EPTEMBER 1959

FLYING SAFETY

UNITED STATES AIR FORCE

APPROACH and TOUCHDOWN

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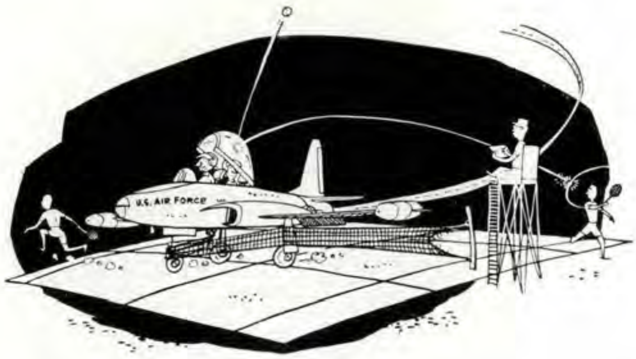


Let Ball!

THE EDITOR'S VIEW • • •

The regular reader of this magazine will recall that The Checklist feature first appeared in the July issue of this year. The editors intend that it will be a regular item if valuable and timely information can be found. So far, the information has come largely from the files and desks of DFSR; we hope it has been found interesting and useful. It is admittedly a catchall page, a sort of wrap-up of short items which, though important, are not of sufficient import to be expanded into full articles.

It is not possible or probable that all valuable bits of safety information will end up in the offices of the DFSR. Many find their way into base or command fly safe publications. This is good, but it seems wasteful to pass up the opportunity to feed some of it to the agency which can, in turn, give it to the largest possible audience. At this printing, 46,000 copies of *Flying Safety Magazine* go all over the world. Our readership is estimated to be over half a million. Naturally, the editors feel their responsibility to this audience and wish to fill the pages with stories, hints or suggestions which will save lives. We ask, then, that our readers contribute items, however small, to the magazine for use within The Checklist (Page 20). Pass the word, and thanks.

The 42nd Air Force-Industry Conference will meet on the 9th of this month at the Biltmore Hotel in Los Angeles. The subject under discussion for this meeting of the regular bimonthly gathering will be Missile Safety. A banner turnout has already been indicated. The first of these conferences was held in January, 1954, when 21 conferees met to discuss aircraft fuel systems and their relationship to aircraft accidents. Since that time, the response and attendance has grown until now an average of over 200 leaders in the Aircraft Industry and the Air Force show up for the valuable exchange of ideas and views. At most meetings, Canadian industry and the RCAF also are represented. Four hundred persons are expected to be on hand for the discussion of safety in missile operation. Experience has shown that the meetings are invaluable as a means of enlisting the aid of industry in the USAF battle to reduce the aircraft accident rate. FLYING SAFETY wishes to thank and commend the conferees for their interest and help.

FDH

CROSSFEED
LETTERS TO THE EDITOR

Setting the Record Straight

The "Follow the FSO" article (August) is indeed a day in the life of Capt. Joseph McClure, FSO of the 6041st Air Base Group. Capt. George Jensen, also shown with Captain McClure in picture number one, is a pilot and FSO of the 6000th Operations Squadron. Sorry if we confused you.

★ ★ ★

Turnpike Gazettes

The article, "More Chart Chatter," (FLYING SAFETY, March) is indeed informative. At least it explains some of the problems the chartmakers face. However, there are several problems arising from the new Flight Information Publication Enroute—Low Altitude Charts that seem, to me at least, disgustingly ridiculous. Have the people who dreamed up this nightmare ever flown a T-33 at night (alone) at 38,000 feet, about 10-15 knots below the mach limitation, and attempted to fumble through this maze of rabbit-eared "turnpike gazettes" while flying the bird with one's knees and holding a flashlight in the mouth?

It has always been easier for me to "fly off the map" and turn a page in a neat (but old-fashioned type) Radio Facility Chart, than it is to unfold and fold several gazettes.

In order to close with one bouquet for the charts instead of the multitude of brickbats they deserve, I would like to say that the "Terminal Flight Information (High Altitude)" -3 volume booklets are the "most." Congratulations are definitely in order!

Capt. Charles E. Woods, USAF
Langley AFB, Va.

★ ★ ★

Inadvertent Gear-Up Landings

Headquarters Airways and Air Communications Service has always supported USAF programs for the prevention of gear-up landing accidents by requiring our controllers to issue gear-down reminders to pilots of landing aircraft. We perform this extraneous air traffic control function as an aid in decreasing this type of aircraft accident and, despite the fact that FAA never has accepted this practice, we intend to continue issuing gear-down reminders to landing aircraft.

However, as a result of this practice, investigating boards have repeatedly held AACS control personnel as contributing to aircraft accidents involving inadvertent gear-up landings. Accident investigating boards appear to have interpreted the practice of issuing gear-down reminders as a controller responsibility for determining that the landing gear is down. In a gear-up landing accident involving a T-33 aircraft at Sewart AFB on 9 November 1958, the tower controller issued gear-down reminders to the pilot. Despite this, and the fact that controllers are not responsible for the landing configuration of the aircraft, the tower controllers were assessed as a contributing cause to the accident.

In the numerous aircraft accident reports we have reviewed at this headquarters, it has become apparent that many investigating boards and/or reviewing agencies fail to pinpoint basic responsibility. The above case of the air traffic controller's being assessed as a contributing factor is such an example. This type of investigation degrades the purpose of the accident investigation program and precludes positive corrective action.

AACS controllers will continue, as in the past, to use every means at their disposal to prevent inadvertent gear-up landings. It is requested that you point out that determination for the gear-down position rests with the pilot and that air traffic control personnel will not be assessed as contributory factors to gear-up accidents. May I suggest that you so inform the major air commands so that they can advise their accident investigating personnel. I feel that if our position is accepted and made a matter of USAF policy this approach will more accurately focus attention on the real cause for gear-up aircraft accidents.

Maj. Gen. Daniel C. Doubleday, USAF
Commander, Hqs AACS

Thank you, General, for your letter. Headquarters USAF has notified us that major commands will be furnished the details of your suggestion through TIG Brief No. 14.

From Viet-Nam

Thank you for helping us get a flying safety program going over here in Viet-Nam.

Our new mailing address:

Senior AF Advisor
APO 143 Box 26, San Francisco

Glad to be of help!

★ ★ ★

More on Guard Channel

I sincerely hope that the letter "Guard Channel" by Colonel O. B. Steely, USAF, in the July issue will be the opening shot of a battle that will continue until the abuse of 243.0 mcs has completely ceased. Actually, he has only scratched the surface of a real problem which should be blasted wide open.

By the very nature of its mission, the Coast Guard monitors guard channel UHF (and VHF) perhaps as vigilantly as any other service. Having been assigned to Search and Rescue units for the past 15 years I feel qualified to express some opinions on this matter.

One of the recognized means of drawing attention is to make oneself unpopular. This I shall do forthwith.

The frequency 243.0 mcs has often been referred to among SAR pilots (not in public, of course) as "Air Force Tactical." Now, before you other service pilots, Coast Guard included, sit back and chuckle, you are just as bad, percentage-wise. All of our Armed Services are composed of a cross-section of good, red-blooded American boys with the same attributes and shortcomings. So if the Air Force commits a greater number of transgressions on 243.0, then it is only reasonable to assume that it is because they are greater in number of personnel.

Colonel Steely's main complaint appeared to be with regard to excessive "checking on guard channel." I concur wholeheartedly with this assertion but there is more, much more! Even more serious, in my opinion, are such misuses as continuous chatter during gunnery runs and similar exercises; *practice* GCA approaches, and IFR clearances and read-backs. I have personally been witness to the foregoing on numerous occasions. If the only air-ground frequency available is 243.0 mcs, then there is only one place an IFR pilot should go: *back to the line.* Tower operators who aid and abet such practices are just as guilty but perhaps less responsible than the pilots.

Many times in recent months when hearing obviously indiscriminate use of 243.0 while flying, I've called the offender, identified myself as an SAR aircraft, and asked if I could be of any assistance. This, I thought, was being tactful in making my point. I've gotten just about every manner of reply, from "sorry, I didn't realize" to, in effect, "mind your own business." Keeping guard channel clear for its authorized purpose *is* my business, in part, and I intend to continue my efforts toward this end even though I may appear obnoxious to some jockey who has just put 15 holes in the sleeve and wants all of his pals to know about it. I wonder how many of our aircraft have disappeared without a trace because some meathead had 243.0 blocked while one of his fellow pilots was trying to get off a "MAYDAY" as he was pulling the curtain. This makes it pretty tough for the AA Board to come up with recommendations on how to prevent similar occurrences.

If you are still with me, let's shift to the constructive approach. Colonel Steely's recommendations are definitely worthy of consideration but may I humbly suggest that corrective measures *not* be confined to the Air Force? Perhaps the boys at Fort Rucker, Norfolk, Norton and Flight Safety Section COGARD, Washington, will throw their forces into the fray.

Until such time as every pilot can sit back and say honestly, "I have not made misuse of 243.0 mcs," gentlemen, there is work to be done.

Cdr. Chas. E. MacDowell, USCG
Chief, Search and Rescue Sec
11th Coast Guard District, Calif

★ ★ ★

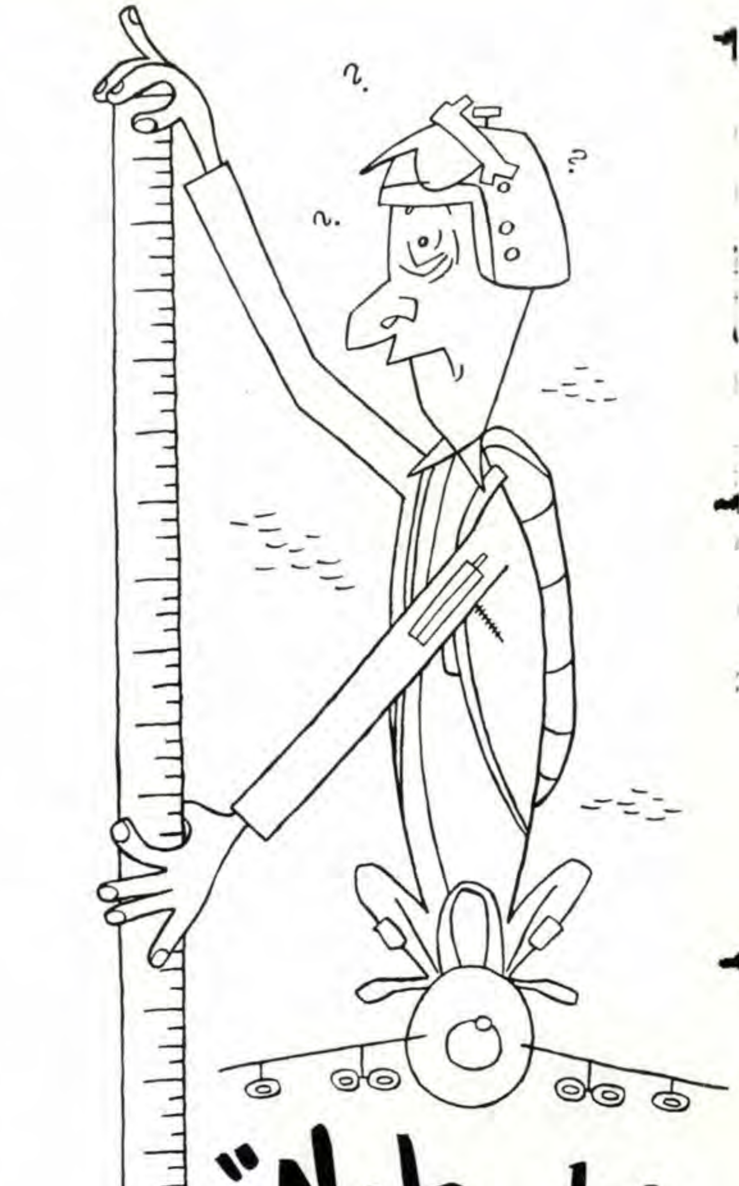
From Scotland

This refers to your article "Come Home to Mama" in the June issue of FLYING SAFETY. I should like verification of the statement, "You will not freeze to death while sleeping. Getting chilly will wake you up."

I've always been under the impression that it is very dangerous to fall asleep when the temperature is well below freezing.

Capt. Wallace L. Emory
1631st AB Gp (MATS)
Prestwick Airport, Scotland.

Once warm and sheltered, sleeping is OK; getting chilled awakens you. If already chilled, without shelter, falling asleep may be fatal.



"Nobody Knows How High I Am."

Altimeter problems will not all be solved quickly or easily, but the real bug-a-boo, misinterpretations, can be erased by one of several methods. An early acceptance of one method will save many lives. Meanwhile . . .

● ● ●

The B-47 pilot reported about 35 miles north of the range station at 28,500 feet and requested a radar monitored jet penetration approach. His request was granted and in a few minutes he was on his way down, reporting that he was leaving 27,000; at 20,000 feet he began his penetration.

His call was acknowledged and he was asked to report leaving 10,000 feet at a fan marker. No other transmissions were received from the B-47, and at 0130 of a dark night, a great ball of fire was seen to the southeast of the base. Simultaneously, the IFF beacon was lost on the radar scope and the rest of the night was spent in the sad task of picking up the pieces.

The findings of the accident board include, along with operator-crew error, the statement that "it is possible to set the altimeters currently in use, 10,000 feet in error with the pressure reading in the Kollsman window at exactly the same setting as a properly set altimeter, and that the altimeter presently in use in high performance aircraft is difficult to read and easy to misinterpret under night or instrument conditions." The board then did consider, and rightly, that such a missetting could have been the reason for the loss of this B-47.

The parent wing of the B-47 then submitted an urgent action UR on the present aircraft altimeter, recommending that: ". . . positive 'stops' be incorporated which will allow use of full range of current pressure readings, but will preclude manually moving the altimeter beyond these settings."

The Aircraft Accident Board further recommended that a priority study be initiated by the Directorate of Flight Safety Research and Air Research and Development Center to develop a positive indicating and logical presentation type altimeter compatible with high performance aircraft maneuvers.

In April of this year another B-47 took off for a formation mission. Takeoff and join-up were accomplished without incident. After approximately one hour of formation, a visual letdown and rendezvous was made with a KC-97 aircraft for refueling. When refueling was completed a climb was established to 30,000 on the pilot's altimeter, power was reduced and the B-47 leveled off. At this time the Instructor Pilot in the rear seat saw that his altimeter was reading 20,000 feet. A crosscheck of the three altimeters aboard disclosed that the aircraft commander's altimeter read 10,000 feet higher than the other two. The mission was then completed without incident, using the copilot's altimeter.

Investigation after the B-47 landed turned up no evidence that maintenance had been done on the altimeter prior to flight. The altimeter in the aircraft commander's position must have been turned up 10,000 feet on the ground by an unknown person and this was not noted by the flight crew during preflight. This incident lends more credence to the belief that the crash narrated above could have been caused by the same error. Altimeters that can be misread by such a margin leave much to be desired.

Now here's a little gem. During a routine navigation flight in 1958, a T-33 pilot with passenger arrived at his destination, a midwestern field, and was cleared for penetration. Reported weather was slightly above published minimums and our pilot started down from what he thought was 27,000 feet. GCA had been contacted and two unsuccessful runs were made. During both attempts GCA had had no target on the precision scope. Now our boy tried a TVOR approach with radar assist. This, too, was no good. Somewhat desperate by now, the T-33 was flown to the nearby municipal airport and an ILAS approach was tried. Again foiled, the pilot climbed to what he thought was 7000 feet and he and his passenger used the next-of-kin switch and a nylon letdown. As you can suppose there was no fuel left for a try at the alternate.

A review of the taped transcript between T-Bird and radar control revealed that the pilot reported he was at 700 feet indicated during one point of the landing attempts. Since this was about 124 feet below the ground elevation at the military base and 300 feet below the ground elevation of the municipal airport, it was apparent to the accident board that our boy was misreading the altimeter. (The pilot stated later that he thought he must have been in a valley!) According to the pilot and passenger it took them about 10 minutes to descend from "7000 feet" in their parachutes. About 17,000 feet would be more like it for this time interval. Small wonder that the precision scopes never picked up the target. This pilot had never at any time come much closer than 10,000 feet to the ground. Rather hard to break a minimum ceiling from that altitude.

There are at least three problems associated with current altimeters. The first relates to the lag in presentation which results in the pilot being deprived of precise altitude information during some critical portions of flight.

The second deficiency inherent in the standard 3-pointer Air Force altimeter relates to the design which permits inadvertent pre-setting so that an erroneous reading of 10,000 feet can be obtained.

The third deficiency relates to the complexity of presentation, which is conducive to misinterpretation. This particular problem was recognized by the Air Force as early as 1947 when the long time required for reading and the possibility of error were factually established.

That the altimeter problem is still current is emphasized by the fact that during the period from 1 January 1953 through 31 December 1958, there were 33 accidents in which various deficiencies of the altimeter were either proven or suspected to be pertinent cause factors. These accidents resulted in the destruction of 35 aircraft and fatal injury to 53 persons. In addition, one other aircraft received major damage and an additional 27 persons received less than fatal injuries. Estimated dollar cost of hardware was $17,800,000. (A person could live fairly comfortably on a 4 per cent return from that amount.)

On 1 April of this year, the Directorate of Flight and All-Weather Testing, Wright Air Development Center, completed a new series of flight tests with the AAU-5A drum-pointer altimeter. During the tests, the drum-pointer was installed on standard production trainer, fighter, cargo and bomber aircraft, and the presentation and performance of the instrument was individually evaluated by 51 highly qualified test pilots during 170 flights and 725 hours.

The drum-pointer altimeter is comparable in size and weight to the present standard altimeter. Basically, this altimeter has two main display elements. The main circular dial uses a pointer to indicate divisions of less than 1000 feet. The 100- and the 50-foot divisions are marked. At the three o'clock position, a vertical drum is visible through a vertical slot on the main dial. Indications of thousands of feet are provided by the drum. The display principle is that of a moving scale, fixed pointer type. Presentation of the barometric pressure is accomplished by the use of a four digit Veeder counter with direct readout at the six o'clock position on the main dial.

The drum-pointer altimeter, in the configuration and the presentation tested, was found to be inferior to the 3-pointer altimeter now in use and unacceptable for general Air Force use. (The drum-pointer installed in the B-52G is being retrofitted with the standard altimeter. This is progress?) It admittedly does away with the 10,000-foot reading error, but introduces a 1000-foot reading error which is especially dangerous at low altitudes.

It also requires the pilot to give it more attention by having to monitor it very closely to be certain that the altitude he is flying is the one received verbally or noted visually during GCA or ILS patterns. This is definitely one of the biggest disadvantages, i.e., too much time is involved in reading and interpreting the information presented. Additionally, the requirement to read two types of displays did not appeal to the majority of the pilots. This was not consistent with the requirement to simplify the instrument display in high performance aircraft. Therefore, the disadvantages of the instrument outweighed the advantages by a wide margin.

Among the latest altimeter developments is the Model R Servo Altimeter, which is a product of Bulova Research and Development Laboratories, Inc. The main feature of the Bulova Altimeter is its readability. The altitude is read from a section of tape scale bearing large, clear figures. The total length of the tape is approximately 40 feet.

At sea level the numbered graduations are separated a full inch for each 50 feet of altitude. At 20,000 feet the numbered graduations mark each 100 feet; at 40,000 feet the graduations stand for 200-foot increments, and from 60,000 feet up, the increments are of 500 feet each. (There are smaller, unnumbered graduations dividing each of the major segments throughout the tape.) This tape presentation supplies the greatest readability and accuracy where most needed—at lower elevations and landing altitudes.

The tape is driven past a window by a servo motor, following the true altitude during climb or dive without fluctuation or hunting and without the necessity of tapping the case. Bulova claims that under these conditions, altitude is indicated with an error of less than 10 feet at sea level. The sensitivity is such that raising or lowering the altimeter as little as two feet will give a visible indication on the scale at sea level. As for accuracy, Bulova claims that when the instrument is taken from sea level to a height of 100,000 feet and then returned to sea level, the error will still not exceed the original

Pilot's view of Bulova altimeter showing tape method of presentation.

10-foot tolerance mentioned above.

The design principle constitutes a departure from conventional practice. The altimeter's sensing elements are aneroid capsules and the output of the sensing elements is transferred electrically to the indicating mechanism, the calibrated synchronized tape scale, thereby freeing the sensing elements from mechanical work. According to Bulova, "the consequent elimination of friction has produced a sensitivity of a previously unknown order. This permits the capsules to develop their inherent accuracy to the fullest." The fully transistorized servo amplifier assures stable performance over the wide range of ambient conditions encountered in aircraft operations. Acceleration effects are eliminated by reverse phase signal to the transistorized amplifier from an additional set of coils and rod armature.

As for general specifications, the Model R has a nominal altitude range from −1000 to +100,000 feet; a barometric setting range from 28.00 to 31.00 inches Hg; a weight of 4.9 pounds; and its size is 3½" x 3¼" x 8½" plus connectors.

During a six-month period, engineers of the Bulova Research and Development Laboratories conducted tests to compare the reading time required and the number of errors committed in reading the Bulova altimeter, as compared with a typical pointer-type altimeter.

Of 241 readings made with a Bulova altimeter, 8 resulted in error, an error percentage of 3.3. Of 235 readings made with the conventional type altimeter, 129 resulted in error, a percentage of 54.9.

The average reading time for tests with the Bulova instrument was 3.4 seconds. With the older type, reading time averaged 7.3 seconds. Included in the test group—in addition to pilots, experienced instrument engineers and technicians—were people with no instrument experience whose errors, of course, affected the percentages. When a group composed exclusively of pilots read the Bulova instrument, the average reading time was considerably faster than the 3.4 figure given for the mixed group.

The tests previously mentioned were made in the laboratories. The Bulova altimeter is being tested in flight, as well. It has been installed in a Boeing 707 commercial jet transport, KC-135 Air Force jet transport/tanker, YC-97J Air Force turboprop transport, Convair C-131 Air Force transport, Douglas DC-8 commercial jet transport, C-133 Air Force turboprop transport, Lockheed Electra turboprop commercial transport, F-104 Air Force jet interceptor, North American F-100F Air Force jet fighter-bomber, and a Beech Model 18 executive transport.

Reaction to the Bulova instrument by the men who have flown it has been consistently good. Mr. A. M. "Tex" Johnston, Test Pilot for Boeing Airplane Company of Seattle, says, in part: "Readability of the instrument (in the 707 prototype) is very good. The possibility of ambiguous readings is greatly reduced compared with presently used altimeters . . . The sensitivity of the instrument is such that altitude changes of 5 to 10 feet are readily detectable . . . The presentation requires very little adaptation by the pilot. It seems quite natural to 'fly toward the number.'. . . The behavior of the instrument was observed during a descent of 6000 fpm indicated, from 35,000 to 15,000 feet. The readability of the instrument during the descent was satisfactory and it is felt that much larger rates of descent could be accomplished with no difficulty."

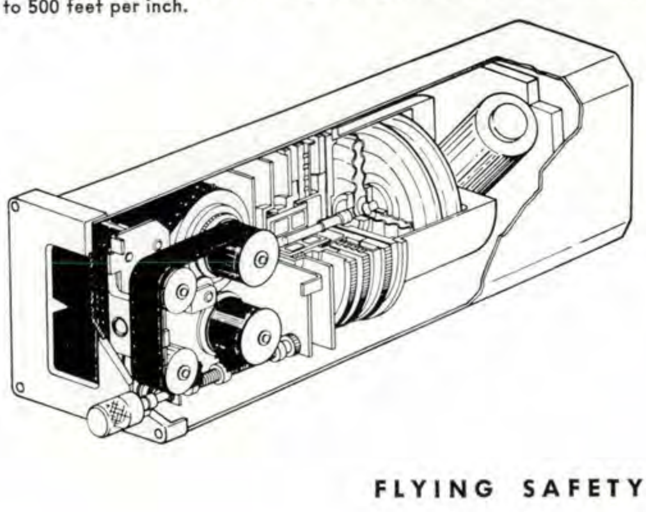
Mr. A. W. "Tony" LeVier of Lockheed, says: "It (the altimeter) has been cause for many aircraft accidents, and I can remember a few times when I missed reading the correct altitude. Your new altimeter should be extremely useful in flight test aircraft as well as regular military or commercial types."

All, of course, is not perfect in this new instrument. One of the primary objections is that the altimeter is electrically powered and would be inoperative with power failure. Two things then are needed here: one, a fail-safe indicator and the other, of course, a provision for an alternate source which would allow the instrument to sense directly from the atmosphere in event of power failure.

Fighter pilots wonder if the altimeter will be readable in high speed dives, or if they will see a blur as the tape goes by. If the tape does move too rapidly to be seen, a companion window with another tape showing larger increments of altitude moving more slowly might be in order.

According to its representative, Mr. Jack Conroy, Bulova has considered these objections and can surmount the difficulties with minor modifications. Large aircraft

Cutaway of Bulova altimeter showing basic parts of instrument which include (left to right) altimeter windows, barometric correction knob, and tape drive; servo motor and acceleration compensating mechanism; three aneroid pressure capsules; and the pitot tube connection. Tape is 40 feet long with gradations varying from 50 to 500 feet per inch.



can, of course, have back-up altimeters for emergency use. The smaller birds are already pinched for space and must have an instrument comparable in size to the present one and it must be fully reliable in itself.

Wright Air Development Center recently made a preliminary evaluation of the Bulova Altimeter. The instrument was flown and evaluated by 11 pilots of the Fighter Operations Branch during 51 hours of flying in the F-100C. From this evaluation it was concluded that:

- It had no fail-safe capability.
- It was not compensated for position error.
- It is easily read in all modes of flight except during very rapid changes of altitude.
- The barometric setting window is too large and too many turns of the knob are necessary to set the barometric pressure.

If the Bulova tape altimeter is considered for Air Force use, it is recommended to the Flight Control Laboratory that the altitude window be larger in size; that the instrument have fail-safe and compensating capabilities, and that no final decision be made until an evaluation is completed in aircraft types other than fighters. (Twenty-five instruments have been ordered by WADC and most of them will be field tested by the various commands.)

Most of the evaluation was conducted on local test flights. The majority of the pilots felt that the instrument provided altitude reference quickly and with a minimum chance for error. Few reading errors were made. About 50 per cent of the pilots experienced some trouble reading the tape during high rates of descent but felt that it was adequate. Seven pilots liked the scale without qualification and the other four had divided opinions. Two of these four pilots felt that the scale was too large and that the instrument was too sensitive for an altimeter which is not compensated for position error.

The altimeter was evaluated in all types of flying, including climb, descent, small altitude changes, climb and descent in high G turns and flight turbulence. Some jerkiness was noted on the first few flights, but this apparently cleared up and was not noticed again. No oscillation was noted during any of the flying. A 3000- to 4000-foot lag was experienced in the extremely high rates of ascent (approximately 35,000 fpm) used in the LABS maneuver. This lag prevented proper level off at a predetermined altitude. The instrument tested is not capable of being compensated for static source position error and a new development program would be necessary to equip the Bulova altimeter with this capability. Compensation is now considered essential in most late model aircraft because of the large position errors at the higher altitudes and speeds.

An English company, Smith's Aircraft Instruments, Ltd., has come up with an altimeter which is similar in principle to the Bulova model. Movement of the pressure sensitive element in the rear of the case actuates the armature of a light electro magnetic pick-off. This contrasts with the conventional altimeter where the pressure sensitive element has to drive the complete linkage and gearing to the presentation.

The electrical output from the pick-off is fed into an external amplifier, the output of which feeds a motor within the altimeter. This servo loop enables a linear drive to be taken from the motor to operate the counter system, which registers height up to 99,950 feet in 50-foot steps, and a pointer which registers 1000-foot changes in height per revolution.

Pilot's view of Smith's Altimeter showing window and pointer system.

The method of indicating thousands of feet by the two large flourished numerals in the windows of the dial makes a mistake of 10,000 feet in altitude reading virtually impossible, according to the manufacturers. The large sweep hand revolving once per thousand feet provides an ideal presentation in their opinion.

The readings of this pointer are duplicated in 50-foot steps by smaller green colored numerals on the altitude counter presentation. The sweep hand should not significantly obscure the large counters which point out the thousands of feet. Ground pressure is set by a knob which operates counters covering the range 800 to 1050 millibars. Movement of the setting knob operates a sliding worm shaft differential mechanism between the indicating mechanism and the pick-off element. A signal is thereby fed to the amplifier and hence to the motor which rotates until a null signal is reached. In this manner the altitude indicating counters and pointer are moved in accordance with the ground pressure scale adjustment.

Three small windows in the upper part of the dial exhibit the word "Off" in the event of failure of the electrical supply. Temperature compensation is incorporated by means of a bi-metallic linkage between the capsule and the "I" bar. Compensation is adjustable over the height range and gives temperature correction from $-20°$ C to $+50°$ C.

The Smith's altimeter with amplifiers weighs 10.125 pounds and the instrument itself is housed in a $3\frac{1}{4}''$ S.A.E. case. As far as can be checked, WADC has not yet evaluated this instrument but DFSR has asked that this be done. Further information on this altimeter will be passed on to the reader as it becomes available to the editors.

It is widely acknowledged that altimeter problems resulting from supersonic speeds and great altitudes are not to be solved easily. But it is not at these altitudes and speeds that altimeter errors are killing pilots today. We are still losing pilots because of altimeter misinterpretation close to the ground, either in letdowns or final approaches. The old 3-pointer system is known to be confusing and it seems only sensible that a simpler, easy to read presentation be adopted while the technicians are working out the other problems. How long must the pilot's refrain continue to be—*"Nobody Knows How High I Am!"* ▲

Wherein C. Z. introduces a Second Lieutenant to the joys and hazards of cross-country flying. All, of course . . . . .

Without Incident

Archie D. Caldwell, Operations Analysis Branch, DFSR

The paper work had all been taken care of, even to the important point of advance per diem. Everything was in readiness. The two recently modified Century jobs were to be flown from the overhaul facility back to the base.

The operations and maintenance officers were in good spirits. The overhaul boys had completed the work ahead of schedule, the sun was shining, "happy hour" at the club that night, and the accident rate was zero—had been for a year! What could be better?

The ops phone interrupted the pastoral scene.

"Base operations, Major Shaw here What? . . . Yessir . . . They're ready on the coast for us to pick 'em up . . . He did what? . . . Yessir, but . . . Yessir, but couldn't we? . . . Maybe we could get someone else? . . . Yessir . . . As you wish . . . thank you . . . 'bye."

The maintenance officer noticed the look of stark terror on Shaw's face.

"Who was it, Bob? You look like someone whose income tax return is being looked at by the T-Men."

"It was the Colonel, Steve. He's got bad news. He broke his ankle water-skiing over the weekend."

"The Colonel?"

"No, knucklehead, Captain Hambley broke *his* ankle and won't be able to pick up the airplanes."

"That's not so bad, Bob. We can get an IP from one of the squadrons. No sweat. Besides, it'll be good training for that new young sport who just joined us, getting to go along with one of the old hands. Do him good. I'll call the Colonel . . ."

Major Shaw put a restraining hand on Steve's arm.

"Nice try, old friend, but we're in deep serious trouble. The old man's already picked a substitute."

"You don't mean . . . ?"

"Who else?"

The operations sergeant paused and walked to the door of the operations officer's office. "That's funny, Hazel," he said to the steno, "I could swear those two in there are crying."

Captain Chauncey Z. Chumley filled out the flight plan with a flourish, and handed it to the ops clerk. As the clerk was making corrections, Chaunce studied the bright-eyed second lieutenant, who appeared to be a bit bewildered by the whole program.

Chaunce smiled and put a paternal hand on the Lieutenant's shoulder.

"First time retrieving machines from facelifting, lad?"

"Yessir Captain, I just finished flying school last March, got my field checks in okay and my transition all finished up. My squadron commander thought that a supervised cross-country would . . ."

"And he's right, lad, dead right. You just stick with your old dad here and you'll find that the world is your oyster. I've got a black book that's unequalled anywhere in this man's Air Force. And I am a bit famous, even if I do say so. You'll note that I always carry my hard hat wherever I go. And the flame-red flight suit and the polka-dot scarf. Yessir, every inch an aviator. But, enough of this prattle, laddy-buck, what say we crank up and get those birds into the blue."

"Okay, Captain, you gonna brief me now or wait until we get out to the aircraft?"

"Am I going to do what?" Chaunce looked askance. "Listen, son, you're out of flying school now, boy, you're on your own. You just follow old master here and do what I tell you. No need for briefings when old Chaunce is your leader. If anything comes up that's out of the ordinary, I'll brief you in the air. You're first balloon material, boy, you mustn't concern yourself with trivials."

The departure was uneventful, with the exception that C.Z. copied the clearance improperly, took off with the speed brakes extended and cleared traffic in the wrong direction. Once airborne, the flight went smoothly with the new lad leading every other leg and C.Z. flying a sloppy wing position. At the three-quarter point lightning flashes were observed ahead and to both sides of the intended course. The old 'pro' calmly assumed the lead and gave his wingman a complete briefing: "Stick close at hand, lad, those are cumulo-bumpus. A chap could get hurt up here"

They hit the dark clouds earlier than C.Z. intended, for he was caught with his head in a sleeping swan position trying to find the frequency of the nearest GCI station when the bottom fell out.

"No time for frequency finding now," he said to himself. "Best thing to do is to try and keep up side right."

Chaunce forced his feet back to the rudders, tried to pick out the instrument that was moving the least, and finally settled on the attitude indicator. He managed to right the fighter and find the mike button all at the same time.

"Hey there lad, how you doin'? Just stick close to me and we'll be out of this before you can say . . . Yipes!! Did you see that other machine? The idiot just missed us."

"I think that was my airplane you saw, Captain." The Lieutenant's voice was strained but not to the point of panic. "I'll continue on course and maybe we can break out on top."

"No. No. Don't do that. No, No." C.Z.'s voice sounded like doom itself. "No, take a heading 10 degrees to the right. I'll turn 15, no 10 degrees left. Right? And you're left for a heading of 15 degrees, right?"

The new boy sounded calm and collected. "I'm on top now, sir, we were right below the tops. Are you climbing through it?"

Chaunce's aircraft came roaring through the mist in full afterburner, a scant hundred yards from his wingman on a collision course. "Through superior airmanship," as C.Z. described the incident later, a midair was avoided.

Arrival over the home station was uneventful with both aircraft in the clear on top. Standard penetration with a GCA pickup was requested and approved. In another six minutes Chaunce could be headed for the club. The two ships in tight formation entered the undercast at an alarming rate of descent as C.Z. fumbled with the letdown diagram. The Lieutenant stuck like glue to the wing position. He had found out the hard way that it was far safer to stay where he could watch his fearless leader.

"Penetration turn coming up lad. How are you doing on fuel?"

"Enough for the approach and maybe one go-around but that's about it. Can we make it a full stop out of the GCA run?"

"Oh very well. I had planned for a fast pass and tight overhead but if you don't think you've got enough fuel we can make it a . . . "

The painting on the side of the truck was unmistakable—BEKINS. It was passed in a flash and a barn hove into view. The world's greatest aeronaut quickly analyzed the situation, split the difference between the ground and the base of the overcast and cancelled his GCA run.

"Well done, lad. Good formation. Must have an altimeter that's a little haywire in this machine. Saw the ground just before passing through one thousand. No sweat now though, the strip is dead ahead. Take your spacing boy, and follow me!

Both "birds" touched down smoothly and were taxied to the line and shut down. C.Z. was out of his bird before the RPM dropped below 15 per cent and leaped onto the Lieutenant's wing.

"Now we won't say anything to anyone about *our* little incidents today during the thunderstorm penetration and the letdown. Don't want anyone to know you lost sight of the leader now do we? You know how gossip gets around and besides, it might affect your promotion to first balloon. One hand washes the other, heh, heh!"

"But Captain, I wouldn't have lost you if you hadn't made those abrupt changes in attitude and altitude and if we had had a prearranged plan on separation. And planning your course through a severe weather area didn't make things any better. And on the letdown, I'm sure that you must have just . . . "

"It's all right lad, I won't tell a soul if you don't . . . yes sir, a First Lieutenant before you know it."

"Okay, I'll go along with the gag, Captain, but if I ever get scheduled as your wingman again I'll break *my* ankle."

Inside base ops, the operations officer and the maintenance officer sat listening to Chumley.

"Are you sure nothing happened to either aircraft?" Major Shaw asked.

"Not a thing."

"Nothing unusual occurred. No violations of flight plan, no excessive radio chatter, no close calls?"

"Not a thing," replied Chumley. "Simply another magnificent example of man's mastery over the machine."

"You conducted an adequate briefing of your wingman prior to takeoff? Covered any unexpected occurrence?"

"No fear when Chaunce is near," C.Z. beamed. "I guess I'll just stroll to the club to get the trail dust out of my lungs. Coming Lieutenant?"

"Not right now sir. I'll be along in a minute."

The three stood watching as Chaunce strolled toward the club, helmet under one arm.

"Well Bob, I guess wonders will never cease, maybe he's finally learning."

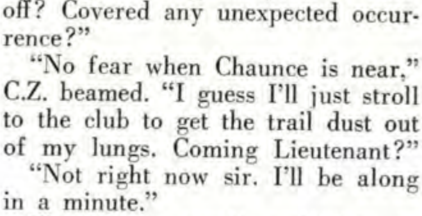
"Yep, looks like he made an uneventful flight and completed the mission without incident."

The two were interrupted by the Lieutenant who—until this time—had remained silent.

"Sir?"

"Yes. What is it?"

"Is it always this tough to make First Lieutenant?" ▲



One big problem in air traffic control is to squeeze the airborne traffic into the terminal areas . . . .

The Small End of the Funnel

Major General Daniel C. Doubleday, Commander, AACS., and Charles W. Antweiler, ATC Consultant.

It's been said that the most critical phase of flight is the approach and landing. This is open to argument. There are some who contend that with the later types of jet aircraft the situation is critical from the time the pilot files a flight plan until he has completed the mission and settled his nerves with a couple of martinis. At any rate, the approach and landing sequence is the phase of flight that seems to introduce the most problems to the air traffic controller. We can easily see why this is so.

To use a simple analogy, the approach and landing phase of flight represents the small end of the funnel which has been filled by aircraft arriving from every direction. Until reaching the terminal area, each aircraft, if IFR, is protected by an enormous cocoon of airspace. Each is happily aware that no other IFR traffic is permitted closer than 1000 feet above or below him, or, generally speaking, closer than 10 minutes flying time ahead or behind him.

Many such widely spaced aircraft are converging on a single point in space and each proposes to land as soon as possible on a single tiny strip of concrete a few hundred feet wide and in the neighborhood of 10,000 feet long. Several things must happen in order for as many aircraft as possible to land on that strip in the shortest time period.

More precise navigation is demanded in the terminal area. The flight path is carefully controlled and firm discipline is exercised among the aircraft involved. Because of the more careful adherence to greatly reduced tolerances in navigation and timing, the cocoon of protective airspace can be reduced to a bare 3 miles of radar separation in the terminal area. This means that an aircraft is landing on that tiny strip of concrete every 1½ minutes, give or take a few seconds.

Anyone familiar with the volume of today's air traffic can easily see that a 1½ minute interval is not sufficient to permit all of the aircraft to land at exactly the time they might prefer. The system has not yet been devised which will allow the small end of the funnel to discharge aircraft at the same rate the big end can accept them, particularly when departing aircraft must somehow be sandwiched in between the arrivals.

The landing rate is increased where possible, but with each increase in the landing rate there is a corresponding increase in the degree of precision required during the approach and landing maneuver. The landing interval is kept to the minimum commensurate with the degree of precision possible under the present state of the art. Any further reduction would introduce a risk not believed to be warranted in a peacetime situation.

If more aircraft are scheduled to arrive within a given time period than the minimum safe landing interval will permit, someone is delayed in order to establish that minimum interval prior to arrival over the approach gate. This delay may be effected by holding aircraft, either en route or in the terminal area, by planned deviation from the most direct route (path stretching), by speed control or by properly scheduling departures to make good a predetermined arrival time. All of these techniques are effective and are in daily use, but each has definite disadvantages. For example:

- Holding aircraft consume a great amount of airspace. The jet aircraft in a two-minute holding pattern at 30,000 feet has exclusive use of a segment of airspace just 3 square miles less than the area covered by the entire State of Rhode Island. Obviously, the controller can easily get into a bind by indiscriminate holding. He can quickly block avenues of departure and arrival to the extent that departing aircraft would be forced to remain at low altitudes for extended periods of time. We are told that a deviation by certain jet aircraft from optimum altitude results in a fuel penalty which amounts to something like 1000 pounds per hour for each 4000 feet of deviation from optimum altitude.
- Path stretching, while a very effective technique with

radar and quite necessary for fine grain adjustments in the terminal area, results in an extravagant use of a controller's time because it means an extra amount of attention to a single target. The controller takes over the job of navigating for the pilot. This is not desirable and should be avoided wherever possible.

• Speed control is somewhat less effective than either of the two techniques discussed above. While speed control is a standard and often used technique in terminal areas, it takes a large change in speed over a considerable period of time to produce a significant adjustment in arrival time over a predetermined point. To illustrate, adjusting the speed of an aircraft from 450 miles per hour to 400 miles per hour over a distance of 300 miles will alter the arrival time by a mere 5 minutes. Further, unless used with extreme care, the speed control technique gets pretty close to letting the controller fly the aircraft. Again, this is something the controller should try to avoid.

• Scheduling departure times to make good a desired arrival time is, likewise, a technique of limited value. It is difficult to apply because of the large amount of coordination required and at best will accomplish only a crude scheduling at destination with a certain amount of holding, speed control or path stretching still being required. Also, it puts the air traffic controller in the aircraft dispatching business, which is undesirable because of the other company business considerations involved in dispatching. It is through an application of this technique, however, that user agencies are in a position to help AACS tremendously and to help themselves by decreasing the air traffic jams that occur during the approach and landing phase of flight.

What I am about to propose will not gain popular support. It is certainly not the most desirable course of action, but until the landing rate can accommodate all aircraft without delay, each bit of relief is welcome.

Our trouble stems partially from the fact that there are a great many organizations and individuals who are operating on a 9-to-5 basis. I, too, favor regular, usual, and comfortable hours of operation, but only if they do not interfere with the proper conduct of the USAF mission.

Problems of separation at altitude are magnified in landing phase.

When the desired amount or kind of flying activity cannot be accomplished because of traffic jams which create intolerable delays, then there may be interference with our mission. The understandable desire of flying personnel to maintain bankers' hours is one of the reasons why more traffic is being concentrated into a shorter period of time than the air traffic control system has the capacity to handle.

I give you a factual example: At an overseas fighter base, AACS services were being criticized quite severely. The base had a history of incident reports involving near misses and excessive delays. The delays occurred both on the ground and in the air. An Air Traffic Control evaluation team examined the situation and found, among other things, that 82 per cent of the traffic at the base was handled between 0600 and 1800.

A more detailed examination revealed an evenly spaced repetition of periods of excessive delay to arriving aircraft. Delays occurred between 1030 and 1200 hours and again between 1500 and 1630 hours. Traffic jams during these periods resulted in several emergency landings from minimum fuel conditions caused by excessive holding. Peak periods were occurring simply because a large number of aircraft from the base in question and from two other adjacent bases were starting their flying activities around 0900 and were landing near lunch time; and following a 1300 takeoff, were getting back for the closedown of operations at the normal 1700 quitting time.

To repeat, I have no quarrel with the desire to maintain normal duty hours. It is only when my people must endure unwarranted criticism because individual pilots and/or flying organizations insist on maintaining a comfortable and convenient schedule that I must point out that the traffic jams and those delays during the final phase of flight are, to a degree, matters of the user's own choice.

The same corrective action called for at that overseas base can be applied, to some extent, to nearly every one of our operational USAF bases. In many cases, a simple revision of flying schedules will effectively reduce the traffic jams. Operators and pilots can, through more careful planning, arrange their departure time to make good a predetermined arrival time which will not coincide with the usual period of peak activity. While we are not suggesting that you do all of your flying at night, we can certainly offer the suggestion that if you are too concerned about excessive holding, or if you are worried about a possible collision with someone in an overly crowded terminal area, you can generally avoid it by arranging to arrive after five o'clock in the afternoon or before nine o'clock in the morning.

There are many among you who cannot adjust schedules because of particular circumstances and many others who will prefer to take a chance on the delay and the increased danger of collision in the crowded terminal area. To those I can only say, "Be alert." The problem is acute at certain locations. Only by being wide awake and by carefully observing all the rules can you increase the probability that you will stay alive to fly another time.

Tips for T-Bird Drivers

In 1956, the T-33 had 293 major accidents, 244 in 1957, and 164 in 1958. These figures are not quoted to impress you with how good we are at DFSR but rather to let you know that we do look at a few accident reports each year. As we look at these reports, certain factors become quite evident. In passing this information along, it is hoped that at least one of you will read and heed—and thus prevent just one accident.

Pilots are convinced that "it won't happen to me." These are the "seat-pin-leaver-inners," the "1200-mile-into-an-80-knot-headwind clearers," and the cruise climb experts with no pressurization. These are the overconfident types, with the low quarter shoes and no gloves. Maybe they're real religious; they sure have faith. You want to come take a look at our records? It can happen to ANYBODY.

Some pilots are careless. These are the "gun-bay-door-and oil-cap-forgetters;" the "pitot-cover-leaver-onners," and the "I-forgot-to-check-the-oxygen" types. Maybe a small part of this is ignorance or lack of knowledge, but if this is so, it's a very small part. Maybe these types are under the influence of a drug commonly known as "carelessness" or "complacency." It breeds from over familiarity. It's a dangerous drug, habit forming, a killer. There are too many users in the Air Force today but, take heart, the habit can be licked. It's real easy, too; just use the antidote, the checklist. If you want to read some "careless" type accident reports, we've got 'em.

A few pilots will deliberately take chances for no good reason. These are the types who land with one tip full, one empty; try to stretch a completely loused up simulated flameout pattern to the runway, or set her down although the GCA was 'way too long and there's only 2000 feet of runway left. It's hard to guess why these poeple do as they do; they know better, but they do it anyway. Maybe they don't want to admit they've made a mistake. Maybe this would bruise their egos. They usually wind up by bruising something else. These kids—if they only knew it—have everything to lose and absolutely nothing to gain. We've got files full of reports of accidents by these experts.

Some pilots are reluctant to ask for help. These are the "lost" types who request no steer from nobody. The types who never have called and never will call the tower for help when they have an emergency; the types who'll try to remember emergency procedures when Mobile has a flight manual and a guy who can read. These are the guys who wouldn't ask GCI for a heading around the big hairy thunderbumper up ahead if their lives depended on it. This may come as a rude shock to some but that's exactly what it amounts to in some cases. We've got files full of reports of this type of accident too. Sure, some of 'em are marked "undetermined" because we couldn't be absolutely sure, but you can read between the lines.

Some pilots will not let others know when they're in trouble. Granted, there are some emergencies where help from the ground—or air—won't do any good. These are the guys who continue a flight with a maybe-not-too-pressing emergency. They make position reports and talk to others but they don't tell anybody their troubles. Some of 'em make it okay and some of 'em don't. Some of these are marked "undetermined" too, but you can read between the lines. The ones who don't make it—maybe telling somebody their woes wouldn't have helped *them* any, but it might help the next guy.

So, what can be done? Let's disregard for a minute the materiel failure type of accident and speak only of those that could have been prevented if the pilot had straightened up and flown right. Every month we have one or more accidents because the pilot allowed the aircraft to contact the ground short of the runway. This can't be because our runways are too short, since you can fly from coast to coast or from Mexico to Canada and never land on anything shorter than 10,000 feet. Even if you are going to Podunk, it's a good bet they've got 7000 feet at least, so length isn't the answer. Maybe this is a throwback to the old days when, in order to be "hot" you had to "put 'er on the numbers." A T-33 looks pretty silly sittin' on its stomach 100 feet short of two miles of paved runway. Bet the pilot feels sillier. So let's get off of this numbers kick and cross the fence with enough on the clock to be good and safe. So you do land 1000 feet down—this is bad?

While we're on landing accidents, let's discuss the clown of the briney, the porpoise. Every month somebody makes like a porpoise. Now the T-Bird gear is a sturdy one and it will take a lot of lumps, but let's face it—you can break almost anything if you try hard enough. In the first place, the reason for a porpoise is known and has been publicized. Most of 'em develop from trying to spike the airplane on the runway before it is ready to stop flying. This, you should not do, but *if* you do and a porpoise does develop, you can still pull the fat out of the fire and lose nothing more than a little "face." Just follow the procedures outlined in the flight manual.

Another type of accident that happens every now in a once and a while is called "getting on the back side of the power curve." This happens on takeoffs, and what it actually means is the aircraft gets in an attitude where the total push available just isn't enough to overcome the drag and weight present. This is very embarrassing—to the pilot, not the airplane—because very soon sparks will fly, metal will be scraped, heads will turn and the pinochle game in the crash station will be broken up. (No offense intended.) Endless forms will have to be filled out and statements made and recorded. The engine will be shipped for TDR because the pilot is convinced that he had a power loss. In 1957 we tried to correlate this type of accident to high altitude and high temperature situations. It is true that these accidents usually happen in the good old summertime and some of them do happen at high altitude fields. However, our records show that as many "back side of the power curve" type accidents happen at low altitude fields as at high altitude fields.

By the way, like all accidents, this type is no respecter of rank, race or religion. So many words have been written on this that it seems kinda silly to remind people that they have to figure takeoff roll for the '175 anyway, and all the poop they need is in the weather office and the flight manual. Sometimes this isn't the whole answer though; one guy correctly figured his takeoff roll at 5500 feet but got airborne and staggered back in at the 4800-foot point. Here, again, the guy who yanks her off early has got everything to lose and nothing to gain. So why not just let her gin along on the mains for an extra 10 knots or so this summer and maybe we won't have any more of this kind.

I suppose dozens of checklists for safety have been written so we won't put one here. There are just a few things though that we think bear repeating, so at the risk of repetition, here they are:

- Be sure you are ready to go.
- Be sure your bird is ready to go.
- Really plan your flight and don't try to go too far.
- Land oftener, and stretch, and gas; you'll be surprised how much more flying time you'll have at the end of the year.
- Always have some kind of an alternate plan, whether its IFR, VFR or any FR.
- Don't just check the weather; watch it in flight. There are enough Channel 13s around now so you can always get somebody. Be realistic about destination weather. Just because the published minimums are 200 and a half doesn't mean that you *have* to go when the weather's that bad. What your unpublished minimums are, nobody knows better than you.

If you get in any kind of trouble, tell somebody. Remember that GCI and its alert pilots are just as close as your mike button and there's nearly always a stargazer within earshot. Last and maybe most important, take it easy. Don't take unnecessary chances and don't do things that you *know* are wrong.

Safe flying is possible and easy, but if you want to know who it mainly depends on, take a look in the nearest mirror. ▲

Major Wallace W. Dawson, Fighter Branch, DFSR

T-BIRD QUIZ

1. T-33 nose compartment doors will come open during flight even though they have been securely latched before takeoff.

True............ False............

2. You have a flameout and stopcock the throttle. Prior to attempting restart, the fuel de-icer switch should be activated.

True............ False............

3. With the Santa Anita fuselage cap installed, takeoff can be made with the fuselage tank full.

True............ False............

4. Surface temperature is at or near freezing. Prior to takeoff, you should actuate the fuel de-icer switch for at least one minute.

True............ False............

5. The higher the temperature and elevation of the runway, the longer the takeoff roll.

True............ False............

6. You are on final approach for a normal landing. The minimum final approach airspeed should be 120 knots.

True............ False............

7. Upon reaching 5000 feet above terrain during descent, all fuel switches for tanks containing fuel should be gangloaded, regardless of the type of fuselage tank cap.

True............ False............

8. In the event of complete electrical failure, the engine can be operated only on the main fuel control. The emergency fuel control is not available because the solenoid-operated bypass valve is spring-loaded open, and requires electrical power to hold it closed. Therefore, after flameout, a manual airstart on the emergency system should be attempted before the battery power fails.

True............ False............

9. When using low altitude airstart procedure, you should switch to emergency fuel system.

True............ False............

10. Stagnated RPM in flight indicates one malfunction only: throttle linkage disconnection.

True............ False............

(*Answers are on page* 25.)

WELL DONE

KNOWLEDGE • TRAINING • ABILITY

Capt. Milton A. Weinstein

101st Tac Ftr Sq, Mass. ANG

Captain Weinstein thought that 12 August 1958 would go down in his log as just another flight, a routine F-86H ferry mission from George AFB, California, to Boston, Mass. From his perch at 35,000 feet the vast expanse of New Mexico landscape streched away to hazy infinity. To the Captain's practiced eye, every gage told a reassuring story, while the bird dog homed unerringly on Kirtland AFB, 100 miles ahead. The jet throbbed with power. There was nothing to interrupt the smooth, unexciting routine—until the engine quit, with a noise that indicated complete seizure.

The sudden, lonesome silence galvanized the pilot into action. Reflexively, he tidied up the cockpit to Dash One standards, while his mind was busy appraising the emergency and weighing alternatives. He tried a relight but quickly realized the engine was beyond an airstart.

The operation of the hydraulic flight controls now depended on the battery-operated emergency hydraulic pump. Under these circumstances, the useful life of the battery is seven to eight minutes. If a landing cannot be made within this time, the Pilot's Handbook specifies bailout as the proper emergency procedure. There was no suitable landing field in the immediate vicinity. If the aircraft was to be saved, the Captain would have to attempt a glide to Kirtland, almost 20 minutes away. He knew that the success of any such bold attempt would depend in large measure on his skill in wetnursing the battery to its last spark of life. He made his decision; since he and the plane had started the flight together, they'd finish together.

After squawking MAYDAY and confirming the course with GCI—which cleared his approach and alerted Kirtland to his predicament—he shut off all electronics except for the emergency hydraulic pump. The flight path was maintained with a minimum use of flight controls; at times even the emergency hydraulic pump was deactivated to conserve precious juice in the battery. Seventeen minutes after flameout, he arrived over Kirtland at 3500 feet with enough battery power to operate the hydraulic flight controls for a landing attempt. The gear was extended by the emergency system on final approach and flight control override actuated one-half mile from touchdown. The deadstick landing was completed without damage to the aircraft.

For this example of professional skill, cool-headed judgment and thorough knowledge of your aircraft, Well Done! Captain Weinstein. ▲

★ ★ ★

1st Lt. Robert L. Jackson

77th Tac Ftr Sq, 20th Tac Ftr Wg, USAFE

The two F-100s bored through the pelting rain and disappeared into the overcast at 900 feet. It was August 28, 1958. The airdrome at Wethersfield, England, was blanketed with an overcast extending from 900 to 39,000 feet. Lt. Jackson, leading the flight of two on an instrument training mission, had planned a GCA monitored instrument climb to 1000 feet on top. As he passed through

25,000 feet, his airspeed indicator failed. He went into afterburner and continued his climb to 40,000 feet, 1000 feet on top. The wingman took over as leader, and Lt. Jackson joined up for a descent.

In the meantime, ceiling and visibility at the home station had deteriorated to 200 feet and ½ mile with rain. The pre-planned alternate airdrome, Woodbridge, had an emergency in progress and could not handle them. RAF Station Mildenhall, with 900-foot broken, 15,000 overcast, and 4 miles visibility in rain, was selected as a diversion base. A letdown was started under GCI control with a GCA pickup planned at Mildenhall. Shortly after descent was established, the new leader also lost his airspeed indicator and climbed back out on top. He landed later with an RB-66.

Lt. Jackson lost the leader in the weather when the power was changed but decided to continue his letdown using attitude gyro, power setting and a 550 feet per minute rate of descent. In addition, he had his wing slats as a reference; while they were in he knew he had plenty of airspeed. He broke through the overcast and shortly thereafter began his GCA approach. A successful landing was accomplished at Mildenhall.

Flying the F-100 in weather without an airspeed indicator would be a challenging feat for any pilot, regardless of experience. Lt. Jackson, with only 550 total hours flying time when this incident took place, displayed excellent judgment and flying skill in bringing his F-100 home under such trying circumstances. Well Done! Lt. Jackson. ▲

★ ★ ★

Any of you birdmen who learned your acrobatics in a C-130 might yawn your way through this one. But for those of you who didn't realize that a transport could give a 3-D imitation of a roller coaster gone wild, the following chronicle may excite your interest.

Lieutenants Pevey and Kramer, this 10th day of May 1958, were cruising at 8000 feet over Thailand, at peace with themselves and well content with their C-130. Lt. Pevey was pilot; Kramer rode shotgun. They and their craft were hosts to 13 passengers and a caterpillar tractor complete with blade. The transport droned along, making 240 knots on another montonous passenger-freight haul. Suddenly, the huge machine nosed over and headed straight down!

Any boredom in the office speedily evaporated as the pilots found themselves straining against their belts and staring at the top of the cockpit. Stunned passengers bounced around the cabin like shuttlecocks. The airspeed indicator wound up like the sweep hand on a stop watch and soon hit 390 knots. The nose of the '130 continued tucking under until the plane was 10 to 20 degrees beyond a vertical position. The giant craft plunged earthward to what seemed an inevitable crash.

Both pilots, meanwhile, exerted all their strength applying back pressure on the control column, with no perceptible effect—the elevator trim tab system had run away to the full nose-down position. One remedy offered itself: reach the elevator trim power selector switch and move it to the emergency position. With the dexterity of a belly dancer in a hula hoop, Lt. Pevey wriggled about in his safety belt and finally positioned the selector switch. UP elevator trim was applied, and with its aid, the pilots pulled the '130 out of its headlong dive less than 3000 feet

1st Lt. Jack A. Pevey

772d Troop Carrier Sq (M) Sewart AFB, Tenn

1st Lt. Walter E. Kramer

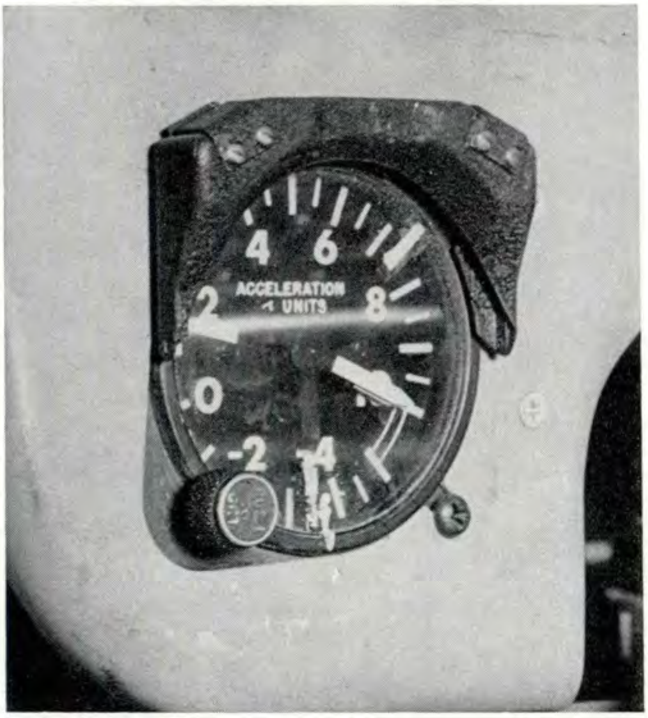
over the accurately charted terrain. The fighter-like gyration had torn away the right elevator and 11 feet of horizontal stabilizer.

With consummate skill and the exercise of superior flying ability, the Lieutenants coaxed their crippled craft back to the departure airfield. Lt. Pevey had thoroughly and expertly analyzed the changed aerodynamic characteristics of the damaged plane and now maneuvered the 60-ton aircraft to a perfect landing.

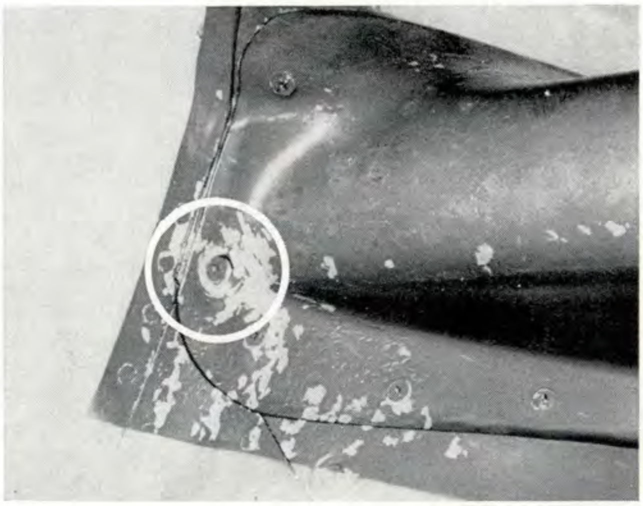
As a tribute to a courageous and level-headed performance in the face of a dire emergency, Well Done! Lieutenants Pevey and Kramer. ▲

Racked by the

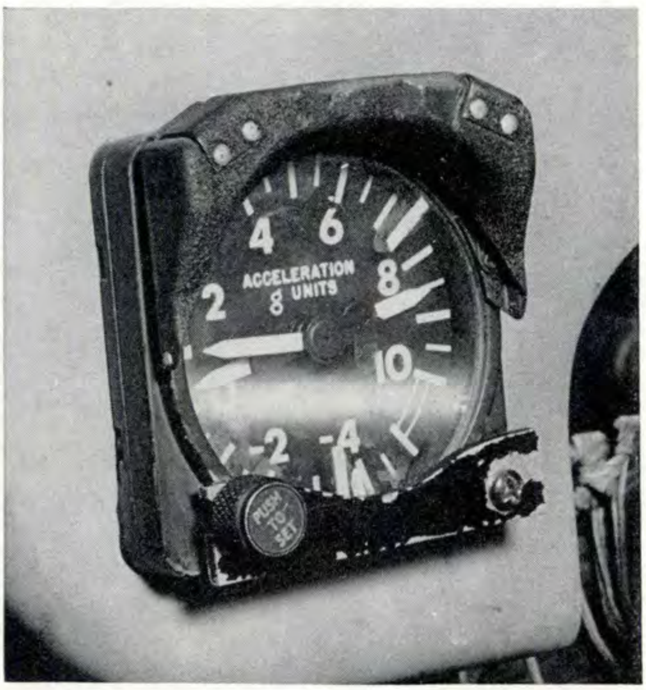
Although the T-Bird shown in the upper left-hand corner looks like a flyable machine, it was actually Class 26 and junked. The accompanying photos show why. The plane was overstressed by a student pilot in No. 4 position in trail formation. At about 16,000 feet, leader went into a descending right turn. At 100 degrees of bank, 30 degrees nose low, he reversed his turn to the left and started a climbing turn. Numbers 2 and 3 were slow to follow. When No. 3 reversed, No. 4 started with him, rolling left and increasing back pressure. At this time, "a loud snap was both heard and felt." The instructor pilot

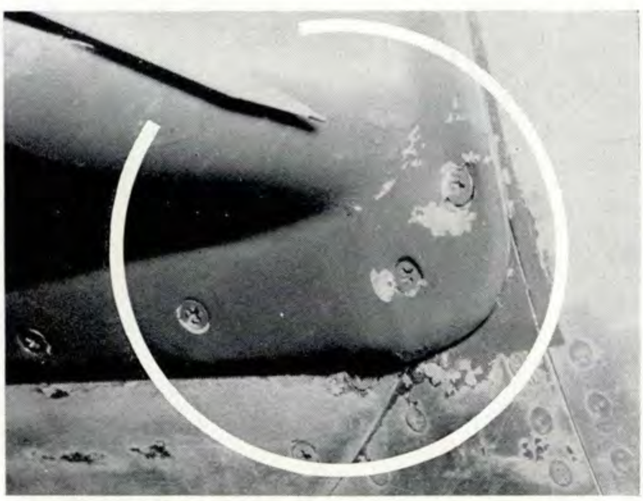


Above, inoperative G-meter, front cockpit. This was carried in the AF TO Form 781B as inoperative. The instrument was stuck at positive and negative 10G prior to flight. Below, G-meter in rear cockpit was reset and locking bar positioned prior to flight. Note the 8.5G.



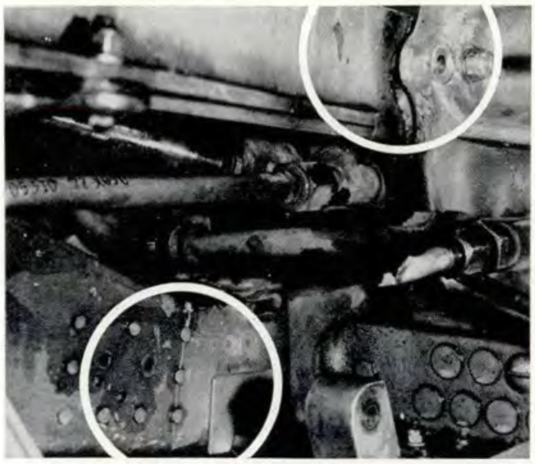
Above, circle shows underside fuselage skin surfaces buckled on left side. False leading edge is pulled away from screws at root. Below, right false leading edge is pulled away from screws at root.





Rolling "G"

returned controls to neutral and broke out of formation. The T-33 was examined by the flight leader and found clean. The instructor performed controllability stalls to determine flight characteristics before returning to base. The G-meter in the rear cockpit registered 8.5G, far exceeding the limitation of 4.9G placed on rolling pullouts by T.O. 1T-33A-1, yet neither pilot felt any excessive G during the maneuver! Leader did not exceed 2.5G at any time while leading the formation in trail, and all maneuvers were smooth and coordinated. The damage came from poor technique in flying the "tail-of-the-whip" position. Tail-end Charlies, gently now!



Lower left shows left main gear wheel well revealing breaks and pulled rivets. (Plumbing removed for examination.) Above, close-up of left main gear wheel well showing breaks and failed bolt of wing fitting to forward spar. (Plumbing removed.) Below right, wing fitting to foward spar attaching bolts sheared and separated.

Below, forward wing spar lower cap broken at station ZERO. (This photograph taken through right wheel well.)

Some people think that high density air traffic today makes the mid-air collision as inevitable as the head-on auto accident of two-lane highways. The Air Force contends that with positive control of all air traffic and an efficient airborne anti-collision device. . . .

"It ain't

The Air Force is justifiably pleased, although not satisfied, with the tremendous strides which have been made in the aircraft accident prevention area. The almost inconceivable increases in performance complexity of the equipment and the tremendous increases in the number of hours in which men and equipment are airborne have produced a parallel increase in hazard potential. The fact that this has been controlled, even reduced, is indicative of the results which can be obtained when a concentrated, cooperative effort is made to solve a difficult problem.

Over fifty years ago, on 17 September 1908, Mr. Orville Wright was performing an acceptance flight for the Army in a Curtiss biplane at Fort Myer, Virginia, with Lieutenant T. F. (Tom) Selfridge as a passenger. At about 75 feet above the ground, one of the propellers broke; the machine side-slipped and dived into the ground. Lt. Selfridge was fatally injured and Mr. Wright suffered a broken leg. Then, in May 1911, three years later, another fatal accident occurred. Since that time, accidents have increased in frequency.

With the flying of greater numbers of aircraft at the same time, a new type of accident—the mid-air collision—made its appearance. On 17 August 1917, the first major mid-air collision on record occurred. This accident, associated with the training program of World War I, was followed by a large number of others. Those who are accustomed to thinking of mid-air collisions as being of major import only in recent years will be surprised to find that in 1918 there were 45 mid-airs; 22 resulted in fatalities. This peak number was associated with the build-up in airpower during World War I. With the decrease in emphasis upon military flying which followed, the annual number of mid-air collisions decreased, and the peak of 45 was not reached again until 1941. It is interesting to note that with 32 mid-air collision accidents in 1958, the present record is better than that of 1918.

The higher performance capability of jet aircraft, together with the increase in the numbers of such aircraft, introduced a new element of mid-air collision hazard which culminated in the first jet mid-air collision. In January, 1947, two P-80s collided two miles northwest of March Air Force Base. As has so often been the case since, the accident occurred under day contact conditions in the course of normal flight. Fatalities were sustained by both pilots and the aircraft were destroyed. The cause of the accident was assessed as "undetermined."

From 1947 through 1958, the Air Force had a total of 568 major mid-air collisions. These happened at the rate of slightly more than two accidents per month in 1947 and reached a peak of well over five during the years 1952 through 1954. From this point on, there has been a decline in the number of such accidents.

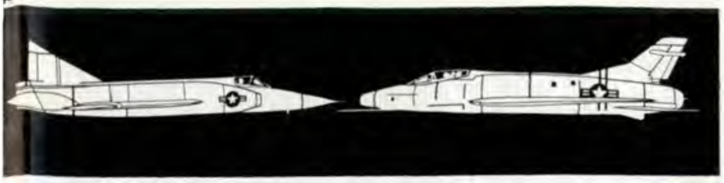
Numbers often tend to hide the relative importance of a problem. On the basis of 100,000 flying hours the highest rate was reached in 1948, the second highest in 1952, and from that point on there has been a consistent decline in rate. During 1958 this rate has reached an all-time low of 0.38 accidents for each 100,000 hours of Air Force flying. The comparable fatal collision rate for 1958 is also at a point equal to the all-time low of 0.24 accidents per 100,000 flying hours.

This gratifying reduction during the past six years parallels the over-all reduction in major accidents in the Air Force as a whole. From an all-time high, 506 major accidents for each 100,000 hours of flying in 1922, the Air Force has reached the all-time low of 10.4 accidents per 100,000 hours of flying during 1958. The smooth, constant downward trend from 1947 to the present has been produced during a period marked by almost astronomical increases in the performance capability of aircraft and with the consequent higher demands on the human operator. Even a one-point reduction in accident rate at the current low level represents a major achievement.

Both the over-all and the mid-air collision accident rates are continuing in a definite downward trend. But—mid-airs still represent one of the most acute problem areas. Despite this downward trend, the percentage of midair to total accidents has grown. In 1958, the portion of all accidents which were mid-air collisions was two times as high as it was in 1947. The fatal collision rate, although not precisely parallel, follows the same general trend.

In military flying there are two kinds of mid-air collision accidents: those which occur between aircraft that are "associated," such as during formation flying; and those which occur between aircraft that are "non-associated," that is, aircraft in which one or both pilots involved are not aware of the proximity of the other aircraft. The "associated" flying type accidents are uniquely the problem of the military services. "Non-associated" accidents, however, can occur between any type aircraft using the airspace. The lessons to be learned from their accident evaluations have universal applicability.

From 1950 to the present, 118 major accidents between "non-associated" aircraft have occurred. Eighty-



necessarily so"

eight of these have resulted in one or more fatalities and 163 aircraft were destroyed.

Historical data clearly indicate that the mid-air collision problem is not new to the Air Force nor are the corrective measures which have been applied. Public awareness, however, both of the problems and suggested solutions, is fairly recent. This awareness followed a series of spectacular and highly publicized mid-air collisions between Air Force and civilian aircraft.

From 1947 through 1958, the Air Force has had 18 mid-air collisions with civilian aircraft. Only two of these accidents have involved passenger-carrying commercial transport aircraft; unfortunately, both occurred during 1958 and resulted in many deaths. The first was the DC-7 and F-100 accident which occurred on 21 April 1958, near Las Vegas, Nevada; the second was the Air Force T-33 and Viscount accident that occurred on 20 May 1958.

Although, as stated above, public awareness is of fairly recent origin, the Air Force has been critically concerned with the mid-air collision problem for many years. Extensive evaluations of the accidents have consistently resulted in either cause-undetermined classifications, as was the case with the first jet midair collison, or, as more often has been the case, the cause was assessed as "pilot error." A more critical evaluation of the assessed causes in relation to the pilot's capabilities and the situational demands have indicated that in many instances mid-air collisions are the result of a *situation which exceeds the capabilities of the pilot and machine.*

In order to demonstrate how this conclusion was reached, it is necessary to define what both the pilot and the aircraft must do. In any activity involving a machine and a man there are certain integrated functions which each must perform. In terms of the man there is a sequential three-step program which must be carried out in any activity.

First, there is perception. This involves seeing, hearing or otherwise getting information about what is going on in the outside world and it also involves understanding what this stimulation implies.

The next step involves a decision as to what action is necessary.

The third step involves the action itself. Once the pilot has completed the appropriate action—in the case of operating an aircraft, initiating movement of the controls—the aircraft must also respond. All of these activities take time. Evaluation of the time involved in various human and machine activities places this "point of no return" at surprisingly great distances from the pilot.

When perception is considered, even if the pilot is looking directly at an oncoming aircraft, there is a measurable lag in the length of time it takes for the stimulation, once it has reached the eye, to be directed to the brain and to be meaningfully interpreted. If the pilot is not looking directly at the stimulus, this time is even longer.

When the amount of airspace to be scanned is considered, the probability of seeing an oncoming aircraft which can materialize from a mere speck to a perceived, threatening object in a matter of seconds, is relatively small. At a minimum, a perceptual lag of from 0.035 to 0.30 of a second is involved.

The problem of actual recognition of the object and of meaningful evaluation regarding its direction, rate-of-closure and so on, which are essential for an adequate decision as to the action to be taken, may require several seconds. The decision itself also involves time. Considering the amount of time spent on less important decisions, a one-second delay is not unreasonable. The reaction time itself, once a decision has been reached, may be considered to be in the neighborhood of 0.4 of a second at a minimum. Once the controls are activated, the aircraft must respond to the modified airflow by deviating from its flight path. Two seconds here is the minimum required.

What this means in terms of mid-air collisions is obvious. On a 180-degree collision course, 4 seconds before impact, two aircraft at a 600 mph closure speed would be $1\frac{1}{3}$ miles apart. If all of the activities involved were performed in the minimum time allotted, a collision would be avoidable. If not so performed, a collision would be inevitable.

When the basic acuity limitations of the eye are considered, together with factors such as the position of the sun, haze, and aircraft color, it is apparent that an aircraft at high speeds is essentially inside the "point of no return" before it is seen. *A recognition of this fact led to a clear formulation of the philosophy that the days of "see and be seen" in flight are at an end.* This position, firmly held by various Air Force agencies since 1955, has been the direct stimulus for a number of preventive activities.

Critical evaluation of the mid-air collision problem indicates that there are two approaches which can be taken to reduce this type of accident.

The first of these approaches is to guarantee that aircraft will not be placed in the position of being on collision courses by insuring separation through the medium of positive control of all air traffic. Now what is the scope of the ground control problem at the higher altitudes?

There are over 5000 military IFR operations per day above 17,000 feet, and 4000 per day are above 27,000. (These figures do not include VFR flight plan traffic, either local or en route. Nor do they include ADC interceptor operations or operations within a military exercise maneuver area.)

Present clearance requirements for aircraft separation are such that many hundred cubic miles of airspace per aircraft are necessary to assure separation while operating on IFR clearance. This is essential because present air traffic control is predicated upon pilot position reporting, which is not always accurate. Now, airspace is a vast quantity, but not that vast, especially when one considers the volume of military traffic alone that operates above and below 29,000 feet. If just SAC operated in the continental United States above 29,000 feet, and tried to operate under full IFR control with assigned altitudes, its operations would be drastically reduced through excessive delays. Today, only 15 per cent of our IFR traffic at altitude is receiving assigned altitudes. In other words, 85 per cent of this IFR traffic is operating VFR-on-top.

In this regard, it must be pointed out that there are two limitations to consider: one is human, the other mechanical. Positive control means maintaining assigned altitudes and assigned lateral separations, and here a pilot's integrity must be relied upon. And by that it is not meant to impugn anyone. Circumstances sometimes can force a pilot to deviate from an assigned altitude. Furthermore, the inherent inaccuracy of present altimeters provides the pilot with information which will compromise the altitude control as established by the controller on the ground. *If all aircraft at altitude are to operate on a fixed altimeter setting, the instrument must be improved.*

About the mechanical limitation: on a lateral separation, controllers must know where an airplane is. One of the methods of determining this is by position reports. But, when a jet pilot reports over a high cone at an OMNI station for example, he usually is reporting from the "cone of confusion" as it is termed. Sometimes it takes a jet aircraft more than 2 minutes, or 20 miles, to get through this cone; therefore, his exact position is not known.

In the low frequency ranges this cone is known as the "cone of silence." At present, there is no requirement as to just where the report should be made—going into, in the middle of, or leaving the cone—unless the pilot is going to enter a holding pattern.

The capability of the new radar equipment and the people who man it will determine the effectiveness of air traffic control from the ground. The new ground surveillance radar has a sweep frequency of 3, 6, or 9 sweeps per minute. That is, 1 sweep every 20, 10 or 6⅔ seconds. Normally, it will be operated at 6 sweeps per minute.

A new Boeing 707 and a USAF jet fighter on a head-on collision course will be closing at about 1200 miles per hour and will cover 20 miles in a minute. At relatively short range with the radar set at six sweeps per minute, the operator will require two sweeps to determine the course of the aircraft and three to determine a collision course, if both aircraft are in straight flight. This will take 30 seconds and the aircraft will have covered 10 miles. If the operator is in contact with one aircraft, it would take approximately four seconds to transmit a warning message. Another mile and a third have been covered by the aircraft. Minimum pilot and aircraft reaction time to avoid collision would be four seconds—another mile and a third!

Total time from initial blip reception to course change would be 38 seconds, and the aircraft would have covered 12⅔ miles. In other words, if the operator does not pick up both aircraft about 13 miles apart, a collision cannot be avoided. Furthermore, although it will normally require three sweeps to determine a collision course if the aircraft are in straight flight, it will take longer to determine the collision course if one or both are in a turn.

If the aircraft are at maximum range from the surveillance radar, 200 miles, it will probably take a minimum of six sweeps for the operator to determine a collision course. This would extend the total time from blip-reception to course-change to one minute and eight seconds, and the distance covered to 22⅔ miles. Please remember that these times reflect *normal* conditions and at least *one* aircraft under the radar operator's control. If an aircraft is not under control, additional time would be lost in giving warning.

There is another new approach to the problem of traffic control from the ground. This combines ground equipment with that already in the cockpit. TACAN and/or OMNI now reads the distance and course which the aircraft is from a given ground station. Telemetering equipment in the aircraft could reverse these procedures to provide a ground controller with the same accurate data. It is believed feasible to show the relative position of aircraft so equipped by projecting the information on direction, speed and altitude on a screen. This would facilitate the ground controller's picture of location of aircraft in the air.

The second approach to guarantee that collision courses do not develop is to supply the pilot with aids that will help him to evaluate his own position in relation to other aircraft and thus facilitate collision avoidance. In the ultimate, this type of assistance would be completely mechanical and would result in automatic collision avoidance. The airborne anti-collision device must give the pilot positive information as to the location and degree of threat of a potential colliding aircraft.

★ ★ ★

. . . the Air Force has been critically concerned with the mid-air problem for many years.

... in many instances mid-air collisions are the result of a situation which exceeds the capabilities of the pilot and machine.

★ ★ ★

This was pointed out by the Directorate of Flight Safety Research in 1956. The Air Force initiated a study to determine the feasibility of such equipment. Since 1955, the Directorate has attempted to interest other agencies in the development of such equipment, without much success. What a difference today—after several dramatic catastrophies! Within the Air Force there was a belief that the "state of the art" precluded such a development. *But history shows that "state of the art" progresses in direct proportion to the money and brains applied to the problem.* The problem of air traffic control is one which has received marked attention by a large number of agencies and is being actively considered at the present time by the Federal Aviation Agency. For one thing, FAA contemplates the abandonment of mixed space in which some aircraft are controlled and others are not controlled. With mixed traffic a thing of the past, wholly controlled space and purely uncontrolled space will both exist but never in common. Strict terminal control is also under study. Radar-coupled computers will bring aircraft into the landing phase with automatic directions, thereby avoiding any chance of collision.

The Air Force is currently cooperating with the FAA as well as all users of the airspace in attempting to insure greater control of all aircraft. This effort is being made even though it involves some inconveniences and some increased accident hazard in other areas.

One activity which the Air Force has voluntarily initiated is the closing of a large number of joint military-civilian airports to transient jet traffic. This has essentially closed large areas of the United States to such traffic and has imposed some serious flight planning limitations. The long-term delays associated with clearance under current control procedures are also in some cases quite serious where jet traffic is concerned. This is because of the high rate of fuel consumption on the ground and the consequent decrease in potential mission length.

Interim means to assist the pilot have been considered. The use of luminous paints has been found to be of value. The Air Training Command experimented with this type of preventive measure for the past several years and during that time reduced its mid-air collisions over 50 per cent. Current Air Force regulations provide for painting all except tactical type aircraft.

The conspicuity marking of Air Force aircraft is only a partial accomplishment of the goal. To be effective, such conspicuity marking should be required of civil aircraft as well.

The organization of the Federal Aviation Agency brought about a transfer of the research and development of anti-collision hardware from the Air Force to the FAA. Conspicuity marking of aircraft, anti-collision lights and other devices are now being investigated by the FAA under separate project programs.

Another approach is in the form of attention-provoking lights which serve to locate the potential collision object. Preliminary evaluations of condenser-discharge type systems has suggested that the bright blue, white, high-intensity light may prove to be a more desirable type of anti-collision measure, both because of its greater intensity and because of its greater attention-provoking characteristic over a wider field of view.

Because most mid-air collisions occur during daylight hours, the use of any type of lighting, unless it can be made effective in daylight, will be effective in preventing only those mid-airs which occur during night operation. For this reason, attempts to develop other means of assistance useful particularly during daylight hours have been initiated. These involve such things as artificial contrail generation for use in aircraft outside of the high density areas.

The last, and—for the time being, at least—the most readily implemented method of mid-air collision avoidance is to re-emphasize to all pilots the importance of precision flying, air discipline, and maximum attention to the surrounding airspace, particularly during VFR flight.

It is not anticipated that any one activity will result in complete mid-air collision avoidance. The cumulative effect of all, however, should have a salutary effect.

To summarize, the mid-air collision history has been a long one. As long as there are multiple aircraft occupying the same general airspace at the same time, a collision hazard exists. With increased density of traffic and the increased speeds of operation, the potential becomes more acute. Accident history of the Air Force over the past years has indicated that *cooperative, intensive effort by interested agencies can result in a marked reduction of any type of accident.* The mid-air collision type is no exception. This reduction, however, will not come from any one remedial measure but instead will be the result of the compound effects of all, integrated through the coordinated efforts of all users of the airspace. Immediate measures center around assistance to the pilot. These are based upon the recognition of the fact that *the days of "see and be seen" flying are essentially over.* Long-term efforts must result in guaranteed, positive separation by the development and installation of hardware which will assure mid-air collision avoidance, once a collision course is initiated.

There is no reason why we cannot expect the development of the necessary hardware. Technically, we are able to devise and manufacture it. As said before, *progress is in direct proportion to the money and brains applied to any problem.* And with the organization of FAA we have at last set up the unified, controlling agency which can direct the efforts of all to the common goal—elimination of all mid-air collisions. They don't have to happen!

THE CHECK*LIST*

Pins. Something new has been added with the issuance of T.O. 1T-33A-1EP, dated 18 May 1959. This little gem says, in effect, that ground crew personnel will not—repeat not—remove the airplane wheel chocks for taxi until flight crewmembers display seat and canopy pins (where applicable). Naturally, this order was designed to insure that pins have been pulled before the bird moves out of the parking area. The procedure, however, will be worthless unless *everybody* gets the word.

- *To Flight Crews:* If ground crews do not ask to see your pins, take the time to tell them that they should, and then cite the safety of flight supplement.
- *To Ground Crews:* If flight crews don't seem to understand what you mean when you indicate that they should show you the pins, take time to tell them about this new procedure, and cite the safety of flight supplement.
- *To FSOs:* It's up to you to see that the above instructions become unnecessary by making sure that all of your people have the word.

Let's everybody get on this and make it work. It's well worth the effort.

★

F-100. The smoke-filled cockpit of an F-100 almost claimed a pilot's life recently, yet even he can't say why he didn't elect to use 100 per cent oxygen. But he assures us he will do so the next time—if there is a next time. He was semi-conscious when he taxied the aircraft up to the ramp and stopped.

★

During the first 6 months of this year, 65 per cent of all ejections initiated below 1000 feet were successfully completed *(non-fatal)*. This represents a significant improvement over the same period in 1958, when only 38 per cent of ejections below 1000 feet were successful. Evidence indicates that increased availability and use of the zero second parachute deployment lanyard was a major factor in the improvement shown. This improvement is also reflected in the number of overall successful ejections. Currently, this percentage is 88 per cent as compared with 77 for 1958.

★

T-33. Each year one or two major accidents occur in T-Birds when one tiptank fails to feed properly. The operator does not try to jettison the tank containing fuel and a landing is attempted with one heavy tank. Page 3-35 of T.O. 1T-33A-1 contains concise instructions to be followed when one or both tiptanks fail to feed properly. Excerpts of the instructions follow:

"If one tiptank fails to feed or feeds more slowly than the other, eventually full aileron trim may not hold the wings level at cruising airspeeds. Continued operation of the aileron tab in one direction will indicate uneven tiptank feeding and can be further checked by visual observations each time the tab is activated. If the wings can be held level at cruising airspeeds without undue effort, the heavy tank should be retained to see if it can be made to feed. Try the following to get the heavy tank to feed: Climb as rapidly as possible to 25,000 to 30,000 feet. The ambient air pressure of low altitudes will remain inside the tank and may start the tank feeding; rock the wings rapidly from side to side without exceeding a maximum bank of 45 degrees and maintain an indicated airspeed of about 250 knots. *If the fuel load is unequally distributed and it is determined that the heavy tank will not feed, it should be dropped in a safe area.*"

In short, try to get the tiptank to feed. If it won't, *jettison it!* Don't let pride get the best of you in this situation. The files are full of reports about guys who did.

★

T-33. During the first six months of 1959, three crewmembers sustained fractures to the upper extremities while ejecting from T-33 aircraft. All three injuries were attributed to contact with the canopy sill as each crewmember ejected with his arms *outside* the armrests.

Supervisory personnel should make sure that crewmembers are given periodic ejection refresher training, particularly tower rides and practice in an ejection trainer. The importance of proper body positioning should be emphasized to prevent injury to the arms or hands during ejection.

★

Basic causes of aircraft accidents don't seem to change. Two years ago, Dr. Anchard F. Zeller, of the Aero Medical Safety Division, DFSR, wrote the following paragraphs in his personal evaluation of an article on pilot disorientation *(vertigo)*:

- "It is undoubtedly a fact that rotating the head through one dimension while there is acceleration in another dimension produces disorientation. It is also undoubtedly true that cockpit unfamiliarity heightened by actual instrument conditions is highly conducive to errors of perception, integration and manipulation. When all of these conditions are combined, the result almost inevitably is a situation with which the pilot cannot cope.
- As has been repeatedly emphasized, one of the best methods of overcoming the effects of vertigo disorientation is the use of instruments. The good instrument pilot may experience vertigo but because of his basic instrument ability, he can ignore the effects and carry on a successful flight in spite of them.
- The recommendation that a blindfold cockpit check should be used as a method of cockpit familiarity is basically sound. Such familiarity is directly related to the ability to recover on instruments under any conditions.

This subject continues to be worthy of discussion, attention and deep concern on the part of all pilots and supervisors." According to Dr. Zeller, who was consulted as this edition goes to press, "As of today, vertigo disorientation accidents are a major pilot fatality problem." ▲

Barter has long been recognized as a good way to do business. Start trading with the weather merchants and be assured you will get an . . .

EVEN SWAP

Maj. Charles Ready, Jr., Hqs Air Weather Service

Air Weather Service weather observations supplement the civilian weather observation nets on a world-wide basis. We have surface weather observations, a weather radar net located in strategic areas, a rawinsonde net that collects upper air data, and finally, we have our reconnaissance aircraft flying regular scheduled flights. Even with this far-flung network, there are many holes where our eyes cannot see and, for reasons unknown to the forecasters, these holes seem to be where much of the bad weather generates.

In these holes, the forecaster needs the pilot to see, record, and relay the actual weather in order to fill the gaps in his forecast. The information which you provide can be invaluable. It can alert the forecaster to impending bad weather that may otherwise go undetected until it is too late. It will give him a better picture of the actual weather as it appears to a pilot in flight and through this the forecaster will be able to give a more accurate and realistic briefing to other crews going into this area.

So you say, as a pilot, "Just what do I look for and how do I report it without cluttering up the air with nonsignificant information?"

Naturally, our first concern is hazards to flight, like moderate to severe icing, thunderstorms and their associated phenomena of turbulence, hail and lightning, and flight altitude winds that are other than forecast. These conditions are of paramount importance and should be reported immediately to the nearest pilot-to-forecaster facility or tower for relay to the weather station.

Secondly, cloud cover with base and top information should be reported. Emphasis should be on bases and tops of cirriform clouds as these are the most difficult to forecast.

Last but not least, report any weather phenomena that appear significant but have not been forecast.

Let's return to the elements that constitute hazards to flight and discuss briefly what the forecaster is looking for and how you should report it to him. Let's talk about icing first. This is usually referred to as light, moderate, heavy, or severe. To standardize the reports, we define *light* icing as an accumulation of ice that does not warrant use of de-icing equipment. Moderate icing is an accumulation of ice that requires occasional use of de-icing equipment but usually no diversionary action is necessary. Heavy or severe icing is an accumulation of ice which is so great that an immediate diversion is necessary and continuous use of de-icing equipment is mandatory. Extreme icing is an accumulation of ice which is so great that de-icing equipment would probably fail to reduce or control its accretion.

The next hazard, the thunderstorm, is the one that generates most of the hazards to flight. The location and intensity of its associated phenomena are very important to the forecaster. Now about turbulence: as this is a very perishable product, it will vary in degree, between pilots and aircraft type. It should be reported as *light*: bumpy but not to the degree to cause concern; *moderate:* safety belts required, altitude changing often with attitude difficult to control; *heavy* or *severe*: practically impossible to maintain attitude and altitude, immediate diversionary action necessary, turbulence approaches aircraft design limitations; *extreme*: aircraft violently tossed about, immediate diversionary action mandatory, design limits may be exceeded resulting in structural damage to the aircraft. Remember, clear air turbulence should be reported also as it has a very significant value to a forecaster in locating areas of jet stream winds.

Next comes hail. It is hard to establish the size of hailstones in flight, but it is important, so try to make an estimate. Be sure to report any damage to the airframe and whether it happened in the clouds or in clear air. *(AFR 55-23 requires a report—AF Form 1228).*

Last comes lightning. This can be reported as cloud to cloud and cloud to ground, with information as to the frequency of flashes. Also, report any strikes to the aircraft.

Remember, the most important consideration is for you to report the weather (*with particular emphasis on the hazards discussed herein, plus any that were not forecast*) as accurately and promptly as possible. This can be done by the pilot-to-forecaster method, but if unable to use this, as you close out your clearance, step into the weather station and report it to the forecaster.

Remember that when you give your weather report you are not only benefiting the weather service and flight operations at your destination but in many other locations, since your weather report will be put on the teletype.

And further remember, you will be the beneficiary of a more effective weather service as a result of your efforts and those of other pilots. ▲

The maze of the middle ear was not designed to function properly under stresses of flight. So to learn to live with what we have, TAC has set out deliberately to . . .

MUDDLE THE

Major Tracy W. Worley, Jr., Aviation Physiologist, Office of the Surgeon, Hqs Tactical Air Command

The inflight vertigo disorientation training procedures presented in this article have been flight tested in a variety of aircraft, such as the C-130 C-123, F-100, T-33 and the H-21. The results of the flight-testing program indicate that the procedures are effective and the training valuable. Although the final standardization of the program at TAC has not yet come about, reading this may help other interested commands make their own evaluation of the training maneuvers and procedures. A life and an aircraft saved by a prototype training program are as good as those saved by the finished product.

The age-old phenomenon, vertigo, as the pilots call it, has affected the airman since the day when he took that first step from a two-dimensional environment into one of three dimensions. He further complicated the issue by adding the factors of speed, motion and acceleration. When these are applied to man, who is designed to function in a two-dimensional environment at relatively low speeds, they help produce the odd sensations which the airman calls "vertigo." The name "vertigo" is actually a misnomer when applied to the sensations frequently encountered in flight. A more accurate term is disorientation—spatial disorientation—describing the condition existing when we are no longer oriented with our aircraft environment. We think and feel that the aircraft is doing one thing when in reality it is doing something other than what we thought and felt. It takes effort and concentration to overcome the strong, almost overpowering false sensations. The answer has always been to fly the instruments, not your feelings. The pilot must have confidence in himself and his instruments. Those who have been able to do this are here to tell about it.

Statistics from the Directorate of Flight Safety Research reveal that vertigo is one of the top killers in the Air Force today. It is particularly prevalent among pilots of jet aircraft. One reason for this is that when vertigo develops, there is much less time for reorientation because of the higher speed of jets. Another is that in fighters there is not the safety factor of a second pilot. Significant also is the fact that the majority of vertigo-associated accidents occur sometime during an instrument penetration. The configuration of a standard jet penetration combined with the required head movements when changing radio channels in some aircraft are conducive to the development of vertigo.

In the latter part of 1958, Brig. Gen. William Gross, Chief of Staff, Tactical Air Command, directed that all avenues of approach be investigated to reduce the number of accidents in which vertigo could be a contributing factor. The initial stages in the investigation of this problem were indeed discouraging. A comprehensive research of available data on vertigo in aviation merely reemphasized the fact that it is one of the most difficult and complex problems to attack. This is true because of the functioning of the middle ear of man. It is this portion which is responsible, in the main, for the production of vertigo. As long as man continues to fly with the set of middle ears with which he has been endowed by nature, vertigo will continue to occur when the necessary conditions of space, motion and acceleration are met.

There is nothing that can be done to prevent vertigo from occurring. This basic fact is recognized by all authorities. The only approach to the problem in the past, therefore, has been that of training and educating the airman to make him aware of the complexity and the shortcomings of his major organ of equilibrium. If he understands and appreciates these shortcomings he will learn to rely upon his instruments for the accurate interpretation of the position of his aircraft in space.

The initial approach to the problem in Tactical Air Command was along two lines:

First, a program to effect immediate action.

Second, a program for long-range study and analysis.

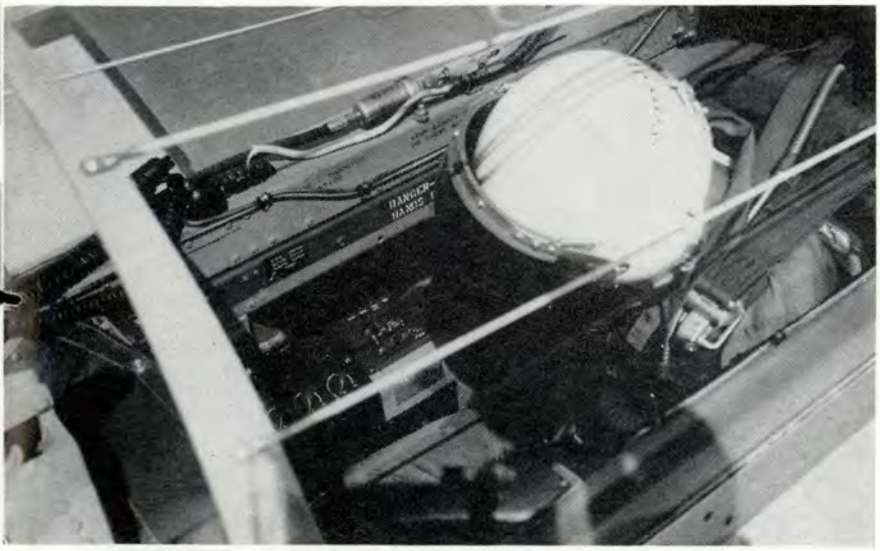
In the immediate action approach, flight surgeons in TAC were directed to conduct a one-time training program for all rated personnel at each base through the medium of flying safety meetings for the purpose of reemphasizing the dangers of vertigo. They were also directed to provide a course of instruction in vertigo in the annual pilots' instrument school.

The subject of vertigo and sensory illusions of flight were made a mandatory part of the standard Air Force Physiological Training Refresher Program. Physiological training units were encouraged to utilize every medium to execute an effective program, such as the employment of Barany chairs and/or similar devices which can produce limited types of vertigo on the ground.

The long-range approach consisted of research in the investigation of past vertigo training procedures in an attempt to analyze the shortcomings of the training programs that had been conducted in the past to see if it were possible to develop a new approach which would be more effective.

The investigation revealed that all past vertigo training programs consisted of academic training with or without ground training aids. What approach had not been tried? Consideration was given to the development of ground training devices which could produce vertigo in any one or a combination of the three

MAZE



Required head movements when changing radio channels in some aircraft can induce vertigo.

planes of aircraft movement — roll, yaw and pitch. The development of such a training device, it became apparent, would indeed be a major engineering project, time-consuming and expensive. Suddenly, the answer became obvious. Why not use the aircraft itself? All thought immediately turned toward pursuing an approach that would lead to an effective inflight vertigo training program. Such a program required that certain specific criteria be met in order to have a maximum training value.

- Specific maneuvers would be required which would produce vertigo of varying degrees.
- The maneuvers required would have to produce vertigo in one, two, or three planes of motion, as well as in combinations of these.
- The maneuvers would have to be of such a nature that they could be easily flown and understood by the instructor pilot.
- The maneuvers selected should not produce unsafe stress on the aircraft structure.

Further study from a training standpoint revealed that subjecting a student to a vertigo producing maneuver was in itself of limited value. After all, it is easy to produce vertigo in flight; at one time or another we've all experienced it. It was decided that to have an effective training procedure, the vertigo would be produced in the student by having the instructor pilot execute a certain numbered maneuver. Then he would correlate for the student the maneuver, the induced vertigo reaction, and the student's body position, all in relation to instrument flight conditions. Having the instructor pilot understand the physiological objectives of the maneuver would help him to perform it and show him what to look for in the student.

At this point we must emphasize that the basic purpose of this inflight course is not necessarily to produce vertigo, but to demonstrate to the student the inadequacies of his organs of equilibrium and convince him that equilibratory sensations under instrument conditions are unreliable.

A number of inflight training vertigo-producing maneuvers were investigated. The maneuvers that were finally selected were essentially those enumerated by General Harry G. Armstrong, former Surgeon General of the Air Force, in his text, "The

Principles and Practice of Aviation Medicine." The test version of the vertigo inflight training program consisted of five maneuvers, each broken down into three areas:

- Maneuver technique
- Correlation under actual instrument conditions
- The object of the maneuver.

All three are considered essential for the instructor pilot to understand fully the technique for producing the maneuver in flight, the effect that he desires to create on the part of the student, and the method of correlating this condition to instrument flight. He must also be able to explain the object or intent of the maneuver after it has been flown.

Upon completion of the initial inflight training program, copies were dispatched to both the Ninth and Twelfth Air Forces' Instrument Training Sections for an evaluation. The program is made up of five vertigo-inducing maneuvers.

In the first, the IP induces in the student the sensation of climbing while turning. The student closes his eyes while the aircraft is in a straight and level attitude. The IP then, with a very slow entry, executes a smooth, well-coordinated turn of about $1\frac{1}{2}$ positive G for 90 degrees. While in the turn and under the effect of the slight positive G, the student is asked for his version of the maneuver. Without any outside visual reference, the normal sensation produced is that of a climb. If the student so responds, immediately have him open his eyes. He can then be advised that in a coordinated turn which is established slowly, the feelings produced are those of a climb and are created by the action of the centrifugal force (positive G) on the organ of equilibrium in the ears.

The instructor pilot explains that when the eyes are diverted away from the instruments, should the aircraft enter a slight coordinated turn to either side, the sensation of a nose-up attitude will occur. The aircraft actually does not have to turn. The instantaneous application of forces can create the illusion.

The object of the maneuver is to show what happens when a change of direction in any one of the three planes of motion occurs. If the rate of turn is 2 degrees per second per second or less, the body cannot detect this motion unless there is some positive visual reference. The result is that the force applied during the turn is the only one perceived. Positive G is normally associated with a nose-up attitude or climb. This association is an unconscious one developed through experience with G forces as well as a direct conscious feeling of climbing due to the effect of gravity on the middle ear mechanism.

The second maneuver illustrates the sensation of diving during recovery from a turn. This illusion can be created by repeating the procedure described in the first vertigo-inducing maneuver, and having the student keep his eyes closed until the recovery is approximately half completed. While the recovery is being executed —and with his eyes still closed—the student should be asked for his version of the aircraft's attitude. The normal response, without visual references, will be that the aircraft is diving. Immediately after the student's response, have him open his eyes while still recovering from the turn. The false sensation is readily apparent. In this maneuver, the IP effects a slow recovery from a coordinated turn at a rate of recovery of 2 degrees per second per second or less, with a normal decrease of positive G.

The IP then explains to the student pilot that while under instrument conditions, should the eyes be diverted from the instruments and the aircraft enter a slow, coordinated turn followed by a slow recovery, the body perceives only the decrease in positive G force. The instructor should then explain that the organs of equilibrium do not perceive the slow recovery from the turn, but do perceive the decrease in positive G and that this is normally interpreted as entering a dive.

The third maneuver which the IP demonstrates is the false sensation of tilting to right or left. While in a straight and level attitude, the student closes his eyes. The IP produces a wings-level moderate or light skid to the left. The normal sensation is that of the body being tilted to the right. This false impression may be explained as the effect of side-to-side accelerative forces on the organs of equilibrium. When the eyes are momentarily diverted from the instruments and at the same time a skid to one side occurs, a false impression of tilting the body to the opposite side is created.

The fourth demonstration consists of inducing a false sensation of reversal of motion. It can be demonstrated in any one of the three planes of motion.

While straight and level, the student closes his eyes. The instructor smoothly and positively rolls the aircraft to one side to approximately the 45 degree position, while keeping the nose level and on a point by blending in stick and opposite rudder pressure. The roll is abruptly stopped and held. The student is asked for his interpretation of the maneuver. The normal reaction is a strong sense of rotation to the opposite direction.

The student should then be allowed to observe the attitude of the aircraft in the banked position. The instructor's explanation should be that a rotary motion when abruptly stopped, while visual references are poor, produces a strong feeling of opposite rotation.

He further explains that when the eyes are diverted from the instruments, should the aircraft either roll or yaw with an abrupt stop, a sensation of either rolling or yawing to the opposite side is produced. Control response based solely on this sensation would, therefore, be opposite to the false feeling and cause a re-entry into the original roll or yaw. This is a common error in rolls or spins when visual references are poor. When abrupt recovery is made, it is followed by immediate re-entry into the original maneuver, sometimes referred to as a "graveyard spin."

Because the fluid of the semicircular canals of the middle ear continues in motion through its own inertia after the body's movement is stopped, it produces the same effect as if the body were actually moving in the opposite direction. The normal reaction to this illusion, based solely on the sensation perceived, is potentially dangerous.

The fifth maneuver is one designed to give the student pilot the sensation of diving or rolling beyond the vertical plane. It produces a marked, very strong, true vertigo which evokes a vigorous physical response. This can be dangerous at low altitudes. (Maneuvers numbers 4 and 5 produced the most positive vertigo reactions.)

While in straight and level flight, the student sits normally and either closes his eyes or lowers his gaze to the floor. A positive roll toward the

45- or 90-degree position is started. As this is definitely established, the IP asks the student to bend over a little bit and look to the right or left, then immediately assume the normal seated position. The instructor should so time the maneuver that the roll is stopped just as the student returns to the normal position. Intense vertigo is produced which gives the sensation of falling into the direction of roll as well as downward. This sensation is so quick and so strong that there is a rapid, forcible movement upward and backward to the opposite side. No further explanation is needed; the confusion speaks for itself. Variations can be effected by having the student make this head movement when the aircraft is turning, spinning or rolling.

This dangerous reaction occurs when the eyes are diverted from the instruments and the head is moved downward and turned, as when changing frequencies on most radios in jet aircraft. If the aircraft rolls or turns and suddenly the head is raised to the normal position, an intense vertigo is reproduced. This is accompanied by an almost uncontrollable urge to move physically in the opposite direction. This reflex movement may well be transferred to the controls.

This maneuver is well designed to induce a combination of two or more of the above false sensations acting at the same time. When the head is moved at right angles to a plane of passive rotation and the rotation stopped abruptly, a sensation of rolling in the opposite direction is produced, as well as a sensation of falling forward. When the head is turned at the same time, the sensation of turning in the opposite direction is also added. The degree of vertigo and physical response is dependent upon many variables—on the movement of the aircraft, motion of the head and the time element.

The best preventive measure against this type of vertigo is education against making excessive head movements under IFR conditions. Extreme caution should be used during descents, turns, and at low altitude, with frequent reference made back to the flight instruments if the eyes are momentarily taken off the panel.

Inflight evaluation tests of the Inflight Vertigo Training Program were conducted at the Ninth and Twelfth Air Forces by qualified instrument pilots of the various instrument training sections. The results of the inflight training program evaluation were generally favorable.

The suggested maneuvers are compatible with single-place and two-place jet aircraft. Cargo-type aircraft and helicopters could not perform some of the maneuvers because of excessive stresses. For example, maneuver No. 4 may cause undue stress on the rudder assembly of the C-130. Maneuver No. 4 is acceptable for the C-123, provided 45 degrees of roll and 140 knots are not exceeded.

Although all maneuvers definitely produce vertigo, the sensation induced varied with the individual pilots. There was a marked relationship between pilot experience and the degree and type of sensation produced. This was more evident in multi-engine cargo aircraft than in single-engine jets and may be related to the propeller and engine noise variations associated with changes of altitude and airspeed in conventional aircraft.

Here are the recommendations submitted by the testing units of both the Ninth and Twelfth Air Forces:

• A suggested vertigo-inducing maneuver for jet aircraft would be to place the aircraft in a nose-low attitude as in a penetration, then gradually roll into a penetration turn, and suddenly stop the turn while blending in opposite rudder. The reaction most commonly noted was that the pilot increased the bank in the original direction, and thus entered a spiral. (Note: This is a practical application of maneuver No. 4.)

• In tandem seat aircraft it is difficult to time the roll in maneuver No. 5 to coincide with the student's return to the normal seated position. It is suggested that the maneuver be modified so that a penetration descent and turn is set up with the student observing. After the turn is established, have the student close his eyes or lower his gaze to the floor. After approximately 20 seconds, have the student bend over (*head and trunk down*), look left or right and immediately assume the normal seated position. In every case tested, the strong sensation of climbing either straight ahead or in the opposite direction was produced. This maneuver simulates an actual situation frequently encountered, that of changing radio channels during penetration turns.

• Reproduce, for training purposes, the sensation of climbing vertically. Under hooded conditions, this sensation can be induced by a go-around from a low approach or a GCA approach. This sensation of climbing is produced by changing from a slow airspeed for approach to full power for climb airspeed, including afterburner for aircraft so equipped. The change in angle of attack plus aircraft acceleration produce a strong sensation of a vertical climb. (Note: This is a practical application of maneuver No. 3 in which the otoliths are affected by acceleration in a foreaft direction.)

• Vertigo-inducing maneuvers should be incorporated in the instrument training curriculum of all Tactical Air Command units. The maneuvers of the inflight vertigo training program could be used as a guide for developing maneuvers compatible with the type of aircraft utilized.

• The U. S. Air Force Instrument Pilot Instructors' School should analyze and develop basic maneuvers suitable for vertigo training in aircraft now in the USAF inventory. This information would be included in the appropriate USAF publications and in the curriculum of the Instrument Pilot Instructor's School.

Since the organs of equilibrium which nature gave man cannot be expected to change, the experience of vertigo, disorientation, or sensory illusions, whichever name you choose, will continue to occur when conditions like those discussed are met.

The only practical remedial approach, therefore, will continue to be that which has been used in the past: *training* and *education*. If the pilot understands vertigo, its causes and consequences, he will develop the confidence to follow the basic rule:

Believe those instruments; they are more often right than wrong. ▲

Answers to T-Bird Quiz
Page 11

1. False	6. True
2. False	7. True
3. True	8. True
4. False	9. True
5. True	10. False

When confronted with a fire warning indication, follow your planned procedures. Make your decision, whether or not to eject, on the basis of sound reasoning.

Think hard for just a moment and recall the first time you had a fire warning light glow ominously from the instrument panel. Remember the initial impact this stimulus had on you? You could probably write pages about what happened, but one thing is certain: your body called for every last scrap of its resources to carry you through that "moment of decision." The truth of the old phrase "There's no substitute for experience" was proved again as the answer to your dilemma came to you from somewhere deep in your subconscious mind. You regained your composure in only a split second and went to work to analyze and evaluate your situation.

Then you remembered: the Part II, 781, had mentioned a tech order on the fire warning system to be complied with on the next inspection. "Anything," the crew chief had remarked, "would be an improvement on the present system which has caused so many false alarms on squadron aircraft." This red light was probably another false alarm. So you used the applicable Flight Handbook procedure. Maybe it went like this: power was reduced, instruments inspected, neck twisted to detect the telltale plume of smoke. No signs of fire, so you hit high and low key and brought it in over the fence for a smooth landing. The flight ended safely with little more than a hazard report to be accomplished. Now let's discuss why.

First, the results of professional training came to your rescue. Self-discipline, acquired through long months and years of education, overcame the panic that exploded in you when the fire warning light glowed red. Instead of blindly ejecting, you stopped to think, took a moment to evaluate your situation.

Second, you knew your procedures and followed them.

Third, after you reduced the power, the rest was just a matter of careful flying. You went into the old, familiar flameout pattern which you had practiced a hundred times.

The Creator endowed man with a mind capable of astounding things. Like any living matter, it can be developed, refined, perfected. But the brain is a sensitive mechanism, easily upset, often shaken and panicked. While "panic" is an irksome word to many, especially to a well-trained individual, it does represent an emotion to which we can all fall victim. In our example, calmness substituted for panic. While calm, the mind had a chance to think, logic had a chance to help, and the outcome was a sound decision based on professional training.

After I decided to write this article I began checking into the statistics. I was surprised to learn that inflight fires and false fire warnings that cause premature ejection take such a big bite out of Air Force appropriations each year.

I've had my own experiences with panic in connection with the fire warning system, but I don't hold myself out as an expert on the subject. Anyway, since a friend defined an expert as "a person who avoids the small errors as he sweeps on to the grand fallacy," I've decided to be cautious about being an expert on anything. But some of the test pilots here at Edwards are old hands at the flying game and I decided to check with them on their procedures for handling this fire warning emergency.

All of them agreed that you have to have a plan of action *ready* when that bright red light comes on. Don't be caught by surprise. There's no need to panic; after all, you're still in the seat and still in one piece. That's in your favor. The first thing to do is *reduce power and search for evidence or effects of fire.* This is where knowledge of the airplane's components and systems—especially the fire warning system—pays off in a big way. All those little things learned in hours of discussion with crew chiefs, tech reps and other pilots now add up to something important: maybe *you* can figure out just what's wrong.

If possible, get a visual check from another aircraft. And consider the location in case you do eject. Will sur-

PANIC!

Maj. James J. Butler, Jr., Chief, Operations Div., AF Flight Test Center, Edwards AFB, Calif.

vival be a problem? Can the plane be set down safely? Just raising the armrests and squeezing the trigger may dump you out of the frying pan into the fire. If you have a course of action—or reaction—planned for the moment when that scary red light comes on, you won't just sit there transfixed with indecision and fear. You'll think, act, survey the situation, and come up with a solution that will in all probability bring you through the emergency safely. The important thing is BE READY.

The procedures in case of fire warning suggested by the T.Os. for the Century Series vary somewhat from plane to plane. But even if the procedures were alike, the question naturally arises, do these T.Os. still leave room for the pilot's own decision? The answer is an unequivocal *yes*. In the words of the old cliche, "It's part of a pilot's inherent responsibilities." The T.O. provides you with a plan, not a dictated course of action.

I asked Dick Johnson, Chief Engineering Test Pilot for CONVAIR at Edwards, what his first reaction was to a fire warning light. His reply was simple: *"Is it telling the truth?"*

He reminded me that, with his rather extensive testing experience, he had become somewhat hardened against the shock of seeing the fire warning light blink on. He emphasized the importance of knowing one's aircraft, especially the geometry of the fire warning system. With sound knowledge and a plan of action, he went on, the pilot can perhaps diagnose the trouble and spare himself the dangers of ejection.

During Dick's career as a test pilot he has seen many improvements made in the fire warning system and in the overall fire protection built into the aircraft. For example, the F-106 airframe is shielded from the engine by a titanium shroud. While he'd had a few false fire warnings in the '102, he's had none in the '106, which certainly shows some progress.

"Takeoff is naturally the most critical time to have the fire warning light come on," Dick continued. *"If the pilot cannot abort safely, then he should try for as much altitude as possible, not just for the sake of ejection but to get himself some time and a relatively safe position so he can do some level-headed analyzing. If the light comes on while in flight, there's a lot less sweat, because he's got time and altitude and can make a calm decision. If there's a populated area below, he may not be so quick to eject."*

When I queried Dick on flameout landings as a tempting solution to fire warning indications his answer was, *"It's risky business. My advice is, don't shut off the engine until you're sure there's a fire."*

And that took Dick back to his first point: Is the fire warning system telling the truth? *"No matter how tempted we may be to eliminate the warning system because of expense or unreliability or difficulty of maintenance,"* he said, *"there will always be a requirement for it, especially in fighter aircraft. Learn the system and its little peculiarities. Then you'll be able to get the truth out of it."*

Colonel "Andy" Anderson (Lt. Col. Clarence E. Anderson, Chief, Flight Test Operations Div., AFFTC) was the next pilot I put the problem to. He surprised me by telling me that though he's been checked out in jets since 1948, he's never had a fire or even had a fire warning light come on.

"But I've got a plan of action all worked out if the light does come on," he said. *"The point I'd like to make, though, is that to my way of thinking it's just another emergency, to be thought out in advance with all the possible alternatives clear in my mind. It won't be too long before a near-perfect warning system is developed, and in the meantime, the smart pilot will know the geometry of the one he's using. For my money, the most critical time for a fire warning light to come on is on takeoff. This is the most likely time for an indication, true or false, 'cause it's the first time you wind 'er up to full power. If you've got enough runway for a safe abort,*

do it, otherwise gain as much altitude as you can for a safe ejection or time to analyze the condition. If you're in flight when the fire warning comes on, I think the best thing is to reduce to idle power and evaluate the situation before stopcocking prior to ejection or flame-out landing. Ejection isn't the safest way of coming down, and deadsticking the Century fighters requires ideal conditions. So analyze first, but if good judgment says 'eject,' then get out of it—fast."

When I mentioned the fire warning problem to George Jansen, Flight Operations Manager for Douglas, at Edwards, the first thing he said was, *"The reliability of present fire warning systems is wholly inadequate. In my opinion, 80 per cent of the fire warning indications I know about have been false alarms..*

"Sure, I'm a multi-engine pilot, with that many more engines to harass me, but that's still a large figure and represents a lot of scared pilots. In two years of test flying the C-133 I had five—FIVE—false fire warnings. Company procedure is to shut down the engine and investigate the cause of the warning down on the ground, but this wastes thousands of dollars in lost time and effort. I'd like to see a system developed whereby the pilot could check out either part or all the circuitry at any time. This way he could test, analyze, isolate and probably draw a pretty accurate conclusion as to the existence of a fire, should his lights come on. But the system should be rigged so that malfunctions did not show up as fire warning indications."

"What does a multi-engine pilot like you think is proper procedure for a single-engine driver to use if he gets an indication?" I asked him.

"I don't know what he'd do, but I know what I'd do," George replied. "If the fire warning occurs close to the ground, I'd get as much altitude as possible in a climbing turn and reduce my power to idle, if necessary. While turning I'd check for smoke trails and have another aircraft give me a double check. Another thing, no matter how high I was I'd always climb for a little more altitude. Gives you time to think."

While each of the pilots I'd talked to had his own ideas on the subject of fire warning indications, they all emphasized the same thing—take a moment to stop and analyze the situation before doing anything drastic.

Bob Baker, Chief Experimental Test Pilot for North American, was no exception. *"I've always felt that a pilot should gather his wits and take a moment to analyze his situation when that fire warning light comes on, and not just blast out into the unknown. My pilots think the same way, and we've finally got our thinking on the matter—in conjunction with ARDC and DFSR—into the F-100 Flight Manuals."*

Bob went on to tell of North American's procedure wherein an aircraft with a fire warning automatically notifies the tower and any chase aircraft in the vicinity. Bob and his pilots have a carefully thought out plan of action to depend on, in case of a fire emergency. And they know their fire warning system down to the last filament and probe.

I asked Bob what he thought of the idea of discontinuing fire warning systems. He was emphatic in his answer: *"Let's not kill development on an item as important as this. Let's learn and understand the present systems, utilizing them to their best advantage, and improve their development."*

The last man I talked to, Mr. Robert Denn, Experimental Test Pilot for Pratt & Whitney (Edwards), had not been as lucky as some of the others. He almost lost his life during a deadstick landing of an F-80 when the elevator control rods burned off when he was close to the ground. In a test flight of an F-100 some time later, he received an engine compartment fire warning and, following T.O. instructions, ejected. Subsequent investigation revealed that an electrical fire had destroyed the fire warning circuitry but apparently had not been extensive enough to have precluded saving the aircraft. But as Bob said, with a touch of sarcasm in his voice, *"Hindsight is more revealing than foresight."* The memory of his F-80 accident, the T.O. instructions which required ejection under these circumstances (since changed, as brought out by Bob Baker of North American, above) and the lack of a suitable landing area had all influenced his judgment.

Bob commented freely and at some length on the inadequacies of present fire warning systems. He revealed that, following his F-100 accident, Pratt & Whitney had modified one of their test vehicles so that a more detailed analysis of a fire warning could be obtained by the pilot through a selective switch arrangement in the cockpit. The condition of various heat probes throughout the aircraft could be tested through independent circuits. Thus the pilot had a better opportunity of diagnosing the true condition of his aircraft if the warning lights went on.

"Even this is not foolproof," Bob went on, "but it affords the pilot an opportunity to improve his logic during a critical situation. Sure, we need a foolproof system, but this will only come about as the result of continuous testing and development. I've spent a lot of time researching this matter, and I've found that nearly foolproof systems are availabe engineering-wise, but there are many drawbacks to them. They're not practical because of their weight, cost or complexity.

"However, taking our present systems as they stand," he continued, there's one thing that could be changed now: the nomenclature in the cockpit that says 'Fire' or 'Fire Engine Compartment.' This could be toned down to reflect a more realistic condition, perhaps, and just say 'Fire Alert' to indicate the possibility versus the actuality. Yes, present systems have deficiencies, but that's all the more reason why the pilot should know the system thoroughly. I think Flight Manuals should have more detailed information on the system."

When I asked Bob to sum up his advice he said, *"The pilot should have patience and analyze the situation before ejecting. If he doesn't, he's likely to be worse off, considering that the ejection process is not the safest way to get on the ground."*

Well, there you have them, many thoughts on one subject, yet all following a similar pattern. In sum they say: present fire warning systems are not 100 per cent reliable, and have caused numerous accidents, some through premature ejection. Development of an ideal fire warning system is essential and likely in the future. In the meantime, pilots have the capacity to bridge this temporary deficiency through training and preparation.

It all adds up to this: When you're confronted with a fire warning indication, Don't Panic! Have a plan and follow it. Make your decision on the basis of sound reasoning. ▲

• Letters to the Editor (Continued From Page One) •

UR It, Captain!

It is requested that an article be published in the next issue of your magazine on the contents of this letter.

On 29 May 1959 I was called to the PE section of a squadron and shown a B-5 parachute which had been repacked and issued with the locking pin still in the pilot chute. (See accompanying pictures.) The man who packed the chute, and his supervisor, were present when we pulled the ripcord. Nothing happened except a bulge showing that the chute wanted to blossom. A shaking of the back pack by hand caused the chute to drop out and fall to the table. The supervisor said that wind buffet would have opened the chute. (To me this sounded like an obvious effort to defend his man.)

It seems that a pilot was being fitted with this chute when an airman noticed the rod ends sticking out of the pack. The history of this event is interesting . . . repacked 13 May 1959 . . . discovered 29 May 1959. This rod was not discovered on the 10-day inspection in the interim. The required 18" rod and streamer were not available . . . the man used substitute item $10\frac{1}{4}$" long without streamer.

The T.O. required rod has since been locally made and a streamer attached to each. The tech order (T.O. 14D1-2-81) leaves a lot to be desired. For instance, the photos show non-standard rods being used (somewhat similar to the almost fatal one in accompanying pictures) yet the sketch of the 18" rod is quite explicit.

A low altitude ejection with this B-5 and all of its fast-time items would surely have been fatal. All chutes on this base have been checked for this condition and this has become a source for providing impetus to our quality control efforts.

Capt. Robert A. McCauley
FSO, 7486th AB Gp APO 115 NY

The UR is still in vogue, Captain.

★ ★ ★

★ ★ ★

Airfield Hazard

This picture shows how operations personnel at one base solved an airfield facilities problem.

An airfield marker light had been placed on a concrete block which had a dangerously high lip. Individuals interested in removing this hazard tried to get Installations to grade the surface level up to the top of the concrete block. Promises of action "at some indefinite future time" was the best they could get.

Officially, the flying safety individual who placed the balloon on the concrete block was trying to warn pilots against running off the runway at a point where damage to aircraft was probable.

Unofficially, the balloon served to remind Installations that they had promised to take care of the hazard "sometime real soon."

"Real soon" came very quickly—after the balloon was raised. In fact, that particular airfield hazard no longer exists.

Col. Robert C. Brown
AF Sr. Advisor
Massachusetts ANG

Let's buy some more balloons!

Controller Training

This headquarters has established a training program for jet indoctrination of Air Traffic Control personnel. The main purpose of this course is to give our controllers a better understanding of the physical and mental problems encountered by the jet pilot in normal operations and a better appreciation of the various emergency situations that may confront him. We believe that a controller's ability to perform his job depends a great deal on an appreciation of the problems peculiar to and affecting the operation of the aircraft. Since jets present many unique problems and procedures, it is important that ground personnel engaged in the control of such aircraft receive special and formal indoctrination in jet operations.

The consistently excellent material contained in your magazine has been selected by this headquarters to be used as a training aid for this program and therefore request that our AACS squadrons be added to FLYING SAFETY's mailing list.

Maj. Edwin T. Brady
Director of Operations
Hq Alaskan AACS Region

Thanks for the kind words. Your squadrons are on the mailing list and we hope that your AACS training program will be a real boost to its controllers.

★ ★ ★

Parachute Landing Fall

I have read the article, "How Hard," in the March issue and the comments by Lt. Francis Coyle, in the July book. Many things have been said for and against training of aircrew members in parachuting procedures. True, to relax when making a parachute landing is very important, but to relax and let your body fall whichever way it chooses is not right. Lt. Coyle's method of looking up into the canopy is, as he states, not the proper method; in fact, it is a very dangerous method. On contact, you could very easily snap your neck.

To wrap this whole thing up, a parachute landing fall is the recommended method used by the Airborne Infantry School and taught here at the USAF Combat Survival Course. We emphasize the importance of relaxing.

Prior to contact, you should have both feet together, knees slightly bent, hands high on risers, eyes on the horizon, and relax.

Upon contact, you should have feet together, knees slightly bent, elbows and hands pulled down on chest, and your chin on chest. Now relax—and fold into the five points of contact:

- balls of feet
- calf of leg, either side
- thigh
- buttock
- across small of back onto pushup muscle (side of back).

All it takes is training, not only here at Stead but also at your own bases. To know how to make a parachute landing fall is as important as the proper fitting of your parachute harness.

And as a closing reminder: Don't forget your boots!

SSgt. John R. Schumann, USAF
Combat Survival Standboard
Stead AFB, Nevada

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