AEROSPACE

SAFETY

UNITED STATES AIR FORCE

MAY 1963

flight safety awards

For Meritorious Achievement in Flight Safety for the period 1 Jan through 31 Dec 1962, the units listed here have been selected to receive the Air Force Flying Safety Plaque. The stringent criteria insure that each recipient has achieved an outstanding flying safety record while maintaining mission capability.

5 Fighter Interceptor Squadron
Minot AFB, North Dakota — ***ADC***

48 Fighter Interceptor Squadron
Langley AFB, Virginia — ***ADC***

328 Fighter Wing
Richards-Gebaur AFB, Missouri — ***ADC***

Air Proving Ground Center
Eglin AFB, Florida — ***AFSC***

3575 Pilot Training Wing
Vance AFB, Oklahoma — ***ATC***

1001 Helicopter Squadron
Bolling AFB, 25, D.C. — ***Hq Comd***

63 Troop Carrier Wing
Donaldson AFB, South Carolina — ***MATS***

62 Troop Carrier Wing
McChord AFB, Washington — ***MATS***

45 Tactical Reconnaissance Squadron
Misawa AB, Japan — ***PACAF***

18 Tactical Fighter Wing
Kadena AB, Okinawa — ***PACAF***

3 Bombardment Wing
Yokota AB, Japan — ***PACAF***

93 Bombardment Wing
Castle AFB, California — ***SAC***

68 Bombardment Wing
Chennault AFB, Louisiana — ***SAC***

4 Air Division
Barksdale AFB, Louisana — ***SAC***

354 Tactical Fighter Wing
Myrtle Beach AFB, South Carolina — ***TAC***

309 Tactical Fighter Squadron
Homestead AFB, Florida — ***TAC***

314 Troop Carrier Wing
Sewart AFB, Tennessee — ***TAC***

86 Air Division
Ramstein AB, Germany — ***USAFE***

366 Tactical Fighter Wing
Chaumont AB, France — ***USAFE***

7499 Support Group
Wiesbaden AB, Germany — ***USAFE***

349 Troop Carrier Wing
Hamilton AFB, California — ***AFRES***

435 Troop Carrier Wing
Homestead AFB, Florida — ***AFRES***

179 Fighter Interceptor Squadron
Minn. ANG, Duluth, Minnesota — ***ANG***

175 Tactical Fighter Group
Maryland ANG, Baltimore, Maryland — ***ANG***

IN THIS ISSUE

FALLOUT

Crash Removal Sling

With regard to General Blanchard's editorial (WHAT I SAW), on page 29 of the March issue, I'm sure many of us have had similar nightmares and are continuing to have them, namely, how to expeditiously clear the only existing runway.

"Bully" for the initiative and ingenuity on the part of many that must have gone into the procurement of material and man hours to fabricate the cable net that General Blanchard referred to. I don't have to check to see if our base has such equipment and procedures for its use. I know we don't!

Is it possible to get a set of the drawings and an account of the project?

Maj Geo. E. Kammerer, Chief of Safety
325 Ftr Wg, McChord AFB, Washington

Yours is one of many requests for a set of drawings of the crash removal sling. The address is: (SGEDS) Hq AFLC, Bldg. 280, Wright-Patterson AFB, Ohio. Project engineers advise that if this equipment is fabricated strictly according to the drawings and specifications, it will do the job. Local fabricators are cautioned not to deviate from the specifications because of the possibility of building in a weakness. The equipment has been tested using a 200,000 lb aircraft and performs the task.

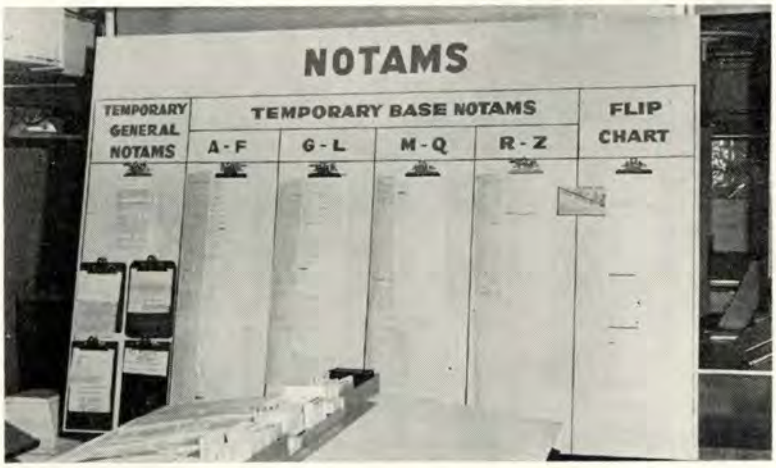
Is Your NOTAM Showing?

The display pictured in the article (page 24, March issue) does not conform to the standards as prescribed in AFR 55-48. I feel this picture should have conformed to these standards, which would have added more emphasis to perfecting the new system.

Vance AFB has had the new system in effect since May 1962.

TSgt Denzel L. Clark
3575 PT Wg, Base Ops
Vance AFB, Oklahoma

You're right, Sergeant, we goofed. Maybe the picture below will make things right. It shows the standard NOTAM display as outlined in Par 7 of AFR 55-48.



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Ever watch an air show and get the urge to try some of the stunts yourself? Sure you have. But before you do, read the advice from a couple of pros.

A LITTLE

Maj Ralph D. "Hoot" Gibson and Capt Ralph L. Brooks

"CACTUS RED, cleared to take off." Lt Black responded mechanically and climbed toward the test area. He was a good pilot—an outstanding pilot if his OERs were to be believed—but today his mind wasn't on the test hop ahead. He had seen an aerial demonstration that morning, and the image of the solo planes kept flashing through his mind. Climbing, rolling, diving, streaking across the field inverted, on the deck. It was a good show, and the spectators ate it up.

When he reached the test area, he looked around. He was all alone out here, boring holes in a cloudless sky. He put his F-100 through its paces automatically, imagining himself as a demo pilot, performing effortlessly for the admiring public. Those guys really had it made.

He finished the check sheet and glanced at his fuel quantity gage, thinking about Whitey, one of the solo pilots. Whitey had always been a good pilot, but no better than he, Black, was. So why couldn't he do anything Whitey could do, and do it as well or better? He had plenty of fuel, and ceiling and visibility were unlimited. Why not? Just one pass, inverted, on the deck. He'd start just this side of the pile of boulders and roll out above the dry wash. The area was about the length of a runway, and it looked perfectly level. Of course, Air Force Regulations prohibited unauthorized on-the-deck acrobatics, but—well, Whitey made it look so easy and, after all, there was no one around to see. Whitey had told him that the trick was to hold his altitude steady until he rolled out, and he'd do it as smoothly, as easily, as Whitey had. Just one pass . . .

The ground looked level, but it was not. If Lt Black had inspected the area before he made his pass, he would have found that it sloped gently upward toward the wash. Nor was he able to hold his altitude exactly. One inverted pass was all that Lt Black made—his first, and last.

Someone once wrote, "A little learning is a dangerous thing." Lt Black possessed more than a little learning on the subject of flying. But there was a great deal he didn't know about low-altitude acrobatics. This was logical, because they were not his mission and he had not been trained to perform them. The demonstration pilots were able to make their maneuvers look easy only because they had been thoroughly trained by pilots experienced in *low-altitude* maneuvers. This had been the only inflight mission of the demo team members for several months and each averaged at least 30 hours of practice per month in order to stay proficient at low altitudes.

The safe performance of low-altitude maneuvers depends upon specialized training. In order to explain what is meant by "specialized training", let us follow a newly-assigned demo pilot—we'll call him Capt Jones—through the training program employed by the USAF Thunderbirds. First, we should mention that Capt Jones competed with 75 other highly-qualified applicants from throughout the Air Force for the position of number-two solo pilot. The fact that he was selected indicates that he is a mature person and an outstanding pilot—top-grade material from which to mold a top-grade demonstration pilot. His eight or nine years in the fighter business provide a good foundation for the specialized training to come.

LEARNING

4520 Aerial Demonstration Sq, Nellis AFB, Nevada

The Thunderbird training program begins with ground training. This phase may be tedious to Jones, who is anxious to show his stuff in the air, but it is absolutely necessary. Jones must master the aircraft Dash-One, with special attention to certain operating limitations and emergency procedures. He must learn the many standardized procedures used in deployment and in the aerial demonstrations. He must master theories concerning such matters as adverse yaw, angle of attack versus available air speed, and inverted flight characteristics. During this period of study, he must also attend all flight briefings and critiques, and spend many hours observing and critiquing actual demonstrations. The only flying time he gets now, however, is logged as he follows the team from one show site to another.

When he has thoroughly familiarized himself with the mechanics and special techniques of the mission, Jones enters the flying phase of his training. The first few missions are dedicated to gaining acrobatic precision. Practice is conducted at altitudes above 3000 feet. Jones is never alone. He is led through his maneuvers by the present second solo, who will be solo leader when Jones becomes an official team member. In addition, a chase pilot often observes his training. There are ground observers, too, using a tape recorder and movie cameras which record every mistake he makes. During the thorough debriefing which follows each flight, he is shown his mistakes on film. And there are many. One may have been caused by his misunderstanding of slat operation under negative Gs, or by a speed brake or afterburner delay. Another may have been caused by ground-effect, uneven terrain, turbulence, visibility, or excesses in temperature. Still another may have been due to a seemingly minor matter such as dirt or debris in the cockpit. Had he performed these initial maneuvers at low altitude, any one of his errors might have been fatal. These conditions, all of them safety factors, are pointed out to Jones, if he isn't already aware of them, and are fully discussed. Jones won't make the same mistake again, at least, not often.

As Jones' proficiency level rises, his practice altitude drops, gradually, until he is performing at normal demonstration altitudes. This is the most critical period of his training, because Jones is developing the ability to assess—correctly and consistently—his aircraft's altitude and attitude in relation to the ground. He has never before needed to sharpen this ability to the degree he must now, nor has he had the opportunity to do so, since tactical wing directives prohibit practice of low-altitude acrobatics.

After Jones has demonstrated that he is capable of precise performance of his role in the demonstration, the other team members are included and the practice continues until the peak of coordination is reached. Now, four months and 70 to 100 missions after the start of his training, Jones is ready to fly his first show before the public. The training program is finished, but the practice is not. In the next two years, Jones will perform at least 800 demonstrations at low altitudes, and almost 600 of these will be practice shows!

The training program described above is the product of ten years of experience in low-altitude acrobatics —experience gained and passed on by members of the demonstration teams. It is based upon the idea that the key to the safe performance of low-altitude acrobatics is specialized training by pilots experienced in these maneuvers. These pilots subscribe to the belief that good planning always includes an adequate margin for error, and the margin they have allowed the trainee is 3000 feet or more between his aircraft and the ground. Without it, as Lt Black learned, error can be fatal. ★

Safety

AS THE X-20 (Dyna-Soar) program rapidly evolves from preliminary design to hardware fabrication, qualification, and flight testing, it is essential that an occasional retreat from the daily pace be made and the X-20's current status be assessed. All familiar with the program realize it represents one of the most ambitious ever undertaken by the Air Force. Our basic objectives not only extend current technological capabilities, but they necessitate pilot, supporting personnel, and general populace safety considerations far beyond those considered in previous programs. As later paragraphs will explain in detail, the success probability of the X-20 program is greatly enhanced by a "before-the-failure" approach to system safety and an honest acknowledgment of the risks.

As a brief review, our current program consists of design, development, and flight testing of a military test system for exploration of maneuverable re-entry by a piloted orbital space glider which includes controlled landing in a conventional manner at a preselected landing site. In accomplishing flight, specific emphasis has been placed upon the gathering of research data such as details on the environment existing around and inside the vehicle during re-entry and hypersonic flight, determining piloted vehicle stability and control, and acquiring hypersonic aerodynamic performance data. The pilot emphasis is concentrated on demonstrating recovery capability through descent from orbital flight, aerodynamic glide from re-entry to local approach conditions, maneuver to reach preselected sites and approach a conventional landing.

The X-20 flight tests follow completion of a stringent laboratory and ground test facility confirmation program. The initial X-20 flights will be unpowered air drops on the Edwards AFB range using a specially modified B-52 aircraft to carry the X-20 aloft. These launches will immediately be followed by flights in which the air-launched X-20s will be propelled by a solid propellant acceleration rocket. This rocket also provides an emergency abort capability during the ground launch phase of the program, which follows. Both unmanned and manned orbital flights will terminate at Edwards AFB. The X-20 will be boosted into orbit by the Titan III, an advanced booster that combines a modified Titan II core with a powerful solid propellant first stage.

This combination and its supporting test and launch facilities present a variety of complex safety considerations. This article, however, will be limited to the safety aspects of the X-20 glider. For the purposes of explanation we can divide the X-20 into four basic sections. First, there is the crew station, a multi-walled pressure shell which houses not only the pilot but the

and the X-20

Planned system safety is a major part of the Dyna Soar Program

Everett J. Hodapp, Jr., Safety Program Manager X-20, ASD

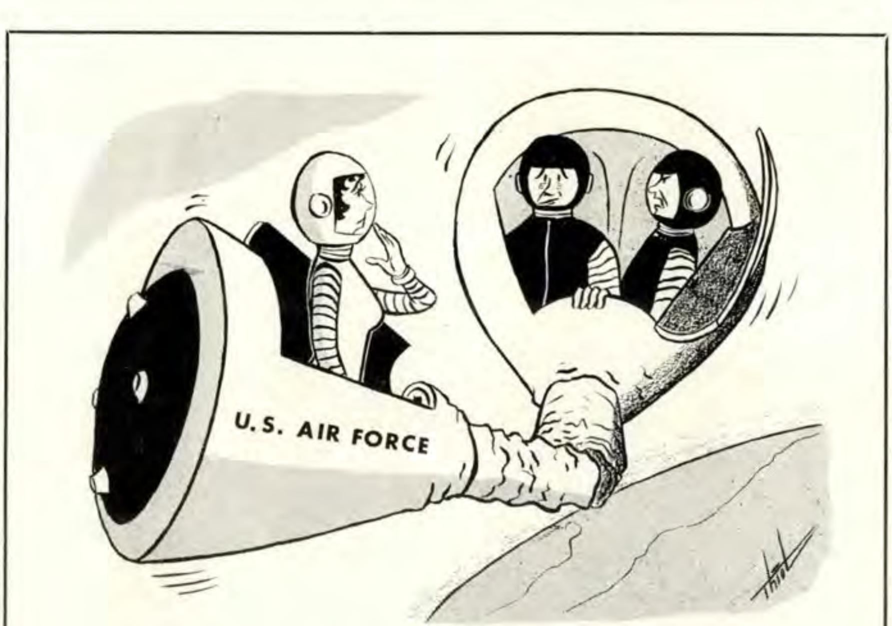
majority of flight instruments and supporting subsystems such as guidance and communications. Secondly, there is the equipment compartment which is located immediately behind the crew station. Within this compartment are the numerous experimental equipments to be evaluated during the X-20 developmental flights. At the aft end of the primary X-20 glider is the third compartment, which is commonly referred to as the secondary power bay. Within this bay is the vehicle power generating equipment as well as the associated expendables and those cryogens used elsewhere within the vehicle. Lastly, surrounding the compartments previously mentioned are the void areas which are referred to as the "Wing and Body" cavities.

Now that the basic X-20 configuration is very generally in mind, it is appropriate to discuss the design approaches that have been selected to minimize the potential hazards of space flight. The complexity of the situation about to be discussed is that the hazard present varies to some extent for each phase of flight. It will therefore be necessary to discuss each compartment mentioned for the prelaunch phase as well as the boost, orbit, re-entry, low altitude and landing phases of flight.

The crew station of the X-20 has had more attention focused upon it than perhaps any pilot's abode in history. Hardware destined for installation within this compartment, and that includes paints, gaskets, and glues, are tested to insure their compatibility in an oxygen enriched atmosphere that could exist under emergency X-20 conditions. Additionally, all materials are analytically investigated to insure that materials exhibiting toxic or flammability qualities do not get incorporated into design. This rigid control program is accomplished in five major steps.

1. Listings are maintained on all materials proposed for use in the X-20 crew compartment.
2. Each material listed is evaluated for compliance with established toxicity and flammability limitations. To keep program costs in line, initial efforts are directed toward a survey of technical literature to equate material limitations.
3. Materials judged to constitute a potential source of toxic fumes will be eliminated from design wherever possible. Where a design cannot be modified to completely eliminate the hazard, the potential hazard will be evaluated in greater detail and, if it is found to remain a definite flight hazard, major redesign or isolation of the item will be authorized.
4. Approved materials lists are published periodically for use by design groups.
5. A final materials list, including a summary of all findings relative to toxicity and flammability, will be published. From this point the maximum effort is concentrated on establishment of safety operational procedures which will further reduce the crew station hazard potential.

Beyond the safety precautions of oxygen compatibility and materials selection, all components are qualified to ignition proofing requirements. The hazard dictating such testing is an extremely remote possibility of hydrogen gas accumulating within the crew station. Hydrogen could be obtained should the X-20 batteries within the crew station dead short or if the external airflow should set up a boundary layer condition shortly after re-entry which would pull the hydrogen rich auxiliary power unit exhaust into the crew station. Another possible source of



"I always dreaded the day that they orbited a woman astronaut!"

hydrogen in the crew station would be "on the pad" operations prior to launch in which the hydrogen vapor could conceivably enter. To compensate for this, the pre-launch operations include an air purge of the crew station. During boost, orbit and re-entry, crew station atmosphere is flowing outward, thus precluding the entry of outside vapors. After re-entry the pressure differential reverses and outside air flows into the cabin. It is during this latter period that entry of hydrogen may theoretically occur.

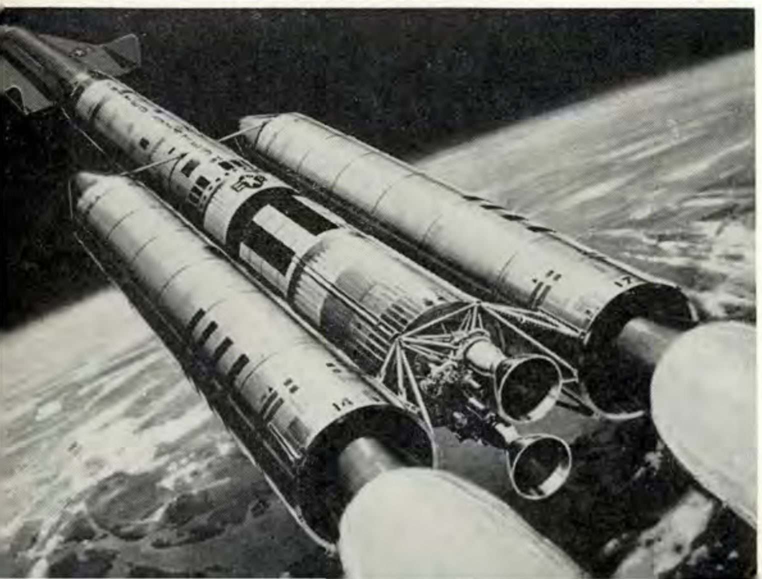
The X-20 equipment compartment is pressurized with 100 per cent nitrogen, thus removing a necessary ingredient from the fire triangle, namely the oxydizer. At present fuels and ignition sources potentially prevail; however, when housed in the nitrogen environment, this compartment enjoys a safety rating not obtainable for other regions.

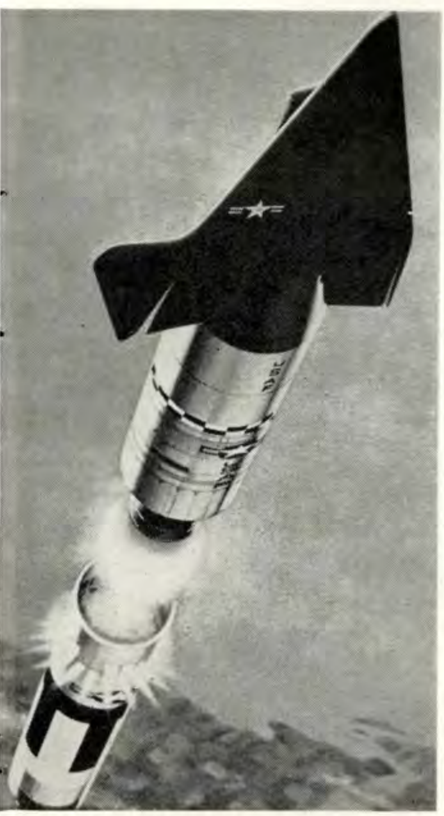
The secondary power bay of the X-20 has provided the greatest challenge to our safety engineers. The maze of complex equipments and routing of electrical and hydraulic lines are a plumber's nightmare. Couple this with hydrogen, hydraulic fluid and hydrogen peroxide, and the hazard potential is indeed awesome. These fuels are supplemented with oxygen and a variety of inorganic materials.

To provide the ultimate in design safety for this complex area all equipments located in the secondary power bay are subject to ignition proof testing in a stoichimetric mixture of hydrogen and oxygen. In the pre-launch phase this area is purged with nitrogen. The inert nitrogen atmosphere is maintained throughout boost until well over 100,000 feet altitude when the rarified atmosphere will not support combustion. In this phase of flight, as well as in orbit and re-entry, a reserve supply of nitrogen gas is available to purge the secondary power bay upon pilot command. The decision to utilize this quenching gas may be made by the pilot based upon information furnished from an overheat detection system which is routed throughout the secondary power bay. After re-entry at low altitudes, and during landing, this compartment is automatically purged with nitrogen. The purging continues after touchdown until the available nitrogen is expended.

Within the wing and body portions of the X-20 are a maze of hydraulic lines and electrical wiring. Also the voids in these regions serve as excellent traps for gases, such as hydrogen which may find its way inside the glider's voids. To minimize this hazard the wing and body areas are purged with nitrogen during the pre-launch phase. This purging affords passive protection during boost, and no hazard is considered to exist in these regions during orbital flight. During reentry the heats encountered release steam from the water-filled environmental control system thus filling the wing and body with a quenching medium. At the lower altitudes these areas are purged with ram air in the belief that stagnated pockets of hazardous gases can be swept away.

The last few paragraphs have explained in very general terms what is being done to make the X-20 as safe for manned flight as possible. A major contributor to the success of the X-20 program is the Titan III which places the X-20 into orbit. This massive and complex launch vehicle, even with the experience of Titan I and Titan II behind it, will remain somewhat less than 100 per cent reliable. Any reliability short of 100 per cent is undesirable for a manned spacecraft. A means therefore had to be provided to insure that launch vehicle failures did not jeopardize X-20 pilot safety. This situation is currently being satisfied through development of a malfunction detection system (MDS) for the Titan III launch vehicle. It is not possible to go into the details of this system in this article, however, the ground rules under which the system is being developed are an example of the concern that exists for system





safety. The specific MDS ground rules, condensed for presentation, are:

• During prelaunch, the airborne MDS shall be under surveillance but inactive and the ground control shall provide prelaunch malfunction detection.

• All launch vehicle malfunctions which could cause catastrophe (destroy X-20 and/or Titan III or incapacitate the pilot or place X-20 in a position where successful abort cannot be achieved) shall be sensed.

• MDS shall sense malfunctions with sufficient lead time to successfully execute abort.

• Initiate automatic launch vehicle engine shutdown and glider abort for impending catastrophies.

• MDS need not identify specific malfunctions nor correct malfunctions in flight.

• MDS shall be functionally independent of other launch vehicle subsystems.

• Design goal is to approach 100 per cent reliability for the MDS.

• The MDS equipment must be more reliable than equipment being monitored.

• Design redundancy shall be provided where dictated by sensor reliability or area criticality.

• The MDS shall be designed to minimize the possibility of unnecessary abort consistent with the other ground rules.

• The air vehicle MDS shall not cause any air vehicle subsystem malfunction or a false abort. A single component failure of the subsystem shall render only that part of the subsystem inoperative.

In conclusion, over the past three years personnel on the X-20 program have pursued a threefold approach to system safety. Initially a system hazard analysis was conducted. This analysis included a review of the preliminary design configuration and the proposed countdown sequence. Numerous design or sequence incompatibilities were uncovered which, if not corrected, would markedly reduce system safety. Secondly, a volume of safety design criteria was prepared to assist engineering personnel in the finalization of system and subsystem design. The safety design criteria reflected not only conventional safety requirements, such as instituted on conventional aircraft developments, but included safety requirements as imposed by the operating ranges and those requirements deemed essential by the Dyna-Soar System Program Office for our advanced systems. Finally, a series of design reviews and inspections has been conducted to assess the various contractors' degree of compliance to safety requirements.

The possible redirection of the X-20 program to include multi-orbital missions as well as use of the Titan III space boosters necessitates updating of previous Dyna-Soar safety efforts. This refinement is currently underway. While the X-20, like other advanced programs, involves a number of risks, these risks are more than compensated by the high technical gains this program can give to the Air Force.

The current safety efforts are not without voids. Certain deviations from safety requirements must be granted to maintain the ambitious schedules associated with our program. The magnitude of the deviations thus far granted has not affected our basic confidence in the X-20 or its ability to provide the pilot the maximum degree of safety. Within the Dyna-Soar SPO we have found that our awareness of the need for system safety activities "before the failure" and a recognition of the pilot's capability of enhancing the probability of mission success contribute greatly to our confidence in this program. Similar safety efforts on other aerospace programs should have similarly satisfactory results. ★

RV

RUNWAY VISIBILITY

A NEW CONCEPT IN REPORTING runway visibility (RV) has taken shape at Air Force bases which allows the pilot to take full advantage of high intensity runway lights for takeoffs and landings. This concept is being developed from the new difinition of RV which now appears in AFR 60-16. This definition says:

"Runway Visibility. An instrumentally or visually derived value that best represents the horizontal distance a pilot can see down the active runway in the direction of takeoff or landing. When the high intensity runway lights are operative, runway visibility observations will take this into account and the reported visibility will be the maximum possible with the lights on."

First, a short explanation of how meteorological visibility is instrumentally determined. The transmissometer (an instrument installed in the approach or touchdown zone of the instrument runway) is designed to measure meteorological visibility by giving a continuous indication of the transmissivity of the atmosphere over a selected line of sight, usually 500 feet in length. The transmissometer projector emits a light of known intensity. The transmissometer receiver measures the amount of light received as a percentage of the amount of light that would be received through a clear atmosphere and registers this value on a meter. The meter reading is converted into a value of linear visibility which is the actual distance an observer would see normal objects if he were looking in the same direction in a similar atmosphere. Visibility measured in this manner in the touchdown zone is very useful to pilots but it is not "realistic," because, for one thing, under low visibility conditions the pilot is looking at bright runway lights, not at "normal objects."

The National Bureau of Standards solved the problem in integrating the illumination afforded by runway lights with the instrumentally determined meteorological visibility to compute the RV. They considered first that runway lights consist of specific types of directional lights spaced at intervals of 100 or 200 feet along either side of the runway. The lights are beamed toward the approach end of the runway with a peak intensity of 30,000 candlepower, or more, in the center of each beam when burning at maximum intensity.

If the pilot is "on the glide path — on the center line" he should be in an optimum position with respect to the runway lights and he should see the peak center-of-beam intensity. However, as the pilot moves along the runway he is not in the same optimum position. Therefore, a representative intensity concept of the illumination afforded by the runway lights was integrated with the instrumentally derived visibility value. Representative intensity is not the peak center-of-beam intensity but rather the light intensity which should be available to the pilot if he is viewing the runway lights from any reasonable angle on the runway.

Further, runway lights usually have five available settings. Light setting *five* is the brightest light with a representative intensity of 10,000 candlepower. This is the representative intensity used to determine RV. The intensity of light at each setting below five is one-fifth lower than the next higher setting. It follows that light setting *four* produces a representative intensity of 8000 candlepower, etc. Runway lights are placed on the higher settings during poor visibility conditions since those are the times when RV is intended to be of operational benefit.

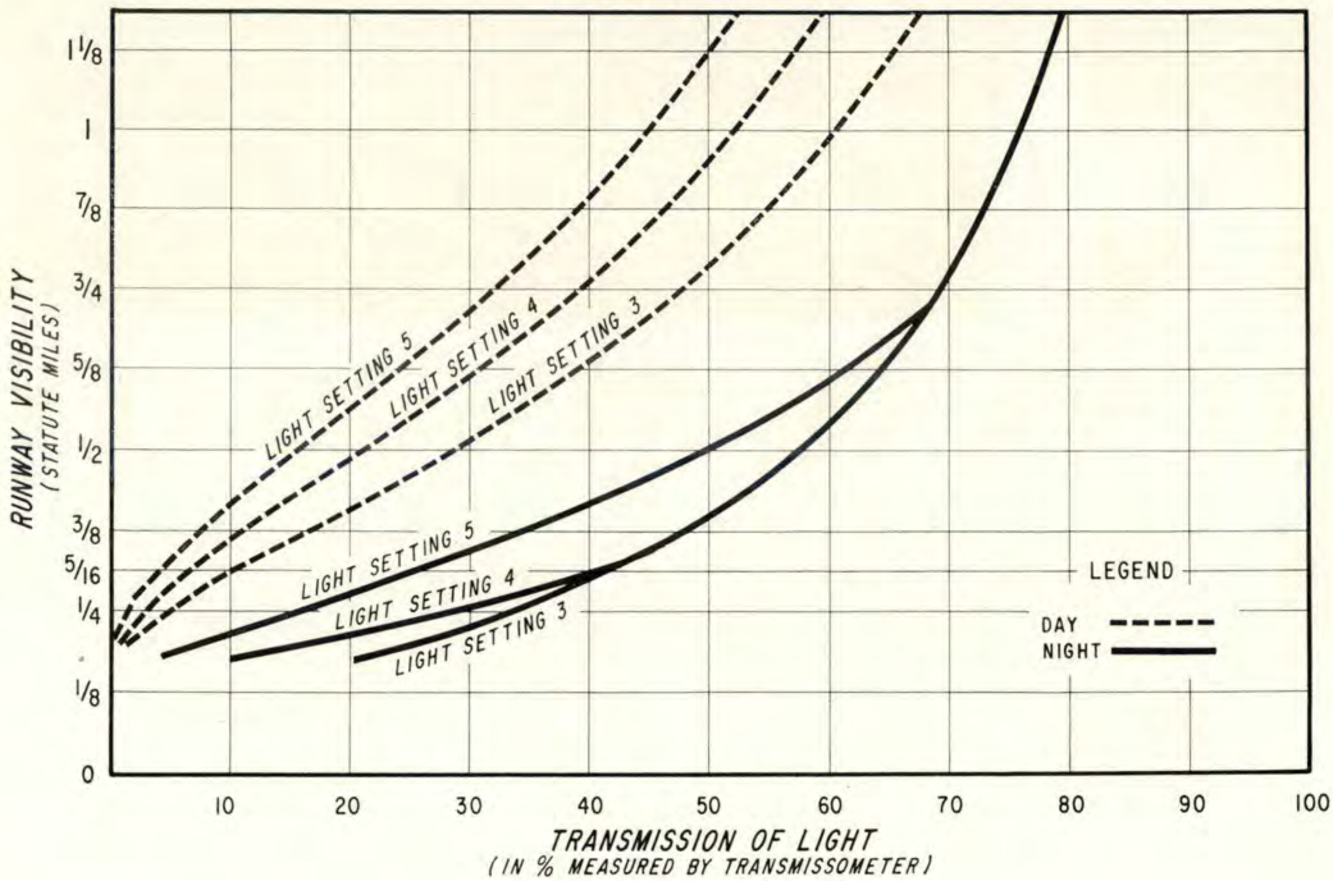
Next, it was considered how runway lights affect meteorological visibility during the change from day to night, and vice-versa. During this change, a discontinuity in meteorological visibility becomes apparent. Even though the meteorological conditions do not change, RV will increase as darkness falls. In fact, with runway lights operating, the nighttime visibility can be more than double the daytime visibility for the same value of atmospheric transmissivity.

The reverse holds true at dawn. Such a change is quite proper and reasonable. This is because background luminance is much greater during the daytime than at night. Therefore, a light will be visible at a much greater distance at night than the same light during the day assuming atmospheric transmission conditions have not changed. The brief periods of dawn and twilight hold difficulties because the background luminance will be changing rapidly at these times, as will RV. To simplify reporting procedures, daytime RV will be reported until lights are plainly visible. The converse holds true at dawn.

Therefore, knowing the transmissivity of the atmospheric sample, the representative intensity of the runway lights and a day or night condition, RV can be instrumentally determined (see diagram); and for the first time the pilot has available a measurement closely approximating the visibility conditions which he

Maj John H. O'Neil, Hq Air Weather Service, Scott AFB, Ill.

RUNWAY VISIBILITY CALIBRATION
(500ft baseline)



will experience on the runway during his takeoff and landing. The advantage of this system should be immediately obvious — it gives a new look to landing and takeoff minimums.

Here are the facts to remember about RV:

• RV is in terms of what the average pilot would see under the same light transmission conditions of the atmosphere as those measured by the transmissometer. An individual pilot may experience a runway visibility value which is greater or less than the reported value.

• RV is determined by sampling a 500-foot path along the runway and extrapolating it to determine RV over a greater distance. This might cause some inaccuracies in the reported values. However, this RV should be much closer to what an average pilot will experience on the runway than will be a visibility measurement which does not take into account the effect of high intensity lights.

• Since RV is determined by using runway light setting *five,* the method being described is really reporting "a potential RV." (Note: Setting *four* may be used at a few locations where setting five is not obtainable.) Conditions may be such that TO 35F5-3-1-1, Brightness Setting of Runway Approach Lights, does not require that the runway lights be turned to light setting *five.* Therefore, to obtain the most representative RV during periods of poor visibility it may be necessary for the pilot to request that the tower operator turn the lights to setting *five.* Should this cause blindness due to light diffusion, the runway light setting should be reduced.

• During nighttime hours RV will always be greater than meteorological visibility. The higher the setting of the runway intensity lights the greater is the actual RV.

• During daytime hours the higher ranges of RV (beginning at three-fourths mile and above) will be the same as meteorological visibility on the runway no matter what the runway light setting is.

• RV is reported when

(1) Prevailing visibility is one mile or less and/or,

(2) RV is one mile or less.

• RV is reported locally to the control tower, RAPCON and Base Ops in the following values:

¼— (less than ¼ mile)	⅝ mile
¼ mile	¾ mile
5/16 mile	⅞ mile
⅜ mile	1 mile
½ mile	1+ (more than 1 mile)

• AFR 60-16 allows RV to be used to determine whether an airfield is above minimums for landings or takeoffs, but not for terminal-to-terminal clearance purposes or circling approach minimums. Civil airfields report RVR (Runway Visual Range) in feet. The pilot must convert the RVR values expressed in feet (or yards or meters) to fractions of miles to insure that they meet Air Force minimums. ★

ONLY IN HORSESHOES

CLANG! CLANG! CLUNK! It seemed that all three horseshoes had landed at once as the "World's Greatest Pilot" and horseshoe pitcher had made his last toss in the base light-sports tournament. "Ringo. High-ho and away!" Captain Chauncey Z. Chumley had done it again and for the second straight year walked off with the singles trophy.

Major Lee, the challenger, moved to Chumley's side. "Don't look so smug, C.Z. If that last one hadn't hit six feet short and bounced up close to the pin, you'd never have made game point."

"Skill, me lad, just skill, and remember, too, that it isn't how you play the game, it's whether you win or lose. Those close ones count, too, you know."

"Okay, but just remember, I'll get another chance at you and . . ."

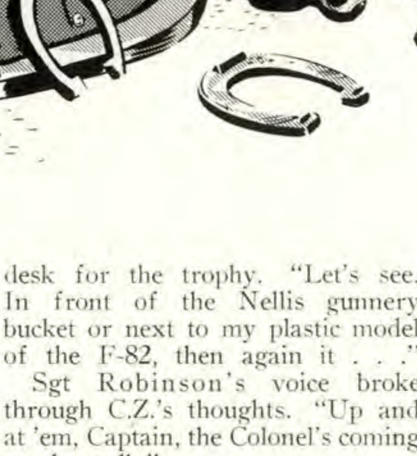
"And for now," C.Z. broke in, "you'll make it to the club with me and buy the winner his due. Oh, to get out of these wet clothes and into a dry martini."

The following Monday saw C.Z., attired in flame orange flight suit, seated at his desk, lovingly attempting to pick the right spot on the desk for the trophy. "Let's see. In front of the Nellis gunnery bucket or next to my plastic model of the F-82, then again it . . ."

Sgt Robinson's voice broke through C.Z.'s thoughts. "Up and at 'em, Captain, the Colonel's coming up the walk."

Chumley dumped the morning paper and a half eaten doughnut into the desk drawer, quickly opened a folder of week old teletypes, and began reading as the door opened.

"Morning, Chumley. I've got something you can do for me. I want you to take these—say, you been up flying already?"



"No, sir, just busying myself with official matters here. Why do you ask?"

"That flight suit. You trying to show someone on this air patch you're a pilot or something, or is it just easier to put it on when you're in a hurry?"

"Well, sir," Chumley sputtered, "I just thought that it looked sort of well—Air Force—you know, build up the image in the public's eye and all that."

The Colonel frowned, "I'll write a regulation against it when I have time. Anyway, you're dressed for the job I have for you. I want this case of documents flown down to headquarters and hand carried to the General. It's a short flight and you should be back for lunch. Questions?"

"No, sir." Chauncey took the brief case, put his trophy in the center of the desk, and started for the door. "These dispatches will reach their destination at all costs. Neither rain nor snow nor gloom of night . . ."

"Just hand them to the General, that's all Captain. Don't make a

Archie D. Caldwell, Supervisory Air Safety Specialist, D/TIG

production out of it. And be careful, I've got you set up in my aircraft and there's runway construction of some sort going on down at headquarters."

"No fear," C.Z. yelled over his shoulder as he clashed gears in the Jag and shot off toward base ops.

The takeoff was normal and C.Z. climbed smoothly en route, noting how clean the Colonel's airplane was and what a wonderful day it was. He could see the destination airfield in the distance and started a gradual descent some 20 miles out.

"Ah—Ripsaw—this is Air Force zero-zero-one, landing instructions —one T-Bird."

"Zero-zero-one, Ripsaw tower—landing runway one four—altimeter niner niner three, wind calm—first 3000 feet of runway under construction, call on initial."

C.Z. wheeled the T-Bird into a tight turn and hit the initial. "Double O—one- on the initial. How much of the active is usable?"

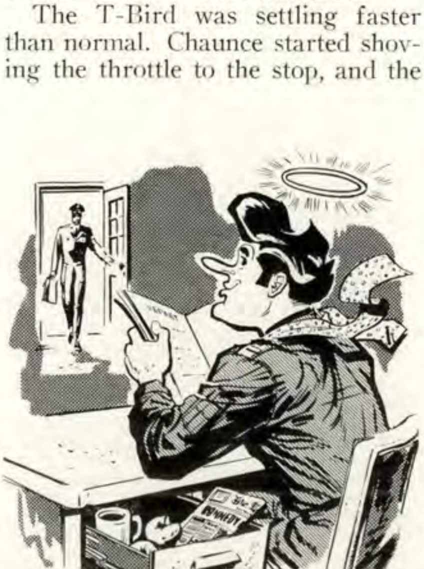
"Roger, zero one—cleared number one—no other traffic reported, six thousand five hundred feet usable, check gear down and locked."

C.Z. racked it on the pitch to a point that would have made the Colonel shudder, looked back to recheck the construction area and bent it on around into a sweeping turn to base and final. "Zero one on base—gear down, locked and green." Chaunce rolled out on final and started easing the throttle back. "Whew, look at them dozers and rollers," he thought to himself, "must take a strong arm to operate one of ———Whoa there!"

The T-Bird was settling faster than normal. Chaunce started shoving the throttle to the stop, and the

workmen started running for cover.

The RPM was at 100 per cent and the aircraft's nose was pointed to the sky when the bottom dropped out. The bird touched down heavily in the middle of the construction zone. A barricade with several red lanterns flew over the canopy, gravel and dirt sprayed like water as the power began to take effect. Chumley had kept the stick full back during the initial touchdown and the aircraft bounded back into the air, but not before depositing all three landing gear on a line of drums supporting a large yellow sign reading "Caution." The secondary stall came just as C.Z. got the throttle into cutoff. As the aircraft bellied in, Chumley cut the master switch. The slide of the aircraft and Chumley's departure from it were anything but dignified. The sobs of the world's greatest pilot were drowned out by the sirens of the crash equipment and the oaths of the construction gang.



The tone of the Colonel's voice was cold and firm. "Captain Chumley, I have before me the deliberations and findings of the accident investigation board. It isn't so much that you broke my best flying machine or that you almost killed yourself or that headquarters is on my neck because of accident rates. It's that you fell down on the job you're being paid for. The job of flying. Flying, as you may recall, involves everything from preflight planning to successful parking of the aircraft, and it includes the act of landing. I notice that the landing flaps were found to have been up after the accident, and your statement indicates that you *may* have forgotten to lower 'em, and that you were distracted by the area under construction. Do you know what would be said if I had pulled a head up stunt like that?"

Chumley thought for a minute. "Materiel failure, cause unknown, sir?"

The Colonel's face reddened as he ignored the remark. "Just what were you trying to do, land in the first 20 feet?"

"Well—actually I did plan to put it down fairly short, and even as it was, I was close to making it. If I just hadn't forgotten the flaps and maybe hadn't aimed so close to the end—or it hadn't settled on me."

"Chumley, you of all people should know that *being close* only counts in horseshoes. You're a professional and there isn't room for just being close. When the chips are down, you've got to be smack on the ball. I guess the only thing that would be appropriate is to have you be with the runway mobile control officer for a few weeks and see how landings should be done. Now get out before I . . .!"

C.Z. headed for the door at a trot. "Yes, sir, you'll see, I'll make you proud of me, I'll show you that . . ." The door of the office opened and the colonel's coffee in the hands of the secretary went flying as she started in and C.Z. hurtled past on his way out. Chumley spun around and grinned. "Wow—that was a close one," then vanished.

The Colonel took his hands from his eyes and looked at the coffee-drenched secretary. Then, shaking his head slowly, he said, "You know, with Chumley, it isn't whether he wins or loses, it's how he plays the game—and he plays it miserably." ★

PREVENTING MOWER·Accidents

SPRING IS POPPING OUT ALL OVER and with it comes the welcoming sight and fragrance of buds and flowers. Lawns are turning green which means it's time to get out the old mower, oil it up and start figuring out a way of getting rid of the grass cuttings.

Now also is the time to give a little thought to the safety aspect of this business of mowing the lawn, especially if you operate a rotary power mower. Somebody is going to get hurt and it might be you. In the files are hundreds of injury and property damage reports all caused by power mowers. But, let's back up a bit. Whose fault? How about the operator?

Experience has taught safety people a number of lessons on how to mow the lawn and do it safely. There is no guarantee that if one follows every rule that he will be 100 per cent accident free, but there is a guarantee that a few simple precautions will increase the odds against his getting hurt.

Here are some of those rules with examples of what to expect if you chuck the rules out the window and have at it without a thought to yours and others' safety.

• *When starting a power mower, be sure the clutch is disengaged, that your feet are clear of the blades and that you are properly balanced when pulling the starter cord.*

Example: An airman was unable to get a mower started, so he moved to the front, placed his right foot on the machine, both hands on the starter cord and pulled as hard as he could. His foot slipped, the mower rolled forward and pinned his right foot under the machine. Although the mower didn't start, the blade revolved cutting through his shoe and into his foot. Lost time, 30 days.

• *Disconnect the sparkplug wire whenever you want to work on the underside of the mower. Use the handle to turn the mower over; don't reach under and expose your hand to the blades. Never remove any object or clogged grass from the blades or any moving part when the machine is running.*

Example: A workman was using a self-propelled, reel-type mower. He stopped the mower to see if anything was clogging the machine, but failed to turn off the engine. As he lifted the drive belt to check it, the increased tension on the belt caused the reels to start turning. His fingers were caught between the belt drive and the pulley resulting in lacerations and fracture of two fingers.

• *Remove objects such as sticks, stones, wires from the area to be mowed and avoid obstacles such as large rocks buried in the ground, heavy tree roots, cement or metal curbs, etc.*

Examples: There are many examples that illustrate the wisdom of this rule with a rotary mower. A few: a stone was thrown approximately 160 feet from a mower through the windshield of a new car. Cost to replace the windshield was $75; an Air Force officer received a fractured cheek bone and severe eye damage when a piece of bone was thrown up by a mower; cases where small stones were thrown into the operator causing minor damage are too numerous to detail. An airman was using a mower with two clutches, one for the blade and the other for the wheels. He disengaged the clutch to stop forward movement but left the blade turning in order to trim around a manhole. The blade hit the concrete cover and sheared off striking the airman in the foot. Result: Severe laceration and compound fracture of four toes. Another airman was even unluckier; he lost a foot in a similar type accident.

• *Do not operate mower on wet grass. Be particularly careful on a hillside.*

Example: While cutting the grass on a 45-degree slope, an airman slipped and fell and his foot went under the rear housing of the mower. The blade cut through the sole of his shoe cutting three of his toes and the ball of his foot. This man was at home which may account for his wearing tennis shoes. Also, the grass was wet, a combination, along with the slope, that would almost guarantee a slip. Under a similar situation two airmen were working together, one at the top of the slope with a rope attached to the mower. Again, the man handling the mower slipped and his foot went under the mower housing injuring his foot.

In addition to the above, there are some other tips that might save you a trip to the hospital:

• Don't leave mower unattended.

• Be careful with fuel—don't refuel when the engine is hot. AND keep stored fuel in an approved can.

• Keep children and pets away from the mower while it is operating.

• Don't mow when the grass is wet. There's too much danger of slipping and, with an electric mower, there's an additional hazard.

• When mowing on rough ground or in high grass or weeds, don't try to be an earth mover—set the blade high to avoid hidden debris and high spots.

• Riding type mowers can overturn. Be extremely careful on slopes.

• When buying a power mower for your personal use, don't make it a point to buy the cheapest one you can find. Be sure it's well made and the blade is properly guarded front and rear. Ask yourself whether a blade could escape should it tear loose.

• Professional type mowers should be given the same care as any other potentially dangerous power equipment. Inspections should be regular and thorough. Why not take equally good care of your home mower? It can maim you just as effectively.

Finally, regard your mower as a piece of power equipment. Respect it, and teach others to do so! ★

. . . . SEVEN EMERGENCIES IN ONE HOUR

ON 2 OCTOBER 1962, 53 Guard transmissions were recorded during an interval of seven hours and 20 minutes. The rather startling implication here is that aircraft in the vicinity of Kansas City Center at that particular time were encountering roughly seven emergencies per hour. The implication would be catastrophic were it not that at no time was any aircraft experiencing real danger. And this is not an isolated case; conclusions of one observer are that Guard transmissions are made at roughly six per hour.

Let us return to the radio log of 2 October. Of the 53 calls received, 12 were unintelligible due to garble or interference from normal en route frequency. The remaining 41 transmissions bear further examination. Forty-seven per cent were initiated by departure and approach agencies. Twenty-seven per cent were from Flight Service Stations. Twelve per cent were from tower facilities. Seven per cent were from ARTC center and five per cent were from ADDC agencies. Only one call, two per cent of the total, was made by a pilot. All these calls arose from mere communications problems and not conditions of actual aircraft distress.

On the basis of this one sampling, ground controllers and coordinators are by far the largest contributors to the noise on Guard. Most of their transmissions consist of instructions to QSY or change IFF/SIF settings, information properly delivered on normal frequencies. Towers are also heavy users of Guard, particularly with test transmissions and often with landing, takeoff, and even taxi instructions. Other agencies perhaps not quite so addicted to the use of Guard, but determined users nevertheless, are ADDC agencies and SAC command posts. Lastly, of course, we have a very small percentage of aviators—engaged in air refueling, formation flight, etc.—who, it seems, must do their share to clutter the emergency frequency. The sad truth is that the so-called emergency frequencies have become mere backup frequencies for dissemination of information of all kinds which, for various reasons, is not being communicated on the proper frequencies. These non-distress transmissions, augmented by frequent tests on Guard, constitute an annoying and occasionally hazardous distraction to the man in the cockpit.

WHAT CAN BE DONE

Full use should be made of nonemergency frequencies. Every pilot should accept only aircraft with fully operational radios.

Possibly a letter from the controlling agency to the pilots' home station would improve pilot procedures or correct radio deficiencies, particularly if an explanation were mandatory.

A revision of Guard test procedures is essential. Frequent or random tests are unnecessary.

Reduce IFF/SIF instructions issued on Guard.

Use VHF receiving capability of omni-equipped aircraft when UHF fails, and have the pilot acknowledge instructions with IFF/SIF equipment.

Use discrete frequencies, as listed in the Enroute Supplement or relay through a Flight Service Station.

Stick to specified primary and backup frequencies for air refuelings.

Formation flights must respect communications discipline. En route frequencies must be briefed and a backup channel for interplane contact should be established.

In conclusion, extensive Guard misuse is annoying, always unprofessional, and occasionally downright dangerous. This widespread abuse warrants the attention of all who speak into microphones that broadcast on air-ground channels. If it's an emergency, go ahead. That's why Guard channels have been set up. Before you select it, however, ask yourself: IS THIS AN EMERGENCY? ★

1/Lt Daniel K. Read, 34 Air Refueling Sq, Offutt AFB, Nebr.

What to do until

LT HAVEN GRABBED THE RELEASE and got rid of the billowing parachute. For a few moments he sat quietly on the ground assessing his condition. Nothing appeared to be broken or out of place, so he got to his feet and looked off to the southeast where a black, greasy column of smoke marked the grave of his jet fighter.

He stood thus for several minutes, pondering his escape from the aircraft after its engine had quit and he had been forced to get out. The rugged terrain below had looked uninviting causing him to delay the ejection. But a gnawing reminder in the back of his brain brought back the advice he had seen repeated many times in the safety magazine—"Under controlled conditions the pilot should eject at 2000 feet or above." With the altimeter rolling past 2000, he realized he had to go, because with altimeter lag and downward velocity he would be somewhat under that elevation before he actually got out of the cockpit. It turned out that his chute made a couple of oscillations and he was on the deck in what seemed no time at all.

Now his mind turned to the practical aspects of his present situation. The desert was remote and vast. He climbed to the top of a small knob and looked out over the great sandy waste that stretched as far as he could see. All about were ragged brown and gray hills and mountains. Far away through the haze he could make out a range of high mountains still capped with snow. Heat waves and dust devils mixed with the sparse vegetation of the desert floor. For a few moments he was awed by the vastness and the dead quiet. Awe gradually turned to fright and for a moment touched on panic when he suddenly realized that he was all alone in a world that seemed completely bereft of life and even the means of supporting life.

"Get hold of yourself, boy," he told himself. He fought down the panic urge and forced himself to relax. Finally he began to feel more optimistic. Within a short time he should be found. It wasn't really true that he would have to stay in this barren waste forever. Why, within an hour he might be rescued. With this thought came the counter thought that rescue might take quite awhile.

He retraced the events since the engine of his fighter failed. He realized now that he had been so preoccupied with trying to restart the engine and then with getting out of the bird that he had done nothing to alert anyone that he was in trouble. Of course he would be missed soon, but where would they look for him? Would GCI be able to assist? He didn't know. Therefore, as far as planning was concerned, he had to face the facts as they appeared to him.

He was down in a seemingly uninhabitable land.

No one knew where he was or whether he was still alive.

As far as he now knew he would have to keep himself alive for, perhaps, several days.

He had been trained in survival techniques and he had better get busy remembering what they were.

Haven was still optimistic about being rescued. Now, however, he realistically considered the fact that he might have to spend several days in the desert and that he would have to provide for himself.

At two o'clock on a summer afternoon the desert temperatures soar to almost unimaginable heights. A

The chart below shows days of expected survival in the desert. Note that survival time is not appreciably increased until available water is about four quarts, the amount necessary to maintain water balance for one day at high temperatures. Using shade or otherwise reducing temperature a few degrees is as effective and as important in increasing survival time as water. At equal temperature the body requires two to three times as much water in deserts as it does in jungles or in humidified buildings. (* No exercise and remaining quiet. ** Walking at night until exhausted and resting thereafter.)

MAX DAILY SHADE TEMP	NO WATER	1 QUART	2 QUARTS	4 QUARTS	10 QUARTS	20 QUARTS
120°	* 2 DAYS	2 DAYS	2 DAYS	2.5 DAYS	3 DAYS	4.5 DAYS
	** 1 DAY	2 DAYS	2 DAYS	2.5 DAYS	3 DAYS	
110°	3 DAYS	3 DAYS	3.5 DAYS	4 DAYS	5 DAYS	7 DAYS
	2 DAYS	2 DAYS	2.5 DAYS	3 DAYS	3.5 DAYS	
100°	5 DAYS	5.5 DAYS	6 DAYS	7 DAYS	9.5 DAYS	13.5 DAYS
	3 DAYS	3.5 DAYS	3.5 DAYS	4.5 DAYS	5.5 DAYS	
90°	7 DAYS	8 DAYS	9 DAYS	10.5 DAYS	15 DAYS	23 DAYS
	5 DAYS	5.5 DAYS	5.5 DAYS	6.5 DAYS	8 DAYS	

TSgt Charles E. Steinwachs, Survival Training School, Edwards AFB, and Robert W. Harrison

the  comes

thermometer reading of 120 degrees or better is not uncommon. Lt Haven now became aware of the intense heat. To himself he thought, "The first thing I have to do is try to get out of the sun." Prior to that, however, he'd better collect his gear. He walked down from the knob to his chute and rolled it up in a ball. After piling a couple of rocks on it, in case a dust devil came along, he picked up his survival kit and carried it to the sparse shade of a nearby Joshua tree. After retrieving the parachute he tore off a strip of the material and fashioned himself a hat which he tied under his chin with a piece of riser. Finally, using the tree and a heavy rock for tension, he used the remainder of the canopy to construct a lean-to. Crawling inside, he sat down to think about what to do until rescue came along.

At first his mind wandered, traveling from water to food to shelter to whether it would be best to stay put or try to travel. After a few minutes of this he realized that his predicament required that he concentrate on those survival techniques he had learned back at the base school. Forcing his mind to focus on the classroom scene helped and before long he was able to recall the instructor's face and the displays around the walls of the room. Finally the instructor's words began to come through. Within a few minutes he was reliving those classroom hours.

"Gentlemen, we are going to spend the next three days discussing desert, seacoast and mountain areas and how you can survive alone in them with little or no equipment." The voice of the instructor continued on.

"Let's say you bail out in the desert with just your survival kit. You don't have any water and very little food. In the desert one gallon of water a day will be necessary just to keep you alive. One gallon a day will ward off dehydration; with anything less dehydration will commence. Once you start to dehydrate, unless the fluid loss is replaced, one thing is inevitable and that is that you are going to die. During the hot part of the year, with no water, the ordinary human may not last more than one day. This has been proven in the laboratory and in actual experience.

"Now there are ways to supplement your water supply and you had better learn them. First, there is the Acacia tree which grows fairly abundantly in our southwestern deserts. This is also known as the cat claw tree and here is a picture of one and a branch. Actually it's more of a bush than a tree. Notice the myriad of very tiny leaves and the thorny spikes. They're one to two inches long and cover the entire tree. This tree is a sure water indicator. Wherever you find an Acacia tree there will be water anywhere from a few inches to a few feet underneath the seemingly arid ground. You'll have to dig down until you hit damp sand. Then wait several hours, preferably overnight, and you will have water which has accumulated in the hole.

"Another method of getting water is from what we call the 'traveler's friend'—the barrel cactus. This plant has a large amount of very watery pulp inside. The easiest way to get at this watery pulp is to cut off the top of the cactus with a knife or machete. An axe or even a shovel will do the job. Dig out some of the pulp, place it inside a cloth—undershirt, handkerchief, parachute material—and wring it out. From a fairly large cactus you can possibly get a quart of water. It may be a little bitter but it really isn't bad.

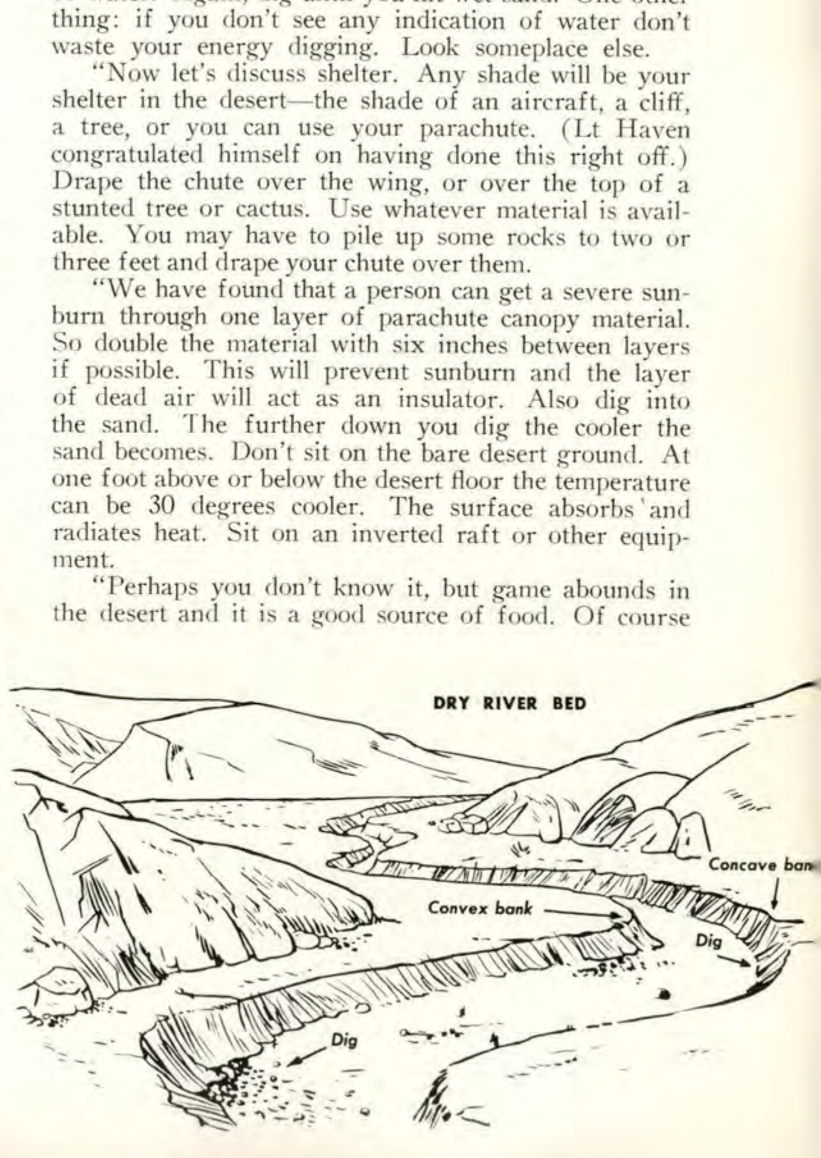
"Another handy plant is the prickly pear cactus, which has a watery pulp but not nearly as much as the barrel cactus. It is a very good source of food too, since it can be eaten after you peel off the thorny hide. Then there is the prickly pear apple which is sticky-sweet. Some liquid can be squeezed from this.

"There's another place where you might find water. That's in stream beds or dry washes. Look along the outside curves on these stream beds, where the water pressure in the spring runoff piles up against the bank. This is the last place where the water will dissipate in the summer. Examine these outside curves for any unusual amount of vegetation. This is an indication of water. Again, dig until you hit wet sand. One other thing: if you don't see any indication of water don't waste your energy digging. Look someplace else.

"Now let's discuss shelter. Any shade will be your shelter in the desert—the shade of an aircraft, a cliff, a tree, or you can use your parachute. (Lt Haven congratulated himself on having done this right off.) Drape the chute over the wing, or over the top of a stunted tree or cactus. Use whatever material is available. You may have to pile up some rocks to two or three feet and drape your chute over them.

"We have found that a person can get a severe sunburn through one layer of parachute canopy material. So double the material with six inches between layers if possible. This will prevent sunburn and the layer of dead air will act as an insulator. Also dig into the sand. The further down you dig the cooler the sand becomes. Don't sit on the bare desert ground. At one foot above or below the desert floor the temperature can be 30 degrees cooler. The surface absorbs and radiates heat. Sit on an inverted raft or other equipment.

"Perhaps you don't know it, but game abounds in the desert and it is a good source of food. Of course



Making an Arab-type headdress

WHAT TO DO UNTIL THE CHOPPER COMES

you'll have to do your hunting at night for that's when the game will be out and moving about. In fact, confine all of your activity to night—stay in your shelter in the daytime. You can trap or snare rodents such as mice; the desert abounds with rabbits, and there are a lot of reptiles—all kinds of lizards and snakes. Every one of them is edible. You're probably a little squeamish about eating these things, but if you go hungry for a couple of days you'll lose that. Snakes are a very good source of food. This includes rattlesnakes. Simply chop off the head, slice the snake down the middle and peel off the skin. Gutting is easy and you should take out the spine.

"All rodents can be eaten. This includes jack rabbits, squirrels, mice. Most of the meat is in the hind quarters. Lizards are another food source. Chuckawallas are abundant in the desert. They grow 12 to 18 inches in length. You'll find them usually in rocky areas of the desert and mountain foothills.

"All lizards are edible and this includes the gila monster, which you've heard is poisonous, but which is good eating. Chop off his head and go to work on his hind quarters and tail. The smaller lizards are very fast and extremely hard to catch, unless you can corner them. The big ones, like the chuckawalla and gila monster, are very slow moving. Usually they wedge themselves down in some crevass in the rocks and have to be pried loose. The gila monster is extremely slow moving so your chances of being bitten are slight if you are careful. Just don't pick him up by the tail because he can switch ends very quickly. Chop off his head and then pick him up.

"In the mountains you have the food problem too, but you also have other problems that differ in some respects from what you encounter in the desert, although some of the western mountains are as arid as the desert. Your primary concerns will be food and protection from the elements. Water shouldn't be a problem. In wintertime, of course, you have snow cover which can be melted to make drinking water. During the summer, with a bit of ingenuity and some hiking around, water can always be located. We spend quite a bit of time in the mountains with these survival classes and we have never had a problem with water.

"Food can usually be obtained since there are deer, rabbits and squirrels. In the southwest mountains there is a variety of very large gray squirrel. In fact, they're the biggest squirrels in the country and one of them is just about more than a man can eat. Farther north there is a red squirrel that is very common. Locating them is no problem. As a matter of fact they will locate you and long before you see the squirrel he will have spotted you and put up a racket.

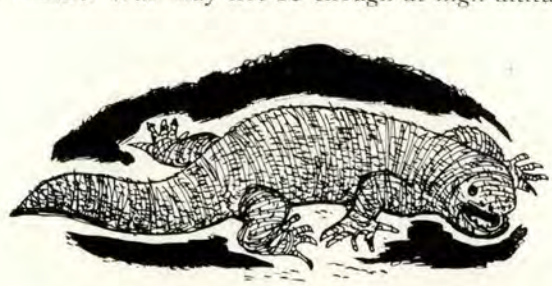
"If you have the survival weapon you can shoot squirrels. If not, make a squirrel snare. This is a two or three inch sapling laid against a tree where he has his nest. Interlace the sapling with several wire snares —five or six—all the way up. Place it against the tree and leave for a day or so. When you come back you're bound to have a squirrel since he will have begun to use the sapling as his access to and from the tree.

"Mountain streams contain fish and there is an abundance of snakes and lizards.

"A person on foot is difficult to see in the mountains so you probably will try to walk out. Go downstream since all streams eventually lead out into valleys and it's in the valleys where you will find civilization. Even if the stream leads to a lake, that will be to your advantage. Remember your emergency transmitter won't be of much use in the mountains so save it, or climb to the top of the highest mountain around, if that's feasible.

"Be sure to purify any water you drink. There's an old wive's tale about running water purifying itself. Don't believe it. If there is a dead animal lying in the stream or animal droppings there are bound to be bacteria and possibly other parasites in the water. They may not kill you but they can make you very ill. Illness is not conducive to survival.

"In your survival manual there is a rule that you boil water for five minutes. For every thousand feet of altitude boil it an additional five minutes. As you know, the higher you go the quicker water boils and five minutes total may not be enough at high altitudes.



"You may recall when we had halazone tablets in survival kits. These have been replaced with iodine. Halazone is okay, and it is sold in drug stores for water purification, but halazone tablets stored for a long time lose their potency and became useless. . . ."

Lt Haven was brought back to the present by the sound of an engine shattering the desert stillness. He crawled out from his lean-to and saw the chopper hovering over the wreckage of his plane a few miles away. Quickly he dug into his survival kit and pulled out the survival radio, signaling mirror and flare equipment. To be on the safe side he fired a flare, began signaling with the mirror and turned on the URC-10 radio.

"Helicopter, this is the pilot of that crashed airplane you're hovering over. I'm about four miles northwest, near a small knob. How about coming over here and picking me up? By the way, have you got a ham sandwich and a cold beer?"

While waiting for the chopper, Lt Haven gave thanks for the quick rescue. Then he paused a moment to think about his chances of survival had the chopper not arrived. "By golly, I think I could have made it." He gave another silent thanks for the survival experts and all they had taught him. ★

Responsibility

WITH THE FAMILIAR LANDMARKS of homebase coming into sight the crew of a jet transport decided to fly local for a time prior to landing, to give the pilot some additional practice. The instructor pilot cancelled their IFR clearance and received permission for 45 minutes flight in the local area.

Finally the aircraft, which carried several passengers in addition to the crew, was lined up with the runway and permission was received for a low approach. One minute later the plane crashed 2000 feet short of the runway. The only survivor was the instructor pilot.

Investigation into what caused this disastrous accident began immediately. It was soon evident that the aircraft had hit the ground on the main gear in a slight nose-up attitude. Just after impact, the right wing cut through a grove of small trees, the right wing tanks ruptured, and the aircraft burst into flames while sliding toward the runway. It was destroyed by fire.

Reconstruction of the events preceding the accident brought out that while the aircraft was descending for the low approach, the IP rolled in full nose-down stabilizer trim and electrically disengaged the normal pitch trim system. Purpose of this was to configure the aircraft for demonstration of control forces required when flying with a stuck stabilizer trim.

Upon entering the traffic pattern the pilot had lowered takeoff and approach flaps. On final approach, at approximately 1000 feet, the pilot experienced the heavy stick forces to be expected in that configuration and advised the IP that he didn't think he could hold the nose up with full flaps but would like to try.

Full flaps were lowered and the pilot soon advised the IP that he could not break the steep rate of descent. Power was applied for the go-around and the instructor reset the normal pitch trim system and applied UP trim. The system did not respond. Emergency trim was engaged; still no response. With both pilots holding the yoke back for a full nose-up position, the aircraft flew into the ground.

Investigators found the flaps fully extended and the horizontal stabilizer in the full nose-down position. It was further determined that there were no defects or malfunctions in the control switches and circuits of the trim system. Laboratory tests of the horizontal stabilizer actuator revealed that a short had occurred in the field windings of the emergency motor, and that while the normal motor operated satisfactorily, excessive electrical loads occurred when the system was operated under maximum design load conditions. Due to the possibility of side loads and the resultant decrease in effectiveness of the stabilizer actuator, the total loads on the stabilizer during the approach are unknown.

The flight manual being used at the time contained the notation that in the event of failure of the trim system in the full nose-down position, a safe landing could be accomplished. However, the following procedures were recommended:

- Plan the landing for a considerably longer runway than the minimum required.
- Plan to land with wing flaps in the full UP position.
- Use a minimum approach speed of 160 knots and a minimum flare speed of 145 knots.

In addition, the command 55-1 manual restricted the practice of emergency procedures to a minimum altitude of 3000 feet. It is interesting to note that initial checkout instructions provided the involved instructor pilot did not include positioning the stabilizer in the full DOWN position. Rather, the procedure was demonstrated with one-half of one degree nose-up trim with the normal trim system engaged at all times.

From the above, most readers probably will agree that the instructor pilot attempted a demonstration of an emergency procedure at an altitude that proved to be too low for safe recovery. It is probable that these same readers will not entirely agree on the cause of the accident because of the condition and abnormal operating characteristics of the stabilizer actuator. If this demonstration had been performed above 3000 feet, an inoperative trim system would probably not have resulted in an accident. On the other hand, had the trim actuator operated satisfactorily, especially in the emergency position, the accident would probably not have occurred. Regardless of which view you share, there's an important point to remember: *Never place your aircraft in a configuration, attitude or altitude that does not provide sufficient room for recovery, should a system malfunction.*

Before final conclusions are drawn concerning this accident, let's consider the other cause factors that stand out somewhat in the background. The degree to which these causes contributed to the accident cannot be definitely established; however, their importance should not be minimized.

Approximately two years prior to this accident, a training conference was convened to determine special training courses required to support this aircraft. Due to various changes, a comprehensive and detailed aircrew training program was not written prior to the date of the accident.

Air Force Manual 60-1 sets forth the responsibilities for standardization, training and evaluation. It contains the requirement and guide for development of standardization/evaluation manuals for the operation of each aircraft. *Such a manual had not been prepared for this aircraft.*

The aircrew training program of the specific organization was not adequate for the checkout and upgrading of aircrew members in a new and complex aircraft.

Finally, and probably most important, is the fact that a complete Air Force Flight Manual (Dash One) had *not* been published although this aircraft had been in the active inventory for some time.

Those of you serving in a supervisory capacity will certainly agree that the lack of these key publications are significant and help to explain why this accident occurred. ★

Lt Col Gordon D. McBain, Jr., Transport Section, Flight Safety Div.

Disorientation

fact and fancy

Capt Victor E. Schulze, Jr., Chief, Aerospace Medicine, Office of the Surgeon, Hq Air Training Command,

IT HAD BEEN A NICE OUT AND BACK with plenty of weather. Now, with home plate only 15 minutes away, the completion of a successful mission was almost at hand. Flying wing on the lead '100 was duck soup, even in the muck, and a fellow ought to get plenty of practice doing that. Over the VOR and into the penetration turn now. A quick glance at the fuel. Little on the short side, but no sweat, really. Lead's got it cooled and made the GCA pickup now. Downwind and cockpit check. Gear set. Six hundred feet and half mile viz. Final turn, recheck gear, give a sneak peek at airspeed and fuel. Watch the lead! Thought for a minute he was rolling over. Number two break-off and go around. That's me. Hit the AB, pull up and get on the gages. Gear, snatch. Fuel getting to be a mite touchy. Better make the next one or it'll be a bind to get around again. What's with that stupid attitude indicator. Got to believe it though. What the Hell! It tumbled. Something's wrong, bad wrong. There's the ground! Oh, God!

Spatial Disorientation, or pilot's vertigo, as it is sometimes called, accounts for a fair share of fatal aircraft accidents each year. The majority occur in a sequence similar to the above story. Weather flying, jet aircraft (frequently single seaters), traffic pattern altitude, switching from contact to instrument flight, some out-of-the-ordinary procedure (go-around, switching radio channels, an emergency, etc.) predispose to the perceptual confusion terminating in an episode of complete operator uselessness. What is this thing called disorientation, and why does it happen? What can be done about it?

To appreciate the subject of disorientation, one should know something of the history of instrument flight, and the early recognition of pilot vertigo as a hazard to flying.

A fortuitous circumstance involving two men in 1926 marked an understanding of human reactions to blind flying. The scene for this significant event was set in 1918 when Elmer Sperry, owner of the Sperry Gyroscope Company, gave William Ocker, an Air Corps pilot, an early model gyro turn indicator. This was a crude needle-ball instrument, but Ocker soon learned to use it in his flying. The original instrument was fitted with clamps so it could be attached to a strut of an aircraft. Ocker carried this instrument in a small black bag, as much to avoid the ridicule its use engendered, as to protect it. When he flew, Ocker would clamp his needle-ball instrument to a wing strut so he could see its face clearly. Others took a fling at using the instrument, but none mastered it to the degree that Ocker did, and thus, they did not regard it as a particularly valuable instrument.

In 1926, Major David A. Myers, a Flight Surgeon at Crissy Field (San Francisco), Calif., had occasion to perform the annual flying physical examination on Major Ocker. In those days, the flying physical allowed a variety of extra tests, this variety being limited only by the imagination and interest of the flight surgeon performing the tests. One of Dr. Myer's tests involved spinning the blindfolded examinee in a rotating chair to demonstrate the unreliability of the human senses in accurately determining spinning movements. When Ocker was tested, he too failed to give correct responses. However, Ocker had an idea about the rotation test. He advised Doctor Myers he would be back in an hour or so to take the test again, and that he would be able to give the correct responses on the second test. He returned with a small black box into which he peered as the rotation test was performed. This time, as he predicted, he was able to give the correct responses. Of course, the box contained Ocker's turn and bank indicator. Dr. Myers was naturally quite interested in the instrument that could depict movements which the human body interpreted erroneously. As a result, Myers studied the equilibrium senses in the human and was able to make several valuable contributions to our present day understanding of why disorientation occurs.

In 1929, Ocker and Myers joined Lt Carl Crane at Brooks Field, Tex., to further study instrument flying techniques. Several interesting facts came from this series of experiments. It was found that blindfolded pigeons could not maintain their orientation when dropped from aircraft, and promptly fixed their wings in a glide configuration in order to fall more or less safely to ground. This established the fact that birds are strictly VFR flyers. It was also found by experiments with blindfolded men, required to walk across a field, that humans will not maintain a straight course without visual aids. In all instances, the blindfolded men pursued a circular path with the curve gradually increasing to form a spiral. It was also noted that the spiral could be to either side and that it never reversed. Meanwhile, Ocker and Crane were attempting to promote the cause of instrument flying in training programs.

By 1930, Sperry had developed other flight instruments, several of which had been tested by Lt Jimmie Doolittle in some notable blind landing tests in 1929. The Air Corps, somewhat reluctantly, began to integrate instrument training into its flying program at that time. The October 1930 Class of the Advanced Flying School at Kelly Field, Tex., was the first instrument-trained class to graduate.

Although the start was meager and involved primarily the "1, 2, 3, Needle, Ball and Airspeed" system, it soon got a boost in the Air Mail tragedies of 1934. By Order of the President, the Army Air Corps flew the U. S. Mail from February 19 to June 1, 1934, in one of the worst winters on record. Approximately 150 Air Corps pilots flew outmoded, poorly equipped aircraft carrying the mail. Most of the pilots were grossly inept in instrument flying technique and had obsolete instruments to use. Within the first three weeks, nine pilots and their passengers had been killed. Forced landings and bailouts were frequent. Pilots often flew at night in snowstorms, using flashlights to read their icy instrument panels. When the Air Mail order was terminated, a total of 14 Army pilots had lost their lives. It might be said, however, that these lives were sacrificed upon the altar of progress, as instrument training received a great deal of emphasis thereafter.

Shortly after the start of World War II, it became evident that better methods of instrument flying than the "needle-ball-airspeed" system would have to be applied to the higher performance aircraft being used in the war effort. Major (later Colonel) Joe B. Duckworth adapted the "full-panel system" as pioneered by Jimmie Doolittle, to the Air Corps training program. In 1943, the full panel system was incorporated into all training programs, and to date represents the basic instrument flying system utilized by the U. S. Air Force.

By now, you are probably wondering what all this has to do with disorientation. Simply this: proficiency in instrument flying is very important in preventing disorientation, now, as always.

Spatial disorientation should be distinguished from vertigo. The two terms are often used synonymously but mean two entirely different things. Vertigo means dizziness, or a spinning sensation. Disorientation implies a lack of appreciation for one's position in reference to the surface of the earth. In flight, disorientation may be rather common, but true vertigo is rare.

Orientation, or position sense, in the human is maintained by means of three sensory modalities: (1) the eyes, (2) the inner ear, and (3) the nerve endings in the muscles, joints, skin, and abdominal organs. Of all these, the eyes are by far the most important. So important are the eyes as organs of orientation that it would actually be helpful if the other two senses or

orientation could be switched off during flight. Because of the false sensations they sometimes transmit to the brain, the inner ear and the sensory nerve endings can confuse the brain as to position sense, and the delay caused by this confusion and indecision can mean the difference between life and death. How can this be? Why would the body be built that way? The answers are actually very simple.

As we stand on the ground in broad daylight, gazing out ahead of us, all is serene balance-wise. Our eyes perceive the distant horizon as a line stretching from left to right, our inner ears tell us that gravity is pulling at our feet, and the nerve endings in the soles of our feet, in our knees and muscles, and in our internal organs confirm this. The complicated balance apparatus is well composed and all systems register "Go." This is what we have grown up to know, to feel, and to depend upon. It is a day-to-day experience with certain ingrained habit patterns and responses. It is natural and normal. Now, keep this picture in mind as we bluntly dissect each of the three sensory systems affecting orientation.

First the eyes. The hand may be quicker, but to see is to believe. The eyes are the most important orienting sense we have. Take away the eyes and we begin to approach the core of the problem.

The second system, the inner ear (or vestibular apparatus as it is often called in more erudite medical circles) is a complicated little gadget that actually has two functions related to equilibrium. It is a gravity sensor and an acceleration sensor. Both of these are worthwhile functions as long as they operate accurately and transmit valid information. Generally, on the ground these things do transmit accurate information. In an aircraft, however, the various motions of flight produce situations the inner ear was not designed to fathom. For instance, the gravity receptors are simply small hairs with little blocks of calcium carbonate concretions on their ends. As the little blocks are pulled down by gravity, they bend the hairs and send impulses to the brain. These impulses are interpreted by the brain, on the basis of experience gained since birth, as certain bodily positions in relation to the ground. Unfortunately, these little blocks may be bent around by G forces as well as gravity. So right off, we have one source of erroneous information that can arise from the inner ear.

DISORIENTATION
fact and fancy
CONTINUED

How about the acceleration sensors? These are generally regarded as the semi-circular canals and they are capable of detecting linear (straight line) acceleration as well as rotational (turning) acceleration. They have certain thresholds of stimulation, below which they do not ring any bell in the brain. This may be presented as being analogous to takeoff speed. Below takeoff speed, the bird isn't going to fly no matter how much concrete you roll under the wheels. At takeoff speed, the bell rings. In flying, many accelerations are sub-threshold and do not register in the brain. An example of this is the familiar "leans" frequently seen in instrument flight. This is caused by a slow, gradual banking of the aircraft—so slow and gradual that the semi-circular canals do not register the change. Suddenly the pilot realizes the attitude indicator is sloped off, so he banks back to straight and level flight—usually somewhat abruptly. Now the semi-circular canals do register, and they register a bank in the direction of the correction. This leaves the pilot with the impression of being tipped to one side, to which he made the corrective bank. He then has a natural tendency to gradually ease back over to the original banked position. This is again detected on the attitude indicator and recovery is effected, again with a threshold bank in the correction direction. This further reinforces the mental impression of being banked in the direction that the corrective banks were made. As a compensatory reflex mechanism, the pilot unconsciously leans away from the direction of the corrective bank so as to "sit upright" according to his mental impression. Although this is an uncomfortable sensation, it is not as likely to produce as critical situations as the erroneous information concerning accelerations that may arise from the semi-circular canals.

The semi-circular canals are filled with a fluid similar to the plasma of the blood. They respond much as the ice in a drink when the glass is rotated. That is, as the glass is rotated, the ice is slow to follow the rotation, then it picks up speed until it rotates at the same speed as the glass. Now if the glass is stopped, the ice continues to rotate for a bit. The fluid in the semi-circular canals tends to follow the same principle. As the head rotates, the fluid starts to rotate also, but at a slower rate than the head at first. This relative difference in the motion between the fluid and the canal is interpreted by the brain as a rotation in a certain direction. Simple enough isn't it? No magic there. Well, let's take it a step further. The pilot in his aircraft is in a turn and the head is rotating. The fluid in the semi-circular canal starts to rotate, but it is moving slower than the canals, so the pilot gets the impression he is rotating. O.K. so far. Now the fluid catches up with the canal. There is no relative movement between the canal and the fluid, just as it is on the ground when the flyer is not moving. What sensation does the pilot have now? Go to the head of the class. Of course, he feels like he is not rotating at all. That's not so good is it? Well, suppose we take it one step further. Let's stop the turn and cease rotating the pilot. Naturally the fluid in the semi-circular canals is going to continue rotating for a few seconds, just as the ice in the drink does when you stop rotating the glass. What sort of sensation does the pilot get now? That of turning in the *opposite* direction, of course. Kinda' hairy isn't it? Well, so much for the inner ear. By this time, you should get the impression that the inner ear is not too reliable as an indicator of position sense in flight.

How about the third sensory modality; i.e., the nerve endings in the muscles, joints, skin, and abdominal organs? How could these honest-to-goodness little fellows ever be wrong? They are essentially pressure sensors, true, and do not involve any complicated mechanisms. For instance, if we stand leaning somewhat on one foot, the nerve endings in that foot send a message to the brain to the effect that they have right smart pressure being applied, while the other foot relates that pressure is low and things are A-OK. The brain, being nobody's fool, immediately chalks up a lean in the direction of the foot reporting high pressure. Nothing tricky there. Let's take another situation. Suppose we are in an elevator that is going up. As the cage accelerates, we are pressed harder against the floor and our stomach is pulled down in a sort of uncomfortable way. We are essentially pulling some G in excess of our normal one positive G. This sensation is one that we associate with going up. This even carries over into flying. We put back pressure on the stick and immediately feel that we are being pressed down into the seat as the aircraft climbs. So, automatically the brain interprets positive G as indicating a climb. Now, suppose we visualize a pilot in the soup. He is in a steep, descending spiral, pulling about two positive G. It is difficult for him to reconcile the unwinding altimeter with the voices of the pressure sensors in the seat of his pants telling him he is in a terrific climb. Examples of this sort of thing are endless. The point is that neither the inner ear nor the pressure sensors are very reliable indicators of body orientation in flight.

Well now, let's get back to our fellow standing on the sidewalk gazing resolutely at the horizon. As we said, all his systems are in tune and the world is a bright and cheery thing. Let's have him close his eyes and then spin him about and perhaps even pick him up and jostle him a bit this way and that. Now it is unlikely he will be able to point out the direction he was headed, and perhaps he will even have trouble indicating the direction of the horizon. If he is asked to now open his eyes, he will immediately orient himself. This is in spite of the fact that he may still be receiving the jostling and juggling. The reason he can orient himself is that his eyes, when functioning, override the other two sources of positional sensory input. One peek is worth two finesses. If we translate this into terms of the pilot flying on instruments in the soup, we immediately appreciate two things: (1) the motions of flight play hob with the sensations of the inner ear and the pressure sensors, and (2) when visual sensory input is lost or restricted, orientation is a serious proposition.

The visiual displays presented by the attitude indicator and the other flight instruments are only a substitute for the actual horizon. One might say they're a rather poor substitute at that, and few would argue the point. All too often, the instrument display is not convincing enough to allow the optical sensory system to completely dominate the inner ear and pressure sensors. In such instances, the brain is bombarded with conflicting sensory input relative to position and orientation, and the harassed pilot is torn between believing a series of gages or his natural sensations of position. In the critical seconds of sweat and indecision, unrecoverable flight attitudes may be entered. Needless to say, the only thought should be to shut out all sensations and ride the instruments.

Disorientation rarely occurs in VFR conditions, or any time the horizon can be visualized. Occasionally on a clear, dark night, spatial disorientation can be a problem. Arctic flying with "white-out" falls into this category also. In these instances, the horizon is lost and disorientation more or less slips up on the pilot who is trying to fly contact. Other times, the lights on the ground may be confused with stars, and some pilots have reported instances where dark ground or water has caused some confusion with reference to the earth-sky dividing line. The clue here is loss of a horizon. Whenever conditions are such as to present an obscured or vague horizontal reference, be on the watch for disorientation.

Well, we said above that disorientation rarely occurs in VFR conditions. This is true. It is a condition primarily associated with instrument flight, and one should immediately assume a state of mental awareness of disorientation whenever instrument flight is undertaken. One should be cognizant of the mechanisms producing the conflict of sensory input to the brain, not to remember what actually happens, but to know and remember that only the *eyes* provide a reliable source of positional sensory input to the brain. Disorientation can occur to anyone, but inexperienced pilots, jet pilots and pilots flying single seaters are more susceptible candidates. Accidents resulting from disorientation are more apt to occur following a transition from contact condition to instrument flight, following some interruption of a normal instrument flight sequence, or following some normal and necessary distractions from the flight instruments (radio channel changes, switching of fuel tanks, etc.).

The answer to disorientation is a difficult one. True, better flight instruments, particularly a composite flight instrument with better visual stimulation, would help. However, the real answer is to know why it happens, how it happens, and when it is most likely to happen. The development of a high degree of instrument proficiency and confidence is important also. In this context, air discipline plays a part. Know when to get on the gages, then get on them and stay on them. Finally, it must be remembered that the eyes furnish the only reliable means of orientation information. This is true regardless of whether the reference is flight instruments, another aircraft in formation, or the horizon of the earth. ★

The author gratefully acknowledges the help tendered by Colonel Carl J. Crane, USAF Ret., regarding the historical aspects of instrument flight.

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"That was close! I'd really have been worried but for those tranquilizers I took before going up."

• missilanea

• HOUND DOGS

HASTE MAKES WASTE. The failure to properly stow equipment causes missile mishaps. A recent example is the missile mechanic who did not take time to properly stow a steering bar before positioning a GAM-77A missile within the maintenance hangar. The steering bar was being carried across the seat of the tug as the missile was being maneuvered into Station Nr 1. The bar struck the turbine exhaust duct assembly of the J-52-P3 engine, causing damage to the extent of 45 manhours. Haste and poor judgment usually result in personnel error. The unit corrective action included procedures which state that no object that extends beyond the width of the tug will be carried on tugs.

STRONG BOY. The water servicing of a B-52 aircraft had been completed and the water stand left at the aircraft. An assistant crew chief of a nearby B-52 required the water stand to complete his servicing. The large size and weight of this equipment requires more than one person to safely maneuver it; however, the airman attempted to move the stand by himself. As he pushed the stand from between the B-52 fuselage and the attached GAM-77, it struck the missile pitot static probe. The damage required replacement of this expensive gear. The unit revised its procedures to require a minimum of two persons to move the water stand equipment.

Lt Col H. M. Hegyessy

TAXI CLEARANCE—Proper taxiing procedures was the subject of "Twenty-Five, Ten or Cut 'Em" in the February issue of Aerospace Safety. The author, writing from experience, discussed the prevention of taxiing accidents by observing proper clearances and the use of FOLLOW ME vehicles and wing walkers. His advice can be equally well used in the prevention of damage to missiles on the ramp.

Recently a tug operator, towing an equipment trailer, misjudged the distance from the nose of a GAM-77. The trailer hit the pitot static tube causing sufficient damage to require replacement of the unit. Obviously, it is a lot cheaper to have an observer on hand to make sure there is proper clearance than to make expensive repairs.

• GARS

DAMAGE TO GARs is a continuing problem for which the best cure would appear to be careful handling, properly trained personnel and rigid adherence to check lists. A few of the many recent incidents will serve to illustrate:

GAR-1D. During uploading of a GAR-1D, the missile slid forward on the handling bar. When the crew applied force on the boattail to compensate for the shift in weight, the missile nose was raised and the radome struck the lower side of the container edge. The result was a cracked and peeled radome. The cause: *improperly adjusted handling bar.*

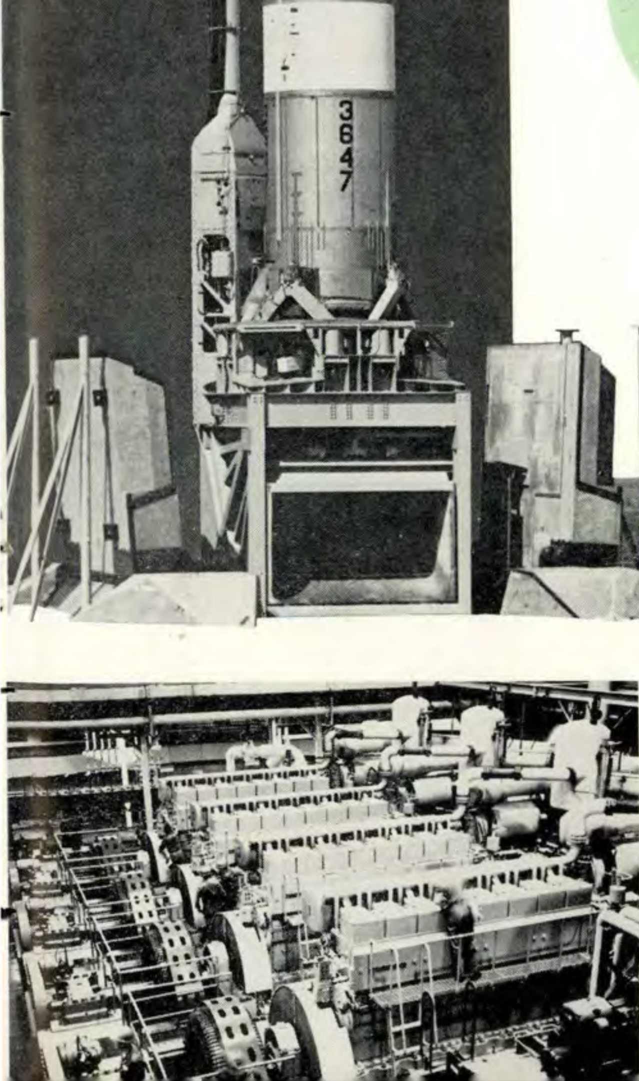
GAR-1D. During downloading the Nr 1 stabilizer was found to be dented and there was a dent in the fuselage near the forward launcher hook. It was thought that the damage occurred during mass loading at night. Probable cause: *careless handling.*

GAR-2A. Minor structural damage was caused to a missile during downloading when an airman slipped on an icy ramp and fell to one knee. The ramp was covered with ice and snow. About all one can say is take it slow and easy under such conditions and use a little extra care.

GAR-8. There have been several cases recently in which GAR-8 missiles failed to leave the launcher on F-100s although the servo grains of the G&C burned. Apparently pilots have released the trigger switch prior to missile launch. It is recommended that the switch be held until after launch. ★

10 9 8 7 6 5 4 3 2 1

SHOULD COUNTDOWN COME



NOT QUITE HALF WAY THROUGH the 24-hour shift, a square plastic button on the BMAT panel in the Launch Control Center began its persistent red blinking. The Launch Control Officer caught it immediately and reached for his headset. At the same time one of three countdown buttons flashed white and a bell rang. He punched the white button, and said into his mouthpiece, "LCO."

"The chiller kicked off the line."

"I thought you were working on it."

"We thought we had it. We've switched over to the ice banks. We'll stay with it."

"Keep me informed."

"Roger."

The LCO tapped a button marked "release." The circuit was broken and the white light went out. The red emergency light kept blinking. There was nothing he could do about this annoyance. One chiller was on a red X because of a bearing. The other had been carrying the load. Malfunctions had plagued it the past few days. Frequently it had been necessary to go to ice banks to provide necessary cooling. Once the ice banks were depleted, there would be nothing else.

This is representative of the type of problem encountered in a routine day at a ballistic missile site. In a way it's difficult to understand. Here, in a huge, disjointed underground submarine the launch crew stands by, just in case. They are responsible for missiles that, in all probability, they will never launch. They have trained, become qualified, and now merely must pull their 24-hour shifts. Is it monotonous to wait for the day when they might have to open valves, actuate switches and push that all important button? Not at all. Let's look at why.

Environment is one thing. In the silos, control terminals, storage areas and powerhouse, temperature, pressure and humidity must be controlled at all times. Electrical power sufficient for a community of 6000 must not just be available; much of it must be used continually in maintaining the environment. This, among other power production needs, makes heat. And, for this reason, considerable refrigeration capacity is needed. Thus, the concern over the difficulty being encountered with the chiller. Design



SHOULD COUNTDOWN COME CONTINUED

had taken this as well as many other possible backup requirements into consideration. Either of the two chillers would handle the load, duplication being merely to provide the safety factor in case one should go out. Beyond this, there were three ice banks that could handle cooling requirements for approximately six hours, depending upon the demand.

The LCO, busy at his panel acknowledging radio calls and phone communications, squeezed in an announcement over the PA system.

"Power production, call the LCO."

In moments, a flashing, white light and the familiar ring.

"LCO."

"Power production. You wanted us to call."

"How you coming?"

"We think we will have it in a few minutes. We'll have to run it up to know."

"Do you have a qualified inspector to sign the work off?"

"We will have to get one."

"How soon will you need him?" The LCO frowned. "It'll take a couple hours to get one out here now."

"Better call one, sir. We will be ready before that."

"Okay, I'll get right on it."

A routine, livable problem was beginning to nudge into something a little bigger. The LCO turned to his Guidance Control Officer, "Hand me that locater file." The GCO passed it over. After looking up the number of the refrigeration inspector assigned to his site the LCO made his call, outlined the problem and verified that the inspector was leaving immediately.

The GCO, who had been taking routine communications on another panel, looked across, "Power production wants to talk to you."

The LCO took the call. "We have about half an hour on the ice banks," he was told.

A little tighter now. The LCO ran through, in his mind, the consequences of loss of cooling and what should be done. He would minimize requirements. In standby status they could probably get by. The real threat was how much heat overload could be withstood if there should be a launch requirement.

Better inform the command post. The LCO pressed another button on his panel, made his report and advised that he would pass on any change.

At the end of one of the tunnels, in an inverted half-bowl shaped room, two airmen worked on the chiller. The familiar Air Force fatigues identified them as maintenance specialists. Like all other personnel in the site, they wore hard hats. Theirs were grey. As is so often the case, these were the people, in final analysis, upon whom the readiness posture depends. The six-man, white-coveralled launch crew monitors, inspects and occasionally exercises systems; but whether or not each component will work as designed, should countdown come, depends upon the maintenance technicians.

The LCO got a call from the site commander. He wanted a status report.

Power production called. The chiller was ready for runup. Nothing to do now but wait for the inspector.

The last ice bank had been used up. The BMAT man came in with coffee. "It's getting warm in here," he observed.

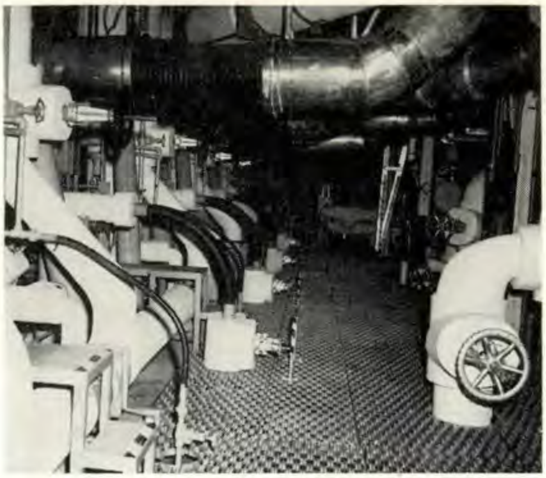
"The ice banks have been used up. The reefer inspector should be here in a few minutes," the LCO explained. He had already called the command post.

The tension level inched up. The cooks had learned of the problem when they complained of the heat to an airman who had stopped in for coffee. Someone said, "I sure hope it's that reefer inspector," when the PA carried the order throughout the complex, "Elevator operator, take the elevator topside."

It was the inspector. In a few minutes he called the LCO to announce that the work had been inspected and signed off and to request permission to apply power. Sign off of all work by a qualified inspector is just one of many rigid accident prevention rules; the fact that no switch, circuit breaker, valve or other similar control can be actuated without first obtaining approval of the LCO is another.

Moments later the red emergency light—the one that had been flashing steadily for several hours—went out. The LCO called his command post, reported that the inspector had arrived, signed off the work, and the chiller was again in operation. Six and a half minutes later, the light came on again but it was only a temporary interruption. The LCO called power production and asked the inspector to stop in before leaving. Temperature throughout the complex began to drop back toward normal.

Again, maintenance men had cor-



rected a malfunction. Some problems take longer and are more serious. Most are comparatively simple. All must be found, reported, evaluated and corrected on a basis of priority established by maintenance control. Consider the potential for disaster. Site storage facilities and transfer lines contain such materials as liquid oxygen, liquid nitrogen, helium, RP-1, hydraulic fluids, acids and alkalies. Pressures range up to 6000 psi. Tremendous amounts of electricity must be routed throughout the site. Explosive devices are used in the missile itself and, if all this should not suffice to motivate each and every individual, all he has to do is remember the destructive power in the re-entry vehicle perched on top of each missile. Surely, in no other operational facility is there greater concern for accident prevention.

How is it done in a complex system—a new system that as yet is far from de-bugged—where each man's final training has to be accomplished on the job, a weapon system so new that component failure rates are not known?

Here are some of the ways:

- There is absolute, day in and day out, 24-hours-per-shift adherence to checklists.
- Individual discipline of the highest order is mandatory; each man must methodically perform each item on his checklist no matter how many times he may have done a comparatively simple task.
- Never use ingenuity—use tech data.
- Any time there is doubt, stop!
- Supervision and inspection, always.
- Brief and re-brief! For each and every task, the man must be job qualified, must have and understand the applicable tech data, must know his procedures, and the back-out procedures, should any sign of trouble develop.
- Use the buddy system—this warning appears on doors throughout the complex.
- Keep the LCO advised of where you want to go, how many are with you, when you get there, when you are ready to leave, and when you have left. Portable phone jacks are everywhere.

No man on a missile site is ever given the opportunity to forget. Every conceivable effort is made to make accident prevention a way of life. Seldom is he out of sight of a safety sign. Never a day goes by but he is given a briefing in which accident prevention is stressed. Fire extinguishers are spotted throughout the tunnels and in all terminal areas. He is required to read and initial the safety file each time an addition is made. Ska-Pacs are spotted wherever they might be needed. Red and green primary escape route arrows line the walls of tunnels and rooms. Decontamination showers and eye wash fountains are centrally located in all chemical storage and use areas. Safety chains and meshed doors protect elevator riders.

And, providing the clincher is the commander's safety policy. Here are excerpts from such a policy as expressed by Colonel Julius Pickoff, Commander, 451 Strategic Missile Wing: ". . . I appreciate that on occasion the desire to get back in the 'green' or to make a good showing will create an atmosphere of 'anything to get the job done.' I want it thoroughly understood that this type of thinking will not be condoned and any supervisor permitting it in his area of responsibilty can expect command action. Take your time, check the procedures, recheck as necessary, and when sure, proceed in a methodical manner that will complete the activity in a safe manner." ★

COMMANDER'S SAFETY POLICY

- Never proceed at a rate that jeopardizes safety.
- Never consider rushing necessary.
- It is far better to accept a delay than to experience an accident or incident.
- No person will be criticized for taking the time to do a job safely.
- No task will be performed in association with the missile, R/V, propellants, AGE or missile support equipment without proper checklists and or technical data, without the express approval of the Director of Maintenance, the Vice Commander or Wing Commander.

AERO BITS

"THANK YOU, GCA, very nice run." This is a comment often made by a pilot after landing out of a ground controlled approach.

During 1962, records released by AFCS reveal there were 107 instances when such comment was particularly apropros. This is the number of "saves" credited to controllers assigned to this service. A "save" is awarded when controller action extricates a pilot from an emergency situation which probably would not have been safely resolved without controller assistance.

Involved in the emergencies were 95 military and 12 civilian airplanes, carrying 252 military and 30 civilian personnel. The dramatic "saves" came as a routine part of AFCS worldwide air traffic control mission. The Air Force makes no claim to lives saved, by the emergency action, because, "the military airplanes, and possibly some of the civilian airplanes involved, carry parachutes, making it impossible to determine conclusively how many lives might have been saved by the air traffic controllers."

The value of the military airplanes "saved" was placed at $106,704,216, but the price of the 12 civilian airplanes was not known. Maj Gen Kenneth P. Bergquist, AFCS Commander, said that the dollar figures are impressive, but that they do not measure the true significance of AFCS air traffic control operation. "We control USAF air traffic all over the world," he said, "in a wide variety of flying conditions, and in support of every type of Air Force flying mission. The number of airplanes saved, their dollar value, and the value of their trained aircrews is best measured as a part of the total effectiveness of Air Force operations: It's that many airplanes still in the inventory; that many aircrews still ready to fly; that much airpower still on hand—and ready."

WHILE UNLOADING the WSEMs on an F-102, armament personnel discovered that one WSEM was missing. A helicopter search of the area where it was thought the missile might have fallen produced no results. During the flight, the pilot noted that during breakaway the rails retracted and the missile doors retracted automatically. He wrote up the discrepancy. The following day the missile was found to be missing. Although no exact cause was determined, one possible cause was that the WSEM was installed incorrectly and the hooks were not positively engaged on the launcher rail. A loading test revealed that WSEMs could be installed improperly and still appear to be properly and solidly installed.

B-66—During takeoff, at about 120 knots, the weather compartment emergency ditching hatch left the aircraft. The hatch brushed the vertical stabilizer but luckily caused no damage. This hatch was not properly secured and inspection was not complete. As a result of this incident, other B-66s were inspected and several escape hatch inspection windows were found to be so scratched or cloudy that a positive inspection was impossible. Windows that are in such a condition should be replaced to allow a positive check of hatch security. This goes for any other such inspection access.

AIRPORT FACILITY—During landing rollout, the left main gear and nose gear of a C-119 sank through the runway paving of a civil field. This airport was listed in the Flight Planning Document, U. S., as an unrestricted PC Field. However, approximately 700 feet of the runway consists of about one-half inch oil and rock watershed covering over adobe and red clay. This is a stabilized extension of the runway with no markings and no visible difference in appearance. Recent rains had apparently soaked the ground until it would no longer support either the aircraft or motor vehicles used in its recovery. This incident points up the danger of operating into civil fields, especially since published information is quite often incomplete. Suggest that when planning to use a civil field other than a major airport that, planning include not only a look in the Aerodrome/Facility Directory and NOTAMs but also, when possible, a call to the airport to ascertain its condition, unless restrictions or hazards are spelled out in the publications.

T-33—The approach and landing appeared to be normal with the T-Bird touching down about 500 feet down the runway. As the pilot called "SB and Flaps UP," the left main gear started to collapse followed by the nose gear. The aircraft, at the time, was traveling at approximately 80 knots with all gear firmly on the ground. The T-33 slid along on the left tiptank, right main gear and nose section until it stopped at the 2500-foot mark. Damage was light and neither pilot was injured.

It was later determined that the pilot was in the habit of placing his hand on the gear handle to prevent the handle from inadvertently rising. In this case he apparently repositioned the handle from the down and locked position, causing retraction.

F-105—A pair of tire failures point out the danger of overheating tires during high speed ground roll. In one case the afterburner failed to light and takeoff was aborted. The pilot taxied back and attempted another takeoff with the same results. Shortly afterward, the left main tire blew out. In the other case the pilot made three takeoff attempts and was taxiing back to the ramp when the main gear tire blew.

The unit in which these events occurred has recommended that a Safety of Flight Supplement be issued directing that after AB failure on takeoff, a second attempt will not be made until the aircraft has been returned to the ramp and the cause of failure corrected. This would help prevent tire failures, as related above, as well as the more serious hazard of a tire blowing on or immediately after liftoff which would require landing with a blown tire.

ARMAMENT PROCEDURES—During an air-to-ground mission employing 2.75 rockets, the pilot placed the master arming switch in rocket salvo and dropped one launcher with two rockets. Fortunately the rockets fell on the range and there was no damage. Apparently the other launcher did not drop because it was empty and, therefore, light.

This inadvertent launch resulted from a misunderstanding of instructions and was responsible for the unit's going back to the books on armament switches and procedures. Action is also being taken to insure that all pilots are familiar with terminology to be employed in flight. Such action includes a memo in the PIF which must be read by each pilot prior to his next flight. Briefings are scheduled for unit training assemblies, and each pilot is required to take a cockpit check during which he must place every switch in the precise position it would be in during an armament expending event. Further, a checklist has been issued to all pilots, who are required to check and recheck to make sure they are following it.

AN F-101 PILOT made a wing takeoff. After the gear was retracted, the "Unsafe" light in the gear handle remained on and the gear horn continued to blow. The lead aircraft indicated the wingman was clear. The pilot then noted that the attitude indicator had tumbled and the heading indicator was 180 degrees out of phase. A few minutes later the pitchup warning horn started to sound continuously, and the anti-skid "OUT" light illuminated.

About 30 minutes after takeoff both crewmembers detected strong electrical fumes in the cockpit so they selected 100 per cent oxygen. After turning onto GCA final, in the wing position, the gear handle was placed in the down position, but both main gear indicated unsafe. The flap selector was placed in the down position but flaps remained up. The landing gear circuit breaker was checked in, and the pilot noted that the rudder trim and flaps circuit breaker had popped. He replaced this circuit breaker and it stayed in. A missed approach was initiated and both aircraft turned downwind for their second GCA attempt. Weather: 600 and 5 in haze. Gear down was again selected, and again both main gear indicated unsafe. Lead aircraft confirmed gear down and apparently locked. Flaps were selected, and this time obtained. At this time, primary hydraulic pressure began fluctuating 400 to 600 psi, and the main gear indicator lights began blinking on and off, finally coming on steady about three miles out but with the gear warning horn and the light in the gear handle still indicating an unsafe condition.

AERO BITS (CONTINUED)

By this time the fumes were extremely strong. The aircraft landed out of this approach without further incident.

Following is a list of malfunctions which occurred during the flight:

- Pitchup horn blew constantly.
- Gear horn blew constantly.
- Unsafe gear light in gear handle indicated unsafe throughout the flight.
- Attitude gyro tumbled and OFF flag came down.
- Heading indicator 180 degrees out of phase.
- Electrical fumes in the cockpit.
- Anti-skid light illuminated and stayed on.
- Wing flap circuit breaker popped.
- Main gear varied between safe and unsafe.

Investigation disclosed that a duct assembly for air bleed pressure (insulated) was misaligned with an insulated high pressure bleed duct assembly, causing leakage of sixteenth stage air into the area around the duct. A wire bundle lay across the top of the main duct. Sixteenth stage air heated the fiberglass duct insulation to such an extent that all the wires in the bundle had burned insulation, leaving bare wires clamped together. The wires were charred completely black and fusion was beginning to take place between several wires. Insufficient heat was available to trigger the fire warning system. Cockpit fumes were caused by the burning out of the exterior light control box. The following systems were affected by the burning of this wire bundle: anti-skid, exterior light control, flap limit switches, gear indicators, AFCS stabilator and aileron servos, landing gear door close limit switches, inboard door limit switches, gear selector, gear down limit switches, nose gear down lock limit switch, and gear comparison switches. No reason can be found for the tumbled attitude gyro, out of phase heading indicator, or primary hydraulic fluctuations, since these systems are in no way connected to the wire bundle.

Duct misalignment was traced to installation error during compliance with IF-101-926.

C-133—What do you do when the cargo door warning light comes on and remains on during flight? This happened three times and was written up three times. On the fourth time out, the inevitable occurred. The C-133 was climbing from FL 23 to FL 25 when the overheat lights on Nr 2 engine came on. The engine was feathered and return to base was begun with the aircraft cleared to 3000 feet.

As the aircraft passed through 6000, a loud explosion was heard followed by rapid decompression. A scan revealed that the left rear clamshell door was open and swinging in the slipstream and the right door was open approximately one foot. Moderate to severe vibration and severe buffeting were experienced throughout the approach to base.

Probable cause was that the door latch valve failed. As stated previously, three prior write-ups indicated the rear cargo door warning light came on during climb and remained on during flight. The discrepancy could not be duplicated on the ground. What do you do when write-ups such as these appear? Simple, you fix it.

H-43B—Following a training mission the helicopter was landed on the alert pad when the Fire Suppression Kit cover insulation blanket was lifted into the air and into the rotor blades. Damage was such that the blades had to be replaced. The detachment removed the Fire Suppression Kit cover when scrambled to avoid delay at the crash scene because the cover, when installed, does not permit free access to the hose and charging lever. Improper storage of the cover caused a hazard, as illustrated by this accident. The cover, incidentally, was some 30 feet away when whisked up by the rotor wash.

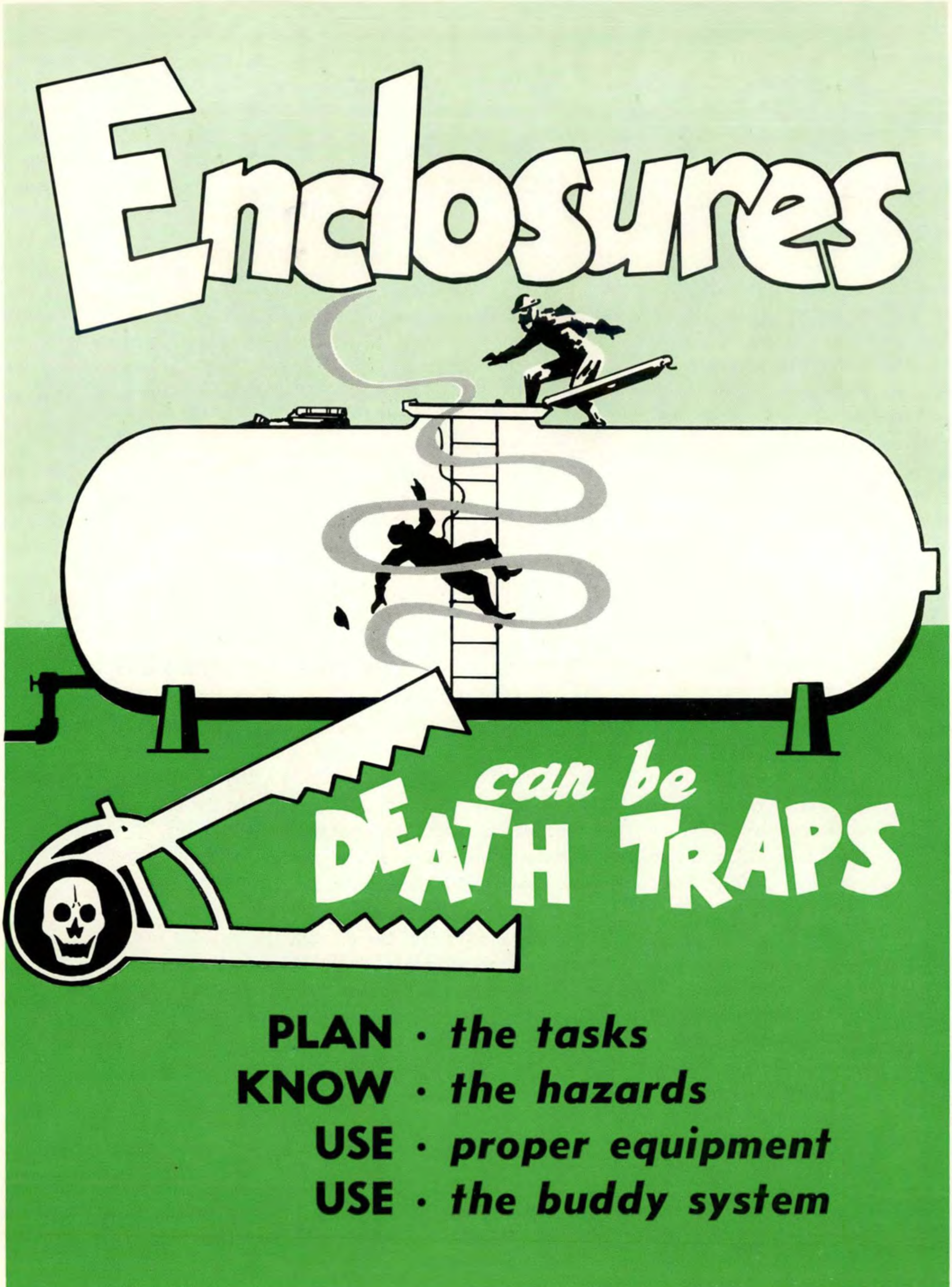
WELL DONE

Capt. Robert M. Bond

4520 Combat Crew Training Wing, Nellis AFB, Nev.

Capt Robert M. Bond, 4520 Combat Crew Training Wing, Nellis AFB, has received the USAF Well Done Award for his actions in the following emergency. Capt Bond began takeoff for a maximum range radar bombing mission in an F-105D that was equipped with three tanks on the external stations and a BDU-8/B training shape in the bomb bay. As he rotated the aircraft during takeoff, the control stick began to vibrate violently from side to side. His first thought was that the autopilot was malfunctioning and he immediately actuated the emergency disconnect. This had no effect, and since the aircraft was well above refusal speed and rapidly approaching the end of the runway, Capt Bond jettisoned the external tanks and got the aircraft airborne. He found that he could not move the ailerons, but that by using the rudder he had very limited lateral control of the aircraft. He decided not to eject before he maneuvered clear of populated areas. As the aircraft accelerated and changed attitude, he found that he could move the ailerons by exerting heavy pressures on the control stick. After some experimenting, Capt Bond found that he could control the aircraft sufficiently to execute a safe pattern and landing. Investigators found that the BDU-8/B training shape in the bomb bay had shifted and pressed against the aileron bell crank when Capt Bond changed the attitude of the aircraft during takeoff. This condition was not detectable when the aircraft was on the ground in a three point attitude.

Capt Bond's superior appraisal of and reaction to a serious emergency prevented damage to private property and possible death or injury to civilians residing near the air base. In addition, he saved a valuable combat aircraft. Well Done! ★



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