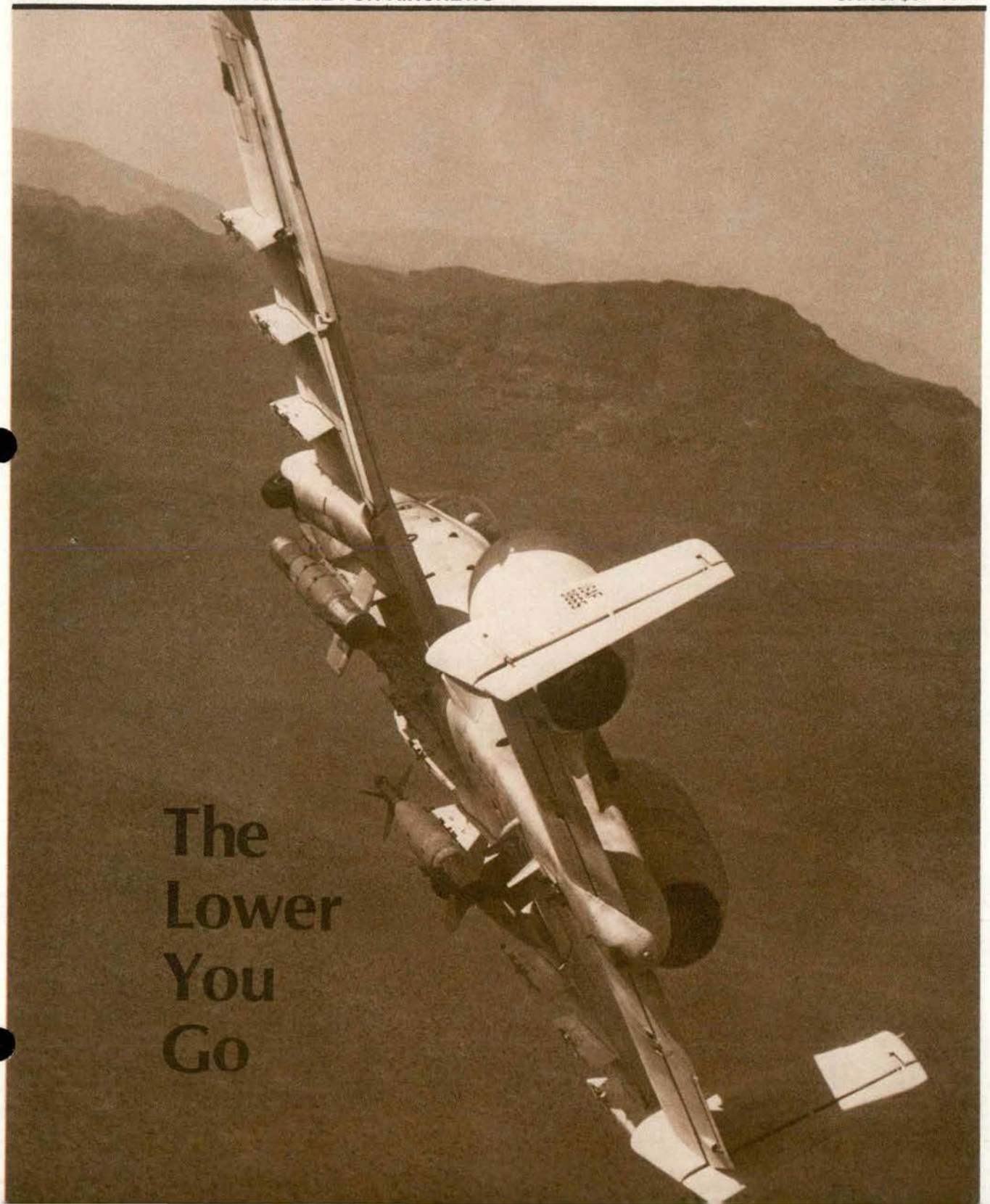
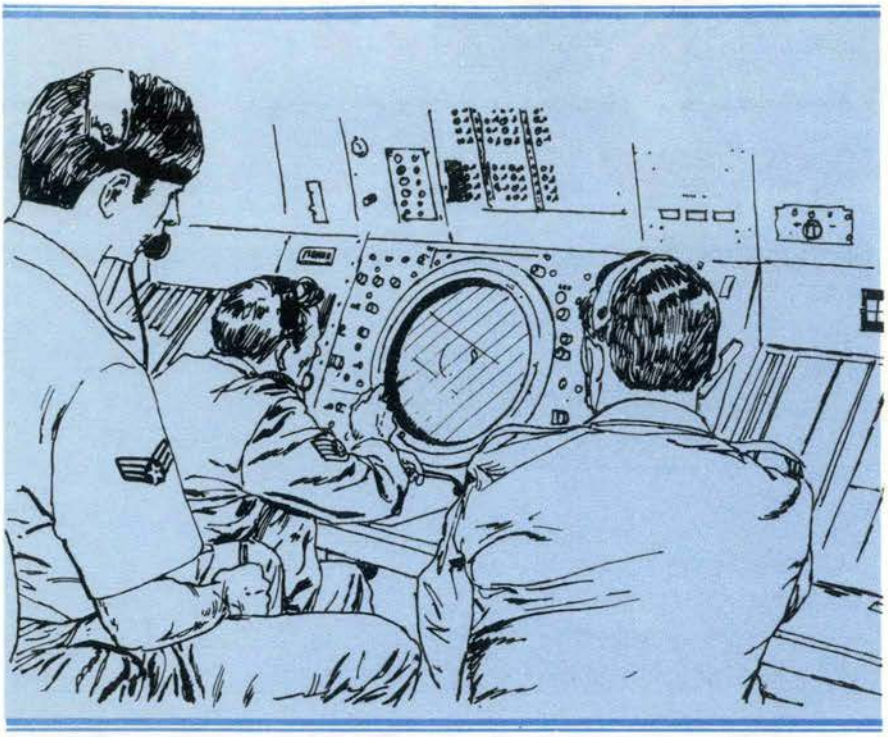
AEROSPACE

SAFETY • MAGAZINE FOR AIRCREWS JANUARY 1979



The Lower You Go

PRELUDE TO REALITY



Captain Ronald H. Dalton • 1908 Communications Squadron • England AFB, LA

SSgt Roger Lund arrived for duty at Jones Radar Approach Control already tired from a long trip back from leave. The weather was definitely IFR and Sergeant Lund was hoping for a light traffic shift. As he sat down at the radar scope after being briefed of the traffic, any hopes of a slow night were erased with ten strips showing aircraft arrivals and departures already on the board.

Traffic was moving smoothly until MSgt Rivers, the shift supervisor, pointed out a possible conflict to Sgt Lund. Sgt Lund quickly gave alternate instructions to avoid a confliction and swore under his breath for not noticing the situation himself.

The assistant controller posted the latest weather and the airfield was now down to one mile visibility. "Jones Approach, this is Halo 22." Sgt Lund quickly scanned the strips in front of him and there was no strip on the aircraft calling. "Halo 22, this is Jones Approach, go ahead."

"Roger, Jones Approach, Halo 22 is 35 miles south of your station, minimum fuel, diverting to Jones AFB."

Sgt Lund quickly scanned his traffic and there was no room for Halo 22 – again Sgt Lund swore under his breath. Sgt Lund yelled at his assistant, "Get on the horn to Center and ask them about Halo 22. We don't have a flight plan."

A1C Levit, the assistant controller, called Center and the Center controller apologized for not calling in the inbound. He explained the Center was very busy, but he did confirm all the information on Halo 22 and advised the traffic was beginning to stack up.

A1C Levit relayed the information to Sgt Lund who again swore – out loud this time. "That's just great, Center is busy, aircraft are everywhere, and where do they think I'm going to put Halo 22!"

MSgt Rivers stood behind Sgt Lund and advised him that the GCA radar just went down and all traffic would have to be vectored or held at outer fixes. Sgt Lund began to panic, fatigue began to take its toll. "Jones Approach, Halo 22, do you have further instructions?" "Jones Approach, Catfish 29, where are you vectoring me?" "Jones Approach, Shark 51, request your latest weather." Sgt Lund was staring at the scope, but he was not reacting. Finally, he turned to his supervisor and said, "I've lost the picture."

MSgt Rivers turned and advised SSgt Polk to stop the problem and reset the targets. Sgt Rivers placed his hand on Sgt Lund's shoulder and said, "Let's get a cup of coffee."

"Roger, you were lucky tonight," MSgt Rivers began in a quiet but firm voice. "If this had not been a simulated problem, we may have lost some airplanes." Sgt Lund was visibly shaken even though it had only been a simulated problem. He realized all too well the seriousness of his performance.

What went wrong? Sgt Lund stretched his leave to the last minute. He reported for duty not prepared mentally or physically to be his best. Does this situation sound familiar? How often do we place the lives of others in jeopardy by our mistakes? Sgt Lund was a good controller but fatigue and stress combined to destroy his ability.

Supervisors must be alert to the physical and mental condition of their people. Individuals must think not only of their own safety but the safety of others. This concern for safety must override personal pleasure. It is far better to admit that we are not ready to fly or control traffic than to cover up with the risk of losing the picture.

If all of us will THINK SAFETY at all times, we will take the necessary steps to ensure safety is not something we read about in a magazine but rather something we value and practice daily. ★

aerospace SAFETY

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AFRP 127-2
Controlled circulation postage paid at Terminal Annex, 900 N. Alameda St., Los Angeles, CA 90052.

The lower you go.

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SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

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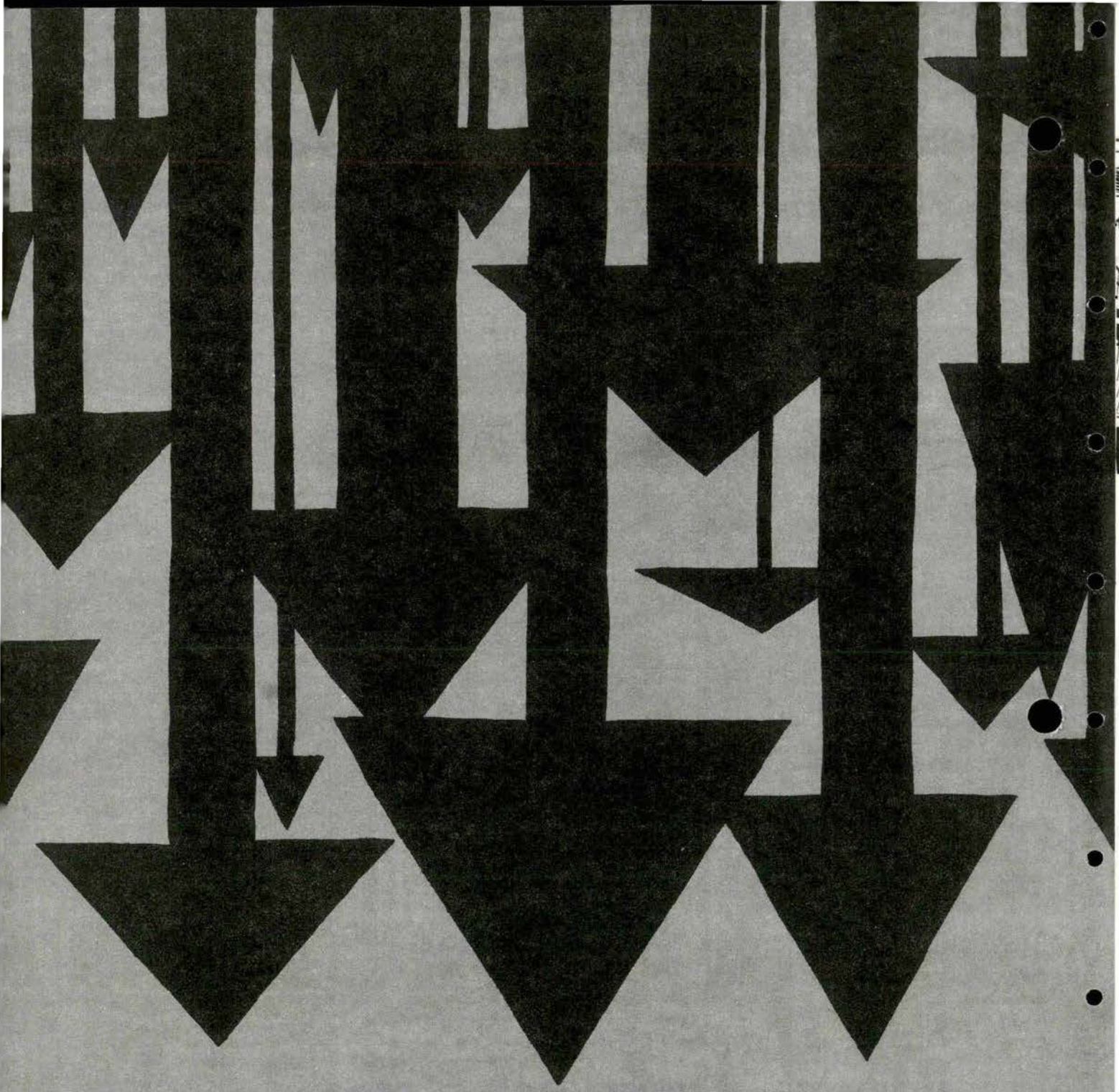
JANUARY 1979 AFRP-127-2 VOLUME 35 NUMBER 1



Chronic Fatigue

Major Roger L. Jacks
Directorate of Aerospace Safety

Problems? Sure, everyone has problems. I mean serious problems—ones that have you going down for the count. For example, are you in the middle of a divorce? Are you totally frustrated with your career? Are you up to your neck in debt with a new house or car and about to get your knickers ripped? Have you been working your rear end off day in and day out and you're just plain pooped? A cold or hay fever got you down?

If you find yourself tired, depressed and tense you might have, or you might be, the perfect candidate for chronic fatigue. What's so bad about that? Well, for starters, you can be suffering from chronic fatigue and not know it! "Okay, so what is chronic fatigue, and why is it such bad news?"

Don't confuse the normal, everyday fatigue we experience after a hard day's work with chronic fatigue. Chronic fatigue occurs when the body continually performs mental and/or physical tasks without receiving proper rest, nutrition, and recreation. Insufficient recuperation and accumulated fatigue can cause a person's performance levels to deteriorate. The process may be so insidious at first that the person may be unaware it's happening.

One may be so involved with family problems, money problems, carer aspirations, reasons for being overworked or fighting a physical ailment that he is unaware of the serious side effect.

Once one has chronic fatigue, a vicious circle begins. For example, adequate rest is a standard human requirement, but the person with chronic fatigue may suffer from insomnia; good nutrition is essential, but he may have lost his appetite; one needs to be rational, patient and calm, but many times chronic fatigue causes irritability, apprehension and irrational behavior. Following are some of the effects of chronic fatigue on the crew member reported by behavioral scientists.

- Increased error potential.
- Increased reaction time.
- Deterioration in timing.
- Increasing willingness to accept lower standards.
- Instrument scanning patterns break down.
- Crew member pays more attention to individual task components to the exclusion of others.
- Tendency to neglect relevant cues.
- Tired pilots are rough on flight controls.
- Crew members become more aware of, and spend more time thinking about, physical discomforts.
- As fatigue worsens, the ability is lost to interpret kinesthetic sensations such as muscular motion, etc.
- Crew members make many mistakes on simple, well-learned tasks and blame these mistakes on the aircraft, not themselves.
- Fatigued crew members are not objective or reliable when asked to reconstruct what has occurred.
- Visual field begins to narrow.
- Attention span reduced.
- Fatigued crew members overlook important elements in a task series.

Although one may or may not be able to eliminate the factors causing chronic fatigue, much can be done to control their effects. To properly contain or eliminate the problem, we must address three areas: physiological, psychological, and pathological.

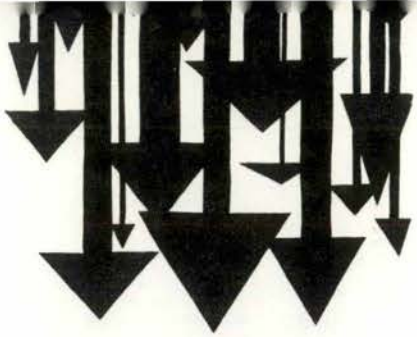
Physiologically, we can combat chronic fatigue with exercise, rest, and nutrition. Studies have proven that pilots in good physical condition are more mentally alert, have a greater capacity for work, are more cheerful and have a better outlook on life than those who neglect their physical condition. Under pressure, pilots in good physical condition are found to be more productive with much better recuperative powers than those less physically fit.

It stands to reason that physical fitness can play a large role in reducing fatigue. Ross A. McFarland, in a book entitled *Human Factors in Air Transportation,* lists the following shortcomings for an individual in poor physical condition:

- A greater percentage of oxygen consumed performing a task.
- More rapid pulse and breathing rate during work.
- Higher systolic blood pressure during work.
- Smaller stroke volume of the heart.
- Higher blood lactate level druing work.
- A slower return of the pulse rate and blood pressure to resting values after exercising.

A person must get the proper amount of rest. If an individual finds himself facing an abnormal fatigue producing situation, then he must adjust his sleep period to compensate, i.e., lengthen it. Quality of sleep is probably even more important than quantity. Supervisors can help by ensuring crew sleeping areas are well ventilated, comfortable and quiet.

Nutrition is very important. Well-balanced meals consumed at proper intervals will prevent hypoglycemia. Try to eat a high protein low residue meal a couple of hours before your show time. If it's going to be a long flight, make sure you take along some type of flight lunch. Drink plenty of fluids. Because of the low humidity level in most aircraft, a person should consume approximately eight ounces of fluid for every 30 minutes of flight. Note: A couple of cups of coffee may increase your sense of well-being and even mildly stimulate mental activity. Too much coffee, however, causes body dehydration. For example, for every four cups of coffee a crew member drinks, five cups of body fluid



Chronic Fatigue

will be lost through urination.

We've all heard much about the effects of alcohol, so I'll make my comments brief. It does cause dehydration and its effects can be long lasting. It takes 3 hours to burn up one ounce of alcohol. Alcohol usually means parties and late nights which can lead to fatigue, headaches and upset stomachs – the classic hangover. The end result is poor judgment, lack of mental awareness, and abnormal behavior when a person tries to fly. It is also a good idea to minimize smoking. Excessive smoking can produce 8-10 percent carbon monoxide-hemoglobin which may impair brain functions.

Let's move on to the psychological area. The easiest thing to say, and yet probably one of the hardest things to do, is to leave your family problems, money problems, career problems, etc., on the ground. It is a proven fact that the presence of serious problems or emotional stress can reduce a person's ability to perform skilled tasks. Psychological stress can burden the mind with anxiety, worry, frustration, and apprehension, making concentration on necessary tasks almost impossible. Emotional stress has been cited as a contributing factor in a significant number of our aircraft mishaps. The presence of mental conflicts has long been known to cause fatigue, and now research indicates that mental stress may make a person more susceptible to certain diseases. Crew members simply cannot afford to carry serious emotional problems aloft. They must learn to cope with their problems and, at least while flying, be in a state of emotional and physical well being. It's not an easy task, but it's something we must encourage if we want to decrease human factor mishaps.

Our third area is that of pathology or, in more simple terms, disease. Fighting diseases and the effects of medication designed to cure them can cause excessive fatigue. Although numerous articles on self-medication, flying with colds, etc., have been published, crew members continue to do it. Certain antihistamine preparations can cause adverse effects such as drowsiness, dizziness, nervousness, upset stomach, blurred vision and overstimulation of body functions. Add to that the effects of the cold itself: Blocked sinuses, breathing difficulties, dizziness, vertigo, aches and pains, and low energy levels, and you have compounded an already serious problem. Now, take the effects of fatigue and add them to the cold and self-medication effects. You no longer have just a serious problem; you have an accident looking for a place to happen.

Commander J. A. White of Tulane University School of Medicine makes an interesting observation: "Most Americans have from one to six colds a year. Although aviation personnel admittedly are a healthy group, they certainly average at least the minimum. Although all aircrew members know they are not supposed to fly with colds, they often do. In fact, there were 13 major aircraft accidents in a recent two-year period in which the common cold, although not on the manifest, was aboard."

The cure to this problem is actually fairly simple, and you've heard it many times before. Drink plenty of fluids, get lots of rest, eat well, see a flight surgeon and don't fly! Let the doc give you the proper medications and decide when you're ready to assume flying duties.

Flying is fatiguing enough! The best way to avoid or minimize the effects of chronic fatigue is to arrive for your scheduled flight in the best possible physical and mental condition. Know the symptoms of stress and excessive fatigue. Stanley R. Mohler in an article entitled "Fatigue in Aviation Activities," states: "The first indication of excessive fatigue in our occupation may appear as what may be termed psychosomatic symptoms. These can include: headaches, burning eyes, sweating, heartburn, chronic constipation or chronically loose bowels, chronic loss of appetite, nightmares, and shortness of breath. If you exhibit these symptoms, and are not mentally and physically ready to fly, don't fly. You'll do yourself a favor and possibly help hold the line on the accident rate. ★

BIBLIOGRAPHY

1. *Bergen, J.J., Captain, "Flight Crew Fatigue,"* Aerospace Safety, *March 1977.*
2. *Cantrell, George K. Lt Col, USAF; Trimble, Ralph W., Capt, USAF, BSC; Hartman, Bryce O., Ph.D., "Long-term Aircrew Effectiveness,* Aeromedical Reviews, *April 1971.*
3. *Hartman, Bryce O., Ph.D., "Physical Fitness and Fatigue in Aircrew Members," May 12-13, 1970.*
4. *Lyons, Joseph A., Maj, "An Approach to Stress,"* Aerospace Safety, *Nov 68.*
5. *McFarland, Ross A., "Human Factors in Air Transportation," McGraw-Hill Book Co., 1953.*
6. *Mohler, Stanley R., "Fatigue in Aviation Activities,"* Aerospace Medicine, *Vol 37, No. 7, Jul 1966.*
7. *Shilling, Charles W.,* The Human Machine, *George Banta Co., Inc., 1965.*
8. *Smith, Ronald L., Capt, "Reducing Pilot Error in USAF Aviation Mishaps," Air Command and Staff College Research Report, 2375-78.*
9. *"The Demon Rum,"* Approach, *Vol 17, No. 5, Nov 71.*
10. *"Tired? Who's Tired?"* Approach, *Vol 17, No. 2., August 1971.*
11. *Weiss, J.M., "Psychological Factors in Stress and Disease,"* Scientific American, *Vol. 226, No. 6, June 1972.*
12. *White, J.A., "The Common Cold: Respiratory Warning Light,"* Approach, *Vol 17, No. 4, Oct 71.*

Annually the Air Force recognizes a given number of individuals, units and commands for outstanding performance in safety. However, competition is keen and not all win major awards. To recognize all of those, AEROSPACE SAFETY is featuring one or more in each edition. In this way we can all share in recognizing their fine performance and, perhaps, learn some valuable lessons.

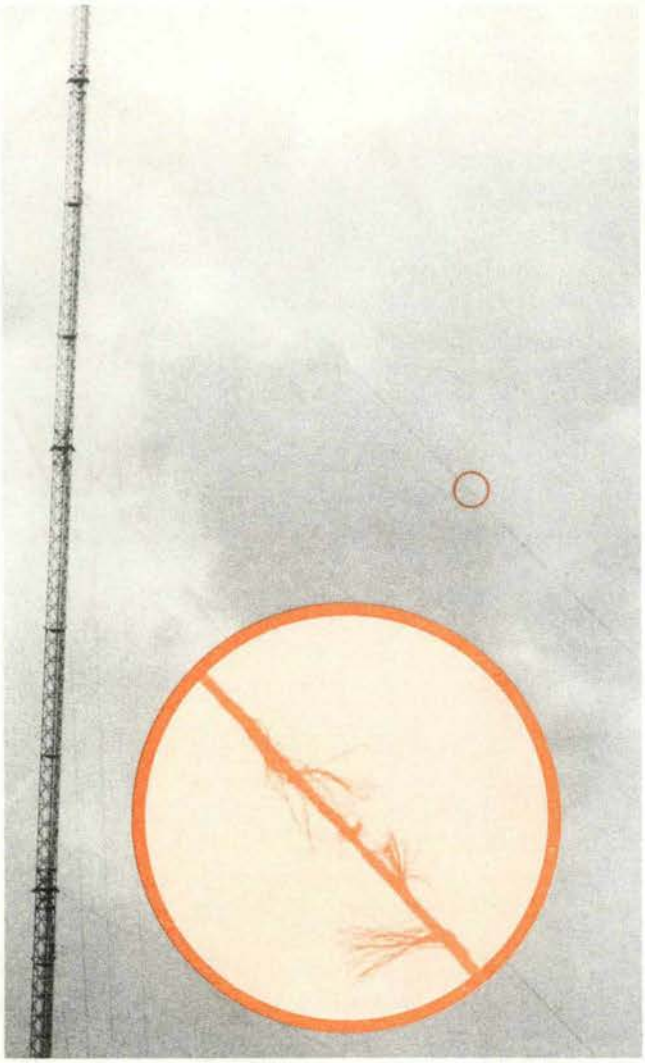
Nominated for the Koren Kolligian, Jr., Trophy

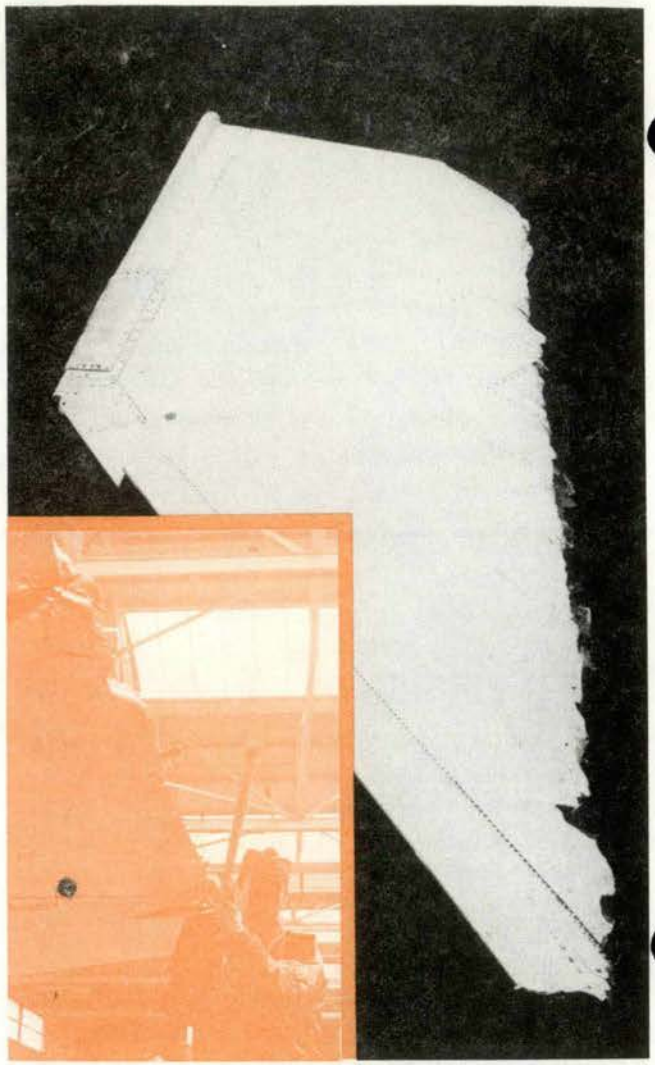
Captain John E. McKnight

Captain John E. McKnight of the 93rd Air Refueling Squadron displayed exemplary professional performance during a night landing accident at Beale AFB, California, on 29 April 1977. Captain McKnight was in the left seat of the KC-135 giving training to the student copilot who was in the right seat. After touchdown and as the airdraft was being reconfigured for the subsequent takeoff, unknown objects on the runway caught Captain McKnight's attention. Immediately thereafter, the aircraft impacted a herd of cattle which had strayed onto the runway from an adjacent field. The collision caused the nose gear to collapse and the left main landing gear to separate from the aircraft, rupturing several main fuel tanks. The intense heat generated by the sliding aircraft ignited the leaking fuel, engulfing the entire aft section of the aircraft in flames. Captain McKnight had already retarded the throttles to idle and raised the speed brakes. He was able to maintain directional control of the aircraft by the application of full right rudder while simultaneously directing the crew to prepare to abandon the aircraft. The aircraft then veered abruptly to the left about 180 degrees and came to a stop on the airdrome infield. After ensuring that all seven crew members had successfully egressed, Captain McKnight ran to the responding emergency vehicles and informed the rescue personnel that all crew members had safely exited the aircraft. About this same time, the aircraft erupted in numerous explosions and was entirely engulfed in flames. Through his professional ability to function under extreme stress, Captain McKnight's action was instrumental to the safety of all the personnel involved. The effective training he gave to his students was apparent as the entire course of events from initial impact to final egress was a mere 45 seconds.

Major Justin J. Murphy

On 1 November 1977, Major Justin J. Murphy and his reconnaissance systems officer were scheduled to fly a classified SR-71 reconnaissance sortie. After approximately one hour and twenty minutes of flight and at the entry point to the reconnaissance collection area, the aircraft experienced a catastrophic hydraulic failure of the right engine inlet control system. Major Murphy was faced with a rapidly deteriorating situation. The aircraft was in a 30 degree left turn when the hydraulic system failed. System pressure instantaneously dropped to zero PSI, causing the right inlet to expell the supersonic shock wave which caused the aircraft to roll rapidly from 30 degrees of left bank to 45 degrees of right bank. Major Murphy re-initiated the left bank to maintain a track critical to the mission and initiated emergency descent procedures. During this critical action procedure, irregularity in engine airflow resulted in right engine flameout. During the yawing and vibrating descent caused by the flamed out right engine, the left engine also flamed out. From the point of initial hydraulic failure through the left turn and initiation of the emergency descent, only 10 seconds of time elapsed. During this brief period, Major Murphy turned the aircraft towards the emergency recovery airfield as it descended without power. Finally, at approximately 63,000 feet, the left engine was restarted; however, the right engine would not respond until the aircraft reached subsonic flight at 29,000 feet. He then executed recovery at a strange field emergency base. During this incident, Major Murphy demonstrated a high degree of professional leadership and competence. The fact that the aircraft was not destroyed is attributed to his exceptional flying skill and execution of timely and correct emergency procedures. ★



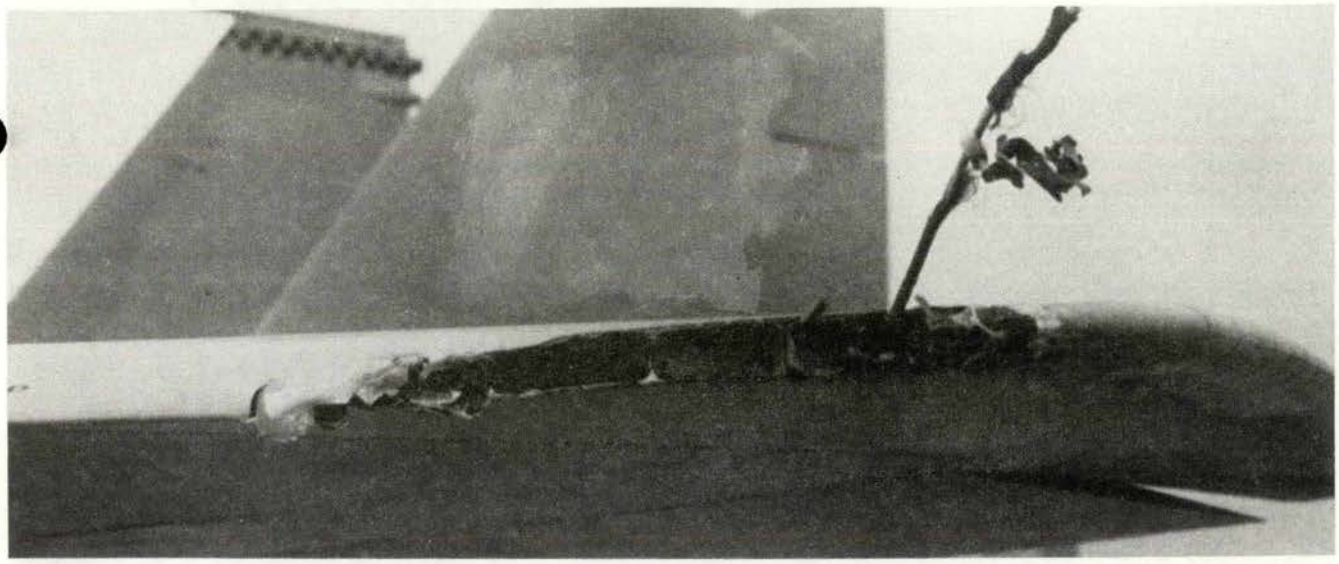


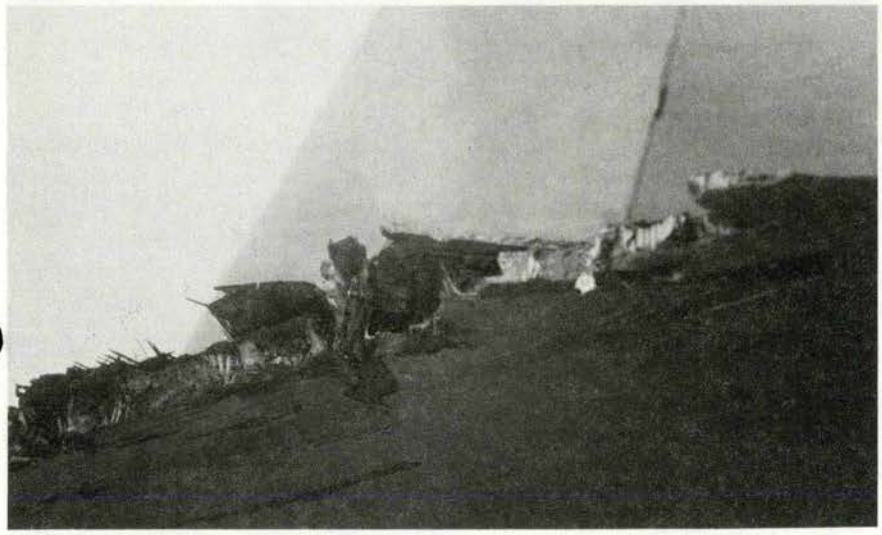
THE LOWER YOU GO

The flight of two F-4s on a night low-level mission had encountered no problems until they ran into deteriorating weather. Lead reversed course but number 2 lost him in the clouds. He broke out and tried to maintain VMC for a rejoin but got back into the clouds. When he next broke out he found himself at 600 ft eyeball-to-eyeball with a 1,020 ft TV antenna. A hard turn cleared the antenna but the left wing struck a guy wire, severing 93 of 163 strands of 2⅛ in cable. The cable neatly sliced four feet off the wing, but the pilot was able to take the aircraft home for a safe landing.

In a recent one-year period 22 of our aircraft were damaged or destroyed, and some crews killed, when they flew into the ground or some other obstacle during low-level flight. The above is one example. Labeled Controlled Flight Into Terrain, these mishaps occurred under a number of different circumstances. To cite a few. . . .

This pilot really tried to kill himself. Fortunately, he did not succeed. He was flying low-level in an A-37 and pulling negative G as he topped the hills and flew down the other side. During one −G period he heard a banging sound on the





Photos at far left, page 6, show antenna and guy wire hit by F-4. Right hand photos show piece of wing sliced off and the damage to the remaining wing. Above and left, damage to F-15 wing and horizontal stab after collision with ground.

canopy, looked up and saw the control lock which had fallen out of storage. He grabbed it and stuffed it in his ditty bag. Soon this scene was repeated except that the loose object was the control lock housing. As the pilot diverted his attention to retrieving the housing, the aircraft hit some trees. What do you do then? This pilot pulled more than 7 +G and lucked out.

A low altitude flight of two F-15s was performing basic flight maneuvers. With the IP in chase position, the pair were flying through some hills at 200-300 feet AGL when the IP saw a cloud of dust and called for a climb. After joinup, the IP could see damage to the left wing and left horizontal stabilizer that resulted from the aircraft striking the top of a ridge. A controllability check showed no problems and a safe landing was made. Color him lucky.

Others weren't so lucky.

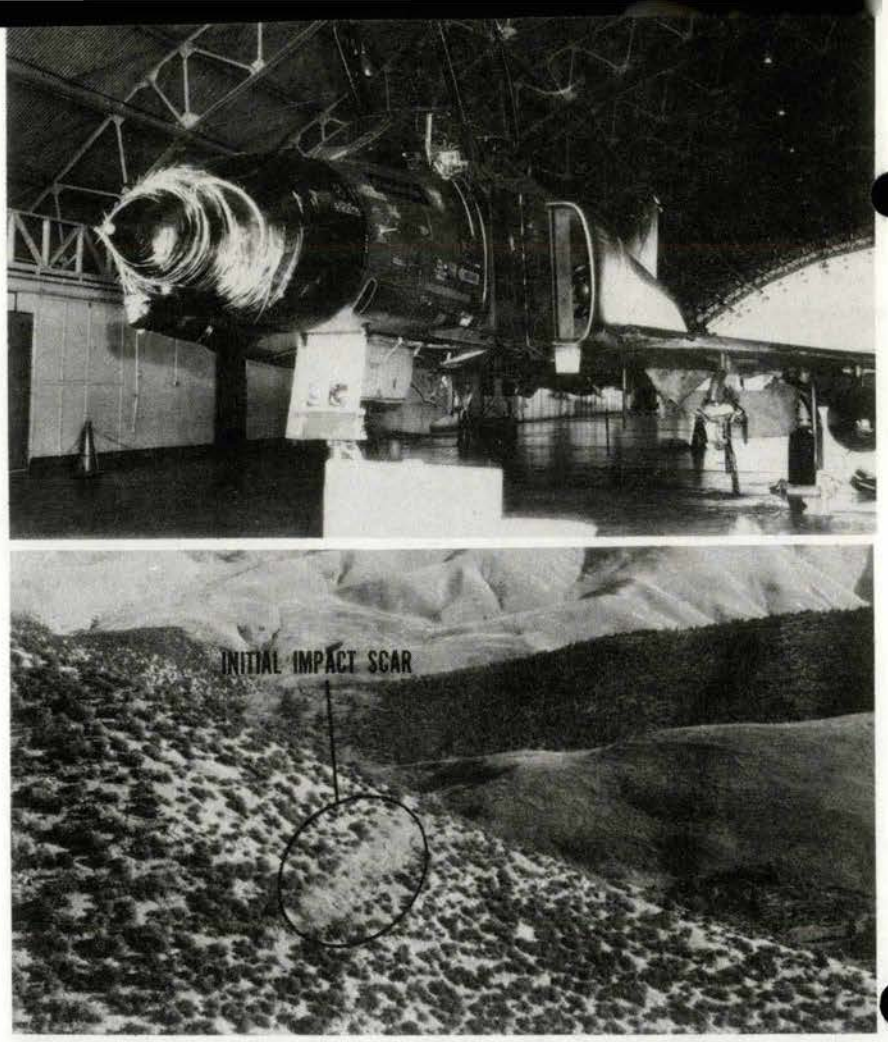
A crew was flying a night low-level single shipper, IFR-VFR. During descending turns the aircraft flew into the ground. There was no attempt to eject.

An F-100 pilot apparently misjudged height over the ground and flew it in. He was very highly motivated on this flight and concerned about joining up with his wingman. Perhaps there was a split second of distraction when he looked back at more than 400 kts and less than 100 feet AGL. The desert bushes in that area are particularly small and may have led him to believe he was higher than he was.

A flight of two encountered bad weather and struck some trees. Both crews ejected, but one crewman didn't make it.

Another crew of two died when their aircraft struck a ridge during a low-level flight. Ironically, they were aborting the low-level part of the flight and joining on lead because of some weather reported ahead.

Some of the factors involved in these mishaps were



F-4D, top photo, struck trees on low level mission. Impact caused considerable damage and tree sap covered windscreen making it difficult for pilot to see to land. Lower photo shows scar where another aircraft struck hillside. Spatial disorientation due to poor weather may have contributed to this mishap.

disorientation, distraction and diverted attention.

Disorientation can be caused by many things. Weather is one—clouds and visibility deterioration of some degree can cause disorientation that could be easily handled at higher altitude but not at very low levels. Crews must be prepared by computing route abort altitude, maintaining pre-planned ground track and avoiding large excursions.

Illusions can be disastrous. Time, distance and speed influence what the pilot sees and thinks he sees. Flat terrain with little or no vegetation, water, snow can all affect a pilot's perception to the point where he can fly into the surface while thinking he is safely above it.

Low-level flying places severe demands on aircrews. Hazards multiply the lower we go. Aircraft were "shot down" by trees, wires, a cactus, weather, hills and mountains. This is where one second of inattention or distraction can be fatal. Crews must understand the environment as well as being highly trained in operating there. Here is where knowledge of the aircraft and its systems is essential. Where knowledge of both normal and emergency procedures must be as much a part of a crewman as his name.

Missions must be thoroughly briefed. Each person must know what to expect from his fellow crewman and other members of the flight. Low-level navigation, flying the aircraft, setting up for weapons delivery, keeping alert for "enemy" aircraft, being aware of the location of others in the flight, maintaining a scan for other aircraft such as a light plane traversing the area—all these must be dealt with. If the pilot feels he is getting over-saturated, the only solution is to break it off. Unfortunately, many accidents occur with the crew apparently unaware of their dangerous situation.

Knowledge of the terrain is essential, and that comes from careful, thorough study of the maps. One of the reasons for good pre-planning and briefing.

Low-level flying requires strict discipline, complete concentration on the task at hand and good technique based on study and practice. Practice is the key. With all the other squares filled, a pilot still will not be proficient at 100 AGL and 450 kts without doing it.

Much of what has been said here may seem obvious. But for every item mentioned there is a pile of wreckage somewhere because someone violated one or more of the rules for survival in the low-level environment. ★

THE PROFESSIONAL APPROACH

Air Force Communications Service • Scott AFB IL

ENROUTE DESCENT

The enroute descent is often flown in lieu of a published penetration and provides the pilot and air traffic controller a flexible method of descending to final approach. It also aids in expediting movement of air traffic, and usually reduces total enroute flying time. The enroute descent may be conducted via nonradar routings using navigational aids or via radar vectors. Air traffic controllers will not insist an enroute descent be conducted, authorize an enroute descent if abnormal delays are anticipated, nor terminate the service without the pilot's consent, except in an emergency.

To perform an enroute descent in a safe and professional manner, you must be aware of several planning considerations that will affect the accomplishments of the descent:

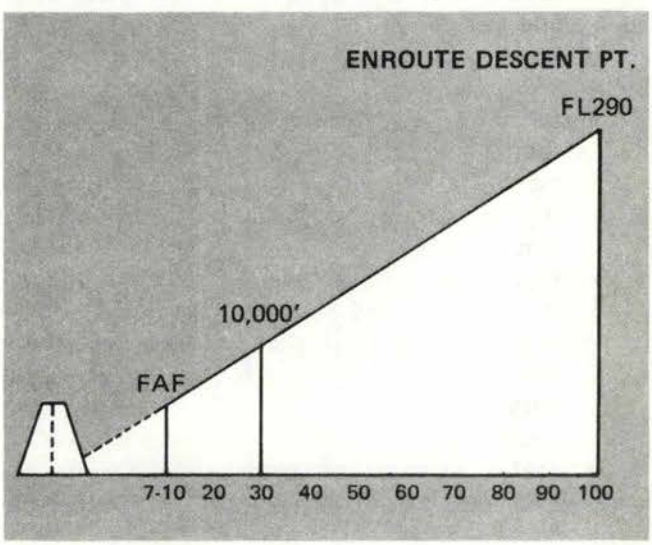
- Your starting point for the enroute descent should depend upon altitude, ground speed, airport elevation and desired rate of descent. A rule of thumb that can be used is to begin the descent at a distance (in NM) in multiples of the aircraft altitude in thousands of feet plus 10 miles. Some preplanning for your specific aircraft will give you the multiple (2X, 3X, etc.) that provides a descent rate suitable for your mission or configuration. When a steeper or more gradual descent rate is desired you must adjust your descent distance from your destination. In any case, coordinate your descent starting point with the air traffic controller, since there may be restrictions based on other air traffic. Caution—beginning descent early at a high descent rate will result in prolonged operation at low altitude with corresponding high fuel consumption.
- The type of final approach to be conducted must be understood by you and the controller. You should request an enroute descent to a specific final approach fix that serves the destination airport. You will then have a definite clearance limit fix which could prevent confusion in the event of a two-way communications failure. We recommend you select a published approach suitable for weather conditions and request a clearance from ATC to fly that approach in the event of communications failure.

Your enroute descent to a normal low altitude instrument approach may be enhanced by the following techniques.

- Plan your descent to arrive at about 10,000 feet AGL and 30 NM from the threshold of the landing runway. If you are coming from the opposite direction of the landing runway, plan your 30 NM point to include distances you will travel in the pattern. Below 10,000 MSL, airspeed should be no more than 250 k unless aircraft operating limitations or military normal operating procedures require greater airspeed. This provides a more consistent flow of air traffic, makes the controller's job less complicated, and allows you more time to accomplish cockpit duties.
- Remain oriented in relation to the final approach fix by using all available navigational aids, especially when the descent is conducted via radar vector. Plan ahead to ensure the aircraft is properly configured and you are prepared to fly the approach when cleared by the air traffic controller.

An understanding of the information in this article and some preplanning are a minimum requirement necessary for a safe and successful enroute descent. Of equal importance are the operating characteristics and limitations of individual aircraft. The flexibility of the enroute descent makes it a desirable maneuver in many instances; yet, because of the many variables involved, the pilot may be required to exercise more judgment than normally required during a published penetration.

We want to make this feature responsive to the needs of aircrews. So, tell us what you want, fire questions, share your knowledge and experience. Together we can work for the good of us all. AUTOVON: 638-5479. Letters: AFCS/FFOS (Flight Standards), Scott AFB, IL 62225. ★



OPS TOPICS

LACK OF COMMUNICATION—COSTLY

The Phantom was preparing for a cross-country launch after a static display. The aircrew had loaded the travel pod with their personal belongings and most of the aircraft's 780 gear when the transient alert (TA) crew arrived at the aircraft.

The pilot asked the transient alert personnel to check the travel pod door closed and secured and told TA he would require an end of runway (EOR) check. The transient alert crew understood an EOR check would be needed but does not remember being told specifically to close and secure the travel pod door. The aircraft was started and taxied to the end of the runway. TA performed a leak check, but did not check the travel pod.

During takeoff roll fire department personnel noticed objects fall from the aircraft. These articles were personal clothes bags. When the aircraft landed, the travel pod was empty. The 780 equipment and a packed drag chute had fallen out during the flight and have not been recovered.

AIRPORT INFO

A recent National Transportation Safety Board (NTSB) report of a civil aircraft accident revealed inaccurate information was contained in the Airman's Information Manual (AIM) Airport Directory for the Airport where the accident occurred. A remark reflecting the correct information had been in the FAA Airport Master Record as early as 1965 but was not published in the AIM until after the accident.

USAF airfield and approach information is contained in many different publications – Instrument Approach Procedure charts, Enroute Supplement, FLIP, AIM, Sectional Charts, etc. They are published by different agencies – Defense Mapping Agency Aerospace Center (DMAAC), Federal Aviation Administration (FAA), National Ocean Survey (NOS).

When was the last time the air field information for your base was checked for accuracy? – Maj Joseph R. Yadouga, Directorate of Aerospace Safety.

THREE TIMES LUCKY

The PSA-Cessna 172 midair collision over San Diego shocked the nation and started a barrage of verbiage over air traffic safety. Those of us in the business were probably just as apalled as the layman, but not as shocked because we have more knowledge of the frequency of near midairs. We mention this frequently in these pages, and we will continue to do so to try to head off any complacency on the part of USAF crews.

ITEM: C-5A – light aircraft. The light plane passed in front of the C-5 at about 300 feet. No time for evasive action. Light plane not on radar.

ITEM: C-141 – Cessna 172. Cessna passed in front of C-141. Pilot did not see USAF plane until a passenger told him later. Estimated miss distance 500 feet.

ITEM: T-38 – Cessna 172. T-38 pilot had to push over to avoid 172. T-38 went under and aft by 150-200 feet.

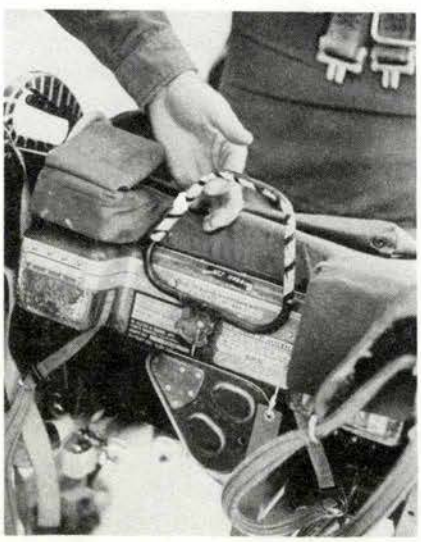
CREW WORKOUT

As the pilot of an RF-4C began a right turn out of traffic at 400′ AGL, the aircraft rolled rapidly to nearly 90° even though he had the stick full left. With the WSO's help, level flight was achieved at about 300 ft. The crew declared an emergency and tried various remedies to no avail and got a chase aircraft which reported the left aileron was down 12 inches and the right one 6 inches with the aircraft in a right turn. Finally, with both crewmembers muscling the controls they were able to make a safe landing. Both were exhausted from constant left stick and rudder inputs. The culprit was FOD in the form of a 5/8-inch number 10 screw jammed between the lateral control bellcrank and the enclosing bulkhead. Runaway trim contributed to the crew's difficulties. Estimated stick force to keep wings level was 30 lbs. This crew had a real workout.

OPS TOPICS

FLYING WITH A HOT SEAT

An F-4 pilot flying an instrument training sortie lowered and raised the ejection seat handle guard at the appropriate times. Upon departing the aircraft, his foot brushed against the handle and he noticed that it was cocked to one side. Thinking this unusual, he wrote it up. Egress technicians responding to the write-up found that someone had apparently pulled the handle out of its detent (probably while the safety pins were still installed). It was then pushed down between the survival kit and the front edge of the seat bucket. This condition cannot be easily detected by the pilot during pre-flight. Even though the pilot lowered and raised the handle guard to arm and safe the seat when he was supposed to, he was really not safing the seat when he raised the guard because the handle was not in its detent. He was, in effect, sitting in an armed seat that was very ready to fire had his legs or anything else tugged at the handle – Mr. Rudolph Delgado, Directorate of Aerospace Safety.

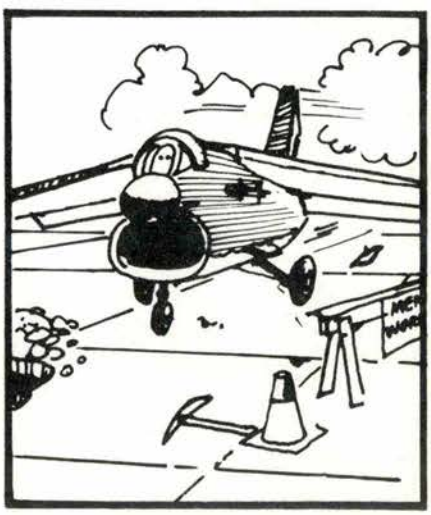


HOW MANY TIMES?

During preflight the transient alert crew chief was told by the aircraft commander that, after electrical power was applied to the aircraft, he would have to remove the drop tank pins and give them to the back seater. After the Dash 60 unit was hooked up to the aircraft, the pilot signaled the ground crew that the power was not on the aircraft. The ground crewman wiggled the plug and got no further response from the flight crew. The pilot stated that after not being able to get external power he elected to make a battery start. No change in start procedures were briefed to the ground crew before the battery start was attempted. After the number two engine was started and the right generator was turned on, the crew chief removed the tank pins and threw them to the WSO, despite attempts by the aircraft commander to wave him off. The crew chief did not notice the pilot's actions. The pilot shut the engine down, but it was too late. The pins sailed over the WSO's head and entered the right engine causing extensive FOD to the compressor section. Oh, Lord, how many times?

A YELLOW "X"

We often see such words as complacenecy, mental set, task saturation as they apply to flying aircraft. In the following narrative they all come together and produce a yellow "X". The aircraft diverted to base B (a P-PR) because of weather. At first the pilot's request was denied because of an ORI in progress, but with the aircraft low on fuel a PPR number was issued. Now at base B the first 7,000 feet of runway was closed, leaving the last 5,000 feet open. The pilot did not ask for NOTAMs but was advised of the runway condition. Sometime earlier he had landed there and the first 5,000 feet were open and the rest of the runway closed. The controller's message did not penetrate. Neither did the MDA given by the controller which varied from the IFR Supplement. Neither did the displaced VASI lights. The aircraft landed on the closed part of the runway. Action taken: Base B painted a large yellow "X" on the closed portion of the runway. Wonder if it glows in the dark. ★



Pieces From The Past

Major P. D. Smith
Directorate of Aerospace Safety

Mission terminated, the aircraft was returning to base. The crew, within a few miles of homeplate, relaxed and started thinking about lunch and how they would spend the afternoon. With the ceiling lowering, there would be no low level work. Suddenly a mighty noise slammed across the desert, echoing and re-echoing against the barren, rocky hills. A fireball rocketed upward . . . nearly three decades later. . . .

One of the more enjoyable ways I have found to spend a Saturday with my two sons (ages 12 and 14) is to haul the dirt bikes out for a ride in the Southern California desert. It's always an adventure, but a recent outing in the El Mirage dry lake area held something extra. A discovery we made there let us play accident investigator and gave the kids a glimpse of what goes on where old Dad spends his working day – at the Air Force Inspection and Safety Center.

We started this ride, as we had on previous trips to El Mirage, by just cruising around the lake bed. It's a unique experience – like driving a fast boat on a real lake. Turns can be made at will in any direction and at almost any speed. There are some hazards though. Occasionally, one will check his six o'clock position and find a 4-ton motor home bearing down in pursuit of a new land speed record. A melange of California fun seekers can usually be found stirring the weekend dust at El Mirage, and this day was no exception. There were dune buggies, dirt bikes, land sailers, a homemade go-cart engine-powered biplane being tested while a Benson Gyrocopter flew chase. All of this was presided over by a covey of four elegant sailplanes.

We eventually tired of dodging the participants in this three-ring circus and number two son, Marty suggested a ride into the rocky foothills to the north. The high-speed cross-country trail ride deteriorated into a muscle wrenching struggle with a sand wash as we climbed higher into the rocky slopes. It was time for a break. The kickstands came down, the helmets off, and we headed for the shady side of a large boulder. On the way, Phil kicked aside a piece of plastic with shattered glass clinging to its sides. Sitting in the shade of the boulder and passing the canteen, we enjoyed a panoramic view of the lakebed, now well below us and several miles away. Marty picked up a thick piece of curved plexiglas, almost opaque with age. "Hey, those are airplane parts." Some air machine from a previous age must

have met its end here just below the highest peak in the area. "Let's see what else we can find."

Easter egg hunt tactics yielded bits of bent O.D. painted aluminum, a piece of fiberglass duct, a sheared bolt with P-W stamped on the end. Recognizing a chance to dazzle the kids with my knowledge of things aeronautical, I bragged, "If you guys find enough parts, I can identify this plane and we can find out when and why it crashed."

The scavenger hunt itensified. We covered the top of a large flat rock with bits and pieces: more aluminum scraps, magnesium casting, and a "press-to-cage" button. "Cockpit parts. That's what we need. This thing has to be very old, but somebody back at the office might recognize the cockpit stuff."

Two pieces of plastic trim wheels told me that it was a large aircraft, but our search ended with nothing positive. We rode out that day with me thinking only of jet aircraft. Driving home with the cycles in tow on the trailer, I finally realized that those odd tubes-within-tubes we found were engine push rods. Our bird was a Pratt & Whitney-powered recip, not a jet.

Identifying the plane became an obsession with us. We had to try again. This time a piece of trim wheel and a "flap release" button bearing the Boeing label were found. We were narrowing it down. I turned over a shiny plate that looked like a tin can lid, and we were handed the answers we sought. It was the aircraft identification plate which gave us the serial number. The aircraft was a Boeing B-50D with Pratt & Whitney R-4360 engines.

Answering the rest of our questions would now be a routine matter. Phil and Marty were eager to know how closely all our conjectured theories matched the real facts, so I went to work early that Monday and dug into the files. Back in the early 1951 cards was the reference I needed. The microfilmed copy of the accident report went into the film reader and the quickly scanned pages showed that it was a test flight. My mind conjured up scenes of the crew struggling with the mighty B-50, crippled by some circumstance of the test mission. But, when I finally got to the bottom line, I was forced to ponder a phrase I have heard many times here at the Center: "There are no new causes – only new accidents." The cause was stated simply as "attempting VFR flight in IFR conditions."

The flight had originiated 27 years ago with a morning takeoff and a climb through a broken overcast to 30,000 feet to test an experimental fuel tank inerting system. A minor problem terminated the test and the B-50 circled George AFB under a 6,000-foot ceiling. At 1100, it departed George on a direct course for Edwards, still VFR, but apparently into a lowering overcast. At 1105, the perfectly functioning B-50, flying at 3,924 feet, encountered the rocky ridge line 10 feet below the top. Eight men were on board.

The kids were reluctant to accept such a mundane cause for the catastrophic event. "Yes," I assured them, "the airplane was equipped to fly on instruments, the crew was qualified, they had to be aware of terrain elevation." I asked them to recall the multitude of times, in the 3 years we have lived here, that civilian aircraft have been "gobbled up" by the local mountains when an unfortunate pilot tried to pick his way through below an overcast. They could relate to that – it always makes the 6 o'clock news.

"Attemtped VFR flight in IFR conditions." I wonder how many more times those words will form that very final ending of reports and aviators. ★

WEATHER RADAR -- ATC RADAR

There is a difference

Since the first day of undergraduate flying training you were probably warned to respect thunderstorms. AFR 60-16 and MAJCOM supplements provide direction on avoidance criteria for these storms. But when the ARTCC relays a SIGMET telling you a squall line blocks your airway and radar indicates it is just 10-15 minutes ahead, where do you turn for help?

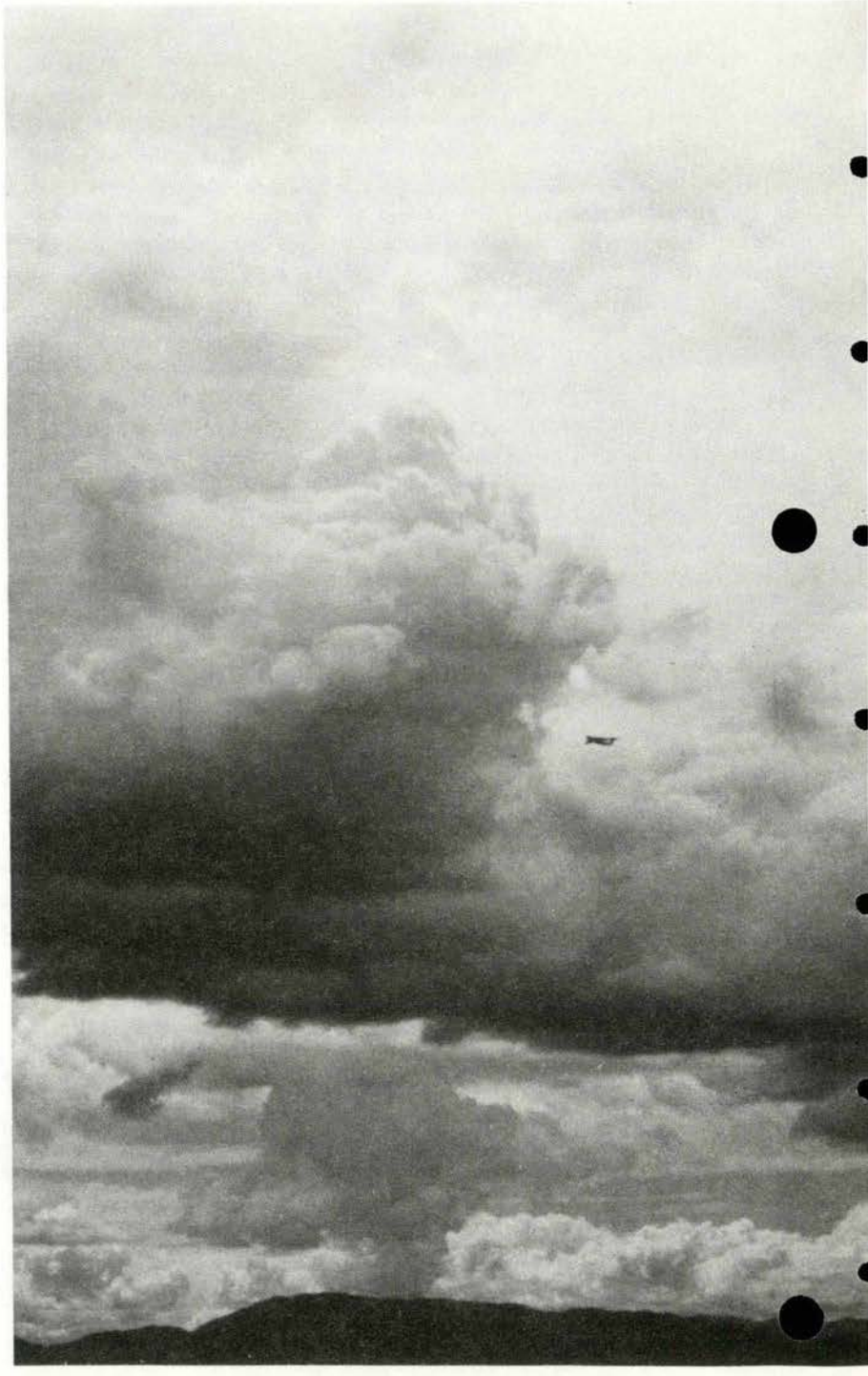
Your first instinct is probably to ask the center controller for help. But before relying totally on the center's assistance, you should be aware of the dubious accuracy of weather information displayed on the controller's scope that would be used to provide "weather vectors."

Air Weather Service (MAC) recently made a study of the FAA's air traffic control (ATC) radars. Air Weather Service concluded that the capability of these radars leaves much to be desired when trying to detect and display the location and intensity of convective cells.

The intensity of weather cells is determined by the relative amount of energy reflected from the cell back to the radar. This reflected energy is expressed in terms of decibels (dBZ). A relationship between dBZ values and weather cell intensity is shown in Table 1.

One major shortcoming of ATC radars is the inability to obtain accurate dBZ measurements. These inaccuracies result from radar characteristics and controller procedures. For example:

The wide beam width of FAA radars causes reflectivity losses of 8.8



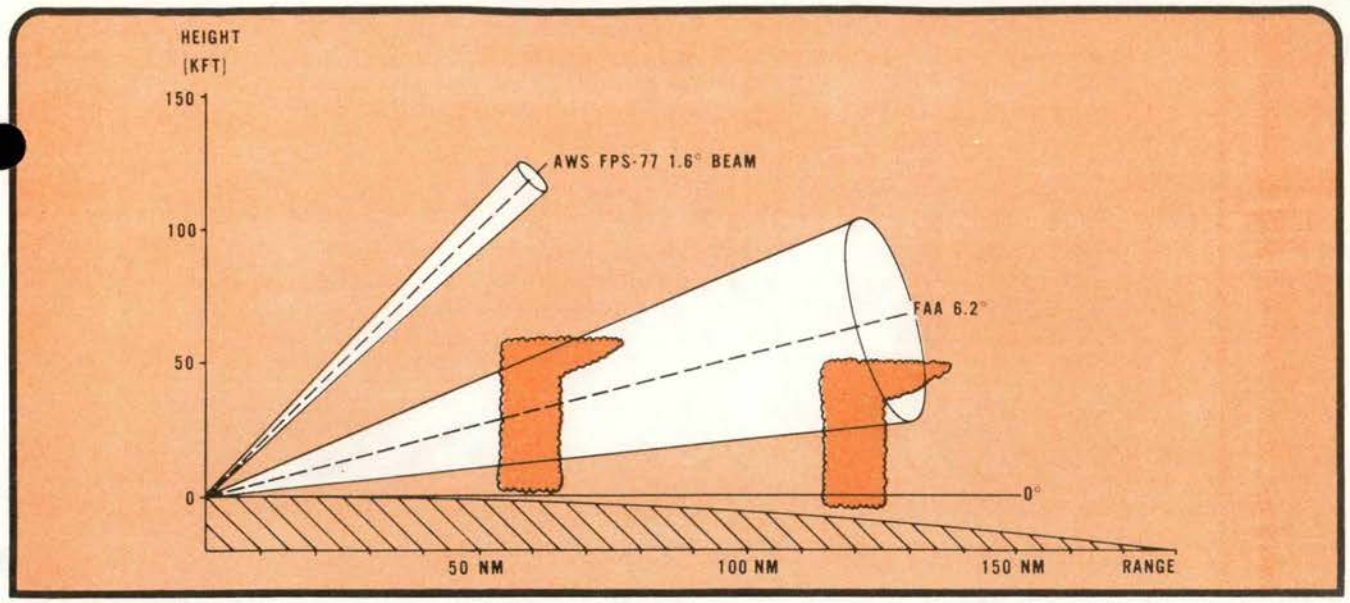


Fig 1. Depiction of a 6.2° radar beamwidth viewing severe thunderstorms at 60 NM and 120 NM.

dBZ	INTENSITY
55	TRWXX (Extreme)
50	TRWX (Intense)
44	TRW++ (Very Strong)
40	TRW+ (Strong)
30	TRW (Moderate)
10	TRW- (Weak)

TABLE 1

Major Duane B. Stoecklin
Hq Air Weather Service Field Support

dBZ at 60NM to 24.8 dZB at 120 NM.

Echoes at different ranges from the antenna must be displayed so that echoes nearer the antenna do not appear stronger than strong echoes farther from the antenna. To do this, a normalization factor must be applied; however, this factor is not the same for aircraft and weather targets. The normalization factor used by the FAA is for aircraft targets (not weather targets), and it is not standard for all ATC radars. Further, controllers request changes in these settings from radar site to radar site. Therefore, when these radars are used to detect weather echoes, losses in weather echo intensity may occur. These losses may be as much as 36.8 dBZ at 60NM to 52.8 dBZ at 120NM, and no corrections are made for these losses before echoes are displayed on the controller's scope.

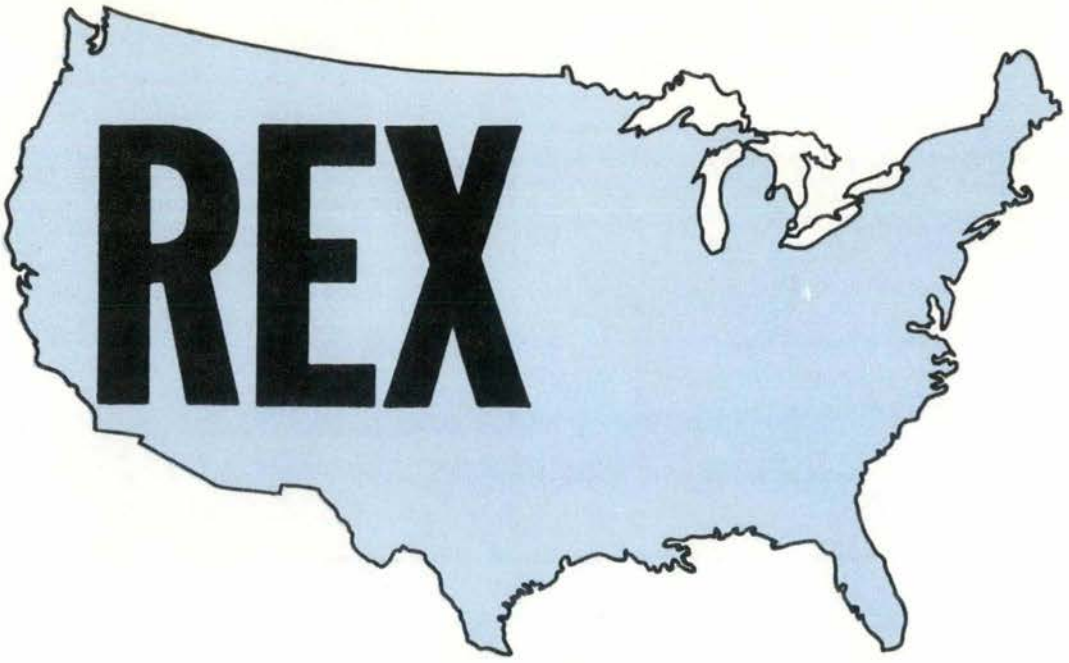
What does all this mean to the aircrews? It means the controller may unintentionally "vector" your aircraft into thunderstorms because his radar scope does not provide him accurate weather echo information. The problem is that the apparently moderate thunderstorms (30 dBZ) on the controller's scope may actually be an intense or extreme thunderstorm (50-55+dBZ). Also, weak or moderate thunderstorms (10-30 dBZ) may exist along your route, but the controller's scope will show no activity because of echo intensity losses that occur on his radar.

Another shortcoming of ATC radars is the inability to measure storm tops. FAA radars have a fan shaped beam which rotates at a *fixed elevation angle* while weather radars employ a pencil beam and the *elevation angle can be adjusted* to measure tops of cells.

Figure 1 compares the size of the FAA radar beam width (6.2) and the FPS-77 weather radar beam (1.6). A typical FAA radar has its beam axis set at a 5° elevation angle as shown. Beyond 60NM in range, it will detect less and less of large storms and may miss smaller storms completely. In contrast, the FPS-77 beam can move vertically to detect the vertical extent of storms anywhere between 5NM and 125NM.

Therefore, when you are flying in an area of known or suspected thunderstorms, make maximum use of Pilot to Metro Service (PMSV) provided by an AWS base weather station with a weather radar. These radars are designed to detect and accurately display weather targets. AWS forecasters can't provide aircrews with flight direction vectors, but they can provide storm tops as well as location and movement of echoes in relation to airways.

In summary, ATC radars are primarily designed and used to separate aircraft traffic. When used to display and interpret weather information they have several shortcomings. Hence, aircrews that rely totally on thunderstorm avoidance information from the center controller may find themselves actually penetrating storms the controller cannot see on his scope. ★



One word before we pass on some letters recently received. Confusion still runs rampant about the scope and intent of the "Rex Riley Transient Services Award Program."

The award program consists of informal evaluations of USAF and USAF/ANG bases which are available to transient aircrews for stopovers or RON's. Thus the intent—we look at a base from a safety convenience, servicing and irritant standpoint as if we were a transient stopping for fuel, food and/or lodging. Our theory is that a transient aircrew in a strange type of aircraft is very vulnerable to a possible mishap. Not only is TA important but also such areas as Base Ops, inflight kitchen, transportation, billeting, snack bars, clubs, etc. We freely admit that we don't play fair—we play Devil's advocate and often try to empathize with our theoretical transient crew in the worst possible set of circumstances. We don't claim to know your business—most folks know and operate well their own little segment of the base. What we really look for are cooperation between agencies and also the extra effort which people expend to make an airecrew stop safer and more pleasant.

There is no set time period! We are planning to try to visit units regularly with a maximum of two years' time lapse between visits. I have, however, revisited one base three times this year so don't sit back on your assets just because you just received the evaluation and certificate.

And now, some feedback from the field. . . .

WHAT SERVICE?

It was one of those beautiful autumn weekends. We had a cross-country trip to . . . AFB. Show time for the crew at home station was 1700 with a 1900 departure. Everything progressed just like clockwork including the anti-hijack inspection on the 15 passengers who were going along.

The flight was uneventful, and a most enjoyable weekend was spent (as far as the passengers were concerned). The crew had to fly overwater navigational missions on Saturday, so they spent their beautiful weekend in the blue.

Then, as usual, came the time when all good things must come to an end; and on Sunday morning, the 15 passengers arrived at Base Operations in preparation for the return trip. Being an old Base Ops type (and still am), I do quite a bit of observing when I proceed to another field. Not only do I do a lot of observing of Base Operations, but also of the aircrew both in planning and flying. Hey, let's face it, anytime I can steal a good idea and bring it home to make my place better, I will do it.

Well, my first and last impression of Base Operations was that if the individual with whom I dealt was working for me I would have fired him long before he ever sewed on those stripes that he was wearing.

Being one of the first to arrive at Base Operations, I tried to gather information for the crew. This was like trying to pull hens' teeth. When I first approached the counter the dispatcher was, I think, asleep, or lost in many dreams somewhere else. I waited for approximately 15 minutes, then I finally got the courage to disturb him by asking him if he had heard from the crew for transportation. Without getting up from his chair he managed a "Yeah." He asked me who I was. I told him I was on the C-130 that came in Friday

night. He then asked me, "Which C-130?" That must have been a tough one as we were the one and only C-130 within several hundred miles.

Knowing that the crew had intended to fly an overwater navigational training mission on the return trip, I asked him where the flight planning room was located, and, without saying a word, he pointed to a door. As I went through the door that was pointed out to me, I noticed a very well kept flight planning room—so sanitary that I could not locate a DD Form 1801 (ICAO Flt Plan), a DD Form 175-1 (There is a TV weather briefing set up), or AF Form 70s. I reapproached the dispatch counter and asked where were these items? I was rudely told to look in the drawers under the flight planning table and I would find them.

After finally finding the needed forms, I started to do a little flight planning. All of a sudden I realized that, hey, I've been here for 30 minutes and no crew yet. I went back out to the counter and asked the dispatcher if he was sure that transport had been sent to pick up the crew. With that question I guess I really upset him. Real snappy—he told me that he had sent the transport, but the driver had to refuel his vehicle first. It was 1030 by that time, so I did as much flight planning as I could Finally, the crew showed up and jokingly the aircraft commander told me that I was some kind of a pal because I didn't even send transport for them on time. I told them about the problems I had since I had arrived. The AC just couldn't believe what I was saying. Finally, the crew obtained everything, filed, and we started to depart for the aircraft. Well, this was the second gaggle. The crew bus driver only had a step van. As it turned out, he had to make three trips to the aircraft. Boy, this really set well—especially after the previous comedy. We finally boarded, started engines, taxied out for run-up, received instructions to taxi onto the active and hold. Everything seemed to be going smoothly now that we were on our way. Wait, I think I hear a discussion; yes, I know that I hear a discussion. Another gaggle!

As the voices crackled over the VHF I heard, "No, I am not going to clear boondoggle 36 for takeoff; that's your job." "Ground control to tower, oh, no, pal, it's your responsibility to clear the aircraft for takeoff." I couldn't believe my ears. Then the AC gets into the act, and after a three-way conversation, sort of looks at me and then calls departure control, explains the problem between ground and tower and requests a VFR departure on course. With the help of departure control, (there was no aircraft inbound to cause the hold that we were placed on) we departed VFR on course and obtained our IFR once airborne.

The rest of the flight was uneventful.

I will have 20 years service in April '79; I have been on many trips during that time, but I have never, in these 20 years, observed such a mess from show time until final departure was made. It displayed complete disorganization and apathy. Get 'um.

Ed. Note: This letter was received after the author saw the base in question on our Rex Riley list. Only the names have been removed to protect the guilty. If the shoe fits. . . .

CLASSIFIED MATERIAL

Just wanted to send congratulations on revitalizing the program. We in the Base Ops business believe in taking good care of the crews—they're #1 in our book!

One subject which has come up recently is the ticklish item of "classified documents" carried by aircrews. I think it's worth the reminder to Base Ops and airfield mgmt types that they need to cross-check their plan for receiving a transient crew carrying classified. A variety of options exist, but the point is—HAVE A PLAN!

Not so SECRET

READ THE SUPP

I've just read some really bad "aircrew evaluation" forms and feel some of the info is worth passing on. We are one of the increasing number of airfields whose "Operating Hours" and "Transient Services Available Hours" *don't* match! An aircrew should note this when they peruse the IFR Supp. but if they don't, they could arrive at our house and find nobody to guide them in, chock their machine or provide any other necessary services. Flying machines with numerous bodies could probably handle the situation, but a single seater without parking brake would be outta luck. Not only could be a bother, but maybe downright unsafe. The moral of the story is read the fine print and compare the times—just because we are open doesn't mean we will have transient services!

Down South Airfield Manager

Dear Down South,

Hadn't thought about that lately myself! Thanks –that's the kind of info maybe we can use to prevent one of those dumb ground/taxi mishaps! ★

The name of the game in safety is prevention of mishaps; however, periodically we must investigate a "smoking hole." This is accomplished by the safety investigation board. Not all officers within the Air Force will serve in this capacity, but those selected can improve on the quality of the investigation by ensuring they have a clear understanding of how the investigation is conducted and why the investigation is taking place.

The safety investigation board usually arrives at the scene with its members somewhat perplexed and possibly asking, where do we go from here? There are two primary reasons for the turmoil. For one, this is the first time the board members have been together and second, this is probab the first time for each board membe

ur Turn On The ARD

Col Richard J. Miller, Jr.
Directorate of Aerospace Safety

to look at a "smoking hole." Thus, a short time is required to resolve the turmoil and organization to take place so the board can begin working as a unit.

In order to reduce this time to a minimum, each wing/base safety office should have a training program to familiarize each board member with investigation requirements. This training should start by answering the questions of how and why the investigation is being conducted. Don't get caught in the trap (we all are) that this is just more ground training or take the attitude that "They won't use me as a board member," because suddenly you are one, wondering what you are supposed to look for.

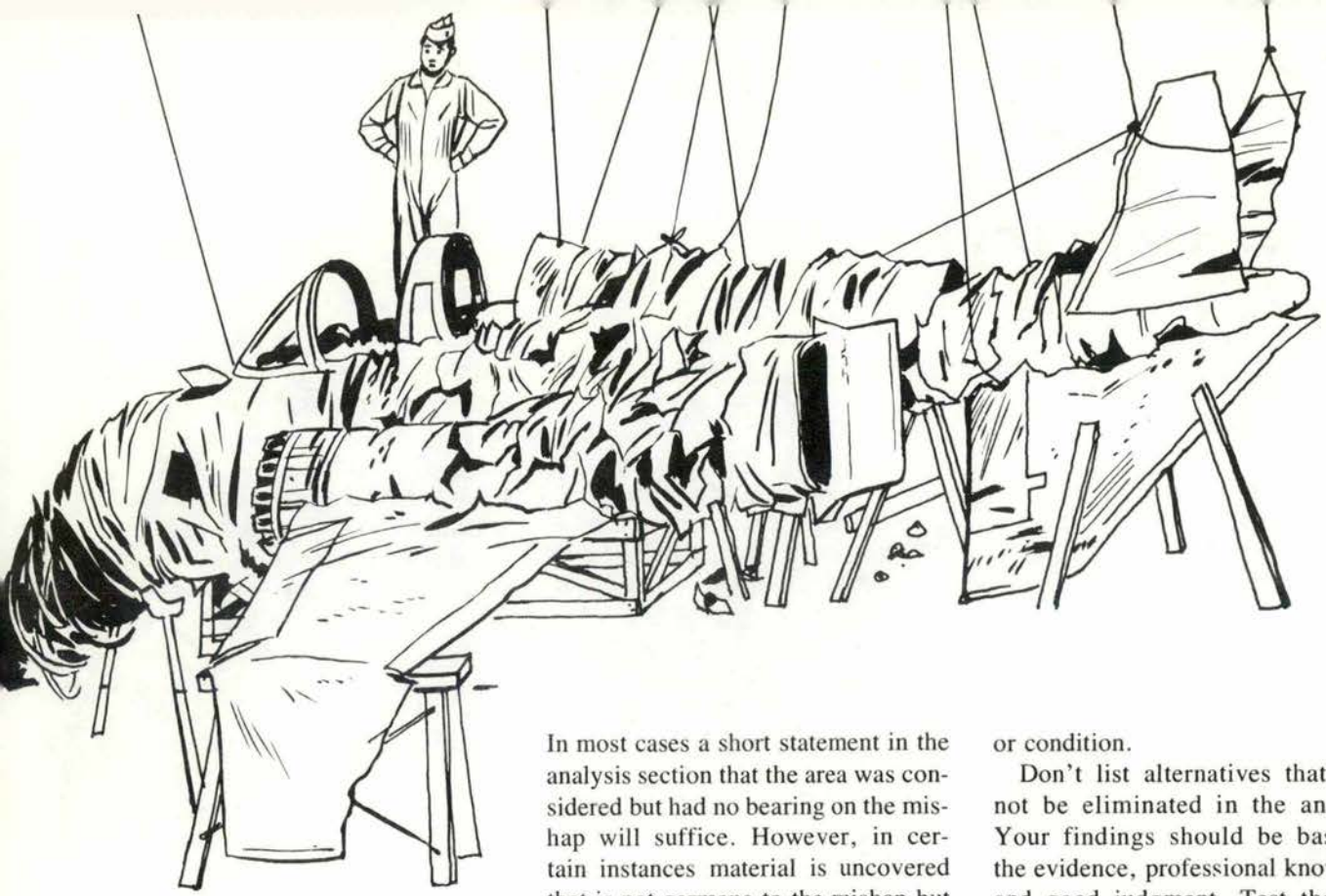
Some "do's" that should be covered during the orientation:

- Plan of attack for each board member.
- How to conduct a walk-through of the mishap site.
- Record impoundment.
- How to obtain witness statements (and the reliability of the witness).
- Obtaining technical assistance from resources outside the MAJCOM.
- How the report is written. Why the two-part report. What should be contained in the Part II of the report (with particular emphasis on Tab W, Technical and Engineering Evaluations of Material that Contain Conclusions)?
- The open mind. No snap judgments.
- Findings and recommendations.
- AFR 110-14 and the safety investigation board.
- Electronic reports and administrative organization of the board.
- Contact point of the MAJCOM and their requirements.

Those personnel appointed to the safety investigating board will probably arrive within a day of the mishap. Initial steps should have been taken by the nearest Air Force facility (disaster preparedness plan) to provide aid to the injured, control the fire, secure the area, determine the status of any explosive components on board the aircraft, initial reporting and impoundment of records. The safety board should receive a briefing of what has been accomplished by the interim board and an initial walk-through of the mishap site. At this time, the knowledge gained during the safety board orientation should be put into effect.

During the investigation, remain impartial. Let the evidence lead to a logical conclusion. Evaluate the data obtained from the technical assistance provided. Several blind alleys will be entered but each should be pursued to a conclusion to resolve the question, did this have a bearing on the mishap?

An area of concern in many investigations is what to do with material that has no bearing on the mishap.



When It's Your Turn on The Board continued

In most cases a short statement in the analysis section that the area was considered but had no bearing on the mishap will suffice. However, in certain instances material is uncovered that is not germane to the mishap but may warrant corrective action if the board president so feels. Do not include these findings as part of the mishap findings. Separate correspondence addressing these findings should be forwarded to the headquarters convening the safety investigation board for their review and action.

The development of the findings and recommendations are products of the board's conclusions and will be the most difficult portion of the report to compose. Remember, findings must be completely substantiated within the analysis of the report. The all cause system places weight on the chain of events which resulted in the mishap. The findings (each finding does not have to be a cause) should be listed sequentially. Each finding is logically connected to the preceding and following finding. However, in those instances where technical data deficiencies and crew rest are identified as initial findings they will not link sequentially with the next finding. The finding should be a clear statement of a single event or condition.

Don't list alternatives that could not be eliminated in the analysis. Your findings should be based on the evidence, professional knowledge and good judgment. Test the findings by linking them sequentially as previously discussed (rememberin the exceptions above).

Finally, cause should be added to those findings which singly or in combination with other causes, resulted in the damage or injury that occurred. Causal findings are an act, omission, condition or circumstance which corrected, eliminated or avoided would have prevented the mishap. (This is the test that should be applied to all causal findings.) And finally, the recommendations made by the board must be feasible and related to the causes of the mishap. *If you do not have a recommendation, don't make one.* (AMEN!)

In conclusion, the safety investigation board has an extremely important function in reducing losses of manpower and equipment through feasible and workable corrective recommendations. The basis for a sound safety investigation begins when your name is initially placed on your unit mishap investigating orders. D your homework. You're next! ★

programmed to trust

Major Roger L. Jacks • Directorate of Aerospace Safety

During the twentieth technical conference of the International Air Transport Association, Pan American World Airways put forth an intriguing observation about the pilot's role in modern day flying. Even though the conference took place three years ago, I think Pan Am's observations are worth repeating.

A pilot's role in today's structured world is that of a trusting man. In an era of specialization, the pilot must rely on scores of others to do their jobs. For example:

After a brief review, he accepts the weight and balance form as being accurate.

On some aircraft, he assumes the loadmaster has secured everything in its proper place.

On other aircraft he is told that the gear pins have been removed and all panels are secured.

Ground marshallers tell him when he is clear of obstacles that could damage his aircraft.

Tower controllers tell the pilot when to move, where to taxi, etc.

He takes off on a runway selected for him.

He follows headings, speeds and altitudes dictated by others.

He depends on fellow crew members for the accomplishment of critical tasks.

Nearing destination he is advised to start descent, the altitude to fly, the air speed to hold and the headings to fly.

He lands on a runway someone else selected—and is once again told where to taxi and where to park the aircraft.

And so the life of a pilot goes; always trusting his life and his aerospace machine to the care of others. Pan American officials state that pilots are programmed to *take* orders. "In the routine situations he has virtually no need to *give* orders. His environment—the "system"—has programmed him not to make decisions." And yet when he is behind the yoke or stick, the total responsibility is his. "The only ultimate authority is his."

"Though he has been heavily programmed to trust, he is expected to take positive corrective action at any moment if required. And the requirement may be subtle: an incorrect heading, an incorrect altitude, a change in wind direction or velocity affecting acceptable weights, loads, or fuel required, a NOTAM overlooked by a dispatcher, a misunderstanding between controller and pilot as to the responsibilities of each. There are many such subtle, creeping, potentially anomalous situations which may and do arise."

Even though the pilot has been psychologically conditioned to accept the dictates of others, his command or assertive behaviour must stand ready to be triggered when his mental faculties detect something going astray. He must at the proper time override his conditioned response to follow the instructions of others and assert himself as the ultimate authority. Pan Am suggests this is a more difficult and demanding task than it may seem. Reliance and trust in others can breed complacency in the unsuspecting pilot.

Many a mishap might have been avoided had a pilot's normal warning reactions not been blocked by his programmed trust. How many mishaps have been caused by programmed trust distorting a pilot's perception of the situation? A quick look at some classic examples that occasionally repeat themselves provide our answer. The pilot who has been cleared for an approach but is given an incorrect level off altitude. With blind, unquestioning reliance, he flies his aircraft into the mountain. Or the pilot who, while routinely flying an approach with a low ceiling, struck the ground short of the runway . . . the voice recorders tell us the crew had such confidence that everything was going as planned that they were casually talking about politics at the time of the mishap.

Trust and faith in the system; we're not knocking that—that's written into the pilot's contract. It is a basic part of flying! What we are saying is unquestioning, irrational trust is not part of the deal!!

Human factors are what we're really discussing in this article. It is an important subject since most of our mishaps are caused by them. Pan American's observations are certainly a noteworthy consideration when pondering the many ways the human factor affects our mishap rate. Make your crews aware of the "Programmed to Trust" syndrome. ★

BIBLIOGRAPHY
Safety in Flight Operations, 20th Technical Conference, International Air Transport Association, The Changing Role of the Pilot: Command 1975 *Pan American World Airways.*

MOUNTAIN WAVES:

a powerful and dangerous force

Mountain wave turbulence, a subject frequently featured in flying safety magazines until a few years ago, seldom appears on those pages now. But it still exists and is a menace to the unwary, uninformed, unheeding. Our new generation of pilots, although they fly aircraft that normally operate above severe mountain wave influence, sometimes are required to fly at lower altitudes and they should know the characteristics of this potentially devasting phenomenon. The following article adapted from the Navy's *Approach* magazine covers the subject concisely and well.

A T-39 was flying a low-level, high-speed navigational training route in mountainous terrain when it encountered severe turbulence. Gust acceleration loads were so high that aircraft design limits were exceeded, resulting in separation of the tail assembly from the aircraft. The plane flipped inverted from its 500-foot altitude and crashed, killing all five crew members. Mountain waves – the result of wind flowing over mountainous terrain – were identified as the cause of the severe turbulence. The crew's perfunctory VFR weather brief and their lack of understanding and awareness of mountain air turbulence contributed to this tragic accident. Indeed, mountain waves are a significant hazard that demand aircrew knowledge and caution whether you are flying helos, props, or jets.

Mountain waves – also known as lee or gravity waves – are produced when normal windflow is distributed by a mountain or substantial ridge of high ground. Mountain wave airflow patterns (Fig. 1) result in waves flowing for miles downwind of the mountain ridge. Wave lengths may be as long as 30 miles, with the average wave being about 5 miles. While larger mountains produce greater waves, turbulence associated with windflow interruptions can exist from relatively small hills or ridges.

Hazards to aircraft exist due to the extreme turbulence and the severe downdrafts and updrafts associated with mountain waves. The severest area of turbulence is found in the "rotor Zone" (Fig. 1) located beneath the crest of the waves. The magnitude of the vertical currents is dependent on the height of the mountain above surrounding terrain. Large mountains can produce currents with speeds in excess of 5000 fps – obvious hazards to the low flier.

Mountain waves are most likely to be found when the following conditions exist:

- A marked stable airmass (little temperature change with altitude) through some layer of the atmosphere on the windward side of the moun-

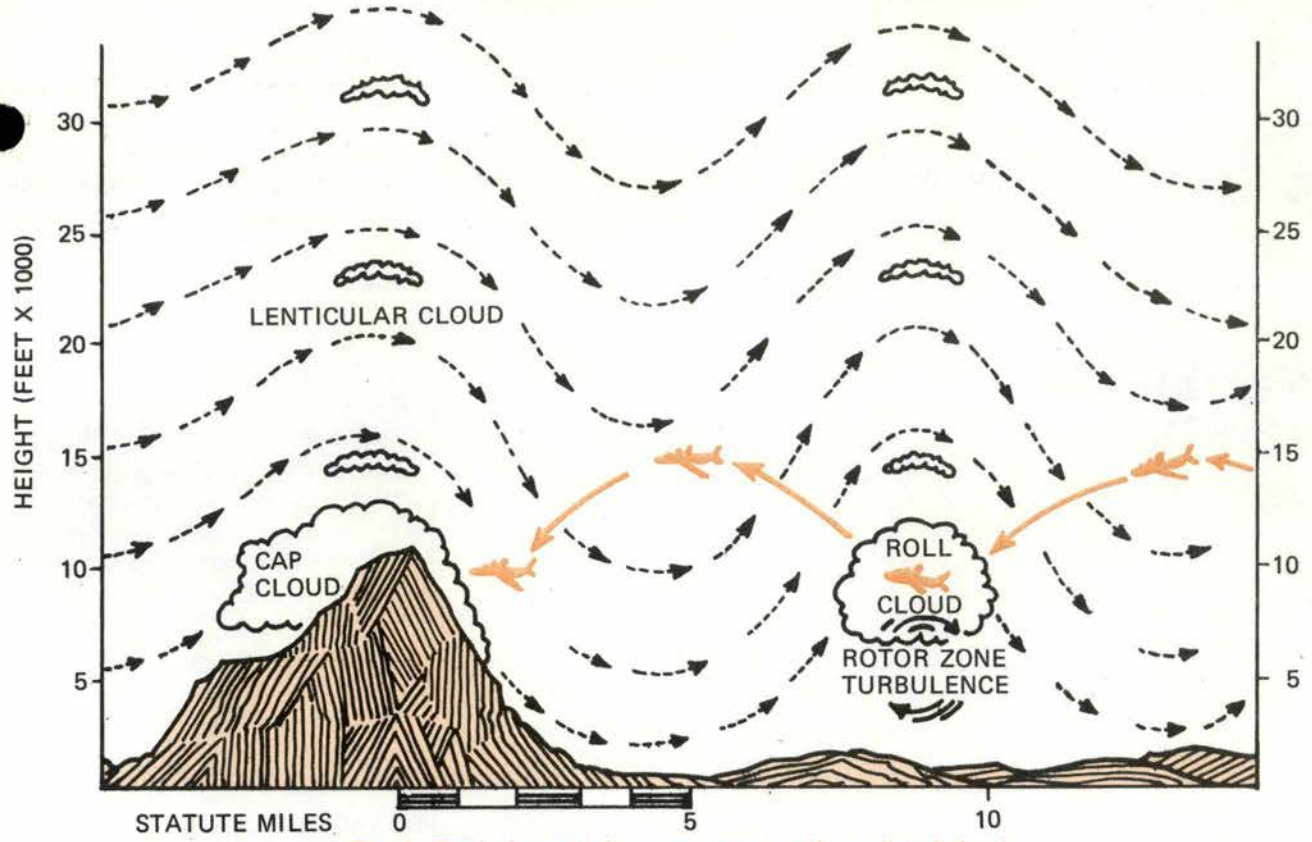


Fig. 1 Typical mountain wave pattern and associated clouds

ain.

- Wind blowing perpendicular to the mountain or ridge, and the direction of the wind remaining mostly constant with height.
- Windspeeds in excess of 20 knots, and windspeed increasing with height.

Although waves are most likely to form in these conditions, they can also be formed in other circumstances.

Lee waves can often be detected by the characteristic lenticular (double convex) clouds which may form in the wave crests (although these characteristic clouds may be obscured by other clouds). Also, mountain and ridge lines where snow or blowing sand and dust are seen rising off the crest give the pilot a clue about the existence of gravity waves. If these conditions are sighted in conjunction with the conditions described (as received in the weather brief), deviation around or over the mountain area is the prudent action.

How high must an aircraft pass to avoid the effect of gravity waves? While turbulence caused by extreme mountain waves can extend into all altitudes that our aircraft use, dangerous turbulence can usually be avoided by clearing the mountains at least half again as high as the AGL height of the mountain. Thus, a 4000-foot mountain located on terrain 2000 feet above sea level should be overflown at a minimum of 8000 feet MSL (4000 x .5 + 6000 MSL = 8000 MSL). This formula is designed to reduce the risk of entering the turbulent rotor zone and will not necessarily give sufficient margin to allow for height loss caused by downdrafts.

The pilot who finds himself inadvertently in a mountain wave situation should take the following action:

- Slow to recommend speed for turbulent air.
- Disengage autopilot altitude hold, if applicable, to avoid the possibility of stalling in a downdraft.
- Fly attitude if turbulence is encountered.
- Alter the route of flight by climbing, not flying parallel to ridge lines, or circumnavigating if feasible.

Mountain waves should never be taken lightly. In addition to the T-39 crash, mountain waves have been identified in the loss of or extensive damage to a number of aircraft. While this type of turbulence is obviously critical to traditional low fliers like helicopters, all aircraft are susceptible.

As with thunderstorms, avoidance of mountain waves is the best flight technique. Understand what conditions produce mountain waves, get a thorough weather brief, and be alert for visual indications of mountain waves. Perhaps the single most easily recognizable clue that mountain turbulence can exist is the presence of strong surface winds (in excess of 20 knots). The stronger the winds, the more likely the turbulence. If mountain waves look likely, circumnavigate or climb over the mountains using the altitude formula. Mountain waves can spell disaster for the uninformed or the unwary. ★

Airport Qualification Program

Following a recent article which mentioned the Airport Qualification Program Slide-Tape series, we were deluged by calls. Here's the most current list we could get. Order them thru your Base Film Library. Questions? Call Major Harry Culler, Chief, Airport Qualification at AAVS, AUTOVON 876-3257.

COMPLETED PROGRAMS

ISD-Q5- 047 Norton AFB
059 March AFB
060 George AFB
ISD-Q6- 346 Barbers Point NAS, HI
348 Beale AFB
353 Cubi Point NAS, PI
354 El Toro MCAS
356 General Lyman, HI
357 Guantanamo Bay, CU
360 Hickman AFB, HI
362 Howard AFB, CZ
363 Fukuoka AB, JA
364 J.F. Kennedy, Bolivia
365 Kaneohe Bay NAS, HI
366 Kirtland AFB
369 Mather AFB
370 McClellan AFB
377 Sandrestrom, Greenland
437 Jan Smuts, UA
441 Dakar, SK
442 Ascension AUX AF, Ascension Island
445 Pudahuel, CI
447 Carrasco, UY
448 Presidente Stroessner, Paraguay
449 Charleston AFB
450 Dover AFB
451 McGuire AFB
452 Travis AFB
453 McChord AFB
454 Hill AFB
455 Pope AFB
456 Dyess AFB
457 Little Rock AFB
458 Andrews AFB
459 Robert Gray AAF
460 Campbell AAF
461 Altus AFB
462 Norfolk NAS
466 Eielson AFB
467 Yokota AB, JA
469 Iwakuni AB, JA
470 Osan AB, KO
471 Kunsan AB, KO
473 Anderson AB, Guam
476 Pago Pago, American Samoa
477 Richmond, AT
479 Christchurch, NZ
597 Buckley ANGB
598 Peterson Field
599 Scott AFB
723 Alameda NAS
819 Bergstrom AFB
ISD-QT- 839 Perth AT
840 Learmonth Aprt, AT
841 Alice Springs, AT
842 Amberly RAAF, AT
843 Ohakea RNAFB, NZ
ISD-Q7- 904 Keesler AFB
905 Kadena AB, JA
906 Taegu AB, KO
910 Wainwright AAF, AK
911 Cape Newenham AFS, AK
912 Cape Romanzof AFS, AK
913 Sparrevohn AFS, AK
914 Indian Mountain AFS, AK
916 Seneca AAF
917 Toncontin Aprt, HO
918 Mariscal Sucre Aprt, EC
960 Tatalina AFS, AK
1309 Kwang-Ju, KO
1311 A-306, KO
1312 Hoengsong, KO
1313 Kimhae Intl, KO
ISD-Q8-1397 Cagayan de Oro, PI
1403 R-407, KO
1404 Kangnung, KO
1405 Cheju, KO
1500 Offutt AFB
1501 Pease AFB

IN PRODUCTION

ISD-Q6- 355 Elmendorf AFB, AK
368 Lajes, Azores
414 Prestwick AB, Scotland
415 Templehof AB, GE
417 Ramstein AB, GE
465 Shemya AFB
ISD-Q7-1056 Adak NS, AK
ISD-Q8-1544 Lakenheath, UK
1549 Los Angeles Int'l
1611 Upper Heyford, UK

PROGRAMS PLANNED FOR FUTURE PRODUCTION

ISD-Q6- 345 Aviano, IT
347 Bardfoss, NO
352 Clark AB, PI
361 Hong Kong
373 Moffett Field NAS
374 Nicosia, CY
375 Ping Tung AB, Taiwan
376 Galeao, BR
379 Tainan, Taiwan
380 Taipei, Taiwan
381 Thule AB, Greenland
411 Torrejon AB, SP
412 Rota NAS, SP
413 Mildenhall AB, England
416 Frankfurt Main, GE
418 Pisa AB, IT
419 Naples NAS, IT
420 Athens, GR
421 Beirut, LE
422 Incirlik AB, TK
423 Dyabikar, TK
424 Trapezon, TK
425 Cigli, TK
426 Samsum, TK
427 Ben Gurion Intl Airport, IS
428 Amman, JO
429 Cairo, EG
430 Daharan, SR
431 Tehran, IR
432 Addis Ababa, ET
433 Asmara, ET
434 Bahrein Island
436 Sigonella, IT
438 Roberts Field, LI
439 Kinshasa, CX
440 Nairobi, KE
443 Jorge Chavez, PE
444 Ezeiza, Argentina
446 Brasilia, BR
463 Goose AB, Labrador
464 Keflavik AB, Iceland
468 Misawa AB, JA
474 Wake Island
475 Johnson Island
ISD-Q7- 915 Cape Lisburn AFS, AK
919 Midway NS, Midway Island
920 Coolidge Aprt, Antigua
959 Galena AFS, AK
961 King Salmon, AK
962 Tin City AFS, AK
1310 R-222, KO
1314 R-404, KO
ISD-Q8-1550 Kelly AFB
1551 Barksdale AFB
ISD-Q9-1634 Nellis AFB ★

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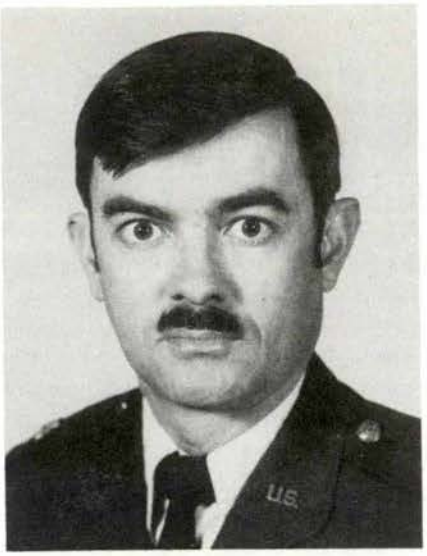
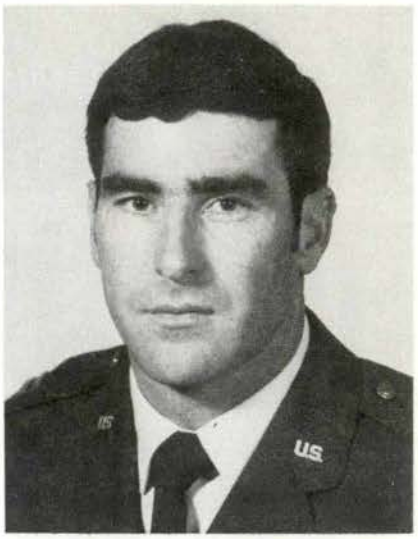


MAJOR
RAYMOND D. FOWLER

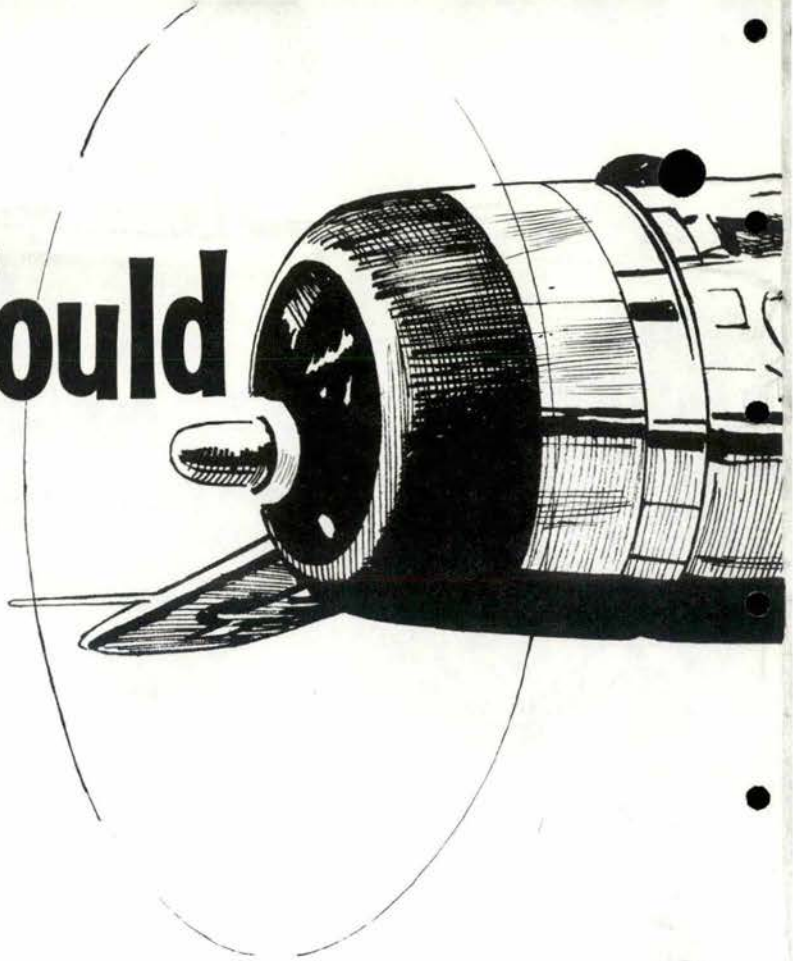


CAPTAIN
DAVID J. McCLOUD

64th Fighter Weapons Squadron
Nellis Air Force Base, Nevada

On 28 March 1978, Major Fowler and Captain McCloud were engaged with four F-15s in a training mission near Eglin AFB, Florida. Major Fowler was on his last mission in the F-5E Aggressor upgrade syllabus. Captain McCloud was the instructor pilot and was flying the lead aircraft. The two pilots were in a left turn, at 20,000 feet and 1.2 mach when the canopy on Major Fowler's aircraft suddenly shattered. Major Fowler was severely injured by flying plexiglass which caused the loss of his right eye and greatly impaired the sight of his left eye due to profuse bleeding and extreme wind blast. He immediately recovered his aircraft, initiated distress calls, gave a position report to his flight lead, and turned to a heading toward base. Captain McCloud who at the time of the occurrence was approximately 1 NM ahead of Major Fowler, effected a rejoin while directing and coordinating emergency recovery procedures with the controlling agencies and the Eglin AFB Command Post. Captain McCloud gave timely and accurate instructions on altitude, attitude, airspeed and heading to effect the safe recovery of his wingman, whose ability to distinguish outside references was severly limited. In spite of severe pain and being in a state of shock, Major Fowler demonstrated exceptional composure and airmanship while simultaneously maintaining aircraft control and responding to information provided by his flight lead. Major Fowler executed a perfect landing, taxied clear of the runway, and completed post landing procedures prior to being helped from the airplane. The superior airmanship and flight coordination of Major Fowler and Captain McCloud, under the most serious conditions, prevented possible loss of life and the loss of a valuable aircraft. WELL DONE! ★

As Luck Would Have It



Lt Col Robert D. Sharp, AFRES (Ret)

Since the event related here, we hope we have become smarter, better disciplined and more professional. We owe a lot to those who in the younger days of aviation learned the hard way. Perhaps by repeating some of their "war stories" we can avoid some of the pitfalls of misguided pilot ego.–Ed.

Numerous stories are told of T-bolts coming home with a couple of jugs missing or a four foot hole in the wing. I'm sure they're all true because the old girl brought me back with no oil pressure and enemy inflicted wounds more than once.

But all flying problems were not enemy initiated.

If you fly enough, you will sooner or later commit the "big one" and whether you live or die could depend to a great extent on how forgiving your aircraft is. Fortunately for me, the P-47 was very forgiving.

One event happened this way. I was returning from a mission in the E. T. O. (European Theatre of Operations) having sustained a slight amount of flak damage. I had become separated from the squadron and returned to the base alone. The weather was not good and it was late in the afternoon, though the rain and darkness was not particularly relevant. Everything else seemed right.

As you remember, competition in the hot-pilot department was fierce amongst fighter jocks and the landing pattern (because of the near-continual audience) was a great place to show your wares. (I recall the day at Harding Field, Louisiana, when the late Major Bong brought in a P-38 and pulled contrails off the wing tips from peel-off to near touchdown. We neophyte pilots had tried all day to get contrails off the 47 to no avail.)

Well, this day in France I crossed the end of the runway on initial approach at 350 mph and 500 ft altitude, preparatory to the grand entrance and my display of excellence, bordering on superiority. I rolled into a near 90 degree left bank, chopped the throttle and honked back on the stick, moved the pitch and mixture controls forward, started the gear and flaps down, opened the engine cowl flaps, ignored the crosswind and waited. All went well until coming around on final approach, when I appeared to be over-shooting the runway to the right. (This due to the left crosswind that I previously ignored.) Still in a near 90

degree bank and determined to land on the first try, I pulled back on the stick harder to try to bend the Jug around and get it lined up with the runway. I continued to violate all the rules of intelligence as I put in some bottom (left) rudder to supposedly help the turn.

From there on nature took over as the aircraft snap-rolled to the left.

Well, I was all over that cockpit with arms and legs making corrective actions. I eased off on the stick, applied opposite rudder and right aileron, and added some power all at the same time, stopping the snap-roll when the Jug was nearly upside down. The airplane then rolled right to a near three-point attitude just as it hit the ground. Luck (or the Creator) took charge as the aircraft hit somewhere around the runway in a not-too-well-controlled crash, heading some 30 degrees to the right of the runway heading.

Immediately, the aircraft was off the side of the runway and on the grass. I hit the brakes and held the stick full back with both hands. The subsequent skid took that airplane across the grass, through a pile of sand and toward a short stack of what looked like railroad ties. That machine went through the lumber like it was paper, with wood flying everywhere. The airplane continued to skid and finally came to rest a few feet from the on-field fire house and fire engine, thereby climaxing the unusual ride. Luckily, the weather and time of day reduced an otherwise appreciative and attentive audience to near zero.

A subsequent hard-landing-and-obstacle-course inspection revealed no aircraft damage resulting from the substandard approach to the parking mat.

I haven't stopped all my stupid acts, but periodically I think of this near wipeout 34 years ago and cringe. I try to blame it on my youth to convince myself that today I'm smarter.

I eventually moved into other aircraft (F-51, F-80, T-33 and F-86) aware that the lessons learned in the P-47 were invaluable. ★

SOME WAYS PILOTS DIE . . .
Stretch the glide!
Tighten the pattern!
I can't wait for better weather, I've got to get home tonight!
We've got plenty of gas!
Close it up. We'll break out in a minute!
Who needs a checklist?

Mail & Miscellaneous

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

GLAD TO HELP!

I am writing this letter to request ten copies of the *Aerospace Safety* magazine for Davison Army Airfield. As the new airfield safety officer, I noted that we were receiving the *TAC* magazine and the *USAF/Naval Safety Journal,* but not *Aerospace.* The unit I just departed received this publication regularly and I found it quite informative. . . .

JAMES T. BLAKE, CPT. MI
Davison U.S. Army Airfield
Fort Belvoir, VA 22060

MINIMUM FUEL, EMERGENCY FUEL, OR EMERGENCY?

Your recent article on Minimum/-Emergency Fuel (p. 26, Sept 1978) highlighted a much abused and often disregarded procedure. There is a definite need for more pilots to become aware of the problems of the air traffic controller when dealing with the low-on-fuel pilot. During my last tour as an ATC Facility Chief I encountered all too often the situation of pride overcoming common sense and sound judgment. There seemed to be the feeling that by declaring Minimum Fuel, or worse, Emergency Fuel, the pilot was admitting to the world he has made a mistake and did not adequately flight plan his fuel requirements or waited too long prior to RTB. Now, this sense of pride and the resulting delay in advising ATC of a critical fuel problem puts the burden on the controller. Without any warning, he has an emergency fuel aircraft on his hands without the luxury of the time to sequence his traffic accordingly. Just because the term "minimum fuel" is related to "normal air traffic services" does not mean that it is of no use to the controller. AFR 60-16 states "use of the term alerts air traffic control that delays or deviations from normal handling may cause a reduction in fuel supply to the point where the aircrew must declare an emergency to obtain priority handling and ensure safe landing." Controllers are like pilots; they don't like surprises. They prefer to plan ahead as much as possible, especially during periods of heavy traffic. Keep them advised.

CLAUDE G. PETTYJOHN,
Capt, USAF
Flight Inspection and Operations Evaluations Pilot
1868th Facility Checking Squadron
APO New York 09057

JUST RELEASED

AFISC, in conjunction with AAVS, has just completed two more safety audiovisual shows of interest to aircrew personnel.

—TS 953, *Little Things Mean A Lot.* This 11½ minute, color 16mm film depicts the many ways Foreign Object Damage is one of our biggest problems in the Air Force today.

—TS 752, *Approach and Landing.* This 15½ minute, slide/tape show is designed to reinforce aircrew understanding of their ability to cope with the principal hazards associated with the approach and landing phase of flight.

You can order these shows through your base film library. Good viewing!

JUDGMENT AND THE FLYING SAFETY PROGRAM

1. This letter is submitted as an attention getter and point to ponder for those who fly and maintain aircraft. Although the particular aircraft involved was a T-38, I believe the lesson learned applies across the board to those tasked to insure the functional integrity of aircraft.

2. The aircraft of interest was scheduled for an FCF following extensive maintenance. During the AFTO 781 review prior to flight, the pilot noted that one of the main wing spars had been identified for six separate and individual cracks. The write-ups were signed off because all the cracks were individually within acceptable TCTO limits and the aircraft was therefore released for flight. The pilot turned down the aircraft on the basis that the cumulative effect of a series of cracks had not been determined. His actions were based on intuition only! As it turned out, he was right, but it took a second look and some head scratching to determine that the structural integrity was indeed compromised by these cracks.

3. I certainly hope that the lesson learned is not perceived incorrectly or construed as an Ops vs Maintenance problem. The point is that within the speciality oriented, multiple sign-off working environment that characterizes the work-a-day Air Force, every individual is an essential member of the safety team. Every situation is not and cannot be covered by TCTO. A helpful questioning attitude is an invaluable tool in identifying new problem areas or something that just "doesn't look right." Neither does it mean that we can resort to "hunch and guess" to maintain and operate the fleet! Intuition tempered by judgment is important and should be encouraged for the betterment of the entire safety program. ★

JOHN R. WITTMEYER,
Captain, USAF
Flight Safety Officer
Armament Development & Test Center
Eglin AFB, FL

PILOTS RATE SAFETY FACTORS

Colonel Norman DeBack, USAFR
Directorate of Aerospace Safety

The real poop on how to fly safely and live to collect retirement.

Recently United Airlines, conducting a study on Flight Safety, asked their retired pilots to respond to a questionnaire of some 29 different aspects related to safety. This is a report, then, by some of the most experienced and least inhibited people that ever have flown.

The relative importance to safety of flight and the average grade on a scale of 10 - 0 was:

Planning ahead	9.32
Everything grooved at the outer marker	9.16
Knowledge of aircraft performance	8.94
Cockpit coordination	8.90
Attitude	8.84
Flying skill IFR	8.82
Adherence to SOP	8.52
Flying skill VFR	8.20
Attention to detail	8.18
Knowledge of airports and facilities	7.40
Knowledge of Meteorology	7.4
Knowledge of aircraft systems	7.02
Knowledge of SOP	6.32

The single most important consideration:

Planning ahead	23%	Attention to detail	3%
Attitude	17%	Total attention	3%
Cockpit coordination	9%	Self-confidence	3%
Flying skill IFR	7%	Know your limitation	3%
Alertness	7%	Take nothing for granted	3%
Professionalism	6%	Fatigue	2%
Judgment	5%	Adherence to SOP	2%
Flying skill VFR	5%		
Knowledge of aircraft performance	4%		

Human frailties that caused the most exposure to accident:

Complacency	52%
Distraction	32%
Illusion	7%
Fatigue	7%
Anger	4%
Ego	2%

Also listed were:

- Failed to plan ahead
- Over-confidence
- Boredom
- Carelessness
- Disorganized cockpit
- Failed to work as a team

Planning ahead received the highest grade and also leads as the most important single factor. Attitude, cockpit coordination, and flying skill IFR were also rated high on both lists. Like patriotism and motherhood, these are easy to agree with and are certainly viable today.

As for the negatives – the human frailties that caused exposure to an accident – *complacency* was listed by over one-half and *distraction* by one-third of those responding. It is interesting to wonder how *complacency* could have been a problem in the uncomfortable, unsophisticated airplanes of the past, but it was listed by many who did not fly jets.

Colonel DeBack is a pilot for United Airlines and a member of the AFRES assigned to AFISC. ★

☆U.S. Government Printing Office: 1979—683-011/3

WIND CHILL CHART

A1-1

WIND SPEED		COOLING POWER OF WIND EXPRESSED AS "EQUIVALENT CHILL TEMPERATURE"																				
KNOTS	MPH	TEMPERATURE (°F)																				
CALM	CALM	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60
		EQUIVALENT CHILL TEMPERATURE																				
3 - 6	5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-65	-70
7 - 10	10	30	20	15	10	5	0	-10	-15	-20	-25	-35	-40	-45	-50	-60	-65	-70	-75	-80	-90	-95
11 - 15	15	25	15	10	0	-5	-10	-20	-25	-30	-40	-45	-50	-60	-65	-70	-80	-85	-90	-100	-105	-110
16 - 19	20	20	10	5	0	-10	-15	-25	-30	-35	-45	-50	-60	-65	-75	-80	-85	-95	-100	-110	-115	-120
20 - 23	25	15	10	0	-5	-15	-20	-30	-35	-45	-50	-60	-65	-75	-80	-90	-95	-105	-110	-120	-125	-135
24 - 28	30	10	5	0	-10	-20	-25	-30	-40	-50	-55	-65	-70	-80	-85	-95	-100	-110	-115	-125	-130	-140
29 - 32	35	10	5	-5	-10	-20	-30	-35	-40	-50	-60	-65	-75	-80	-90	-100	-105	-115	-120	-130	-135	-145
33 - 36	40	10	0	-5	-15	-20	-30	-35	-45	-55	-60	-70	-75	-85	-95	-100	-110	-115	-125	-130	-140	-150

WINDS ABOVE 40 HAVE LITTLE ADDITIONAL EFFECT	LITTLE DANGER	INCREASING DANGER (Flesh may freeze within 1 min.)	GREAT DANGER (Flesh may freeze within 30 seconds)

DANGER OF FREEZING EXPOSED FLESH FOR PROPERLY CLOTHED PERSONS

INSTRUCTIONS

MEASURE LOCAL TEMPERATURE AND WIND SPEED IF POSSIBLE: IF NOT, ESTIMATE. LOCATE DEGREE OF TEMPERATURE ALONG TOP WHICH IS NEAREST TO ACTUAL TEMPERATURE, AND LOCATE APPROXIMATE WIND SPEED IN LEFT COLUMN. INTERSECTION OF THESE TWO LINES GIVES APPROXIMATE EQUIVALENT CHILL TEMPERATURE, THAT IS, THE TEMPERATURE THAT WOULD CAUSE THE SAME RATE OF COOLING UNDER CALM CONDITIONS.

NOTES

WIND

1. THIS TABLE WAS CONSTRUCTED USING MILES PER HOUR (MPH); HOWEVER, A SCALE GIVING THE EQUIVALENT RANGE IN KNOTS HAS BEEN INCLUDED ON THE CHART TO FACILITATE ITS USE WITH EITHER UNIT.
2. WIND MAY BE CALM BUT FREEZING DANGER GREAT IF PERSON IS EXPOSED IN MOVING VEHICLE, UNDER HELICOPTER ROTORS, IN PROPELLOR BLAST, ETC. IT IS THE RATE OF RELATIVE AIR MOVEMENT THAT COUNTS AND THE COOLING EFFECT IS THE SAME WHETHER YOU ARE MOVING THROUGH THE AIR OR IT IS BLOWING PAST YOU.
3. EFFECT OF WIND WILL BE LESS IF PERSON HAS EVEN SLIGHT PROTECTION FOR EXPOSED PARTS – LIGHT GLOVES ON HANDS, PARKA HOOD SHIELDING FACE, ETC.

ACTIVITY DANGER IS LESS IF SUBJECT IS ACTIVE. A MAN PRODUCES ABOUT 100 WATTS (341 BTU_s) OF HEAT STANDING STILL BUT UP TO 1000 WATTS (3413 BTU_s) IN VIGOROUS ACTIVITY LIKE CROSS-COUNTRY SKIING.

PROPER USE OF CLOTHING and **ADEQUATE DIET** are both important.

COMMON SENSE THERE IS NO SUBSTITUTE FOR IT. THE TABLE SERVES ONLY AS A GUIDE TO THE COOLING EFFECT OF THE WIND ON BARE FLESH WHEN THE PERSON IS FIRST EXPOSED. GENERAL BODY COOLING AND MANY OTHER FACTORS AFFECT THE RISK OF FREEZING INJURY.

This chart is adapted from AFP 161-11