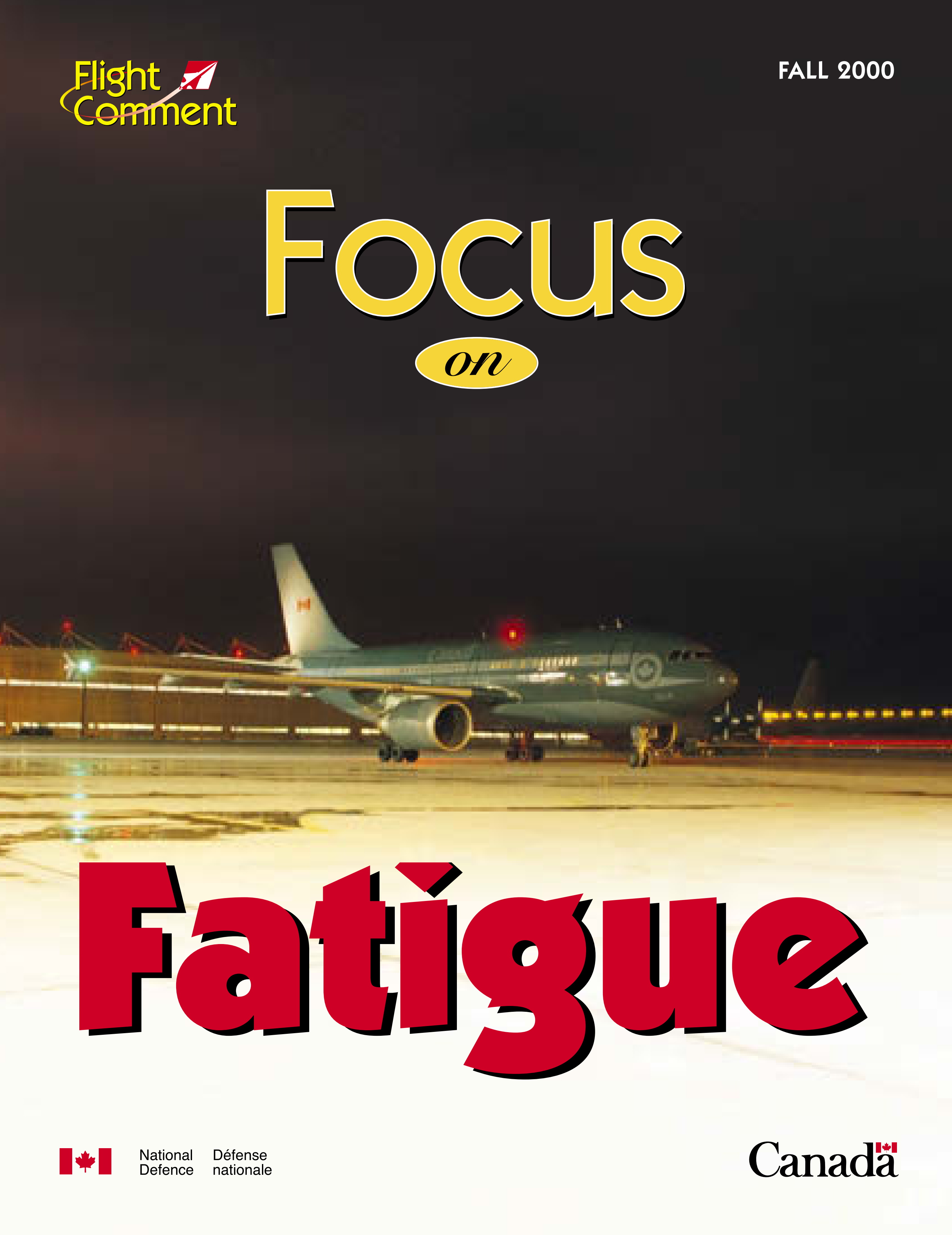
Flight Comment

FALL 2000

Focus on Fatigue



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Flight Comment

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As I See It

So many talented and competent people have put their minds to the issue that it's hard to imagine coming up with anything different. The issue I'm talking about is, of course, "How can we prevent accidents." Have we done everything that can be done, and are we now left with no option but to keep the Flight Safety System running, our people aware, and our procedures tuned? Do we continue to utter, post, publish and proclaim the same messages in the hope that they will make a difference in peoples' attitudes and practices leading to safe operation of aircraft? Do we hope that continuing to exhaustively investigate incidents and accidents will give us enough cues and incentive to prevent the "next big one"? Are there enough of us asking ourselves those questions to make a difference?

While taking all action noted above *will* make a difference, and there are many dedicated people in the Flight Safety business who continue to look for new ways to prevent accidents, I cannot accept that there is nothing more that can be done. From what I've seen and read in the few weeks I've been in this job, it is apparent to me that risks still exist out there which could be more comprehensively and assiduously addressed. I believe there is room for a more rigorous application of risk management techniques across the air force, so that more of us have input into the identification of risks, and all of us more or less agree where the risks lie and on a reasonable and affordable risk mitigation plan. There is room, in other words, to make accident prevention more scientific and more broadly based.

Are there still risks out there which are capable of being identified? You bet there are. Do the Chief of Air Staff, the Commander of 1 CAD, the Director of Technical Airworthiness, or even the Directorate of Flight Safety know about them all? I doubt it. But you do, and the people who work around you or for you do. Together we can further reduce the risk of losing our friends and operational capability to accidents. We owe it to each other... as I see it.

Col R.E.K Harder
Director of Flight Safety ◆

Letters to the Editior

Dear Sir,

I just came down from a flight in Sea King 405 which is featured in the latest Flight Comment. On page 20 there is a series of pictures of a Sea King in East Timor. The photos are out or order and should be in the sequence 1,3,2.

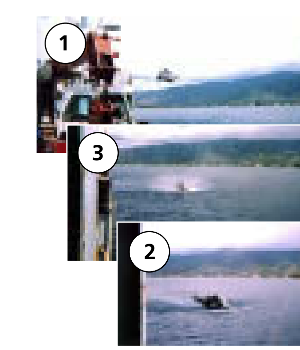
Photo 1 — Hovering and just losing the engine.

Photo 3 — Big splash subsiding after water landing.

Photo 2 — Helicopter water taxiing and preparing to take off.

It is a small point — and it did look a lot different from the Navigator/TACCO seat. Just wanted to set the record straight. Keep up the good work with the magazine.

Michael L. Muzzerall
Major
HMCS PROTECTEUR Det. Cdr
for Op TOUCAN
TACCO on board for the incident
Current 443 (MH) squadron OpsO
250-363-6677 ◆



Managing

Extracts from an article in Aerospace International by Drs Mark Rosekind, David Neri and David Dinges — reprinted with the kind permission of the RAeS.

Human operators remain central to safe aviation operations. Fatigue, sleep loss, and circadian disruption created by flight operations can degrade performance, alertness and safety. There are human physiological requirements for sleep, predictable effects on performance and alertness with sleep loss, and patterns for recovery. The circadian clock is a powerful modulator of human performance and alertness and it can be disrupted in aviation through night flying, time zone changes, and day/night duty shifts.

The importance of addressing human-related error, that accounts for approximately 70% of aviation accidents, remains critical to maintaining and improving safety. It is critical that the core human requirement for sleep be managed effectively and operations should reflect the fact that the basic properties of the circadian clock directly affect an operator's performance, productivity, and safety. Fatigue engendered by operational requirement can degrade human performance capability and reduce the safety margin.

Human Sleep Requirements.

On average, most humans physiologically require about eight hours of sleep per night though they report usual sleep amounts of about seven to seven and a half hours. When sleep is extended, there is a significant increase in daytime alertness.

A Gallop survey examining the report of daytime sleepiness in a random sample of 1,001 individuals demonstrated that 75% reported daytime sleepiness, with 32% of these reporting severe levels. Thirty-two percent reported that their sleepiness interfered with activities and 82% of the respondents believed that daytime sleepiness has a negative effect on their productivity.

Effects of Sleep Loss.

Sleep loss is common and can be acute or cumulative. In an acute situation, sleep loss can occur either totally or as a partial loss. Total sleep loss involves a completely missed sleep opportunity and continuous wakefulness for about 24 hours or longer. Partial sleep loss occurs when sleep is obtained within a 24 hour period but in an amount that is reduced from the physiologically required amount or habitual total. Sleep loss also can accumulate over time into what is often referred to as "sleep debt". Sleep loss, whether total or partial, acute or cumulative, results in significantly degraded performance, alertness, and mood.

Perhaps the most common occurrence in aviation operations is an acute partial sleep loss or the accumulation of a sleep debt. As little

Sleep loss can significantly degrade human performance capability in diverse functions. For example, studies have demonstrated increased reaction time, reduced vigilance, cognitive slowing, memory problems, time-on-task decrements, and optimum response decrements.

Operational FATIGUE

as two hours of sleep loss can result in "impairment of performance and levels of alertness". Therefore, an average individual who obtains six hours of sleep could demonstrate significantly degraded waking performance and alertness. Cumulative sleep loss also significantly reduces alertness and performance. Not only does the sleep loss accumulate but the negative effects on waking performance and alertness also are cumulative and increase over time.

Sleep loss can significantly degrade human performance capability in diverse functions. For example, studies have demonstrated increased reaction time, reduced vigilance, cognitive slowing, memory problems, time-on-task decrements, and optimum response decrements. An important phenomenon, highly relevant to operational environments, is that there is a discrepancy between the subjective report of sleepiness/alertness and physiological measures. In general, individuals will report higher levels of alertness than indicated by physiological measures. Data from an international study of flight crews contains an example where the highest subjective rating of alertness occurred at a time when physiologically the individual was falling asleep within six minutes (an indicator of severe sleepiness).

Recovery from Sleep Loss. There are two factors to consider when determining requirements for recovering from a sleep loss situation. First, when does the internal sleep architecture return to baseline levels. Second, when do waking performance and alertness levels return to their baseline. After sleep loss, recovery is not accomplished through an hour for hour restitution. Rather, recovery is accomplished through an increase in deep sleep observed starting on the first night of regular sleep, though this can be dependent on the duration of the continuous wakefulness. Also, typically two nights of recovery sleep are needed to return to a normal baseline of waking performance and alertness, though this too can be dependent on the length of prior wakefulness.

The Circadian Clock.

Beside sleep, the other major physiologic determinant of waking performance and alertness is the internal circadian clock. Circadian (circa=around, dies=day) rhythms fluctuate on a 24 hr cycle with peaks and troughs occurring in a regular pattern. These patterns are controlled by a circadian pacemaker which acts as the timekeeper for a wide range of human functions. One of the most prominent is the 24 hr sleep/wake cycle programmed for a daytime period of consolidated wakefulness and a night time period of consolidated sleep. There are circadian patterns for cognitive and psychomotor performance, physiological activity, alertness and mood.

The trough or low point of the clock is around 3 am to 5 am with many functions demonstrating reduced levels from midnight to 6 am. The lowest level of function (eg alertness, performance, subjective mood, temperature) occur within the 3 am to 5 am trough. Sleepiness has bimodal distribution, showing the most severe low at 3 am to 5 am with a less marked but significant expression, between roughly 3 pm to 5 pm.

Zeitgebers ("time givers") are cues that synchronise circadian rhythms to their 24-hr pattern. To date, light has been demonstrated to be among the most powerful zeitgebers to synchronise the circadian pacemaker. Bright light can dramatically shift the phase of the human circadian clock when applied at responsive times in the 24 hr cycle. Without cues, the intrinsic rhythm of the clock is longer than 24 hrs. Moving to a new light/dark schedule (eg nightwork or time zone change) can create internal and external desynchronization. These involve an internal desynchronization among circadian rhythms and/or a discrepancy between internal timing and external/environmental cues. The internal clock can take from several days to weeks for adjustment, or in some circumstances not fully resynchronize. ◆

There I Was...

In The Balkans!

It all started on a beautiful day in Kosovo. My crew and I were tasked to fly a reconnaissance mission for a future deployment of five Griffon aircraft from Kosovo to Bosnia. The weather was supposed to be clear all day long and the crew was looking forward to the trip along the Adriatic Sea. Four passengers were also onboard.

The first two legs of the trip went exactly according to plan: weather, timings, flight plan, communications, diplomatic clearances; everything was just fine. The last leg was to be flown at night using night vision goggles. After a nice dinner in Split the last preparations were made for a night departure from the coast of the Adriatic Sea going inland to Velika Kladusa across a 6000 ft mountain range. The weather was still clear, but scattered thunderstorms were now expected

There we were, approaching the majestic mountain range; the stars were shining and everything was calm in the cockpit. Even in black and green night vision goggles the view was beautiful. We had left Split with two hours and thirty minutes worth of fuel for a one hour ten minute leg. Our passengers were relaxed and joking in the back. Everything was going so well that I was almost expecting an early promotion and an exchange posting to some warm and beautiful area of the United States!

Shortly after departure I had noticed that our ground speed was relatively slow. A check with the GPS confirmed that we had a forty knot headwind! Even with the unpredict-

ed headwinds a revision of our estimated time of arrival revealed that we were still capable of making our destination within the VFR fuel requirements. I looked at my co-pilot and said, “it is fairly smooth for a forty knot wind considering these mountains”. This is probably what provoked the Gods! Immediately after that statement it started to get bumpy. At that point we were just about to cross the Croatian-Bosnia border and I immediately instructed my co-pilot to reduce the airspeed to eighty knots for turbulence penetration. Shoulder harnesses had to be tightened, the rotor speed had to be closely monitored to prevent an overspeed, and the jokes from the passengers began to be fewer and further between. By the time we reached the other side of the range, the extra fuel we had been carrying was now reduced to just the normal reserve for VFR flights. At about fifty nautical miles from our destination we encountered a snow wall, approximately ten nautical miles wide, blocking the valley in which we were flying. This caused us to divert to an adjacent valley going ninety degrees from our track, taking us back to Croatia. At that time, the plan was to try to go on top, over what looked to be a local shower. When we got to 7000 ft we saw the anvils created by all the towering cumulus clouds. It was definitively not a good idea to go on top! We went back down the valley, but by then we were just trying to escape from the rapidly advancing snow showers that were trapping us in a corner at the tip of a dead end valley! I had been navigating off a 1:500 000 map and we were now at a two hundred feet above the ground with a quarter of a mile visibility at night. The last call that I had received was from a freshly arrived sister squadron in Bosnia who warned me not to

land in any field in that area since it was heavily mined! However, I was now running out of options and fuel at the same time!

The mine situation in Kosovo is probably the same, or worse, than in Bosnia and through experience we have developed some guidelines to carry out precautionary landings on non-recorded helicopter landing surfaces. For example, we use freshly ploughed fields, useable roads, or vehicle tracks. I made a command decision and elected to land in a backyard covered with footprints. A last call was made to our sister squadron before landing, to give them the grid of the landing spot and to advise them of the plan (which was to wait on the ground). When we reached the ground, we used our satellite phone and called back to inform our sister squadron of what was going on, to arrange for fuel, and to file a new flight plan.

After about two hours on the ground, the weather cleared up nicely and the moon came back. We reviewed our situation and agreed that sleeping in that field was not the best possible option. We decided to fly to another Canadian camp approximately ten miles west of our landing site. The satellite phone batteries were now dead but the HF radio had worked fine on landing. We decided to take off and contact them once airborne to tell them about the new plan! Once again things did not work as planned. We tried to contact them about ten times during that short leg but we did not receive any answers. The next call was done by phone, shortly after landing at our new destination. Unfortunately, no one had received our latest HF calls and a platoon of infantry was already deployed to meet us at the first improvised landing spot. At that point, we realised once again that good communication in an operational environment is a must, and that people start to worry when they lose contact.

In hindsight, one could only conclude that for a trip like this one (i.e. in an unfamiliar region with limited weather information and limited communications), it would be preferable to execute the whole mission during daylight. In this specific mission, good crew cooperation and experience from similar theatre resulted in a story ending successfully. As Murphy pointed out before:

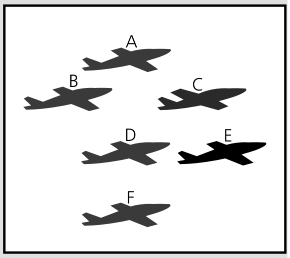
"Hope for the best but always expect the worst!" ◆

Epilogue

TYPE: CT114156
DATE: 10 Dec 1998
LOCATION: 26 NM South of Moose Jaw, Sask.

On the morning of 10 Dec 98, a formation of six aircraft from 431 (AD) Sqn were conducting training manoeuvres to the South of CFB Moose Jaw. The aircraft were in arrow formation with the outer left echelon position vacant. The manoeuvre, called an "up and down left spiral right" comprised a left wingover followed by a descent to a reversing right level turn.

As the formation rolled through approximately 50 degrees of right bank in a level turn at 1200' Above Ground Level (AGL) and 260 Knots Indicated Airspeed (KIAS), the underside of the left wing of aircraft "E" came into contact with the upper surface of the right horizontal stabilizer of aircraft "C".



The entire horizontal stabilizer and part of the vertical stabilizer separated from aircraft "C" and the aircraft dropped through the bottom of the formation. Aircraft "C" rolled inverted under extreme negative G, stalled and fell vertically to the ground. The aircraft struck the ground in an inverted position and sustained damage beyond economical repair. The pilot was killed during an unsuccessful ejection.

At the moment of impact, the position error between aircraft "C" and aircraft "E" was approximately 14' laterally and 5' vertically. It was determined that the pilot ejected from the aircraft between approximately 1100 and 700 feet AGL. It could not be conclusively determined whether the ejection was initiated within a surviveable envelope.

It was determined that, during the ejection sequence, the airlock fasteners on the pilot's Rigid Seat Survival Kit (RSSK) were not connected when seat/man separation occurred. Evidence suggests that these were most probably released as a result of compressive loading caused by extreme negative Gz after the collision occurred. The pilot had not connected his maritime lanyard nor had he properly tightened the anti-submarining (negative G) strap. During the initial ejection sequence, the pilot slid down and forward in his seat (submarined). Post ejection contact then occurred between the pilot, the ejection seat, and the unattached RSSK. The contact adversely affected seat/man separation and briefly delayed parachute deployment. The parachute had not blossomed (inflated) when the pilot impacted the ground.

Issues of squadron training, Cockpit Resource Management (CRM), and oversight were highlighted during this investigation. The pilot of aircraft "E" was flying with an ex-team member at the time of the mishap for the purpose of receiving advice. A combination of various influences, however, caused the pilot to undergo an unusually high level of workload at the time of the collision. Also, the 431 Squadron training plan was found to be deficient in a number of key areas. A CRM plan tailored to the specialized needs of the team had never been developed. Oversight of the Snowbirds' standards and training was deemed to be deficient. Also, some recommended preventative measures from a prior accident had yet to be implemented at the time of this accident.

Since the accident occurred, many safety measures have been implemented: a computer based training package has been completed, a course training standard and plan is being developed, three-year tours for Snowbird pilots have been approved by the Commander of 1 Canadian Air Division, and the Central Flying School now conducts flying training evaluations on the team's pilots. The investigation also recommended that: a 431 Squadron CRM training package be finalized, the Canadian Forces CRM programme be reviewed to ensure it is applicable to all operational communities, a technical analysis be done by the Quality Engineering Test Establishment on the possible failure modes of the CT114 air lock fasteners, the consequences of an improper strap-in and the phenomenon of "submarining" upon ejection be emphasized in the CT114 Aircraft Operating Instructions (AOI's), the teaching syllabus of the AOI course and the ejection trainer, and the staffing of Flight Safety Investigation Reports be reviewed.

This accident underlines the risk involved in small, self-contained organizations, which require as much oversight of standards and processes as any other unit in our Air Force. This external oversight is a key element in objective risk management for 431 Squadron activities. The challenges of the next few years (fleet transitions, organizational changes and limited resources) will further strain our ability to maintain an acceptable level of safety for the Canadian Forces air demonstration team. ◆

TYPE: CH124A SEA KING 124A422
LOCATION: At Sea 19˚01'N 156˚ 58.5'W
DATE: 23 June 2000

The occurrence crew had completed a hot fuel and crew change aboard HMCS Protecteur and launched on an Anti-Submarine Warfare (ASW) Exercise. 25 minutes after take-off, hovering at a range of approximately 25 nautical miles (NM) from HMCS Protecteur, the Maritime Helicopter Crew Commander (MHCC) noticed a "Main Transmission Oil Hot" light on the caution panel. The temperature indicated in excess of the red line and the MHCC decided to declare an emergency and return to the ship for landing.

HMAS Adelaide was in company with HMCS Protecteur and both ships closed the aircraft's position at top speed. During the transit toward the ship, the Main Gearbox (MGB) pressure gauge began to fluctuate within the green arc and the pressure decreased steadily. The decision was made to enter the hover and wait for the ship to arrive.

Subsequently, the crew noticed a burning smell similar to burning metal and the MHCC felt an intense heat on his neck and left shoulder. A MAYDAY was transmitted and the crew conducted a controlled ditching from the hover. The engines were shutdown, the floatation bags were deployed and the crew stepped into the multiplace inflatable raft via the cargo door. As the crew drifted away, the tail of the aircraft began to settle lower in the water. At 2306Z the aircraft was observed rolling inverted and sinking below the surface. No salvage operation was attempted due to the extreme depth of water. There were no injuries.

A Day/ VFR operational restriction was imposed on all Sea Kings equipped with the 21000 Series MGB until the safety and Airworthiness of the MGB can be assessed. ◆

Managing Sleep for Night Shifts Requires Personal Strategies

Aviation professionals — pilots, flight attendants, maintenance technicians, air traffic control personnel and others — can adopt sound sleep practices to counteract sleepiness at work, improve performance and reduce safety risks by understanding factors that affect human ability to sleep during the day and to work at night.

J. Lynn Caldwell, Ph.D.
U.S. Army Aeromedical Research Laboratory
Fort Rucker, Alabama, U.S.

Aviation professionals have no immunity to sleepiness or the related challenges to human performance associated with shift work. Some aspects of their work environment today — such as increasingly automated flight decks — make these issues more complex. Continuing education and training about sleep and physiology — especially the operational significance for flight safety — are vital to establish effective personal strategies to meet these challenges.

Shift work generally refers to an extended production process in industry (or other cyclical work activity) that is covered by two or more groups (shifts) that relieve each other based on a schedule. In sleep research, shift work sometimes is differentiated as permanent or rotating, and as diurnal (day), nocturnal (night) or nychthemeral (combined day and night).[1]

One of the major concerns of researchers is the conflict between working late-night hours or predawn morning hours, and the human body's circadian rhythms — clocklike biological mechanisms that control many functions essential to health.

One research group said, "Typical work hours [in shift work] may be 0600 [hours] to 1400 [hours] for the morning shift, 1400 to 2200 for the afternoon shift, and 2200 to 0600 for the night shift. Roster work, which is more irregular and may contain more overlaps or gaps between shifts, also belongs [in this description of shift work]. Work hours that are only slightly displaced from daytime and do not constitute part of an extended production process (i.e., 'displaced work hours') [should be studied separately from shift work]."[2] Scheduling of the 24-hour day into shift-work periods varies among employers. One schedule in the United States, for example, is 0800 to 1600 for the day shift, 1600 to 0000 for the evening (or swing) shift and 0000 to 0800 for the night shift. In other schedules, the day shift may begin between 0400 and 0700.

Although some assignments in aviation require working many hours for weeks at a time, or responding to unpredictable emergencies at any hour, "reverse-cycle" shifts raise especially difficult theoretical and practical issues. ("Reverse cycle" means working primarily during times other than conventional daylight hours.)

Nevertheless, ongoing research has identified sleepiness, diminished performance and other effects of shift work, and has suggested some appropriate countermeasures. The fundamental concept is that in any aviation environment where pressures for reduced sleep time are beyond the individual's control, development of good personal sleep practices — sleep hygiene — helps to maximize the value of sleep time.

The work of many pilots has characteristics of shift work. While flight crews may be restricted by crew-rest guidelines in how *many* hours they may fly within a specified time period, there is usually no restriction on *when* these hours may be flown. Many times, aviators are required to fly at times when they may need to reverse their work hours from typical day periods to evening periods and morning periods.

When such rotations occur, the aviation professional becomes a "shift worker" in that he or she no longer works set hours, but must change work schedules every two days to three days, every week, every few weeks or possibly even daily, for the short term or long term. Thus, aviation professionals may face problems of sleepiness at work in common with approximately 20 percent of workers in industrialized nations who perform shift work.[3]

The U.S. National Transportation Safety Board (NTSB) and U.S. Federal Aviation Administration

(FAA) in 1997 recognized the need for additional study of duty time and scheduling practices for safe maintenance of air carrier aircraft following NTSB's investigation of the ValuJet Flight 592 accident in 1996.[4]

The NTSB's report also contained the following recommendation: "According to Part 121 of the U.S. Federal Aviation Regulations (FARs) that establishes limitations on duty time for individuals performing maintenance on Part 121 airplanes, including those who work in a Part 145 repair station, individuals must be off duty for 24 consecutive hours every seven consecutive days. However, the option exists to give the equivalent number of off-duty hours within the span of a calendar month. This regulation allows for mechanics to work as many as 26 consecutive days, taking all of their off-duty time at the end of the month.... The [NTSB] concludes that the current duty-time limitations... may not be consistent with the current state of scientific knowledge about factors contributing to fatigue among personnel working in safety-sensitive transportation jobs. Accordingly, the [NTSB] believes that the FAA should review the issue of personnel fatigue in aviation maintenance; then establish duty-time limitations consistent with the current state of scientific knowledge for personnel who perform maintenance on air carrier aircraft."

FAA's response to this NTSB recommendation said, "... [FAA's *Human Factors Guide for Aviation Maintenance*, published in 1995] is the principal reference used by the aviation industry and includes a chapter on personnel shift work and scheduling as they affect human performance. FAA data suggest that night shift and/or mixing of day/night work schedules affect performance more than an extended length of duty time; however, no current definitive studies are available to evaluate these parameters as comparable measurements. Consequently, the FAA will expand its human factors research program to include studies of duty-time fatigue that will investigate factors regarding duty length and shift scheduling."[5]

In the mid-1990s, scientifically based recommendations relevant to night work emerged from Flight Safety Foundation's Fatigue Countermeasures Task Force. Beginning in 1994, the task force focused on human fatigue during corporate flight operations, recognizing that increasing numbers of segments are flown by crews in a single day and some aircraft are capable of 14-hour flight endurance. The task force said that significant differences exist among individuals in their tolerance for shift changes and night work, required sleep, effects of sleep loss, recovery time and special factors such as long commutes before beginning a duty period. Off-duty periods of at least 10 hours within any 24-hour period were recommended to provide an eight-hour sleep opportunity, awake time off and time for transportation to and from layover accommodations, meals, bathing and other personal needs. Task-force recommendations also specified longer off-duty periods for crews operating during the "window of circadian low" (0200 to 0600 for individuals who are adapted to the usual day-wake/night-sleep schedule) or when crossing multiple time zones. Two-week, monthly and yearly limitations on cumulative duty periods and flight time were recommended to reduce the potential for long term fatigue effects on performance.[6]

The amount and quality of sleep that flight crews obtain during a succession of long-haul flights with 24-hour rest periods (layovers) also have been shown to be significantly affected by adaptation to local time, prior flight direction and the disruption of environmental time cues needed by the body's "internal clock."[7] The result is that any of the physiological symptoms typically experienced in shift work may occur. The symptoms include increased fatigue, sleep deprivation, sleepiness, insomnia, moodiness and others. Along with these symptoms come diminished performance and errors.

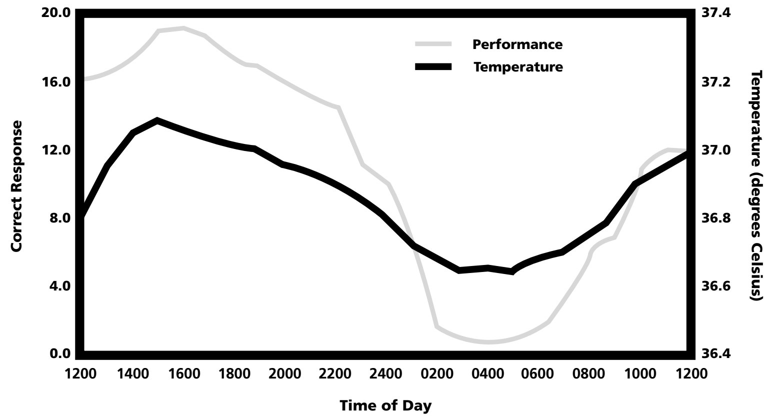
For example, some U.S. flight crews have reported their belief that too little sleep and irregular work schedules have contributed to major operational errors such as attitude deviations, navigation-track deviations, landing without clearance, landing on an incorrect runway and improper fuel calculations, said a 1989 study.[8]

One researcher said in 1988, "Each year, increasing numbers of shift workers must work at times in conflict with their circadian rhythms.... Given the evolutionary legacy and pervasiveness of circadian rhythmicity, it is not surprising that most pilots have difficulty countering its influence."[9]

Shift work is difficult because several factors affect people when they alter their normal work hours and sleep hours from society's predominant work/rest pattern. These biological, circadian and social factors all must be addressed when a person has to adapt to varying schedules. Working nonstandard periods also means sleeping during

Figure 1

Test-subject Performance and Body Temperature, by Time of Day



Source: J. Lynn Caldwell; adapted from Timothy H. Monk et al., "Circadian Rhythms in Human Performance and Mood under Constant Conditions." *Journal of Sleep Research* Volume 6 (1997).

nonstandard periods, which goes against the body's natural rhythm and against society's schedule. Several studies — some in aviation — have documented the problem.

One 1996 study — in which flying at night required crews to sleep during the day — said, "The organization of sleep during daytime layovers [among pilots flying a series of overnight cargo trips] reflected the interaction of duty timing with circadian physiology.... These data clearly demonstrate that overnight cargo operations, like other night work, involve physiological disruption not found in comparable daytime operations." Also, reports of headaches quadrupled, reports of a congested nose doubled and reports of burning eyes increased nine times among overnight-flight crewmembers on duty days compared to pretrip days, said the researchers.[10]

Reverse-cycle work can restrict a person's sleep period to less than the seven hours to eight hours needed by the average adult. But effects of the reductions that people commonly experience — that is, periodically sleeping for only five hours to six hours — are unclear because of limited research. Human sleep research, however, has found that restriction of the sleep period to four hours or less definitely increases sleepiness and decreases performance when the person is awake — and these effects are cumulative (that is, they produce sleep deficits that require recovery sleep).[11]

Reverse-cycle Shift Work Presents Several Problems

Almost every person who works rotating schedules experiences sleepiness during the night when alertness is needed to perform safely and effectively. Then the person experiences difficulty sleeping during the day when trying to recoup from this reverse-cycle work day. This is normal because night activity and day sleep are in opposition to the body's natural programming — the day-active orientation dictated by the human circadian clock.

Although there are individuals who prefer to work late hours and awaken late in the day, and others who retire early and arise early, most people cannot comfortably tolerate extreme shifts of sleep/wake periods. They consistently obtain the majority of their sleep during nighttime hours and are active during daylight hours.

Circadian rhythms govern predictable natural patterns of being awake and being asleep, with related hormonal secretions, changes in physical and mental performance, digestion, moods and small variations in core body temperature during the 24 hours of each day. These rhythms do not adjust rapidly to change. The following stages are typical:

- As the day begins, body temperature, alertness and performance gradually increase;

- These increases continue into the day, with a slight dip in the midafternoon;
- Body temperature, alertness and performance begin to decrease as the day ends and night begins; and,
- The lowest point occurs during the early morning generally between 0200 and 0600.

Figure 1 shows these temperature rhythms and performance rhythms.[12]

In contrast, the following stages of sleepiness occur in the circadian rhythm:

- Sleepiness declines as the day begins;
- A small increase in sleepiness occurs in the midafternoon; and
- Sleepiness then steadily increases as the day ends and night begins.

Thus, the ability to fall asleep and to remain asleep — sleep propensity — is naturally low during daylight hours. After evening comes, sleep normally is easier to obtain, with sleep propensity being greatest in the early morning between 0200 and 0600 — the times at which performance and alertness are lowest.

Figure 2 shows the average amount of time that a person can maintain sleep when sleep begins at various hours of the day, as well as the average time for sleep onset.[13]

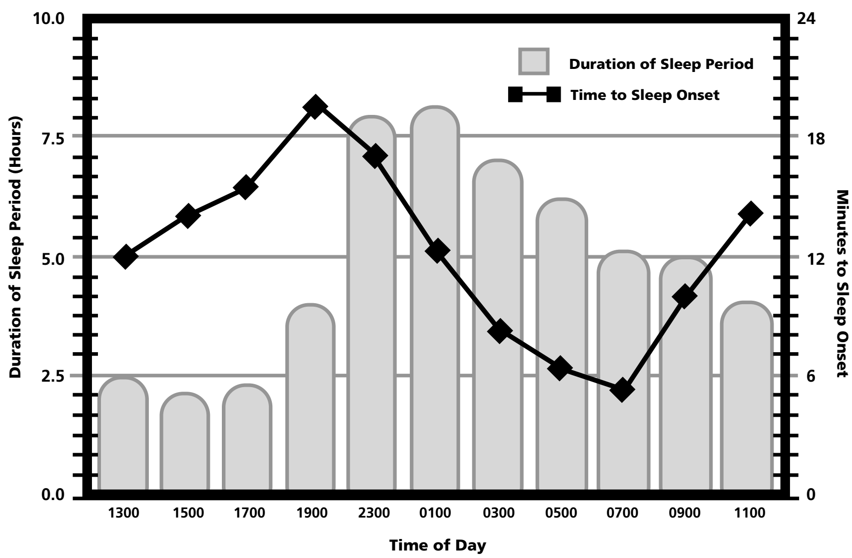
The effects of disturbing the circadian rhythm can he significant. One study showed that the ability to fly a flight simulator at night, when compared to normal daytime pilot proficiency, decreased to a level corresponding to that after moderate alcohol consumption.[14]

Sleep researchers also said that some common practices in aviation — such as requiring early report times for pilots — may make it difficult for flight crews to obtain adequate sleep because circadian rhythms impede falling asleep earlier than usual, except after major sleep loss.[15]

Sleep researchers have found that many external factors affect a person's ability to sleep during the day. A powerful cue to the human body is sunlight, which increases alertness and alertness helps resynchronize the natural 24-hour rhythm of daytime alertness and nighttime sleep. Many airline passengers and crewmembers have felt a "second

Figure 2

Duration of Sleep Period and Time to Sleep Onset, by Time of Day



Source: J. Lynn Caldwell; adapted from A. Smiley, "Fatigue Management: Lessons from Research." In *Proceedings from the Third International Conference on Fatigue and Transportation: Coping with the 24-hour Society.* Fremantle, Western Australia, 9-13 February 1998, and Mary A. Carskadon and William C. Dement, "Daytime Sleepiness: Quantification of a Behavioral State." *Neuroscience and Biobehavioural Reviews* Volume 11 (1987).

wind" (feeling of renewed alertness) that occurs when arriving in the midmorning to late morning after a night flight. Sleepiness may increase before dawn, but when the aircraft is flown into the sunrise, sleepiness dissipates and alertness increase. Although this early-morning alertness may be an advantage for approach, landing and performing postflight duties, this alertness also can interfere with sleep during daylight.

Sunlight thus may shorten the subsequent daytime sleep period, leading to sleep deprivation. As the length of sleep decreases and sleep deprivation increases, the difficulty in remaining awake increases during the next night's duties. Eventually, cumulative sleep deprivation may result in extended sleep during the day, but after the sleep debt is satisfied, the cycle may recur. Such an endless loop can be diminished by using coping strategies, or can be stopped by returning to the natural rhythm of night sleep and day activity. (See "Strategies Make Rotating Shifts Easier to Manage".)

Crew Study Finds Shorter Sleep Periods during Daylight Hours

A 1996 study by the U.S. National Aeronautics and Space Administration (NASA) of flight crews engaged in an eight-day shift of successive overnight cargo operations made the following observations concerning sleep during daylight hours:

- "Daytime sleep episodes were about three hours (41 percent) shorter than nighttime sleep episodes and were rated as lighter, less restorative and poorer overall;
- "The incidence of sleeping more than once in 24 hours tripled on days with duty, compared to days without duty;
- "Overall, crewmembers averaged 1.2 hours less sleep per 24 hours on duty days than on pretrip days;
- "Crewmembers were also accumulating a sleep debt across the eight days of the trip patterns; and,
- "Regardless of the time that they went to sleep after coming off duty in the morning, [crewmembers] tended to wake up around 1410 local time, even after as little as [four hours to five hours] of sleep. This clustering of wake-up times coincides with the timing of the circadian 'wake-up signal' identified in laboratory studies."[16]

Rotating Cycles May Have Social Consequences

Constant change of work schedules affects a host of activities and relationships, including work performance, safety, health, family life and social life.

Work-performance decrements may occur when aviation professionals feel sleepy most of the time. This sleepiness normally is caused by sleep deprivation, difficulties in obtaining adequate sleep and circadian-rhythm factors. When sleepiness increases, performance decreases; attention to detail, accuracy and motivation are affected. This is particularly a problem when work is scheduled during hours when the circadian effects are most pronounced.

According to the 1997 National Sleep Foundation Poll, workers on a night shift accomplish only about 70 percent of the work that they normally accomplish on a day shift.[17] Safety decrements also may occur. Data have shown that workplace accidents such as falls, electrocutions and fires in many settings increase during the night shift. A peak in vehicular- accident data occurs during the early morning hours as well.

Sleepiness is considered a major cause of accidents in many industries. Sleep researchers have taken special interest in some major industrial mishaps involving human error that have occurred between 0200 and 0600. The Three Mile Island Nuclear Power Plant reactor accident in Pennsylvania, U.S., occurred at 0400 on March 28, 1979.[18] The Davis-Besse Nuclear Power Plant reactor shutdown in Ohio, U.S., occurred at 0130 on June 9, 1985.[19] Russia's Chernobyl nuclear power plant accident began at 0123 on April 26, 1986.[20] (Although a causal relationship between the time of day and the events cannot be assumed, investigators consider time of day among other possible human factors.)

Health detriments may occur when normal schedules are disrupted. Individuals vary in their required sleep period and sleep-recovery time, age, experience, health, off-duty lifestyle and other personal factors. Nevertheless, most individuals need a relatively consistent schedule of work and sleep to avoid physical and mental stresses and sleep disruption. On average, adults need seven hours to eight hours of sleep in a 24-hour period — although a range of normal sleep needs greater than and less than this amount has been documented.

When times for meals, exercise and sleep constantly change, susceptibility to health problems such as gastrointestinal distress, menstrual irregularities, cardiovascular problems such as hypertension, viral illnesses such as colds or flu depression and insomnia may increase for some people Digestion disrupted by irregular eating schedules may lead to gastrointestinal problems and weight gain. Psychological stress may lead to family problems and social difficulties. Lack of a consistent sleep period and period of being awake can contribute to insomnia, chronic sleepiness, depression and sleep deprivation.

Chronic sleepiness that some aviation professionals experience when working rotating and/or reverse-cycle shifts can lead to problems in the home and in social arenas. Spouses and children may feel neglected. This is especially true when the duty period occurs between 1500 and 2300 — that is, while the family is home. Dinner time cannot be shared, for example, and other evening social activities are missed.

Compounding the problem is a schedule of night flights (or other duties) during a short period of time — after which the person may feel too tired to participate in family activities at normal times because sleep was not satisfactory during the day. Similarly, many people who work rotating shifts reduce their social activities because such schedules do not allow consistent involvement, which can lead to a feeling of social isolation. Some friends and family members may not readily grasp the complexities that affect the ability of shift workers to find adequate time for work, family, social life and rest.

Strategies Make Rotating Shifts Easier to Manage

Many shift workers have difficulty sleeping during the day because so many cues say, "stay awake." Pilots may be requested to report to work during the day to complete administrative tasks that cannot be done at night. Some people experience sleep problems because they feel lazy sleeping while others are working. Family members may expect errands to be accomplished by the person who is home during the usual business day.

The answer is to explain to managers, family and friends the critical importance of getting adequate sleep. Family members and friends appreciate knowing about sleep schedules so they can be considerate. If someone occasionally must reach the daytime sleeper, a pager kept by the bed gives peace of mind in knowing that an emergency will not go unanswered.

Psychological cues can help convince the mind and body that the time for sleep has come. A person should dress, bathe, brush teeth and perform other "sleep rituals" (consistent routines) just as if the sleep period were at night. The bed, pillows and bed clothes should be comfortable. Sleeping in bed is recommended — not on a couch or in a reclining chair. Napping on the living room sofa is a poor strategy for getting enough quality sleep during a sleep period.

Psychological factors also affect perceptions of the sleep environment. The design and familiarity of the room in which one sleeps can increase the ability to settle down without distractions and obtain quality sleep. One strategy is to make the bedroom very dark, because light is the major cue that tells the body to wake up. Black-out shades can be installed under drapes. Aluminum foil also block's daylight effectively.

To avoid door-to-door salespeople, unexpected deliveries and unwanted visitors, disconnect the doorbell or hang a sign on the door with the message SHIFT WORKER — PLEASE DO NOT DISTURB.

The level of noise can interfere seriously with sleeping. For example, noise, from deliveries, construction and traffic greatly increase during daylight.

Use low-volume background noise to muffle distracting sounds. A fan is a good choice. Sound from TVs or radios does not work well because the varying, volume levels can disturb sleep even if the sleeping person seems unaware of the sound. If distracting light and sounds cannot be blocked, slumber masks to cover the eyes and ear plugs are useful.

Make sure the room is cool (65 degrees Fahrenheit [18 degrees Celsius]); most people typically sleep better in a cool room than in a warm room. In a warm room, people have more difficulty adjusting to the ambient temperature. In a cool room, they can use a blanket to easily adjust the temperature so that they feel neither too hot nor too cold.

Other strategies may be necessary to remain asleep for the planned sleep period. Many day sleepers awaken about three hours into their sleep, and have difficulty returning to sleep. People who begin their sleep a few hours before dawn — for example, between 0300 and 0500 — after an early morning flight often have difficulty completing the sleep period in the late morning. Staying in the dark room even after awakening to avoid circadian cues such as exposure to sunlight, can minimize this problem and can lead to a rapid return to sleep.

When unable to return to sleep, the best approach is to do something quiet and relaxing, such as reading a book or listening to music until sleepiness recurs. If sleep does not return, a person should not try to force sleep. Trying to force sleep will cause a person to become frustrated, which defeats the sleep mechanisms. If sleep does not return after 20 minutes, the shift worker should get up and try to sleep later in the day. Two short sleep periods are better than only one.

Some countermeasures for sleepiness have been found to improve sleep during the day and alertness during the subsequent night shift. Such strategies for better sleep in healthy adults may require a few weeks of practice to show a noticeable benefit. The following strategies may be appropriate:

- Careful attention to shift design can help. Rational and physiologically based scheduling practices — many adopted successfully by airlines and other aviation organizations — have been recommended to the aviation industry during the 1990s. Researchers at the FAA Civil Aeromedical Institute (CAMI) said, following studies of shift-work performance by air traffic controllers in the mid-1990s, that shift designs must consider not on1y how many shifts occur during daylight hours, but the time available for people to travel home, obtain sufficient sleep and report to work on the next assigned shift. In the shift schedule studied by CAME workers theoretically could maintain relatively stable sleep/wake cycles with one night shift every four days, but the schedule provided as little as eight hours between shifts. Thus, the 1995 study recommended redesigning shifts, "to minimize quick turnarounds."[21]

  "Employees should be instructed about the importance of maintaining a stable sleep/wake schedule, even on days off from work," said the study, which urged caution in drawing general conclusions from CAMI's experimental results. "This includes standardizing arise times, as well as times for exposure to sunlight in the mornings to maintain the timing of the biological clock."

  Other researchers have recommended that shift designs for aviation professionals provide sufficient awake time off (breaks from continuous performance of required tasks, in addition to adequate time for sleep between shifts) and frequent recovery periods of several days to reduce cumulative lack of sleep (sleep debt) that can accrue during the duty cycle (that is, weekly recovery periods provide greater benefit than monthly recovery periods).[22]

  One school of thought concerning rotating shift work is that it is preferable for workers to change from one shift to another shift as infrequently as possible, allowing the body to adjust to the new schedule. When a person rotates from one shift to another shift, the easiest rotation is to change from day shift to evening shift to night shift. This direction of rotation fits the body's natural rhythm. If a person rotates shifts in the opposite direction — from nights to evenings to days — the body will take longer to adjust to the change of shifts.

- Good sleep during the day requires careful planning of activities and behaviors, even before reaching home or another rest location. Prepare for changes of shifts on days off before the shift changes (for example, prior to the change to an evening shift, remain awake later and later in the morning). Schedule a block of at least six hours for sleep and adhere to this time just as for any other important appointment. Then let friends and family know the time of the sleep period.

- Poorly timed caffeine consumption is a common reason that night workers have trouble sleeping during the day. Many people consume coffee, tea, soft drinks, chocolate and other products containing caffeine toward the end of the shift to stay awake those last few hours. Used appropriately, caffeine can be a convenient and effective countermeasure for sleepiness, but caffeine also may interfere with sleep later. Thus, sleep scientists recommend avoiding caffeine within four hours to six hours of the sleep period.

- Rotating-shift workers especially benefit from good sleep hygiene (such as the following behaviors) to improve the quantity and quality of daytime sleep:

  - Relax before going to sleep, avoiding work-related tasks if possible;
  - Stay indoors and avoid sunlight exposure until the sleep period is complete;
  - Pay attention to the comfort of the sleeping room in terms of physical preferences (clean air, near-total darkness, adequate ventilation and air movement, temperature, humidity, noise level and cleanliness) and psychologically important preferences (peaceful and familiar furnishings, personally significant items from home);
  - Take a hot bath about 90 minutes before retiring (the drop in body temperature that follows may cause sleepiness);
  - Read a calming book, watch a nonstressful television program or find another relaxing activity to "tune out" thoughts about the day's frustrations and prepare for sleep;
  - Turn off the telephone ringer in the sleeping room, if possible, and use an answering device to record messages;
  - Avoid placing the clock in a direct line of sight or watching the clock while waiting to fall asleep;
  - Eat a light snack and drink just enough water before sleeping

to avoid hunger or dehydration later, but not enough for prolonged digestion (an empty stomach may disturb sleep as much as a full stomach);

- Avoid alcohol within three hours before the sleep period (alcohol — a sedative — may increase sleepiness initially, but disturbs sleep later in the sleep period);
- Avoid nicotine for four hours to six hours before sleeping (quitting smoking provides important health benefits, including better sleep);
- Avoid vigorous exercise within three hours to four hours before the sleep period; and,
- See a health-care professional to relieve symptoms, such as chronic headaches from allergies, chronic joint and muscle pain, and similar problems that may disturb sleep.

There are many medical and psychological conditions that can affect an individual's good sleep, recovery from insufficient sleep, sleepiness and other factors. For any unexplained or chronic fatigue, insomnia or other sleep problem, a health professional should be consulted. Major sleepiness during any period when a person expects to be awake should not be ignored.

Some over-the-counter medications contain caffeine, and some prescription medications have comparable stimulant effects that interfere with sleep. Ask a physician or pharmacist about such side effects, mentioning the aviation work environment, to avoid safety problems and sleep interference. The physician may want to change the dosing regimen or change medications for a patient who must sleep during the day.

Regarding alcohol, NASA sleep researchers in 1996 said: "The widespread use of alcohol as a means of relaxing before going to sleep has deleterious effects on subsequent sleep. It thus seems likely that the quality of sleep on trips could be improved in many cases by providing pilots with information on alternative relaxation techniques which have been well tested in the treatment of sleep disorders."[23]

An aviation professional driving home after night duty may be at increased risk of falling asleep at the wheel. Similarly, an aviation professional with an early-morning report time may be sleep deprived while driving because many people do not begin their sleep periods earlier than usual when they must work in the early-morning hours. Reasons include being unable to sleep earlier in the evening because of circadian factors, or simply choosing to remain awake for social reasons. When leaving work after a night shift, exposure to sunlight should be reduced as much as possible because the morning alertness that sunlight triggers is counterproductive to daytime sleep. Wrap-around sunglasses may help reduce this effect.

Car pooling or hiring a taxi is a method for a night worker who feels sleepy to avoid an accident while driving home. In car pools, conversation will help the driver stay alert. Depending on other safety factors, the driver also may choose not to wear sunglasses to take advantage of the wakening effect of sunlight. While the driver later may have difficulty sleeping this one day, the tradeoff may be necessary for highway safety. Other car-pool participants can wear sunglasses and, by rotating drivers, on1y one driver at a time would have the potential sleep problem.

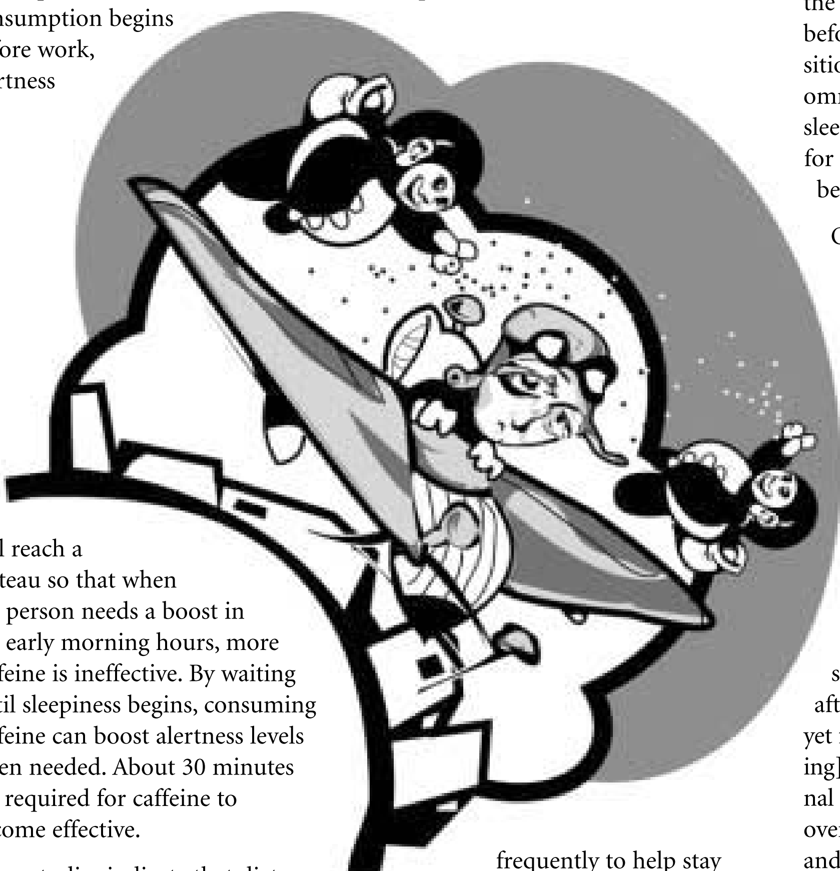
The Expert Panel on Driver Fatigue and Sleepiness for the U.S. National Highway Traffic Safety Administration made the following observations:

- Drowsy-driver accidents usually are serious and occur most frequently during late night/early morning and midafternoon with the driver alone in the vehicle;
- At highest risk for such accidents are young people (ages 16 to 29), especially males, shift workers whose sleep is disrupted by working, at night or working long or irregular hours; and people with untreated sleep-apnea syndrome (in which momentary cessation of breathing causes the sleeper to awaken);
- One or more of the following major factors typifies these accidents: acute or chronic sleep loss, driving between 0000 and 0600, use of sedating medications, untreated or unrecognized sleep disorders, and consumption of alcohol; and,
- Key countermeasures against such motor-vehicle accidents are education of young drivers and shift workers about these risks, and installation of rumble strips (raised areas in pavement that jar drivers awake when tires strike them) along the shoulders of highways.[24]

Strategies Can Help Crewmembers Stay Alert while Working at Night

Although sleeping during the day enables one to be alert during night work, sleepiness at night still occurs naturally. A person cannot completely trick the human body into being fully alert throughout the night because of the strong physiological drive for sleep at certain hours. The body can adapt somewhat to staying awake all night and performing work safely, but many days of strict schedules are required before the body adjusts to reverse-cycle work — and most shift workers are off the night shift or morning shift by the time maximum adaptation occurs. Nevertheless, there are some proven strategies that can improve alertness at night.

A common method to counteract the feeling of sleepiness is to consume caffeine in some form. This is an acceptable way to increase alertness, but the timing and amount of caffeine consumption are very important. The recommended guideline is to wait to use caffeine until the stimulation is really needed — and consider the unwanted effects on sleep later. If caffeine consumption begins before work, alertness will reach a plateau so that when the person needs a boost in the early morning hours, more caffeine is ineffective. By waiting until sleepiness begins, consuming caffeine can boost alertness levels when needed. About 30 minutes are required for caffeine to become effective.



Some studies indicate that diet can make a difference in sleepiness at work. Foods high in carbohydrates tend to promote sleepiness, while protein increases energy (and so should be avoided close to the planned sleep period). Foods like potatoes, rice, cereals, breads and pastas — all high in carbohydrates — promote sleep.High-protein foods such as meat, fish,cheese and eggs, in contrast may lessen sleepiness at night.

Staying active is a good strategy for workers who can manipulate their work environment. For some aviation professionals — such as flight crews — this may not be feasible, but similar strategies may be helpful. If possible, change posture and move around frequently to help stay alert. Stretching and isometrics in the cockpit can help. Use appropriate opportunities to leave the duty position to stand and move rather than remaining stationary for hours at a time. Interesting conversation and other social interaction also will help increase alertness.

Keep the air temperature of the work environment on the cool side of the comfort range. Feeling slightly cool helps the shift worker avoid becoming too comfortable, which may lead to drowsiness. If control of the workplace temperature is limited, adjust items of clothing.

Advance planning for a change in rotating shifts is helpful. Ideally, preparation for reverse-cycle duty should include gradually delaying the sleep period and wake-up time before the change. To ease the transition, some sleep researchers recommend a nap to obtain as much sleep as possible before reporting for night duty, even when there has been a satisfactory sleep period.

One research team said in 1989. "Naps, especially afternoon naps of approximately [one-hour] duration, are a common feature of the sleep of healthy adults in many countries.... If nocturnal sleep is inadequate, daytime napping is more prevalent.... Naps generally do not adversely affect nocturnal sleep or indicate disordered sleep at night. Although sleep inertia [a temporarily lowered psychological state upon waking or brief time after waking when a person is not yet fully awake] can occur after [waking] from naps, as it can after nocturnal sleep, naps generally have later overall beneficial effects on mood and performance. Thus, the available data on nap patterns and nap effects in otherwise healthy adults suggest that napping is a normal, appropriate and beneficial feature of adult wake/sleep patterns."[25]

In relation to prolonged work, other researchers said: "Naps taken during prolonged work periods can prevent or reduce sleep decrements after they have occurred.... The length of the nap required depends on the duration of sleep loss involved and the type of task to be done. There is evidence that sleep fragmented into two [two-hour] naps can be as beneficial as one four-hour sleep. Moreover, at least one study has reported that a nap before prolonged work can be as beneficial as one taken during or after such work.... The problem is that napping is a double-edged sword, its beneficial effects must be balanced against the negative effects of sleep inertia, which, although transient, are nevertheless important in some operational situations."[26]

Studies have found that planned and controlled in-flight rest periods for flight crewmembers are effective in promoting performance and alertness in nonaugmented long-haul flight operations. Research also is continuing into creative uses of flight-deck automation techniques to help flight crews maintain performance and alertness, said a 1996 report. Such developments have the potential to help offset some of the adverse effects associated with shift work and operations during the window of circadian low.[27]

Research Reinforces Need for Shift-work Countermeasures

Many night workers sleep as soon as they reach home or another designated place for rest, so they wake up many hours before the time to return to work. This is the opposite of what happens on a day shift. The typical order of activity for day shift is wake up, work, socializing and sleep. For most night workers, the order of the day is wake up, socializing, work and sleep. Thus the time elapsed between the end of the sleep period and work is longer for night workers than for day workers. If the night worker can take a short nap (perhaps an hour) before reporting to work, the nap will alleviate some of the sleep debt that may accumulate between the end of a sleep period and the beginning of the next work period. Such a nap does not "store up" alertness for later use, researchers believe, but does help assure that accumulated sleep needs are met. The shorter the time between sleep and work, the more one can delay sleepiness at night.

NASA researchers said in 1996: "Currently, there are no countermeasures, which have been shown to be safe and effective in operational settings, to overcome the incomplete adaptation of the circadian clock to night work.... [There are] several approaches for minimizing sleep loss. In trip construction, particular attention can be given to the timing and duration of rest periods and to the number of consecutive nights of flying."[28]

Adjusting to rotating schedules and reverse-cycle shifts is not easy. Nevertheless, taking care of some of the manageable variables will lead to better work performance, social relationships and health. Planning adequate time for sleep should be a constant priority because of the safety implications in aviation.[29]

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2. Àkerstedt et al., 205.

3. Àkerstedt et al., 205, citing M. Maurice. *Shift Work*. Geneva: ILO, 1975.

4. On May 11, 1996, ValuJet Airlines Flight 592, a McDonnell Douglas DC-9-32, departed from' the [Florida, U.S.] International Airport. An intense fire erupted in the forward cargo compartment and burned through the aircraft's control cables. The aircraft collided with terrain about 17 miles (27 kilometers) northwest of the departure airport. The two pilots, three flight attendants and all 105 passengers were killed. The aircraft was destroyed. The accident occurred during daylight in visual meteorological conditions. The U.S. National Transportation Safety Board said. "The probable cause of the accident, which resulted from a fire in the aircraft's class-D cargo compartment that was initiated by the actuation of one or more oxygen generators being improperly carried as cargo, were (1) the failure of SabreTech [ValuJet's maintenance contractor] to properly prepare, package and identify unexpended oxygen generators before presenting them to ValuJet for carriage (2) the failure of ValuJet to properly oversee its contract maintenance program to ensure compliance with maintenance-training and hazardous-materials requirements and practices, and (3) the failure of the U.S. Federal Aviation Administration (FAA) to require smoke-detection and fire-suppression systems in class-D cargo compartments. Contributing to this accident was the failure of the FAA to adequately monitor ValuJet's heavy-maintenance programs and responsibilities including ValuJet's oversight of its contractors and SabreTech's repair-station certificate, the failure of the FAA to adequately respond to prior chemical oxygen generator fires with programs to address the potential hazards; and ValuJet's failure to ensure that both ValuJet and contract maintenance-facility employees were aware of the carrier's 'no-carry' hazardous-materials policy and had received appropriate hazardous-material training."

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17. The National Sleep Foundation (NSF) conducted two polls in 1997. Results of "NSF Harris Poll: Sleeplessness and the Workplace" were released March 27. 1997 (http://www. sleepfoundation. org/pressarchives/newsurvey.himl). Results of "NSF Gallup Poll: Sleepiness in America" were released June 3, 1997 (http://www.sleepfoundation.org/pressarchives/ newsurvey.html). Both polls are discussed in a 1997 NSF brochure titled *Strategies,for Shift Workers*, available at this web site.

18. In the Three Mile Island Nuclear Power Plant (TMI) reactor accident, a malfunctioning pump, a jammed valve and a series of operator actions caused a loss of cooling water from the core of one of two reactors. Plant officials closed the damaged reactor and said that no radiation was released to the environment. Nevertheless, state authorities advised pregnant women and children living within five miles (eight kilometers) of the plant to evacuate the area temporarily. The consensus of state and federal authorities during the following decade was that the accident would cause no significant physical health effects. The second reactor was restarted in October 1985. A news summary said that a federal commission that studied the accident cited poor training as a causal factor. (Source: Peterson, Cass. "A Decade After Accident, Legacy at TMI Is Mistrust." The Washington Post, March 28, 1989, IA.)

19. In the Davis-Besse Nuclear Power Plant reactor shutdown, plant technicians used emergency methods to temporarily resupply water to a reactor-cooling system that lost water after the failure of various components of the main cooling pumps. These actions averted an accident and normal safety mechanisms were restored. No major damage occurred and no radiation was released into the environment. A news report said that the U.S. Nuclear Regulatory Commission found the underlying cause to be "lack of attention to detail in the care of plant equipment." (Source: Weisskopf, Michael. "Ohio Nuclear Plant Mishap Raises Questions on U.S. Safety." The Washington Post. May 24, 1986, 1A.)

20. In the Chernobyl nuclear power plant accident, 30 technicians and firefighters died from high doses of radiation after the nuclear reactor and part of a building were destroyed by a steam explosion and fires. Radioactive materials were released into the environment, the plant was encased in a shelter, and many residents of the region were permanently relocated. Causal factors included problems in the reactor's control and protection system, an unstable operational mode and violations of operational safety rules. [Source: Kurchatov Institute Russian Research Center. "Chernobyl and Its Consequences (Project Polyn): The Causes of the Accident and Its Progress."http://polyn.net.kiae.su/polyn/history.html]

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"Overcoming Effects of Stress Offers Greatest Opportunity to Sleep Well." *Human Factors & Aviation Medicine* Volume 45 (July–August 1998).

About the Author

J. Lynn Caldwell, Ph.D., is a research psychologist and board-certified sleep specialist at the US. Army Aeromedical Center, Fort Rucker, Alabama, U.S. She has been conducting, research with aviators for the past 10 years, including studies of sleep deprivation, shift lag and jet lag, and countermeasures to alleviate related problems. Caldwell also has conducted training for physicians, flight surgeons and U.S. Army commanders regarding problems associated with fatigue, sleep deprivation and changes in the sleep/wake cycle.

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FLIGHT SAFETY FOUNDATION — HUMAN FACTORS & AVIATION MEDICINE — MARCH–APRIL 1999 ◆

"He was no busier than the rest of us..."

As part of every ADF (Australian Defence Force) Flying Safety Officers (FSO) Course, each student is invited to write a fictional or factual flying safety story for possible inclusion in *Spotligh*t. SQNLDR Haggarty wrote the following article in November 1998 while a student on FSO Course 2/98.

The article provides an interesting insight into the witness interviewing process following an aircraft accident.

'TACCO, Pilot. Are you happy with 1, 000 ft?'

'Yep, that is good Pilot, I want to stay below the enemy radar horizon for the moment.'

'TACCO, Radar. I think this display software is glitching again. I have lost the left-hand forward quarter again!'

'Roger Radar. I am rebooting your display, check the Radar interface and note the fault codes.'

'TACCO, Captain, Nav. New tasking from the ships, primary search is for enemy patrol boats. We are close to infrared detection range for ID.'

'Got that Nav. Pilot, new fly-to point, Radar, can you clear the track to that point?'

'Negative TACCO, it's in the blind arc.'

'Ah TACCO, Nav. I think the GPS has dropped out. I'll go off the INS, but we really need to climb and get a fix.'

'Not now Nav. Can you clear us visually, Pilot?

'Standby, it's awfully dar...'

The interviewer placed the tape recorder in the middle of the desk in the empty room and switched it on.

'This is an interview conducted by the Directorate of Flying Safety into the accident of A9-655, P-3C update aircraft on Friday 13 Nov 98 at approximately 0200 hrs in Bass Strait. Please state your name, rank, serial number and position on the unit for the record.' The interviewee looked uncomfortable and tugged idly at his ear. 'Flight Sergeant John Andrew Holmes, A 123456, Squadron Scheduling Officer.'

'Please tell us what you know of the events leading up to the accident, asked the investigating officer.

'Crew 8 was scheduled to conduct a Fleet Support sortie on the day in question. Take-off time was 1700 hrs local. They made their take-off time. The crew was fully qualified for the mission. Their TACCO on the mission was the D FLTCDR, who had been flying off and on with the crew for the last month. I first heard of the accident when the XO rang me at home at about 0300 hrs and told me to report to work.'

'Was the crew fully fit and rested?'

'Yes, they last flew on Tuesday, and that was a six-hour trainer in working hours. Apart from that they had an early morning simulator on Wednesday at 0600, to work up for their upcoming Hawaii trip. The FLTCDR and the captain were at work at about 1200 on the day of the accident, then had to go to the Base flying safety meeting. After that, I think the captain had a meeting with the company rep about a glitch in the last test flight and I remember seeing the FLTCDR in his office doing officer evaluation reports (OERs) or something. That's about all I know.'

'Please state you name and position for the tape,' asked the investigator.

'Flight Lieutenant Harm Connick, 065432 TACCO Training Officer.'

'How much observation have you had of Crew 8 and what is your assessment of their abilities '

'Crew 8 was a really good crew. You only have to look at the positions held by the people within it. The captain and the AE were both in Standards.'

'Is that usual, for training officers to be crew?' asked the investigator.

'No, but we're so short of experience these days. Even more so now I guess. I just can't believe these guys would smack in.'

'What about the rest of the crew?'

'All solid operators, the lot of them. Hell, they were good.'

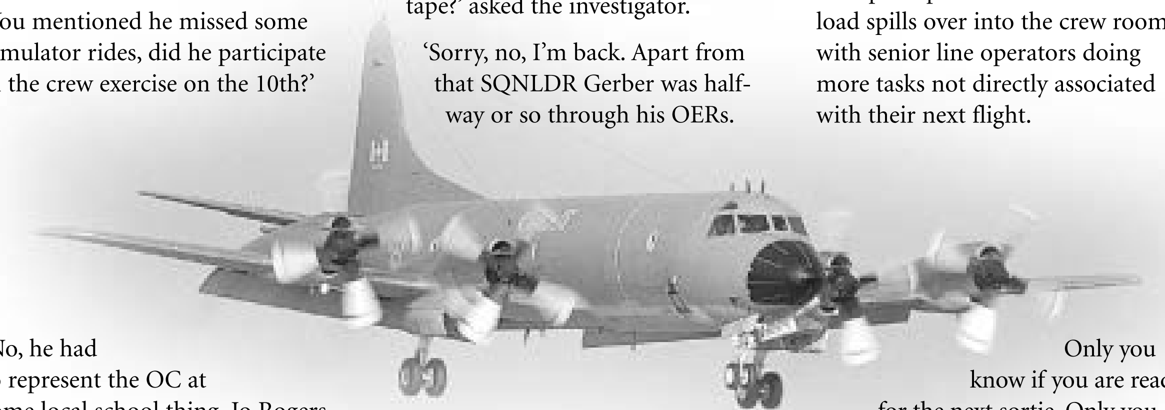
''What about the FLTCDR, SQNLDR Gerber as a TACCO?' quizzed the investigator.

'The boss was a great TACCO, he had over three thousand hours in the seat. He probably knew more about Maritime than most of us could forget.'

'So how come he has only made Category C on the classic and Category D on the update?'

'Flight Commanders just don't get the hours. He missed a few simulators through meetings and bloody paperwork, he always said he had too much paperwork He used to joke that promotion wasn't worth it, too much paperwork. But he made the grade, he was a fair C Cat.'

'You mentioned he missed some Simulator rides, did he participate in the crew exercise on the 10th?'



'No, he had to represent the OC at some local school thing. Jo Rogers, the regular crew TACCO, did that one. But hell, he wrote that scenario five years ago, he didn't need it.'

The tape recorder rolled on. 'Squadron Leader Mark Proust, 0234567 Squadron XO. Crew 8 was one of our best crews; they had been picked to go to Hawaii for a series of important trials with the update aircraft. They had been working hard, but had managed to stay current on the 'classic' at the same time. I can't think of any reason why this could have happened. Has the wreckage revealed anything yet?'

'Not really,' replied the investigator, 'Our investigation of the wreckage, the impact dynamics and our analysis of the maintenance history of the aircraft have revealed nothing to indicate an equipment problem. What were the duties of the Flight Commander and the other crew executives prior to the accident?'

'John, that is SQNLDR Gerber, had been re-writing the Wing Tactics Manual. He chaired the working group for that task. He was also our UFSO and had been planning the next crash exercise on behalf of the Commander. He was studying for his MBA, same course as me in fact. We had a joint assignment due next week.'

'Would you like me to stop the tape?' asked the investigator.

'Sorry, no, I'm back. Apart from that SQNLDR Gerber was half-way or so through his OERs. Of course the planning for Hawaii was keeping him busy.'

'What about the rest of the crew?'

'The captain was an A/UFSO and our test pilot for the production line. The TACCO was on the software review team for the new program, that was why she missed the flight, a last minute hot issues brief for Command. The AE, he was also the Acoustic Warfare Training Officer for the last three months. Sure they were working hard, but they were no busier than the rest of us.' The investigating officer turned the tape recorder off, removed the tape and switched the light out as he left the room.

We are all busy.

This situation never occurred; however, does it sound familiar? In this hypothetical scenario, the crew's executive had been employed on a range of duties above and beyond their primary task of being professional aircrew. Today's Air Force places huge demands on all of its personnel, particularly on its managers and leaders. No one, it seems, is immune from the increased number of distracting tasks that have come from doing 'more with less'. Squadron executives are busier today than perhaps ever before. This workload spills over into the crew room, with senior line operators doing more tasks not directly associated with their next flight.

Only you know if you are ready for the next sortie. Only you know if you are ready to handle all the problems that you might have to face. Experience is invaluable, but being current is equally important. As a senior FLTLT or a SQNLDR, you expect your people to be fully prepared to meet the operational tasks before them. Don't forget to apply the same principles to yourself. You may be working no harder than your colleagues, but are you concentrating on the right things at the right time?

About the author:

SQNLDR Dallas Haggarty is currently employed as the Operations Officer/Base Flying Safety Officer at RAAF Base Amberley. Prior to a number of staff positions in Canberra, he spent II enjoyable years as a Maritime Navigator on 10, 11 and 292 Squadrons. During that time he served as 0NAV, sensor operator and TACCO.

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Stress — who needs it? You do.

by Surgeon Commander C J Stoot, Royal Navy President CAAMB

Introduction

Let's be honest, there is a lot of nonsense talked about stress these days and the subject needs to be kept in perspective. We all work for a military organization and much of what we do and are training to do is to function effectively in high stress environments. That is what going to war is all about, is it not? This article will examine how and why stress may be good for you and how it may have an adverse effect.

What Is Stress?

There are as many definitions of stress as there are causes. Most people think of stress in the negative sense in that they automatically assume that it is a "bad" thing. Stress may be physical or mental/psychological. On the physical side it may be due to such things as acceleration, heat/cold, vibration, etc. These will not be discussed in this article. On the mental/psychological side it could be anything from problems at work to problems at home. A useful working definition is this:

". . . the way in which psychological or environmental factors threaten an individual's physical or psychological state of well being"

Why Do We Need Stress?

There are two reasons why we need stress. The first is that unless we have some stress then we do not function as effectively as we would otherwise, i.e. some stress is good for us. For many of you who have done aviation medicine training, this will be familiar. It is represented by what is called the Yerkes-Dodson curve:

As you can see from the diagram, at low stress levels we are, if not asleep, at a low alert state and our performance and operating efficiency is equally low. As stress levels increase so does our performance until we reach peak efficiency. From then on, however, it is downhill until we reach the stage of panic where we have confused thought and cannot operate properly. Therefore, the right amount of stress is good; too much or too little most probably not being a good thing.

Of course where we are on the graph will depend on many factors, e.g. character, past experiences, the nature of the stress concerned, training and experience. And it is the latter which must be an important consideration in training.

Therefore, the second reason is that unless training is able to achieve its aim, i.e. to train us for what we are supposed to do (which we may consider to be functioning effectively in high stress environments), then it has failed. Hence, by definition we must achieve high stress levels during training. How else could we ever be prepared for active operations?

So there, in a nutshell, are some reasons why stress is "good for us" — but of course it is not all good news. You only have to ask any PMO and he will tell you that his Department has a number of what might be termed "stress cases" every year. Many cases do not even reach the sickbay; it is not always appropriate.

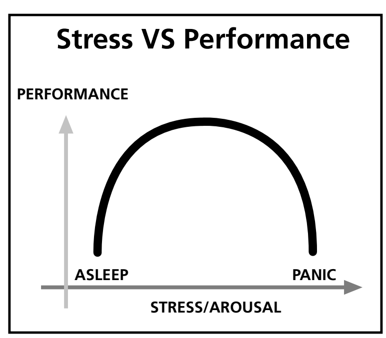
Dosage

There is a dosage of stress, both short and long-term, with which we are able to cope. This dosage is related to the type of stress as well as the amount. The dosage is individual or personal — the amount of stress which we are able to cope with will depend on many factors including an individual's personality, past experiences including training, expectations, personal circumstances etc, etc.

All of us are able to exceed this dosage for short periods without there being any adverse effects. However, if the dosage is acute and extreme we will not cope and this is when panic occurs. If the stress is longer term then the signs and symptoms may develop further.

It is also important to realize that one cannot separate what stresses there are at home with what there are at work. They all contribute to the same dosage.

... one cannot separate what stresses there are at home with what there are at work.



The Adverse Effects Of Stress

Stress can come from all directions. The following diagram summarizes these and illustrates what outcomes there may be:

Work Factors

Demands. These may be derived from things like high workload, too much responsibility, short deadlines and interpersonal demands — from bosses, colleagues and subordinates. Whilst we do concentrate on, say, excessive levels of work, don't forget that too little to do can be equally as stressful. Whilst it may at times sound attractive, boredom is a dangerous thing!

Supports. Even if we are having a difficult time from one direction, our overall dosage can be reduced by support from other areas. For instance, if workload and deadline demands are high but your peer colleagues and subordinates are supportive, this support can go a long way to minimizing the effects of the stress. Remember the most important factor in stress reduction: **everyone functions better and is more resistant to stress if they are part of a cohesive team.** That is something the FAA does well.

Family/social factors. As mentioned earlier, when it comes to stress you can never separate what goes on at home with what goes on at work. Both areas may contribute to the "overall dosage". It has certainly been the case that many patients suffering from excessive stresses at home have "presented" as cases of deteriorating flying performance.

Warning Signs Or Strain Symptoms

So what are the warning signs of the stress dosage being exceeded? They may be listed as below:

Warning Signs

- Defensiveness, sensitivity to criticism
- Inappropriate aggression
- Acute or chronic interpersonal problems... at work... at home
- Financial problems which may be the result of stress or the cause of it
- Excesses in routine habits e.g. smoking, eating, drinking
- Retreat from normal social activities e.g. crew room banter
- Fatigue for no particular reason e.g. despite having a good night's sleep
- Deteriorating or poor flying performance
- Increased risk taking
- Personality changes

In short:

"If these are happening to you or those around you, you are at risk"

If stress does become truly chronic, then it is possible for actual disease to develop -e.g. early heart attacks, raised blood pressure, early strokes and even many cancers. Sounds pretty alarming, but just remember that the stress has to be severe and present for a long time for these to develop.

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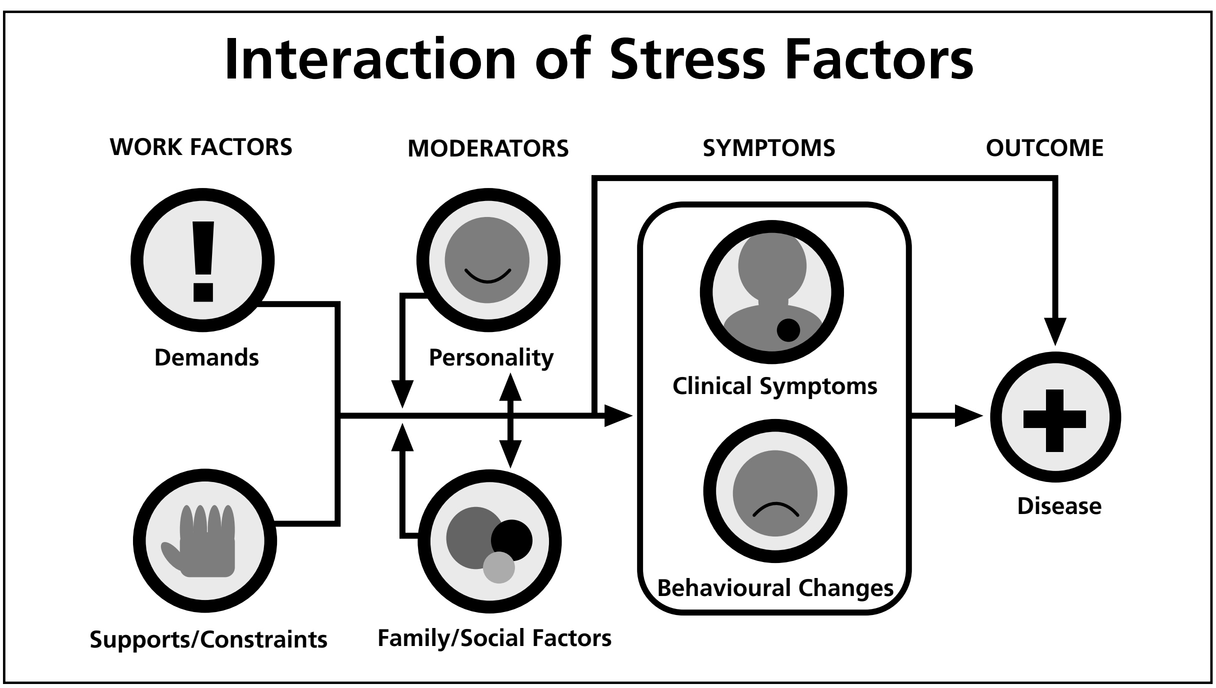

TALON 41

LIEUTENANT(N) HENRY DAVIES

CAPTAIN PAUL QUINN

CAPTAIN DAVE WOOD

CAPTAIN ERIC HILL

MASTER WARRANT OFFICER JACQUES DUSSAULT

On 17 April 2000, while conducting a routine training mission off the coast of Shearwater, the crew of Talon 41 noticed a burning smell throughout the aircraft cabin. The crew initially suspected an electrical fault and attempted to localize the source of the odour. Concurrently, the aircraft captain turned the aircraft towards Shearwater to minimize the distance to transit as quickly as possible. While three other crew members continued to search for the source of the burning smell, the co-pilot scanned the critical systems gauges. He noticed that the main gear-box oil pressure was dropping and fluctuating erratically. The aircraft captain then quickly altered course towards the nearest point of land and advised the crew to prepare to ditch. The crew quickly complied in a calm and efficient manner. The co-pilot continued to monitor the main gear-box gauges and assisted the aircraft captain as he positioned the aircraft for a water landing. At this moment the main gear-box pressure stabilized in a low but constant reading. The aircraft captain momentarily delayed his action to ditch and the crew quickly discussed options. With the main gear-box pressure steady and no signs of increasing transmission temperature, the consensus of the crew was to attempt to fly the aircraft to the shoreline some eight nautical miles away and to perform a forced landing at the first available site. The crew readied themselves for immediate action and began the cautious transit towards land. As the aircraft passed closely abeam Shut-In Island approximately one half mile from the main shoreline, the main gear-box pressure suddenly dropped. Prepared for this contingency, the crew reacted swiftly and immediately turned the aircraft into wind and towards Shut-In Island. Short minutes later, the aircraft settled onto the boggy terrain as the main gear-box pressure indicator needle reached zero. Without hesitation the crew conducted an emergency shut-down and exited the aircraft.

A post shut-down examination revealed that the aircraft's fuselage was coated with oil from the main gearbox. The oil had leaked from a cracked fitting on a forward oil distribution manifold. Approximately one third of the main gear-box oil had escaped through the cracked fitting robbing the transmission of its cooling and lubrication.

The crew of Talon 41 exhibited outstanding professionalism and exceptional crew-cooperation. Their calm assessment of a critical aircraft emergency and decisive action minimized their risk while preserving a valuable military asset. *Well done!* ◆

CORPORAL CLAUDE THAUVETTE

Corporal Thauvette is a first line aviation technician working at the 3AMS survival equipment section. While carrying out a 24-month routine inspection on a CF-18 emergency parachute, Corporal Thauvette discovered, during the process of unpacking the parachute, that the suspension lines holding the parachute canopy to the harness were twisted (twice). Realizing that this unusual situation could seriously affect flight safety, he then carried out an additional in-depth verification that is not in the normal sequence of inspection of the parachute and discovered that in addition to the suspension lines being twisted they also had (six) rotation turns in them.

Faced with the importance of the situation, Corporal Thauvette immediately reported the situation to his supervisors. A special inspection was then initiated to find the extent of the problem. This inspection revealed that several other CF-18 parachutes had the same anomalies. Further investigation of this problem concluded that the procedures followed during packing were different from those prescribed in the CFTO. This situation could have led to a delay in the opening of the parachute that would have had harmful consequences in the event of an emergency ejection by the pilot at low altitude.

Corporal Thauvette's initiative led to a flight safety investigation. The investigation revealed that even though recently qualified on this type of system, his perseverance permitted him to identify a situation that could have seriously affected flight safety if allowed to go undetected.

Corporal Thauvette's professionalism and exceptional attention to details as well as his quick actions made it possible to discover a situation, which could have had disastrous consequences. ◆

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Prevention

As the saying goes, prevention is better than cure. So what can we do to minimize the potential effects of excessive stress? Nothing works better than sorting out the root cause, not always that easy. However, there is much we can do ourselves to make us more resistant to stress. Some examples are:

Stress Management

- Organization — organize your life so that you avoid any unnecessary stresses and do not create any new ones by your action.
- Health — those who are physically fit and in good health are far more resistant to stress. So keep fit by taking regular exercise and eat a good and balanced diet.
- Relaxation — is vitally important. You need to have a form of relaxation to recover from the stresses of the day.
- Laugh — Laughter is a good cure all, releasing tension caused from stress.
- Spend time with friends and enjoy other people's company.

Worried?

What I do not want to do is create a problem which does not in reality exist. If you are worried in any way, though, remember that a problem shared is a problem halved. Don't keep things bottled up, doing that will only create more stress. Talk to someone, whoever you feel most at ease with... and remember, the Sickbay is always there and is prepared to help you out.

Reprinted by kind permission of the Royal Navy from 'Cockpit' issue No. 161 Fourth Quarter 1997 ◆

During an engine removal for a vibration snag on a T-33 aircraft, Corporal's Hosegrove, Baker and Private Dubé discovered a non-related discrepancy in the travel limits of the Engine High-Pressure Cock (HPC) control system. Not specifically called for on the primary snag, these technicians decided to investigate this discrepancy further and conduct a rigging check. Although the control cable travel was adequate to open and close the HPC, it was outside the critical limits of the micarta piston housing and lacked the necessary bounce at the stops. These conditions were noted in both the front and rear cockpits and also in the aircraft engine compartment.

Following intensive fault finding, Corporal's Hosegrove, Baker and Private Dubé were able to isolate the source of the problem to the HPC control cable conduit that was in excess of one inch inside the forward cockpit control box. The allowable distance being 1/4 inch. This condition potentially could have allowed the cable to disconnect from the front control box, leaving the pilot with no control over the HPC.

As a result of their initiative and perseverance, Corporal's Hosegrove, Baker and Private Dubé are responsible for the discovery and elimination of a very serious Flight Safety Hazard and prevented what may have been a disastrous loss of engine control during the next or subsequent flight. They are to be highly commended for their actions. ◆

CORPORAL JOE DUBE
CORPORAL MIKE BAKER
CORPORAL PAUL HOSEGROVE

CORPORAL ROXANNE FREDETTE

On 13 February 2000, while carrying out a maintenance task, Corporal Fredette noticed a Challenger main wheel bearing retaining ring stowed on a maintenance chair. She took it upon herself to determine where the ring came from, and commenced a fleet inspection.

Upon removal of 144 611 right hand outboard wheel cover, the wheel speed sensor cap was found unsecured. Further inspection of the area revealed damage to the anti-skid wheel speed sensor. Had this condition remained undetected, an anti-skid failure would have degraded the aircraft's braking performance, resulting in a hot brake condition or blown tire. The inspection for the retaining ring was completed on remaining unit aircraft and determined not to have originated from within the fleet.

The consequence of this situation going uncorrected could have been severe. Without Corporal Fredette's exceptional professional demeanor and action this condition would have remained undetected and resulted in a serious flight safety incident. ◆

CAPTAIN BOB BELL

PRIVATE DONNA MILTON

On 18 January 00, Tiger 307, a CC130, landed Runway 06 and taxied off at PAPA taxiway. Captain Bell, the Aerodrome Controller, noticed some smoke coming from the portside main landing gear well. Private Milton, the ground controller, relayed the message and the pilot acknowledged the information and continued to taxi. When the aircraft reached the intersection of PAPA and Runway 13/31, Private Milton noticed another larger plume of smoke. She informed Captain Bell and the pilot. The pilot acknowledged the information and continued to taxi to the ramp.

Even though the pilot had not declared an emergency, Captain Bell decided to initiate an emergency response and alerted the Fire Hall. Just as the emergency vehicles began their response, the Aerodrome Control staff noticed that the aircraft had come to a full stop, shut down its engines, and the aircrew evacuated the aircraft. The aircrew proceeded to a safe distance from the aircraft. Captain Bell informed A3 Duty Watch of the situation, who in turn sent Flight Line to pick up the aircrew. After inspection, the aircraft was towed to the ramp without incident.

The Aerodrome Control staff was later informed by the Aircraft Commander, that after the second call from the Ground Controller he instructed the Flight Engineer to go to the back of the aircraft and investigate. The Flight Engineer returned immediately and advised that he had seen flames coming from the Ground Turbine Compressor (GTC). The aircraft commander ordered an immediate ground evacuation of his crew.

The crew speculates that the flames were caused by the start-up of the GTC in extremely cold weather, which is not common, although possible. Had the aircraft continued to taxi onto the crowded ramp, there was the potential of causing a fire, which in turn could have caused significant damage to the aircraft and possibly others.

The diligence, professionalism, and teamwork of Captain Bell and Private Milton highlights the success of Crew Resource Management. Captain Bell and Private Milton displayed acute situational awareness; furthermore, the decision to deploy emergency response resources even though the aircrew did not request it exhibited extreme initiative on the part of Captain Bell. ◆

For Professionalism

On 24 January 2000, while completing a bubble check following a replacement bleed valve for number two engine, Corporal Ferguson noticed the #2 engine fuel pressure gauge was pegged at over 50 psi during the start. He also noticed an overwhelming smell of raw fuel. Corporal Overland, who was outside of the aircraft completing the start checks, noticed a puff of smoke and fuel mist exiting the compressor inlet and exhaust ducts of the aircraft. The pilot was already in the process of shutting down the aircraft due to a higher than normal ITT reading when he received the signal for shut down by Corporal Overland. Corporal Ferguson had already grabbed the onboard fire extinguisher and was exiting the aircraft when Corporal Overland noticed flames shooting out from the forward #2 engine compartment and yelled “We’ve got a fire!” two times. Corporal Ferguson immediately readied the fire extinguisher and quickly put out the flames and continued to suppress the area with the extinguisher agent until it was empty.

If it were not for the quick action and teamwork of Corporal Overland and Corporal Ferguson in recognizing the immediate danger of the situation and extinguishing the fire, the loss of aviation resources may have occurred. The timely response, without undue hesitation of Corporal Ferguson and the calm professional attitude of Corporal Overland is an excellent example of the superior professional attitude of these two technicians. ◆

CORPORAL STEVE FERGUSON

CORPORAL BRIAN OVERLAND

PRIVATE IAN SLATER

During an aircraft periodic inspection, a crack was discovered on the CC115462 brake accumulator bracket. Private Slater was called to evaluate the crack and repair, if necessary. Upon inspection, Private Slater deemed it unserviceable and repairable. On his own initiative he proceeded to check every Buffalo aircraft in the squadron, discovering two others that needed repair and immediately brought his findings to the appropriate authorities.

Private Slater’s actions went far beyond the realm of his duty, and due directly to his dedication to the well being of his service personnel, he may have prevented a catastrophic brake failure, at the least, saving thousand of dollars in damages. Private Slater has shown exceptional attention to detail, dedication, and initiative far beyond that expected for his rank and time in service. ◆

CORPORAL TERRY ALLAIN

On 18 January 2000 Corporal Terry Allain, a qualified 514 Aviation technician, was assigned to a park crew of three to simultaneously turn-around two individual four-plane formations of FIS/FLIT Tutor aircraft. Despite the increased workload — a park crew usually handles four aircraft at a time — and prevailing cold temperature, Corporal Allain performed the very repetitive after-flight "A" check inspection in his customary thorough fashion.

During his meticulous examination of aircraft 114064, Corporal Allain found the threaded yellow canopy jettison hose fitting (an item beyond the published scope of the regular after-flight "A" check inspection) which is normally attached to the right hand seat Personal Lead Block assembly, completely disconnected.

He investigated the discrepancy further, and after ensuring, with his supervisors, the integrity of the components and that of other aircraft, they rectified the unserviceability.

Had the occupant of the right hand seat initiated an ejection during the previous or ensuing flight(s), the canopy would not have jettisoned as expected. Furthermore, the normal ejection sequence could have been compromised and may have resulted in severe complications and/or injuries for the aircrew.

Corporal Terry Allain is to be commended for his sense of duty and exceptional dedication to the axiom "Safe Jets on the Line." His keen awareness and well-nurtured professional ethos contributed to averting a very hazardous situation, and the likelihood of severe injuries to personnel. ◆

MASTER CORPORAL MICHEL GAUTHIER

On 22 February 2000, Master Corporal Gauthier was conducting a routine after-flight check on Sea King aircraft #413 while embarked aboard HMCS Preserver. During this check, Master Corporal Gauthier noticed a problem with the thomas coupling between the #1 and #2 positions of the tail rotor driveshaft. The thomas coupling had a large split between the coupling discs which rendered the aircraft unserviceable.

Further inspection found similar faults between the #2 and #3, and #3 and #4 positions of the tail rotor driveshaft.

It was apparent that a very dangerous driveshaft misalignment situation had been discovered. According to the Sea King inspection requirements, thomas couplings are not a required item during after-flight check inspections. Thomas coupling inspections require specific attention and are found in difficult to access areas of the aircraft.

Master Corporal Gauthier's professionalism and concern for the airworthiness of the aircraft prevented a potentially catastrophic situation. It is obvious that Master Corporal Gauthier went well beyond the call of duty when he chose to include a detailed inspection of the thomas couplings in his after-flight check. Master Corporal Gauthier is to be commended for his outstanding performance and dedication to his work. ◆

The Holistic Pilot

All active military pilots are under the direct supervision of a Flight Surgeon when taking medication — right? No pilot (let alone a military pilot) would knowingly take anything that would impair his or her ability to function in the cockpit — right? I'm a pilot and that's what I believe! I believe this because my colleagues and I are professional pilots and in no hurry to end our days in a needless blaze of glory. But I have never considered vitamins and natural supplements as medicine. They are shortcuts to healthy eating and well-being for the busy family — right?

Skimming through the April issue of "Corporate Aviation Safety Seminar" I came upon an interesting tidbit that set me to thinking. Two doctors concerned with Preventive, Occupational and Environmental Medicine wrote an article entitled "*Alternative Medicine — Impacts to Flying Safety*". The authors opined (thanks for the word Jim) that the unregulated use of holistic (natural) medicines is on the increase despite the fact that the side effects are poorly, if at all, understood.

Civilian advertising hails several common remedies as cure-alls for everything from anxiety to impotency, without the requirement for, or expense involved with, prescription medicines. Statistics indicate an increasing market for herbal remedies and high dose vitamins, and I am forced to agree because, deep within the recesses of my own family medicine cabinet, I found Ginseng, Ginko-Biloba, St. John's Wort, Echinacea and a plethora of mega-vitamins.

My family has bought into the hype concerning proper nutrition and natural products. Nothing processed, no MSG, low-fat, no salt, glowing with health wonder foods...and medicines. But if I were on active flying duty and consumed some of these...what are they... freeze-dried plant foods?...what would happen? What would happen if I took them along with aspirin or Actifed? The truth is, we don't really know! But, for the sake of argument, I will paraphrase some of the theories from the article referred to earlier:

a. **Ginko Biloba.** This is used to increase cerebral and peripheral blood flow. It may cause bleeding problems and conflicts with such agents as aspirin, vitamin E and Garlic. The Readers' Digest version is that if you really need Ginko Biloba, you shouldn't be flying.

b. **St. John's Wort.** It has been suggested that this may be effective against depression. Some side effects may include dizziness and confusion. Allergic reactions occur in about 0.5% of users. It also conflicts with common prescription antidepressants, so once again, if you really need it, you should not be flying.

c. **Ephedra.** This agent is used as a decongestant, for weight loss and as a stimulant. The side effects are many, but primarily concerned with serious cardiovascular dysfunction such as insomnia, hypertension, and even death. Remember that the use of these drugs is normally not guided or monitored by a flight surgeon, so intake may be unintentionally excessive.

d. **Echinacea.** This is thought to enhance the immune system and reduce flu-like symptoms. "*...In general, it is felt to be non-toxic and it should not affect flight safety.*"

e. **Ginseng.** Studies have claimed that Ginseng can increase your stress tolerance and even improve sexual performance. Some side effects however, may include high blood pressure, insomnia and bleeding.

f. **Indian Snakeroot.** This agent is used to lower blood pressure. The FAA bans pharmaceutical derivatives of Indian Snakeroot from use by aviators. "*Supplements containing snakeroot put an aviator at risk for a marked reduction in G tolerance...*"

I don't mean to say that herbal remedies are bad, or good for that matter, but given the preponderance of uncertainty regarding the effects of some of these products, not to mention their reaction to other prescription and non-prescription medications, I must ask those of us who have taken, or are considering taking these products, if we ought not consider consulting our friendly flight surgeon first. I offer this as food for thought as you strap on your own personal modes of military transportation.

Major McCurdy ◆

National Defence
Défense nationale

4 Ways to Control FOD

Keep Alert–Look!

Control Your Tools

Read the CFTO's

Fight Complacency

Concept by Corporal E. Clarke
Art Direction: DGPA Creative Services 2000CS-0438

Corporal E. Clarke of 12AMS designed this months poster. Well Done!!!

Do you have an idea for a poster that you would like to have published in Flight Comment? Don't hesitate to propose your idea to the editor, whether by Internet, Intranet, photocopier, or by mail. You don't have to have the talent of Da Vinci; we'll be delighted with your imitation of Klee or Picasso… it's the idea that counts.

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