Our 50th Year

flying SAFETY

AUGUST 1994

THERE I WAS

■ In 1974, aircraft maintenance had just been opened up to women. I was one of the first women maintainers on the base.

In those days, we didn't have "shadowed" tool boxes or even marked tools. In fact, most of the time, the folks on the line used their own tools. I had not needed tools before this and, therefore, used the shop tools when I went out on jobs.

One summer day, we had an instrument writeup on a KC-135. I was using a socket wrench, and when I changed sockets, I put the old one down next to the throttles. A few minutes later, I reached for some other tools in the copilot's seat. The socket near the throttles fell over and rolled down into the throttle bay.

I was horrified. I tried to reach my hand down into the bay to get the socket, but I couldn't find it. My supervisor was due by to check on me soon, so I finished up my job and went downstairs to tell him about the FOD and ask him to get the flight controls guys out to open up the throttle bay.

"What are you worried about?" he asked. "I have another one of those in my truck. We'll just go in and get it."

I was astounded and told him so.

"What's your problem?" he said.

"That tool could cause an accident!" I said.

"So what? They're officers, and no concern of yours. Besides, that'd be one less pig we'd have to work on."

I told him I couldn't go along with him, and I was going to report the lost tool.

"Well, you'll never get anywhere in this man's Air Force with that kind of attitude, I can tell you!" he said in disgust.

It took 4 hours and a lot of razzing to get the socket out of the throttle bay, but I did it. I also have completed nearly 20 years of service, during which I was commissioned, and I now hold the rank of captain.

The moral of the story? Peer pressure isn't limited to teenagers. Integrity is just as important an attribute in an airman basic as it is in a general. Stand up for what's right, ignore the doomsayers who try to lead you off the path, and you will get somewhere in today's Air Force. ■

Our 50th Year

UNITED STATES AIR FORCE

Flying Safety

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Cover photo by Captain Denny Peeples

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SPECIAL FEATURES

REGULAR FEATURES

DEPARTMENT OF THE AIR FORCE • THE CHIEF OF SAFETY, USAF

PURPOSE — *Flying Safety* is published monthly to promote aircraft mishap prevention. 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 mishap stories are fictitious. The contents of this magazine are not directive and should not be construed as instructions, technical orders, or directives unless so stated. **SUBSCRIPTIONS** — For sale by the Superintendent of Documents, U.S. Government Printing Office (USGPO), Washington D.C. 20401; send changes in subscription mailings to the USGPO. Back issues of the magazine are not available. **REPRINTS** — Air Force organizations may reprint articles from *Flying Safety* without further authorization. Non-Air Force organizations must advise the Editor of the intended use of the material prior to reprinting. Such action will ensure complete accuracy of material amended in light of most recent developments. **DISTRIBUTION** — One copy for each three aircrew members and one copy for each six direct aircrew support and maintenance personnel. Air Force units must contact their base PDO to establish or change requirements.

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Photo by CMSgt Don A. Bennett

FOD PREVENTION PROGRAM:
Manage It — Don't Damage It!

CMSGT DON A. BENNETT
Technical Editor

■ *FOD prevention programs throughout the Air Force are sound, proven management tools for eliminating FOD damage to USAF aircraft. However, in the majority of recent mishaps, FOD damage occurred because someone failed to execute already established policies.*

Here's a sampling of some people "sleeping at the wheel." You decide who. (Hint: Look past the obvious.)

▪ A crew chief (avionics technician) finished the **prelaunch duties** and the pilot completed a **preflight inspection**, but **both** failed to catch an external protective cover with attached streamer still installed on the mission aircraft. The FOD incident was discovered *upon the aircraft's landing!*

▪ Workers 1 and 2, jet engine mechanics, and workers 3 and 4, crew chiefs, were tasked to perform an engine balance. Both W2 and W3 were supervisors in their trades.

W1 performed the inlet work on one engine, inspected the inlet for FOD, exited the engine, inventoried the toolbox, and gave the clearance to start the engine. W2 and W3 ran the engine with W2 as the run supervisor. W4 saw sparks coming from the engine exhaust and had it shut down. Upon discovery of FOD damage, W1 and W2 each reinventoried the toolbox with no tools missing. W1 initiated a *fourth* toolbox inventory and discovered the missing tool.

▪ An instructor and students (S1 and S2) went to the hush house for engine run training. Both students installed the engine's antipersonnel screen. The screen required minor repair work, so S1 received a tool from the hush house manager.

After the repair work, **everybody** assisted in conducting a pre-engine run FOD check. Another tool inventory *was not* accomplished after the antipersonnel screen maintenance was performed! The FOD damage caused by S1's missing tool was found on the post engine run inspections.

▪ An engine mechanic blended some nicks on an engine's fan blades. The mishap toolbox was inventoried before and after the work by toolroom personnel and the mechanic. The mishap aircraft departed on an overseas mission.

Meanwhile, the mishap toolbox was issued to another mechanic. On this occasion, however, a tool was discovered missing, but a lost tool report *was not* initiated. Upon turn-in, again *no* action was taken on the missing tool. The mishap aircraft returned and underwent a special engine inspection. Any engine FOD damage would have been discovered during this inspection, but none was found.

That same day, the mishap toolbox was issued to yet another mechanic, but still there was *no* lost tool action. However, upon its return, a different toolroom technician found the tool missing and initiated a lost tool report. A search was terminated by a production supervisor who determined the mechanic *did not* actually use the toolbox, therefore wasn't accountable for the lost tool. Also, the supervisor *did not* know where else to conduct a search for the missing tool! (Guess no one thought about looking at the toolbox's Sign In/Out log.)

The next day the aircraft departed on a cross-country trip. While at an en route base, a maintenance team performed an engine FOD check and found the damage. Also, part of the tool was found imbedded in the inlet. Apparently, it was on this leg the tool had finally become dislodged from within the engine nacelle area and FOD damaged the engine — **almost a week from loss to damage!**

▪ There isn't enough space to recount *all* the FOD mishaps caused by loose, worn, or wrong-type securing pins on engine antipersonnel screens. **A safety and FOD prevention device causing many FOD mishaps — *incredible!!***

Well, maintenance managers, what's your opinion? ■

FATIGUE MANAGEMENT — New Insight

Photo by Bob King

Aircrews are particularly susceptible to the effects of fatigue. Here's a new examination of an insidious problem.

LT COLONEL COURTNEY D. SCOTT, JR., MC, FS
Chief, Flight Medicine
Office of the Command Surgeon, AMC

■ When we were young, it was fun to stay up late — maybe even all night. Then there was college and the occasional all-night cram session before a major exam. No problem.

Today's geopolitically demanding climate which drives our work patterns in AMC clearly gives us many chances to stay up all night. Unfortunately, this circumstance lacks a party aspect and often involves dangerous work activities. Perhaps the most important danger is fatigue.

Fatigue is classically defined as weariness due to bodily or mental exertion. By this antiquated construct, fatigue is simply attributed to workload. Over the past few years, the relatively new discipline of chronobiology has demonstrated biological clock and circadian rhythm phenomena exert great influence on our fatigue patterns.

In this article, I discuss some of the most common questions asked about fatigue in terms of chronobiology and review what you can do to improve your fatigue management. There are always individual variations, but if you understand the scientific principles, you can adapt your own solutions accordingly.

"The feeling of sleepiness when you are not in bed, and can't get there, is the meanest feeling in the world." **— Edgar Watson Howe**

Why is it my jet lag is much worse when I fly eastward than when I fly westward?

To really understand the answer to this question, one has to have a working knowledge of circadian rhythm. Many measurable biological processes vary in a rhythmic manner. Some of the more easily recognized include sleep and wakefulness, urine production, and body temperature. The periodicity of these rhythms follows a pattern we call circadian (*circa*, about and *dies*, day).

The natural period is between 23 and 27 hours, but these are ordinarily adjusted to 24 hours by environmental cues. If the 24-hour day cues (such as sunlight and social patterns — family behaviors, alarm clocks) are removed or disrupted, the period tends to lengthen so the average time is about 25½ hours.

If one needs to resynchronize the rhythms to a new external time, it is much easier to phase delay toward this 25½ hour period, equivalent to westward travel, than to phase advance, equivalent to eastward travel. In the latter case, if many time zones are crossed, the individual is subject to severe circadian desynchronization. Reestablishing a synchronized circadian pattern trained to local cues can take a significant time — approximately 1.5 days for each time zone crossed.

The process of normalization does not occur all at once; each rhythm pattern tends to establish itself somewhat separately. Some rhythms advance while others delay. This can make a human extremely dysfunctional for a few days.

Why is my sleep pattern so variable after a long mission? Sometimes I sleep for 7 or 8 hours and feel rested and other times sleep for 12 hours and wake up still feeling tired.

Sleep patterns are highly correlated with body temperature patterns as shown in figure 1. If one initiates sleep near the peak of temperature, the average duration of sleep will be 14 to 16 hours, regardless of the presleep workload. Sleep initiated at the body temperature trough will last only about 8 hours and will end when the temperature pattern begins to increase.

These two sleep patterns are also

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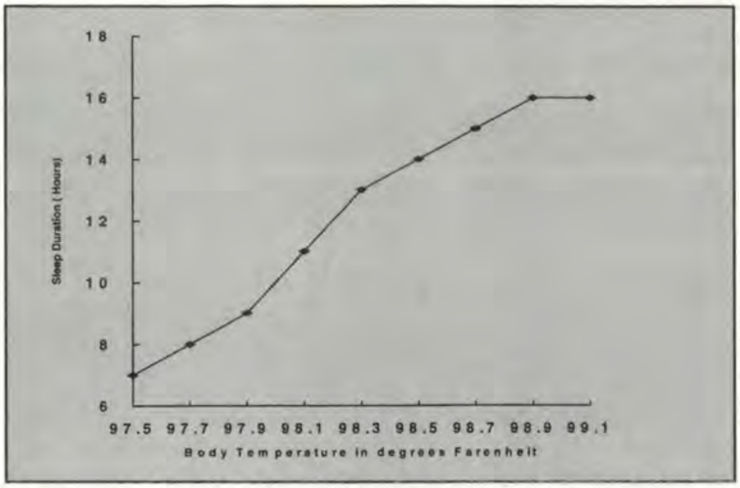


Figure 1

FATIGUE MANAGEMENT—New Insight

continued

very different. Rapid eye movement (REM) sleep, which is important to feeling rested, occurs primarily at the temperature trough. In sleep initiated at the temperature peak, REM sleep does not occur until the second half of the sleep cycle. In sleep initiated at the temperature trough, REM sleep occurs early in the sleep cycle.

The message here is the critical factor controlling sleep duration, and to some extent sleep quality, is the time in the temperature cycle that mission sleep is initiated, not the presleep workload. The educated aircrew member in crew rest after a long mission can plan sleep timing to optimize the rest from that sleep.

Why is it that, at certain times of the day, I often seem to get sleepy regardless of how rested I am?

Several factors govern the sleep/wake cycle. One of the most important is a hormone called melatonin (different from melanin which is involved in skin pigmentation). The release of melatonin is strongly affected by light. At dusk, the blood level of melatonin begins to rise precipitously; at sunrise, the melatonin level falls off sharply.

Melatonin can be obtained commercially but is not yet recommended as it has not been tested for flying safety. The hours between 0300 and 0600 show a profound sleep peak in the sleep/wake cycle. Other factors governing the sleep/wake rhythm cause a pronounced turn toward sleep in the midafternoon. This correlates well with a highway accident study from rural Texas that showed a pronounced peak in accidents at 1500 hours.

All other factors aside, these two times of the day — midafternoon and 0300 to 0600 — are the most dangerous for fatigue.

Now that I'm getting older, why is it I can't seem to adjust to these crazy hours like I used to?

Many biologic systems demonstrate a remarkable capacity to adapt to stress; however, most systems, including circadian rhythm, lose some of this capacity with age. Many workers who are on rotating shift work schedules report after age 40 to 45 they simply "can't do it any more," even after having successfully managed this for a number of years. The offset to the loss of ability to circadian adapt is experience. Older people exposed to circadian desynchronization on a frequent basis usually learn other coping mechanisms which allow them to adjust.

How much does my performance really diminish when I am tired?

Performance decrement varies in individuals but shows to some extent in virtually everyone. Untrained individuals in complex cognitive tasks may demonstrate a 75 percent decline in performance with fatigue. Trained, experienced individuals accustomed to dealing with fatigue may show only about a 10 percent decrease.

A recent sustained bomber operations simulator study showed that when crews performed three missions with adequate rest between, performance significantly improved in the third mission over the first. This suggests a training effect for dealing with fatigue in the sustained operations setting.

Inadequate rest between work cycles allows the buildup of fatigue. This is often called cumulative fatigue. Acute and cumulative fatigue are synergistic, not merely additive. This is why we restrict total hours per unit of time.

Like most other measurable performance parameters, crew coordination diminishes with fatigue. One of the dangers in the multicrew setting is a tendency to rely on other crewmembers when one is tired. One civilian study of a night transoceanic flight showed that during the hours of 0400 to 0600, with

The critical factor controlling sleep duration is the time in the temperature cycle that mission sleep is initiated, not the presleep workload.

the plane on autopilot, all five crewmembers displayed brain wave patterns characteristic of sleep or extreme drowsiness.

What are some predictors of in-flight fatigue?

The best predictor of in-flight fatigue is *preflight* fatigue. Aircrew members need to be fully rested at the beginning of the mission. Mission planning should reflect this, and individual crewmembers must take personal responsibility to comply. Other predictors include:

■ Landing times later than 0230;

■ Landing times more than 14 hours after waking or 10 hours after arriving for work;

■ Flying on the fourth day (cumulative fatigue);

■ Flying a second sortie.

What measures will minimize fatigue?

Most people are aware physical fitness improves performance in the face of fatigue. Yet surveys of AMC crews involved in sustained operations revealed an interesting result: Only 42 percent exercised three or more times per week. Personnel subject to sustained operations taskings must perform regular aerobic exercise in order to optimize their performance.

One should not overlook the importance of motivation. Fatigue-induced performance decrement is remarkably influenced by the degree of motivation.

Another factor often overlooked is nutrition. Our current approach to in-flight meals is simply not adequate nutrition for a lengthy flight (greater than about 8 hours). Small, nutritious hot meals are very helpful in reducing the effects of fatigue. Diet selection should emphasize high protein meals for flight and high carbohydrate meals for crew rest. Legumes, nuts, and grains may actually increase sleepiness and are not recommended on long flights.

Hydration is important. There is a tendency to not keep up with fluid requirements on long flights. Aircraft commanders must insist on good water discipline for their crews.

The use of caffeine can be helpful in increasing vigilance and reaction time. Persons not accustomed to using caffeine should be cautious with dosing as it can be a powerful drug. Other medical stimulants have been found to be effective, but concerns still exist about their safety.

F ully Rested

A ttitude

T raining

I nflight Naps

G ood Hydration and Nutrition

U nderstanding Circadian Rhythms

E xercise

Figure 2

In-flight naps are definitely helpful but need to be timed carefully. Naps lasting from 1 to 2 hours can be refreshing, and they don't have a major impact on regular sleep cycles.

Figure 2 shows a simple mnemonic device summarizing the above tips for overcoming fatigue.

What is the most sensible approach to circadian shift?

One important decision that must be made is whether or not to try to shift the circadian rhythm to match the time zone of destination. When only a brief stopover for crew rest followed by return to home base is planned, the prudent thing is to not circadian shift. Here, crewmembers should keep their wristwatches set to home time and perform their normal daily activities around this as much as possible. They should avoid bright sunlight during their home night hours and should expose themselves to as much bright light as possible during their normal daylight hours.

Crew rest facilities need to provide support correlating with crewmember home time zones. This may require opening the dining hall at 0200 for "lunch" and setting up recreational activities at unusual hours, but this is what aircrew support requires.

If the crew will be staying for more than about 3 days in the new time zone, it is best to go ahead and resynchronize one's circadian rhythms with the new time zone. With only a few days' advance notice, a trained and motivated crewmember can preshift the circadian rhythm. This is done by delaying or advancing the sleep/wake pattern. Kits with dark glasses and light visors are commercially available to assist with this.

Recall that the capacity to phase advance is limited, and one should phase advance only a maximum of an hour per day. As much as possible, environmental cues such as light and family social style should be shifted to help adjustment. Family members need to understand the basics of circadian rhythms to fully support their fliers.

Fatigue is a real hazard for AMC personnel, and it is not going to disappear. The first step in improving management must be to expand our knowledge base on this topic. We can then minimize the impact of fatigue by integrating this knowledge into our daily living and mission planning. ■

Courtesy *The Mobility Forum*, May-June 1994.

Have you ever been airsick? If so, you would remember it! Today, even though
to this question is still as elusive as nailing Jell-O® to the wall.

What *Really* Causes MOTION SICKNESS?

... And how do you treat it?

FREDERICK V. MALMSTROM, Ph.D.
Ohio Department of Rehabilitation and Correction

■ If you'd asked 10 years ago what the causes of motion sickness are, I probably could have confidently given you an answer. Today, even though research into motion sickness continues at a very fast clip, finding the answer to this question is still as elusive as nailing Jell-O® to the wall.

My observations and investigations into motion sickness point more and more to an obvious conclusion motion sickness isn't a unitary "sickness" per se. Yes, it's a sickness insofar as nobody "wants" it. But it's more a syndrome — that is, it's a collection of symptoms which may have many, many causes.

Just as there is no specific cancer,

research into motion sickness continues at a very fast clip, finding the answer

schizophrenia, or even common cold, there is no specific motion sickness. All of us have slightly different learned behaviors, body wiring and chemistries, and heredities which constantly complicate our understanding and treatment of motion sickness. Therefore, I'd like to present the three various "causes" of motion sickness — behavioral, physiological, and hereditary factors.

1. Motion Sickness is Learned

In two previous *Flying Safety* articles (February 1984 and June 1991), I discussed at least two major findings suggesting motion sickness can be learned. (No, I am not making this up.)

First, extensive laboratory investigations from researchers Dr. Patricia Cowings of NASA/Ames Research Center, and Dr. Thomas Dobie of the Naval Biodynamics Laboratory, find behavioral treatments such as biofeedback and cognitive-behavioral desensitization training are effective treatments for motion sickness. These jaw-breaking clinical psychological terms have been used for years to treat psychosomatic (i.e., "it's all in your mind") illnesses and various other forms of anxieties.

According to Dr. Dobie, motion sickness is greatly elevated by anxiety. Indeed, Dr. Cowings found many laboratory subjects would experience full-scale motion sickness symptoms (including vomiting) even before her motion sickness experiment began! Apparently, just the anticipation of getting there is half the agony.

Second, the more recent emergence of a mystifying phenomenon, called "simulator sickness," has given researchers like Dr. Robert S. Kennedy of the Essex Corporation no end of employment. Simulator sickness is a weird combination of nausea, inability to walk a straight line, and even flashbacks of disorientation which sometimes occur in *high-time,* experienced pilots after completing simulator rides.

Apparently, high-time, experienced pilots are (subconsciously) quick to pick up on minor differences between aircraft and simulator performances, and their bodies quite literally rebel with motion sickness symptoms. Simulator sickness is potentially quite dangerous, so Army and Navy aviators are frequently prohibited from flying within 24 hours of a simulator ride.

2. Motion Sickness is Physiological

Regarding motion sickness as a medical problem is probably more familiar ground to most of us. After all, there are people called flight surgeons and otolaryngologists (i.e., ear, nose, and throat specialists — also known to their colleagues as "Dizzy Doctors") who spend a high proportion of their time treating motion sickness.

By far, the most common "cause" of dizziness (but not necessarily motion sickness) seen by the garden-variety physician is the common cold. Viruses are associated with abnormal inner ear pressure and a buildup of fluid behind the eardrum. No mystery here.

There are long lists of medicines and treatments available ranging from "not so good" to "somewhat better than not so good." It is the frank, professional (and board-certified) opinion of Kenneth J. Dvorak, M.D., that medical treatment is often a quite subject-specific, hit-and-miss proposition. His clinical experience suggests all these treatments combined have a success rate of less than 15 percent! And so he quotes the anonymous, but honest, Native American medicine man, "Sometimes the medicine works; sometimes it doesn't."

Medical treatment does not always work probably because there are several locations in the brain and body which can control motion sickness. Mark Sanders of California State University, Northridge, cites evidence motion sickness can be divided into two general classes — HEAD and GUT.

The first head location is, of course, the inner ear. The inner ear contains three semicircular, fluid-filled canals which are largely responsible for controlling the vestibular response — your ability to orient yourself in space. To set these motion detectors going at cross-purposes, you need only to spin yourself around 10 times quickly on a piano stool (or imbibe three martinis, or both) and then attempt to walk a straight line. Drugs like atropine (belladonna alkaloid), dimenhydrinate (Dramamine), and scopolamine (Transdermal patch) inhibit vestibular responses to the central nervous system.

The second head location is the brain stem (specifically the reticular formation) which contains the vomiting center. Drugs such as scopolamine and atropine may also affect the reception of impulses to the brain stem. Valium is commonly used posttreatment to treat the anxiety which seems to elevate symptoms of motion sickness.

More recently, William Chelen, M.D., and Matthew Kabrisky, Ph.D., of the Air Force Institute of Technology, have found promising leads in the treatment of motion sickness with low levels of the antiepileptic drug phenytoin (Dilantin). Dr. Chelen, himself an undergraduate electrical engineer, discovered the electroencephalographic "brain waves" which occur prior to epileptic seizures also occur prior to the onset of motion sickness.

Administration of a small "day before" phenytoin capsule has been noted to reduce motion sickness symptoms as much as fourfold. Clinical trials of phenytoin are also

continued

believed to suppress motion sickness indicators in yet a third head location known as the cerebellum.

Gut-based symptoms have been successfully treated with biofeedback by Dr. Joe Kamiya of the University of California, San Francisco Medical Center. For the future, Drs. Chelen and Kabrisky have planned clinical trials with the gut hormone vasopressin.

Treating motion sickness with medications is probably all right for use with the general population but to aviators, the side effects could be pure disaster. Side effects of scopolamine and atropine are drowsiness, dry mouth, blurred vision, confusion, loss of memory, hallucinations, and — believe it or not — dizziness. Side effects of valium are drowsiness, depression, fatigue, and ataxia (an inability to coordinate voluntary muscular movements). Side effects of phenytoin include fatigue, drowsiness, confusion, insomnia, and headaches.

And, to make matters worse, few physicians consider the withdrawal symptoms these medicines produce, such as dizziness, nausea, headache, and equilibrium disturbances. Use of medications is not a pleasant thought to either flight surgeons or aviators. The cure is frequently worse than the disease itself.

3. Motion Sickness is Hereditary

To my great surprise, I could find practically no references indicating the hereditary nature of motion sickness. Other than obscure hints from the 1920s that women are more susceptible than men (untrue — there are no reliable sex differences) and the heritability of rare disorders like Meniere's disease, I came up with a blank. (Meniere's disease is characterized by occasional dizziness, hearing loss, and ringing in the ears, probably brought about by a small drainage duct in the inner ear.)

My own research into the hereditary factors was spurred by observations from one of our graduate students, Thomas L. Yanus, of Embry-Riddle Aeronautical University, that complaints of motion sickness seemed to run in families. Indeed, it practically seemed to gallop. Therefore, in 1992-3, we conducted two purely statistical surveys in which we computed the heritability of motion sickness symptoms of both subjects and their natural parents. The results are classical and were presented to the 1994 Annual Convention of the Human Factors Society.

WOULD YOU LIKE TO PARTICIPATE IN A SURVEY?

Do you have direct knowledge of both your natural parents' reaction to travel (air, land, or sea) and their motion sickness histories (whether absent or present)? I'd like to send you a survey. You may drop a self-addressed postcard to us at:

Dr. Frederick V. Malmstrom
Psychological Services, OCI
P.O. Box 511
Columbus OH 43216

or call *Flying Safety* magazine at:

(505) 846-0950/DSN 246-0950 and leave your name and address.

I'll publish the results in a future issue of *Flying Safety*.

In the first survey, we queried 83 male graduate students as to the severity of three major motion sickness symptoms (fatigue, headache, and nausea) of both subjects and their natural parents. In the second survey, we queried 95 male and female members of an Air Force Reserve medical unit as to the frequency of their motion sickness symptoms and their natural parents.

First, we found the severity of all three motion sickness symptoms (fatigue, headache, and nausea) was strongly predicted by the father's symptoms. Second, we found the frequency of the motion sickness symptoms of fatigue and headache (but not nausea) was predicted by both father's and mother's symptoms. Contrary to previous reports, neither the subjects' sex nor age were implicated.

Finally, the incidences of motion sickness symptoms reported by our population were almost in the same, identical classical proportions as the hereditary incidences of disorders such as cancer, schizophrenia, and diabetes.

At this stage of research, application of gene splicing as a cure for motion sickness would probably be a bit dramatic and uncalled for. However, our results suggest there is much research left to be done on the relationships between motion sickness and heredity, and much larger populations need to be studied.

In conclusion, I confess the problem of motion sickness has become more complicated than I ever intended. The federal government annually invests millions of dollars studying this problem, and yet the final answers elude us. That's normal for good scientific research, as good research tends to raise more questions than it answers.

For now, it seems the ultimate "cure" for motion sickness is a long way off. The cure may well be a combination of biofeedback, medical, and hereditary precautions. In the meantime, follow your flight surgeon's advice, and use prescription medicines only as directed. ■

The Author

Frederick V. Malmstrom, Ph.D., is a Clinical Psychologist with the Ohio Department of Rehabilitation and Correction. He is a mental health technician with the 35th Aeromedical Staging Squadron (AFRES), Wright-Patterson AFB, Ohio.

IS TROUBLE-SHOOTING A DYING ART?

Not identifying and investigating repeated replacements of otherwise performance-proven parts is just another example of poor troubleshooting.

CMSGT DON A. BENNETT
Technical Editor

■ Troubleshooting: It's not dead yet, but, if we aren't careful, it could be.

Make no mistake about it. Troubleshooting has been and will always be a fine art encompassing expert mechanical knowledge and skill. It's a skill that's critical to our success as Air Force maintainers. It's also a skill critical to our ground and flight mishap prevention programs.

But it's *not* a skill that's developed easily. Our mechanics master it with varying degrees of ease. For some, it comes naturally — for those with analytical mindsets. For others, it takes years and years of education, training, and experience.

However hard fought to obtain the expertise, one thing is for certain: Maintainers must be capable of properly troubleshooting and repairing our aircraft for safe flight.

There is a slow deterioration of one of the most critical skills our Air Force maintainers **must** possess. It will take a concerted effort from all of us in the aircraft maintenance business to turn the tide.

Beside the obvious mishap prevention aspect, we must also be extremely concerned with the monetary impact of improper troubleshooting. Damaging or wasting limited resources will continue to affect mission readiness and effectiveness.

Today's reduced budgets and manning strengths demand an acute awareness of our critical resources. In the past, when we were pretty satisfied with manning and money, we still couldn't afford the waste. However, in this day of sweeping changes, we are forced to extreme frugality.

Safe, quality maintenance, coupled with resource conservation, has and always will play a significant role in mission success and mishap prevention.

Swap-ology

Some time ago, our aircraft maintainers coined phrases or words like "black box maintenance" or "swaptronics" to describe the results of poor troubleshooting. Although these terms tend to be slanted toward electronics systems only, they apply to all aircraft systems.

They basically mean a mechanic will keep swapping things out until the affected system or subsystem finally works. Mechanics frequently employing this technique were inadequately trained or had received little or no troubleshooting training. Additionally, there were others who were adequately trained but failed to stay proficient.

One of the most significant factors in driving a mechanic to perform swaptronics maintenance is *time!* An inexperienced mechanic performing "red ball" maintenance on an advanced, complex aircraft system usu-

continued

IS TROUBLE-SHOOTING A DYING ART? continued

ally doesn't have the patience or the confidence to adequately troubleshoot an immediate-launch aircraft.

Results of Swap-ology

Whatever the reason, swap-ology troubleshooting is pretty expensive in terms of spare parts and premature system wear and tear.

There are times when an undetected system fault will "fry" a new, good part which isn't the cause of the problem. There are also many cases of maintainers chasing ghosts by treating the symptoms of a system fault instead of the cause.

Even the simplest system fault can be misdiagnosed and subsequent maintenance only masks or worsens the original condition. This last example is certainly true in automatic flight control systems and flight control rigging. Make an initial mistake, and the resulting cascade effect can haunt a mechanic for many hours.

Mechanics weak in troubleshooting skills sometimes resort to swapping out the most probable parts immediately. Others, with partial troubleshooting skills, will start swapping only after running into a dead end. Most of the time this procedure happens on aircraft or equipment with writeups tending to have chronic "could not duplicate" corrective actions. This "hit and miss" approach to problem solving does, in fact, get many aircraft missions off on time.

However, there are some side effects. An aircraft was recently destroyed on the ground after some very unorthodox methods of troubleshooting (among other questionable maintenance practices).

One of the most disturbing side effects of swap-ology is the "ripple effect" of trainers: Inexperienced in troubleshooting, they pass on bad habits to their students. This situation is aggravated when many of our expert troubleshooters opt to early-out or retire during the current force reduction. Therefore, our maintainers' troubleshooting training, education, and experience levels are slowly degrading.

Lack of Training and Education

Unfortunately, AFSA records indicate there are numerous mishaps where weak qualification and proficiency training programs are also to blame. Clearly, training and troubleshooting go hand-in-hand. Sound, quality troubleshooting techniques require expert aircraft systems knowledge and skills. Therefore, it's imperative maintainers receive top quality aircraft systems qualification and proficiency training and education.

Expert on-the-job troubleshooting trainers need to take the needed time to pass on all the traits, qualities, and experiences for yet another generation of expert troubleshooters. It's important to reemphasize at this point many of these experts or corporate "old heads" are retired, going to retire, or getting out early. Maintenance commanders, managers, and supervisors beware!!

Is troubleshooting a dying art?

We will be entering the next century with aging aircraft as well as aircraft with extremely complex and state-of-the-art systems technology. Both the new and old will demand maintainers possess advanced troubleshooting skills.

Today, we still have many maintainers with excellent troubleshooting skills, but what about the turn of the century?

Proper Environment

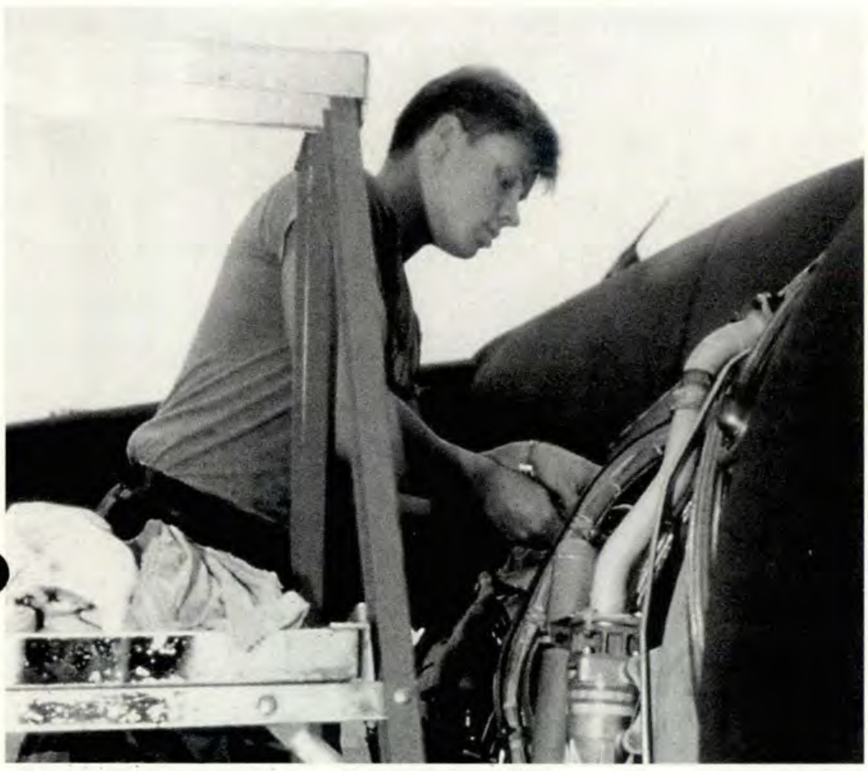
Many years ago, an airlifter was being prepared to launch on a highly visible special mission. The aircrew discovered a grounding condition when a system's in-the-green indication light failed to illuminate.

With 2 hours to go before the scheduled takeoff time, there was a flurry of unorganized activity to correct the problem. Everybody from the Deputy Chief of Maintenance down to the shop chief was on the jet trying to find the problem.

Fifteen minutes into a delay, and with every possible avenue already explored three times over, a young airman climbed into the flight station for a shift change turnover. After listening to all the urgent chatter from at least a dozen or so people, he calmly snaked through the people to the errant light indicator. He took an already *lit* 327 peanut bulb out of another system's control panel and put it in the bad indicator's light socket and **"BINGO" ... it worked!**

It was obvious everything was checked three times over, except the light bulb. The flight engineer's initial action of replacing a light bulb convinced everybody, except the

A critical element to the health and well-being of our maintainer force and mishap prevention programs relies on maintenance supervisors and leaders to create a safe, quality environment — an environment which promotes effective training and education. Then the fine art of troubleshooting will flourish.



young airman, that it was not the bulb. Consequently, they all failed to recheck the light bulb again, even when all the other checks continually turned up no system abnormalities.

Everybody involved must have reminded themselves of the old adage ... "haste makes waste." Supervisors and senior maintenance managers were reminded about stepping out of the way and letting the experts fix the problem without undue pressure and stress.

Supervisors, managers, and mechanics alike got caught up in the act, and somewhere along the line, their common sense and logic tools were overlooked in the repair effort.

The pressure placed on the mechanics created an undesirable atmosphere which virtually sanctioned maintenance "swaptronics" shortcuts. An atmosphere, if still repeated, which could create a generation of mechanics without the proper troubleshooting proficiency and experience to become "experts" in their specialty or trade.

A critical element to the health and well-being of our maintainer force and mishap prevention programs relies on maintenance supervisors and leaders to create a safe, quality environment--an environment which promotes effective training and education. Only then will the fine art of troubleshooting flourish.

This will ensure our maintainers meet the challenges of maintaining our older aircraft as well as those packed with advanced technology. During these austere times of dollar and spare part shortages, we cannot afford to do anything less! The lives of others demand it! ■

Mishap Research

■ Research of hundreds of ground and flight incidents or mishaps occurring in just the last couple of years prompted this article. The following examples best illustrate the problems we face:

- An aircraft aborted on takeoff roll when a long-standing electrical backup system problem suddenly resurfaced and caused a momentary cockpit blackout. There was significant main gear damage during the abort. The last corrective action was only resetting the circuit breakers.
- An aircraft had to have three functional check flights to finally find the real system malfunction.
- An aircraft crashed during its third functional check flight for the same problem. Before its last flight, the corrective action was to change the most likely part to cause the otherwise, could-not-duplicate problem. (It was not the sole reason the aircraft crashed, but it certainly did influence the mishap scenario.)
- An aircraft landed with the nose landing gear up. Two separate maintenance shops played a major role in the mishap sequence.

One shop failed to follow the tech data in their inspect-and-repair activities. The other shop failed to document or see the significance in numerous replacements of a certain gear component.

- One piece of pneumatic ground support equipment damaged two different aircraft because of excessive air servicing output. The first incident was caused by a legitimate component failure. The second incident, however, was caused by misdiagnosing an excessive pressure problem and returning the unit to the flight line for use. ■

The Ultimate S.A.*

*Situational Awareness

CAPTAIN DENNY PEEPLES
494 FS
RAF Lakenheath

■ **Situational Awareness:** *"The capability to appropriately assess yourself, your system, and your environment in order to execute the right decision at the right time."*
LARSEN, 1991

Ultimate S.A.: *The highest level of S.A. that enables you to know when you and those around you are losing S.A. so that the loss may be arrested, S.A. regained, and the mission accomplished correctly and safely.*
"PEEPS," 1993

It's 0 dark-thirty Friday morning after a killer week, and during the drive to work, you are listening to the early morning guys on the radio when you see a car slowly pulling out in front of you. He doesn't see you, and you know it, so you cut him some slack as you slow down and let him join the traffic safely.

Four hours later, you are leading a two-ship of F-15Es to take out a C^3 facility during an exercise with the British in Scotland. Thirty miles prior to the target, two Tornadoes appear on your radar scope, and your WSO sorts the targets with your wingman. The bandits split and are confirmed "hostile," so you engage to work your way to the target. After

Photo by Captain Denny Peeples

You already have it ... But do you know it? Do you use it?

shooting your bandit, you notice your wingman is still welded close, mirroring your maneuvers.

"Mongl 2, your bandit is right, 2 o'clock, 15 miles." Mongl 2 acknowledges, engages his bandit, and you hit the target on time.

So how did these two seemingly unrelated incidents end up safely reconciled? Some people may say, "When the hair stands up on your neck, watch out." With the conscious, smart use of Ultimate S.A., the course of events should change so your hair will never stand up on your neck.

Ultimate S.A.: Knowing when you and those around you are losing S.A. How do you know when you or your wingman are having a bad day? In noncritical situations, I give everyone one error, one missed radio call. Then my antennae really listen out because a second mistake usually indicates a bad day, and guidance or correction needs to be given to regain S.A.

In time-critical situations, being off altitude or out of position, an unexpected radio intonation, or a missed radio call (remember your ears are the first to turn off during stressful situations), all are clues which could indicate S.A. is lacking to complete the mission.

Dr. Al Diehl, an Air Force Human Factors expert, calls it a "S.L.O.J., Sudden Loss of Judgment." What do you do when your Ultimate S.A. tells you that you are beginning to experience an "S.L.O.J."?

Recently an ATC radio call caught me off guard during some IMC flying, and I was told to turn on a 10NM right base when I thought I was on a 15-mile final. The radio call cued me something was wrong, and I tried to slow down my thoughts, made my actions more methodical, and reviewed the situation from all available inputs. I then reassessed the available inputs to see which was right — my inputs, ATC, or my initial thoughts.

This time I was right. I had been misidentified on radar. This reassessment could be as easy as asking my WSO, "What did he say?" Or it could be as complicated as handling an emergency checklist heads down, single seat while still flying instruments in the weather.

How do you use your Ultimate S.A. to your advantage? First, if *you* have lost S.A., 'fess up and get it back from the quickest, most reliable source, be it your wingman, WSO, copilot, navigator, or ATC (have you heard of CRM?).

Second, if you feel *those around you* are losing S.A., then communicate to them as concisely as possible (since time is usually critical) the problem and your solution so their S.A. can be turned around ASAP.

Third, if it doesn't involve immediate safety of flight and you can maneuver to correct the situation, do so. Then debrief it thoroughly so all can learn from the event.

Ultimate S.A. — you already have it. But do you use it daily to keep yourself and those around you safe and efficient on and off the job? Now you know the concept of preventing the loss of S.A. by realizing when you are beginning to lose it. Spread the lessons learned and debrief it when there are others who will benefit from your mistakes. ■

AMC RODEO '94

The many faces of safety

Photos by Major James H. Grigsby and CMSgt Don A. Bennett

This past July, US Transportation Command (US TRANSCOM), Air Mobility Command (AMC), and McChord AFB, Washington, played host to some of the best air mobility forces in the world as they gathered to compete in RODEO '94. This international gathering tested the skills of aircrews, maintainers, combat control, security police, and aerial port personnel in a spirited competition.

As the AMC staff gathered to begin planning for RODEO '94, General Ronald R. Fogelman, CINC US TRANSCOM and AMC Commander, is rumored to have said to Major General Marvin Ervin, RODEO '94 Commander, "You are going to give me a *safe* RODEO, aren't you?" In a superb cooperative effort, the staffs at AMC Team McChord did just that.

Courtesy AMC Forum

To quote AMC Chief of Safety, Colonel Tom Dooley, the theme of this year's competition was ***"If it isn't safe, it isn't happening."*** We salute the competitors and staffs on completing a safe and spirited display of global reach capability and look forward to RODEO '96. See you there!

MIDAIR C

LT COLONEL NEIL "BONE" KRAUSE
Air Force Safety Agency

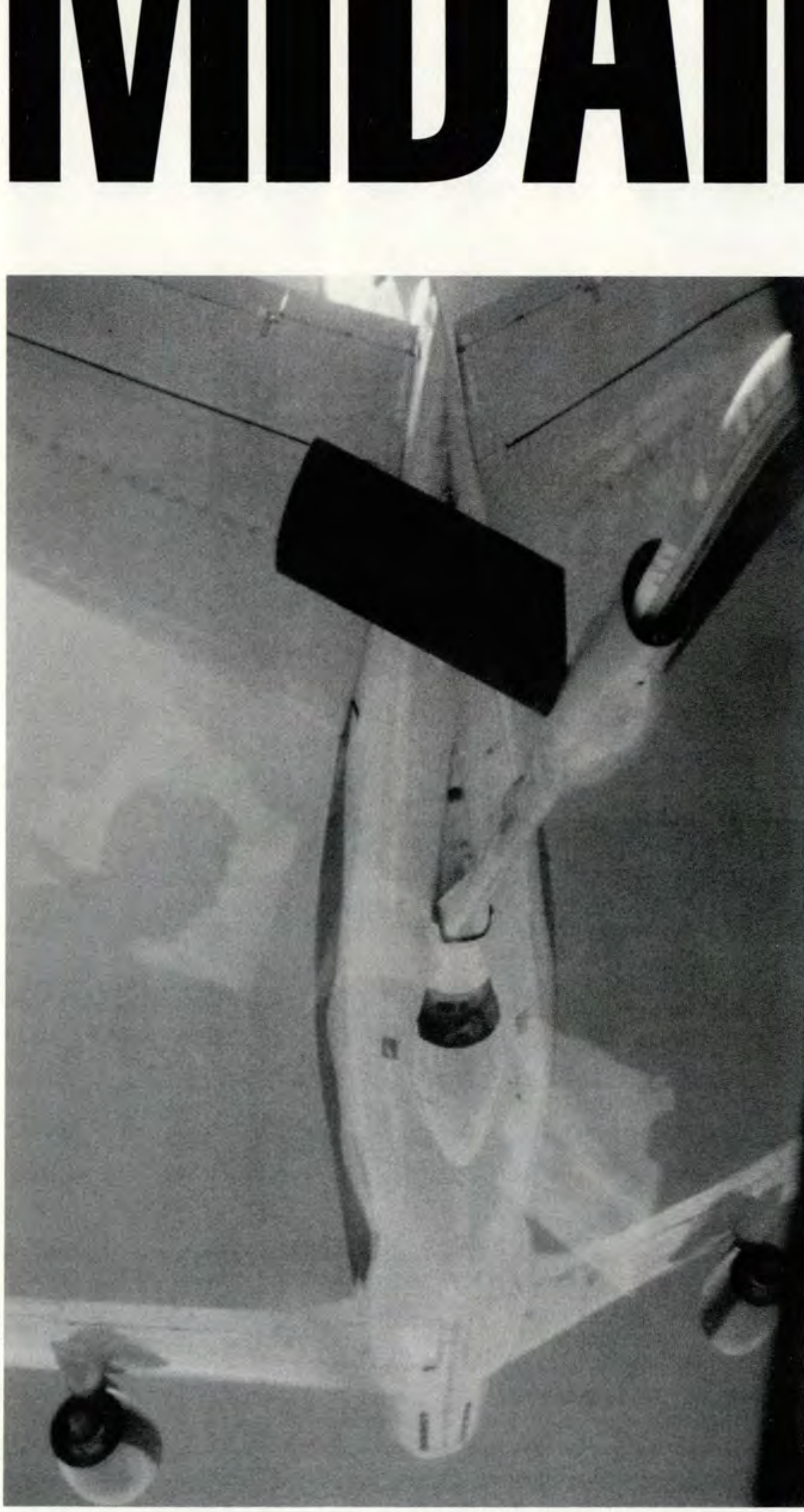


Photo by Major James H. Grigsby

Since January 1980, the USAF has experienced 88 midair collisions, or about one every 2 months. They seem to occur in cycles — peaking about every 3-4 years.

■ What's the typical midair collision scenario? While each situation is unique, some factors are overrepresented in the attempt to create inflight aluminum fusion. Here are three actual examples to choose from:

SCENARIO 1. *Returning from a student training sortie, a fighter begins a TACAN approach to homebase and hits a small civilian plane transiting the airport traffic area without contacting RAPCON or tower.*

SCENARIO 2. *During a 4 V 4 DACT mission, an attacker follows his lead into the defender's altitude block within 10 miles without a tally on all of the defenders. The attacker collides with an untargeted defender.*

SCENARIO 3. *While executing a tactical formation cross-turn on a low-level training mission, a wingman hits lead attempting to remain inside the turn. The lead briefed the option of remaining inside the turn under certain circumstances.*

Once you decide, read on. The scenario you *thought* represented the highest risk may not be the most likely to result in an unscheduled meeting with the Wing King.

The Size of the Problem

Since January 1980, the USAF has experienced 88 midair collisions, or about one every 2 months. Of these collisions, 62 were Class A mishaps, 13 were Class B mishaps (major damage), and surprisingly, 13 others resulted in Class C or less damage.

Midairs seem to occur in "cycles,"

OLLISIONS

peaking about every 3 to 4 years* (1983, 1987, and 1990). The good news is the number of midairs during the peaks is getting smaller (11, 10, 8). The bad news comes in two parts. First, we're due for another peak in 1994. Second, it looks like that prediction is coming true. If we keep going at the current rate, we'll have six by the end of 1994 (we've had three midairs since January).

So what do we look for? Are there any common factors in midairs to identify high-risk missions?

The Environment

Reinforcing the theory that midairs are a cyclic phenomenon (not to be confused with helicopter aerodynamics), there are no "bad" seasons in the mishap data. The worst months of the year (January, March, and June) are immediately followed by the best months of the year (February, April, and July). Could it be that awareness is heightened during the bad months, resulting in a short period of *everybody paying attention?*

What about meteorological conditions? Sorry, no alibis here. The overwhelming majority of midairs occurred in VMC (92 percent). IMC was probably a factor in only 6 percent of the midairs, and night was probably a factor in only 8 percent of the collisions (all VMC).

Looking at the IMC collisions, though, shows three of the five were *lost wingman* collisions, and the other two were with civil aircraft flying *VFR in IMC*. A small bite could be taken out of the problem with an emphasis on proper lost wingman procedures, and a healthy fear of some civil operator's definition of VFR!

*I'll use calendar years since the Air Force used CY until 1986 and FY after 1987.

The Man (Generic, Nonsexist, *Homo Sapiens*-Variety)

Who's responsible for all these inflight entanglements? The aviator with about 300 to 500 hours of time-in-type seems to be overrepresented in the midair statistics. While accounting for only 14 percent of the pilot population, the 300- to 500-hour pilot has over 20 percent of the midairs. And that is the *most* experienced person at the controls! Nothing counts like experience, though: The next group, 500 to 1,000 hours in type, has 35 percent of the population, but only 22 percent of the midairs. And while you're pondering that, consider that 48 percent of the midair collisions are committed by pilots with less than 500 hours in type.

The Machine

Fighter aircraft were involved in 74 of the 88 collisions since 1980. Civil aircraft, however, were participants in only nine collisions with military aircraft. So, if you're keeping track, SCENARIO 1 at the beginning of this article is *not* typical.

The F-15 leads the pack with 21 percent of the midairs, followed closely by the F-16 with 19 percent. Of course, you say, the F-15 has the role of air-to-air and would be exposed to more midair opportunities. True, 13 of the midairs involving the Eagle were ACT/DACT, BFM, ACM, and a few more acronyms, but 9 midairs occurred during other "less demanding" feats of skill (such as straight and level). Also, the F-16 has its share of air-to-air midairs (12) and other maneuvering buffoonery (9, including rejoins and refueling).

Trainer aircraft have had only seven midair collisions in all phases of flight. They include extended trail (2), fingertip formation (2), and collision with civil aircraft (2).

The only group not represented is helicopters. While two helos show up in the midair stats, they were both foreign helos colliding with USAF fixed-wing aircraft (or vice versa).

Heavy aircraft (and you know who you are) were involved in 13 midair collisions since 1980 — predominantly before, during, and after air refueling. Luckily, most were only Class B mishaps, but a few were infamous exceptions. This is one sure way to star on CNN ...

The Mission

At the risk of planting a seed of distrust among flight members, your biggest risk is the *person sitting across from you at the briefing table*. Since 1980, 61 percent of the midairs have been between members of the same flight. Another 20 percent of the collisions occurred between members of the same mission group, i.e., someone you knew was there (such as aggressors, defenders, tankers, other package members). Only 16 percent occurred between strangers — someone you did not know was there. (For those with calculators, the rest were undetermined from the information that was available).

So, how many of you correctly

continued

MIDAIR

Photo by Captain Denny Peeples

Fighter aircraft are at the highest risk for midair collision — especially the F-15 and F-16. You're three times more likely to hit your lead and almost four times more likely to hit him than hit a stranger you didn't know was there.

picked SCENARIO 3 at the beginning of this article?

Also, add the first two groups and you'll find 81 percent of the midairs happened to people who had a good idea where the threat was, if not a completely precise location. At least their clearing job was easier.

What maneuvers led to the collisions? Surprisingly, basic formation airwork, or lack of it, led to 35 percent of the collisions. Specific examples follow.

■ **Close formation turns (6).**

After a battle damage check on RTB from the training area, lead began a shallow turn. The wingman hit lead while heads-down rewinding the HUD tape.

■ **Straight and level cruise (4).**

Both crews were dual student pre-solo formation rides. Both IPs channelized attention on ground references when no. 2 IP looked up and noticed they were too close and took control. The pitot tube of no. 2 brushed lead's wingtip.

■ **Tactical turns (4).**

Four jets in a battle-box formation, 6,000 feet line abreast and 6,000 feet between elements. During an in-place turn, no. 2 and no. 4 collided.

■ **Rejoins and overshoots (3 each).**

Two fighters rejoining off the range, no. 2 overshoots and pulls back into lead before killing overtake. The pilot loses sight, the WSO doesn't direct action. After collision, both aircraft land at home station.

■ **Lead changes (4).**

While descending for low-level entry, lead of a four-ship directs no. 2 to take the lead while no. 1 goes low for a weather check. Both nos. 2 and 3 acknowledge taking the lead, stepping on each other's transmission. While in a slight right turn, no. 3's radome hits no. 2's right stabilator. Both aircraft RTB with minor damage.

■ **Improper/unauthorized maneuvers (4).**

Arriving at the destination as part of

COLLISIONS

continued

an overseas deployment, flight lead elects to penetrate weather as a six-ship for an arrival airshow. Entering the weather, nos. 5 and 6 collide attempting a locally developed, briefed, but unpracticed lost wingman procedure.

The traffic pattern is not as dangerous as everyone believes, possibly because everyone thinks it is and looks out the window more. Takeoff and landing phases of flight account for eight midair collisions, five of which involved non-USAF aircraft (civilian or foreign military).

The light transport collided with a foreign helicopter on final to a foreign field. The tower controller did not issue traffic advisory to the transport because of minimal English ability. The helicopter pilot did not comply with a request to extend base leg or heed a traffic advisory about the transport.

Air-to-air maneuvering accounted for 33 percent of the midair collisions. This figure doesn't include another 5 percent from intercepts (actual and training). Training rule (TR) violations preceded the crash in 26 cases, including:

■ **Pressing the attack after losing sight, KIO, or DLOs achieved (15).**

The IP in a defensive perch setup began a hard turn. The wingman lost turning room and lost sight, but continued the attack. The IP reversed and also lost sight. Wingman regained sight at last second, too late for last ditch evasion.

■ **Improper radio/terminology/procedures, including clearance to engage (7).**

On a 2 V 1 DACT mission, no. 2 lost sight of single bandit during a bracket maneuver. Lead engaged the bandit, no. 2 hit lead trying to reenter the fight without sight or clearance to reenter.

■ **Violating altitude block without a tally (2).**

During a 4 V 3 intercept mission, lead of a four-ship of attackers departed the altitude block without sight of all target aircraft. Defender no. 2 pulled up to shoot attacker lead at short range without a tally.

■ **Head-on attacks inside 9,000 feet (1).**

During a 2 V 2 DACT engagement, dissimilar aircraft both maneuvered for front-quarter missile attacks. Both pressed their attack inside 9,000 feet and collided after a last-ditch maneuver failed.

■ **Unbriefed or unauthorized maneuvers (1).**

During a BFM mission, the IP directed an unbriefed add-on engagement that degenerated into a low-speed scissors. Neither aircraft had the maneuverability to avoid the collision, and neither pilot called knock-it-off.

The Recommendations

From all these mishaps, several recommendations stand out. Many directly resulted in procedures or restrictions now familiar to all. Others have not been feasible to carry out, such as attempts at positive control of civil aircraft near military bases. Variations of these recommendations can be used in unique, local situations. Still, safety officers are encouraged to use their imagination in devious (yet legal) ways. For example, while controlling civil aircraft may not be possible, briefings, charts, and tours for local municipal pilots may open their eyes.

Add strobe lights. If you have them, use them—particularly if the weather is marginal or the airspace is congested.

Knock off the engagement *before* it turns ugly. Most pilots realize when they're up to their necks in alligators. The real leaders are the ones who see the alligators slipping into the swamp one by one, and knock it off while there are still options.

Practice lost wingman — before you need to. Those who don't probably don't have insurance on their cars, either.

Tankers can have lots of people on them. They don't have ejection seats. Be careful around them.

The Conclusions

So what have we learned today? Midairs are minimally affected by the environment. They seem to occur in cycles, and we're due for a peak right now.

Fighter aircraft are at the highest risk, especially the F-15 and F-16. You're three times more likely to hit your wingman (or lead) than someone in the tanker cell, target element, or package, and almost four times more likely to hit him than hit a stranger you didn't know was there.

Heavy aircraft are most likely to tangle with tankers. Extra caution around the refueling track is a good idea.

Look at lead when you're flying formation. Sounds basic, doesn't it? Too many reports are generated by inattention while flying the most basic of formation maneuvers, such as straight and level, turns, rejoins, and lead changes.

Air-to-air requires special skills. It also requires superior judgment in knowing when to knock it off. Losing sight is dangerous in combat. It's equally dangerous in training. And pressing the attack past learning objectives won't win you an Air Medal — it's only training.

So fly smart, fly safe, and don't lose the bubble. ■

"Jolly Five Five,

MAJOR CHUCK FOSTER
CAPT BRETT HARTNETT
210th Air Rescue Squadron
Alaska Air National Guard

■ It was a sunny Sunday afternoon at the home base. Our HH-60 rescue alert crew was without a working helicopter, so both we and our maintenance troops were at work this quiet summer weekend trying to get one in working order. This meant several functional check flights to evaluate whether the vibrations coming from the rotors and rotor head were within acceptable limits.

All day, thus far, we had flown to take measurements, landed to make adjustments, and flown again to check for improvements. At the time, the airplane was still "technically" not airworthy in the sense it couldn't be flown for any other purpose than to determine its maintenance status.

On our third hop, we planned to repeat our previous flight profile — a climbout to 1,500 feet to the functional check flight (FCF) area, straight and level flight at various airspeeds while the two crew chiefs on board took computer readings of the vibrations, and then back to the helipad for more adjustments. Things changed when the copilot called departure control.

"Jolly Five Five, can you respond to an emergency and head down to Chickaloon Flats? We have a report of a crash in that area." We were a bit taken by the call, having expected to hear something more like "Radar contact."

The pause which followed must have been perceived as a tacit "Yes" because the controller came back to give us more information. "There's an aircraft orbiting overhead at 4,000 feet. I can give you a heading if you want."

The copilot and I looked at each other. There was no doubt we wanted to respond, but I had a few mental hurdles to jump first. I had developed the attitude as a T-37 instructor that it's best not to deviate from your established procedures without first imagining how it might read in a mishap report. Would my peers think it a wise move? Is there unnecessary risk? Does it make sense?

"Jolly, the aircraft says the crash is

Can You Respond?"

on fire. Maybe you can see the smoke." Even with the visors down, we could tell we agreed. I pointed to the south and nodded. The copilot called "Right turn!" and banked sharply. We were on our way.

I switched to Approach Control's frequency and motioned to the copilot to change his radio configuration. This relieved him of everything else except just flying the plane. I confirmed with Approach we were en route and asked for that heading he offered. We couldn't see the smoke through the haze, so I asked him how far. "About 9 miles." We'd be there pretty quick.

In the back, the flight engineer and crew chiefs were in agreement with us that diverting from our planned profile was the best thing to do. We briefly discussed the fact we would be without any medical gear or trained pararescue specialists to treat injuries. Should we ask for the alert PJs to be called? "No time," we agreed.

The copilot wanted to know what kind of traffic was between us and the objective. Approach said he would vector all the traffic he was working so they'd be out of the way. The flight engineer began a before-landing check and prompted me to be sure to turn off the weather radar. (If it were left on, we would emit harmful radar signals for a distance of about 15 feet from the nose of the helicopter.)

We were in a groove now —everyone doing what they were supposed to do. We'd all done it before (except for the crew chiefs who were busily following the flight engineer's precise directions to break down and stow their test equipment) but not quite this quickly. I began to worry.

I'd heard stories — read them in magazines and such — about the perils of following a plan which has no visible downside. Here we were, en route for less than 2 minutes, and we'd made dozens of decisions, begun dozens of tasks, and committed ourselves to a course of action. Had we really done a good enough job of thinking it through? It seemed so cut and dried, but we hadn't identified the downside — at least no one had articulated it. "Where is this going to rise up and bite us?" I asked the crew.

"Well, we *are* in a plane on a red

continued

"Jolly Five Five, Can You Respond?"

continued

'X'," offered a crew chief. His point was not lost on the crew. We were committed to perform a rescue in an aircraft which wasn't even cleared to fly around the airfield without special clearance from maintenance. This is good?

In the brief discussion about this point, we agreed to be careful but to press on. Our previous experience that day had shown the helicopter wasn't likely to fall out of the sky. The crew chiefs vouched they were confident it was up to the task. The copilot and flight engineer agreed the urgency of the situation justified the increased risk. We continued.

What about somebody else? Someone offered there might be another helicopter airborne in the area. Might they be better to do this? We simultaneously doubted such was the case. Surely any other helicopter would be no better equipped than we, nor would they likely have three guys in the back to help out. And they probably weren't as fast as we. Still I asked Approach Control. "No," he said. "You're it." Case closed.

Nearing the crash, we began to see the fire. It was something out of a movie! The aircraft was in a ball of flames, but there was very little smoke except for the mushroom from the original flash. It hung overhead like a cloud of doom, but at the same time, it gave us our best indication that the winds would not be a problem on the landing.

The aircraft overhead was now telling us the crashed plane was (he thought) a Supercub (he was right), and two guys were out of the wreck. Good news. It had been about 5 minutes or so since we diverted, and from overhead, we surveyed the area for the best place to land.

One of the survivors was apparently in shock, walking this way and that, cradling his hands to his breast. We wouldn't want to land close to him. The other was on the ground about 75 feet from the fire. Even from the air, we could tell he was critically burned. We would want to avoid hurting him further by the downwash.

By this time, the radios had quieted (we had given up on trying to talk to our command post and rescue coordination center in favor of concentrating on flying). The copilot would make the landing while I would handle the other pilot stuff. I turned off his intercom access to the radios so he could hear only intercom transmissions. The flight engineer did the same. If we were going to screw up, this would be a likely place to do it. We didn't need distractions now.

The flight engineer surveyed the marshy ground below. If we landed far from the crash, it would be hard to muck our way to and from the helicopter, especially with a guy in a

Off the nose, not more than 150 feet, was a man about to die, and everything in our beings wanted to do something to save him.

litter. Too close meant battering the wreck and survivors with rotor downwash.

One of the crew chiefs mentioned that although the flames were diminishing, there was still a pretty good fire. If a tire or something exploded, it could be a real problem. (I hadn't thought of that!)

The flight engineer suggested a crosswind landing to avoid being either upwind of the survivor or downwind of the crash. (The survivors had wisely, or luckily, moved directly upwind of the fire.) The copilot agreed and rolled out on final. "How about right there off the nose?" he asked no one in particular. The flight engineer answered, "That's fine," and then continued by calling the altitude, speed, and angle of the approach — in essence "talking" the pilot down the landing path to a soft touchdown. We'd done this a thousand times, and I took particular note that this time didn't seem much different from any of the others. He visually cleared the area beneath us, and we set down in the marsh grass. The skis held us well above the mud.

Immediately, the flight engineer wanted to be cleared off the helicopter with the crew chiefs. The copilot also volunteered, reasoning the three of them would need his help mucking the survivor through the mud, and the flight engineer would need help with the rescue gear which the crew chiefs were not familiar with. I was reluctant to let him go. I had assigned myself the role of foot dragger. I considered it my job to tug on the chain of events just enough to prevent us from taking the most obvious, rather than the wisest, path.

The entire crew was high on adrenaline now. Off the nose, not more than 150 feet, was a man about to die, and everything in our beings wanted to do something to save him. We were ready, and we were willing. I just couldn't avoid the nagging suspicion we could go too fast and make a major mistake.

"Do you need the copilot to help?" I asked the flight engineer.

"You bet, sir! This is pretty muddy out here."

I nodded and took the controls. The copilot was out of his harness and through the door in seconds. Only then did I remember I hadn't told them I'd listen to 282.8 on the radio so they could call me on their survival radios. Damn! It wasn't that I expected to need to talk to them. It was that I'd earlier thought of this very thing but decided to delay mentioning it until later. Now I'd forgotten. What else would I (we) forget?

From inside the cockpit, I watched as the crew hurried to the survivors. One of the crew chiefs ran to the passenger with burned hands. Seeking to cool his skin in a nearby river, he had slipped down a steep, muddy embankment and disappeared from view. I could only hope his rescuer would not slip down and be unable to get back up.

The other three were headed for the pilot. I could tell he was in great pain and unable to sit up. He was black from head to toe and tore at his burned clothing, trying to soothe the pain, but it wasn't helping. No sooner had they reached him than the flight engineer and copilot spoke to one another. After a brief exchange, they came running back to the helicopter.

The copilot grabbed the Stokes litter, and the flight engineer fitted the two collapsible pieces together and pinned them in place. Putting a sleeping bag inside to cushion the survivor from the wire basket, they gently lifted the man into the litter. Even from my distance, I could tell it hurt. But I was doing my own stuff at the time.

I tried again to raise the rescue coordination center on the radio. I wanted to tell them what was happening so they could tell us which hospital to go to. For some reason, they just weren't hearing me. I abandoned the effort and began entering data into the navigation system. I loaded all three hospital coordinates and selected the closest one as the active waypoint. I was ready.

After reaching the door of the helicopter, with the survivor in the Stokes litter, some of the rescuers headed back for the other guy, now struggling up the slippery slope with our crew chief pushing from behind. Without the use of his hands, he would have been hopelessly trapped.

It was a stroke of luck he hadn't disappeared before we arrived to watch him. Looking for him would have taken valuable time. With the aid of our crew chiefs, they soon made it back to the HH-60. The copilot was giving me the thumbs up. He was ready to go, and I polled the crew: "Everybody ready to go?" "Yes!" came the answer all around. We were off.

This time, I flew. During the ground time, I had reminded myself the hospital to which we were headed presented a challenging landing situation. I didn't want to confuse things later by swapping the controls in the middle of a recovery. Besides, I had the controls already. We had been on the ground a scant 5 minutes.

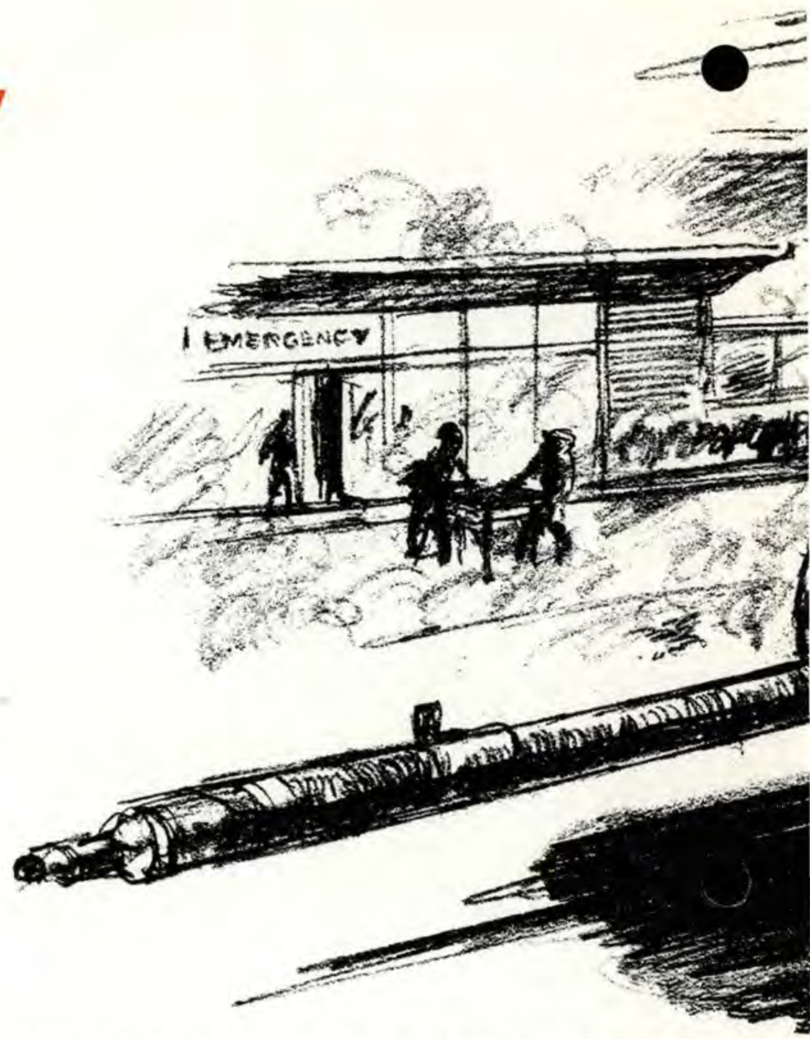
I briefed the crew on what I had done on the radio and with the navigation system. I asked them if they were familiar with our destination hospital (they were) and if they had anything to ask or add to the discussion (they didn't). At that, I put the copilot to the task of getting our command post to call the hospital to tell them we were coming. He reminded me the emergency room had a radio to communicate with its own air ambulances. (Really? I hadn't known that!) "Good idea. Try that."

First, he called Approach Control again to let them know what was going on. Again, the controllers moved traffic away and cleared us direct to the hospital. We begged off the controllers' frequency so we could use the radio to call the emergency room. They let us go. But try as we might, we got no response

continued

"Jolly Five Five, Can You Respond?"

continued



from the hospital.

We checked the frequency — it was good. We checked the radio settings — they were correct. We pondered for a while what to check next, but as the city got closer, we abandoned that comm plan altogether. Calling our own command post, we asked them to immediately call the hospital to pass our inbound call. They did.

Arriving at the hospital illuminated our landing challenge. Two pads served the hospital. One was right next to the emergency room doors, the other was 1/2 mile away, wasting valuable time. The closer one clearly offered the advantage of quicker access to care, but it was also the riskiest. As a helipad, it was small.

Designed for an air ambulance helicopter half our size, our operations and safety folks had examined it every which way but upside down to see if it was usable by our helicopters. They concluded it was, if — if the local automobile traffic was blocked; if the situation was a life-or-death question; if the crew had made a practice approach previously; if all the poles, bushes, and other obstacles were clearly in view; if the crew had enough excess power available to hover at 70 feet above the obstacles before landing.

Well, the traffic wasn't blocked. Not everyone on the crew had made an approach to this pad (it was a new addition). But if there ever was a life-or-death situation, this was it. The crew voiced agreement to go to the near pad.

Completing the before-landing check, the flight engineer had just enough time to move to his duty station at the gunner's window while I told everyone I planned to fly a steep approach to a high hover, then come straight down. Mindful of my ability to make a mistake, and wary anyone else would call me on it for fear of prolonging our patient's misery, I added, "If I start to screw up, anybody call a go-around. It won't take long to try again." Listening to my copilot's and flight engineer's calls and thankful for the excess power of the HH-60, we completed the approach and landed without incident.

This time I cleared the cabin crew and passengers out as soon as I lowered the collective. Emergency room personnel had looked out for a moment to see what the noise was, as the outer hospital doors had swung in with the rotorwash blast. They reappeared quickly with a gurney and hustled the mishap pilot inside. The passenger with the burned hands followed behind, visibly relieved to finally be at a hospital. Watching them disappear inside, the crew turned to reboard the helicopter.

Once aboard, we relaxed. It had taken less than 20 minutes from the time the aircraft crashed to when the survivors were being treated in the hospital emergency room. The cabin was a mess, and the crew was muddy and tired. We were worried that staying on the ground would just attract the kind of automobiles and kids on bicycles we didn't want. But we purposely paused. For about a minute, we stayed on the ground, catching our breath, getting more comfortable in our seats and harnesses, and processing what we just did and what we would do next.

"What do you think? Will he be okay?" "He's hurt pretty bad." "Good thing we got to him so quickly." "You maintainers make some pretty good PJs!"

By the sounds of our voices, we knew we were okay to fly. "Everybody ready to go?" We were. We left the opposite of our approach — straight up and out to the southeast. (Thank goodness for the power available!)

I can't remember if we finished

our FCF that day. After such a drama, everything else seemed so mundane. But I do remember we got our vibration readings before landing at the home helipad. We were still out of limits.

In retrospect, I'm convinced we did a damn fine job. The situation was tense, the injuries critical, and everything happened so fast! I'm convinced we were able to succeed because of our operational training and because we worked as a crew.

The mechanics of flying were not much different than most of our flights in the local area. The radio calls were similar. We were familiar with the local procedures and terrain, and we were proficient with the aircraft. But we were also able to accomplish compartmentalized tasks, back each other up, and work as a crew. I recall we discussed many things but argued about none. We trusted each others' ability to perform, and this capability freed up each of us to concentrate on the critical tasks at hand. When the time came to focus the crew's attention, such as on landing final, we focused.

We were lucky too. Lucky to be airborne at just the right moment; lucky the other aircraft had seen the crash and stayed overhead; lucky the weather was good and the winds light; lucky the hospital helipad was clear of the air ambulance; lucky we flew in a unit which believes in crew resource management and trains for the mission it is likely to perform and where the crews are honest and straightforward in training so they can be counted on in a pinch; lucky we paid attention to the stories about the bad things which can happen when the crew loses control of the situation, cannot work together as a crew, is afraid, or unable to keep a tight rein on the chain of events and crashes during a rescue attempt.

We later visited the hospital to learn the mishap pilot had been immediately flown by a Learjet ambulance to the burn center in Seattle. We were informed by the emergency room physician we had saved the mishap pilot's life that day.

Now, almost a year later, we know he had survived his ordeal and is now struggling through physical therapy to reclaim what he can of his prior abilities. His friend recovered and was released shortly after arrival.

There is a joy in doing a job well — when you know you've done a good thing and done it well. We all felt good. But we'd just as soon never do it again. ■

The Elmendorf AFB Rescue Coordination Center awarded the crew — Aircraft Commander Major Chuck E. Foster, Copilot Captain Brett A. Hartnett, Flight Engineer Master Sergeant John R. Silsbee, Crew Chief Technical Sergeant Mark E. Van Vliete, and Crew Chief Staff Sergeant Vernon A. Cordell — two saves for their actions. Saves are given to Air Force rescue crews when the Rescue Coordination Center deems someone's life was saved on an operation.

The two crew chiefs, put into a very difficult situation for which they were not trained, but responded to the challenge with the utmost professionalism and courage, are the only two crew chiefs we know of in Rescue today who have been awarded saves. — Ed.

THERE I WAS

■ My midshift at the Peterson AFB, Colorado, weather station had been uneventful. I was a staff sergeant weather forecaster and had been enjoying the several months I had been there since PCS'ing from Ohio. The 3 a.m. forecast preparations had been going well when the Pilot to Metro Service radio squawked.

"Peterson Metro, Thacker 22."

"Thacker 22, Peterson Metro, go ahead, over."

"Request weather for Gray Army Airfield for 1230 Zulu."

"Understand Gray Army Airfield, 1230 Zulu, uhhh, please say call sign for Gray, over."

"Metro, call sign for Gray is Golf Romeo Fox."

I thanked him for the info and requested the observation and forecast for GRF from my computer. While waiting for the printout to arrive, I checked with the pilot about just where Gray was. He said Fort Hood in central Texas. That clicked because I was familiar with the location by that name, but this was the first call I'd ever had for there.

The springtime weather for GRF was fair at the moment, but 800-foot ceilings were expected to move in soon and then lower. The charts showed low stratus clouds pushing north from the Gulf of Mexico.

The pilot asked about chances for improvement, grumbled a bit when he found out it wouldn't, and then said he would get back to me. It seemed he and three other C-141s were full of paratroops ready to do a dawn drop at Fort Hood. My forecast put them out of the safety window, and they needed to think about it a bit.

The PIREP he provided was encoded and sent to the rest of the world, and I went back to my local forecast work. Half an hour later, Thacker 22 was calling again.

"Peterson Metro, we've turned around, and we're going back home to Tacoma. Give me the weather for Fort Lewis, Washington, Golf Romeo Fox, 1345 Zulu."

While the alarm bells were going off in my mind, my weather observer commented, "Didn't you just give them that info?" I sure did, because that's what was on the printout I used to make the forecast. Time to double check.

"Thacker 22, Peterson Metro. Sir, I gave you the weather for Golf Romeo Fox earlier. Is that the call sign for Fort Hood or Fort Lewis?"

Long pause.

A quick trip through the Location Identifiers book revealed Fort Lewis has Gray Army Airfield, GR*F*, while Fort Hood has *Robert* Gray Army Airfield, GR*K*. As the computer printed out my request for GRK, Thacker 22 called again.

"Peterson, please tell me the weather for Golf Romeo Kilo, that's Kilo, Robert Gray Airfield, Texas, will be good at 1400 Zulu?" The anxiety in his voice was bad, but it was even worse when he added, "Please?"

No dice. The Gulf coast stratus was still coming, and the ceilings were going down. Unfortunately, they were going down after 1300 Zulu. If they had made their 1230 Zulu drop time, it would have been safe weather. Now that they had been flying in the other direction for over half an hour, their earliest time over target would have been 1400.

Adding insult to injury, the Pacific storm moving into the northwest would put Fort Lewis and McChord AFB below minimums for their return. A few minutes of chart and computer checking later, and four aircraft with several hundred paratroops and at least one chagrined pilot were en route to an alternate base.

What might have been a successful mission became an expensive flop over a *single letter* miscommunication. I made the assumption the pilot knew what he was talking about when he gave me the call sign. So did the pilot.

Since then, I've made it a point to double check when I'm not familiar with the call sign being requested. The potential mixup of having two Gray Army Airfields to fly in and out of will still exist. And it was pure fluke the weather in Texas and the Puget Sound were so similar that day, but flukes can happen again.

The basic problem here was not that bad information was given, but rather the wrong information was requested, and I didn't know enough to challenge the request. It twisted the old computer saying to read Garbage Out, Garbage In.

Then again, the other people in the cockpit didn't challenge it, and neither did the other aircraft in the formation, if they were listening. Would your crew coordination catch a goof like this? ■

Tech data is tech data!

■ A bomber lost a main landing gear strut door during a training sortie. It also suffered minor damage from the departing door assembly. The crew was able to safely land the aircraft without further incident.

The mishap door's aft hinge had been replaced weeks before, but the wrong mounting bolts were installed, and the bolts weren't safety wired. Consequently, the mount bolts loosened and fell out.

The bolts installed were like the old ones removed, but tech data required a new, different kind of bolt to be installed that had a safety wire-locking feature. The technician and the supervisor were aware of the old/new bolt requirements, but because the new bolts weren't available, the supervisor elected to allow the old-type bolts to be installed. **This action was taken to keep the bomber operational.**

Of course, this replace-by-attrition policy could have given the supervisor a false confidence in the old-type bolts. After all, if they were used all these years, then it should be all right to continue using a few more, right? Especially in light of the grounding condition, and none of the new bolts were in supply, right? Not hardly!

Well, it's certainly easy to see how the technician and supervisor got sucked into this dilemma, but the fact remains that **tech data is tech data**! There are good reasons (that sometimes we in the field don't always understand) for the way system managers and engineers handle things. If we have problems with tech data, there are procedures for elevating them to the proper authorities. In this case, the decision to install the old bolts wasn't within the supervisor's scope of responsibility or authority.

Actions are constantly taken to provide fleet-wide corrections action to prevent incident/mishap recurrences — actions which even system managers and engineers find out too late should have been taken long ago.

We all can take away a lesson learned from this preventable mishap. ■

Bad, New F-110 Engine

■ A Viper unit received a new production F-110 engine which was rejected during the acceptance inspection for high vibrations at the fan frame. After guidance from engine experts and subsequent repairs, the engine was again run and rejected for high vibrations.

After more expert guidance and repairs, the engine finally passed its test cell run. It was used as a spare for some time. Later, some modifications were performed, and the engine was again successfully run at the test cell.

After the engine was finally installed on its first jet, it was removed a short time later for missing aft hanger brackets. It was successfully tested again and installed on a second jet but was removed nearly a week later to facilitate other maintenance. While out, it had two modifications performed and was successfully tested.

The engine lasted on its third jet for a little over 30 days before being removed for high oil consumption. The high oil consumption problem couldn't be duplicated during test cell runs; however, some components were changed IAW a manufacturer's service bulletin, and the no. 5 carbon seal was changed. The engine repeated its high vibration problem during an ops check run and was rejected for the third time.

During the engine teardown, there was metal found on the chip detector and the just-replaced no. 5 carbon seal was discovered to be cracked. After the high pressure turbine rotor was removed, **there were 34 out of 46 bolts missing that secure the forward shaft!** An air seal and rotor disc were also discovered missing.

It took about 5 months of rejects, extensive maintenance, and frustrations before the cause of the high vibration problem was found. It was a production engine, so *probably* the engine manager, maintainers, and maintenance supervision didn't suspect a bigger problem could be hidden within the bowels of this engine.

Let's play heads-up maintenance out there! Being new doesn't always mean quality! ■

FSO's CORNER

Flight Safety Hotline

MAJOR DALE T. PIERCE
919 Special Operations Wing/SE
Duke Field, Florida

■ A few weeks ago, I was perusing an FAA publication when I observed a small block on the bottom of an interior page. The information in this block was simple and straightforward. It said you could call the FAA Flight Safety Hotline on a 1-800 telephone number to report flight safety hazards. Anonymous reports are acceptable.

At first, I considered this just another bureaucratic gimmick to fill a square. But as I considered it further, I realized this could be a great marketing tool for reminding people to report flight safety hazards — a proactive measure. Maybe we could use such a tool.

So I considered how I could implement such a program in our wing. I decided I needed two things to start — a telephone number and a way to let people know the program exists.

Since we don't need a 1-800 number for a local hotline, I used a safety office number we hadn't previously advertised. This was the easy part.

Letting people know the program exists was a little more work. First, I wrote an article for the local (Duke Field) paper. Since this would last only until the next paper came out, I put together a small poster to serve as a bulletin board eye-catcher.

SHARE YOUR IDEAS

What are you doing in your safety program that could help other FSOs if they knew about it? If you have something you would like to share with your fellow FSOs, call me at DSN 872-5378 (USAFAWC), FAX me at DSN 872-5212, or drop me a note at 919 SOW/SE, 506 Drone St, Ste 110, Duke Field FL 32542-6644.

For the poster, I selected a photograph of 129, *The First Lady**, flying over the northern coast of Honduras. On the photograph, I overlaid text in the clear areas above and below the aircraft. The text above reads "883-6620, 919 SOW FLIGHT SAFETY HOTLINE."** Below the aircraft, it reads, "ONE CALL CAN MAKE A DIFFERENCE."

I had 50 of these 8- X 10-inch posters made up at a cost of about $2 each (glossies would have been $5 each) and put them up on operations and maintenance bulletin boards. Everyone likes the picture, so they've remained on the boards instead of being recycled at the first opportunity.

Calls made to the hotline are documented and processed as hazard reports. The hotline is now part of our hazard reporting program. It serves to make it clear to all unit members we really want people to call us, and the information is readily available as a reminder. ■

*The First Lady is the first production Lockheed Hercules C-130A aircraft.

****The Air Force Safety Agency's Safety Hotline is DSN 246-0950 or (505) 846-0950. — Ed.**

*U.S. GOVERNMENT PRINTING OFFICE 1994-573-261/84013

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 Mishap Prevention Program.

Captain Coleman is pictured on the right.

CAPTAIN **Kevin C. Coleman** FIRST LIEUTENANT **Christopher R. Sosinski**

336th Fighter Squadron, Seymour Johnson AFB, North Carolina

■ Captain Kevin Coleman and First Lieutenant Christopher Sosinski were flying an F-15E Strike Eagle participating in an Operation Southern Watch night coalition multiservice strike exercise going deep into Iraq. The mission was picture perfect until they heard a loud noise aft of the cockpit. The entire aircraft shook, and the cockpit suddenly filled with blinding toxic smoke and fumes. Their F-15E environmental cooling system (ECS) turbine had experienced catastrophic failure.

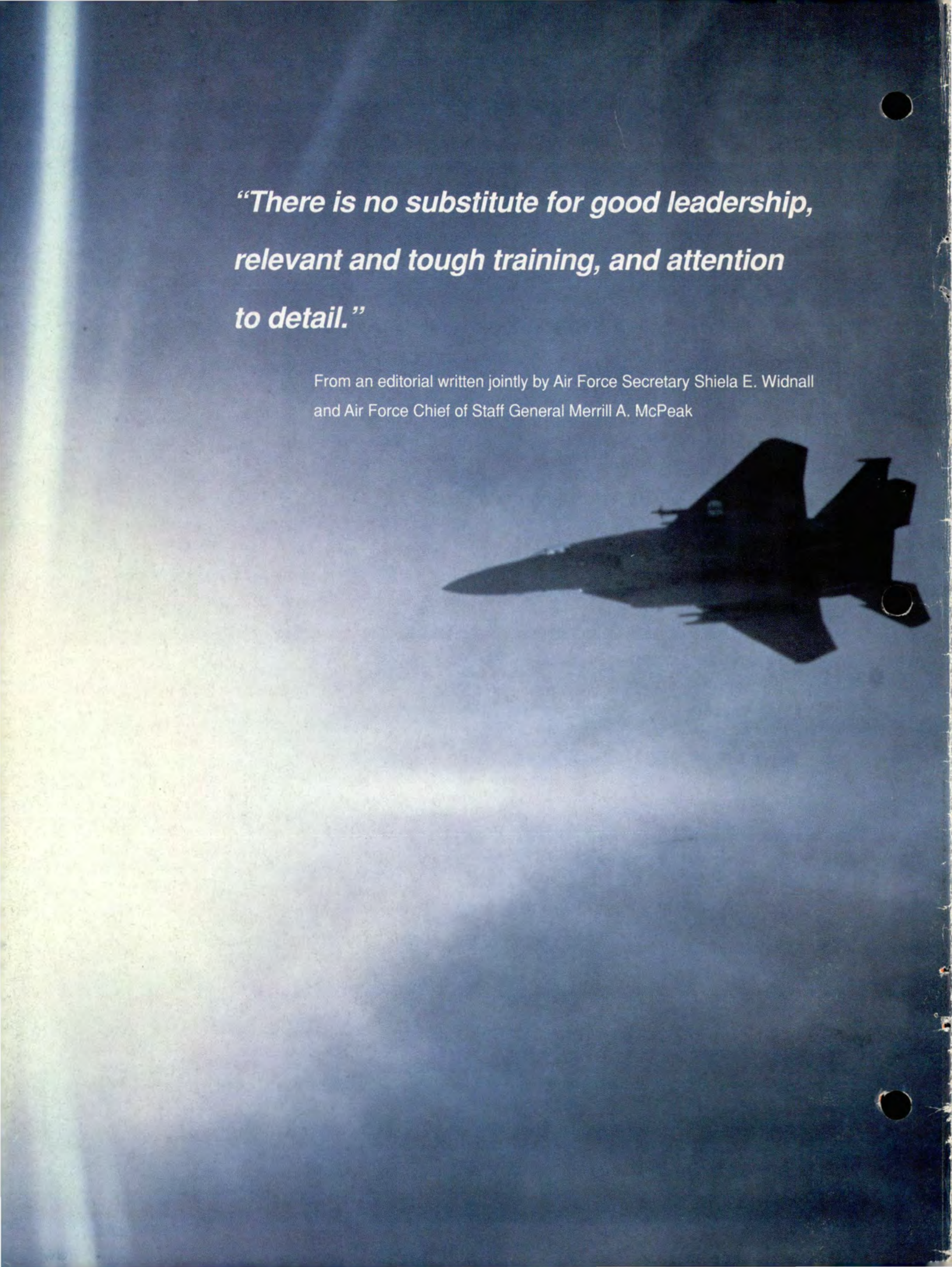
Capt Coleman quickly turned towards home as Lt Sosinski initiated the emergency procedures checklist. However, this meant they must egress across hundreds of miles of Iraqi territory in their crippled jet. Due to the loss of the cooling ECS airflow to the glass/electronic cockpit, the avionics automatically shut down for protection from overheating.

Now in a dark cockpit over enemy territory with home plate approximately 550 NM away, they braved the extreme cockpit temperatures created by the failed turbine located just aft of the WSO's seat. Capt Coleman and Lt Sosinski, with the help of another F-15E and an E-3A AWACS, accomplished a visual only rejoin onto a KC-135 tanker which was vectored towards their position. They took on enough fuel to make it home as they crossed into friendly territory.

The temperature inside the cockpit continued to rise. They elected not to jettison the canopy because of possible injury to the WSO. The final obstacle facing Capt Coleman and Lt Sosinski was the landing. Using standby (emergency) instruments, Capt Coleman and Lt Sosinski accomplished a flawless landing and rollout.

Using their superior skill and airmanship, Capt Coleman and Lt Sosinski saved a valuable combat asset and prevented its loss over hostile territory.

WELL DONE! ■


"There is no substitute for good leadership, relevant and tough training, and attention to detail."
From an editorial written jointly by Air Force Secretary Shiela E. Widnall and Air Force Chief of Staff General Merrill A. McPeak