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FLYING SAFETY

UNITED STATES AIR FORCE

DELTA - FOXTROT

GOLF - COCA - INDIA

pages 4 to 11

FLYING SAFETY

VOLUME ELEVEN NUMBER TH

Department of the Air Force
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Publications

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LOST?

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SUBSCRIPTIONS

FLYING SAFETY magazine is available on subscription for $3.00 per year domestic; $4.25 foreign; 25c per copy, through the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Changes in subscription mailings should be sent to the above address. No back copies of the magazine can be furnished.

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Major General Victor E. Bertrandias

Deputy Inspector General USAF, (Inspection)

- Directorate of Flight Safety Research
- Directorate of Readiness and Materiel Inspection
- Directorate of Procurement Inspection

General Bertrandias retired from extended active duty last month following thirty-seven years of active and inactive service. During retirement ceremonies at Norton Air Force Base, California, General Bertrandias received the Distinguished Service Medal in recognition for his service in the Office of The Inspector General, USAF. The award was made by Lt. General Truman H. Landon, The Inspector General, USAF.

General Nathan Twining, Chief of Staff, USAF, in a letter to General Bertrandias, presented him with a USAF Flight Safety Plaque — originally developed by General Bertrandias for presentation to USAF organizations for outstanding safety records — for "outstanding contribution to the Air Force Flight Safety Program."

During the past five years General Bertrandias has been responsible for the world-wide activities of the Directorate of Flight Safety Research as well as the Directorates of Readiness and Materiel Inspection and Procurement Inspection.

The staff of *Flying Safety Magazine* and the officers, airmen and civilian employees of the Office of The Inspector General, USAF, join in wishing General Bertrandias continued health and happiness and extend sincere congratulations for his years of distinguished service to his country and the United States Air Force.

LETTERS TO THE EDITOR

The Erring Altimeter

Reference is made to the December 1954 issue of FLYING SAFETY, and particularly to the following paragraph of the interesting article, "Plan It—Fly It," page 9:

"Inherent error in altitudes at high speed is a problem, but there is a simple rule-of-thumb method for compensating for error that can be used. For every mile per hour increase in airspeed over 200 mph, the altimeter will indicate one foot too high. As an example, at 600 mph the aircraft will be 400 feet lower than the altimeter reading."

This rule is a safe rule inasmuch as it helps to provide an additional safety factor in the clearance of ground obstacles. However, it does not provide a sufficient amount for some aircraft and it is not universally applicable to providing safe vertical separation of aircraft on the airways under IFR.

The rule-of-thumb may apply very well to a particular model of airplane but will apply in an opposite way to another model. There is a wide variation between models even in the same family of aircraft. The F-84B differs from the F-84F. It is suggested that the particular model of aircraft and altitude of flight be mentioned for this rule-of-thumb, such as: Model F-94C at 10,000 feet. It does not apply to the model F-89C or the model B-47 which have static port installation errors with an opposite sign.

The Dash One Flight Handbook should be consulted where the error is tabulated for some aircraft.

While this error is excessively large in some military aircraft it also exists in commercial transports and is the subject of increasing concern by ICAO, IATA, CAA, various foreign governments and various airlines. In the DC-6 at 18,000 feet this error approaches minus 250 feet at cruising conditions while in the Constellation L-749 under the same conditions the error approaches plus 200 feet. In the last two years there have been more than six instances of near-collisions on the airways where a DC-6 was supposedly flying 1000 feet higher than a Constellation on the same route. When the Constellation is assigned to fly a level 1000 feet higher than a DC-6 the actual clearance probably is more nearly 1500 feet. The application of the rule-of-thumb mentioned in FLYING SAFETY will not help a situation like this. An individual rule for the DC-6 and a second more correct rule for the Constellation are necessary to prevent these near-collisions.

Another rule-of-thumb regarding this error which is also significant is that the value of the error in terms of feet of pressure altitude is doubled for each increase of altitude of 18,000 feet. In other words, at 18,000 feet the value of this error is double the value at the same indicated airspeed at sea level conditions and at 36,000 feet (actually at 33,500 feet) the value is four times that at sea level. At 54,000 feet (actually at 48,000 feet) the value of the error is eight times that encountered at sea level at the same indicated airspeed.

Lt. Col. John G. P. Callahan
Directorate of Research and Development, Office DC/S

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More T-Bird Tips

This unit is interested in obtaining any material available on the effects of gun access doors on T-33A aircraft opening during takeoff or during flight and what counter-measures pilots should use to help assure a safe landing.

Any information or publications you may furnish us regarding this matter would be greatly appreciated.

Your article "T-Bird Tips" in the November 1954 issue of Flying Safety Magazine has been made mandatory reading for pilots of this organization.

1st Lt. Hal W. Morrill, ANGUS
FSO, 116th F-I Sq
Geiger Field, Spokane, Wash.

This is in answer to your request for information available on the effects of gun access doors on T-33A aircraft opening during takeoff or while in flight. This office has a draft copy of the proposed revised edition of the T-33A Flight Handbook (T. O. IT-33A-1) which has been approved by Wright Air Development Center (WADC) and will be published in the near future. Included in Section III of the handbook are the following instructions and procedures recommended in event of the opening of the armament hood doors during takeoff or while in flight:

"The armament hood doors have been known to come open in flight. Almost invariably, the reason is that they were not locked prior to takeoff. If they are not locked they usually will start to come open just as the aircraft leaves the ground on takeoff at 120 knots. If they do, drop the dive flaps. The sucking action thus induced by the dive flaps helps to hold the doors closed. Get the air-speed above 130 knots as soon as possible.

"The armament hood doors normally will stay closed at airspeeds above 130 knots and below 215 knots. Make gentle turns, jettison the tip-tanks if over one-half full and come back in to land. Fly the final approach at 140 knots and bring the aircraft down very close to the ground before leveling out. Be cautious. Do not balloon or attempt to spike the aircraft on the runway.

"In the event the armament hood doors come open in flight, lower air-speed immediately by dropping dive flaps and reducing power."

The above procedures were established by Flying Training Air Force, *Air Training Command, and are based upon experience within the command. The procedures were approved after further study by WADC and although they have not been published as yet, may be considered as official.*

I would be obliged if some additional information could be forwarded to me with regard to an article in the November 1954 issue of Flying Safety. Reference is directed to page 6, *T-Bird Tips* by Major James A. Jimenez.

During the course of the article much attention is directed to malfunctioning tip tanks. In particular I am rather vague as to how tip tank feeding is readily determined by checking the aileron trim. Granted, excessive aileron trim (up or down) will be a definite indication of one tip feeding faster than the other, or not feeding at all for that matter, but the big question that enters my mind is, "Which tip tank is the heaviest?"

The trim tab location will tell me which wing is heavy, but does this mean the tip tank on that wing is yet full of fuel? I have had occasion to believe that the tip tank opposite the heavy wing would be the one with more fuel.

Additionally, I would like to know which wing will have the greatest lift at the instant one tip tank may have to be jettisoned.

Your cooperation and concern in the above questions will be gratefully accepted.

1st Lt. Robert Ball
Craig AFB, Alabama

If the aileron trim tab is toward the up position, it means that you have added trim to hold the right wing down. The left tiptank is malfunctioning, causing abnormal left wing heaviness. If the trim tab is deflected downward, the right tiptank is malfunctioning and causing the right wing to be the heaviest. When in doubt, actuate the aileron trim tab slowly to the neutral position. Unusually heavy stick pressure will indicate which wing is the heaviest. Be sure to move the trim tab very slowly and make sure that you can maintain control of the aircraft satisfactorily with the trim tab in neutral.

In regard to wing lift, a wing with a tiptank installed has greater lift than one without a tiptank. The difference in lift is negligible, however. The amount of fuel in the tiptank means increased weight at the outer end of the wing. This brings up another point. If you have to jettison a heavy tank, be sure to have the aileron trim as close to neutral as possible. If you have full left aileron trim rolled in to correct for a heavy right wing, the aircraft will roll quickly to the left at the instant that the right tank is jettisoned. You must neutralize the trim as much as possible before jettisoning and anticipate a roll to the left when the heavy right tiptank is jettisoned. Be ready to apply firm stick pressure to the right at the instant the tiptank goes.

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Cross-Wind Computer

Many airfields presently in use have only one runway or one primary runway, hence it is often necessary to make cross-wind landings. A knowledge of the actual amount of cross-wind present is essential. As cross-wind operations become more common, wind can be given by the control tower in terms of cross-wind component with respect to the runway assigned. Meanwhile, it is necessary for the pilot to compute the cross-wind component from information furnished by the tower, i.e., landing runway and wind direction and velocity.

I am enclosing a cross-wind component computer which I developed and made for use here in the Azores where often we have to contend with a strong cross-wind component before landing. This computer is held together with a thumb tack (rather than the rivet type fastener normally used) so that it may be disassembled easily for inspection and/or photographing of the two parts for possible reproduction in FLYING SAFETY.

This computer was made photographically and then laminated in plastic. This method of production is not completely satisfactory, as the photographic paper is stretched in the process of lamination, and the finished product, while still accurate, becomes distorted and somewhat difficult to read on certain settings. Also, when carried in the pocket (for which it was designed), body heat causes the light plastic to warp, shortening the effective life of the computer.

All necessary instructions are printed on the computer. For example: Runway in use is 32, with wind from 020° magnetic at 25 knots. Place 020° (wind direction) under 32 (runway heading) and opposite wind speed of 25 knots. Read cross-wind component of 21 knots. The wind is from the right on landing, so you have a 21-knot component from the right. Yes, the component can be computed on the reverse side of the E-6B or on the AN-01-20-CAC-1 cross-wind component chart, but neither of the above provides an easy and instantaneous method of computing the component, and in addition, each requires a certain amount of interpolation. This computer is simple and easy to use and provides an instantaneous computation which is read directly from the face of the computer. Try it and see.

As mentioned before, this computer was developed to fill a local need and was constructed out of the material at hand. However, it is felt that it may fill a more universal need, or rather I should say that it might fill a more universal need if it were available. It is further felt that this computer could be easily mass produced, either on metal or a plastic or fiber compound which is not affected by changes in temperature.

This computer is submitted for your evaluation and possible dissemination of the information to others through your magazine.

Anyone interested in further information on the construction of these computers can write to me c/o 57th Air Rescue Squadron, APO 406, N.Y.

Major Parker B. Mudge
Operations Officer.

Looks good to us. If you have any questions the man gave you his mailing address.

This computer enables a pilot to figure the cross-wind component rapidly and accurately.

Lost—
Misplaced—
Disoriented—

THE PILOT WHO SAYS HE HAS NEVER BEEN LOST is either pulling your leg or has never flown an airplane. Granted, everything is relative, including the term "lost." Maybe your definition of the word is like Daniel Boone's, who said, "Wal, I've never been lost, but I was misplaced once for three days."

Regardless of whether you like the term lost, misplaced or maybe disoriented, if you're holding on a beacon when your radio compass goes out, you need help. If on a cross-country you miss a checkpoint, cannot recognize the terrain and your radio equipment fails to pick up anything resembling a range or beacon, consider yourself lost (misplaced), (disoriented).

Add to these thoughts the possibility of encountering mechanical difficulties requiring an airfield right now, and you really establish the need for some fast navigational assistance.

The facility that has the primary function of assisting lost aircraft is the Direction Finding station. A single unit has the potential of giving bearings to or from the station. Two or more stations can establish the actual geographical position of an aircraft. The DF systems are reliable and can be depended upon provided you are within VHF or UHF range. A look at Figure 1 reveals the location of the DF stations included in the March Flight Service Center evaluation net.

It should be realized that the time may come when you need help but cannot raise a DF unit. In this case, the Air Defense radar network may be of assistance. These radar units have the primary responsibility of protecting our industrial plants and cities, but also possess the inherent capability of rendering assistance to lost or distressed aircraft. The procedure to be used in the event of radio failure when within range of a radar installation was covered in the article entitled "Hidden Help" in the November issue of FLYING SAFETY. The methods outlined in the following story for both DF and Radar Assistance are based on having operational radio receivers and transmitters.

It should be noted that utilizing the Air Defense system should be reserved for emergencies only, or in cases where, if assistance is not received, an emergency may subsequently become a reality. Conversely, utilizing the DF network for practice steers and fixes is strongly encouraged.

DELTA-FOXTROT

IT WAS a clear and cold March morning when the student pilot started rolling down the active runway. The T-Bird appeared to enjoy the chilled air for it leaped off after a minimum roll.

Climbing upstairs, on course, the pilot mentally reviewed each phase of his projected flight. This planning business was great stuff, but it surely did take up a lot of time. Passing through 5000 feet, he made the normal oxygen and fuel checks. Funny how easily habit is acquired.

He hit the first two check points right on the button. Computed airspeed was just right. Even now he was amazed at the accuracy of forecast winds. Those crystal-ball lads were really hot.

Sometime later the T-33 passed close to another check point, but the pilot missed it. He frowned, studied his map and looked at his watch. The bird-dog cranked around about 160 degrees and settled down. Then, without waiting longer, without considering a relative bearing, the student pilot tried to tune in the next station.

Possibly no one ever told this lad that ranges are often shut down for maintenance during VFR conditions. Maybe he didn't check the NOTAMS. There are several possibilities why he didn't know, but the fact remains the next range ahead was off the air.

Okay, you say, why didn't he fly a reciprocal from the last station? His course had been fairly good. Although he didn't see the last check point, the time element and bird-dog swing indicated station passage. Why fiddle around with a dead duck?

Of course you'd be right, but don't forget this laddie had a couple of hundred hours *total!* You've probably got more than that just taxiing. So he made his first mistake.

Remember how you got your wind up the first time you were lost? Sure, you were lucky and finally got oriented by flying down a railroad track and reading names of stations and water towers. Remember, too, you were flying an old BT-Vibrator and had lots of gas to mill around. But this lad had a T-Bird. Altitude meant fuel. Fuel and planning were his only hope. No hedge-hopping here.

In a few minutes the T-33 driver made his second mistake. After frantically trying to match up landmarks with existing hills and towns on the map, he concluded he had been blown way off course. Those weather jokers weren't so hot after all. Maybe if he held the map upside down it would help. But, no. That big mountain range up ahead still didn't fit anywhere on the chart.

Let's see. We were flying a heading of 240 degrees. Maybe a 180 would be the best bet. Seems as though there's a field back a ways. Let's see. The reciprocal of 240 must be ——'um, that would be 200 subtracted from 240 less 20. Sure, that's it. 20 degrees. Okay, we're lost. We might as well face it, but there should be enough fuel to get home.

Another few minutes sped by as the T-Bird boomed along over the desert wastes. A large dry wash slipped underneath. Some jagged black rocks thrust themselves from the desert floor like primeval monsters. Finally, a dusty road appeared, turning and twisting aimlessly. A rutted highway from nowhere to no place.

This was completely strange country. The pilot realized that something had gone wrong. Bad wrong. The totalizer was ticking off his last hope with monotonous, hesitating little skips. He could feel perspiration dripping from his armpits. The drops were cold as they soaked against his body. *Something* had to be done now!

He remembered vaguely that one of the instructors had talked about steers one day. Was it his instructor or somebody from the ground school? Funny how you can't tie things up right when you're excited. Well, who ever it was had said something about using the radio and calling for help on one of the channels. But, who to call? Doesn't seem very logical to call for help in the blind.

He studied the radio receiver panel for a bit, finally decided to take a gamble and punched the A button. He waited for the whistle of the channel change. It took but a moment. Then he wondered what to say.

He started the transmission timidly.

"Hello, this is Air Force jet 25012. If anyone can hear me, I'm lost."

He waited and listened. He could hear his own breathing and the harsh swishing of the ear phones. Nothing. Then the voice came. So suddenly that he jumped. It was a casual, friendly sort of voice.

"Air Force 25012. This is Yuma Radio; DF is standing by. Switch to Delta channel and call Yuma DF. If contact is not established in one minute, give Yuma Radio another call on this same frequency—over."

Well, this was more like it. The student could feel confidence bubbling through his system. He didn't feel lost now. Somebody was close by; somebody could help him.

He quickly changed channels and squeezed the mike button. "Yuma DF, this is Air Force jet 25012. Can you read me? This is an emergency. Which way should I fly to find a field? Over."

"Air Force 25012, this is Yuma DF Homer. Transmit for a steer—over."

The student pondered for a moment. He remembered something about a key that some radios had. There didn't seem to be anything like a key in the cockpit. Maybe if he talked into the mike the people at Yuma could find him. That's strange. Yuma must be a long ways off. Doesn't seem as though the wind could be that strong.

He started to count out loud, "One, two, three—" and on up to twenty. Then backwards to one again. He repeated this three times. Surely that would help the people on the ground.

He waited just a moment then heard the voice again.

"Air Force 25012, your inbound heading to Yuma with zero wind is 215 degrees, class 'Bravo'."

A moment later the station called again: "Air Force 25012, DF Evaluation has placed you approximately 90 nautical miles northeast of Phoenix. As you are low on fuel, DF net advises you are closer to Luke and suggests that you land there. Give Luke DF a call on Delta channel. They are reading you. Over."

This was peculiar gibberish! Somebody was mixed up. Luke field just couldn't be in that direction and what was this "Bravo" stuff. Still, he hadn't been doing very well on his own. In a few more minutes there wouldn't be any fuel. Let's give it a whirl anyway. He turned the T-Bird in a sweeping arc to a heading of 215 degrees.

He called Luke DF Homer and immediately received a response. At one minute intervals they requested he transmit a signal for a steer. They told him to hum into the mike rather than talk. Fifteen minutes later he was over the base. The engine flamed out just as he touched down.

This student was lucky, you say? There is no question about it, but his experience is duplicated many times a month, and it isn't always the new boys who get lost. Here are a few quick examples. They are true.

• A T-28 on a flight from Williams to Edwards became "temporarily uncertain of his position." The aircraft was worked by George and Edwards DF units to a position over George AFB. The pilot stated that he would continue to Edwards at which time Edwards DF took over and monitored his flight into Edwards AFB.

• A B-26 on a DVFR flight from Colorado Springs to Long Beach became lost. He was picked up by Williams DF and his position was fixed through steers from Williams and Davis-Monthan DF sites. The aircraft was brought to a safe landing at Williams AFB.

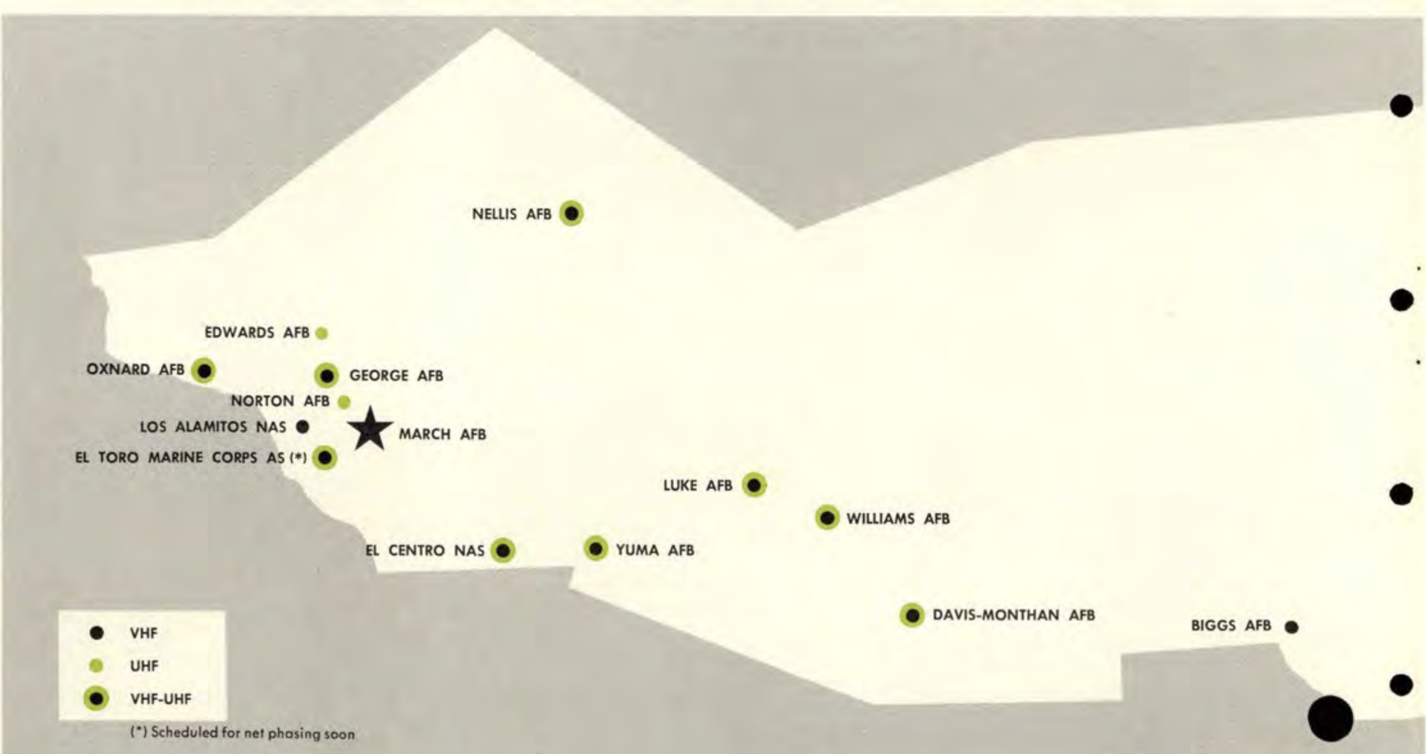
• A C-45 on a VFR flight from Big Springs, Texas, to Davis-Monthan AFB was reported lost by Tucson approach control. His last known position was over El Paso, Texas. DF evaluation net notified all DF sites along his route of flight. The pilot was contacted by Davis-Monthan DF and directed to Davis-Monthan safely.

• An Air Fore jet was on a VFR flight from Luke AFB to Lowry AFB via Loma Radio, which is northwest of the Albuquerque ADIZ. The aircraft had an hour and forty-five minutes ETE and three hours of fuel. Approximately two hours and fifteen minutes after departure, the aircraft was reported lost and low on fuel by Clovis tower. The DF net alerted Clovis and Webb DF sites. Shortly thereafter, fixes established by the two DF units placed the pilot 30 miles northeast of Clovis. The pilot was vectored into Clovis and landed without incident. Point of initial pickup by DF was more than 300 nautical miles off his filed route of flight.

• Recently the operations officer on duty at March DF Evaluation Center was notified by the Yuma DF site that a Navy aircraft, a TBM flying in formation with an F4 was requesting an emergency steer. The Navy pilot thought he was north of Yuma County Airport. At that time, he was given an inbound steer of 357 degrees, class Bravo. All other DF sites in the area were alerted, but they reported no contact. The weather at the time was VFR. The information was plotted on the DF board, and the reciprocal of 357 degrees from Yuma extended south into Mexico over a large body of water. The pilot at this time stated that he was over a large body of water. The March DF evaluation net relayed to him a probable position of 55 miles south of Yuma County Airport over the Rio Hardy, in Mexico. El Centro Naval Air Station DF site was also able to give a bearing to the evaluation net and, as a result, the pilot was advised that he was approximately 22 miles south-southwest of Yuma County Airport. The aircraft landed at Yuma with no further incident.

The foregoing are just a few "saves" selected at random from the files of the March DF Evaluation Center. Interestingly enough, DF stations

Figure 1. March DF Evaluation Center area of responsibility. Seven such areas exist in the continental U.S.



throughout the country find that the CAVU days are the busiest. This, of course, means just one thing. Pilots tend to get lax when the sky is blue and visibility is unlimited. Here's an example of a jet jockey who flew past his ETA and failed to request a DF.

The Air Force jet departed from a base in northern California. His flight plan was filed as DVFR direct to a base in the Phoenix area. There wasn't a cloud in the sky.

When the aircraft became low on fuel, the pilot located a hard-surfaced strip and set the aircraft down. He felt rather ill at ease when the alert crew that met the plane turned out to be an individual driving a donkey who greeted him with, "Buenas Dias, Señor." You've probably guessed it. The pilot had overflown his destination and landed deep in Mexico.

Although Directional Finding service has been with us for quite a number of years, it has only been of late that a coordinating system has been established. If you are like most of us, you probably wonder how the whole thing works.

The DF net is made up of all UHF-VHF/DF stations operated by the USAF and many U. S. Navy sites. Within the continental United States

The DF operator gives a steer to the lost pilot and advises the evaluation net controller.

there are seven separate nets, each with a Military Flight Service Center acting as the DF net control and evaluation center for its respective area of responsibility.

DF nets and DF Evaluation Centers are utilized primarily for lost aircraft as well as emergency and distress operations. The service may be utilized for practice fixing operations to familiarize pilots with the systems employed. However, such practice with an entire net is limited to hours when circuits are not busy. Individual DF stations will work practice runs at any time. When the chips are down, of course, the entire net is immediately available for any distressed aircraft.

In general, all emergency operations should be conducted on "D" channel (121.50 Mcs) for Air Force aircraft equipped with eight channel VHF communications sets, "C" channel, (137.88 Mcs) for the four channel VHF sets and channel "1" (243.00 Mcs) for airplanes equipped with only UHF sets.

Should an aircraft, in an emergency, contact an approach control or any other facility on a frequency other than 121.50 Mcs or 243.00 Mcs, the pilot normally will be instructed to use the same frequency with which the original contact was established for DF purposes. This procedure is recommended because aircraft in emergencies have lost communications with all ground agencies after being instructed to change frequencies. It should be noted, however, that unless an emergency is declared by the pilot, he will be instructed to change to the regular DF frequency.

Advisories to the net control MFSC and the primary coordinating agency under both IFR and VFR conditions for lost aircraft, aircraft safety, emergency and distressed operations, consist of the following:

- Aircraft number and type.
- Frequency being utilized.
- Course being flown, altitude and indicated airspeed.
- Nature of the emergency.

- Remaining fuel in flying time.
- Other operating frequencies available in the aircraft.
- Whether aircraft is IFR or VFR at the time of the emergency.

The DF operator working the aircraft advises net control MFSC and the primary coordinating agency or Air Route Traffic Control at the respective station, immediately after the first course is given to the aircraft. The primary coordinating unit or ARTC facility in turn alerts all necessary agencies and facilities at the station. From this point on, many people in the various activities begin to take a personal interest in the distressed aircraft.

The DF operator classifies all courses and fixes to the distressed aircraft. When you utilize the DF service, the following classifications should be known:

Bearings

Class *A* ± 2 degrees
Class *B* ± 5 degrees
Class *C* ± 10 degrees

Fixes

(two or more sites)

Class *A* — Within 5 miles
Class *B* — Within 20 miles
Class *C* — Within 50 miles

In addition to plotting your position through the DF Evaluation Center, Flight Service Centers also offer an advisory service. Many pilots do not realize the potential benefits that are available from such service. Rapidly lowering ceilings at the destination, en route thunderstorms, status of alternates and other pertinent information may be passed on to the pilot by the DF operator.

Advisories to the pilot from Flight Service are of an informative nature and are not directive upon the pilot. (You're still flying the airplane.)

In a controlled area, should the pilot desire to change his flight plan or deviate from his present heading as a result of an advisory from Flight Service, an ARTC clearance must first be obtained. The Flight Service Center will obtain the new clearance prior to clearing the pilot to effect the desired change.

Under VFR conditions or IFR outside of controlled areas, the system works just a bit differently. If a pilot elects to alter his proposed flight plan as a result of an advisory, the DF operator will advise the Flight Service Center of any flight path change taken by the pilot. The DF operator also will advise the control tower at his station of the change in course or the pilot's intentions. Flight Service will advise the pilot, through DF, of the proper heading for his newly elected destination and will insure that the pilot is advised of current weather conditions along his newly chosen route. (Don't forget to reset your gyro compass!)

The DF operator working the aircraft gives the first course to the aircraft prior to alerting MFSC net control. The DF operator then continues to give courses every minute for jet and fighter type aircraft, and every two minutes for reciprocating type aircraft. These steers are continued until the plane is over the station, at which time the appropriate control facility takes over.

The DF station that makes the original contact with the aircraft and gives the first steer to the pilot continues to be the only station to transmit to the aircraft under normal conditions. Exceptions can be made when the original contacting DF station is experiencing difficulty working the

Flight Service personnel are ready to give assistance to aircraft in emergency situations.

A plotter can establish geographical positions of aircraft through two or more DF bearings.

aircraft and another DF station could establish better communications. The MFSC net control is responsible in such instances for effecting and directing the change in stations.

Flight Service alerts the necessary DF stations for fixing operations upon alert from the original contacting station.

If the original contact is with a DF station, the other alerted DF stations will not transmit to the aircraft. If the original contact is with another type facility, i.e., control tower or approach control, and DF assistance is requested but is not available at that respective station, DF evaluation is alerted by the respective contacting facility. DF evaluation in turn alerts the appropriate DF stations and advises the original contacting facility to have the pilot initiate a call to any one designated DF station. If and when contact is established by any one DF station, the MFSC net control designates that DF unit as the transmitting station. Requests for re-transmission for homing come from the transmitting station only.

When a DF operator hears an emergency call, but is unable to make contact with the aircraft concerned, he makes every effort to obtain a course and alerts MFSC net control, advising them of the full particulars. If a course cannot be obtained, the net control is still alerted and full particulars are given. The MFSC in turn alerts ARTC and makes every effort to have other stations in the vicinity contact the aircraft.

Where a course has been rendered to net control under such conditions, ARTC is notified and every effort is made to have other DF sites on or near the course listen in an attempt to establish secondary steers for relay to the net. The DF operator also advises the primary AACS coordinating facility at his respective station of this traffic.

Advisories to the pilot regarding other AACS facilities at the station where the DF unit rendering the courses is located comes from the DF operator. Advisories regarding emergency altitudes, terrain features and local weather conditions come from the DF operator as a voluntary measure without awaiting a query from the pilot.

From this description of DF service we hope that you'll remember some of the more important phases. If you ever need help, there's aid as close as your microphone. ●

GOLF-COCA-INDIA

RENDERING assistance to lost aircraft is the job of the DF station. It works fine and is used daily to assist aircraft.

Now, here is a story about the DF station's big brother, the Air Defense radar network. It should be kept in mind that the vast radar surveillance system was not established to assist aircraft. It has the primary responsibility of detecting unknown aircraft and vectoring interceptors for identification purposes. However, ADC radar installations are responsible for insuring continuous monitoring of emergency frequencies and responding to any call from an aircraft in distress or requiring emergency navigational assistance. Among other things, they also may be utilized to provide general storm advisory information with suggested flight paths to avoid intense storm areas.

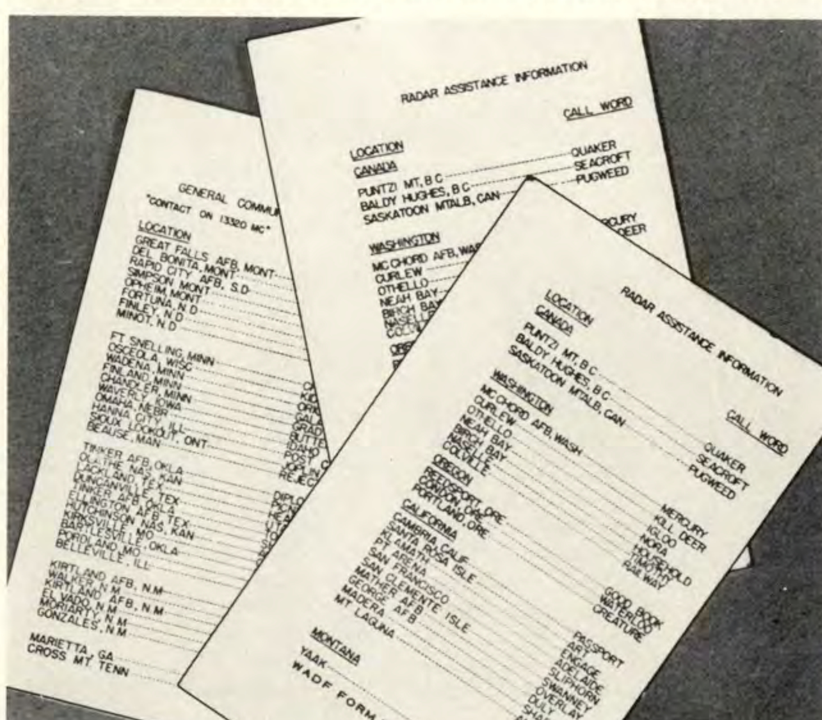
Utilizing the ADC's radar facilities for navigational assistance is particularly attractive to aircraft equipped with UHF. The UHF/DF net is expanding rapidly; however, there are still many areas where it is not possible to receive such aid. Thus GCI assistance comes in mighty handy.

It is possible that your request for radar assistance may be answered by the one word "UNABLE!" This means that for some reason the service cannot be furnished. Under these conditions it may be possible to contact another site and receive help.

Many flying organizations have prepared maps or cards pinpointing the GCI sites throughout the country by call sign and location. They are prepared in pocket size, yet are large enough to be readable. A blow-up of such a map is illustrated on page 11.

One very good point to remember whenever or wherever you fly concerns your IFF equipment. If you have this equipment installed, place it in the stand-by position just prior

Many flying organizations have prepared cards pinpointing GCI sites throughout the country.



to take-off. In this position the set will warm up and be ready. If the GCI controller requests a certain setting for identification purposes you can give it to him without any delay. What is even more important is that in an emergency you merely flip the IFF to that position and you transmit the signal *right now;* then things really start popping to get you some help.

An example of the system's capabilities recently involved a lost B-29. After three hours of flight on a round-robin, the pilot was not able to pick up his next checkpoint. After trying to locate a radio facility for homing purposes the pilot called in the blind. He was answered by a CAA communications facility and directed to contact "Hubert" on the emergency channel. After contact it became evident to the director that the aircraft's magnetic compass was inoperative. The aircraft's track and the radar indications differed by some 60 degrees from the vectors given. By specifying the amounts of turn to either right or left, the director was able to control the B-29 to an area where he could orient himself and make a successful letdown and landing.

Each radar installation has a video presentation of all airfields of 5000 feet or more within its area. In the event of an emergency necessitating an immediate landing, the director can assist in vectoring the aircraft to a suitable landing area.

There are numerous cases on the books where aircraft have received advisories that have guided them around severe storms. If radar advisory service is desired, the pilot of an aircraft will request such service through the appropriate Air Route Traffic Control Center, using normal en route communications facilities. ARTC will relay the request to the appropriate radar station. Upon receiving the concurrence of the director, the aircraft will be cleared by ARTC to establish radio contact with a radar facility for advisory information. ARTC will advise the aircraft to change to the appropriate frequency and to stand by for a call. When the aircraft is properly identified, the director will furnish the pilot with the information requested. The pilot then advises ARTC of any changes in his filed IFR flight plan.

If contact with the radar facility is not made, or upon receipt of the word "UNABLE," the pilot will return to the appropriate ARTC frequency and so advise.

Under radar advisory control, aircraft position information, and the direction and distance from easily recognized reference points will be forwarded by the radar facility to the appropriate Air Route Traffic Control Center when a vector is started, when it is completed or when requested by ARTC. This will facilitate correlation of the aircraft's position, and permit ARTC separation.

There is an additional feature of the radar network known as flight following. For example, an F-86 started out on an extended IFR cross-country flight. After 20 minutes of flight he noticed that his external fuel tanks had failed to feed. A fast calculation revealed that he could not reach his destination, so he immediately contacted the closest airfield. He was informed that the field was IFR, still he requested and received letdown instructions.

Prior to starting his descent, the tanks started functioning again. He advised the airfield that he intended to continue to his destination, then contacted "Top Coat," the closest GCI site. He advised them of his previous external tank difficulties and, since the weather in the immediate area was bad, that he had decided to continue to his destination. He requested flight following just in case the tanks gave him trouble again, necessitating a landing, en route.

He was kept under surveillance by "Top Coat" and called them periodically to confirm his position. "Top Coat" passed him on to the next radar installation along the route and so on, until he reached his destination. He let down VFR through a break in the cloud cover and completed his landing. Only one thing was wrong. After landing he was greeted with a flying violation. During the entire flight, nobody bothered to inform ARTC as to the aircraft's position and altitude. ARTC had this aircraft listed as missing. Flight following is not a routine service. It does not relieve the pilot of his responsibility to navigate. Except in an emergency a pilot being flight followed is responsible for guarding an en route frequency and making position reports.

In order to utilize the facilities available through the Air Defense Command's radar installations, it is important to remember a few basic responsibilities:

• There have been cases where pilots, who were not in any difficulty, jammed the frequencies so much that interception operations of unidentified aircraft has been hampered. Also, pilots who have successfully utilized the GCI flight following plan previously, have become lackadaisical in their flight planning. They have assumed the attitude that maps and charts are just so much excess baggage when there is a system available that can direct them to any airfield on the continent. The hazards associated with such an attitude are obvious. It is entirely probable that the

radar unit may not be able to work you or maybe your UHF or VHF radio equipment becomes inoperative. Then without maps and charts you're in real trouble.

• The responsibility for separation of aircraft within controlled airspace remains with the Civil Aeronautics Administration. The pilot should assure himself that the appropriate ARTC Communications Center is notified in accordance with existing regulations. ADC assumes no responsibility for the provisions of separation between aircraft. The pilot will retain the reponsibility for any operation which may be conducted out of controlled airspace.

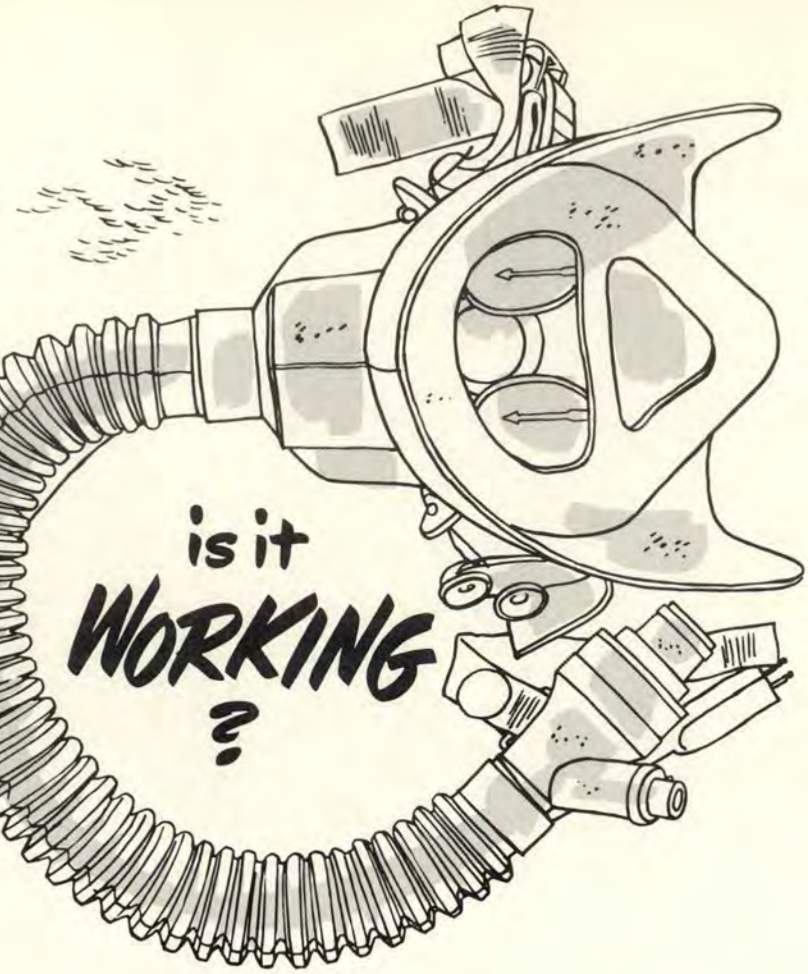
• The primary mission of the Air Defense Command is the air defense of the Continental United States. In the program of USAF Radar Advisory Service, no liability will be incurred by the Air Force nor will the primary mission of the Air Defense Command be compromised.

• In all cases any information given is advisory in nature and the responsibility for the operation of the aircraft rests with the pilot.

• When calling for assistance give the GCI director your position (if possible), aircraft type, altitude, heading, departure point and destination.

One last thing, DF has the major responsibility for rendering assistance to aircraft; try it first if you happen to become lost (misplaced), (disoriented). ●

This map shows the location and call sign of GCI sites that can be used by pilots in an emergency.



Brigadier General A. H. Schwichtenberg, Surgeon, ADC

A PILOT WAS leading his flight back from a mission which involved flying at 30,000 feet. This altitude had been flown for approximately one-half hour. When told to return home, the pilot stated he felt very gay, seemed to be flying into a haze and that the visibility was decreasing. He checked his oxygen regulator and found the blinker working.

He made a routine descent, flew a good traffic pattern and turned onto final. After lining up with the runway, he allowed the airspeed to drop off excessively, stalled out and landed short, destroying the aircraft.

His first words upon being pulled from the plane were, "I feel woozy. I must have hypoxia."

He later stated that the last thing he remembered was deciding to let down fast; the last part of the mission was a total blank.

He was wearing a borrowed helmet and oxygen mask, both too large for him. A leak was found between the mask and the bridge of the pilot's nose.

Today, an airman must be sure his equipment will stand the test and that each and every part will work when he needs it, whether his mission involves potential battle or training. Sometimes our airmen overlook seemingly small, unimportant items like dust in their masks. They don't understand fully how to care for and use all of their equipment and they fail to visualize situations where they must depend on the perfect functioning of this equipment.

Recently this office, in conjunction with Air Defense Command's Office of Flight Safety, initiated a project to check the reactions of pilots unknowingly subjected to unpressurized flight at 30,000 feet. It was believed that with the present pressurized cockpits, pilots could easily become complacent about their oxygen equipment. However, in case failure or malfunction of the pressurization equipment occurred, and a pilot was wearing poorly maintained or improperly fitted oxygen equipment, hypoxia could occur and probably would result in a serious accident. In short, it was considered that many of our pilots had come to depend upon their pressurization rather than their oxygen equipment to carry them at whatever altitude they were flying. Perhaps another instance of the idea that "it couldn't happen to me." But, unfortunately it does.

Two pilots, Capt. William Gray and Capt. William Savidge, from the Office of Flight Safety, ADC, were assigned as project officers. They made a tour of eight ADC bases, ostensibly to conduct spot instrument checks throughout the command. They flew with a total of 29 pilots during the survey. The experience level of this group ranged from 400 hours to 750 hours total time, and from 150 to 500 hours jet time.

All flights were flown in unpressurized cockpits, with the students in the rear seat. None of the pilots being checked were informed that the flight would be conducted under unpressurized conditions although the squadron commanders had been fully briefed and were completely in accord with the test.

Prior to starting the survey, the two check pilots went through the altitude indoctrination chamber at Lowry AFB to check the performance of the oxygen equipment to be used during the tests. In addition, they removed their masks at 25,000 feet to be sure of their own individual reactions to hypoxia and were given additional instruction in order to help them recognize it in others.

The pilots being tested were told to make instrument takeoffs, climbing turns, work an aural null problem, perform ADF tracking, steep turns, an ADF penetration and a GCA run. The pressurization dump valve was intentionally opened by the IP prior to engine start.

Each flight remained at 30,000 feet for at least 30 minutes, which was considered to be sufficient time for any hypoxic symptoms to develop. Each pilot was instructed to advise the IP of his procedures as he performed each maneuver. This was used as a check on the mental condition of the pilot to determine if hypoxia was occurring.

Of the 29 pilots tested, two developed severe cases of hypoxia and one experienced mild hypoxic symptoms. This represented slightly more than 10 per cent of all the pilots tested. When the tests were first proposed we had expected perhaps one case with mild symptoms but had not anticipated that the percentage would run so high.

As is usual in hypoxia, each case in which a pilot had trouble varied from the others. In one, the pilot proceeded with his mission as briefed and was performing climbing turns through 24,000 feet when he complained of feeling dizzy. His airspeed control became erratic and he was instructed to maintain 215 knots, but he was unable to follow instructions.

He was then told to turn to a specific heading, but again was unable to do so and failed to roll out of the turn. Upon being asked why he failed to follow instructions he replied, "I can't remember what you told me."

At this point he also complained of dizziness and a tingling over his entire body. The IP took over the aircraft, instructed the pilot to place his oxygen control on SAFETY and descended to a lower altitude.

The student placed his regulator in the desired position, the *only* instructions he had followed since the onset of hypoxia, and recovered normally. No evidence of mask or system malfunction was discovered in a subsequent investigation. However, it is believed likely that the pressure of the oxygen on the SAFETY position caused stuck valves to release. At no time did this pilot recognize the sensations of dizziness and tingling as two indications of approaching hypoxia.

In the second case, the pilot performed his instrument takeoff and climbing turns satisfactorily, but five minutes after leveling off at 30,000 feet his airspeed control began to fall off. Then the aircraft started into a steep left turn and dive. The IP recovered from this maneuver and asked the pilot what he was doing. There was no response to this question; however, when asked how he felt, the student pilot replied that he felt fine.

Next he was told to make a 90-degree turn. When there was no reaction to this instruction, the IP took control of the aircraft, told the pilot to turn to SAFETY position on the regulator and descended rapidly. The student recovered at the lower altitude but professed no knowledge of what had taken place after leveling off at 30,000 feet. He stated that his first recollections were that the aircraft was in a steep dive and that the instrument panel was coming back into focus. This pilot received none of the warning symptoms more commonly associated with hypoxia. A subsequent check of his mask revealed minute particles of dirt in the valves, particularly the exhalation valves, although the mask had been cleaned and checked one week prior to the flight by individuals in the personal equipment section.

The third pilot experienced hypoxia after being at altitude for approximately 15 minutes. He was performing a steep turn when he complained of a tingling sensation in his arms and legs. The IP told him to place the regulator on SAFETY and the symptoms disappeared. No malfunction of his equipment was discovered though again this may have been a case of stuck valves releasing.

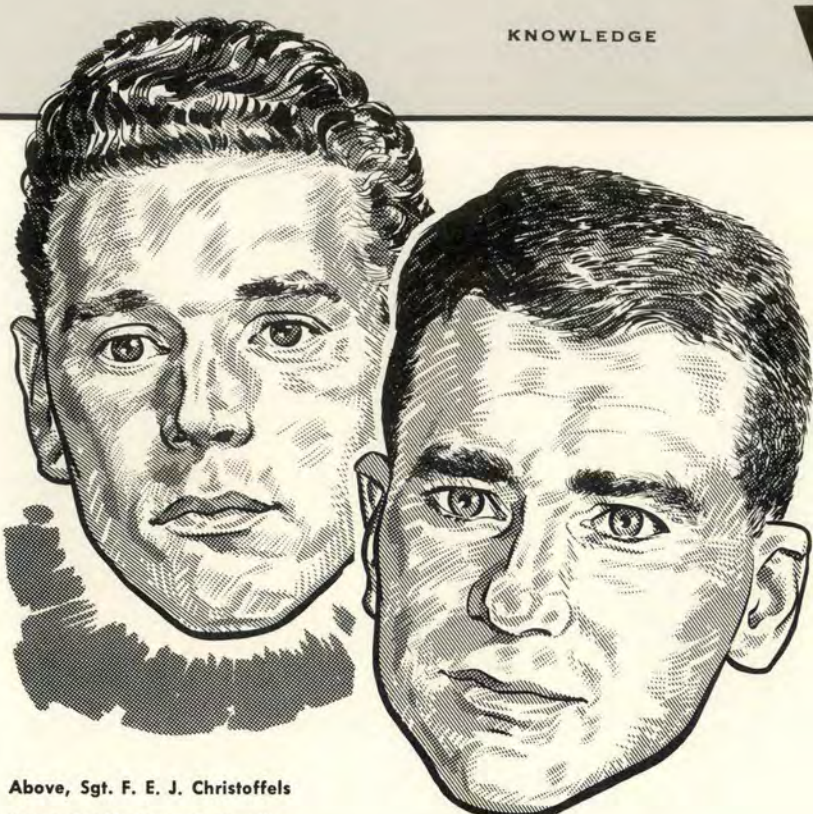
In addition to these cases, one of the check pilots experienced slight hypoxia during one ride. His mask had been cleaned two days before, but small particles of dirt were found in the mask valves, again most frequently in the exhalation valve.

A few of the pilots tested complained of the cold and asked for a check of the pressurization system. Each time they were informed that everything was normal in the front cockpit. Significantly, most of them failed to turn their regulators to 100 per cent, nor did they turn the dial to give themselves pressure oxygen.

These tests emphasize the necessity of observing *all* of your equipment, and how important it is to know what to do if a malfunction occurs. It is possible and even probable that many undetermined accidents have been caused by hypoxia brought on by malfunctioning oxygen equipment in depressurized aircraft.

Some of our conclusions and recommendations derived from these tests include:

- It is considered highly probable that we are having more trouble with our masks than many pilots realize. This particularly may involve the exhalation valve (the lower one in the mask). Many pilots have noted that they must forcibly exhale in order to free the valve when first putting on the mask. It is clear now that even small amounts of dirt or mucous may dry on this valve and cause it to stick open or closed. More common and — also more difficult to discern is an intermittent malfunction such as when the valve sticks open part of the time. A simple test which will often reveal this condition is to place the thumb over the end of the oxygen hose and breathe in and out lightly. If the valve is sticking open it will permit one to inhale and exhale lightly though deep breathing will cause it to open and close normally. Such a valve should be replaced. It is worth knowing too, that when the exhalation valve sticks open and one becomes hypoxic and the respiration becomes deeper, just enough negative pressure can be created in the system to cause the blinker to snap open and closed for an instant. When one is dull mentally this is misinterpreted as normal operation. These are the tremendous trifles upon which your life may well depend.
- Intermittent failure of regulating systems may disrupt the flow of oxygen.
- Standard oxygen test equipment should be used by all units. During this experiment it was noted that some squadrons used a bellows tester, others a complete oxygen system as a tester and one unit had *no* test equipment. (With a good pressure demand oxygen mask, a bellows tester will show a no-leak fit when the mask is held in one's hand!)
- Many pilots are not properly aware of hypoxia symptoms and need more training in how to care for their personal oxygen equipment. They need to be more fully impressed with this danger and that it is as serious as fuel shortage.
- Most units have sufficient masks, but size distribution sometimes doesn't allow proper fitting. Consequently, many pilots are forced to use an incorrect size mask. Commanders should check this constantly.
- A requirement exists for intensive training of personal equipment specialists in the care, cleaning and fitting of masks. Masks should be protected from dirt and other foreign matter by a dust-proof cover at all times when not in use.
- Periodic unpressurized flights should be made with two pilots aboard. This will serve to force careful inspection and maintenance of personal oxygen equipment. When this is done, at least one pilot must be certain of his oxygen equipment functioning.
- The point of this article is, if you're a pilot who flies high-altitude pressurized aircraft and must use oxygen equipment, remember that those "small" things are as important as fuel in the aircraft. The oxygen system must function properly or the means of burning the human fuel is eliminated and what might be termed a pilot flameout, occurs. ●



Above, Sgt. F. E. J. Christoffels
Right, 1st Lt. Donal F. Cuddihy

1st Lieutenant Donal F. Cuddihy

★

Sgt. F. E. J. Christoffels

Netherlands — MDAP Student

★

3604th Flying Training Sqdn.
Luke AFB, Arizona

Capt. Donald H. Swan

1738th Ferrying Sqdn., Long Beach Airport

Capt. Swan and his wingman took off on a flight from Edmonton Airport to Ft. Nelson under instrument conditions. Shortly after takeoff, while flying intermittently through an overcast at 25,000 feet, the wingman reported that his T-33's hydraulic pressure was fluctuating but that everything seemed to be functioning normally.

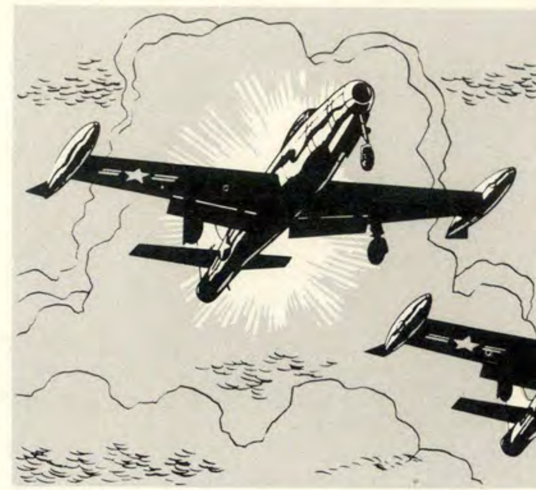
After contacting Ft. Nelson, the flight received approval for a straight-in IFR letdown. About six minutes out, at 13,000 feet, the wingman called again stating that he was in severe difficulties. He had lost sight of the lead ship and was unable to control the aircraft.

Capt. Swan decided that the hydraulic system had

Sergeant Christoffels, MDAP student from the Royal Netherlands Air Force, and his IP, 1st Lt. Cuddihy, were participating in Sgt. Christoffels' initial checkout in the F-84. During a gear down, flaps down, stall series, Sgt. Christoffels experienced an engine explosion and subsequent power loss.

Lt. Cuddihy, flying wing on the student's aircraft, then advised Sgt. Christoffels to set up a flameout pattern for a Luke auxiliary field. Their position was 25 miles north of the field at an altitude of 15,000 feet. Through constant instructions during the actual flameout, Lt. Cuddihy directed the MDAP student to the landing end of the runway.

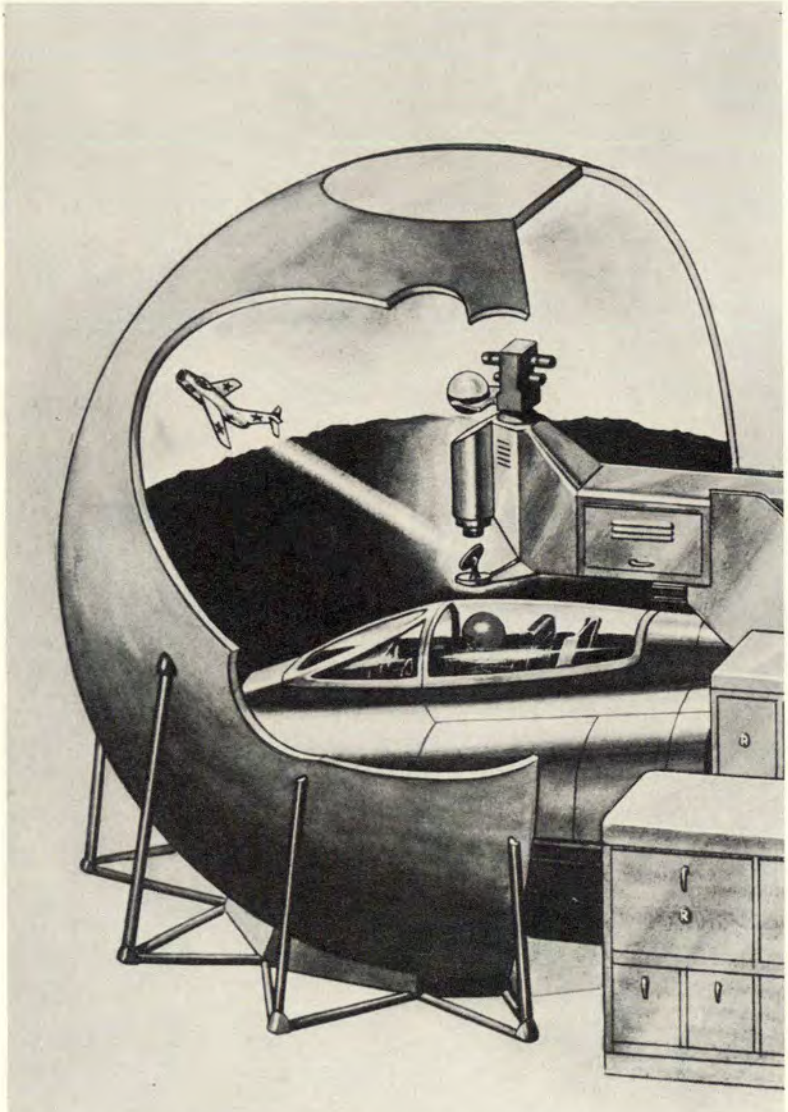
Due to his decisive action and complete knowledge of emergency procedures, Lt. Cuddihy talked his student through the emergency pattern to a landing. Sgt. Christoffels, on his first ride in a jet fighter plane, was confronted with a serious emergency situation, but through his calmness and swift execution of instructions he landed his aircraft satisfactorily. Their actions reflect credit to themselves and their respective services. Well Done!



failed and that the flight control boost was out. He immediately advised the pilot to go on instruments, and repeated his instructions several times for emphasis. Suddenly the wingman called that he had the lead ship in sight and was coming down in a dive off his right wing. Capt. Swan spotted the plane and peeled off after it. He attempted to talk the pilot into reorienting himself by stressing the need of recovery to normal flight. The wingman responded by pulling up into a steep, right turn and again was advised of the aircraft's attitude. His instructions had a steadying effect and he was able to talk the pilot into what was actually a recovery from a vertical position.

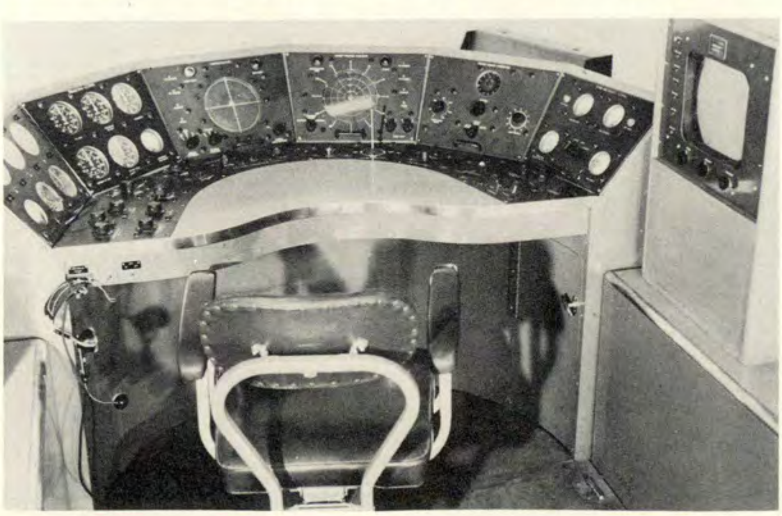
The wingman, who was suffering badly from vertigo, regained control of his aircraft and returned to a straight and level attitude on the lead plane's wing. The flight resumed the letdown and made a normal landing.

The skill and excellent judgment displayed by Capt. Swan during this emergency are a credit to him and to the U. S. Air Force. Well Done!



The F-151 is designed to teach the basic gunnery skills and approach and positioning tactics.

The instructor's console is equipped with scoring devices used to evaluate the student pilots.



TIGER

Roy H. Gardner, Equipment Laboratory,
Wright Air Development Center

FLEDGLING fighter pilots who return from their first mission on the gunnery range are usually hopelessly disillusioned individuals. Instead of hitting the target a reasonable number of times, many discover they cannot so much as find the sight reticle. This experience can be so unnerving that a good many of these junior Tigers are just thankful to return to the ground, regardless of their gunnery score.

From such an inauspicious beginning came the aces of Korea and World War II, but in between were long periods of arduous and oftentimes discouraging training. Those who showed promise in this training period received their post-graduate course in combat itself, but to become aces they had to become so indoctrinated in the operation of their equipment that their actions were automatic. A brief mental lapse or a pause of a second or two to think out a situation often led to somewhat unpleasant results.

A requirement has long existed for a device that would provide instructions to fighter pilots in the complete operating technique of their aircraft armament system. A trainer of this type has, as its justification, ability to overcome some of the difficulties encountered in teaching fixed gunnery skills when the instructor can only monitor the student's performance from a distance. After three years of research and development, Wright Air Development Center believes that it has the answer to this requirement in the form of the F-151 Fixed Gunnery Trainer.

No longer must the frustrated,

TRAINER

This indicator enables the instructor to position a target in relation to the student's simulator.

long-suffering student pilot go through life wondering how all those bullets went through that rag without leaving a hole. This gadget can give him the answers.

The design of the trainer is based upon the principle that pilots must be taught those gunnery skills necessary for successful completion of various combat missions with fighter aircraft. Secondary considerations include the training in procedures and skills which will increase the likelihood that such missions will be achieved with a minimum of cost in terms of men and material.

With this combination gunnery trainer and flight simulator, a pilot is able to run through his preflight check, engine start, takeoff, target interception and return to base without leaving the ground.

Basically the F-151 Fixed Gunnery Trainer consists of an aircraft flight simulator which represents the attacking fighter, a suitable projection system to display a realistic target and an instructor's console equipped with the instrumentation and scoring devices necessary to present the attack problem and to evaluate the student's gunnery score properly.

The prototype trainer utilizes a standard F-86D Flight Simulator which has been equipped with an optical gunsight. Since the flight platform is incapable of motion, roll, pitch or yaw, rate signals are fed directly from the flight simulator to the gunsight computer, thereby bypassing the sight rate gyros.

The target presentation system consists of a television pickup and projection system, which portrays a realistic simulation of air and ground targets, and constantly depicts a true-to-life situation between fighter and target, regardless of course, speed or type of maneuver. The target model, located in front of a television camera, is free to move in attitude and relative range so as to simulate the geometrical conditions prevailing. The image of the target is transmitted from the camera through the television projector and then displayed on the spherical screen surrounding the simulator cockpit.

Various analogue computers continuously solve the complex equations which describe the dynamic relationship between fighter and target. These computers provide azimuth and elevation positional data to the target projector as well as altitude, attitude and range information to the target model. Thus the complete freedom of maneuver and attack pattern, inherent in the real situation, is duplicated in the trainer.

The display screen is a segment of a sphere of 10-foot radius. It has an azimuth span of 240 degrees, elevation span of 120 degrees (70 degrees above the horizon, 50 below), and a mean height of 18 feet. The screen is composed of self-supported panels of plastic resin impregnated fiberglas molded over a honey-comb structure. The simulator cockpit is so positioned that the pilot's head is located at the optical center of the sphere. From this position the pilot can observe a target at any location on the screen without any apparent distortion.

A second projector is mounted above the cockpit and is so arranged that it casts an image on the screen depicting sky and earth with respect to the interceptor aircraft. This projector is free to rotate so as to simulate the relative effect of roll, pitch and yaw.

The necessity for some visual earth reference was proved by actual tests conducted with the trainer. A veteran fighter pilot attempted interceptions on a bomber-type target while the horizon projector was inoperative. He consistently lost control of his aircraft and had to abort the attack and utilize his instruments in order to recover. When the horizon presentation was restored, the same pilot had no difficulty in maintaining control during the interception.

The instructor's console is equipped with target flight controls and instruments, television monitoring equipment, scoring clocks and recorders indicating errors in azimuth, elevation and range. In addition, the flight instructor is provided with a duplicate set of flight instruments and a "fault" panel with which he can introduce any operational malfunction that might occur in actual flight.

The instructor, by means of a selector switch at the console control station, may select either an air-to-air or air-to-ground problem for the student. Assuming first that the ground target is selected, and the mode of attack (gun, bomb or rocket) is chosen, the instructor will position the target somewhere within the operating radius of the simulated aircraft. He will then inform the student by interphone the nature and approximate location of the target to be attacked. The position of the target with respect to the student's aircraft is displayed in a cathode ray tube at all times. While the attack is in process, the instructor is informed continuously of the student's approach and tracking ability by a television monitor, meters and clock-type indicators. Simultaneously, a permanent record of the student's performance is obtained by operation of a multiple channel recorder.

If the aircraft target is selected, the instructor may, in addition to the foregoing, vary the course and altitude of the target and introduce bank and pitch attitude variations with a manual control stick, thereby simulating evasive tactics on the part of the target. If he desires, the instructor may operate a switch at the console to "freeze" the complete attack problem. In this manner he is able to advise the student and comment on his attack procedure at any time.

In pursuing and attacking the target, the student must exercise full control over his aircraft, and except for such factors as vibration and acceleration forces on his body, the system closely simulates true flight conditions on the display screen and on the instruments in the cockpit.

The gunnery training portion of this device is quite flexible and can be attached easily to any modern flight simulator. The F-86D simulator was utilized on the developmental model because it was the only one available at the time. Present plans are for a production quantity of gunnery trainers utilizing the F-100 simulator as a flight platform.

In the development of a device of this size and complexity, several basic decisions must be made early in the program. Probably two of the most important questions involved in the design of the F-151 were, "What is the scope of the gunnery training problem which this trainer shall encompass, and what will be the initial skill level of the student?"

The scope of the training problem to be provided for in this trainer is very clearly defined in the Visual Contact Gunnery Trainer Study conducted by the American Institute for Research. Skills, behaviors or techniques to be trained on this device may be summarized as those necessary to navigate a fighter to a place of combat, to make air-to-air and air-to-ground attacks and to break away successfully or recover from such attacks.

Simulation by this trainer was limited to those techniques involving the use of an optical gunsight. Simulation necessary for any special techniques or procedures will only be provided incidentally; no special provision was made for such purposes in the prototype model.

It was assumed by the Wright Air Development Center project engineers, responsible for the development of this trainer, that the equipment would be used for both training in the basic gunnery skills and at squadron levels as an aid in maintaining proficiency. In the absence of the Air Force training curriculum which will be employed with this device, no assumptions have been made as to the training time to be spent in the trainer versus time in operational aircraft. However, it is obvious that a trainer of this type should reduce considerably the flying time required to reach any particular level of skill. It should be noted at this point that the purpose of the F-151 is not to eliminate or reduce flying time, but to provide the Air Force with a more effective pilot-fighter combination.

In the operational squadron a measurement or evaluation of the student's ability becomes even more difficult than in the training phase. Here the student must learn to evaluate the situation and choose the best tactics. The static situation of tow target position and speed no longer exists; instead, thought and action must be practically concurrent.

A summary description of a good fighter pilot, as determined by research conducted in combat theaters, is quoted below:

"An ideal fighter pilot is primarily a person who thinks and acts quickly and accurately. His actions are sharp and decisive and reflect good judgment, superior ability in identifying speeds, altitudes, range, other distances and an alertness to everything that is going on around him.

"In addition to the traits previously mentioned, the ideal fighter pilot has a strong desire to fly and is eager for combat. He is aggressive, but is cool and collected, has good control of his emotions, and can be depended upon to do the jobs assigned him."

Obviously the F-151 cannot instill all of the aforementioned traits in a pilot. However, there are many pilots who possess these qualifications but still are not good fighter pilots. Therefore, there must be some variable which provides the solution to the very complex equation involving the dynamic characteristics of the aircraft, the fire control system and the pilot. Only after solving this equation can the pilot achieve success in combat engagements. We at WADC feel that the key to a successful solution of the problem is proper training and sufficient practice.

Veterans of the Korean theater who have flown the F-151 were enthusiastic about the possibilities of this trainer, both as a device for teaching basic gunnery skills and as a means for teaching approach or positioning tactics against another fighter of approximately equal flight characteristics.

The old saw to the effect that practice makes perfect certainly applies to gunnery techniques. But, up to the present time, practice in fighter tactics has always had to be done in the air. This is not only expensive but the time consumed traveling to and from the gunnery range and on-the-ground down time of aircraft limit the amount of training that can be obtained.

If a trainer of the F-151 type were available, much of this necessary practice could be obtained on the ground and at a greatly reduced cost. Time normally lost in aircraft could be utilized effectively in trainers. The trainer would provide an opportunity for practice in tactical situations that normally are not attempted in the air. The constant presence of an instructor would result in errors being detected and pointed out when they occur. Furthermore, the scoring means provided in such a trainer would provide a more consistent method of student pilot evaluation.

Even though the development of the F-151 Fixed Gunnery Trainer represents a major advancement in the art of visual flight illusion, personnel who have been associated closely with the project feel that this is only the first step.

It now appears quite feasible to provide a greater terrain coverage by utilizing a wide-angle television system. This could broaden the scope of the trainer to permit simulation of takeoff and landings, low altitude bombing or any special mission requiring accurate terrain simulation. It is feasible also to tie two F-151s together; this would result in a fighter vs. fighter combat trainer.

The developmental model of this trainer is now being installed at an Air Force Base, where it will be subjected to functional and operational suitability tests over a period of time. It is anticipated that the production model of this device will find widespread usage in the Air Force training program. ●

Get The FULL TREATMENT

Reprinted from the MATS FLYER. By Lt. Col. James M. Fahey.

WHEN I GO into a weather station during my flight planning, it is for one purpose and only one purpose — — to get a weather briefing. The full treatment. Before going in, it's a good idea to review the weather factors and then make sure you are told about them.

You know, sometimes these forecaster chaps, despite checklists and other memory devices, forget an item. Not often, but sometimes. So you make sure you get all the poop by knowing what is needed and by asking when it's not given.

Do you recall that jet pilot who forgot to ask the forecaster for the runway temperature and pressure altitude? The forecaster didn't include them in the briefing because they were not critical.

Well, this chap didn't bother to calculate his takeoff roll. As he rolled down the runway, it disappeared but fast. The book says he could and should have made it. He didn't know, so he cut power, picked up the gear and slid onto the overrun. When flying a jet, get that info and calculate the takeoff roll! I do, and I didn't have to wait for a TWX from USAF to make me do it either.

Entering the weather station, I clench my fists, grit my teeth and fight back that overwhelming urge to get to the sequence board to see what my destination is reporting.

Forecasters used to peeve me when they'd drag me through the current surface chart, the upper air charts, the progs, the severe weather warning chart, the pireps and the rareps. It always seemed that they were just trying to show how much they knew. "A forecast, quick!" was my attitude.

One pilot changed all that. He was the pilot who called in by telephone, on a squadron clearance, and told the forecaster that all he wanted were the winds and the terminal forecast for the destination. He was doing okay until he got to his destination and started a letdown.

Just as the dawn glistened off his wings, the fog rolled in and he had to go elsewhere. He was short on fuel because of other mistakes and couldn't wait for an alternate forecast to be processed through Approach Control. So he headed north. You guessed it. He sat down in a fog-engulfed cornfield while airfields galore to the southwest, south, southeast and east glorified in the clear, fresh dawn.

His impatience cost him the general synoptic situation which could have told him where the fog was. The weatherman miscalculated its speed of movement, but the pilot could have known that north was not the direction to seek refuge.

My desires for a quick briefing vanished like a gorgeous blonde at the office Christmas party when I read another crash report. One of the boys in the office, looking into an accident blamed on weather, found that the chap actually didn't get the full treatment in his briefing.

He was soaring along above an overcast-to-broken deck when he began to have radio trouble, so he decided to make a stop en route. He spotted a hole near an airbase and peeled on down. The descent was uneventful until the base of the clouds was passed. It was too late then to know he was only a couple of hundred feet above terra firma. The altimeter was reading 21 feet—underground.

True, the weatherman didn't brief him on that base's weather, but remember my first point. Weather en route is a prime factor. Heck, you don't know when you might lose an engine or two and want to know where to go — quick like.

Funny thing, you know we've been overestimating these weather forecasters all along. They make like pretty sharp characters, but the other day a pilot walked into the weather station and asked which was the best weather route to his destination.

The weatherman gave him a briefing on a route which, instead of being a straight line, called for a dogleg flight east of the mountains with a late swing to the west. Everything seemed okay, so the forecaster signed the clearance, not recognizing that the route indicated was *direct*.

To make it short, the pilot flew the direct route and down came the boom. He went smack dab into one of those "black areas" with severe thunderstorms, turbulence and hail. The latter did enough damage to cause a landing at an auxiliary field.

The pilot blamed the forecaster for not briefing him on the "black area." The forecaster blamed the pilot for not flying the route as briefed.

Brother, one thing to make sure of is that the forecaster understands where you're going.

But even in your cockpit you are not out of the weather business by a long shot. After takeoff, get a reading as you pass through the base of the clouds and call it back to the tower with a request to pass it on to weather. Do this again as you pass through the tops.

Many times I have asked a weatherman if he had any reports on cloud tops, only to find that he was as denuded of pireps as the Christmas turkey is of meat when it's passed my way. Right now, I'm the best cloud-base-and-top indicator in the Air Force, bar none.

Remember, the weathermen are pumping out terminal forecasts periodically, on a vast network of stations. So when the forecast isn't clicking by the numbers, just pick up the microphone and ask for the latest forecast. We can get terminal forecasts from CAA stations, airbase control towers, approach controls or even from the forecaster direct on VHF pilot-to-forecaster if necessary.

Most of the same can give you a route forecast. Why stand by on an old forecast when the Air Weather Service has all those forecasters down there ready to help?

Well, after a grease job on the landing, I always manage to find a few moments to drop into the weather station and give them the story of the flight. Who knows, maybe a friend of mine will be heading the opposite way and can use the info. ●

Left is the Type IVB pictorial display with a course line computer. Below is the Type V display mounted in the cockpit of a C-47.

The recently designed pictorial display unit is previewed here in a look into . . .

Tomorrow's New View —

HAVE YOU ever wished that your actual navigation could be as simple as your preflight planning? It's almost that easy with a pictorial display. A pictorial display converts the information from a VOR/DME receiver to an automatic symbolic representation of your aircraft and its position on a chart of the area over which you are flying.

Operating and technical personnel have for years recognized the value of displaying navigational information in a pictorial form in order to reduce the workload on the flight crew and add flexibility in the selection of desired ground tracks. With the adoption of VOR/DME navigational facilities, the advantages of a continuous indication of position information in a simple and direct form increased the interest in pictorial display devices.

Initial studies conducted by the Departments of Defense and Commerce, aided by the Aviation Psychology Lab at the University of Illinois, resulted in a development and evaluation program sponsored by the Air Navigation Development Board and conducted at the CAA Technical Development and Evaluation Center on three types of displays. Since these three displays were developed to evaluate the various features of pictorial displays, the original specifications included as many of the most desirable proposed features as possible. Many of the advantages and possible applications of airborne pictorial displays were outlined in a previous article entitled "The Automatic Way," in the August 1954 issue of FLYING SAFETY.

The Type III Portable Pictorial Display, manufactured by Aero Electronics Company, consists of a display unit and an amplifier unit connected by a five and one-half foot flexible cable. The display unit is approximately eleven and one-half inches in diameter, four inches deep, weighs about nine pounds and has a fixed circular chart holder, an aircraft position indicator assembly and a small control panel.

The special aeronautical charts used with this display are 10 inches in diameter, with the VOR/DME station at their center. A chart is inserted after lifting a clear plastic bridge on the top of the unit. The aircraft position is indicated by a small hole in a piece of clear plastic which moves along the bridge assembly. The distance between this hole and the center of the chart shows aircraft distance from the station. This entire assembly also rotates over the surface of the chart to indicate the bearings to or from the station. An azimuth scale is engraved around the chart holder. The point of a pencil may be used to mark the position of the aircraft at any time, or to trace a continuous track.

The two controls near the bottom of the display unit are the power switch and a three-position selector switch which must be set to the scale of the chart being used. During evaluation tests, special charts corresponding to the scale of local, sectional and world aeronautical charts were used. To operate the display, the VOR/DME station is tuned in, the power switch is turned on, a chart of the desired scale is chosen and inserted and the scale selector switch is set properly.

When the aircraft position indicator nears the edge of the chart, the next VOR/DME station along the route of flight is tuned in and a new chart is inserted. The scale selector switch should of course be checked to insure that the switch position and size of the chart agree. If flight beyond the range of a station occurs, or if display error becomes excessive for any reason, the flag on the course deviation indicator will warn that display indications are not correct.

One noteworthy feature of the Type III display is its portability. No space on the instrument panel is used and the display may be placed out of the way when desired. Although this unit was originally designed to be carried on the lap of the pilot, experimental preliminary flight tests indicated that this was undesirable because of weight, heat generated and interference with necessary operation of aircraft controls. In later evaluation tests, the display was supported between the seats of the pilot and co-pilot, and a bracket was provided to hold the unit when not in use.

Following the current trend toward compactness, an improved version of a portable display was designed and built at the Technical Development Evaluation Center. This version, designated the Type IIIA, is transistorized and consolidates the display and amplifier units into a single nine pound unit which is eleven inches square and two and one-half inches deep.

Charts are printed on translucent plastic sheets which are inserted manually. Chart scale selection is automatically taken care of by small coded perforations on each chart which adjust the distance servo-mechanisms. Aircraft position is indicated by a small point of light which shines from beneath the map, and although the aircraft heading is not displayed, a small tiller indicates the direction of progress by adding a tail to the spot of light.

The Type IV Rotatable Panel Pictorial Display consists of a display and an amplifier unit, and is manufactured by the Sperry Gyroscope Company. This model combines the display with a course-line computer.

The Type IV display is mounted on the aircraft instrument panel (Figure 1), and requires an opening that is fifteen and one-quarter inches wide and twelve inches high. The unit is nine inches deep and a plastic window covers the circular opening on the face of the display. Charts ten inches in diameter are used and a cantilevered transparent arm supports a small red arrow to indicate the aircraft position. The arrow also indicates the magnetic heading of the aircraft when used with a Magnesyn, or similar system.

The charts are printed on heat-sensitive recording paper and are mounted on metal backing discs. Tracks may be recorded permanently by the stylus under the aircraft position indicator. This stylus, in contact with the map surface during operation, is a fine wire which, when heated by an electric current, melts a small spot on the white map surface. As the stylus moves over the map, this spot generates a permanent black line, recording the track of flight. The indicator arm assembly automatically moves out of the way when the hinged door is opened to insert the charts.

Controls on the panel of this display include the power switch, the scale selector and trace switch and a flag alarm. The same steps, in general, are necessary for operation, as with the Type III display. Integral edge lighting is incorporated, and for those who dislike mental gymnastics, a knob is provided to rotate the chart in order to proceed up the map during flight in any direction.

The Type V Pictorial Display, manufactured by the Arma Corporation, is a panel-mounted optical projection unit which is extremely simple to operate. Figure 2 shows this display mounted in the cockpit of a C-47 aircraft. After only two manipulations, i.e., turning on the power switch and selecting a chart, the pilot has an operating display of his position and heading.

Charts are printed on a 100-foot roll of 35mm film and are projected on the rear of the display screen which is 10 inches in diameter. To select a chart, the slewing handle at the lower left of the panel is turned in either direction. This moves the charts in sequence across the screen. The degree of turn governs the speed of film motion. The center of a small aircraft silhouette, projected on the screen, indicates position. Rotation of the image corresponds with actual magnetic heading. A spare projector bulb may be placed in position by pulling a knob provided on the panel. Image brightness may be adjusted by the pilot to permit operation under varying light conditions.

Operational evaluation tests conducted at the Technical Development and Evaluation Center indicate that these displays will provide the pilot with continuous position information within the range of any omni-bearing and distance facility. Direct presentation of aircraft position on a map decreases the workload of the pilot considerably when compared with the use of symbolic display systems. The pilot is not required to translate instrument readings into a visual picture of his position. This automatic and continuous indication of position with a reduction of mental workload allows the pilot more time for other in-flight tasks.

This type of presentation also provides simplified navigational guidance in all directions from all points. That is, present radio aids and aircraft instrumentation limit continuous navigational guidance to certain specific tracks, these tracks being radial, or, in some cases, orbital with respect to the ground radio facility. With pictorial presentations, no such restrictions apply.

With more efficient use of air space possible, improved air traffic control procedures can be developed to reduce air traffic congestion and delays. Air traffic controllers can use additional air space to expedite traffic movements by providing lateral separation, whereas vertical or longitudinal separation is required with present navigational equipment and instrument flying procedures.

With the exception of ILS, pictorial displays can provide accuracy comparable to navigational methods now used and has the advantages of simplicity and versatility.

Although these navigation systems are still in the experimental stage, they do show great promise. Whether the Air Force will adopt similar systems or modifications thereof is purely conjecture, but eventually we'll all be using something on this order. It doesn't require a crystal ball to foresee automatic linkage with Volscan, visual navigation reference units, radar eyes for instrument flight and completely automatic let down and landing systems.

The All Weather Air Force comes closer to reality each and every day. ●

Keep Current

NEWS AND VIEWS

Balloons in Color — Often mistaken for flying saucers, approximately 800 balloons per day are released in the United States to measure weather elements aloft. Balloon observations are taken four times a day from almost every government and military weather station.

The smallest balloon is approximately one and one-half feet in diameter and is used to measure the heights of clouds. These are either black or red and expand to about three feet before bursting at an altitude of 15,000 to 20,000 feet.

Two types are released daily to obtain data used in computing winds aloft. The smaller expands to a diameter of three to four feet before bursting aloft. The larger balloon expands to about six and one-half feet before bursting at around 50,000 feet. These balloons are colored white, red or black and at night carry a small white light for tracking purposes. The smaller balloon may, on occasion, be colored orange or yellow under special sky conditions for easier tracking.

Uncolored translucent balloons used to carry radiosondes, measure six feet in diameter before release and expand to 26 feet before bursting above 80,000 feet. The radiosonde and red parachute are attached to the balloon by a 100-foot line. Weather stations may release as many as four a day to obtain pressure, humidity and temperature data.

On occasion a larger balloon measuring 73 feet in diameter is released to soar over 100,000 feet. These balloons carry a wide variety of equipment for specialized atmospheric research purposes.

★ ★ ★

New Bird—Designated the Hercules, the YC-130 is built by Lockheed Aircraft Corporation and is currently undergoing flight tests in California.

It is designed to take off from short runways with personnel or cargo, fly higher and faster than existing military transports, land on rough makeshift airstrips and serve as a transport in longer-range logistical movements. The YC-130 measures 132 feet from wingtip to wingtip, is 95 feet long and 38 feet high.

Powered by four Allison T-56 turboprop engines, it develops a total of 15,000 horsepower. Test pilots state that its fast-acting propeller reversal mechanism enables the YC-130 to land and stop on extremely short runways.

★ ★ ★

Trainer—A prototype of what might be a standard cockpit procedure training aid in the future is being installed at some AF bases for evaluation.

The device, the Stanley T-33 cockpit procedure trainer, provides a method of teaching normal and emergency procedures to student pilots and rated personnel in transition from a reciprocating aircraft to the T-33.

This trainer provides complete cockpit representation of a T-33 and a console panel where the activation of the controls and instruments by the

Left and above, the B-66B light bomber made its initial flight on 4 January 1955. It carries a crew of three in a pressurized air-conditioned compartment. Special features include a single-point fueling system and a thermal-cycle de-icing system for the wing and empennage surfaces. The B-66 has two Allison J-71s, a wing span of 72 ft., a length of 75 ft., is 23 ft. high and grosses 78,000 lbs.

Below, two supersonic twins used for USAF's high speed, high altitude research program.

The new Lockheed YC-130, a turbo-prop aircraft designed as an all-purpose military transport.

student is monitored by an instructor. The instructor can declare any emergency, such as a flameout, fire or hydraulic failure. The student's procedure technique, in response to the situation, can be observed by the instructor through the use of signal lights on a control panel.

It is not contemplated that the trainer will reduce flying hours but it is considered a possible answer to the much needed introduction of the pilot to alien or complex equipment or unusual situations.

★ ★ ★

Twin Bells — The Bell X-1B has joined its sister ship, the Bell X-1A, at the Air Force Flight Test Center, Edwards AFB, Calif.

Identical except for instrumentation, the presence of both aircraft at Edwards provides the Air Force with a double-barrelled opportunity to accelerate its investigating of the aerodynamic effects of supersonic flight at high altitudes.

Neither the X-1A, which has attained a record speed of 1650 mph and a record altitude reported to be 90,000 feet, nor the X-1B is intended to be a tactical aircraft. Both are flying laboratories, equipped with approximately 1000 pounds of complex instrumentation. Operations of these types of aircraft have provided the Air Force and NACA with data already applied to current and future tactical aircraft and guided missiles.

Both aircraft are powered by rocket engines, and while designed for take-offs from the ground, the planes normally are carried aloft and launched from a B-29 mother-ship at altitudes over 25,000 feet.

Although the X-1B is the sixth and last of the X-1 series of airplanes which Bell Aircraft built for the Air Force, it is essentially the same plane that was designed in 1945.

The main differences between the original X-1 and the X-1B are that the latter is nearly five feet longer, has an increased fuel capacity and is equipped with a turbine pump to force-feed propellants to the rocket engine.

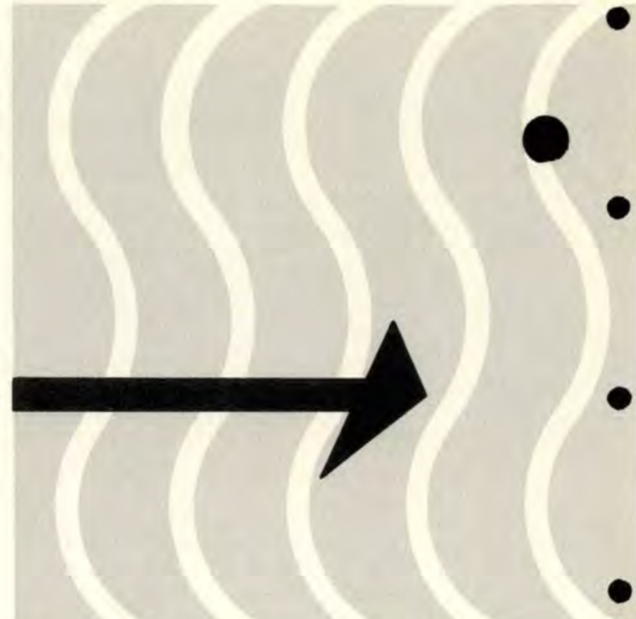
The X-1B is 35 feet, 7 inches long; 10 feet, 8 inches high, and has a wing span of 28 feet. Fully fueled for launching, it's gross weight is over 16,000 pounds.

In general contour the X-1B resembles a .50 caliber bullet. The aircraft is made of polished duraluminum and, like the rest of the X-1 series, is considered to be a very sturdy plane.

The engine burns an alcohol-water mixture and uses liquid oxygen as an oxidizer. It is cooled regeneratively by these propellants. Flight endurance under full power conditions is approximately 4.2 minutes.

Entrance to the pressurized but unrefrigerated cockpit is from above. The jettisonable canopy is made of plexiglas but the windshield is a specially tempered glass. At present, an ejection seat is being installed in the X-1A.

THE NEW APPROACH TO ROUGH AIR



IN SEPTEMBER 1954, many of the more important aspects of thunderstorm flying were covered by FLYING SAFETY. We hit at the subject both from the point of view of the weather forecaster and the structural engineer as well. Since that time, some additional investigative work has been accomplished by personnel of the All-Weather Testing Group at Wright Air Development Center.

As a result of the findings by WADC, the time is not far off when virtually all penetration speed bar graphs will be discontinued from Flight Handbooks and penetration speeds will be based on "power on" stall speeds instead. Some positive steps have been taken in that direction already, but of necessity, complete changes will take time.

One of the most widespread and frequent problems of weather flight is operation in turbulent air. Military specifications require that comments on turbulent air be included in the Handbook of Flight Operating Instructions for each aircraft. The Directorate of Flight and All-Weather Testing was asked to compile a realistic presentation because of the general dissatisfaction with the method presently used. Such dissatisfaction has been expressed by flying personnel on many occasions.

The present turbulent air penetration charts show indicated airspeeds for flying average gusts (30 feet per second) and high gusts (43 feet per second) in terms of weight, altitude, stall and structural failure. Regardless of the various titles used (mild turbulence, average gusts and so on) computations for the charts are based on the penetration of a sharp edged gust with an effective gust velocity of 30 and 43 feet per second. The choice of effective gust velocities of these magnitudes was based on very preliminary results of the joint thunderstorm project conducted by the USAF, NACA, U.S. Navy and Weather Bureau.

Actually the highest recorded effective gust velocity during this project was found to be 43 feet per second, so that value became the high gust. The choice of 30 feet per second as an average gust is even less justified. An unbiased sample of 24 thunderstorms chosen at random from the project revealed a total of 13,315 gusts having effective velocities of over four feet per second. Of these total gusts, only 13 were 30 feet per second or greater. This hardly justifies a 30 feet per second gust as "average" much less "mild." But, the penetrated thunderstorms were not in the "black area" category as defined by the Severe Weather Warning Center.

With the foregoing in mind, it was determined that the bar graph method of determining penetration speeds was not realistic. This led to a search for a solution to the problem. How should penetration speeds be analyzed and presented to pilots?

It appears that present methods for presenting turbulent air penetration speeds are not only difficult for the pilot to use and remember, but also that they may be misleading. The panacea would be a single airspeed for all cases. This would enable a pilot to set up the airspeed before penetration, or if he encountered a storm accidentally, he could slow down to the general range of selected speed. When selecting this given airspeed a pilot would have to consider gust intensity, gross weight, structural integrity, handling and altitude problems. Since an airspeed is to be chosen, each of these considerations will be evaluated with regard to the most desirable airspeed. No consideration is given to cruise control or fuel conservation in the selection of an airspeed.

• *Gust Intensity*—This is a function of atmospheric conditions and cannot be controlled. However, the accelerations received from the gusts are directly proportional to airspeed. Hence this consideration would warrant a slow airspeed.

• *Gross Weight*—Weight is indirectly concerned in this problem since little can be done to change it in case turbulence is encountered. However, it has a definite effect on selecting the correct airspeed.

• *Structural Integrity*—This can be compromised most easily by a combination of over-controlling (maneuver loads) and turbulence (gust loads). In most cases the higher the airspeed when an aircraft is displaced from its flight path, the greater are the loads to recover. On the other hand, at very low airspeeds, sloppy response invites over-controlling. Therefore, the optimum airspeed would be one high enough to allow good handling but not in the range to introduce excessive loads that might cause structural failure.

• *Handling Problems*—It is known that instrument flight at higher airspeeds requires a higher degree of pilot skill and greater concentration. It is also known that the effects of accelerations are greater at high speeds.

The combination of these two conditions introduces a handling problem that can be alleviated by choosing an airspeed somewhat lower, yet high enough to maintain good flight handling qualities.

• *Altitude Problems*—Altitude encompasses consideration of gust intensity, structural integrity and handling problems. The operating range between stall and maximum airspeed (or buffet) decreases with altitude.

Since none of the problems above has given high airspeed as an optimum solution for turbulent air flight, it would seem logical to pick a satisfactory low airspeed. The lowest speed possible, would be just above a stall. Inasmuch as stalling speed is affected by gross weight, configuration and acceleration, it appears desirable not to select a fixed number as a penetration airspeed, but rather a number that is related to the stall speed. For an example, an airspeed of 60 knots above power on stalling speed has been analyzed for cargo and bomber aircraft. This is the average speed that these type aircraft fly on final approaches, with a 10 per cent safety factor added.

Most recommended airspeeds for instrument approaches are within 60 knots of the stalling speed for the weight and configuration under which the approach is made. These recommended airspeeds allow easy handling and accurate control of the aircraft. The highest of these airspeeds is about 200 knots for Ground Controlled Approaches because of the difficulty for the radar controller to handle the aircraft at higher speeds. All operational aircraft today are capable of making satisfactory GCAs. This establishes the fact that if an airspeed 60 knots greater than the stalling speed is chosen (which will generally be under 200 knots), positive handling characteristics are assured for present day reciprocating aircraft.

For cargo and bomber type aircraft this airspeed is not high enough to cause structural damage for severe gusts. There is considerable leeway between the limit load and the ultimate load where failure occurs. Loads in this higher range result from attempted recoveries or maneuvers rather than from gusts.

Since penetration speed is based on stall speed—and since the stall speed varies with gross weight and configuration—these items are automatically compensated for.

In the relatively slow speed range utilized in this example, accelerations are reduced and the most comfortable ride is provided. Because of this low airspeed, the question of the possibility of stalling should be answered.

All of the discussion here is based on a single gust—in fact, on a theoretical sharp edged gust which previously has proved satisfactory for this type of work. The possibility of actually stalling in a single gust is quite remote. Studies have shown that the average distance to the peak acceleration in a gust is around 10 chord lengths. For a large chord of 15 feet this would be about 150 feet to the maximum acceleration. Using the example of "stalling speed + 60 knots," if the very low stalling speed of 60 knots is used, this would mean the aircraft would be flying at 120 knots, or about 200 feet per second. The aircraft would completely traverse the gust (in this extreme example) in a second and a half. Even if a breakdown of airflow over the wings occurred (giving a theoretical stall), it would be so momentary that the inertia of the aircraft would prevent serious displacement.

The problem of stalling in turbulence, therefore, does not come from the gust but from the failure of the pilot to employ proper techniques to keep the aircraft in a level attitude. This must be controlled by recommended procedures which are based on maintaining a predetermined speed and attitude.

Considering all aspects, the choice of an airspeed 60 knots higher than stalling speed, for turbulent air flight appears justified. This is substantiated by actual flight tests of bomber and cargo type aircraft.

The greatest mass of the data was accumulated at 175 nautical miles per hour. The average stalling speed for the aircraft employed was found to be around 111 knots. Adding 60 knots to this speed would give 171 nautical miles per hour. This means the recommended airspeed, as determined by this proposed criteria, would give a speed very close to the one actually used to make any successful turbulent air penetration.

American Airlines conducted a thunderstorm investigation in Convair aircraft (similar to USAF T-29A) to evaluate airborne radar. Some 600 miles of flight including 40 thunderstorm penetrations were flown. The airspeed flown was 140 knots. The stalling airspeed for the pertinent weight and configuration here was about 100 knots. Adding 60 knots to this would give around 160 nautical miles per hour. This is well above the airspeed of 140 knots where it is known that successful penetrations were made. Further, it agrees with the American Airlines "Operating Manual-Convair" which states that when operating in turbulent air, airspeed will be reduced to 148-156 knots IAS.

These cases of repeated extreme turbulence penetrations are in good agreement with recommendations that the optimum airspeed for turbulent air penetration for bomber and cargo type aircraft should be the stalling speed of the aircraft plus 60 knots. Although there may be cases where other airspeeds are preferable for turbulent air penetration, this proposed "rule of thumb" will provide excellent flight characteristics and is a more realistic approach than the bar graphs presently used.

Turbulent air penetration presents less of a problem for fighter type aircraft because of their inherent characteristics. They are designed to undergo greater loads than the heavier aircraft and the personal equipment (safety belts, harness and helmet) available to the pilot helps prevent discomfort and injury. These two considerations allow a safe penetration without requiring the more exacting techniques used in larger aircraft.

The clean stalling speed for the F-84G at design gross weight is 127 knots. The optimum airspeed determined as a result of actual penetrations during the all-weather tests of the F-84G was between 220-260 knots. The F-86D, a swept wing fighter, stalls at about 115-120 knots. Flight tests determined the optimum penetration speed to be somewhere around 240-250 knots.

From these examples, it appears that twice the stalling speed provides adequate handling for turbulent air penetrations by any modern fighter. ●

when you're in the soup...

Capt. John F. Welch, 28th Strat. Recon. Wg., Ellsworth AFB, S. Dak.

IN THESE days of stretching the dollar, the Air Force is looking for every possible means of cutting costs. We must reduce operating overhead and accident rates. We must cut down direct costs wherever possible by obtaining the maximum in personnel efficiency.

Proof of efficiency in our training is not to be found in the number of hours we fly. Rather it is in the amount of actual practice in essentials that we get while flying. If we can finish our required training in fewer hours than scheduled we display greater efficiency as a result of savings in fuel, parts and other direct operating costs. When the requirements of a training mission have been completed unnecessary time spent in the air is likely to be sheer waste and wears out aircraft which might be critically needed.

The pilot of the C-47 was lost and had the 9000-foot level all to himself.

The attitude of the airlines is that every unnecessary minute in the air reduces profit. We're in business for profit, too. Our profit may be a little hard to measure since it consists of combat capability rather than dollars. But our returns, like airlines', must be as large as possible.

In their search for profit, the commercial carriers long ago were forced to stress minimum time in the air and minimum time lost at any particular stop. Time lost in making an instrument approach can louse up a schedule just as badly as time lost on the ground. So proficiency in making instrument approaches has been important to the airlines ever since they started to maintain regular scheduled operations.

The payoff is in greater efficiency in approaches — — that is, getting on the ground quickly and smoothly at the end of each flight.

Now, in order to attain this efficiency in instrument approaches, we must go back to *instrument proficiency*. Real instrument proficiency means the ability to conduct an effective instrument flight from takeoff to landing in minimum time. The purpose of this article is to show how each pilot can, by maintaining and sharpening his own proficiency, reduce traffic control problems and contribute to efficiency of operation.

Let's consider an example. One night last spring, an RB-36 arrived over its home base at 14,000 feet IFR. The crew was in good spirits because the mission had been successful, the airplane was in good mechanical con-

Meanwhile the fuel supply of the RB-36 in the holding pattern at 10,000 feet was dwindling.

dition and there was still three and one-half hours of fuel aboard. The base was well above minimums and the alternate, only an hour and a half away, was CAVU. Prospects were good for a quick letdown, routine GCA and landing, debriefing, a short session at the "Scan" room, some hot chow and into the sack.

But at 9000 feet a C-47 was lost. It was overdue and could not be contacted by ground stations. In a brief, barely readable conversation with the RB-36, the pilot gave his position as approaching the station from the north. He reported VHF trouble, and asked the 36 to relay his request for approach clearance. Clearance was obtained from ARTC but the Gooney could not be re-contacted. Ground stations joined in trying to contact him, but with no success. So the C-47 had the 9000-foot level all to itself in all directions.

Meanwhile the RB-36 had entered the holding pattern and let down to 10,000. The comfortable fuel reserve started to dwindle. ARTC could not approve a letdown through the occupied 9000-foot level. The weather remained unchanged, 900 feet and 10 miles with snow showers, top of the overcast somewhere above 14,000. As 30 minutes lengthened into 45, the prospects of going to the alternate increased rapidly. Careful calculations allowed 15 more minutes of holding. After that, if approach time were still indefinite, immediate departure for the alternate would have to be made to insure arrival with minimum fuel reserve.

At about this time the C-47 pilot contacted a radio station 80 miles south of his destination. The lost pilot had finally oriented himself after a 50-knot north wind had caught him unawares. His radios were good; he had simply been out of range. Since he had only established himself on the south leg, position still somewhat uncertain, the C-47 pilot was cleared on in. The RB-36 was cleared behind him and landed, finally, an hour and a half after the initial approach was started.

The foregoing is an example of how lack of proficiency resulted in one crew getting lost and fouling up another. Fortunately the RB-36 had enough fuel to meet this particular situation. Under other circumstances the aircraft commander could have been forced to go immediately to his alternate or to declare an emergency. An emergency let-down through an altitude at which another aircraft is lost without radio contact would make an ARTC controller pull out what little hair he had left.

But this is not the entire story. In our example, efficiency also took a beating. Look what happened to the taxpayers' money. The cost of the extra fuel burned probably equals a month's pay for a pilot.

Another example occurred at a SAC base recently. The wing's aircraft were returning at approximately 30-minute intervals from a unit mission. We'll concern ourselves with only the last six.

Weather at the base was IFR and lowering. Since it was a maximum performance mission, none of the six aircraft had a large fuel reserve. The first three aircraft made instrument approaches and landed without incident, but by the time the third one was on the ground the ceiling was 600 feet. At 1050, the No. 4 plane was cleared from his position in the holding pattern at 10,000 feet, instructed to descend to 8000 on the east leg and cleared to GCA. The descent was not standard, but was used by ARTC because an airliner was climbing out on the west leg. Meanwhile, the fifth aircraft had requested a long range descent, cutting off a dogleg of the briefed route from 200 miles out because of a shortage of fuel. ARTC had let him descend as traffic permitted, and he arrived over the station at 12,000 feet at 1055, but did not request any priority. As No. 4 reported leaving altitudes, No. 5 was cleared behind him.

But trouble was brewing.

At this particular base it requires about 10 minutes in the GCA pattern from the GCA fix to landing. Descent from 10,000 feet to initial altitude should not have required more than five or six minutes. So No. 4 should have been on the ground about 1106. His let-down was so slow, however, that he did not ease down out of the soup onto the runway from his first approach until 1132. That was about 25 minutes too long.

For the crew of No. 5 that meant about 25 gallons of perspiration. Their fuel was already too low to consider going to an alternate, and the weather was now down to 400 feet. So, as you might expect, they didn't waste time. They were cleared at 1133, but because of poor visibility they missed their first approach at 1148. They were cleared immediately for another try and landed at

Number 6 needed two passes to get in; a few minutes later weather went below minimums.

1201. It was a good thing they did, too; they didn't have enough fuel left in the tanks to make another pass. Number 6, which arrived about 1130, also needed two passes and landed at 1230. The weather went below minimums a few minutes later.

A little more proficiency on the part of the crew in No. 4 could have eliminated the uncomfortably close shave experienced by the aircraft behind him. A little less proficiency could have cost the taxpayers an expensive airplane; perhaps several expensive crew members. As critical as the fuel supply was, a declaration of an emergency by No. 5 might have caused either No. 4 or No. 6 to have to declare one also; providing more problems for ARTC and the crews.

Air Research and Development Command has developed traffic control equipment which can control approaches at the rate of 120 aircraft per hour. (See "Volscan," FLYING SAFETY, April 1954.)

Probably we shall never try to attain such a rate on a sustained basis, especially with multi-engine aircraft. But no matter what the capabilities of the machines and instruments, until the day of the completely automatic landing, our rate of instrument approaches is limited by the skill and proficiency of the average pilot.

For jet operations, speed and proficiency in making instrument approaches are indispensable. You must be on the money the first time, and fast enough to give the following pilots their try at it. In reciprocating aircraft, under conditions of heavy traffic, efficient use of time is also of prime importance, as illustrated by the last example.

There is probably nothing in the following IFR suggestions that most pilots do not know already. It's just that occasionally we need to be reminded of them. They are offered in the hope that they can be used to improve instrument proficiency.

• Maintain a constant listening watch on one of the CAA frequencies. If you are listening on UHF, check the facility charts to be sure the stations for which you are listening have the equipment. If you do not have UHF, and VHF must be used for something else, have someone on your crew monitor the frequency of the nearest Omni or Low Frequency Range station. If you have been talking to a station and must change channels, tell the operator you will stand by on his range frequency. Be particularly attentive for a while after making position reports and when approaching fixes previously estimated. The Air Route Traffic Control Center may have a clearance or a weather report for you, or perhaps an emergency or a lost aircraft in your area.

• Keep constant track of your position. If you have radar navigational equipment, your radar observer can help you. But don't depend on him alone. Be alert for wind shifts and unpredicted winds. Don't let the weather get you lost.

• If your mission requires some time in the base area after arrival, be sure to tell ARTC of your plans. They may be able to work in under you those succeeding aircraft which wish to land immediately, if you let them know ahead of time. Also, they can plan a lower altitude for you, to let the next crew, with plans similar to yours, in above you.

• Comply with clearances promptly when you receive them, or request changes immediately. The reason for a new clearance may be to maintain separation between you and another aircraft, or to assist another aircraft in trouble.

• Accept approach clearance when it is given to you. If cleared for descent, start letdown immediately and make your approach as rapidly as possible. Descending at 500 feet per minute is good practice in instrument school, but you can and should let down much faster in your approach to the GCA fix or procedure turn.

• Make all requested reports during your descent as promptly as possible. Under ANC Manual, paragraph 2.04020, Control may descend aircraft a constant 1000 feet apart if the aircraft are in communication with each other. If that is being done, be sure to tell the pilot above you as you leave each 1000-foot level.

• If you are given a descent in a quadrant, on a bearing or on a leg other than the normal approach leg, go no farther from the station than the clearance requires, and return to the station or the normal letdown pattern as soon as the clearance permits. That way you can avoid getting lost and will be in a better position to begin a GCA or low approach upon reaching the proper altitude.

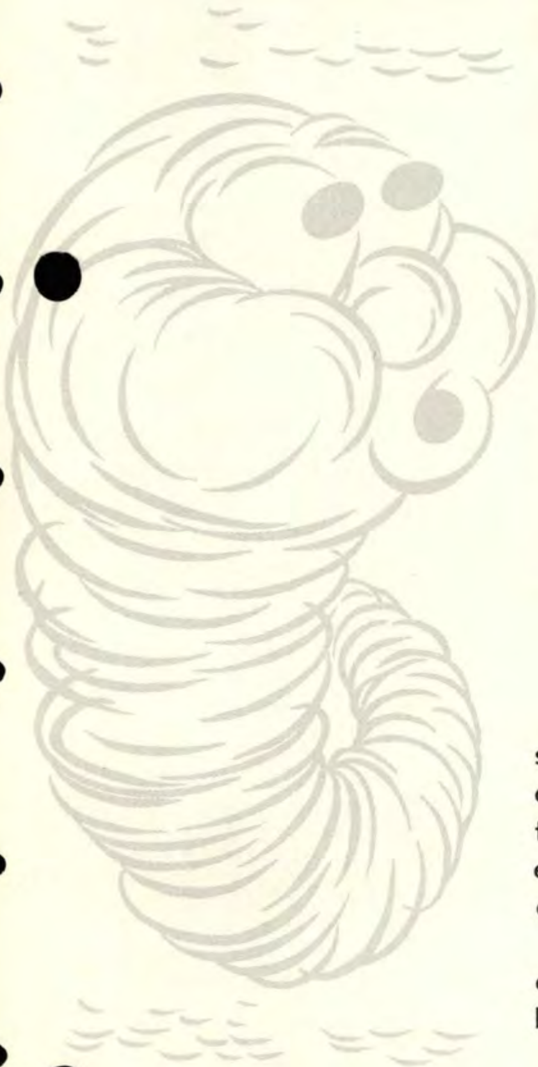
• Unless instructed by Control to do so, it is not necessary to approach the GCA fix from any particular direction, so long as your altitude will clear obstacles and terrain by 1000 feet. If your turn is made to the first GCA heading immediately upon station passage, you are normally assured of adequate terrain clearance and good GCA radar contact.

• If your fuel supply is below that required to get to your alternate, and landing base weather is poor, you are bordering on an emergency. Do not hesitate to declare an emergency if it is warranted.

• Don't forget the other crews. One of those behind you may need to save every possible minute, even if you do not.

Proficiency alone is no guarantee that a pilot will make an approach in minimum time. But if he is conscious of the problems of other flight crews and those of Air Route Traffic Control, and makes use of his proficiency, he will be contributing to a more efficient Air Force, and the Air Route Traffic controllers will have fewer nightmares, and, in the long run, we'll all save money. ●

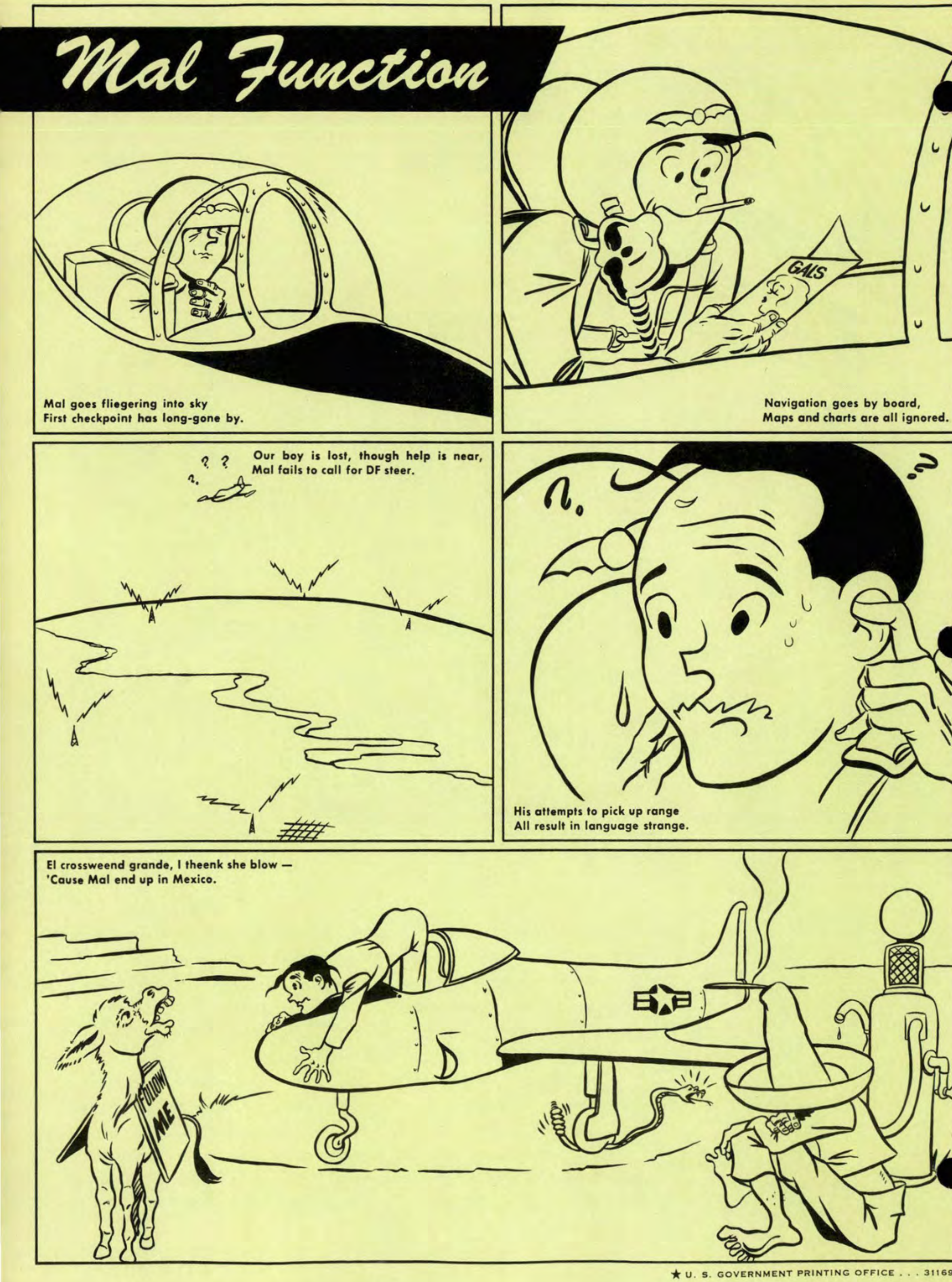
The Wind Doth Blow



Probably the best harbinger of spring is the March winds. They start melting the snow and ice of winter and furnish mankind with delightful previews of things to come: summer warmth, green fields and Bikini bathing suits. Sometimes they reveal some interesting facts and figures, but at other times these same winds can cause a bit of trouble for the unwary pilot.

The breezes that we enjoy on terra firma may well drift an aircraft far off course. We hope that will never happen to you, but if it does, remember the many aids that are available.

The story that starts on page 4 of this issue should not be overlooked by any reader. Becoming lost, misplaced or disoriented is unpleasant, but help is as close as your microphone.


Mal Function
Mal goes fliegering into sky
First checkpoint has long-gone by.
GALS
Navigation goes by board,
Maps and charts are all ignored.
Our boy is lost, though help is near,
Mal fails to call for DF steer.
His attempts to pick up range
All result in language strange.
El crossweend grande, I theenk she blow —
'Cause Mal end up in Mexico.
FOLLOW ME