flying

SAFETY JULY 1982

Who's The Enemy?

See page eight

THERE I WAS

■ . . . in the overcast layer with an airplane full of passengers. It was a joint use airfield with a civilian operation on one side and a military operation on the other. The weather was about 800 overcast and five miles visibility. Although it was a strange field to us, we were not overly concerned because we were an experienced crew and the weather was not bad. The approach controller vectored us in for the ILS to the left runway. We had the approach plates out and had briefed all of the applicable items. We rechecked the course and frequency and caught the localizer as it came across. Everything looked good as we intercepted the glide slope and started down — until we broke out of the overcast.

We were lined up on the right runway. There were no problems getting lined up with the left runway and getting everyone safely on the ground, but we mumbled a lot about the stupid approach that lined us up on the wrong runway.

After we parked, and before we wrote up the localizer, we discovered that this airfield had an ILS for each runway and we had tuned, identified, and monitored the wrong frequency. None of us had ever flown into an airfield with parallel IFR runways. Fortunately for us the traffic was staggered, and the weather was bad enough to prohibit VFR traffic but still good enough to allow us to make a safe transition from the right to the left runway. ■

Don't let it happen to you! Thanks to the author for sharing. Could save an aircraft, a life, or many lives!

Brig Gen Leland K. Lu[illegible]
Director of Aerospace Safety

UNITED STATES AIR FORCE **flying** SAFETY MAGAZINE

AIR FORCE RECURRING PUBLICATION 127-2 JULY 1982 VOLUME 38 NUMBER 7

AFRP 127-2
Entered as a publication at the Second-Class rate (USPS No. 586-410) at San Bernardino Postal Service, 1331 South E Street, San Bernardino, CA 92403

page 2

page 5

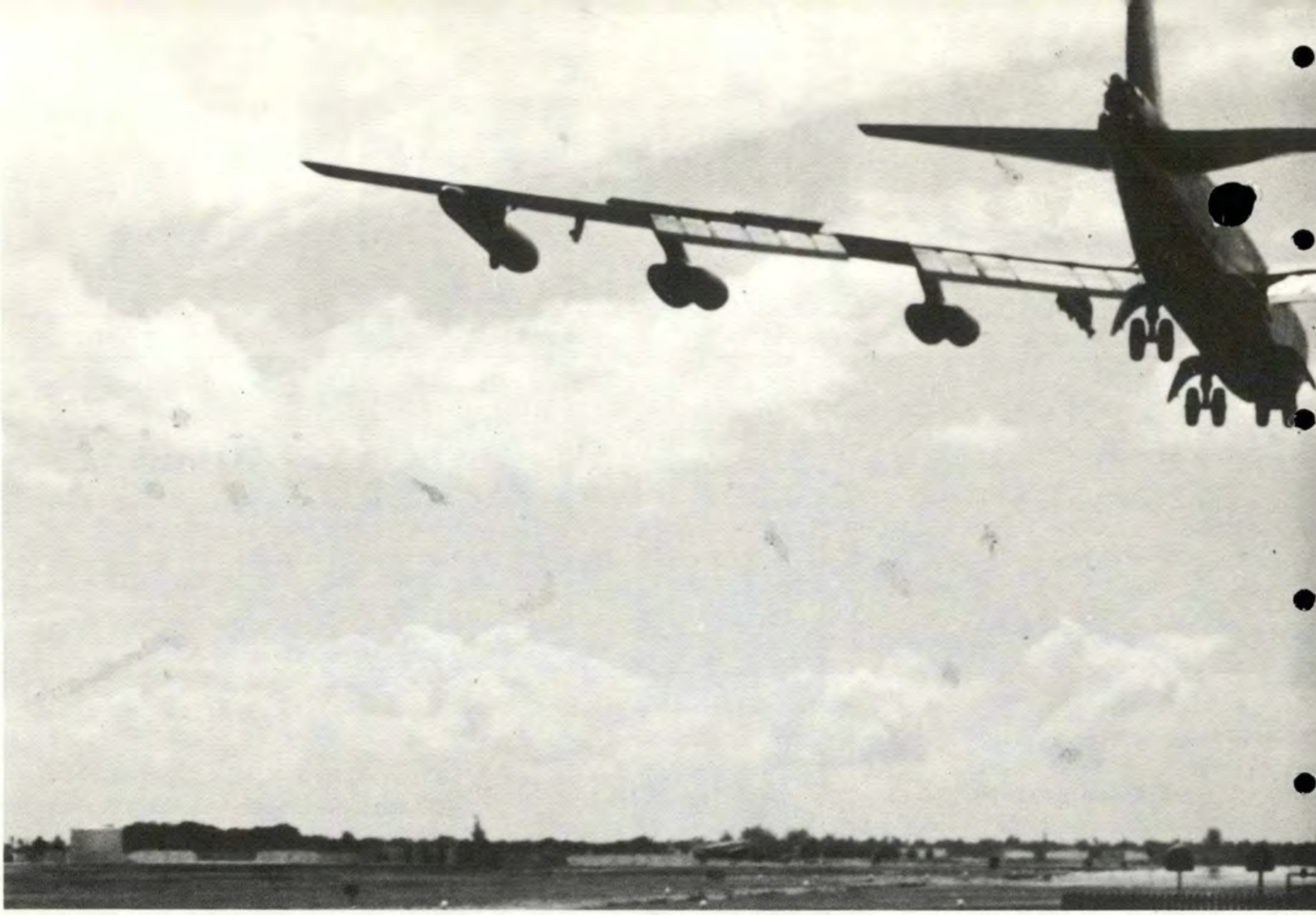
page 8

SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE INSPECTOR GENERAL, USAF

SUBSCRIPTION — FLYING SAFETY is published monthly to promote aircraft mishap prevention. It is available on subscription for $21.00 per year domestic; $26.25 foreign; $2.50 per copy, domestic; $3.15 per copy, foreign, through the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Changes in subscription mailings should be sent to the above address. No back copies of the magazine can be furnished. Use of funds for printing the publication has been approved by Headquarters, United States Air Force, Department of Defense, Washington, D.C. Facts, testimony and conclusions of aircraft mishaps printed herein may not be construed as incriminating under Article 31 of the Uniform Code of Military Justice. All names used in accident stories are fictitious. No payments can be made for manuscripts submitted for publication in the FLYING SAFETY Magazine. Contributions are welcome as are comments and criticism. Address all correspondence and, Postmaster: send address changes to Editor, FLYING SAFETY magazine, Air Force Inspection and Safety Center, Norton Air Force Base, California 92409. The Editor reserves the right to make any editorial change in manuscripts which he believes will improve the material without altering the intended meaning. Air Force organizations may reprint articles from FLYING SAFETY without further authorization. Prior to reprinting by non-Air Force organizations, it is requested that the Editor be queried, advising the intended use of material. Such action will ensure complete accuracy of material amended in light of most recent developments. The contents of this magazine are non-directive and should not be construed as regulations, technical orders or directives unless so stated. Authority to publish this periodical automatically expires on 30 Oct 1982, unless its continuance is authorized by the approving authority prior to that date. Distribution: 1 copy for every 3.0 aircrew and aircrew support personnel.



KEEP YOUR NOSE IN THE DIRT

CAPTAIN MARK R. HUSSEY • 23d Bombardment Squadron, Minot AFB, ND

■ "You're on the 'GO' segment of a touch and go and you lose one or two outboard engines. The aircraft begins to yaw to the right. What are you going to do?"

My IP looked at me and the other copilot on the crew like he already knew what we would say, so I gave the question some extra thought. Since I was straight out of UPT, my first response would normally be to "zoom and boom," that is, climb for as much altitude as possible and punch out. I somehow got the feeling, though, that this was not the answer he was looking for.

He said, "If you're thinking 'plug in full burner and eject' you're wrong, dead wrong, for two reasons. First, in case you haven't noticed, the BUFF doesn't have afterburners. Second, in this airplane the one thing that will save your life is airspeed. If you try to jerk this beast into the air before you've got flying airspeed, as soon

as you get out of ground effect you'll be in 90° of bank and 20° nose low until you impact."

"Okay, I'll buy that," I said. Since I worked as an aero-engineer for two years before going to UPT, the analysis seemed valid to me.

"When you find yourself low and slow, keep your nose in the dirt," the IP said. I was imagining some rather graphic depictions of this when I was snapped back to reality by the rest of his explanation.

"You've got to keep the nose down to allow the aircraft to accelerate to a speed where the control surfaces become effective. This is called minimum directional control speed."

I decided to remember this lesson — having a keen interest in filing away those things that may someday save my life. What I didn't realize was how soon that someday would be.

"Did anyone else hear that grinding noise during flap retraction?" The IPs question seemed rather obscure since this was only my fourth sortie in the B-52. There were lots of strange noises to me, so I really didn't know which noise he was talking about, and the aircraft was flying normally. Apparently the IP was concerned, however, because as we stabilized in the pre-contact position behind the tanker he asked the boomer to look us over.

"Looks OK from up here," was the boomer's response, so the crew let the matter go as just some more groanings from an old airplane. We completed the entire low level route and headed back to the pattern for some transition work. Since the aircraft was handling fine, we didn't give the noise a second thought. I flew the penetration down to a touch and go, noticing that quite a bit of left control was necessary. On downwind, I thought about saying something, but remembering stories about how you can always tell a copilot takeoff or landing because of the right wing low attitude, I wrote it off.

During my second touch and go the left spoiler required was even greater than the first time, so on downwind I finally spoke up.

"Sure had to keep pushing the left wing down on that last one."

"Check your fuel balance," the IP said.

Since the externals were empty, I checked the outboard wing tanks.

"Five hundred pound imbalance between outboards, but that's no big deal," I said.

"Okay, let me try one," was his response.

"Way to go," I thought. "Now he's going to show you how much you don't know about flying the BUFF."

After touching down, the IP brought the airbrakes to position

continued

KEEP YOUR NOSE IN THE **DIRT**

continued

six, I reset the takeoff trim, he took the airbrakes off and brought in a little power to spool the engines up evenly.

"Power's good," I said, as he began advancing the power to the thrust gate.

I was just beginning to think about how badly I'd just been shown up when we began to veer toward the right side of the runway. Both the IP and I had the same thought at the same time, so after checking the engines again I called "power's good" twice more. However, with full left rudder and full left control wheel we continued off the right side of the runway into the dirt. Being simultaneously low on airspeed and ideas I did exactly what I felt I should do. I guarded the controls in case the IP got tired and needed help and kept my mouth shut.

Seeing the ILS shack for the opposite runway coming up I began to think about how much firewood it would make when we hit it. Then I noticed the drainage ditch ahead coming up fast. I was thinking about how we'd probably lose the front gear when the IP pulled back on the yoke and we were flying — just barely. As we continued to climb, the tower asked if we needed any assistance. We performed a quick controllability check, requested a full stop landing, and made a normal airbrakes four approach.

When we got back to the ramp we realized we had hot brakes, so we quickly shut down and got out eliminating our normal post-flight walkaround. On the bus ride back to Base Ops the radar navigator kept saying, "I couldn't see what was going on after we left the runway . . . the grass kept getting in front of the steerable TV (STV) camera."

An inspection of the aircraft, coupled with an analysis of the tracks on the runway and in the grass, pieced together the series of events that almost led to a rather large hole alongside the runway.

The grinding noise on takeoff was not imagined nor was it the complaining of a tired, old bird. Unknown to us, the actuator rod to the right inboard spoiler group had apparently broken on takeoff, and the grinding noise we heard was the lower portion of the rod being driven into the flap during retraction. The upper portion of the rod, being able to swing freely, had caused no problem until the IPs touch and go. By the time he flew his pattern, our gross weight was low enough so that the slower touchdown speed allowed the upper portion of the rod to swing out when the airbrakes were put to position six and become jammed in the top of the wing when the airbrakes were taken off.

We also had a dragging brake on the left forward gear which decreased the speed below which we would normally have begun the takeoff portion of the touch and go. This lower speed put us below rudder effectiveness speed but above spoiler effectiveness speed. In short, the rudder couldn't help us control direction and the effect of full left wheel input coupled with the stuck right spoiler group had the same effect as having full airbrakes deployed.

This situation would have been bad enough by itself, but added to this was a 3,000 pound fuel imbalance unknown to us due to a faulty right wing fuel probe. The extra fuel in the right wing was almost "the straw that broke the camel's back." Neither the IP nor I recall him pushing throttles 7 and 8 through the thrust gate, but evidence exists that by doing so he arrested the right yaw and provided the additional thrust to get us airborne. Although at the time it appeared the IP jerked back on the yoke to avoid the drainage ditch, at that moment we had obtained sufficient airspeed to become airborne. The tracks in the grass off the side of the runway show that we traveled for some distance in the dirt and then became slightly airborne, breaking the grass off three inches above the ground. By keeping the "nose in the dirt" after becoming airborne, the aircraft was able to use the decreased drag of ground effect to accelerate and obtain sufficient airspeed.

Later in the training program we were scheduled to fly that same aircraft again. While reviewing the 781 on the bus, the crew chief was wearing a rather sly grin. Upon completing the review, the IP asked if there were any questions. The crew chief spoke up and said, "Sir, we just washed the aircraft. Do you think you can keep it out of the grass?" Through the laughter I heard the IP say, "I'll try, chief. I'll certainly try." ■

WHEN YOU'RE HOT YOU'RE HOT ???

MAJOR GARY L. STUDDARD
Directorate of Aerospace Safety

■ The time of year is here when the thermometer starts to climb and our thoughts shift to sandy beaches, the surf, and bikini watching. It's also the time of the year when flight suits rapidly take on the "goat skin" smell and salt rings run from the armpits to the knees. For the next few months, because of the heat, many aspects of flying will become uncomfortable and sticky.

Everyone has felt the extra

continued

WHEN YOU'RE HOT, YOU'RE HOT ???

continued

requirements hot weather imposes on the ol' bod. So, if you start noticing some impairment of efficiency of your thought processes — nausea, weakness, light-headedness, headaches, or rapid onset of fatigue, the diagnosis could very well be heat stress. Conversely, heat stress may cause a slight increase in irritability and diminish a pilot's insight, creating a tendency to overreact and make more mistakes. Heat also increases susceptibility to motion sickness, hypoxia and G. Those that have less G tolerance tend to be affected more.

Operation of aircraft in hot climates can impose significant heat strain on aircrew members. Briefly, dehydration and mental impairment are the main dangers. Research has shown that effective human performance is impaired above 100° F, a condition which is easily exceeded during the summer months, especially while holding in the Number 1 position with the canopies down. Due to the greenhouse effect, temperature inside the cockpit may reach 140° F. So much heat can be stored as to take 20 minutes or more to recover. While waiting to take off on hot days, leave the canopy open as long as possible.

These same studies also repeatedly demonstrate wide individual differences in maximum heat tolerances even in homogeneous groups of young men under experimental conditions. There are many human variables affecting a person's tolerance to heat, including age, physical condition, alcohol/coffee intake (the less the better), sex (women generally tend to be less heat-tolerant than men), clothing (the green bag, helmet, G-suit, boots, gloves, oxygen mask, and parachute don't do much for the heat exchange variables), sweat rate, and degree of hot weather acclimatization. Therefore, there is no all-encompassing index which is universally applicable to determining heat exposure in the work environment.

But in 1978, the Fighter Index of Thermal Stress (FITS) was developed at the USAF School of Aerospace Medicine to address one segment of the problem. The index was developed to provide a realistic guideline for insuring safe fighter operation in hot weather. The assumptions involved in developing the FITS limit its use to an individual wearing a lightweight flight suit in a fighter-type aircraft with a bubble canopy. The index is not valid for determining exposure limits for maintenance crews, or for crews flying large multiengine aircraft because the radiant heat loads are different. Nevertheless, the FITS chart may still provide some food for thought for larger type aircraft aircrews.

Here are a few thoughts and recommended actions to help aircrews understand and cope with the heat conditions which could affect them.

- Generally, the majority of heat stress occurs during preflight, engine start, taxiout, and pre-take off.

The heat load experienced by the aircrew in the cockpit is more severe than on the ramp because of reduced air circulation, personnel equipment, and the aircraft's equipment heating — not to mention taxiing in the exhaust area of your leader.

- Ground exposure heat loads followed by a prolonged low level mission, where no high altitude cooling off period exists, should be closely monitored.
- Sweat evaporation is the major heat dissipation mechanism and rapidly depletes body fluid reserves. Don't be fooled that you are being effectively cooled because a lot of H_2O is dripping off the body. This is useless as a heat loss mechanism; the sweat must evaporate to be effective.
- Try to drink more liquids than thirst dictates. Fluid intake is vital to sweat secretion, and an average person requires 2 to 3 quarts of fluid per day even without hot weather. Middle East countries require their aircrews to drink three plus gallons of water a day to avoid the effects of heat stress, and failure to do so is considered a serious offense. Water-diluted fruit juices and iced tea are recommended over carbonated drinks.
- A person who is acclimatized to the heat, which takes about 90 minutes of hard work in the heat daily for 12 to 14 days, only needs about 3 grams of salt per day. The average American diet has over 2 grams per day. Eating a normal diet is better than taking salt tablets, which should never be taken directly, anyway. The preferred method is mixing 1 quart water with

FIGHTER INDEX OF THERMAL STRESS (FITS) °F FOR LIGHTWEIGHT-FLIGHT SUIT

Instructions: Enter chart with local air temperature (°F) and relative humidity (%). At intersection read FITS value and determine Zone.

Air Temp (°F)	Zone	Relative Humidity (%) 10	20	30	40	50	60	70	80
70		67	70	72	74	76	78	81	83
75		71	74	77	79	82	84	86	88
80		75	79	81	84	87	89	92	94
85	Normal	79	83	86	89	92	95	97	99
90		83	87	91	94	97	100	103	105
95		87	92	96	99	102	105	108	111
100		91	96	100	104	108	111	114	117*
105	Caution[2]	95	100	105	109	113	116*	120*	122*
110		99	105	110	114	118*	122*	125*	128*
115	Danger[3]	103	109	115	119*	124*	127*	130*	134*
120		107	114	119*	124*	129*	133*	136*	140*

Comments:

1. Chart is valid for clear sky to light overcast (shadows visible).
2. **Caution Zone:**
   a. Be aware of heat stress.
   b. Limit ground time (preflight, cockpit standby) to 90 min.
   c. Recovery time minimum 2 hours between flights.
3. **Danger Zone:**
   a. Limit ground time to 45 min. or less if possible.
   b. Avoid more than one flight a day if possible.
   c. Low-level mission with temperatures in this zone are not advised.
   d. Recovery time as above.
4. *When index is greater than 115, consider cancelling all nonessential flights.

NOTE: FITS was designed to provide supervisors a guide to predict when fighter type cockpit environmental conditions during low level missions may jeopardize aircrew performance.

(FITS developed at USAFSAM by Stribley and Nunnely, 1978.)

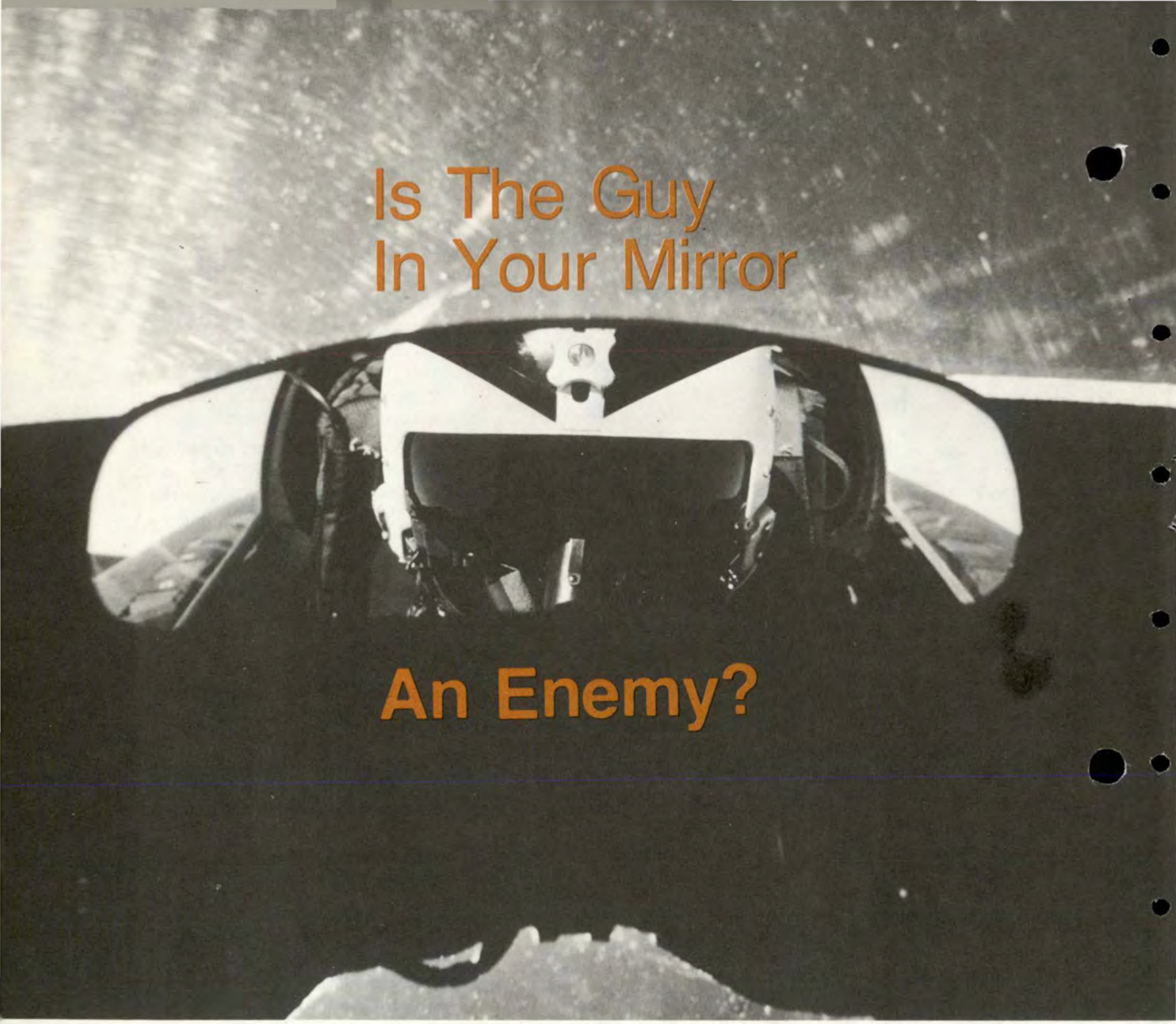
two 10-grain tablets (one-fourth teaspoon). Avoid salt in any form without plenty of water.

■ Avoid unnecessary exposure to heat outdoors prior to flights; avoid exercise programs until after the last flight of the day. The body's slow dissipation of stored excess heat could work against you if you go straight to a light briefing following a strenuous game of handball.

■ The only cure for heat stress is to remove the individual from the source and replace the water loss. Significant time will be required to alleviate the problem. If airborne, the recommended procedures are climbing, slowing down, going on 100 percent, and emergency oxygen, selecting ram air, and landing as soon as possible.

Admittedly, heat stress is not one of the more interesting subjects. However, it can become an extremely hazardous problem in all aircraft operations — especially in fighter-type aircraft. Awareness is the key to prevention. When the temperatures soar, even a minimum time preflight and climbout can constitute a significant drain on physiological reserves which can compromise performance in the later, more demanding, phases of flight. The consequences of a possible error by an aircrew member makes it essential that personal efficiency and alertness not be compromised. Give the various effects of high temperatures some thought during your mission planning and briefings just to ensure no one loses his cool. ■

Is The Guy In Your Mirror An Enemy?



MAJOR TERRELL J. OSBORN
Directorate of Aerospace Safety

■ The F-4E crew was on a live missile firing mission against a PQM-102 target drone. They were leading a flight of two which had not previously achieved a "kill" shot. If they were to get a kill, it would be on this mission. Things started off slowly. Lead's first attack didn't work out, then Number 2 had problems getting to firing position. Meanwhile, Lead's repositioning maneuver took him outside visual range of the other aircraft. Well, it was Lead's turn again, and they reentered the fight, sighted another aircraft and attacked. It was now or never, and it was going to be easy.

The target went into a climbing turn, affording an easy shot for the AIM-9P against blue sky. Lead slid into firing position, got the tone and launched his sidewinder. It was beautiful — a direct hit. Then, as the target began a flaming, spiral down, the horrible realization came. It was his wingman. He had shot down Number 2. How could he have done such a thing?

The human factors folks call it an excessive motivation to succeed. It

is a state of mind where the feat becomes so important that other important stimuli and responsibilities become short-changed. We could not begin to discuss all of the rules of engagement which were violated in achieving this unfortunate kill. We can sit and wonder about the violations, how a pilot could mistake an F-4 for a Deuce, and how a repositioning maneuver could be mistaken for a downward turn in the opposite direction.

Well, it is surprisingly easy to make such mistakes. All you have to do is want something very much, get fixated on one particular object, and stop considering other important information. Human beings (all of us) have the potential to become overmotivated. It is a self-imposed psychological stress every bit as strong as that imposed by supervisors or peers, and it can be just as deadly.

Another F-4E pilot, this time a much less experienced wingman, was on a basic fighter maneuvers mission against his flight commander. The "Old Head" decided he was going to show the new guy how good he (the flight lead) was. The wingman had never been pressed this hard before, and he soon became tasked far beyond his capabilities. Surely, the flight lead was at fault when the wingman went out of control and crashed. He was more interested in his own kill than in "bringing the youngster along." Well, he proved his point. But the new guy also had a choice.

He tried to do things he hadn't done before and exceeded his own capabilities (as well as violating the rules of engagement). An excessive motivation to perform well led to attention fixation and a failure to attend to aircraft control. The stress he placed on himself was every bit as strong as the pressure he felt from his flight commander. It is this type of intense personal pressure that we see again and again in our mishaps. We may not be our own worst enemies, but we certainly are in the running. Here are some similar occurrences.

- An F-15 aerial demonstration pilot had completed his training program and was performing in his first air show. At the completion of the mission, he attempted to fly a landing pattern with about half of the required turning room. He wanted to give the folks a good show, and a tight pattern seemed to be appropriate. Even when it began to look bad, he refused to take it around. The folks got a good show all right. The aircraft crashed beside the runway. Score: Ego 1, Pilot 0.

- Two highly experienced IPs were in the same F-4 on a basic fighter maneuvers mission. It should have been an easy mission, but they inadvertently entered an undercast. This should have been no big problem; just get on the gauges and climb. Unfortunately, one error led to another, and the crewmembers found themselves out of altitude, airspeed, and ideas below the clouds in hilly terrain. Still, they could have salvaged the situation by using good judgment and making an instrument climb. Instead, pride and the realization of these basic errors had a "snowballing" effect, and stress built until their judgment became clouded. They tried to maneuver through the hills until they ran into rising terrain. We must wonder how

continued

Is The Guy
In Your Mirror
AN ENEMY
continued

these experienced and capable pilots could end their lives with such a series of basic errors.

■ A highly experienced RF-4C crew was involved in a "Flag" exercise. The pilot was known to be aggressive and very capable, and he had been indoctrinated on how effective the surface defenses were. He was determined not to be "shot down." During the mission, the crew received indications of a reaction from ground defenses, and the pilot's excessive motivation to succeed got the best of him. He tried an inappropriate max performance maneuver at very low altitude and lost control. The aircraft and both men were lost. The ground forces and their imaginary bullets weren't nearly as formidable an enemy as the pilot's self-imposed pressure on himself. To quote Pogo, "We have met the enemy, and he is us."

The pressure we, as aircrews, can impose on ourselves is not only manifest in exceeding our capabilities. Sometimes it shows up as very bad judgment. An F-4 crew was involved in a local surge exercise, and they were on their third sortie of the day. They had encountered an external fuel transfer problem on the previous sortie. Had the problem been reported, the aircraft would have been grounded and repaired.

We will never know what rationale the crew used to justify in their own mind taking a nonoperational aircraft on a training mission. But take it, they did, on a mission to be flown at 100 feet AGL. During a high G turn at low altitude the aircraft hit the ground. The crewmembers were killed. Asymmetric loading from the transfer problem may have been a factor.

In a similar mishap, an F-4G crew was on a "Flag" exercise. During air refueling, their centerline tank would not accept fuel, so they were short on fuel heading into the exercise area. But instead of aborting, they slowed down to conserve fuel. They flew at a speed which afforded little margin for error and was tactically unsound. They got dangerously low and slow, and the aircraft lacked the energy needed to clear a hill. Poor judgment compounded a minor aircraft problem into a situation which exceeded their capabilities, and the aircraft and crew were lost.

Just as a crew may have an inappropriate motivation to fly faulty aircraft, we also see examples of crewmembers who fly when they aren't physically or emotionally airworthy. Each year fatigue and psychological stress are involved in a number of mishaps. It is unfortunate that crews all too often believe they can abuse themselves, yet fly unaffected. They can kid themselves, but fate won't be so easily fooled.

An example of such an inflated confidence to handle a physical problem is found in the circumstances of an 0-2 mishap. The pilot had earlier experienced some problems with dizziness and fainting. The problems subsided, and he was medically cleared to fly. He subsequently experienced similar problems in flight, however, he did not report the problem to the flight surgeon. He continued to fly, eventually losing control and

crashing. Investigators were unable to determine why this fatal mishap occurred, but the circumstances suggested that the pilot had become incapacitated. His compulsion to fly with a serious physiological problem was a fatal overmotivation.

We don't want to be left with the idea that the motivation to "press on" in spite of one's limitations exists only in the crews of tactical aircraft. A C-130 crew had been involved in a series of consecutive TDYs, exercises, and a unit PCS move — activities which contributed to high levels of fatigue. The pilot added to his fatigue by violating crew rest requirements. The aircraft was on a routine night low level nav mission, when an abnormal shallow descent began. No member of the crew noticed the descent. The entire crew let the descent continue until recovery was not possible. The errors cost them their lives.

In another C-130 mishap, a crew was scheduled for a very demanding night exercise mission for which they were not proficient. They made a series of planning and procedural errors and attempted a recovery under conditions which exceeded their capabilities. As we discussed in some previous examples, supervisors had placed them in this predicament, but the crewmembers could have said "enough is enough" and taken steps to reduce the risk. However, they felt the pressure to "press on," ignoring the signals that things were not right. The impact with the ground took them all by surprise.

Similar personal pressures have led to rotary wing mishaps. An H-53 crew was scheduled for a low altitude air refueling demonstration for an air base open house. The first attempt at a contact was unsuccessful, and the aircraft were getting closer and closer to the viewing area. The tanker's drogue was oscillating, making the contact more difficult than usual. The pilot rushed the contact and overcontrolled the aircraft. The result was an abrupt rotor blade flex, and the blades hit the refueling probe and the top of the cabin. Fortunately, the crew was able to make an emergency landing in a field.

Another H-53 crew was not so fortunate. The IP was known as an aggressive pilot, and he decided to demonstrate for his student the proper response to an enemy aircraft attack. The aircraft was at an altitude of 60 feet AGL over hilly terrain when the IP made an aggressive descending turn — without first checking where he was going. His demonstration of the "best" way to fly in simulated combat took them straight into a hill. All six members of the crew died.

continued

Is The Guy
In Your Mirror

AN ENEMY

continued

A final example of a pilot's trying too hard to do a good job concerns an A-7 pilot who was practicing for a bombing competition. While in the bombing pattern, he became engrossed in retrieving information from the bombing computer in order to perfect his scores. He failed to check the aircraft attitude for much too long — probably 10 seconds or more. The aircraft entered a diving turn from which recovery was impossible. We must wonder why a highly experienced pilot would make such a basic error as to forget to fly the aircraft. He put the pressure on himself to excel and then forgot the basics. Such is the nature of personal psychological stress.

Two additional mishaps show a slightly different side of the personal stress coin:

■ A T-37 UPT student was known to his IPs as a model student, but his peers knew him as considerably more daring and adventuresome. No one knows for sure what he was doing on his last solo flight, but he was known by his friends to be fond of an unofficial aerobatic maneuver he had learned on his own. He had very likely performed this unauthorized maneuver on previous occasions. Unknown to supervisors, he played by his own rules and set his own standards. The day of the mishap he pressed his own limits too far and lost control of the aircraft. He ejected too low and was fatally injured.

■ An 0-2 pilot had a vivid history of misbehavior in the air and on the ground. His supervisors knew him as being on the fringe (and occasionally outside the boundary) of discipline, and some of his peers knew him as reckless and dangerous. Unfortunately, many of his episodes of violations of directives were not known to supervisors. The pilot would follow only those rules which suited him. Unfortunately, the rules he ignored included minimum altitudes, crew rest, nourishment, and flight planning. The end came quickly when he flew into power lines at an altitude of 34 feet AGL. He had convinced himself that he was too good to kill himself. Is anyone that good?

The last example of a pilot's succumbing to intense personal stress is a classic. A young A-10 pilot had yearned for quite a while to get the opportunity to fly over his parents' home. He had previously not been known as a risk-taker or a discipline problem, but the desire to give his parents a show had grown until it virtually became an obsession. When he finally found himself in a situation where he could fly to the vicinity of their home, his customary behavior pattern changed.

To the surprise of those who knew him, he willfully violated altitude and maneuvering guidelines and attempted maneuvers which exceeded the capabilities of himself and the aircraft. His desire to give a "good show" completely clouded his judgment of his abilities and the purpose of the rules he was willfully violating. He started performing aggressive maneuvers at a very low altitude and lost control at an altitude too low for ejection. Those who knew the pilot were amazed at his change in behavior. No one realized the intensity of his desire to "show his stuff." Such is the sometimes subtle side of personal psychological stress.

As can be seen from this collection of mishaps, there is no neat, predictable pattern to the phenomenon of self-imposed stress. Some of the crews had been strong performers, and some were mediocre. Some were highly experienced, and others were inexperienced. Although the survey does not use a scientific sample and the variables are complex, we can allow ourselves to draw some broad and useful conclusions.

■ Although a few of these crews had previously exhibited problems, most were known as solid individuals who would not intentionally violate the rules.

■ It seems to make little difference whether the stress is entirely self-induced or not. The stress which drives people to exceed their own capabilities at the moment may be wholly personal, or it may come from mission commitments which have been accepted as a personal commitment.

■ In all cases, the crews violated directives, prior training, and/or common sense. Following the directives would have prevented these mishaps, but for some reason the crews were compelled to ignore the rules.

■ An intense desire to accomplish a personal goal seems, at least in these instances, to cloud judgment. The crews failed to realize they were getting into trouble until it was too late to prevent the mishaps. The problem is that an intense emotional commitment to the goal destroys a person's objectivity. Even worse, the crewmember does not realize that judgment has been affected. There is no telelight warning that this critical system is malfunctioning.

■ Poor judgment due to stress can affect anyone. No one is too good or too strong never to be caught up in the phenomenon. Supervisors, peers, friends, and fellow crewmembers must be aware that strong desires can lead to problems in judgment. A little word of caution for your gung-ho friend may help to keep him or her alive.

■ Mishaps resulting from self-imposed stress have a high probability of being fatal. The crewmembers involved do not realize in time that they are in trouble and are about to die.

The instances of self-imposed stress are not uncommon. The mishaps discussed in this article all occurred in *less than 12 months*. Our hope is that aircrews will learn from the mistakes of those who have gone before. No one is infallible, and you are most fallible when you are least ready to admit it. When that little voice tries to advise you not to press so hard, pay attention. The little voice is speaking from experience. ■

Landing Uneventful . . . But

MAJOR TIMOTHY J. SHAW • Directorate of Aerospace Safety

■ "We were really lucky on that one; we could have flown into a mountain." Kind of a chilling postscript for a "routine training mission," wouldn't you say?

Something is wrong when luck is the safety margin between the aircraft and a mountain. However, an incident like this happened on a low level training route. The postscript for the mission would have been substantially different if a moment of distraction/inattention were added to the following sequence of events.

A B-52 crew was flying a night terrain avoidance (TA) training mission after a rushed mission planning session the day before. The aircraft had several minor equipment malfunctions. As a result, the crew flew the aircraft out of the low level corridor. They didn't recognize the error and continued to fly TA. After a time, the crew became disoriented and climbed to IFR altitude. Outside the corridor, corridor IFR altitudes no longer guarantee safe terrain clearance, and the aircraft was well outside when a turn was initiated. While in the turn, the pilot noticed the ground rising rapidly. He rolled wings level and expedited an MRT climb to abort and exit low level. During the climb, the pilots became aware of very high terrain about one mile in front of the aircraft and, reacting quickly, narrowly cleared the terrain. The flight home and landing were uneventful, but filled with comments of "we were really lucky, . . ."

Night low level TA flying is a safe and effective tactic when thoroughly planned and executed with precision. When it is not, things can quickly go wrong. For night TA in a B-52, the mapping radar, TA system, radar altimeter, and doppler/INS must be fully operational. More limitations are listed in SACM 51-52 Vol VI. Other aircraft and commands have similar requirements and limitations for low level night operations. Once the written requirements and limitations are met, aircrew judgment will be the primary factor in determining safe terrain clearance altitudes. The actual altitude to be flown will be the pilot's decision based on the aircraft, equipment, weather, aircrew capabilities, and aircrew proficiency.

Exercise your judgment using these considerations, and all your landings can be uneventful. ■

VISUAL NARRO

By Non-Visual F

WHY YOU DIDN'T SEE IN TIME

ROBERT J. RANDLE, JR.
NASA/Ames Research Center

Every pilot has had the rather unsettling experience of suddenly having an aircraft "appear" well within visual range.

The implications of such lack of visual contact for midair collision are obvious but, as this article points out, the same factors can seriously affect air-to-air combat capability.

The research by Randle and Malmstrom does more than just identify a problem. They have actually determined some possible ways around the problem as well as pointing out avenues for future research.

■ For the past seven years we've been occupied by a series of studies on how non-visual factors can affect the boundaries of an aircrew member's visual field. Our research has been related to the *psychological* factors rather than the physiological factors that can warp the aircrew member's visual field. Therefore, our work falls under the heading of "visual narrowing." This is caused by psychological phenomena, mental stressors such as concurrent mental tasks (secondary tasks, workload) or heightened emotional arousal.

By contrast "tunnel vision," a medical term, can be induced by physiological stressors such as hypoxia, G-loading, and numerous drugs. Many of our findings are relatively new, and the results so far have been limited to laboratories and non-operational tasks.

We have measured both the visual point-of-regard and the point-of-focus of pilots and non-pilots, thus permitting us to look in all three dimensions at what a person looks at moment-by-moment. With the latest laboratory equipment no longer do we have to ask the pilot what he was looking at, we can now read it directly from a strip chart and plug the data directly into the computer. More often than not the results have been startling and, in some cases, unexpected.

How Voluntary Are Visual Responses?

That's a loaded question. Our research indicates that the answer to that one depends on an almost infinite number of variables, including the person's age, their IQ, their level of emotional arousal, lighting levels, and even the extent to which a visual display interests them, to name a few. For example, it's well known that the pupil of the eye involuntarily constricts in light and enlarges or dilates in darkness. It also constricts when the lens is focusing on a near target and dilates for a far target. But did you know that the pupil of the eye also involuntarily constricts when you see something that disgusts you and dilates when you see something that delights you?

Psychologists who study pupillary responses have long used *Playboy* centerfolds as stimuli to obtain maximum pupillary diameters from normal, healthy

FIELD
OWING
Factors . . . OR
THAT AGGRESSOR

DR. FREDERICK V. MALMSTROM
University of Southern California

American males. Likewise, the pupil also dilates when you concentrate on solving a mathematical problem — the more difficult the problem, the more the dilation. Somewhere from deep within the central nervous system signals are getting to your visual response mechanism and causing it to do odd things that, in some circumstances, may be extremely mal-adaptive.

Visual Fatigue

Research by others into the pupillary response led us, on logical grounds, to speculate that whatever affected dilations might also affect the eye's point-of-focus. Any visual scene that causes a pupillary dilation should also shift the eye's point-of-focus toward the visual far point. Several of our experiments have confirmed this, with both commercial pilots and college students. If you're focusing on a near object and are given a concurrent mental task (such as computing an ETA) your point of focus will slip *involuntarily* off that object toward the visual far point. The more difficult and extended the mental manipulations, the more severe the shift to the far point.

From a practical standpoint, we must add that the shift in the point-of-focus isn't much — at the most, perhaps a dozen centimeters or so beyond the target. Therefore, to a pilot who spends much of his time looking outside the cockpit, we doubt that this shift to the visual far point would be a hazard. But even the pilot, while searching an empty sky, should be very careful to refrain from letting his mind stray from that *primary* task (see next section, below). For the navigator who spends hours at a time concentrating on close-up tables, charts, and scopes, we surmise that this focus shift could contribute to a severe case of "hot eyeballs," an instance where eventually nothing up close seems to be in focus. In short, this could be a description of visual fatigue, a phenomenon that is not well understood. In fact, human fatigue is not, in general, well understood.

Empty Field Myopia

It's been known for several decades that when the eye views a featureless field such as in darkness, fog, high altitude flight, etc., it exhibits a reflex property known as "empty field myopia." The point-of-focus drifts slowly and inevitably to a natural resting position. For the typical person, this empty field resting position is about a meter or so in front of their nose. There are huge individual differences in this one meter distance. It ranges from about a quarter of a meter out to close to infinity.

Empty field myopia may take a few minutes to develop, and the position of focus assumed by the eye is somewhat dependent upon where it started from. You become extremely vulnerable to missing distant targets, particularly since you are not aware of the subtle change taking place. When that "huge" black spot, way out there, turns out to be a dirt spot on your windscreen you know you've been had by empty field myopia. What's to be done? Can we will our eyes to "get out there and search?"

A provocative answer is provided by a combat-wise fighter pilot who told us that he was quite able to spot enemy aircraft in an otherwise blank sky merely because he had the ability to "think far." Nice.

continued

VISUAL FIELD NARROWING

continued

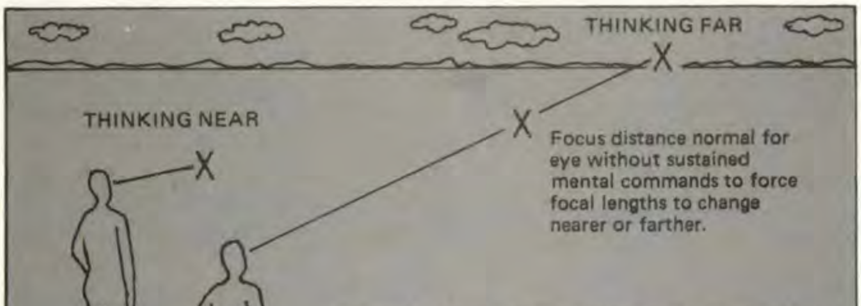


Figure 1. Research into biofeedback has shown it possible that pilots can train themselves to see distant objects better through a process of "thinking far" that is voluntarily controlling visual accommodation.

True? Let's take a closer look at what might be going on in the attempt to voluntarily control visual accommodation. Up until recently this was thought to be a completely reflex (involuntary) function.

When we ran a study on the usefulness of "thinking near" and "thinking far" we could not quite verify the pilot's story. Our results were, yes, with no previous training, one could alter his point-of-focus in an empty field by "thinking near" and "thinking far" but only a few centimeters on either side of the resting position. The instructions to "think near" resulted in focus positions nearer than the resting position; instructions to "think far" in positions slightly farther than the resting position. An incipient voluntary control was thus present, but the "pull" of the resting position could not be overcome. Was the pilot fooling himself, then? Not necessarily. That pull of the resting position, that is, the tendency to involuntary empty field myopia is an unconscious process. Can training be used to bring this tendency into awareness? Can it then be controlled? The data are encouraging.

A great deal of research in autogenic (self-generated) control during the last decade has shown that many body processes, heretofore thought to be inaccessible to voluntary control, have been amenable to training using bio-feedback, or a knowledge of the current state of the body function to be controlled. We tried this with visual accommodation. We fed back to our experimental subjects their current state of focus using a frequency modulated pure tone.

Now, when the subject slid off the target tone, and, of course, the visual focus distance, a higher frequency told him he was accommodating too much, a lower frequency too little. Even when he stared into a dark, empty field with no target he knew where he was focused. All six of our subjects, after training, were able to "drive" their focus to a near infinity position when suddenly confronted with the empty field. As they learned the task better we were able to remove the tone and they were still able to do it! Later, we trained eight commercial pilots to do the same task, again using bio-feedback techniques.

There were some very interesting side-lights to these studies. For instance, all the experimental subjects *eventually* learned to do the task. However, training time ranged from a single one-hour session all the way up to fifteen one-hour sessions. This *seemed* to be related to personality or chronic emotional factors. Many trainees continually "tightened" up the ciliary muscle instead of relaxing it to achieve distant focus. To "do" in this task means something a little different than it normally does. We cannot explore this aspect of the training in this short article, but the ramifications could be of considerable significance in aircrew selection and trainability.

We had one commercial pilot who, upon hearing of the intent of our study through a colleague who was one of our trainees, stated that he could already control his focus. We invited him to our lab, and, sure enough, he did the task on the first trial and was able to repeat it easily.

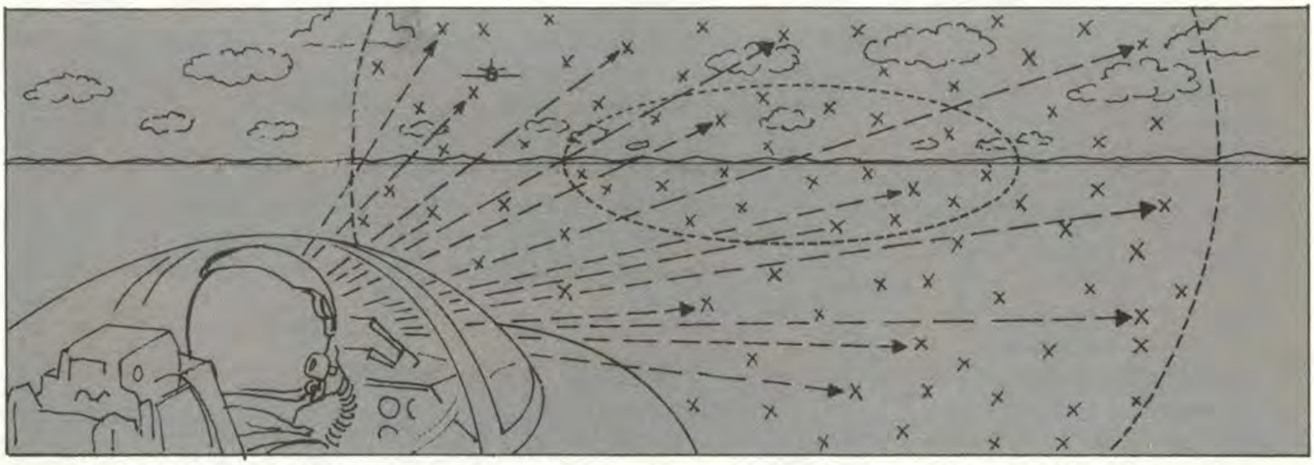


Figure 2. Visual field shrinkage has significant safety of flight implications. Experiments have shown that when a pilot is faced with a visual tracking task and a concurrent mental computation/identification task the range of eye movements could be restricted by as much as 60 percent as shown in Figure 2. The pilot's field of visual tracking is reduced to the point that he misses the target closing from 10 o'clock.

He had trained himself through his own rich life experiences. Was this young commercial pilot our fighter pilot in another guise?

What About Eye Movements?

In addition to tracking the point-of-focus, tracking the eye in the other two axes — horizontal and vertical — led us to even more startling revelations of visual field shrinkage. There seem to be even more significant safety of flight implications on the interference of psychological variables with the ability of a person to track a target successfully. It was again on logical grounds that we surmised that whatever affected the pupillary response and the point-of-focus should also affect certain types of eye movements.

Basically, one argument runs like this: a person has only so much mental processing capacity, and if they attempt to do more than one thing at a time, will do well on one task only at the expense of doing poorly on the other. A person who wants to pat their head and rub their stomach at the same time will do better on both tasks if they do them separately. Likewise for eye movements. We thought that a pilot who must track a moving target would do less well at their visual tracking task if they had to do additional tasks such as computing ETA's or monitoring radios.

There have been innumerable experiments both with airplane pilots and automobile drivers which have relied on motion picture films of the pilot's/driver's eyes. Informative as this kind of study might be, these studies have ignored the fact that the world is always in motion, and the eye can track moving as well as stationary targets. In fact, in military and other technological systems moving stimuli are rampant.

Therefore, we performed a series of experiments where Air Force personnel were required to track a small target bounding constantly either up and down or right and left. Concurrently, these subjects were required to listen to and identify a series of dots and dashes. The results were, in most cases, surprising.

Depending upon the difficulty of the tasks, the primary visual tracking task and the concurrent listening/identification task, the actual range of eye movements of our Air Force subjects could be restricted anywhere from 10 percent to 60 percent! Thus, if a pilot were scanning through a visual angle of 20 degrees (the length of this magazine held at arm's length) the onset of a difficult concurrent mental task could possibly reduce his range of visual tracking down to a field of only 8 degrees. An even more curious, unexplained, and

continued

VISUAL FIELD NARROWING

continued

tentative finding is that the range of vertical eye movements appears to be more restricted by the demands of the concurrent task than were the horizontal eye movements. Again, the more difficult the secondary mental task, the more severe the eye movement range restriction.

An even more ominous finding was that *not one* of our subjects who participated in these experiments was aware that his range of eye movements was narrowing, nor does it presently appear that subjects can learn to overcome this visual narrowing phenomenon. Like the pupil and accommodation, it appears to be involuntary, beyond awareness. Perhaps bio-feedback techniques would be useful here also, but we have not been able to try that so far. Happily, we must also report that this visual narrowing response lasts only as long as the concurrent mental task is around. Once the subject is released from mental arithmetic, the eye movement ranges appear to return quickly to normal, within seconds.

What Does It Mean?

First, there are implications that the phenomenon of visual narrowing is *three-dimensional,* not two-dimensional. The cone of vision whose apex is at the eye (one for each) can have a truncated distance from base to apex due to an approaching point-of-focus, and it can have a severely reduced solid angle at the apex due to restricted eye movements. Future experiments ought to allow us to quantify the field reduction as a function of the factors that influence it.

Since there are non-visual tasks that can restrict the visual field, we would recommend that if one crewmember is given the critical responsibility of visual search (such as a tally-ho) that they be given only that responsibility and not be required to perform concurrent duties such as monitoring radios or computing ETA's. In the absence of training, while searching empty skies remember to return your gaze regularly to a reference such as a wing tip or a fellow member of a formation. Also, be aware that daydreaming is a concurrent mental task.

We state again that this task-induced visual narrowing phenomenon appears to be both involuntary and temporary, but the best defense against it is to know that it affects everyone. Everyone is susceptible to being blind-sided, and it would appear that psychological factors are just as effective as either physiological or operational factors in producing this "short-sightedness." ■

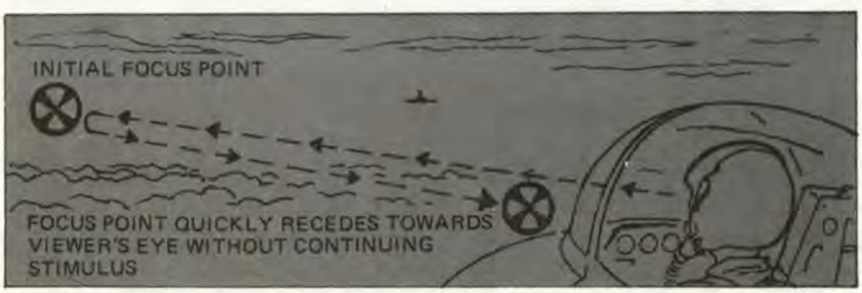


Figure 3. There are implications that the phenomenon of visual narrowing is three dimensional. Thus, the ability to focus on objects can be severely restricted both in distance and area. Such a restriction is of serious concern to all pilots, whether engaged in air-to-air or merely applying "see and avoid" procedures VFR.

About The Authors

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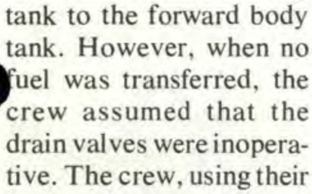
OPS topics

Some Unnoticed Clues To A Problem

■ A KC-130 took off to refuel a B-52 with about 40,000 lbs. During the refueling, the center wing fuel gage malfunctioned, and the circuit breaker was pulled. The aircraft commander estimated that between 18 and 22 thousand pounds of fuel remained in the center wing tank at that point.

Prior to landing, the crew attempted to transfer fuel from the center wing tank to the forward body tank. However, when no fuel was transferred, the crew assumed that the drain valves were inoperative. The crew, using their fuel estimates, believed that the CG was within limits for landing.

The landing and taxi were normal although the speed deviation indicators registered high. After braking to an abrupt stop in the parking area the aircraft continued to porpoise as though it had an aft CG. The AC had the boom operator install the tail jack as a precaution before shutting down the engines.



Maintenance dipped the center wing tank and found it empty. Further investigation discovered that the gages indicated *20,000 pounds high.* There was no record that anyone had noticed this discrepancy during refueling nor did the crew suspect that they were 20,000 pounds short on fuel.

However, there were several indications of a lighter than expected fuel load which the crew failed to notice. First, the aircraft lift off during takeoff was rapid. Then, the aircraft would cruise above best range using the planning factors. Also, the inflight trim was 1.5 units nose down and, as mentioned before, the speed deviation indicators on final approach showed that planned airspeed was too high.

One other point, the crew did not follow the checklist sequence for fuel usage. Had they done so, the fuel shortage would have been detected. The crew should also have checked their assumption that both the center tank drain valves had failed by burning fuel out of the center wing tank. If the main tanks continued to decrease, it would have been obvious that the center wing was empty.

It's a good thing this was a local and not an overwater deployment — 20,000 pounds could make quite a difference.

Detecting Fatigue

Most pilots who routinely fly flights of long duration have experienced "skill fatigue" in one form or another, during which reaction times may become slowed, carelessness slips in and coordination, peripheral vision and adjustment to altitude all suffer.

The senses also are dulled by the effects of hypoglycemia, or low blood sugar, and by everyday emotional stress. The Texas Aeronautics Commission notes that recognition of the causes of such fatigue and its effects are important first steps in preventing potential accident-inducing situations. The commission offers the following "lifesaver checklist" to be used in determining one's ability to fly:

- General irritability, often characterized by a short temper.
- Low morale, a possible loss of motivation or mild depression.
- Short-term memory lapses, i.e., forgetting something you have been told.
- Making simple mistakes, such as tuning in the wrong frequency or misreading a navigation chart.
- Timing and accuracy loss.
- Tendency to accept a wider margin of error than normal, such as not making a determined effort to remain exactly on course and/or altitude. — Courtesy FSF *Human Factors Bulletin,* Jan/Feb 1982.

Wrong Fuse/Hot Load

During a climb, heavy smoke entered the cockpit of a T-38. The pilot performed the appropriate emergency procedures and made a successful recovery. The cause of the smoke was a burning console lighting rheostat in the rear cockpit.

At some time the required 5 amp fuse had been replaced with a 15 amp fuse. Later, a wire chafing bare shorted against the rear cockpit bulkhead rails. The fuse did not protect the rheostat from the surge of electricity. The base inspected all T-38's assigned and found 41 aircraft with wrong fuses installed.

continued

A Little Short

An F-101 was making a cross country flight to a northern Texas base. The pilot was briefed about thunderstorms in the area of the base. The flight went smoothly, and the pilot had made a successful precision radar approach to decision, height, where he acquired the runway environment.

Seconds later, all forward visibility was lost in heavy rain. The pilot started a missed approach, but the right main gear struck a runway light

stanchion. The aircraft settled slightly, and the right gear then hit the concrete base of the next and last runway light stanchion. At this time, the right tire blew. The pilot was able to keep the aircraft on the runway for a successful emergency landing.

Thin Air

An F-15 mission was briefed as a DACT sortie. Everything seemed normal until passing FL 340 on climbout. Then the pilot began to experience hypoxia or hyperventilation symptoms. Upon recognizing the symptoms he went to 100% oxygen and, checking the cabin altitude, found it to be FL 340. The pilot declared an emergency and made a successful recovery.

After landing, the pilot recalled that prior to taxiing the canopy was difficult to close, and the canopy handle had to be pushed farther forward than normal for closure.

Maintenance performed a rigging check and discovered that the canopy would close enough for the cockpit canopy unlock light to extinguish and the handle lock in place, but the canopy roller would not seat fully in the lock detent. If this roller does not seat properly, the canopy seal will not inflate, thus precluding cabin pressurization. The only question remaining is: Why didn't the pilot recognize the lack of cabin pressurization until FL 340?

DOD Standard Instrument Departure (SID) Discrepancy

Several recent incidents have accentuated an inconsistent altitude graphic depiction on DOD Standard Instrument Departures (SIDs) published by the Defense Mapping Agency (DMA) when compared with:

- SIDs for Civil Aerodromes published by the National Oceanic and Atmospheric Administration (NOAA).
- DOD Instrument Approach Procedures Publication published by DMA.

The DOD SIDs in question are the single or multi-page issues presently available in the flight planning room at military aerodromes which depict the instrument departures for that specific aerodrome. These DOD SIDs do not depict altitude requirements in the same graphic manner as the NOAA SIDs and the DMA DOD Approach Plates. The altitude requirements for the latter two publications are shown as:

- A solid line beneath the altitude ($\underline{1500}$) which indicates the minimum altitude that is permitted.
- A solid line above the altitude ($\overline{1500}$) which indicates the maximum altitude that is permitted.
- A solid line above and below the altitude ($\overline{\underline{1500}}$) which indicates a mandatory altitude.
- No lines (1500) which indicate a recommended altitude.

On the DMA DOD SIDs, the altitude requirements are depicted as:

- "Cross at or above 1500" (equivalent to $\underline{1500}$).
- "Cross at or below 1500" (equivalent to $\overline{1500}$).
- "Cross at 1500" (equivalent to $\overline{\underline{1500}}$).

Failure to recognize "cross at 1500" as a mandatory altitude requirement on the DOD SID has resulted in flight violations being levied against highly experienced aviators. These pilots viewed the depiction, "cross at 1500," as a "recommended" altitude as would be the case when no lines appear above or below 1500 on the DOD Approach Plates and NOAA SIDs. Flight violations resulted when climbs above the mandatory altitude placed aircraft in the approach corridors of several heavily used civil aerodromes.

Efforts are presently being undertaken to standardize the DOD SIDs with other DMA and NOAA flight publications. Until these changes are published in DOD SIDs, a potential for misinterpretation and possible midair collision exists. It is recommended that all aircrew be briefed concerning the method of altitude depiction on the DOD SID in contrast with the depiction graphics on other flight publications. — Adapted from USN *Weekly Summary* No. 12-82.

Navigation Error

Two F-4s were scheduled for a ground attack mission expending BDU-33s. The crew received clearance onto the range and went low for the run in. Initially, the flight misidentified the IP and started their run approximately eight miles west of the true IP. However, the aircrews made a correction to compensate for the error.

When the preplanned time ran out, the flight initiated a left pop-up. The preplanned target could not be identified so the lead rolled out wings level, but heading south instead of west as planned. The aircrew then identified a built up area similar to the target and attacked, releasing six BDU-33's on a troop concentration more than 15 miles from the planned target.

Birdstrike Protection

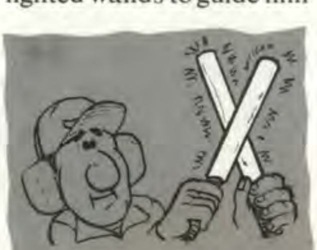
A student pilot in the front seat of a T-38 was performing a circling approach. As the aircraft approached the final turn point it hit a hawk which

penetrated the front wind screen and struck the pilot's helmet. He was wearing both visors down and was not injured. The IP in the rear cockpit took control and made a successful landing.

Motivated To Succeed?

A C-141 crew was preparing to taxi for an urgent night airevac mission. There was one NF-2 cart to the left rear of the marshaller with a light shining toward the aircraft. The engineer and scanner were busy with other duties when the aircraft commander began to taxi.

He started toward the marshaller with only the lighted wands to guide him



because the rest of his vision was obscured by the light cart. The aircraft taxied about 75 feet past the taxiway centerline before starting to turn. The copilot who could see the taxi lights and the pilot, after his eyes accommodated to the dark, knew they were too far left, but both thought they could return to centerline. During the sharp right turn to come back to centerline the left main gear struck one of the dual taxiway lights at the intersection causing the tire to fail and damaging the gear doors and other components.

The investigation report comments that "The crew was obviously motivated to perform this airevac mission." It's too bad they didn't take the necessary precautions to do so.

A Problem With Guard

Congestion or blocking of emergency frequencies continues to cause problems. An Air Force fighter was on downwind for landing at an East Coast base. While on downwind the pilot was directed to contact squadron ops.

He requested and received permission to leave Tower frequency. During the time he was off frequency, Tower advised on Guard that an aircraft from a nearby airport had penetrated the traffic pattern airspace.

The Air Force aircraft pilot returned to Tower frequency just prior to turning base and, for the first time, was made aware of the traffic passing 1,000 feet behind and coaltitude. The pilot had turned Guard off because of interference and did not hear Tower's traffic advisory.

Turbulent Refueling

A routine training mission was scheduled with three KC-135s refueling six C-141Bs. One of the C-141s was well within the refueling envelope in a good contact position when both aircraft encountered light turbulence. This vertical upset caused the tanker to climb and the receiver to descend putting the C-141 at the lower limit of the envelope. The boom operator tried to disconnect but could not because of boom binding. The C-141 stabilized in this position for several seconds with the boomer holding full retract and full down pressure on the boom rudders.

As the receiver started to back out, it drifted three to four degrees right, and the boom swung free minus the nozzle. Both aircraft returned to base safely, the C-141 with the refueling nozzle still in the A/R receptacle. ■

■ Since we recognized the need for more realistic training in the mid-seventies and increased our exposure in the low altitude/high-speed environment, we have noticed some change in our overall mishap picture. The way we operate our aircraft in terms of procedures, policies, tactics, etc., has to have an impact on the type of mishaps we are likely to see. In other words, time and type of exposure affects degrees of risk and possible losses.

AFISC recently completed a study comparing all USAF aircraft by type and their relation to "Operations-related" low level mishaps. The study covered a six-year period (1976-1981) and excluded typical "range type" mishaps. Here are some of the highlights.

■ Eighty-eight ops-related low level Class A/B mishaps were experienced from 1976 to 1981, including 14 birdstrikes. During this period, the rate increased from 0.1 per 100,000 flying hours to 0.7 at the end of 1981.

■ There were 74 mishaps without birdstrikes. Of these, 67 percent involved collision with the ground (flying a good aircraft into the ground), and 23 percent involved loss of control as a result of pilot actions/inactions.

■ All aircraft (by type) contributed to the numbers:

	Class A	Class B
Bomber	3	0
Observation	10	0
Trainer	1	1
Helo	2	0
Transport	3	1
Fighter/Attack	45	8

■ Since 1976, low level mishap trends have been rising for all aircraft except trainers, where a low mishap rate could be mainly due to relatively low exposure in the low level environment. (Takeoff and landing mishaps fall under a different category.)

■ The fighter/attack community has historically experienced the highest number of low level mishaps. Since 1976, this rate has continued to rise because of more realistic training and increased low level operations.

■ Approximately one-third of all airplanes lost in ops-factor, low level mishaps had "control loss" as a cause, but two out of three losses had to be labeled "collision with ground."

■ Suppose there are no significant changes or improvements over the years to come, with even more low altitude exposure, the present mishap potential for low level related mishaps would further increase.

Collision with ground remains our largest factor when we analyze low level mishaps. By definition, a collision with the ground mishap occurs when a perfectly good and flyable aircraft is flown into the ground (or any "earthbound" obstacle). These mishaps are ops-related, operator caused. Most of them are deadly, and the tragedy is all of them seem preventable at the aircrew level. Look at some of our recent mishaps:

■ An A-7D was descending in VMC from higher altitude for a target clearing pass over an overwater range in support of a second element of A-7s. Below 1,500 feet AGL, the pilot encountered an unexpected condition of no discernible horizon or sky/water contrast. The pilot continued his pass, overflew the target at 500 feet. He then entered and failed to detect a shallow descent from his altitude. The aircraft impacted the water 20 seconds later. There was no ejection attempt.

Low Level R

■ An A-37B took off on an instrument training mission. After reaching the clearance limit, the aircrew cancelled IFR and proceeded in visual conditions to conduct low level training in an unauthorized area at an unauthorized altitude. The instructor pilot aboard the airplane flew into a canyon and struck two parallel power lines between 200-250 feet AGL. The aircraft received major damage and caught fire. Both crewmembers ejected.

■ An F-5E was on a low altitude CAP mission at 1,000 feet AGL when the pilot was warned about another aircraft at his 4 o'clock position. Rolling out of a left turn, he perceived the other airplane within 2,000 feet, belly up, closing fast. Sensing a life or death situation, he instinctively executed an evasive maneuver during which he blacked out or grayed out from rapid G onset. The maneuver placed the aircraft in an approximate 30-40 degrees nose low attitude from which it could not be recovered. The aircraft hit the ground in a shallow descent, bounced, and skidded before major breakup and flash fire. The ejection seat was triggered during breakup. The pilot hit the ground during parachute deployment and sustained major injuries.

■ The F-4E was number two of a flight of two performing a low level/tactical weapons delivery mission during Red Flag. The pilot, although having 1,900 hours F-4 time on his record, had done only minimal flying in the immediate time period preceding the exercise. In fact, prior to deployment to the exercise he had flown five sorties in 90 days with no significant exposure to the low altitude/tactical formation environment. Negotiating the attack of an aggressor aircraft, the pilot failed to adequately clear his flight path for terrain obstacles ahead. The aircraft impacted a 7,571 foot hill. There was no attempt to eject.

By the end of April, we had experienced five collision with the ground mishaps in 1982. The forecast for the year reads 15. There still is time to prove the forecasters wrong. What can we operators do?

■ Plan our low levels the best we can, consider and prepare for any possible "threat."

■ Stick to the rules and regs, not cut corners, and resist those instantaneous "irrational acts."

■ Not press. Be "manly" enough to call knock-it-off when things aren't going our way. Being safe isn't being a sissy!

■ Review our own capabilities time and again. Be, at least, honest towards ourselves. If we aren't ready for something, let's stay away from it. To use our own good judgment as a pilot is our ultimate and total responsibility.

■ Learn about human limitations, common pitfalls, illusions, deceptions, etc., — better yet, develop our own personal warning device or threat detector which lets us "sense" the traps ahead of us.

After all, the "boss" likes us to come back to fly a mission again the next day. Heads up! ■

LT COL HORST GAEDE, GAF
Directorate of Aerospace Safety

LT COL GERALD H. SHERRILL
Air Force Flight Test Center, Edwards AFB, CA

■ In all I have heard and read about vertigo, I have never really had negative Gs singled out as a culprit or cause. Let me relate a humorous (now) experience that has several lessons for an aviator.

But first a joke (which is part of the story and the lesson): Being a Texan and an Aggie, Aggie jokes are old favorites, and this one was related to me by a fellow Aggie pilot many years ago. Here is a short version.

It seems this couple was looking at a brand new house in a new development, and throughout the visit the developer kept shouting out the window, "Green on the top, brown on the bottom!" When he could stand it no longer, the husband inquired as to the reason for these periodic outbursts. The man replied, "Oh, I've got an Aggie laying sod, and I have to remind him which way to lay each piece." Now the true story.

I was flying an FCF on an F-4 in Korea one morning. The weather was scattered clouds at about 5,000' and 30,000'. When I reached the negative G autopilot disconnect point, I was at 20K heading toward the coastline, and what I could see over the nose were white clouds with a blue background (the sea). Ditto for the sky.

At the FCF test point, I dived to pick up airspeed and pulled the nose up to about 15° above the horizon. As I pushed the stick forward to beyond -1½ Gs, the autopilot refused to auto disconnect.

I felt that I was floating at the top of the canopy and had to "reach and fumble" to get the paddle switch to disengage the autopilot which was continuing to pitch the airplane over at about one and three-fourths negative G.

Lesson I: Unless you really haul on the seat belt in the chocks, it will feel "loose as a goose" under negative G, exaggerating the sensation.

During this time I felt the old F-4 complete one-third of an OUTSIDE loop, and I was able to recover about 135° nose low inverted (I thought).

After rolling 180° to upright I looked at the attitude indicator. It was wings, level, black on top, gra

IT'S NOT A JOKE

on the bottom. That looks funny, I thought to myself, and the punch line "Green on the top, brown on the bottom" kept running through my mind. What color was it really supposed to be?

Well, that wasn't right, so I rolled "inverted" again using the attitude indicator and looked outside. Sure enough, I was inverted again (or was I?). Above and below looked the same. Only the attitude indicator showed gray on top, black on the bottom. And the joke still raced through my mind. OK, Aggie, it is supposed to be gray on the top and black on the bottom — fly it that way. (That's Lesson II, and it's in 51-37 somewhere, too!).

Still dizzy and confused, I made a slight turn so I could see land, and the attitude indicators proved right. My "outside loop" was really only about 30° pitch over and I had disengaged the autopilot at 15° nose low, upright, not 135° inverted.

This time I headed away from the coast with brown land in the visual background, steadied my sensory gyros, and repeated the autopilot disengage test. (It failed to pass once more). But my sensation *was exactly the same!* Only I was prepared this time.

Lesson III: Unexpected or substantial negative G, sustained for even a few seconds will seem like forever and *will* "tumble your gyros" — *bad!*

I wonder how many aircraft may have been lost during high AOA or unusual attitude recovery in marginal visibility or IFR conditions when the pilot may have been subjected to negative G which tumbled his or her gyros, further complicating an already sticky situation.

Negative G is a sure fire vertigo maker! So remember:

- Strap in tight.
- The attitude indicator really is gray on top, black on the bottom. (Funny how you know that until you are *sure* you aren't upside down.)
- When you need to reduce AOA or recover from unusual attitudes, do so but use negative G cautiously otherwise the bad joke may not be too funny. ■

MAIL CALL

EDITOR:
FLYING SAFETY MAGAZINE
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Temporal Distortions

■ As an old "has been" fighter pilot, I still enjoy reading aviation periodicals. The article, "Temporal Distortions," in your March 82 issue of *Flying Safety* was most interesting. I was forced to bail out of my F-51 Mustang over Korea when the engine was struck by enemy ground fire. Not wishing to roll over and drop out (less than 1,000'), I elected to "scratch" over the side and keep my head down. From that point on, everything was in slow motion. I still remember seeing the fuselage "slowly" move past, the horizontal stabilizer "slowly" striking my elevated right leg just below the knee (compound fracture) and being flipped to a standstill while I reached for the ripcord. It seemed like several minutes before I hit the ground and rolled into a rice paddy.

I have often wondered about that strange feeling of time. Lt Col Carson's article has certainly enlightened me. Temporal distortion is difficult to believe unless one has experienced an instance similar to those mentioned in the article. Good article and highly recommended reading, particularly for the ejection seat jocks.

Robert H. Dunnavant
Chief of Safety
Aerospace Audiovisual Service
Norton AFB CA

A Success Story

The article entitled "A Success Story" on page 22 of the January 1982 issue of *Flying Safety* magazine was certainly appreciated by personnel of the Improved Windshield Protection Program Office of the Air Force Wright Aeronautical Laboratories at Wright-Patterson AFB, Ohio. The F-111 BIRT which we developed is credited with well over ten F/FB-111 aircraft saves by defeating potentially catastrophic windshield birdstrikes.

The true success story, however, lies in the close working relationship between USAF, AFSC, AFLC, TAC, ATC, SAC, and the industrial and academic communities in the accelerated development and application of Bird Impact Resistant Transparency (BIRT) technology. Through this association we were able to use the F-111 BIRT technology to develop the improved transparency system now going onto production F-16 aircraft, and we are now developing an improved system for the T-38. We have worked with those responsible for the T-37, B-1, and the A-10 in their application of the BIRT technology, and we are currently working with those responsible for advanced aircraft such as the Next Generation Trainer, the Forward Swept Wing Flight Research Vehicle, and advanced versions of the F-15 and F-16 . . . This BIRT Technology application is credited with saving the Air Force over $500 million in aircraft saves and improved life cycle costs — not a bad return on an R&D investment of less than $20 million.

We would like to comment on some information in the article. . . . Losing an F-111 about every eight months in the early 1970's due to a windshield system birdstrike resulted in the philosophy of "reduce the birdstrike loss rate with tolerable penalties to optics, cost, weight, and durability and then improve these secondary parameters later." This problem prioritization philosophy has carried through on all of our efforts to provide improved transparency systems. . . . The areas of maintainability and optical quality are continually being addressed by Air Force and industry personnel and improvements in these areas are constantly being made. F-111 and F-16 experimental transparencies are being obtained to evaluate suggestions for improved durability. The F-16 improved transparencies now being provided for operational use are warranted by the manufacturers to have at least a 4-year service life. The F-111 optical quality is now comparable to the original glass units, and the F-16 optical quality is better than that originally required. The tradeoffs in weight and system costs are also not as dramatic as anticipated. . . .

The Improved Windshield Protection Program Office is proud of the contributions which we have helped to make in supplying high-quality, low-cost, transparencies which have reduced the hazards of high-speed low-level flight. We will continue our efforts to provide optically acceptable and affordable transparency systems which will allow our aircrews to fly with reduced concern for the birdstrike hazard. ■

2Lt Robert Simmons
Project Manager

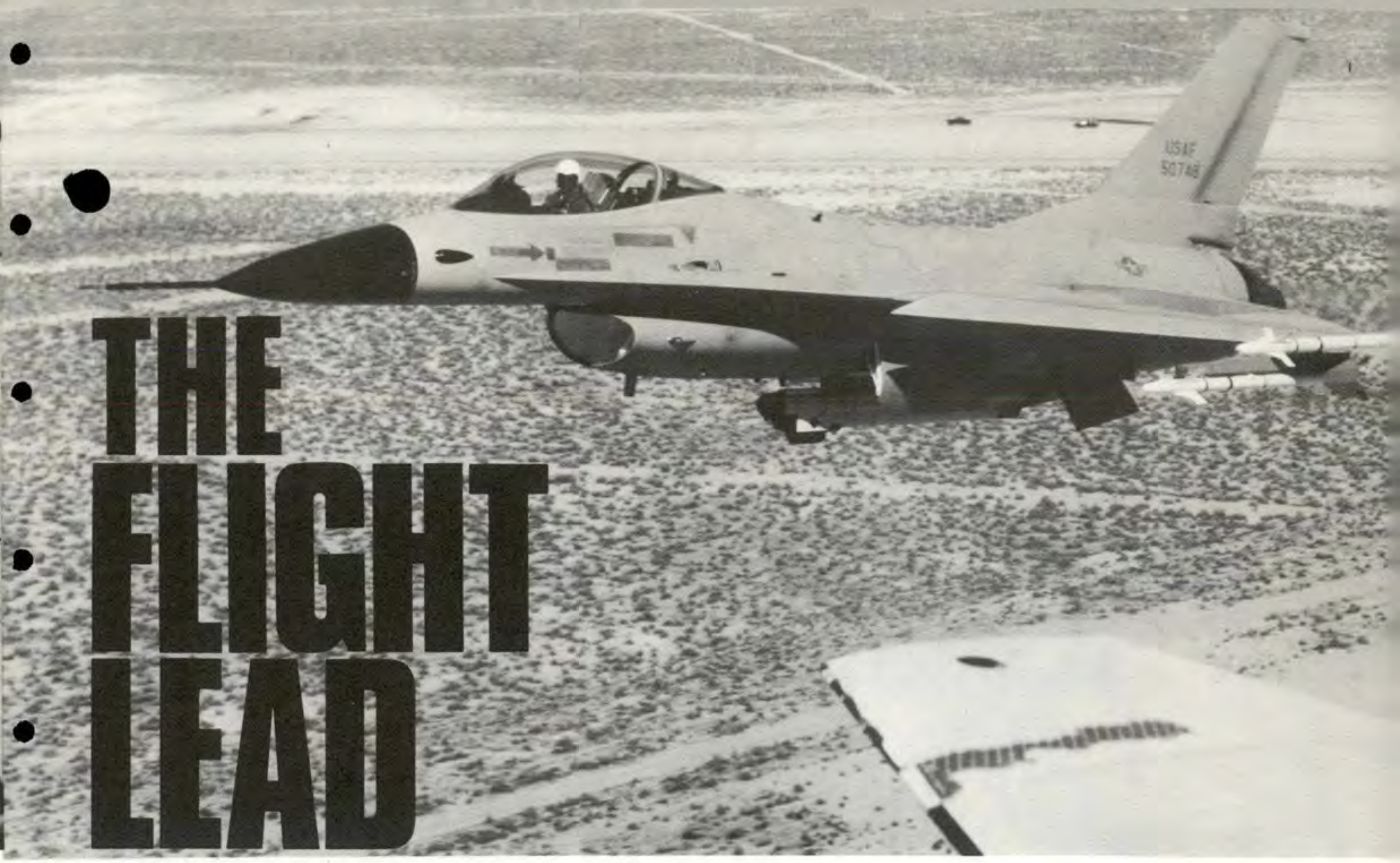
Do You Have Something To Say?

Mail Call is an open forum for aircrew members and others to discuss subjects relating to flying safety. There are only a few ground rules. Don't use Mail Call to report hazards or tech order deficiencies. These should be reported through official channels. The subjects must be related to flying safety. Finally, we must have names and addresses. The names will be withheld from publication upon request.

So, when you have something to say write to:

Editor, *Flying Safety* magazine
AFISC/SEDF
Norton AFB CA 92409

THE FLIGHT LEAD



Every fighter pilot has had a variety of experiences with different flight leaders. Some were silky smooth — considerate of their wingmen. Other leaders flew as if the responsibility for keeping the flight together rested solely with the wingmen. This type revels in catching his wingmen committing an error, rather than leading so that even the weakest wingman will think himself the greatest formation flyer in the world.

The following incident is about the kind of flight leader that every squadron commander would like to fill his squadron with — the type of flight leader that validates the premise that flying safety is an attitude. The flight of four fighters finished their ground gunnery mission and climbed out heading for home. At level off they moved into route formation and were cruising smoothly at FL 190 when Number Two experienced a severe compressor stall and then several minor ones. The pilot retarded the throttle to idle and the stalls ceased. He advised Lead of his problem and Lead immediately diverted the flight to the nearest suitable recovery base and moved into an observation position on the emergency aircraft.

During the idle descent, Lead briefed number two on approach and landing procedures, emphasizing airspeeds and techniques. EGT remained high and a heavy black smoke trail continued to exhaust from number two. The flight entered a precautionary landing pattern on the downwind leg and configured for landing. The turn to final was commenced and headwind encountered. It was at this point that the leader recognized that the glide slope as it was set up would not allow the sick bird to reach the runway. Lead directed number two to raise his flaps to one-half to extend the glide.

Altitude continued to decrease at a higher than desired rate and Lead advised number two to advance the throttle. The engine did not respond and Lead immediately ordered gear up. The airspeed increased and the glide angle reduced. As the aircraft passed over the overrun, gear was extended and a normal landing performed. (Maximum airspeed for drag chute deployment had already been discussed.) The engine was shut down with the main fuel shutoff valve switch.

There were several times during the approach that a decision delay of 2 or 3 seconds would have been disastrous. The flight leader didn't delay. He didn't cloud the radio with a lot of unnecessary chatter but he did exercise his command responsibility. He reassured the young pilot, provided pertinent information and directed him to a safe landing. This is really what flying safety is all about. ■

Reprinted from *Aerospace Safety*.

LIEUTENANT COLONEL
Ronald L. Butler

CAPTAIN
Michael D. Mechsner

91st Tactical Reconnaissance Squadron
Bergstrom Air Force Base, Texas

■ On 17 July 1981, Lt Col Butler, aircraft commander, and Capt Mechsner, instructor pilot, were flying an RF-4C on a single ship, low level reconnaissance training mission. At 700 feet above the ground and 420 knots ground speed, they struck a juvenile broadwing hawk which shattered the left windscreen. Bird and windscreen fragments exploded into the cockpit striking Col Butler in the face and left shoulder area. The impact tore his oxygen mask from his face and rendered his left arm useless after severely cutting the upper bicep. As they had previously briefed, Capt Mechsner took control of the aircraft, climbed toward a safe altitude, and decelerated. As the aircraft began to climb, Col Butler felt Capt Mechsner shake the stick and knew the plane was under control. Capt Mechsner noticed the EJECT light was illuminated, but being unable to communicate with his front seater he analyzed the situation and maintained his body in position, but otherwise disregarded the light. He transmitted a Mayday call while turning the aircraft toward home base. He contacted Houston Center and declared an emergency. Col Butler repositioned his mask and regained intercockpit communications quickly verifying to Capt Mechsner that he had not activated the EJECT light, that he was in great pain, and his left arm was useless. Due to bird remains in the front cockpit and wind blast in the rear cockpit, Capt Mechsner had great difficulty seeing out of the aircraft. He requested a chase aircraft to aid him in returning to Bergstrom. Col Butler used his right hand and lowered the landing gear, flaps, and the tail hook. As the chase aircraft arrived, approach control began vectoring the two aircraft to a 12-mile final. Approach control positioned the formation on a five-mile final, and at one mile Capt Mechsner took over visually. Bird remains and the aircraft attitude almost totally obstructed forward vision through the windscreen and canopy, so Capt Mechsner flew the approach by displacing the aircraft from the left side of the runway. Col Butler and the chase aircraft aided Capt Mechsner by giving verbal reports of the plane's position relative to runway centerline. Capt Mechsner flew a flawless approach and successfully engaged the approach-end arresting cable. Col Butler shut down both engines with his right hand, and crash/rescue personnel aided the crew in deplaning. The professional competence, superior airmanship, and crew coordination displayed by Col Butler and Capt Mechsner prevented possible loss of life and a more serious aircraft mishap. WELL DONE! ■

☆U.S. GOVERNMENT PRINTING OFFICE: 1982 — 583-020/1008

UNITED STATES AIR FORCE

Well Done Award

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

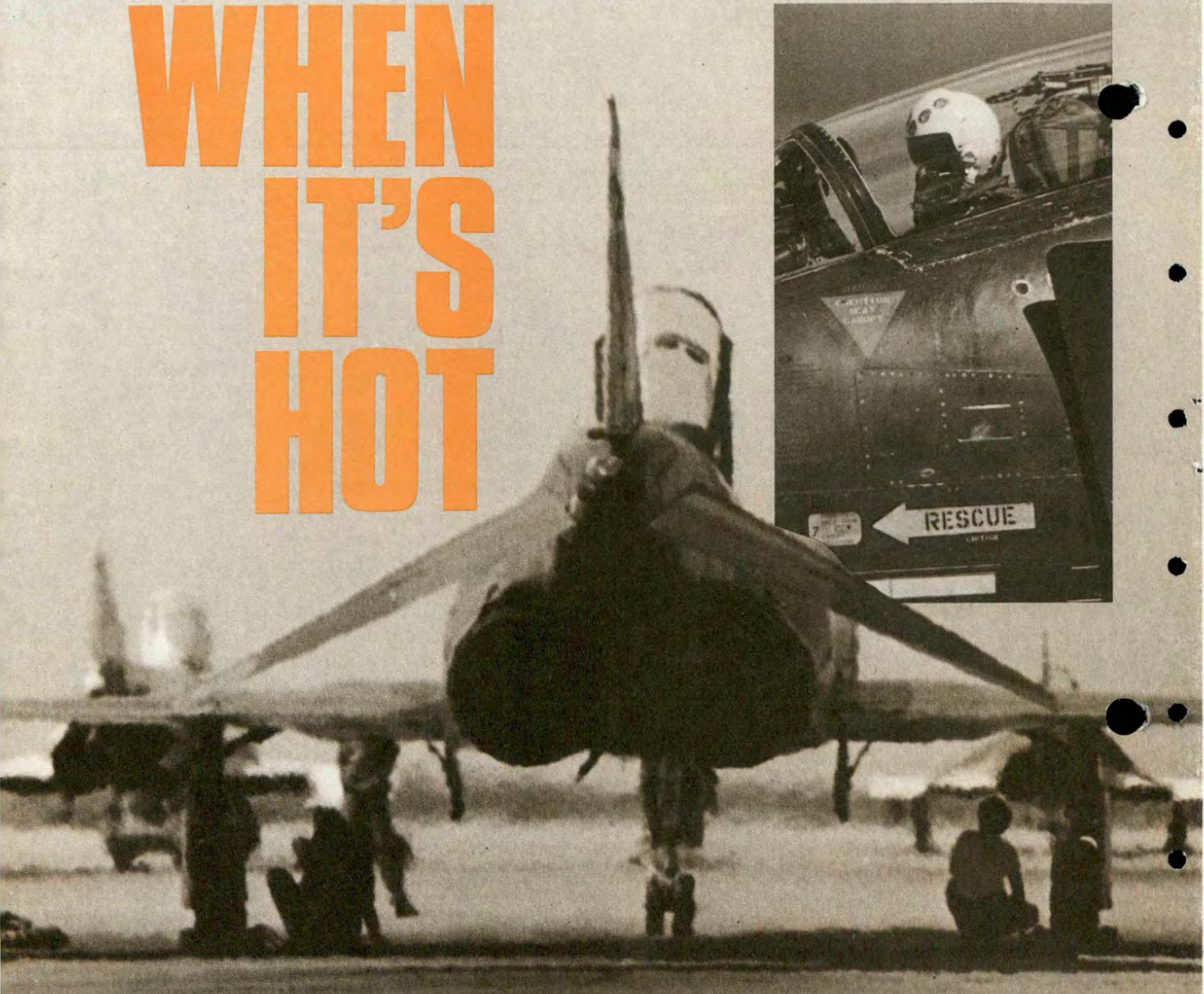
MAJOR

Phillip G. Anderson

58th Tactical Training Wing
Luke Air Force Base, Arizona

■ On 6 July 1981, Maj Anderson was flying as wingman in a two-ship F-104G navigation training flight. After cruising uneventfully at FL280 for over an hour, his engine suddenly decelerated and then accelerated, followed rapidly by an rpm rollback to 88 percent. He engaged the start switches, declared an emergency, and assumed lead of the flight. During the turn toward the nearest suitable emergency field, the engine flamed out. Although he was able to restart the engine, it only ran for approximately two minutes before it flamed out again. This time the rpm decreased below 40 percent before the engine recovered. While setting up a high key abeam the runway at 16,000 feet, he was forced to restart the engine two more times. Visually acquiring the runway at Forbes Field, Kansas, he contacted the tower and informed them of his emergency and desired approach. Poor in-flight visibility compounded his approach problems. The TACAN at the field was out of service, forcing Maj Anderson to remain within 4 NM of the field during his flameout approach. He was able to use idle, speed brakes and G forces to place the aircraft on a 4 NM final at 4,000 feet AGL. During the turn to final, the engine flamed out again and was restarted. A series of high G turns were accomplished on final to slow the aircraft to gear lowering speed of 260 KIAS just prior to the overrun. As he lowered the gear and initiated the landing flare, the engine flamed out again, and a successful dead stick touchdown was accomplished at 200 KIAS. After touchdown, Maj Anderson restarted the engine successfully to provide normal braking, deployed the drag chute, and was able to stop the aircraft on the nonbarrier equipped runway. The superior airmanship and situational awareness demonstrated by Maj Anderson in executing this difficult recovery prevented the probable loss of a valuable aircraft and possible loss of life. WELL DONE! ■

WHEN IT'S HOT



Don't Lose Your Cool

Use Minimum Ground Time

Drink Plenty of Fluids

Avoid Heavy Exercise Before Flight