-10). Still we seem to lean on the automatic systems—the automatic flight control systems in this particular respect—to such a degree that we may become lax in our attention to the primary flight instruments or even revise our priorities.

SOME EXAMPLES FROM REAL LIFE:

In an automatic approach, a bend on the glidepath at 500 ft caused a very marked pitch down, resulting in excessive sink rate. The pilot, though fully aware of the situation did not react until the situation was so critical that a very low pullup had to be made.

In nav mode enroute, the aircraft turned the wrong way over a checkpoint. Although the wrong behavior was immediately noticed, the aircraft turned more than 45° before the pilot took action.

Enroute during INS operations, the crew did not notice that the nav mode selector had been switched to HDG. The aircraft proceeded on a straight course for five minutes instead of turning over the waypoint.

In an approach, the autothrottle became inactive. The speed dropped 15 Kt. below correct speed before the malfunction was noticed.

The altitude preselect malfunctioned during descent. This went unnoticed by the pilots and an excessive undershoot was made.

At leveloff by use of the altitude preselect, the throttles in idle, the speed dropped close to stall before detected and rectified by power application.

These examples, of which kind there are many, are not unnatural in a logical sense. They are fully explainable human-engineering wise but they should not occur unless there is a breakdown of the normal routine.

What is disturbing is that we tend to defend ourselves by blaming the system (which is only a contributing factor) and considering it legitimate to trust the technique and change our otherwise sacred instrument scanning routine.

Another way to describe the problem is that we tend to fall out of the "loop." We have a problem of complacency and we as individuals may not be aware of it. The problem is not the pilot but our understanding of the mechanism that creates the problem and also the lack of intelligent means to train the pilot into the concept of integration with a competing machine. We are, of course, also aware of the fact that our aircraft installations, though at the top of the state-of-the-art, may not always be optimized in their function to serve the man.

THE CURE:

Because we do not know all the factors that create the problem, we are not prepared to give a recipe that totally eliminates the problem.

We can all agree, however, on some sound and concrete rules that, if followed, will keep us virtually out of the problem. But first, there is a need to clarify what the machine, the black box in our case, is really supposed to do for the man. We apparently make a big mistake if we believe that the machine has entered our environment for the sake of our convenience only.

THESE ARE THE REALITIES:

1. The machine does not relieve the man of his responsibilities.

2. The machine does not reduce the workload of man as regards his expected achievement. BUT . . .

3. The machine increases the total capacity.

4. The added capacity serves—
   - to improve safety,
   - to balance the workload,
   - to improve accuracy,
   - to improve regularity,
   - to reduce costs.

In this world of realities, the pilot's managing role in the man-machine teamwork can be condensed into this sequence of actions: plan—program—confirm—monitor—correct-reject—if necessary.

And with these facts in mind, you may agree that when you leave it to the automatic systems:

- Don't change your piloting priorities.
- Be aware of the system limitations.
- Be highly suspicious.
- Make clear beforehand what the system is supposed to do.
- Check what it's doing.
- Don't hesitate to reject the aid of an inferior system.
- Don't accept a system performance that you yourself under the circumstances could do safer or better.
- Don't make the use of an automatic system an end in itself.

To express these rules in a short sentence: "BE SYNCHRONIZED WITH YOUR AUTOMATIC SYSTEMS" or still shorter—"BE IN THE LOOP." ★

—Air Canada **Grapevine.**

presents
Rocky and His Friends Comment on Taxi Mishaps
or
"How to Ding a Wingtip (or whatever) Without Really Trying!"

By

MAJOR JOHN D. WOODRUFF • Directorate of Aerospace Safety

BULLWINKLE ASKS WHY

I'm sure you all remember the subtle humor of "Rocky and His Friends," a popular TV cartoon series. We recently had the pleasure of having Rocky and his friends visit us here at the Air Force Inspection and Safety Center. We gave Rocky and his staff the full blown treatment on our historical mishap data. Rocky didn't have too many question to ask (being a flying squirrel and, like most pilots, slept through most of the briefing), but Bullwinkle, in all his intellectual splendor, asked us one important question. "Why do you have so many mishaps where pilots taxi into things?" Bullwinkle thought all our mishaps took place in the air or on impact with the ground.

You know, we didn't have very many good answers for him. We've consistently done the same dumb things over and over again. To make a point, Bullwinkle translated a few of our taxi mishaps into a "Fractured Fairy Tale" format for us. (Let's hope he doesn't use any of them on the next show with Rocky.)

FRACTURED FAIRY TALES

FATIGUE AND CONFUSION: A B-52 was taxiing to parking after a 17-hour crew day. The marshaller handed the aircraft off to another marshaller and changed duties to a wing walker. The left wing tip nicked a truck.

WHICH TRUCK? A B-52, while taxiing to takeoff, struck a parked truck. The gunner monitored the wrong parked truck.

HEAD IN COCKPIT: An A-7, while taxiing as nr two in a three ship, answered a radio call from lead. As the pilot looked left and down into the cockpit to determine which radio he was transmitting on, his right wing struck another A-7 parked on the end parking spot.

TAXI LINES: A C-130 pilot failed to maintain his position on the established taxi line while on taxi out to takeoff. A parked C-130 was struck.

FOREIGN MARSHALLERS: A C-130 was being taxied in a foreign country to takeoff. The "local" marshallers thought there was adequate clearance. The right wing tip struck a tree.

UNHEEDED WARNINGS: The C-130 engineer warned the pilot that he was too close to obstacles on the left side. The copilot continued to run the checklist. The pilot looked left, but continued to taxi. The left wing struck a light pole.

NO MARSHALLERS: A C-130 was taxiing in a congested ramp area at a sister service airdrome. Ground control assured the pilot C-130s parked there all the time. No marshallers were available, and the aircraft commander failed to deplane a scanner to assist in parking. The C-130 pressed on and struck an A-4 with its wing tip.

MISJUDGED DISTANCE: A C-141 was taxiing in on a night cargo airlift mission behind a "follow-me" vehicle. During taxi-in, the pilot observed a tow tug carrying a feathered prop. He thought the aircraft was clear, but the right wing collided with the upper tip of the prop.

WING WALKERS: A C-141 with a wing walker and "follow-me" was given a left turn to position for parking. The copilot and scanner queried the wing walker about sufficient clearance. After receiving a signal to proceed, the aircraft moved forward and the wing tip struck a tree.

CLEARING THE AREA: During preflight, the aircrew of the F-4 observed that a power unit was located forward of the right wing and would have to be moved prior to taxiing. When taxiing signals were received, the aircraft moved 5 feet and hit the power unit.

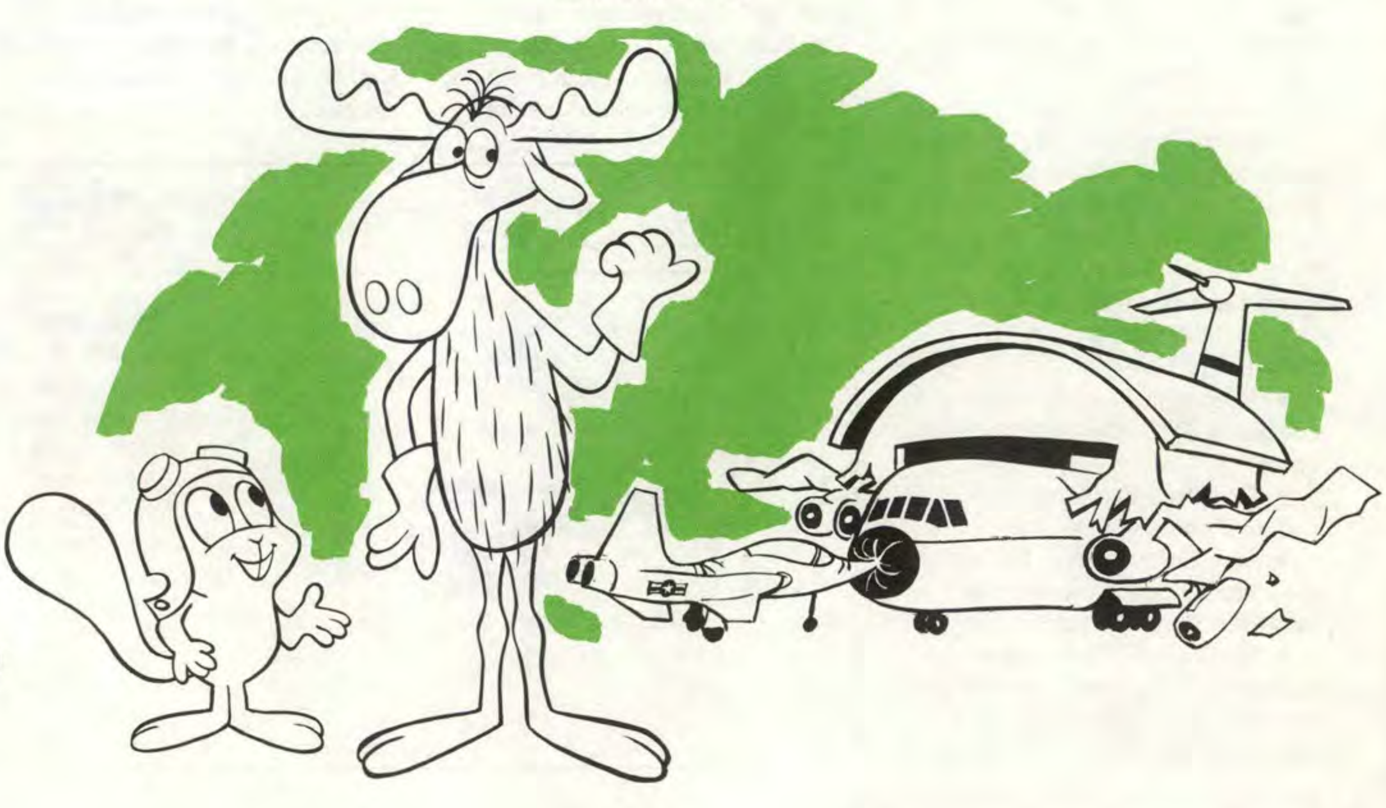
FORMATION TAXIING: Two F-4s were taxiing for takeoff. One aircraft pulled forward and attempted to pass in front of the nr two aircraft. The left wing tip brushed the radome of the second aircraft.

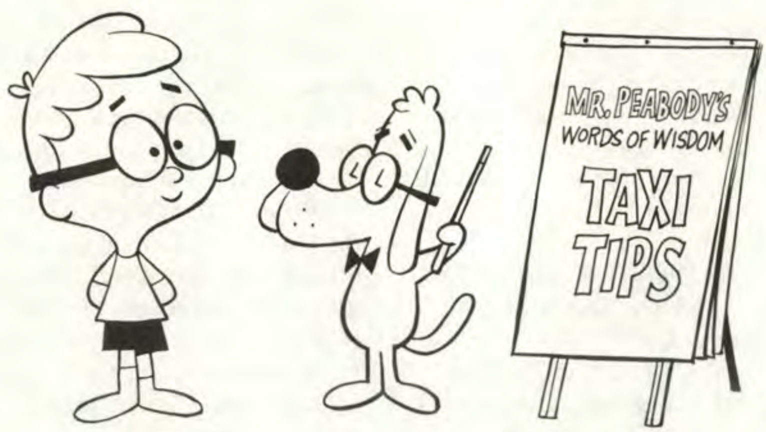
IF AT FIRST YOU DON'T SUCCEED: An F-4 was scrambling out of an alert shelter and as it passed the arch opening, the left wing tip contacted an electrical junction box. After the aircraft stopped, the launch crew inspected for damage, and gave the pilot the okay signal. As the aircraft began its taxi again, the pilot began a slight left turn and the left wing tip struck the (you guessed it) electrical junction box again.

DROPPED TOLD CARD: As the F-100 taxied out of the parking position, the takeoff and landing data card slipped off the pilots clipboard. While the pilot attempted to retrieve the card, the left wing tip struck a tug parked in the next taxi lane.

RADIO CALLS: As the F-102 taxied out of the alert hangar, ground control called the pilot. Nosewheel steering was momentarily lost when the pilot accidentally hit the nosewheel steering button on the stick in an attempt to acknowledge the transmission. The left wing tip contacted the hangar wall.

KNOWN HAZARDS: The condition of the ramp and taxiways had numerous hazards known to the pilot. While an O-2 was taxiing to takeoff, the front propeller





struck a section of PSP that was sticking up.

MULTIPLE DISCREPANCIES: Crowded parking area, unlighted rockpile, no wing walkers. The T-33 was being taxied to the parking area when the left wing tip tank fin struck an unlighted rockpile just off the edge of the ramp.

DISORIENTATION: While taxiing the T-39 to the taxiway from the parking ramp, the pilot became disoriented due to restricted visibility (darkness and blowing snow). The pilot turned short of the taxiway and the aircraft coasted to a stop off the ramp area.

MR. PEABODY OFFERS WORDS OF WISDOM

After the briefings, Mr. Peabody had a few words of wisdom to offer "his boy Sherman" on how to prevent some of our "Fractured Fairy Tales." We in the USAF might recognize them as "lessons learned." Mr. Peobody told Sherman:

- Keep your head out of the cockpit while taxiing in congested areas.
- Don't run checklists while taxiing if you don't have to.
- Stay on those taxi lines—they won't guarantee you clearance, but they will help.
- Don't place blind faith in marshallers, they make mistakes too—if it doesn't look right, stop and get it straight.
- Heed warnings given by other crew members, marshallers, wing walkers.
- Don't taxi into congested areas without marshallers or wing walkers.
- Use all the people you can muster to help you clear—that means other crew members as well as ground personnel.
- Check the area around your aircraft prior to starting engines for obstacles that need to be removed before taxiing.
- Tuck away hazards in your mind that might affect your taxi route and use that information.
- Remember, your judgment of distance and clearance can fool you.
- Don't let the radios distract you when taxiing in congested areas.
- Wingman consideration applies to ground operations as well as air operations.
- Take into consideration the weather—it's a factor on the ground as well as in the air.
- Don't taxi too fast—you can't take corrective action at 50 knots.

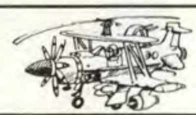
DO YOU NEED A REVIEW?

Mr. Peabody made several good points to Sherman that we should pay attention to. However, if you want to really get into the "act," and I don't mean the starring role in one of our "Fractured Fairy Tales," then browse through AFR 60-11, "Aircraft Operation and Movement on the Ground or Water." This regulation addresses a lot of things other than taxi procedures, some of the more important ones being:

- General procedures for run-up of aircraft engines.
- Use of position lights.
- Use of radios.
- Requirements for personnel engaged in towing operations.
- Aircraft marshalling signals.

Review your ground operations procedures—we don't want to see you in the next presentation of fractured fairy tales! ★

Name That Plane



This aircraft introduced thousands of WWII pilots to flying. Primary training was contracted to private schools, 64 of which were operating at war's end. Can you name it? For the answer, see Page 28.

NEWS FOR CREWS

Information and tips to help your career from the folks at Air Force Military Personnel Center, Randolph AFB, TX.

CAPTAIN ROBERT A. ZIENER
Rated Departmental/Joint Career Management Section
Air Force Military Personnel Center

Most Air Force officers realize fully that central selection boards are used in the temporary and permanent promotion process. However, many officers are not aware that in addition to promotions, MPC also uses central selection boards to identify officers for entry into several of the Air Force's most popular (and expensive) training programs. The use of central selection boards assures eligible officers the opportunity to compete for valuable training programs. This article specifically addresses six training programs which are currently manned by central selection boards: Advanced PME, AFIT, ASTRA, Research Associates, Test Pilot School, and Fighter Weapons School.

Each year the USAF Temporary Major and Lieutenant Colonel Selection Boards nominate officers from among the best qualified selectees for Intermediate and Senior Service Schools. However, this nomination does not guarantee PME attendance. Each October (for Intermediate Service School) and January (for Senior Service School), MPC holds PME designation Boards to determine which officers previously nominated by promotion boards will actually attend school that year. Smaller Supplemental Designation Boards are held each spring for both the Intermediate and the Senior Service Schools. In FY 78, 874 officers were designated (627 for Intermediate PME and 247 for Senior PME) from among approximately 2900 eligibles.

The USAF AFIT Selection Board meets each fall. A small Supplemental Board is held each winter. The Boards pick volunteers and centrally selected individuals for graduate education and education-with-industry programs. Each year of AFIT training incurs a three year active duty service commitment (ADSC). Application is via letter to AFIT as outlined in AFM 50-5.

The ASTRA Board meets each March to select junior officers for a one year training tour on the Air Staff. To be eligible, you must have between four and six years commissioned service, have completed three years rated duty (if rated), and have completed Squadron Officers School. ASTRA incurs a two year ADSC following completion of the program. Application is via the AF Form 90 as outlined in AFR 36-20.

Research Associates is a program in which selected senior majors, lieutenant colonels, and colonels with advanced degrees spend one year in post-graduate studies in the fields of National Strategy, Policy, and Defense. The Research Associates Board meets each December. The FY 78 board considered 429 officers and nominated 62 to HQ USAF, Directorate of Concepts for selection of the final 12 individuals for entry to the program.

The Test Pilot and Flight Test Engineer Selection Boards meets once a year to select entries for classes starting each February and September. The next board will be held during May 1978 and will select entries for the FY 78B (Sep 78) and FY 79A (Feb 79) classes. A typical board would select 12 fixed wing pilots, 1 rotary wing pilot, 7 flight test engineers and 1 flight test navigator for each class. Application procedures are in AFR 53-19.

Entries to Fighter Weapons School are selected three times per year: January, May and September. Officers considered must be experienced fighter personnel nominated by their major command. Additional criteria can be found in AFM 50-5, Vol II. Each Fighter Weapons School Board selects 12 F-4 aircraft commanders and 7 weapon system operators from approximately 80 eligibles. As the F-15 and A-10 schools become fully developed, attendees will be selected in a similar fashion. Completion of Fighter Weapons School, which lasts 18 weeks, incurs a four year ADSC.

Effective education and training are extremely important elements of total readiness. But education and training are only effective when administered to the right people at the right time. USAF requirements dictate timing, while MPC is tasked with identifying the right people.

ABOUT THE AUTHOR

Captain Ziener is an ASTRA officer assigned as a Resource Manager in the Rated Departmental/Joint Career Management Section, AFMPC. His previous assignments have included flying T-29 and T-43 aircraft at Mather AFB, CA, and a tour as an IPIS instructor pilot at Randolph AFB, TX. ★

COMMON HUMAN BEHAVIORS & AVIATION

R. F. GABRIEL, Ph.D.
Human Factors Engineering
Douglas Aircraft Company

Look at Figure 1. Do you perceive the lines in A as spiraled . . . the long diagonal lines in B as unparalleled . . . horizontal lines in C and D also unparalleled? If you perceived them so, you were wrong. Trace the circular lines in A and you will find they are concentric circles. Measure between the diagonal lines in B, also between the horizontal lines in C and D, and you will find them paralleled. The preceding geometric illusions commonly affect all humans. The relevance of such illusions to aviation is uncertain, but it is probable that many aircraft accidents attributed to human error rose from other universal psychological characteristics (common human behaviors).

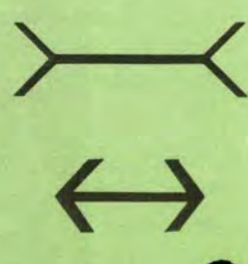
Appropriate corrections can come only from understanding and application. This writeup, therefore, briefly presents some fundamental human behaviors and generalized backgrounds related to perception, attention, set, motivation, learning, memory, central information processing, and stress.

Approximately 80 percent of our real-world information is obtained visually. Under normal conditions, perceptions obviously can be quite accurate. But under illusory perceptions, visual errors can lead to un-

Figure 1

Geometric Illusions

Figure 2



Muller-Lyer Illusion

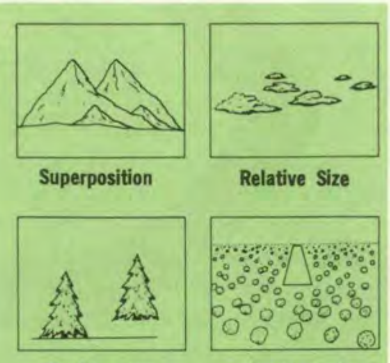
fortunate results. Despite extensive studies, no satisfactory explanation of illusions has been discovered. Figure 2 shows a well-known illusion. Although the top vertical line appears longer than the bottom, they are exactly the same length. Even after the lengths are measured with a ruler, the illusion persists. Another illusion is demonstrated in Figure 3. In each figure, the two horizontal bars are the same length. Figure 3B illustrates that the lack of realistic cues is not responsible for the illusion.

One concrete example of an illusion in aviation involves the Poggendorf Illusion (Figure 4). The oblique lines cutting across the two parallel lines are actually an extension of one straight line although they appear separate. Figure 5 depicts two converging aircraft on an Air Traffic Control display. An Air Traffic Controller observing this screen might mistakenly conclude that the two aircraft, if continuing on their present course, would pass safely when in fact they would collide if both were flying at the same altitude.

At times, pilots are forced to choose between conflicting cues. If chosen incorrectly, illusions will occur. The "black hole" illusion is one of these. Simulator studies found that pilots seriously misjudged height on the approach when forced to make approaches using vision alone. The error depended upon how the airport was located with respect to city lights. An airfield with no lights in the foreground but with the city suronding it, such as might be experienced when approaching over an ocean or a lake, was especially hazardous. Sloping runways were another major source of illusory error.

One of the most interesting and important factors of human visual abilities is the judgment of depth perception. The perceptual cues of superposition, the relative size and height of the object in a plane, and texture gradient are illustrated in Figure 6. When some of these cues are lacking, or are inadequate, or in conflict, the ability to perceive distance may be seriously degraded and errors may result. An example of this is haze or fog interfering with vision. In very clear weather, hills appear near and dwarfed; in misty weather, they seem remote but loom large. Another depth cue is aerial perspective (dimming of an image as a function of distance). Reduction of brightness and color contrast also acts as a cue to distance.

Figure 6

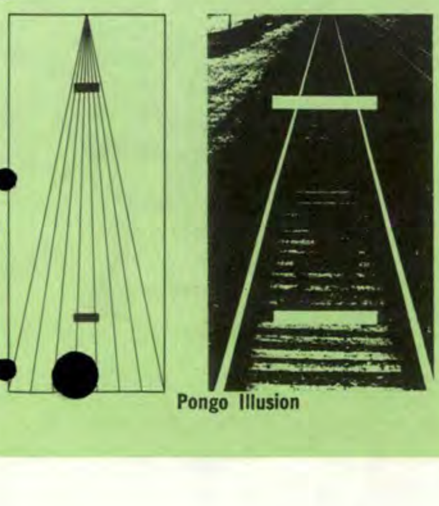


Monocular Cues to Depth Perception

Central nervous system effects can result from certain apparently harmless stimuli. For example, overexposure to flashing lights (strobe lights, anti-collision beacons, etc.) at certain frequencies and intensities can induce reactions ranging from drowsiness, nausea and disorientation to convulsions and trances. These effects are increased by the presence of fatigue.

Pilots visually judge glideslope, speed, and altitude with an adequate degree of accuracy. On occasion, however, the external visual environment is lacking in cues or offers cues that can be misleading

Figure 3

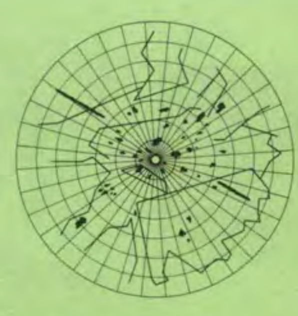


Pongo Illusion

Figure 4

Poggendorf Illusion

Figure 5



Concrete Example of Illusion in Aviation cues because they differ from those most often experienced. Visual approaches and landings in the Arctic are notoriously difficult because snow covering the runway reduces the contrast between the runway and the surrounding terrain causing inaccuracy of depth perception. When a pilot has to land at an unfamiliar airport, perspective and size cues are assumed to be important cues to glideslope. All runways, however, do not have the same dimensions. A 12,000-foot-long, 200-foot-wide runway looks different than a 6000-foot-long, 100-foot-wide runway. Different spacing of runway lights can also cause speed judgment errors. Thus, while human perception may be quite accurate on an average, it needs consistent cues which are too often lacking in actual environment. Over confidence in one's ability to use visual judgments can lead to serious error. The pilot who heaves a sigh of relief once he breaks out of an overcast during an approach and relies totally on visual cues during the landing may be in for a rude surprise.

Focusing our perceptual abilities on one class of stimuli is called attention. Through our attentive processes we keep in focus selected stimuli and resist distracting stimuli. When two sets of stimuli are competing for our attention, the advantage generally falls to the ones of greatest size, intensity, most frequent repetition, and most vivid contour, contrast, or color. The specific need or interest of the individual can overcome all other factors.

Figure 7 illustrates that the brain can control the intensity of the stimulation reaching it and can actually tune out some stimuli. A cat was implanted with electrodes to measure the amount of neutral excitation going from the ear to high centers in the brain. Noises in the form of "clicks" were then introduced. When the cat was presented with mice inside a jar, its attention was devoted to them. "Clicks" introduced during this situation produced much less activity in the auditory centers of the brain.

Man is able to focus his attention selectively. Psychologists presented different stimuli simultaneously to the ears of human subjects (dichotic listening). When subjects in one study were told to direct their attention to what was presented in one ear, they remembered nothing of what was presented to the other ear—not even gross shifts like changing from English to French sentences.

A relevant example of selective attention in aviation is target fascination (see Table 1). This is a situation in which the senses are functioning accurately but the pilot fails to respond to stimulation. Two types of this occurrence have been identified. One involves the operator concentrating so hard on one aspect of his task that he fails to notice other (perhaps more important) elements of the task. In the second type, the operator perceives the information but fails to act appropriately.

The concept of set is very important and influences our behavior in many ways. Set is the tendency to use a particular method or type of solution to a problem based upon previous experience or directions. The influence of set in aviation might be as follows: Assume you are making an approach into an unfamiliar island airport. You have the

Figure 7

Modification of Sensory Stimulation Received in the Brain Resulting from Attention Elsewhere

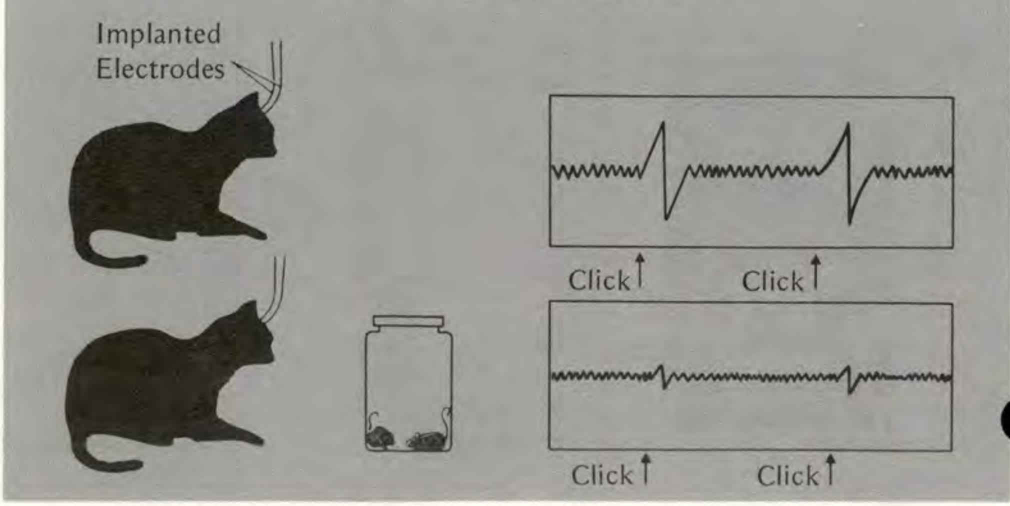


Table 1 TYPICAL TYPES OF ERROR OCCURRING AS A RESULT OF INNAPPROPRIATE ATTENTION, SET, OR MOTIVATION

Attention	• Pilot so intent on tracking to flight director that he ignores sink rate, altimeter, airspeed, or raw ILS data. • In weapon delivery, pilot so intent on tracking target that he flies aircraft into target. • Pilot distracted by malfunction and forgets to maintain flight. • Pilot does not acknowledge or correct too high a sink rate or too low an altitude and undershoots.
Set	• Pilot expecting to be at 10,000 feet and misreads 1,000-foot altimeter indication as 10,000 feet. • Unintentionally continuing below minimums when inaccurate weather report received.
Motivation and Conflict	• "Cutting corners" to maintain schedule. • Deviation from flight path to please passengers by providing view of geographic phenomena. • Consciously continuing below minimums. • Noise abatement approaches and takeoffs. • Making repeated attempts to land when weather deteriorating. • Reluctance of crew or the traffic controller to call to captain's attention an omission or error.

Figure 8

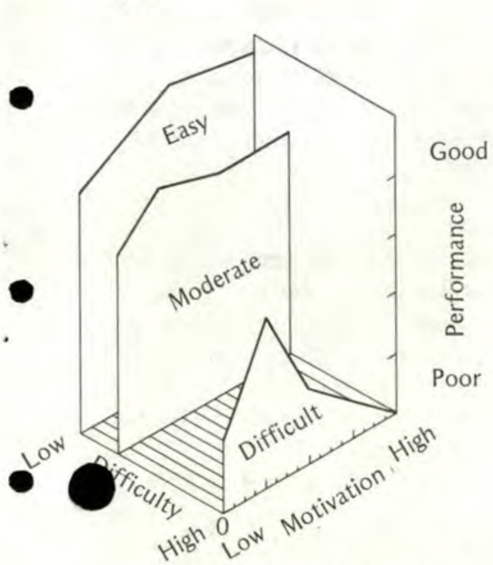


Illustration of Yerke's-Dodson Law

runway lights in sight. Suddenly the lights are no longer in sight. Your set impression may be that you encountered a cloud. It can also be that you are too low and a mountain peak blocked your view of the lights, but you do not consider the latter possibility because clouds have often interfered with your visual perception while mountains have not. So, you wait for breakout and crash into the mountain.

Motivation is central to human behavior. It is a factor which arouses, directs and integrates all behavior. Optimum motivation for good performance depends upon the difficulty of the task. Figure 8 illustrates this law. In short, too much motivation may adversely influence performance when the task is difficult for the specific individual.

While some skills are innate (breathing, sneezing, etc.), most information-processing skills are learned. Man receives information from the environment through his senses; this information is processed and results finally in some type of behavior. For higher order mental processing, man has a fairly limited channel capacity. Have you ever looked up a phone number, got distracted and discovered you had to look up the number again because you had forgotten it? If so, you had experienced the limitations of a short-term memory (STM). This ability is important in most continuing tasks. While STM is limited to a capacity of 8 to 10 items, it is not greatly influenced by the type of information. Continuous attention and rehearsal are necessary for new information to be placed in the long-term memory store, but this rehearsal occupies the central information processor and limits the processing of other data.

If items could be recoded into larger conceptual units (called "chunks" to distinguish them from "bits"), memory capacity would be greatly increased. For example, many license plates use a combination of letters and numbers. Remembering LAC 059 is easier than 795-059 because "LAC" can be processed as one "chunk."

In contrast to modern digital computers, man's "computer" is very slow and the maximum processing rate for simple tasks is approximately two to three decisions per second. Simulator studies have found that the average time from engine failure to brake application in an aborted takeoff takes slightly longer. Of course, speed can be greatly increased when a particular situation is anticipated and highly practiced.

Although slow and often difficult to acquire, some skills can be lost quickly if not practiced. A recent study found that instrument flying skills were reduced approximately 20 percent after 4 months without practice. Procedures were most adversely affected. Skills of holding

Figure 9 Flow Diagram of Information Processing System

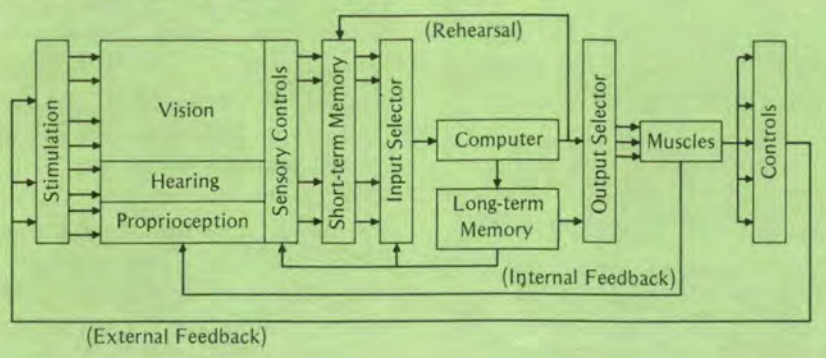
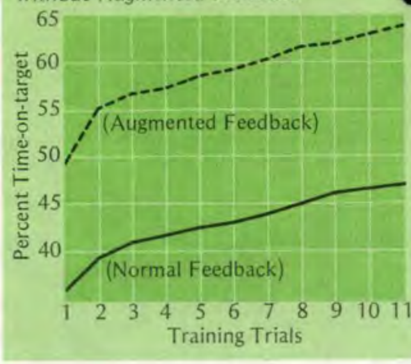


Figure 10. Performance on Tracking Tasks With and Without Augmented Feedback



COMMON HUMAN BEHAVIORS & AVIATION continued

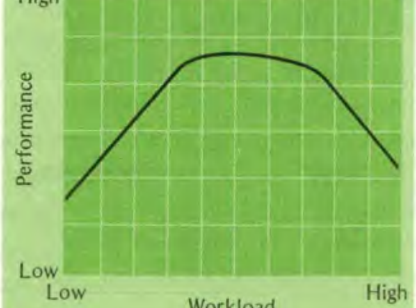
heading, altitude and speed suffered losses to a lesser degree. Time required to relearn the skills was directly related to the amount of original training. Something once learned or experienced is never lost from the long-term memory storage. Problems of long-term memory may be matters of retrieval rather than storage. Skills once learned are more quickly relearned even after long periods of disuse.

Very little learning takes place without feedback (knowledge of results). The essential information conveyed by feedback is the difference between intention and actual results. Feedback allows the individual to eliminate ineffective responses and to "fine tune" response patterns. In initial phases of learning, feedback is obtained primarily through the visual and auditory channels. The subject sees or is told the consequences of previous actions. As learning progresses, some of the feedback may be obtained through the sense receptors in muscles and joints (proprioception). An unskilled typist, for example, must look at the typewriter keys to hit the correct ones. Later, after a great deal of practice, stimuli from within takes over and finding the right keys becomes automatic. Feedback is not only essential to learning but also acts as a powerful motivator. (See Figures 9 and 10.)

Stress is the demand a work environment places on an individual and includes workload, boredom and other similar facts and conditions. Two types of overload are recognized. Speed stress occurs when the rate at which signals occur is excessive. Load stress results from having an excessive number of different information sources.

The effects of overload are dramatic; those of underload are not as immediately apparent. Underload can be as dangerous as overload. Literally hundreds of studies indicate that performance rapidly degrades on tasks such as monitoring sonar or radar displays (in which the sound or appearance of a target cannot be predicted and occurs infrequently). Degraded performance takes place within half an hour. To reduce the effects of a boring task: introduce artificial signals when feedback in the form of knowledge of results is provided; enrich environmental stimulation by adding aural noise when task is primarily visual; or add redundant observers to increase the probability of stimulus being detected. When workload exceeds either the upper or lower limits of the acceptable range, performance will suffer (Figure 11).

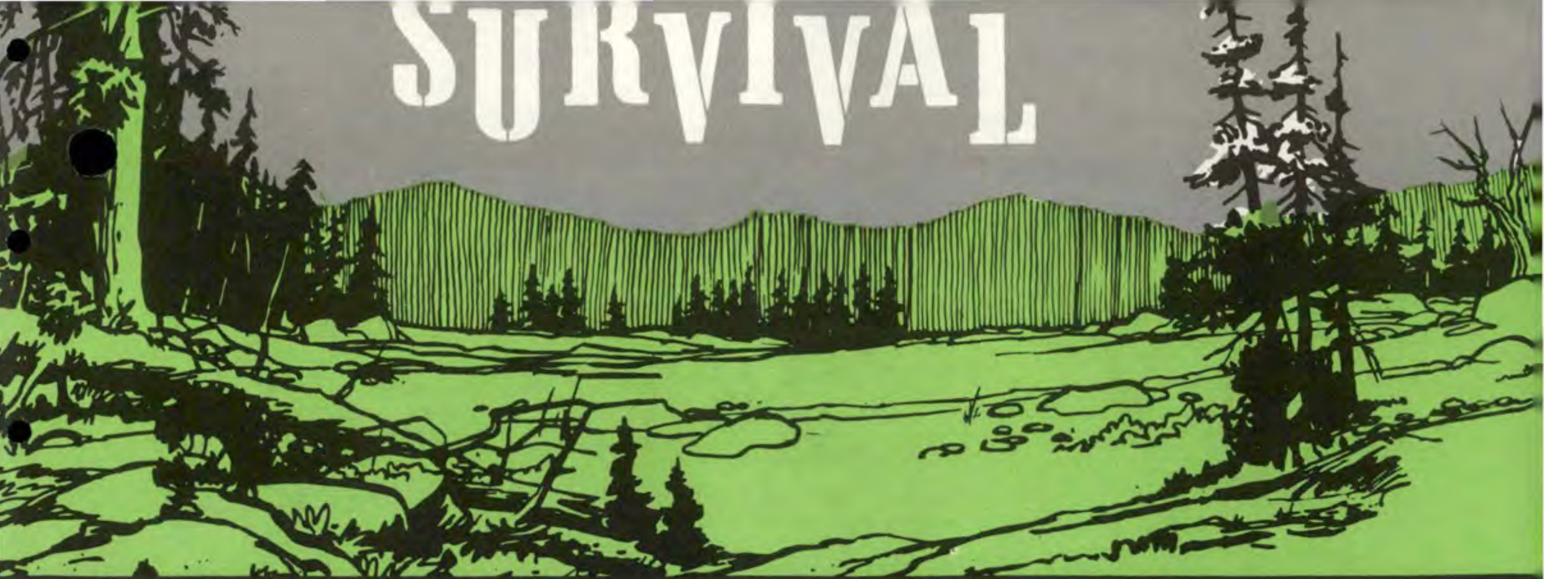
Figure 11. Functional Relationship Between Workload and Performance



It is hoped this brief discourse has apprised pilots of the undue risk of relying solely on visual cues during critical phases of flight. Moreover, it is hoped operators will delve further into common human behaviors and select applications relevant to aviation, then incorporate such findings into special training or modification of existing flight rules and procedures, causing a decrease in human errors in the cockpit.

* * *

(This writeup has been based upon Douglas Paper 6401, "A Review of Some Universal Psychological Characteristics Related to Human Error," by Richard F. Gabriel, Ph.D. — presented to INTERNATIONAL AIR TRANSPORT ASSOCIATION 20TH ANNUAL MEETING at Istanbul, Turkey, 10-15 Nov 1975.) — Courtesy *DC Flight Approach.* ★



NATURE'S COMPASS

SSgt ALFREDO VARGAS
Operations and Requirements Branch, 3636th Combat Crew Training Wing (ATC), Fairchild AFB, WA

Captain Salvo was drenched in perspiration as he pushed through the brush. He felt his camp should be near by, so he picked up the pace. It seemed that the faster he went, the thicker the brush got. It was like reaching a light at the end of a long tunnel when he broke into the clearing. But the light slowly darkened as he recognized the clearing as one he had come to earlier in the day while trying to get back to his camp.

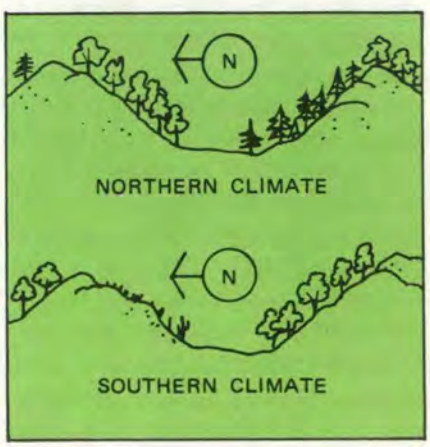
Cursing himself for having lost his compass, he sank to his knees—frustrated and exhausted. He had been wandering for the better part of the day with no sense of direction. He had done well when he left camp early that morning by using the sun to maintain an easterly direction; but when "mother nature" obliterated the sun, she messed up his navigation, and his nice camp by the trickling stream became but a picture in his mind.

Neither Captain Salvo nor anyone else should have to go through such an ordeal, but it does happen—especially during the nice months of the year when we are all trying to get closer to nature. Getting disoriented and hopelessly lost have been frequent occurrences, at times with fatal results—as we often read in the newspapers. This should not be, because it can be avoided by gaining knowledge of plant life and certain insect characteristics which have come about due to the influence of the sun and wind. These factors can help you determine direction, thereby making your outing or survival episode more pleasant (if a survival situation can be labeled such) and assisting in your prompt and safe return.

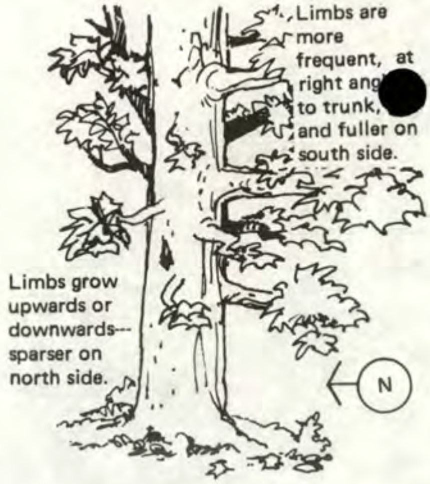
VEGETATION

In order to determine direction using plant life, you must realize that the sun and wind are the primary causes for those distinguishing factors which are directionally oriented. In order to detect and use these signposts, you must become conscious of the type and natural shape of *vegetation in your area.* Initially, you must associate these signposts with the cardinal directions (north, south, east, and west) by using other sources of information (magnetized needle on a string, sun, stars, or compass).

The first factor to consider is the overall picture of the vegetation in your area. In cold and temperate climates in the northern hemisphere, conifers grow better on the northern slopes; leaf-shedding trees grow best on the south side, because of the warmer temperatures resulting from more exposure to the sun's rays. For example, the deciduous trees (cottonwoods and aspens) grow on the southern slopes while conifers grow on the northern slopes. Conversely, in the southern hemisphere, the vegetation which can tolerate hotter temperatures thrive on the northern slopes, while grasslands are more common on the southern slopes.



Plants will tend to be fuller on the side catching the most sun---usually on the south.



SURVIVAL: Nature's Compass continued

Wherever you are, in order to use vegetation as a guide, you must make yourself aware of the type and shape of vegetation that thrives there. Once you have this fixed in your mind (it can be done in a matter of minutes), determine whether there are recognizable patterns such as shape, size, and color, which are consistent and direction-related. Such patterns frequently are wind and sun caused. In any case, if you can recognize these same patterns as having consistent orientation, they will provide usable clues.

Wind damages the young shoots of plants on the windward side. They will be thinner and stunted, while those on the opposite side will be normal and flourishing. The wind, if persistent enough, will even bend trees, causing them to grow in that direction. Cone-shaped flower blooms and grass tassels will also grow in the direction of the prevailing wind. One exception, which is also a navigational aid, is the palm tree. Palms normally lean into the wind. The fronds (leaves) exhibit greater growth on the sheltered side, with the "head" flattened. The fact that you can determine wind direction by vegetation shape is important only if you know the direction of the prevailing wind for that area, in relation to north and south.

The effects of the sun on vegetation are also good aids in navigation, especially where the wind direction is variable. In most of the northern hemisphere, the arc of the sun (from rising to setting) is entirely on the south side of the sky. The midpoint of this arc is true south; in the southern hemisphere, it represents north. Abundant foliage will be detected on the sunny side of plants. In our hemisphere, the branches on the south side of trees will be almost horizontal, while the north-facing branches will be fewer in number and grow at a more vertical angle. When using this indicator, it is best to use trees in open areas which have not been damaged by man or in some natural way.

Another way, not so readily available, to tell direction is by cutting down or notching a tree and examining its growth rings. Pick a small tree if you can't find any lumbered area. In the northern hemisphere, the growth rings will be closer together and the bark will be thinner on the southwest side of trees. On the northeast side, the rings will be farther apart and the bark thicker.

Other plants are affected in the same way as trees and may be used for navigational aids. Most people have heard that moss grows on the north side of trees. Actually, it will generally grow on the north to northeast side. There are certain factors you must consider when using moss to determine direction. Two important ones are humidity and shade, with humidity being the dominating factor. Moss will grow where it is coolest and where moisture is retained the longest. You

Bark and tree rings are thinner on the southwest side. Moss will grow on the northeast side and can be a grey-green to brown color.

Ants will orient their ant hill to catch the sun's rays----normally NW to SE with the opening on the SE end of the hill.

Spider webs will most often be found to be parallel to the prevailing winds.

must get to know the characteristics of moss' color and where it grows in the area in which you are operating. Most mosses take on a darker brown color when growing in greater sunlight and are mostly sage green (almost gray) when in more shaded spots. Whether you use trees, grasses, blooms, or moss, look for the recognizable consistent patterns which are widespread. Determine their direction-related causes (prevailing winds and sunlight) and use them as clues to find your way.

INSECTS

Certain insect characteristics may also help you determine direction. Ants in the cool areas of the northern hemisphere align their hills to absorb both the earliest and the longest possible sunlight. They do this by orienting their oblong hills in a southeast by northwest direction. The entrance and the highest point on the anthill will be at the southeast side, with the hill sloping down to the northwest. If they build their nest close to trees or stumps, the nests will generally be on the southeast side. There is one exception, in excessively hot areas, ants generally try to shade themselves by building nests on the northeast side of trees. Ants and insects will react with slight differences, depending on temperatures in your region.

The prevailing winds can be determined by observing spiderwebs because spiders cannot build webs against the wind. They take advantage of wind eddies and gusts to lay their strands from point to point, thus paralleling the prevailing wind. The principle is the same whether you are using the effects of the sun and wind on vegetation or on animals. These effects must be converted to signposts by associating them to the cardinal directions at the first opportunity.

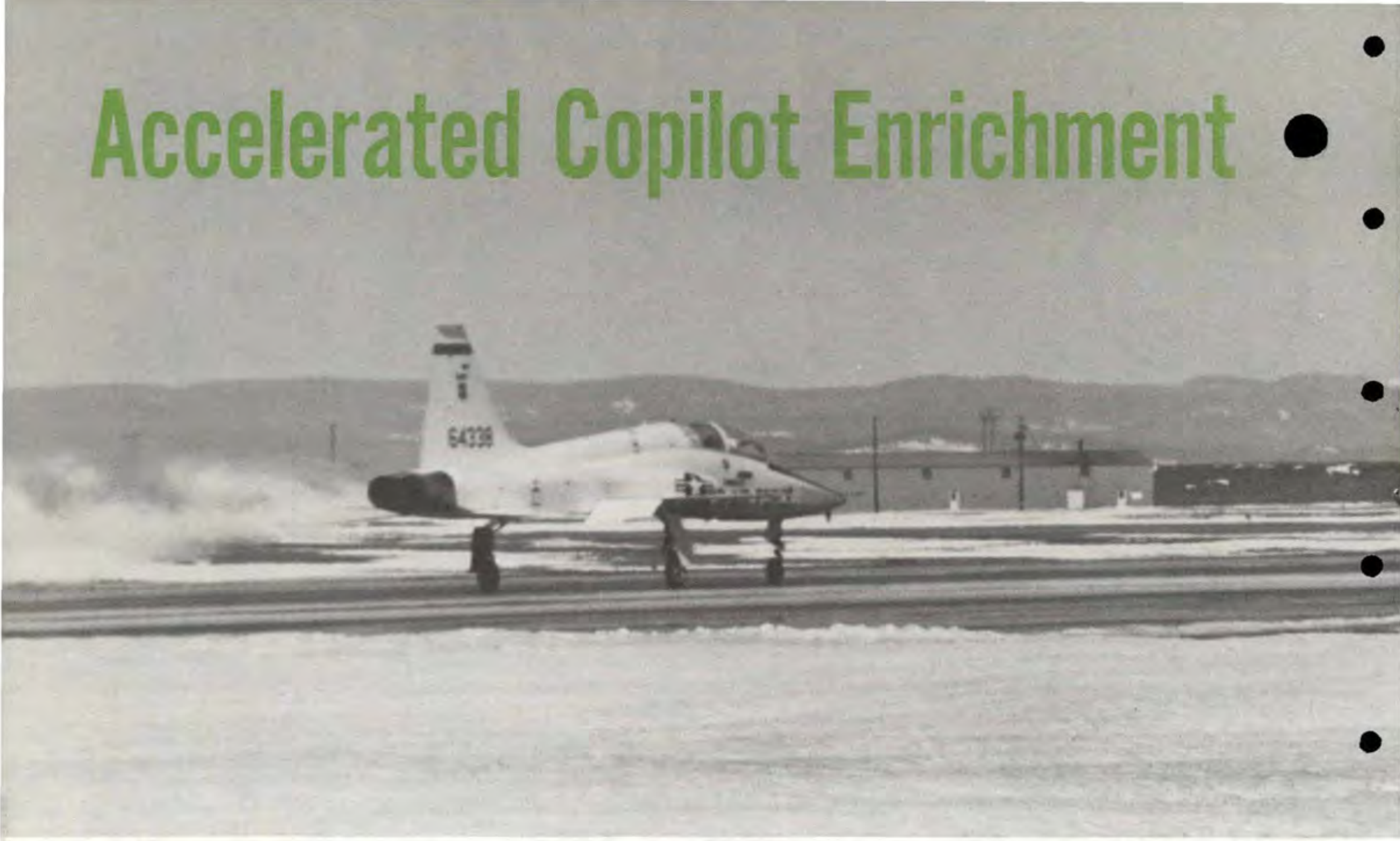
Most people have a hard time maintaining a straight line of travel when distinguishing landmarks are unavailable as reference points. Moreover, they cannot even return to their point of origin if a conspicuous trail is not present. The areas mentioned above are designed to open your eyes to the fact that, with observation and awareness of your environment, you, too, can have the confidence of an old mountain man.

Some plants will face towards the sun whether the day is clear or cloudy.

A little stroll to reconnoiter the area for a possible signaling sight had turned into a nightmare for Captain Salvo and after awhile, still on his knees on the edge of the clearing, feeling helpless, he was wishing that he was a mountain man, with the ability to find his way in nature's garden. He could remember leaving camp early in the morning with the sun in his eyes and the stream on his left side. He could also remember that the stream was flowing in the same direction as he had traveled, and his dry mouth reminded him he had not crossed it. After some basic logic, he figured he had to go north to get to the stream. Great! But, where was north?

In a moment of stress, the mind is a wonderful thing—if you give it a chance. It came through for Captain Salvo, for he remembered a grade school experiment where pinto beans were placed on the windowsill to show how they grow toward the sun. With this in mind, Captain Salvo applied his sense of sight to his surroundings. It was not long before he figured out where south was and walked to the stream. He followed it upstream for awhile and came to familiar surroundings. Now, it was time to get on with the business of getting rescued. ★

Accelerated Copilot Enrichment



CAPTAIN JOHN H. WAYNE, JR. • 5 BMW Minot AFB ND

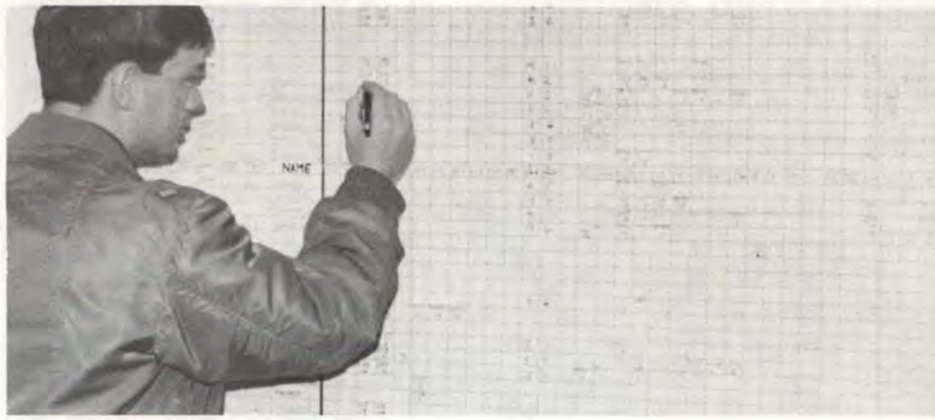
October of 1978 will mark three years of copilot participation in ACE programs across the country. What follows is an attempt by the author to assess the value of ACE and enumerate some of its strengths. The viewpoint expressed is based on the author's observations as a participant in the program.

Flying solo in T-37 and "team" (two copilots) in T-38 aircraft, SAC copilots are gaining valuable experience performing in roles as aircraft commanders. The ACE program presents the young copilot with unsurpassed opportunities to hone flying skills, strengthen judgment, and develop maturity through exposure to increased responsibility. The program adds another dimension to copilot duties and forms a strong foundation for future rigors as B-52/KC-135 aircraft commanders.

Prior UPT experience with T-37/T-38 aircraft enables copilots to qualify for local area solo or team sorties in a minimum amount of time. Copilot familiarity with these systems means comparatively little is invested in sunken costs before benefits of the program are realized. Upon completion of qualification and instrument check rides, copilots are soon free to fly unsupervised to practically any airfield in the CONUS.

Such freedom, however, carries with it a commensurate amount of responsibility. Herein lies the heart of the ACE program. The safe and successful completion of the mission becomes the responsibility of the individual copilot. Diminished supervision makes each sortie a decision making exercise from start to finish. Copilots become less complacent and soon develop a vigilant attitude towards flying safety. Each sortie adds a sense of personal accomplishment and builds confidence in flying ability. The result is a more mature and responsible SAC copilot.

Strange field approaches, often in high density air traffic areas, present new demands on a copilot's flying judgment. They require greater attention to detail in mission planning and strong air discipline during enroute and arrival phases of flight. Responsibility for the aircraft does not end with engine shutdown. Copilots must ensure that transient alert crews perform proper servicing and coordinate any necessary maintenance, a capability which may or may not be available. Decisions of a "go-no go" nature must often be made when continuing the mission is affected by degraded equipment. If remaining over a period of days, weather developments may necessitate an earlier departure than planned. Copilots often have scheduling constraints and cannot



afford to allow weather to ground the aircraft on the day of return. Services normally available for mission planning, such as an on-base weather shop, may be unavailable and must be obtained through other means. Much of this type of exposure is totally new and sometimes intimidating. We all make mistakes and sometimes swallow a little pride but become much wiser for having experienced error.

ACE provides a relaxed but professional environment where copilots can still "hangar fly" with instructors who readily impart their knowledge and wisdom. As part of initial and subsequent check rides, copilots are orally tested in ground evaluations reminiscent of those experienced in UPT. Questions often relate to aircraft systems and applicable flying directives. As a result, copilots enhance their procedural knowledge. Other questions, however, are less direct and answers are not found in black and white. The "what if" situations presented, by design, are strictly judgment calls. The copilot is tasked to rely on his own knowledge and experiences to respond with a plausible course of action utilizing every remaining capability that the aircraft and situation present.

In a comparative sense, ACE is a cost effective program. T-37/T-38 aircraft use much less fuel and have lower operating costs per flying hour than either the B-52 or KC-135. And though flight characteristics of these aircraft may differ, the instrument approaches flown and environment in which all aircraft operate do not. Similar instrumentation between cockpits enhances flying proficiency and facilitates transition from one aircraft to the next. A larger amount of similar training can be accomplished at much less expense.

Participation in the ACE program is, however, subject to primary duty schedule constraints. Squadron copilot duties entail manning alert sorties, training flights, presentation of EWO and ORI briefings, and numerous hours of mission planning and ground training classroom instruction. Continuous ground testing and in-flight evaluation are a way of life. Much off duty time is devoted to personal study in order to meet standards in these areas. Family considerations also play a large part in determining availability.

In terms of cost and benefits derived, expenditures for ACE are an investment in the future. Copilots upgrading to aircraft commander in primary assigned aircraft will be better qualified as a result of their experiences in this program. ★

Mail & Miscellaneous

Send your ideas, comments, and questions to:
Editor, Aerospace Magazine
Norton, AFB, CA 92409

FLY SMART

As I finished writing a young pilot friend of mine, I signed off with "Fly Safe." But, as I looked at it, I thought to myself "Damn, he is really going to think I'm a jerk." So, I scratched out the "Safe" and changed it to "Fly Smart."

Some of our young troops aren't getting the flying time necessary to keep up with the pace of modernization of aircraft and tactics. They sometimes push themselves beyond their capabilities and get bit.

Maybe I have a misconception of how the young guys think, but I feel they have a lot of pride that sometimes gets in the way of judgment. Some even take offense to the safety initiatives and their message goes unheeded or, worse still, causes a reverse reaction with catastrophic results.

Perhaps if we change the approach to "Smart" it might ease off on their pride yet still achieve the desired effect.

Just a suggestion. Maybe it will help.

Capt Sandy Sharpe
HQ TAC/XPF
Langley AFB VA

BASE, GEAR CHECK . . . BEEP, BEEP, BEEP

The enclosed article (Ops Topic, Base, Gear Check . . . Beep, Beep, Beep," Page 16, January 1978) cannot go without comment. The O-2 pilot was not the first, nor will he be the last, to be caught in the old "switched-off-and-forgot-to-turn-on-Guard trick." How long are we going to continue to hammer the jock, who is only doing his best to cope with a situation beyond his control, while the real culprits are those who cause him to turn off Guard in the first place? I am aware of one command's regulation which requires its ground stations to announce to the world on Guard the dawn of a new Zulu day. It could have been such an inappropriate Guard transmission that caused our unfortunate O-2 pilot to turn off Guard. Ask a pilot when he last heard a bona fide emergency on Guard and he may not remember. Ask him when he last turned off Guard because of a non-emergency transmission and I'll lay you odds he'll say it was on his last flight.

I have two suggestions for consideration. First, the IG, noted for looking for the root causes of problems, could generate a Special Interest Item on the unauthorized use of emergency frequencies. Second and less formal, the jocks of the world could rise up with pen in hand and generate an AF Form 457, USAF Hazard Report, each time they heard an unauthorized Guard transmission. Either should straighten out the problem eventually.

Your article cited the communication breakdown, caused by not monitoring Guard, as one link in the chain leading to the accident. Let's throw a nickel on the grass to help buy the axe that breaks this particular link.

Lt Col R. J. Vanden-Heuvel
111 B Birch Circle
Eglin AFB FL

WHAT'S A DRAGON LADY?

Looking for a unique assignment? The only squadron in the world flying the Lockheed U-2 is the 99th Strategic Reconnaissance Squadron, at Beale AFB, CA. The 99th is presently in need of experienced pilots who enjoy flying alone and can think for themselves. The U-2 is a relatively uncomplicated aircraft and is, therefore, "flown" rather than simply programmed and monitored. **You** carry the responsibility and you'll make the decisions.

Being extremely cost effective, this aircraft is continually tasked against a wide variety of missions, including photo recon, atmosphere research and systems development. Operational missions are flown from Beale and operating locations around the world.

You'll find flying the U-2 is a demanding job. The long recon sorties are flown in a pressure suit and at maximum performance. It's not just a set-it-and-forget-it aircraft. Even landing the "U-Bird" challenges the most experienced pilots.

Still interested? If you have 18 months as a pilot in command and 1500 hours flying time (or, 1350 hours total with 100 as FP/IP), contact the U-2 Manning Section of the 99th SRS, 9th SRW, Beale AFB, California, or call AUTOVON 368-2156/2927.

NAME THAT PLANE ANSWER

The Ryan PT-22 was powered by a 5 cylinder radial engine. Some of these aircraft can still be seen at airports in the US.

NEW SLIDE/TAPE PRESENTATIONS

1. "Lessons Learned — Midair Collisions" (TS 749) (Length 15 minutes). Air space has become increasingly congested. This program helps pilots develop good clearing habits and helps them to understand the need to see and avoid other aircraft. It is based on midair collision prevention techniques. Order through your servicing base film library.

2. "Lessons Learned — The Supervisory Role" (TS 753), Length 15 minutes. Accident investigators find supervisory lapses as underlying causes of aircrew factor accidents. This program helps audience gain an appreciation of the role supervisors play in the prevention of accidents. Order through your servicing base film library.

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UNITED STATES AIR FORCE

Well Done Award

Presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Accident Prevention Program.

1Lt Vaughn P. Belliston

466th Tactical Fighter Squadron (AFRES)
Hill Air Force Base, Utah

Lieutenant Belliston was on an instrument low approach in an F-105B aircraft. About 200 feet AGL, as he raised the gear handle on go-around, Lieutenant Belliston heard and felt a thump, and the cockpit immediately filled with dense, white smoke. The fumes burned his eyes, and he could not see the instrument panel. By putting his helmet against the side of the canopy, he was able to see the ground directly below. He established what he thought was a climbing attitude, checked oxygen at 100 percent, and went to "ram" with the pressurization lever. By leaning forward, he could see that the gear lights read unsafe. Lieutenant Belliston suspected a hot air line fire, and since the utility hydraulic system had apparently failed, he turned the main air line switch off. This stopped the utility hydraulic pump and AC generator. Then lead joined up, told Lieutenant Belliston he was descending slightly, that the gear was down, and that no evidence of fire was visible. As the smoke and fumes gradually dissipated, Lieutenant Belliston decided not to restart the hot air line and used emergency gear extension to get safe gear down indications. He followed loss of utility hydraulics and AC generator procedures and landed, using emergency brakes to stop on the runway. The source of the smoke was hydraulic fluid from a split line in the right main landing gear area. The fluid was vaporized when it went through an auxiliary air inlet into the engine compressor, main air line and, finally, into the air conditioner. Lieutenant Belliston's timely and decisive actions during a critical phase of flight possibly prevented loss of life and resulted in the recovery of a valuable, undamaged aircraft. WELL DONE! ★

SAFETY TROPHIES

FOR DISTINGUISHED CONTRIBUTIONS DURING 1977

Secretary of the Air Force SAFETY TROPHY

Category I
MILITARY AIRLIFT COMMAND (MAC)

The Category I award is presented to the USAF major command that has accounted for more than 2% of the total USAF flying time and has demonstrated the best overall safety program. The Military Airlift Command compiled over 750,000 flying hours yet had a mishap rate of only 0.8 per 100,000 hours, lowest of any major flying command and a 40% reduction over the 1976 rate. The nuclear weapons safety program was rated outstanding by the Directorate of Nuclear Safety, and MAC's motor vehicle accident rate was lower than the Air Force average. MAC's safety program displayed strong command support and heavy supervisory involvement in all aspects of accident prevention.

Category II
ALASKAN AIR COMMAND (AAC)

This Category II award is offered to a USAF major command that has accounted for less than 2% of the total USAF flying time and has demonstrated the best overall accident prevention program. The Alaskan Air Command stood out among other competitors by effecting impressive improvements in flight, ground and weapons safety. For the third consecutive year, AAC was able to boast zero Class A mishaps while completing over 16,000 flying hours in high performance aircraft. The explosive mishap rate was cut by two-thirds from the 1976 rate, and AAC did not have a military or civilian off duty private motor vehicle fatality. These safety accomplishments highlight Alaskan Air Command as an innovator in mishap prevention.

MAJOR GENERAL *Benjamin D. Foulois* MEMORIAL AWARD

AIR FORCE RESERVE (AFRES)

This award, sponsored by the Order of Daedalians, is presented annually to the command having the most effective aircraft mishap prevention program. Major commands, the Air National Guard and the Air Force Reserve are all eligible. AFRES, the 1977 winner, was judged to conduct the most effective and consistent program toward the goal of minimizing flight mishaps. Flying over 140,000 hours in nine different aircraft types, AFRES experienced only two Class A mishaps without any mishap fatalities. The actual cost of all mishaps was $4 million lower than that incurred in 1976. The command compiled this impressive safety record despite aging aircraft, global missions, and minimum safety manning at all echelons. The award presentation is scheduled for 3 June 1978, in San Antonio, Texas.