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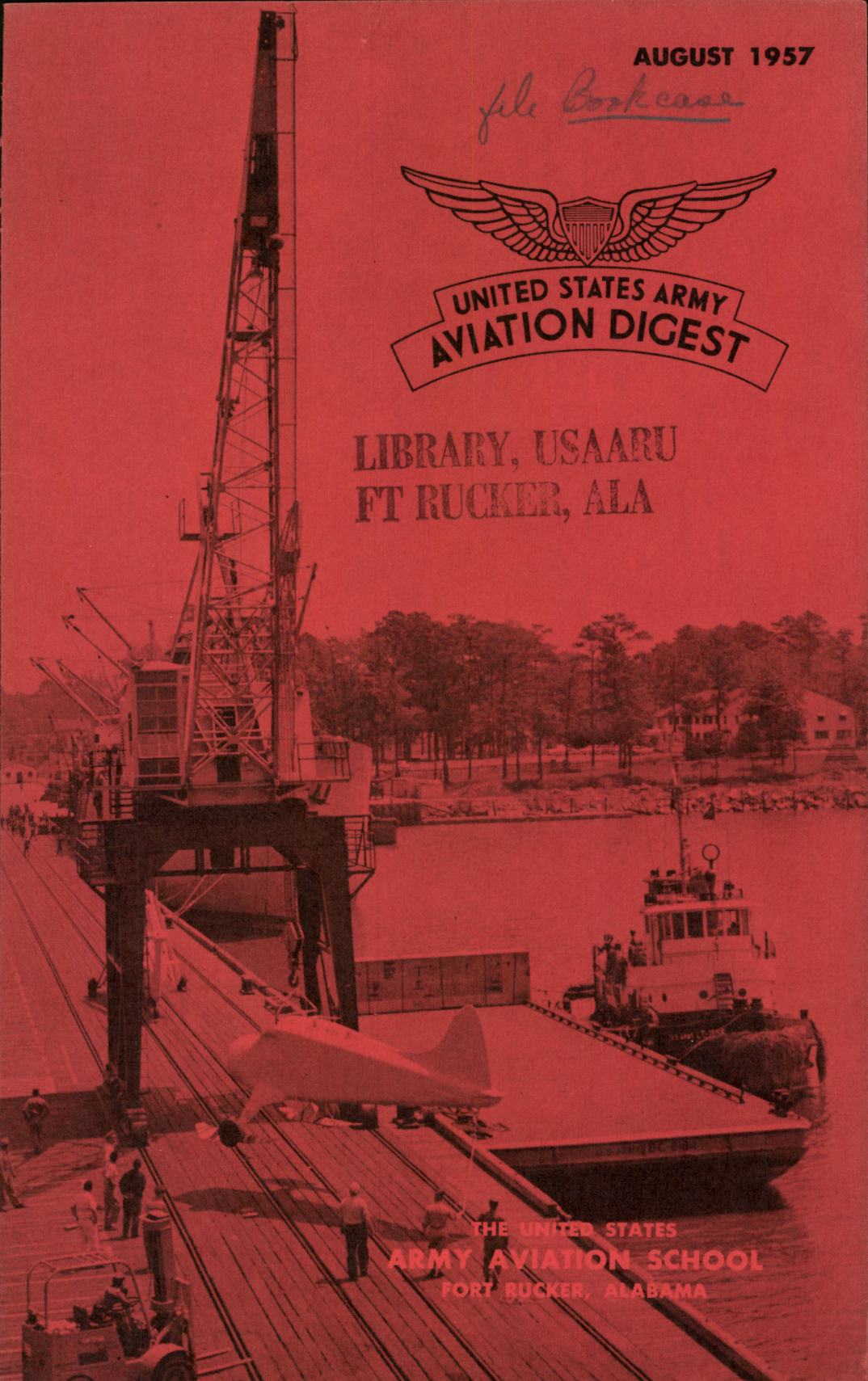

THE UNITED STATES
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FORT RUCKER, ALABAMA

U. S. ARMY AVIATION DIGEST

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The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

Manuscripts, photographs, and other illustrations pertaining to the above subjects of interest to personnel concerned with Army Aviation are invited. Direct communication is authorized to: Editor-in-Chief, U. S. ARMY AVIATION DIGEST, U. S. Army Aviation School, Fort Rucker, Alabama.

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NG: State AG.
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For explanation of abbreviations used, see AR 320-50.

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DIGEST

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COVER

The Army aircraft from Fort Eustis, Virginia, is being loaded on a barge at Hampton Roads Army Terminal, Norfolk, in the first stage of its journey to Greenland. The L-20 will be used to support a 14-man Army Engineer unit in making its route survey project across the bottom of Greenland's famous icecap.

Notes FROM THE PENTAGON

Major General Hamilton H. Howze, *USA*
Director of Army Aviation, ODCSOPS

INSTRUMENT TRAINING is more than an intriguing approach to the control of an aircraft in the air. An actual weather flight —or, even more, getting inadvertently caught in the "soup" when unprepared for that adventure—drives home with considerable force the importance of instrument training. Sometimes the force overcomes the aviator.

As the Army comes to rely more and more on Army Aviation, we must develop the capability of supporting the Army under all weather conditions. The modern concept of future combat envisions widespread battle formations, describable perhaps as a number of isolated islands of force. Under these circumstances, mobility is the key to effective troop employment, command, supply, and communications.

Unfortunately, Army Aviation and ground units are not always able to utilize their mobility potential in concert because of poor weather or ground conditions. By augmenting its round-the-clock mobility, Army Aviation will have a better chance of improving its availability to the Army commander and of approaching the desired goal of providing support to ground units under any condition of weather or darkness.

A famous aviation writer once said, "From now on, the superiority of an airman will be measured, not by the old yardstick *Courage,* but by the new yardstick, *Knowledge.*"

This knowledge must include the know-how necessary to perform instrument flights safely, but it is not a bad idea to hang on to your courage, too.

The ability to fly in instrument weather provides another goal for continued self-development as an aviator. Development of this ability will provide you an increased feeling of satisfaction and confidence and will greatly increase your ability as a VFR pilot.

The number of Army pilots not instrument qualified is a matter of concern. Lack of adequate instrumentation in our aircraft in past years may ease our consciences on this score, but this excuse is vanishing as instrument-equipped aircraft inventories steadily rise.

Lack of funds needed to increase student input into the instrument course at the Aviation School has also contributed to the difficulty of increasing the number of qualified instrument pilots in the Army. This, too, is being corrected by use of civilian contract instrument pilot schools, and, beginning in fiscal year 1958, the Army plans to graduate as fully qualified instrument pilots approximately 60 percent of the students from each advanced fixed-wing course at the Aviation School.

There is some—but I think rare, fortunately—reluctance on the part of pilots to fly actual weather flights. Those who have flown lots of actual weather suggest a simple cure for this situ-

ation: get your feet wet—file into the clouds. Nothing is more effective in building confidence and creating a desire for further experience than the first instrument flight. To allay misgivings on that first flight, take along an experienced hand as copilot.

We can learn a valuable lesson from Air Force experience in instrument weather flying. Many will remember the tragic record of the Army Air Corps during the 1920s when it attempted to fly the mail without adequate instrument training and equipment.

There are even stories of early attempts to fly weather using a saucer filled with coffee balanced on the pilot's knees as an improvised attitude indicator.*

During the years 1930 to 1942, little progress was made in the art of weather flying, yet during this period, aircraft became larger and more complex until they could no longer be flown by "feel" or by the seat of the pants. But at the start of World War II the picture changed abruptly. The requirement for all-weather flight suddenly became an absolute necessity.

The instrument flight system in common use had been the 1-2-3 or needle-ball-air speed system devised in 1930, which was completely inadequate for the times. In 1942 the Air Force conducted a study of instrument flying. This led to the full-panel system of attitude flying which was incorporated into the Air Force training program during the early part of 1943, and has become the common system in worldwide use today.

We in the Army are fortunate to be living in an age when techniques and equipment have already been developed for a safe instrument flight. There is no excuse today for not joining the expanding ranks of instrument-qualified Army Aviators. File an instrument flight plan with confidence, and don't abort a flight because of weather unless judgment and experience indicate the hazards are or may be beyond your ability.

On the other hand, indiscriminate weather flights should not be attempted in aircraft not suitably equipped. For example, aircraft lacking adequate deicing equipment should not be flown into known icing conditions, nor should an aircraft with limited communications and navigational equipment be flown IFR into a high density area such as Washington, D. C.

Because of the severe structural stress placed on the aircraft and the inability of windshields on Army aircraft to withstand heavy hail, intentional flights into areas where severe thunderstorms are known or believed to exist should be avoided whenever possible. But even here, remember that if inadvertently caught in such a situation, thousands of thunderstorms have been flown through without disaster.

Every Army Aviator should want to be listed among those pilots who "know what they ought to know." Competence in instrument flying is included.

**You can believe this if you want to. Seems to me the instrument would lose its value (by spilling the coffee) the first time the airplane left straight-and-level.*

FOREWORD

THIS ARTICLE by "Captain Anonymous," which was recently published by the Flight Safety Foundation, is an excellent presentation of factors relating to our greatest problem confronting aviation today.

This problem is a matter of increasing importance to all of us as there are three to four "near misses" each day. The Army has experienced five midair collisions thus far in CY 1957 resulting in the loss of six aircraft, six persons killed, and five persons injured.

Investigation has determined that contributing factors to midair collisions are poor scanning habits and cockpit preoccupation. Now is the time to review operating procedures, traffic patterns, clearing procedure for takeoff and landing, and other possible contributing factors.

All flying personnel must cooperate to the fullest extent in order to resolve this problem.

During September-December 1956, 452 "near collision" reports were submitted by pilots: a daily average of 3.7. Of the 452 reports, military pilots accounted for 259 (57 percent) and civil pilots for 193 (43 percent).

A total of 4,429 persons were aboard the reporting aircraft in the 452 "near collisions" reported; the number aboard the "other" aircraft involved is not known.

In the 452 incidents the following circumstances or factors existed:

SITUATION	
In controlled air space	406
VFR conditions	347
IFR conditions	102
Daylight	328
Piston vs piston	260
Both aircraft under 200 mph	261
In transit	250
In level flight	244
Head-on	172
Crossing	184
Arriving/departing airport with control tower	172
Jet aircraft involved	146
Military vs military	131
Visibility over 5 miles	127
Altitude 4,000-15,000 feet	200
Became aware of other aircraft 500-2,000 feet	136
Closeness of "near collision" 100-500 feet	202

The Growing Problem of MIDAIR COLLISION

"Captain Anonymous"

I HAVE BEEN giving considerable thought to the growing problem of midair collision and I feel that my ideas on this subject may be of interest. The suggestions I am offering are not intended as a cure-all for this ever-present danger nor will they apply to all types of aircraft in all kinds of operations. They are made as a result of several months of observations as pilot and check pilot in flight operations and as trainee on instrument refresher flights in the New York area.

First of all, we know that although there are far fewer cases of reported near misses of aircraft flying on IFR clearances in actual IFR or marginal weather than there are of such cases in VFR conditions, we must realize that the possibility of IFR collision is still a very great one. We also must realize that the number of cases is greater in VFR conditions for three reasons:

1. There are more aircraft in the air.
2. Most of them are "uncontrolled," that is, on VFR clearances.
3. There is a greater air traffic build-up near airports where more aircraft are cleared for local flights.

Actually, however, there would be more cases of IFR near misses reported if actual instrument conditions did not prevent us on many occasions from seeing how close we have come to other planes. The point I want to make here is that some of the reasons for the hazard are the same, whether visual or on instruments, and in most cases, the pilots, myself included, are responsible.

Let us consider first, then, the causes of possible collision of IFR aircraft in actual IFR weather.

1. *Mistakes by ATC or the controlling agency.* This is prob-

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This article was recently published by the Flight Safety Foundation. Views expressed in this article are the author's and are not necessarily those of the Department of the Army or of the U. S. Army Aviation School.
—The Editor

ably the least frequent cause of near misses although we know it is a very real one and will continue to be as long as humans operate it. We know also that control is poor in some of the Western European countries and that it will continue to improve, as it certainly has, only as long as pilots continue to report every instance of error and every violation that comes to our attention.

2. *Pilots not flying in accordance with clearances:*

a. "Cheating" on altitudes, to stay "on top" or get a little extra altitude to use for gaining airspeed after leveling off.

b. Not staying on their own assigned airway, or on the right side of low/medium frequency airways.

c. Not revising ETAs when affected by wind or airspeed changes.

d. Not starting a letdown or climb when instructed or not doing them at the proper rate.

3. *Extreme turbulence rendering altitude control difficult.* This possibility should be considered by pilots when entering frontal areas, particularly when near centers of high air-traffic concentrations.

The above may seem an oversimplification of the IFR collision problem. However, it has not been my intention to minimize it. I have merely given more attention to the problem of VFR collision because the record and my own observations indicate it deserves more thought than the IFR problem.

First, let us assume that a near miss occurs because the pilots of one plane did not observe the other aircraft in time to take proper action to avoid coming into too close proximity to it. Assuming that conditions of sufficient visibility exist, let us consider the elements which might prevent the pilots from seeing each other's plane IF THE PILOTS WERE LOOKING FOR OTHER AIRCRAFT.

These may be the result of:

1. Blind areas caused by the inherent structure of the aircraft.

2. One aircraft being between the sun and the other aircraft.

3. Confusion of aircraft lights with lights on land or water, or with reflections of lights inside the cockpits.

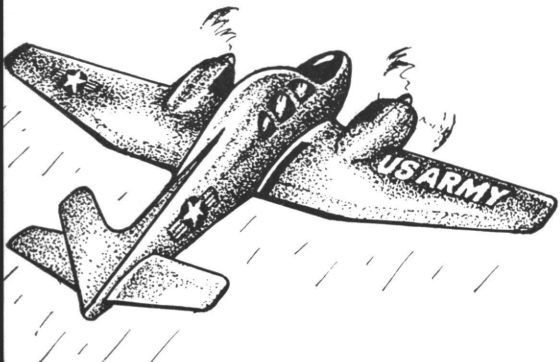
4. Spots of dirt on windows or windshields.

5. Window shades or glare shields being left in place in the cockpit when flying in areas of high air-traffic density. (It is interesting to note that occasionally pilots begin landing approaches or takeoffs with the window curtains in place.)

6. Training aircraft with various types of hoods in place partially obstructing the view of the instructor pilot.

7. *Failure to look out for other planes!*

Of the above seven items, there is not much we can do immediately about the first two. Regarding No. 3, I agree with



one of our instructors that there can be some confusion of direction of flight when the Grimes light and the running lights are all flashing simultaneously. It would be better to carry the navigation lights in the fixed position when using the Grimes light, provided this was established as a universal practice.

Although the different frequency of the two kinds of lights is supposed to allow one to readily distinguish one from the other, I know from experience that they can be confusing, and a pilot, upon finding another aircraft in dangerously close proximity, is not going to have time to start timing the lights to tell whether they are navigation or Grimes lights. Concerning reflections of lights inside the aircraft, I consider that some of our pilots and other crew members are too indifferent about the number and intensity of unnecessary lights on the flight deck when in congested areas where everything possible should be done to improve night visibility.

The solution to items 4 and 5 is quite obvious—don't start a flight with a dirty windshield and don't have the shades in place except at cruising altitude.

Regarding item No. 6—training aircraft with hoods in place—I believe that in view of the number of near misses which our instructors report, and in view of the number of actual collisions of hooded aircraft which have occurred, we should be able to carry out our training program with the same results and with CAA approval, with reduced use of the hoods. Naturally, the question follows, "How can you fly as much on instruments during training flights without a hood as with one?" The answer is that you can't; but I feel that our very experienced instructors can evaluate the ability of our captains and first officers by using the hoods only during instrument approaches, after procedure turns, as well as they can by keeping it continuously in place, unless some type of hood completely enclosing the trainee is adopted. As a matter of fact, I question the necessity of having the captains checked, as at present, on holding procedures, outbound courses, etc., in the DC-3 or other training aircraft, with the present type hood. Most pilots don't know the location of various radio aid installations on the ground anyway, so looking out wouldn't give them much help, even if the present type hoods were not used at all, except approaching "final." I'm sure that some of our exceptionally well qualified instructors will not agree with this idea, but in any case I would like to have it discussed with them.

We now come to the most important part of this discussion, item No. 7. It is a fact that most midair VFR collisions are the result of the pilots of one or both aircraft not seeing the other BECAUSE THEY WERE NOT LOOKING.

Now let's find out why pilots don't do more looking. Some of the reasons are understandable, some ridiculous, but all very interesting, especially to those responsible for accident investigations and to those responsible

for developing flight techniques. It is no longer sufficient to merely conclude that an incident occurred because of pilot error or because pilot so and so was doping off and didn't watch where he was flying, unless we try to determine the cause of and eliminate the possible reasons for such errors or alleged lack of proper vigilance.

The principal reason why pilots don't do more looking out of the cockpit is partly psychological. We have been so indoctrinated in instrument flying practices and it has become so necessary to fly our modern transports with almost constant help from instruments that we have difficulty in constantly shifting our attention from the instrument panel to outside. This emphasis has, of course, been necessary because of the complexity of our machines and the nature of instrument and radio aid flying. We might also say that we have been taught to do everything except look out. As a matter of fact, the use of that very valuable machine, the Dehmel trainer, has, in spite of its great contribution to the safety record, probably been responsible for what we might call our "overinstrument-consciousness."

When I use the term "overinstrument-consciousness," I do not mean to minimize the importance of precision instrument flying nor of the proper use of instruments as an aid to good VFR flying. I do feel that if we are to attain the greater all-around safety which more vigilance in VFR conditions will provide, we can and must sacrifice some precision.

Most schedule flights depart and approach on IFR clearances and I have observed that even in VFR conditions the pilots, through habit or because they want to do a good job, especially for a check pilot, will stay "on instruments" and fly precisely on the airway, as cleared. Unfortunately, however, to do this precise job, they have their attention so confined to the instruments that they don't do much looking out. We know that an airline aircraft will climb quite well at speeds 5-10 knots plus or minus its published optimum climb speed; it does not have to be held at exactly the recommended speed. On normal climb a reasonable adherence to this climb speed will do the job and the pilot shouldn't have to sit with his eyes glued to the instruments, keeping the IAS at exactly optimum climb speed.

We know also that normal visual landing approaches, either circling or straight in, are made with most of the attention of the pilot centered outside the aircraft and with only occasional glances at airspeed and altitude to aid him in the approach. This, then, is the kind of flying we should encourage in all VFR conditions, no matter how the aircraft is cleared—attention centered outside the airplane with an occasional glance inside for help from the instruments—and not as so many now fly, glancing out only infrequently and rather haphazardly.

Some instructors will object to this idea because of a fear that it will cause pilots to develop unprecise habits that will be carried into their instrument flying. However, I believe that

if a pilot makes a conscious physical and mental shift from one type of flying to the other, as weather conditions change, saying to himself and his copilot, "we are now flying instruments" or "we are now flying VFR," in the same manner in which he shifts from instruments to contact upon breaking out during an instrument approach, his instrument technique may even improve rather than deteriorate.

This strong emphasis on instrument flying, then, may be considered the No. 1 psychological reason why pilots center their attention too much inside the aircraft during VFR flight, when it should be concentrated outside.

The other psychological reasons are:

2. Airline pilots flying long flights at high altitudes, often through areas of relatively little traffic, can easily fall into habits of relaxation and complacency. The complacency may be carried into areas where greater vigilance is necessary.

3. Dependence on radar control in some terminal areas which is improving but still far from satisfactory enough to handle the problem, and the lack of realization that radar is not an anticollision guarantee for all aircraft in the area.

4. The erroneous assumption that an IFR clearance gives a pilot right and title to his altitude and airway to the exclusion of all other aircraft.

5. The erroneous assumption that because the pilot of the other aircraft is VFR he will do the looking for both, when actually it would be safer to operate on the theory that every other plane in the sky is an enemy plane bent on destroying you. (I recently advised an ATC Center that I would probably be landing with restricted visibility because the cockpit windows were iced up after failure of both alternators, and suggested they so advise other aircraft in the approach area. The controller later asked me to advise him when the windows became clear; I wondered if he asked this so that he could then tell everyone else to relax. I also thought how much better it would be for everyone to consider that "the other guy's windows were iced up.")

6. The erroneous assumption that "3 miles forward visibility" —sometimes obtained through a small hole between the clouds— meets their required "VFR" clearance condition.

The technical reasons why pilots do not properly watch for air traffic are many and understandable, but with study and modification of procedures, the attention-holding and time-consuming nature of some of the items may be reduced.

In a recent article titled "How Much Can A Pilot Do," by L. I. O'Kelly of the University of Illinois and presented to an ALPA Safety Forum, it was shown that a pilot can do only one thing at a time, "although it is sometimes surprising and seemingly in contradiction that such should be the case."

It further stated, as an example, "comprehension of an auditory message which is highly detailed, containing such items as bearings, runway numbers, altimeter settings and the like,

can be imperfect to the extent that the pilot may, during the transmission, undertake any other action sequence."

Further, to paraphrase another statement of this article, "since we are all aware that the expected air-traffic density is greatest during the first and last stages of the flight the pilots should be freed as much as possible of transactions furnishing possible 'competition' to their exercising the greatest vigilance during these periods."

Listed below is a partial list of items that provide that "competition":

1. Flying the aircraft, as discussed above, in such a way that there is an overuse of instruments.
2. Operating the radios:
   a. As directional aids.
   b. For communications.
3. Completing check lists.
4. Checking charts for headings, frequencies, etc.
5. Checking and recording data on flight time analysis.
6. Keeping radio log.

We know that all of the above operations have to be performed, but not exactly as they are done now. In the case of the check lists, we have for some time emphasized doing the prelanding list well before entering the congested traffic areas. We may do the same with the after-takeoff list, waiting until we are four or five thousand feet high and away from at least the immediate airport area before doing all the items except gear and flap operations, which may be considered part of the takeoff itself.

While it is true that some of the other items don't take long to do, neither does it take long for two aircraft to come together at closure speeds of 300 to 600 miles per hour (up to nearly 300 yards per second).

In fact, the closest near miss I've had occurred following a left turn out of Idlewild, after takeoff on 31 Right. As I started turning, radar control advised that there was only one plane in the area, "over Floyd Bennett at 3000 feet." But this plane passed very close in front of us when we were at 1000 feet and had completed only about 90 degrees of our turn. It was not seen by my first officer who, just at that instant, had looked down to change the hydraulic valve to the bypass position. I had previously cautioned my third officer to watch out the left side of the airplane. I was watching generally ahead during the left turn.

Regarding the problem of check lists, an airline captain has suggested that the pilot look out for other aircraft between each item on the list, a very good habit to have.

Concerning item No. 2—operating radios—this is where good cockpit organization and teamwork is very important. In any case, if charts, FTAs, and radio logs are not ready at hand for instant use, the radio operation will be slow and inefficient and will "compete more with the job of looking out." If frequencies to be used cannot be set up before departure or beginning descent, they should be jotted down in large numbers on a handy pad or clipboard so they will not have to be groped for in a route manual at a busy moment. This suggestion may seem elementary, yet it is amazing and alarming

how much time is lost or spent in doing these things because of poor cockpit organization.

Where cockpit or panel space is available, larger frequency dials with larger numbers and better lighting should be provided.

I stated earlier in this discussion that there are many things which distract a pilot that are understandable but still somewhat inexcusable and should not take place on a well organized, orderly flight deck. The following is a list of such items:

1. **Unnecessary Conversation**
   This is distracting not only because of the actual talking and the subject matter of the conversation taking one's attention, but also because it is courteous and natural for two persons to look at each other when they converse; thus, their attention is taken from the job we are discussing, that of watching for other aircraft. This then is a doubly distracting factor and the **greatest single one which can be fairly easily eliminated.**

(I realize the importance, which was recently pointed out, of captains conducting their flights in a friendly manner and of having good relations between crew members. I realize, too, that a great deal of technical and training information is disseminated during our trips. It is true also that too strict rules of operation could lead to strain and an atmosphere of tension in the cockpit. But one thing is worse—overrelaxation, carelessness, and inattention caused by the distraction of unnecessary conversation between any persons on the flight deck. I should like such conversation limited to that necessary to the safe conduct of the flight operation being performed at all times during critical operations, both VFR and IFR. For purposes of this discussion, I consider all operations critical whenever the engines are running except during extended delays on the ground or at cruising altitude.)

2. **The Use of the Public Address System**
   The use of this device takes a considerable amount of the pilots' attention and should not be used during climbs or approaches. I know of letters to pilots from passengers criticizing the pilots for using the P.A. system during approaches. I also witnessed a pilot start an approach to the wrong runway because, at the time landing instructions were given, he was occupied with the P.A. system.
3. **Interference by Other Crew Members, or Other Company Personnel**
   a. Flight service personnel asking to have logs, documents, etc., signed at the last minute during an approach.
   b. Extra personnel on the crew list and, in some cases, passengers, whose presence on the flight deck is contrary to regulations.
4. **Pilot Not in Seat in Cockpit**
   This seems almost unbelievable, yet it has been reported that an otherwise responsible captain left his station without asking anyone to replace him "to get a quick shave," during a descent, 50-100 miles from destination.
5. **Eating in the Cockpit during**

Descent or Climb

6. **Sleeping or Reading in the Cockpit**
   These are inexcusable except when cruising at high altitudes in areas where all traffic is IFR controlled. Reading, in any case, should be confined to short technical articles related to the flight.

I may seem inconsistent when I suggest that sleeping in a cockpit can be condoned under some circumstances, as high altitudes in areas where all traffic is IFR controlled. Yet we must admit that under stress of frequent adverse weather or of abnormal aircraft or engine condition, it is safer for a captain to be at his station than in a crew bunk when it is necessary for him to get some rest on a trip of 15 to 24 hours duration.

Another difficulty is that pilots don't look around and up and down as much as directly ahead. Partly as a result of pilots' suggestions and complaints, some of our airliners have cockpits which allow relatively good visibility; it is now up to the pilots to make the best possible use of this feature of modern design.

As stated above, the thoughts expressed in this discussion were reached after discussions with many pilots. Many of them seem elementary and obvious. We all have seen examples of the items mentioned and some may even seen unimportant. Yet **collectively** they add up to a serious hazard, proved by the record of actual collisions and a rapidly growing rate of near misses, most of which could have been prevented by greater pilot vigilance.

When we consider the millions of dollars spent annually by the various governments, airline associations, airlines, and the pilots themselves, through the ALPA, towards the operations of the various ATC agencies, and also the cost of delays, stacking, holdings, reroutings, etc., all done to prevent midair collisions, it seems ironic that the greatest and cheapest contribution in this direction can be made by the pilots themselves.

In conclusion, the story of an old, old lady is appropriate. She was asked, upon reaching the age of 90, how she had spent her later years. She replied, "Jist sittin' and lookin' out the window and sometimes jist sittin'." Some of us may reach the age of 90, but we're not so likely to if we don't do more "lookin' with our sittin'."

CORRECTION

The Under Secretary of the Army, pictured on the back cover of the July issue of the U. S. ARMY AVIATION DIGEST, who was identified as Charles E. Finucane, is actually Dewey Short.

Torque Sense

Captain Donald S. Muttoni, TC

DO YOU REMEMBER the old days when maintenance was simple and uncomplicated, and it was not unusual to find pilots who could do just as good a job as any mechanic? Torque wrenches were practically unknown and torquing was accomplished by cinching up the nut and adding a half turn for luck. If a mistake was made it very seldom turned out to be serious.

Although those days are gone forever, it is an unfortunate fact that many of those techniques, or rather lack of techniques, are still being used. These mistakes are now having serious consequences. The failure to use proper torquing procedures has resulted in the loss of aircraft worth millions of dollars and the loss of many lives. The tragic part is that these losses are the result of a lack of understanding of just a few simple principles or in some instances, the "Heck, I've been tightening nuts for years; I don't need a torque wrench," attitude.

What is torque? How are torque settings determined? Where is the information found? What precautions should be observed? Let's discuss these and other essential bits of information which every mechanic and maintenance officer should know.

Torque is the twisting force which determines the amount of preload placed on a nut, bolt, or other fastener. The use of correct torque will reduce to a minimum the possibility of failure. Before you use a torque wrench on everything in sight, however, check the Dash Two handbook. There are some instances in which torque is measured in terms of "finger tight" forces. For example, applying torque in excess of the force which can be applied with the fingers to the nut and bolt which connect the H-13 swashplate to the fore and aft irreversible arm may crack

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Captain Donald S. Muttoni, TC, is presently assigned as Special Assistant to the Chief, Aircraft Maintenance Engineering Division, Directorate of Engineering, Transportation Supply and Maintenance Command, St. Louis, Mo. Views expressed in this article are the author's and are not necessarily those of the U. S. Army Aviation School or of the Department of the Army.—The Editor

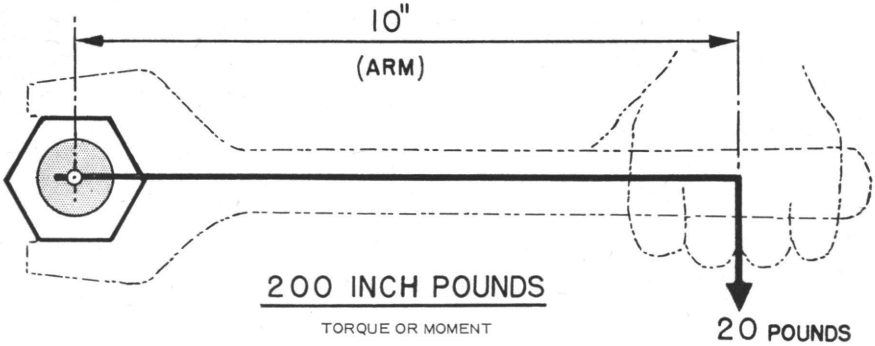

Figure 1

the swashplate. When in doubt, check the Dash Two. It will only take a minute.

Aircraft designers establish torque limits which will withstand, without failure, the loads to be imposed. The upper limit is based on the ability of the metal to snap back from an imposed load with no deformation. The stress range where this characteristic occurs is referred to by engineers as the elastic range, and the upper limit of this range is called the elastic limit. Any stress imposed beyond the elastic limit (such as overtorque) will result in permanent deformation or failure. Stripping of threads or the twisting off of a nut or the head of a bolt are examples of this type of failure. Unfortunately, many of the results of overtorque are not immediately visible, and failure at some later date becomes a dangerous probability.

The lower torque limit is determined by the amount of required preload placed on a fastening device to prevent a relative movement of the parts being held together. Such movement, if permitted, will induce fluctuating or impact stresses which result in metal fatigue and failure.

The torque limits for nonstandard items are always found in the applicable Dash Two handbook. The torque limits for standard items are found in the engineering series technical orders.

Now that you know the importance of proper torque, and have assembled your maintenance personnel, briefed them, and instructed them to go forth and sin no more, there are still certain precautions to observe. Make sure enough torque wrenches are available to cover the complete range of torque settings which your aircraft requires. It would be desirable to have more than one in each range, so that a maintenance operation is not delayed because a wrench must be repaired or adjusted.

All maintenance personnel must be given thorough training in the care and use of each type of torque wrench. Remember that the torque wrench is a precision tool and must be protected against corrosion, rough handling, or improper use. Regardless of how well it is maintained, it must be periodically

recalibrated to insure accuracy. Never use a torque wrench to loosen or back off a nut, for this can seriously impair its accuracy. Make sure that when torquing a nut, at least one thread extends beyond the nut.

Bolts longer than specified should not be used, for this could result in a false torque reading if the nut is run onto the unthreaded portion of the bolt. Finally, to double check, instruct the tech inspector to watch for improper procedures and to spot check torque settings after maintenance has been performed.

There is one field expedient which can be used if no torque wrench is available and if the job can't wait.

Since torque, or moment, is the product of a perpendicular force and the distance of its point of application from the axis of rotation, a torque setting of 200 inch-pounds, for example, can be thought of as a perpendicular force of 20 pounds applied at a distance of 10 inches from the center of the nut, bolt, etc., to be torqued. (See figure 1)

Use the formula "Torque = Arm x Force." Don't confuse inch-pounds and foot-pounds. This relationship can be shown by a simple formula:

$$\text{foot-pounds} = \frac{\text{inch-pounds}}{12} \quad \text{OR}$$

$$\text{foot-pounds} \times 12 = \text{inch-pounds.}$$

Assistance on any torque problems can be quickly obtained from the Transportation Supply and Maintenance Command, St. Louis, Missouri.

It is hoped that the information presented in this article can be effectively used to reduce maintenance error accidents and to prevent the premature failure of equipment.

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Members of the crews for the overseas delivery of the L-23Ds listen intently as Beechcraft representatives explain the operation of the new engines. Left to right are Capt. Weldon C. Britton, Beech pilot Frank Singer, Capt. John R. Goodrich, Beech pilot Ralph Bills, Capt. Herbert Reed, and Capt. Daniel O'Hara. (Photo courtesy Beech Aircraft Corp.)

L-23Ds Complete Transatlantic Trip

THE FIRST U. S. Army planes to be flown to a transatlantic destination landed in Heidelberg, Germany, in June, and were placed in service with Army units in Europe. The aircraft were two Beechcraft L-23D command transports, Army version of the Beechcraft commercial E50 Twin-Bonanza. Among those on hand to meet the planes when they arrived was General H. I. Hodes, Commanding General of the U. S. Army, Europe.

"This is the climax of three very important things concerning Army Aviation," General Hodes stated. "The first was the recent opening of the Army's first flight operation facility at the airport here, the second was Army Aviation's 15th anniversary and the third was this flight which was completed today."

The planes departed Fort Belvoir, Va., on June 6, the 15th anniversary of Army Aviation.

Crews of the two planes spent several days at the Beechcraft plant in Wichita, Kans., preparing for the historic flight. The flight plan included stops at Goose Bay, Labrador; Narsarssuak, Greenland; Keflavik, Iceland; and Prestwick, Scotland. Extra fuel tanks were installed to extend the range.

The flight was the first under a new program of aerial delivery of Army aircraft to overseas destinations, and was scheduled to test the feasibility of long-range flight delivery. A number of additional flights are slated this summer.

The L-23Ds will be assigned to commanding generals of Army units in Germany and Italy.

Human Research Enters Army Aviation

George D. Greer, Jr., Ph.D.

PROJECT TRAINFIRE is a good example of scientific research in military human resources. This study, conducted by the U. S. Army Infantry Human Research Unit, has mobilized the ingenuity of combat veterans and scientists for one goal: realistic rifle training. The objective has been to teach marksmanship under field conditions.

It may be that nothing short of combat can teach combat. But the designers of TRAINFIRE have come to believe that shooting under field conditions can be taught under field conditions. Their findings to date bear out this belief.

What has this to do with Army Aviation? The answer is the soldier-scientist teamwork that produced better marksmen is being put to work to produce better Army Aviators.

A long-range psychological research effort is now under way in Army Aviation. Begun as an exploratory effort in the fall of 1955, the Human Resources Research Office established a more permanent organization, the Army Aviation Research Detachment, at Fort Rucker in September, 1956.

The George Washington University's Human Resources Research Office—HumRRO—is a nongovernmental agency, supported by a continuing contract with the Department of the Army. The mission of HumRRO, now in its sixth year of operation, is to help the Army use its human resources most efficiently.

HumRRO conducts psychological research in the fields of training, motivation, and leadership. Researchable areas are attacked through long-range programs which permit thorough scientific investigation. This sort of careful, programmatic attack has won acceptance by the Army as an effective way of approach-

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Dr. George D. Greer is Detachment Leader of HumRRO's Aviation Research Detachment at the U. S. Army Aviation Center, Fort Rucker, Alabama. He is a former Navy pilot, having instructed at Corpus Christi, Texas, during World War II. Discharged in 1946, he returned to the University of Iowa, where he obtained his doctorate in 1952. Prior to assuming his present position, Dr. Greer was affiliated with the U. S. Army Leadership Human Research Unit at Fort Ord, California. Views expressed in this article are the author's and are not necessarily those of the Department of the Army or of the U. S. Army Aviation School.—The Editor

ing broad problems, existing or anticipated, in training and motivating Army manpower. Successful research means money savings and a better end product. Thus HumRRO not only is an integral part of the U. S. Army's research arm, under the Army's Chief of Research and Development, but makes the defense dollar do more.

The Director of HumRRO and his staff supervise programs of various field research installations, staffed by psychologists and experts, both civilian and military, in the area under study. At present, large efforts, called U. S. Army Human Research Units, are established permanently at Fort Ord, Fort Bliss, Fort Knox, and Fort Benning, home of the TRAINFIRE Research. At Fort Rucker, where the present research effort is smaller, a Research Detachment is administered by the Training Methods Division, HumRRO's central research laboratory at George Washington University.

HumRRO's mission does not include research in personnel selection for pilots, mechanics, leaders, etc. Selection research is the job of the Personnel Research Branch, (PRB), AGO-DA. Because PRB and HumRRO frequently find their work overlapping, they often work in close liaison, though research results are analyzed and implemented in accordance with their separate missions.

At request of the Chief of Research and Development, Department of the Army, HumRRO entered Army Aviation with the broad mission of conducting long-range studies on training methods. Initial efforts have been directed toward helicopter pilots, and began with a survey of the Cargo Helicopter Pilot Training Program at Fort Rucker in 1955 and 1956. Student flight records data were analyzed, tape recordings of actual in-flight instruction were made, and instructors were interviewed. This much was intended primarily as a foundation for further work. However, as a result of a summary of the in-flight tape records, a "Patter Booklet" including basic, conversational descriptions of each flight maneuver was published and provided the U. S. Army Primary Helicopter School at Camp Wolters.

Military and civilian supervisors at Camp Wolters feel that this book will help them in their efforts to standardize instruction as their new program is established. The Patter Book was published in an experimental edition, and HumRRO will systematically obtain critical and observational comments from the instructors and students who use it. It is expected that this information will provide a basis for learning more about student and instructor needs, as well as for a subsequent revision of the booklet.

The second phase of HumRRO's study of helicopter pilot skill is directed at the development of a special kind of flight proficiency measuring instrument. In order to study human behavior—for that matter, even the behavior of animals, plants, or chemicals—a measuring device must be available.

Aviation researchers are attempting to develop an in-flight measure which will allow for systematic, detailed, and dependable

analysis of the helicopter pilot's performance. Because greater detail, standardization, objectivity, and dependability are required for a research instrument than is provided by training flight checks, the latter cannot be used. However, the proposed measuring system is *not* intended as a substitute for the flight checks given during training. It appears currently that the more detailed check will be too complicated to administer and score for training purposes.

Once the flight check is fully developed, it can be used in the following ways: (1) The check can be used as a quality control measure in training. By administering it periodically to samples of students, the check should provide a relatively stable basis for determining the general level of effectiveness of a training program at any time and place, as well as details of strengths and weaknesses. (2) Administered to students at varying stages in their training, it will provide detailed data on the average student's progress in mastering RPM, pedals, altitude, airspeed, subcomponents of approaches, takeoffs, etc. (3) It can serve as a criterion measure in studies of alternative training programs, simulators, instructional techniques, etc., using the classical experimental-control group comparison.

Clearly, the next logical step in the research program will be to determine and test means of improving the Rotary Wing Training Program. During this phase, particularly close liaison will be necessary between the Detachment and expert Rotary Wing Training personnel, since it is the expert who generally has the best ideas for improving training.

Soon, HumRRO will initiate work in another area of Army Aviation—the training of aerial observers. Presently, only very preliminary exploratory efforts have been conducted, but with expansion of the Detachment, the effort should be larger by the fall of 1957. It is anticipated that simulation equipment will be purchased or built; this will allow for the study in the laboratory of some of the basic perceptual aspects of aerial battlefield surveillance. Planning and conduct of this work will be carried out, of course, in close liaison with the Department of Tactics, the U. S. Army Aviation School.

A third effort, a study of the training of maintenance personnel in Army Aviation, is being initiated by the Training Methods Division at HumRRO's Washington office. This effort, slated to move to the Detachment within a year, is also in an early exploratory stage, and will be closely coordinated with the School's Department of Academics.

Because many activities of Army Aviation personnel require complex coordination, special perceptual skills and, as a consequence, considerable training, it is foreseen that HumRRO's Training Methods' psychologists, working with Army Aviation military and civilian experts, will provide a useful adjunct to the Army Aviation Program in the future.

FLIGHT TRAINING and aircraft testing at the United States Army Aviation Center require more than the specialized skills of flight instructors and technicians. Needed also are units and troops whose training and operations assist aviation personnel in accomplishing their varied missions. Support troops for tactical phases of training are provided by the 99th Battalion Combat Team, commanded by Lt. Col. David E. Milotta.

School problems require troops and vehicles in many varied operations designed to give fledgling aviators well-rounded experience in typical combat situations. Fixed-wing students get practice in aerial observation by spotting for the cannoneers of the 337th Field Artillery and by studying the movements of the 99th Infantry Battalion when practicing attack problems in the field.

Students must learn the exacting techniques of message pick-up, wire laying, resupply, and evacuation on the front lines. For these operations, the 99th BCT enters mock battle.

Support troops also make themselves indispensable to the United States Army Aviation Board by furnishing troops and equipment to aid in the evaluation of new aircraft.

n BCT Medics Transfer "Patients"

H-19 Brings Supplies to 337th FA Gun Positions

Personnel Move Out of H-37 in Their Vehicle

10th Tank Platoon

Aids in H-21

Tow Study

THE COMMANDANT'S COLUMN

Brigadier General Bogardus S. Cairns, *USA*
Commanding General, United States Army Aviation Center

UPON ASSUMING command of the Army Aviation School from General Hutton on 8 June this year, I felt a great weight descend upon my shoulders—a burden that I ask each of you to share.

The mission of the U. S. Army Aviation School is to develop doctrine, procedures, tactics, and techniques relating to the employment of Army Aviation, and to instruct and train officers, warrant officers, and enlisted men in this field.

Here's how you can help. First, consider the current process for improving instruction and you will see where you fit in. The instruction at the Army Aviation School is under constant study and revision to maintain the high standards required by a modern mobile Army as well as to keep current with improvements in equipment. Changes in Programs of Instruction are brought about through information received through official channels, by changes to training directives from higher headquarters, and occasionally by comments from the field. With your help, timely and constructive comments from the field can significantly improve instruction.

As is common practice in most Army schools, graduating students are given an opportunity to critique their course of instruction. While this practice has much merit, comments on such items as billeting, classroom facilities, transportation, etc., are often combined with comments

Views expressed in this article are the author's and are not necessarily those of the Department of the Army.
—The Editor

relative to the course of instruction and tend to becloud the issue. In addition, student comments frequently are not backed up by practical application. Until instruction is put to practical use, valid criticism is often difficult.

Another source of criticism and ideas for progress is the periodic aviation training conferences held throughout the Army. Suggestions and recommendations resulting from these conferences are, of course, adopted when appropriate, but why should you have to wait for a training conference? Why not drop us a line stating your problem, criticism, idea, or "what-have-you" and let us go to work on it? There are many problems and we don't have all the answers, but we'll give yours a try or let you know why not.

Through this column I extend to all aviation personnel the capabilities of the School to review and study your comments on aviation training, any of the various courses, or other problems pertaining to aviation. I especially invite correspondence from aviation unit commanders and aviation staff officers. You are not only authorized but encouraged to correspond directly with the AVIATION DIGEST. Your letters will receive a prompt acknowledgment and will be thoroughly staffed and studied for any action that the Aviation School can direct or recommend in each particular instance. After the correspondence has been thoroughly reviewed, you, the writer, will be informed of the results.

As pointed out by Major General H. H. Howze in the June issue of the U. S. ARMY AVIATION DIGEST, the key to the successful future of Army Aviation lies in the collective efforts of each of us as individuals doing our part. I therefore ask each of you to assist me by calling upon your experience and passing on your considered opinions of how to improve our capability to perform the vital role of Army Aviation.

With your help, we can continue to fly ABOVE THE BEST.

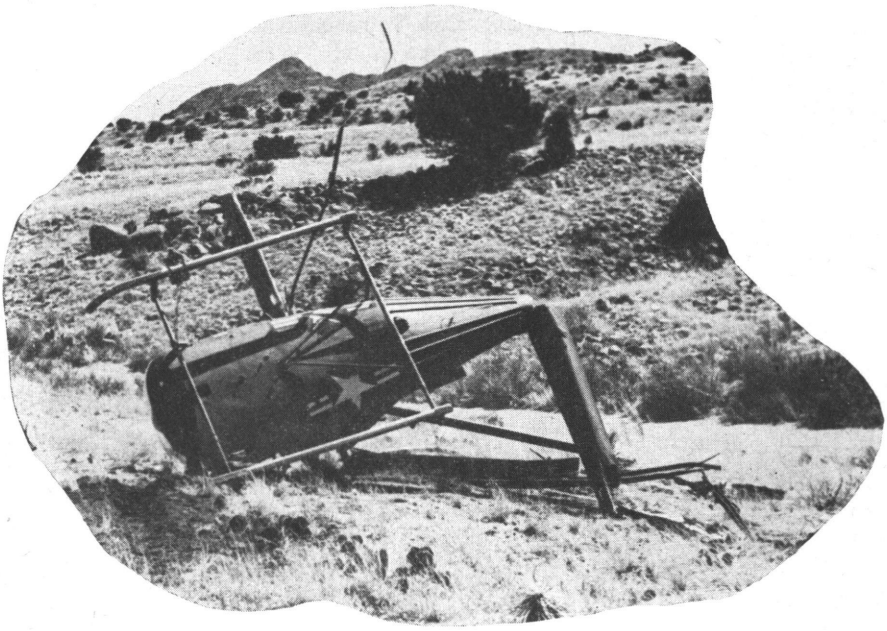
H-19 to the Rescue

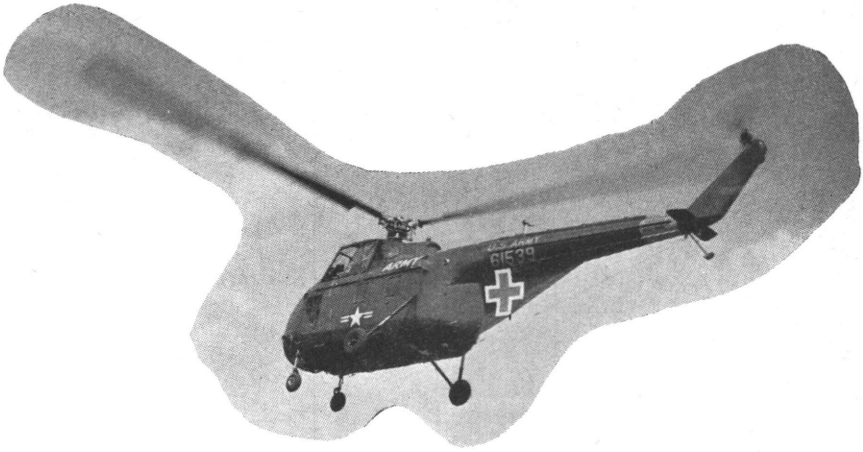
Captain Foy R. Ketchersid, *Inf*

TWO WIDELY unrelated events —the crash of a helicopter and the visit of West Point cadets last summer—combined to help form the extremely efficient crash-rescue unit now in operation at the United States Army Aviation School.

The helicopter accident that occasioned the change in crash-rescue procedures happened in an inaccessible area. Ground crews were unable to reach the site because a deep ravine separated the crash area from approach roads. A student pilot with a broken leg was treated by the crew of the H-13 regularly used for rescue calls, but the accompanying doctor was handicapped by the lack of a qualified assistant in caring for the injured man.

Later, in preparation for a visit of West Point cadets to the United States Army Aviation Center, an H-19 was readied to serve as an ambulance and for crash rescue. Fortunately the aircraft was not needed during





this visit, but someone remembered the earlier accident which demonstrated that a helicopter larger than the H-13 was needed. The result was the establishment of an H-19 ambulance, working as a team with an L-19, which is used to guide the slower aircraft to the scene of the crash.

LONG HOURS

The crash-rescue team is built around an experienced flight and crash-rescue crew. The hours are long for these officers and men, because one crew serves during all flight hours daily. It is tedious and often boring, since it requires crew readiness at all times. The men take their job seriously, and frequently answer calls that are preceded with "H-19 not needed," just to get the experience and put a keener edge on personal proficiency.

These prolonged inactive periods are broken with a mad flurry when the crash horn sounds, and both the L-19 and H-19 take to the air before the echo dies. It's a race to see which gets airborne first.

"During the first month of operation," Warrant Officer Stewart Park, one of the original officers assigned to crash duty, said, "we had the H-19 engine running every time we received a call."

That readiness paid off. One crash call required only four minutes from the sound of the horn until the H-19 was on the ground at the scene of the accident.

Fire-fighting equipment, crash tools, litters, blankets, surgical equipment, and a resuscitator are carried as standard equipment. In addition to the pilot and co-pilot, two crash-rescue men and one medical aid man make up the crew.

"The aviators and crew members have been checked out in use of the resuscitator," Mr. Park said. "In fact, every member of the team can do every other member's job, with the exception of flying the helicopter."

L-19 FINDS CRASH SITE

The L-19 is an integral part of the rescue team. Making the high reconnaissance of the area, Army Aviators in L-19s usually

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have the wrecked aircraft located by the time the medically-equipped H-19 arrives. Too, the L-19 orbiting in the area acts as a radio relay station between rescue helicopter and control tower. This versatile team has on occasion had victims of crashes at the U. S. Army Hospital helipad within 13 minutes from the time of accident report.

Using both fixed- and rotary-wing aircraft in crash-rescue work can save precious minutes in locating a crash site since more than 300 flight strips and confined-area pads in use are not marked. In order to facilitate tactical training in the location of points by map, areas are often intentially left unmarked and add to the difficulty in locating downed aircraft.

"One incident was almost funny," a crash-rescue pilot related. "We got a crash report to go to a road strip. We flew down the road and couldn't find any sign of the aircraft. After several passes we found it—the L-19 was literally hanging by its tail in a tree. The pilot wasn't hurt in the least."

Even though the pilot may appear unhurt after a crash, the standard practice is to evacuate him to the hospital for a check-up.

"One aviator I remember," another crash-rescue pilot said, "appeared to be all right. But that night he collapsed. It was sort of delayed action."

One of the rescue crew pilots, a former "pick-up" aviator at a missile range, possesses an al-

Monotony of Long Wait is Lessened by Card Game

Crew Moves Swiftly at Sound of Alert

most unbelievable knack for finding wrecked aircraft in the brush. He gained this faculty looking for missiles in the desert. He learned to search for disturbed earth, broken tree branches and the glitter of metal. It serves him well in his present duty as a member of the crash crew.

The ability to spot downed aircraft is especially valuable when there are no survivors to signal from the wreck. Even the international orange which distinguishes school aircraft is difficult to locate in the thick underbrush of the surrounding area.

"During the first month of operation, we went ten days without an incident," a crewman said. "Then we received three calls, all within 15 minutes of each other."

It takes a crack aviator to qualify for the crash-rescue helicopter. Aircraft often may fall into inaccessible areas. The aviator must be able to land the H-19 successfully in a confined area. A novice might do it once, or even twice; but as a regular diet, it requires a skilled, experienced aviator with a lot of calm judgment, developed by many hours of flying.

The officers and enlisted men comprising the crash-rescue team are aware of the importance of their job. Tedious and boring though the waiting may be, they know that at any moment of any hour in the day they may be put to the test of saving a life. In a word, they are contributing their full share to preparedness.

New Puzzler Feature to Test Your Knowledge

WITH THIS ISSUE, the U. S. ARMY AVIATION DIGEST introduces a new department. The letter which follows was received recently from Major General Hamilton H. Howze, Director of Army Aviation, ODCSOPS, and explains the background and purpose of this new feature.

Dear Captain Wasko:

The Army Aviation School now has the job of preparing a new annual aviation written examination for use starting in fiscal year 1958. Many criticize our present examination but few submit valid—or perhaps I should say usable—recommendations to better the situation.

The training people here have strongly recommended use of an open-book type examination similar to the one recently adopted by the Air Force. I personally favor the open-book examination, and a request has been sent to USCONARC to give full consideration to this type.

I believe that, regardless of the type examination we adopt, more emphasis should be placed on the type of questions which will require the examinee to display his ability to use good judgment. The "PUZZLER" as inclosure 1 is an example of the type question I have in mind.

I recommend that you add a section to the Army Aviation Digest titled "PUZZLER" or with some other descriptive title, as you desire. In each issue in this section a different question of this type could be presented to the readers for their edification. Readers should be invited to submit criticism of the questions to you. In addition they should be encouraged to submit "PUZZLER" questions for publication in later issues. Contributors could be identified for their personal satisfaction and as a possible incentive for contributions.

Questions for this feature could be prepared by the action section at the Army Aviation School which is preparing the new examination. All criticism and questions submitted by readers should be helpful to the school during preparation of the new examination.

You may use any part or all of this letter as a "kick-off" for the new feature if you decide to incorporate it in the Digest.

Instrument flying is becoming a very vital skill in Army Aviation. Every effort must be made to bring this important matter to the constant attention of every aviator—active Army, National Guard, or USAR.

Sincerely yours,
s/Hamilton H. Howze
HAMILTON H. HOWZE
Major General, GS
Director of Army Avn, ODCSOPS

The initial Puzzler may be found on the opposite page. The recommended solution to this problem will be found on page 33. If you should come up with an answer which you think is preferable to that published, send it in and we will print it in a future issue. Also, if you have any suitable problems for future "PUZZLER" departments, let's have them. The more response this new department receives from our readers, the more valuable it will become.—The Editor

PUZZLER

PROBLEM: You have departed Washington, D. C., cleared IFR to cruise at 8,000 feet, destination Charleston, West Virginia, alternate Lexington, Kentucky. Weather: no ice reported; lapse rate en route 2° C. per 1,000 feet; cloud tops en route 19,000 feet; Washington, 1,000 feet, 3 miles; forecast in one hour 200 feet, 1/8 mile in fog; Elkins, Va., 200 feet, 1/4 mile in fog, 45° F.; Charleston, W. Va., 1,000 feet, 5 miles, temperature 32° F.; Lexington, Ky., 2,000 feet, 5 miles, 38° F.; Parkersburg, W. Va., 1,500 feet, 7 miles, 49° F.; Columbus, Ohio, 3,500 feet, 8 miles, 50° F.; Dayton, Ohio, 7,000 feet, 10 miles, 51° F.

Your flight has been rather routine so far although you encountered light rime ice shortly after passing Front Royal. The deicing equipment on your L-23E is working properly, and the light ice is causing you no concern—in fact you expect no difficulty on the rest of the flight.

You are 15 minutes east of Elkins at 8,000 feet and immediately encounter heavy clear ice. Your free air temperature is −8° C. Within a few minutes, airspeed drops to about 120 mph, and ice is accumulating steadily on your L-23E despite the best efforts of your deicing equipment. A cold dew appears on your patrician forehead.

Obviously several alternatives are open to you. Indicate by a √ those alternatives which are proper, and by an X those which are not proper.

- ☐ **Start an informal roundtable discussion with copilot and passengers on the delightful inconsistencies of weather forecasting.**
- ☐ **Immediately descend on course until icing stops.**
- ☐ **Call Elkins, request lower altitude, and change of destination to Parkersburg.**
- ☐ **Bail out.**
- ☐ **Call Elkins, request lower altitude, change of destination to Columbus.**
- ☐ **Climb on course until icing stops.**
- ☐ **Report emergency to Elkins, request permission for immediate landing at Elkins.**
- ☐ **Immediately leave airways, and climb until icing stops.**
- ☐ **Immediately leave airways, and descend until icing stops.**
- ☐ **Call Elkins, request lower altitude, and continue on course.**

References:

1. Chart 16 and 17, Jeppesen Manual 1.
2. Letdown charts in Jeppesen Manual 2 for stations being considered.

Views expressed in this article are not necessarily those of the Department of the Army or of the U. S. Army Aviation School.—The Editor

Memo from Flight Surgeon

BECAUSE IT MAY take you when you're unaware; because it may deal with you treacherously, hypnotize you, pick you up and set you down in a world of make-believe, and tease you into self destruction; because its effect can be so very, very final, HYPOXIA (oxygen deficiency) is, perhaps, the gravest, yet most blithely underrated enemy you may face in your whole flying life.

The following veteran aviator was lucky. He met the enemy, fraternized, and came away whole. But, we say again: he was lucky.

One evening last December, he flew an L-19A out of Pocatello eastbound across the Rockies. He planned a gas-stop at Rock Springs, Wyoming. To stay on top, he flew between fifteen and seventeen thousand. And, after nearly an hour and a half, he began to adjust his manual loop to home-in on Rock Springs.

Suddenly, he felt a violent shudder and "what seemed to be a loss of power." He said afterwards, "My immediate reaction was that there was a possibility that I had lost my propeller, or that there was some structural failure in the aircraft. At this time, my first movement was to switch gasoline tanks, increase the mixture control to full rich mixture, pull the carburetor heat to full heat, and turn on my auxiliary fuel pump."

But the airplane went into a spin to the right. It recovered, and then fell off to the left. The pilot found himself in the cloud layer then, and unsure of his altitude or the exact height of the peaks, he bailed out. Breaking through the overcast, he watched the L-19 spin into the ground.

Well, they found the propeller. It wasn't lost. Matter of fact, it was still attached quite properly to the wrecked L-19. They could find no sign of structural failure in flight.

Flaps were set at 60 degrees—more evidence of confusion.

As for the shudder and spin, a stall might explain them best, so says our Safety Board—and, anyway, the clearest reaction to a lost prop is an engine surge.

The pertinent fact: a pilot flew an L-19 at 15,000/17,000 feet without oxygen for 80 minutes.

Views expressed in this department are not necessarily those of the Department of the Army or of the U. S. Army Aviation School.—The Editor

Sequence: loss of control and subsequent irrational action.

Inference: hypoxia.

It's pretty hard to convince a pilot that hypoxia will make him do some very queer things. You don't have to tell a man twice not to sit on a hot stove, especially if he's backed into a radiator once or twice. But, unless he's taken "up" (and well indoctrinated) in a low-pressure chamber, about the only way he can learn about hypoxia is to read about it or get lectured. If he's like the rest of us, he forgets half of what he sees or hears, and ignores some of the rest.

A man needs a lot of convincing about hypoxia. The truth doesn't pop right out.

One reason: above 10,000 feet, seeing and hearing go bad very gradually. And your memory begins to slip at the same time, so that, usually, you don't remember how well you saw or heard in the first place. (For a little proof—try breathing pure oxygen after you've been flying at 12,000 feet for an hour. Watch the dashboard jump up to you, the sky switch to a deep, robin's-egg blue and the low drone of the engine surge to a sudden roar.)

An alert pilot might recognize the symptoms, but the brain of an oxygen hungry pilot is temporarily the brain of a dullard.

His mind may grapple with the warning symptoms, but in slow motion like a deep sea diver trying to pry a treasure chest open at forty fathoms. He may know vaguely that something is wrong, but lack the will to do anything about it.

Or, on the other hand, he may get a real "high" feeling, become flooded with the fearless and fixed idea that all life is rosy and he can do anything—even clip off the top of that little old church steeple way down there. Sometimes he'll try it.

Some pilots know that hypoxia is bad. But, "only way up there," they announce, "where the Army never flies." Well, the truth is, any pilot is liable to have to fly "way up there" once in a while, and the man who isn't checked out is like a trout who dives into a large puddle of sulfuric acid. After all, he reasoned, it looks exactly like water.

Another thing, "way up there" is a lot lower than you suspect.

Let a pilot fly a three-hour mission as low as eight or ten thousand feet. Like as not he'll find himself weak and tired, ready to sleep, maybe too logy to eat.

Well, the work of the mission is little to blame. Hunger is the villain—a mild hunger for oxygen plus length of time.

The really first significant ef-

fect invades you at 12,000 feet when your immediate memory begins to fade.

At 14,000/15,000, you may lose your coordination, flip-flop from one mood to another, get drowsy, and lose part of your will. Your vision begins to dim, you become mildly confused, and the pink beneath your fingernails gradually shades into a purplish-blue.

At 17,000/18,000 feet, double the above effects. And now you may lose any ability to judge your own actions. You may develop some fixed irrational idea like one high ranking L-19 passenger who confesses in private that he once conceived a deep hatred for the very scarlet, sunburned rear of his pilot's neck—barely managed to keep from bashing said neck with the fire extinguisher. Assuming you pass through the irrational stage unscathed, you will in a little while, and without warning, pass out cold.

This veteran pilot walked away from his brief *tête-à-tête* with hypoxia. He got by without a cut or a bruise—suffered only hot, red-faced embarrassment.

He'll tell you, himself—he was lucky.

MONOXIDE TRAGEDY

The time was a little past 2100 hours when the pilot taxied his L-20 out to the runway and took off for home. The ceiling was low and the night rainy and uncomfortable, so he turned on the heater for comfort. It was cold, so he kept all the vents closed.

His wrecked clock shows that he hit the tree ten minutes later; the Investigation Board reported his angle of bank as about 45 degrees, left wing down, at impact—" . . . strong possibility of vertigo indicated by low left-wing attitude."

The lab report confirmed the Flight Surgeon's suspicion: CARBON MONOXIDE, about 40 per cent saturation. Not lethal, in itself, but enough to make a pilot weak and sick and impair his judgment and vision.

It's a deadly killer, this monoxide. You can't taste it, you can't see it, and you can't smell it, but you can be sure it's part of any exhaust you may breathe. And lucky for all of us, exhaust does have an odor.

The pilot of a multiengine aircraft can relax a bit, but not the pilot of a single engine plane. With the engine directly in front of the fuselage, the prop blast will force the exhaust under, around, and by the cockpit. One tiny leak means trouble.

Sure, every new Beaver or Nineteen or any of the rest is built according to rigid specifications and is given a careful, detailed inspection for gas presence in the cockpit. But like the rest of us, airplanes stay spic

and span and seal tight for only a little while.

They get old. They get bounced around by pilots, mechanics, and technical modifications—and life itself. They get broken a little and neglected a little. And maybe the little break and the little neglect combine into a not quite perfect cockpit seal, or a leak between the exhaust and heater assembly, or a crack in the fire wall. A setup for tragedy.

So look for defects during your preflight. Make sure you're sealed off from the exhaust in every way. Take nothing for granted. This gas has even been known to sneak into the tailwheel opening, float up the fuselage and squeeze into the cockpit—in back of the pilot.

So if you detect exhaust in flight, or feel a headache coming on; or if you are taken with nausea or dizziness, reach for the cutoff switch on the heater —quick.

Ignore the cold and rain and discomfort and open the vents wide. Keep that fresh, clean air flooding your lungs. Keep alive.

Solution to PUZZLER

On the basis of the factual information contained in the PUZZLER on page 28 the recommended solution is as follows:

√ Call Elkins, request lower altitude, and change of destination to Parkersburg.

This solution is based on the following line of reasoning: It appears the pilot is located approximately 40 miles east of Elkins when he encounters heavy icing conditions. The freezing level at Elkins should be about 6,000 feet. One alternative is for the pilot to call Elkins and request the minimum en route altitude so that he can maintain a safe airspeed by descending. He should also request a change of destination to Parkersburg to get into warmer air as soon as possible.

If icing continues at the minimum en route altitude, the pilot can get the latest altimeter setting from Elkins and descend below minimum enroute to 6,000 feet, since minimum en route altitude provides a 2,000-foot terrain clearance. Upon reaching Elkins, he can request the minimum en route to Parkersburg. Upon reaching 5,000 feet out of Elkins, icing should stop and aircraft ice should start to dissipate. After passing Benson intersection, the crisis should be over.

The Gray Hair Department

"IF A PART can be installed a right way and a wrong way, someone, sometime, will install it the wrong way." This philosophical safety maxim "caught up" with the crew chief of an H-13G when he installed the tail rotor blades backwards, reversing the position of the leading and trailing edges.

The H-13 was grounded for the 300-hour change of the tail rotor retaining bolt and bearings. The crew chief and another mechanic performed the disassembly. At lunch time the crew chief departed, leaving the assistant to continue the reassembly. The mechanic completed the work with the exception of fastening two pitch change links and went to lunch.

The crew chief returned and completed the job, then informed the line chief the helicopter was ready for test flight. The operations officer was notified and said he would accomplish the test immediately. The line chief then instructed the crew chief to perform the postflight runup and leave the engine running.

When the operations officer arrived, he discussed the maintenance work that had been done and told the mechanic to sit in the passenger seat. He

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Lieutenant Colonel Miller T. Nesbitt, the Senior Army Aviator above, is presently assigned as the Director, Department of Fixed Wing Training, the U. S. Army Aviation School, Fort Rucker, Ala. He started flying in 1923, and his career as an Army Aviator began in 1943 when he attended the Field Artillery Liaison Pilots' Course, Fort Sill, Oklahoma.

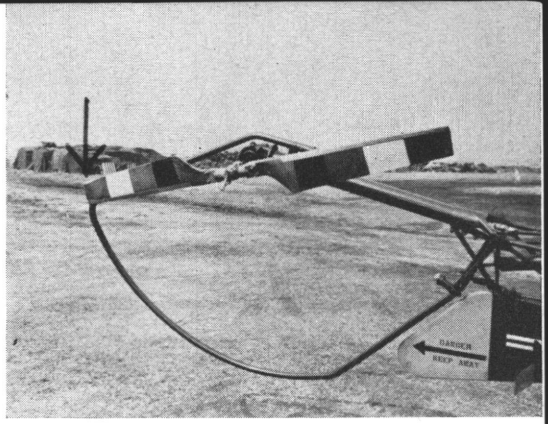
Upon graduation, Colonel Nesbitt was assigned to the Asiatic-Pacific Command where he served with several units. In 1951 he was assigned as Aviation Officer to the XVIII Airborne Corps, and in

checked the "mags" and pulled pitch. The takeoff was abrupt, and the helicopter immediately turned to the left. The aviator closed the throttle and executed an antitorque failure type autorotation. However, the left turn increased in velocity until the helicopter touched down.

As one witness reports, "The helicopter hit the ground hard and the tail boom seemed to lie over on its right side." The damage included a twisted tail boom, a bent tail rotor drive shaft, dented tail rotor blades, and cross tubes bent beyond allowable limits.

Some discrepancies such as design error, maintenance error, and inspection error cannot be checked by the aviator in minute detail, and the results may be lethal. An aviator has an opportunity to recover from inattention, but he has no opportunity to recover from a maintenance error.

Even more lethal is the situation where no inspection is made, which was the case in this accident. Although accident causes run the gamut of maintenance, inspection and pilot errors, this question flashes to the forefront: Would this aviator, or any helicopter pilot, have noticed reversed tail rotor blades during a *thorough* preflight?



No Detailed Inspection Performed

This accident proves an additional point — that familiarity breeds contempt. It appears that confidence in the mechanic's ability and thoroughness was so great within this unit that proper inspection was not practiced. Teamwork between mechanics and aviators in a closely knit air section often causes one to rely on the work of the other; however, it is this type of familiarity which breeds contempt for sound safety practices.

ONE HAZARD FOR ANOTHER

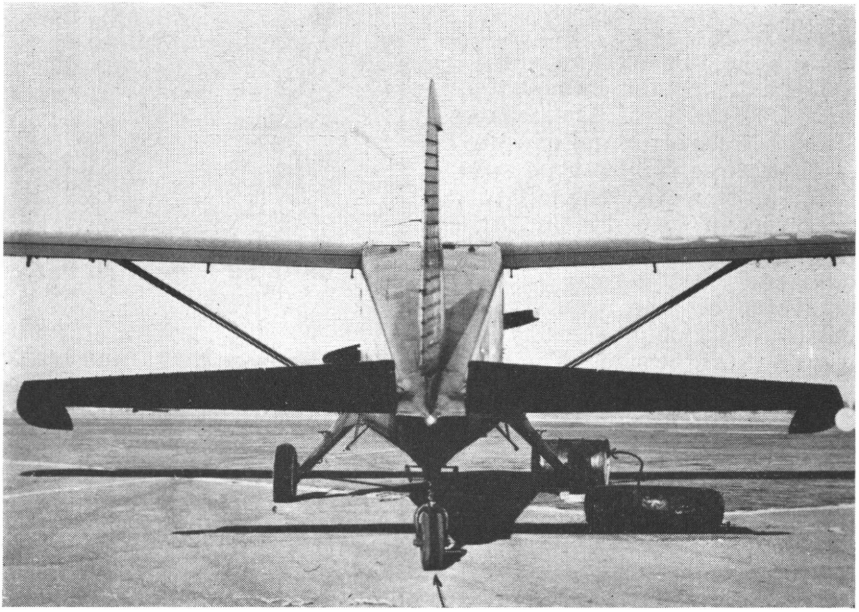
An aviator was taxiing an L-20 from the parking ramp to the active runway for a night cross-country flight. Several spotlights illuminated most of the ramp and taxiway. As the aircraft rolled into a dark area, the propeller struck a 50-gallon oil drum placed on a truck tire in the center of the taxiway.

The drum and tire arrangement had been placed over a

1955 he joined Headquarters, USAREUR COM Z as Staff Aviation Officer.

Colonel Nesbitt holds a master's degree from Massachusetts Institute of Technology and a CPA degree from Pace Institute of New York. He is an active member of the Wings Club, New York, and the Royal Aero Club of London, England.

In 1948 Colonel Nesbitt attended the USAF Helicopter School, San Marcos, Tex., and is currently qualified in the H-13 and H-19. Holder of a Special Instrument Card, he is rated in all fixed-wing aircraft and has accumulated over 7,000 hours in the air.



The Propeller Struck the Obstruction

manhole cover which, several days prior to the accident, was considered unsafe to support the weight of aircraft. The aviator did not use his landing light because the airfield was illuminated. He had no reason to believe a 50-gallon oil drum would obstruct his path on the taxi strip. Tower personnel were unaware of the obstruction, and this information had neither been disseminated in NOTAMS nor placed on the bulletin board in base operations.

There are several accidents on record caused by fire extinguishers, oil drums, or lubricating carts being placed in taxi areas at night by absent-minded personnel. However, it is hard to understand why airfield operations personnel would place an elaborate marker in the taxiway without marking it with a light.

Tower personnel should be informed of obstructions and a marked-off bypass provided, or the taxiway should be closed until proper repair can be accomplished.

This accident proves that an aviator is "on his own" when it comes to safety. He cannot be too careful.

The Gray Hair Department is prepared by the U. S. ARMY AVIATION DIGEST staff with information obtained from the files of the U. S. Army Aviation Safety Board. Views expressed in this department are not necessarily those of the U. S. Army Aviation School or of the Department of the Army.—The Editor

A FORGOTTEN SCHOOL SOLUTION

Probably, Army helicopter pilots can still hear their instructor's voice ringing out these memorable words, "Do not hover

or take off downwind." On stagefields at the U. S. Army Aviation School, any such practice is strictly forbidden except when practicing rearward flight in the hovering squares.

Hovering downwind requires more aft cyclic to counteract wind velocity. With increasing wind velocities, the "neutral" cyclic position is moved progressively aft until the back cyclic stop is reached. Further rearward control is beyond the capabilities of the pilot. Therefore, helicopter pilots should avoid hovering downwind.

The following accident resulted when an Army Aviator *forgot.*

An aviator with one passenger was preparing to take off from an Air Force base in an H-13G. Wind conditions were 16 knots gusting to 25 knots from 270 degrees. The helicopter was facing approximately east toward a line of parked C-119s. To the aviator's immediate left was a fire truck, and to his rear was an open grass area.

He applied collective pitch and lifted the helicopter to a hover. It immediately started to move forward, and the aviator applied rear cyclic with no effect. His helicopter was moving rapidly toward the parked C-119s so he lowered pitch.

The aircraft hit the ground hard in a nose-low attitude. Both skids were broken, and the cross tubes were bent beyond allowable limits.

The aviator's takeoff to a hover was too abrupt. With the strong, gusty downwind condition, he lost aft cyclic control before he could take action to turn the helicopter into the wind. He should have gradually brought the helicopter to a low hover. By doing so he would have had ample time to check the amount of available cyclic travel.

The primary purpose of the initial hover is to check C.G. loading and position of the cyclic control, which should be done carefully, especially when transporting loads and in adverse wind conditions.

HIS FOOT IN IT

During takeoff in an L-19, the observer attempted to free his trousers caught on the rear seat. He felt an unusual pressure on his right foot and reacted against it. His toe became caught under the fire extinguisher on the back of the pilot's seat and the aviator, trying hard for left rudder correction, held the observer's foot in place with the right rudder pedal.

When the observer succeeded in freeing his foot, the aviator, still trying hard for left rudder, pushed the pedal full in, and the aircraft ground-looped.

Although the observer had been thoroughly briefed on use of the safety belt, parachute, and shoulder harness, as well as his conduct during the flight, he still "put his foot in it." Unless

Rear Cyclic Applied with No Effect

an instructor pilot is in the back seat, the rear cockpit rudder controls in the L-19 should be folded down.

EXCESSIVE BRAKES

An L-19 was number two of three aircraft on final approach to an auxiliary airstrip. Runway surface was sod with portions covered by cinders. The L-19 touched down in a three point attitude, and the aviator immediately applied brakes. His intention was to shorten ground roll and clear the strip, expediting landing of the third aircraft. The wheels skidded over the cinders and partly rolled, partly slid over the patches of bare ground. As the aircraft decelerated, the tail steadily rose until the propeller dug into the ground, and the aircraft nosed over onto its back.

The aviator used poor technique in holding a steady, hard pressure on the brakes during the ground roll, and poor judgment in considering effects of runway surface texture on tire friction. Had he gradually released brake pressure as the aircraft slowed down, the accident could have been prevented.

COMMITTED

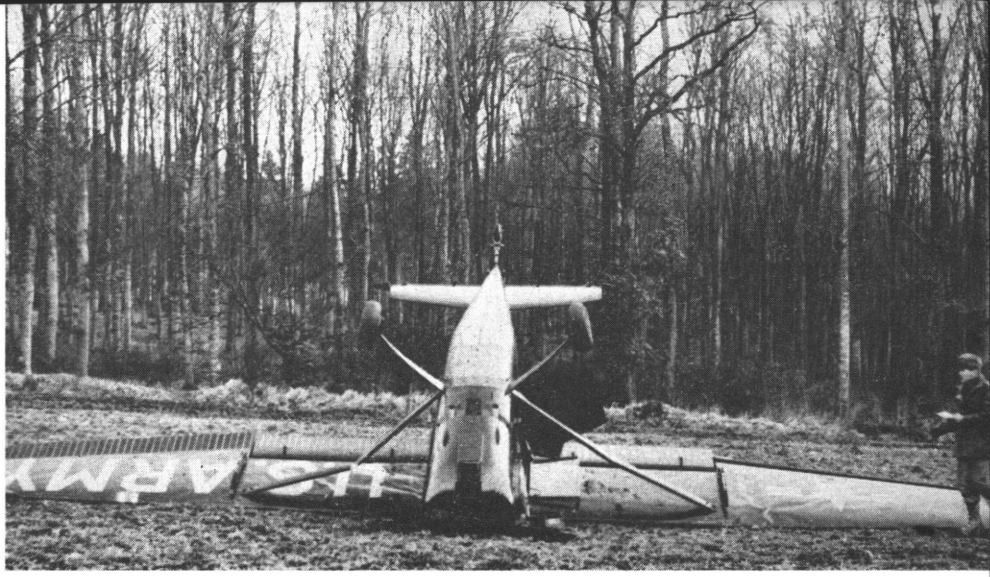
The aviator was landing an L-19 on a field strip. The marked-off landing area was 750 feet long. He had 45° flaps and was maintaining between 60 and 65 mph airspeed.

As the aircraft cleared the trees at the downwind end of the runway, he realized he would land too far beyond the panel. The tall trees at the upwind end of the strip changed his mind about a go-around. A few feet above the surface, he retracted the flaps.

The aircraft hit the ground and bounced. On the second touchdown he applied brakes, but the wheels slid over the wet grass.

The L-19 continued to slide

Observer not Thoroughly Informed



Flaps were Retracted Prior to Touchdown

off the end of the marked runway, over a dirt road, and into a plowed field. After sliding 30 feet more, the wheels sank into the soft earth, and the aircraft nosed over.

The aviator's quick thinking in his attempt to get into the strip was a few seconds late. He should have engaged his mental powers earlier on the approach and recognized the overshooting approach angle before it was too late to go around. Retracting flaps close to the ground is not recommended because the resulting loss of lift may prove disastrous.

SHEAR FORCE

Prior to takeoff in an H-23 with two passengers, the aviator instructed the crew chief to install the ballast bar on the tail boom.

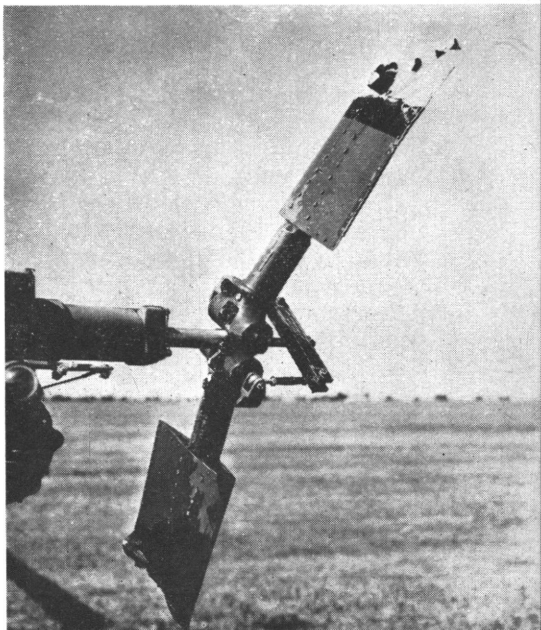
The two bolts normally left in place on the boom were missing. However, the crew chief fastened the bar with the two bolts used to secure the bar in the cockpit and tightened them "just a little more than they should have been."

Thirty minutes later, while hovering, the aviator felt a severe high frequency vibration in the antitorque pedals and landed immediately.

He discovered one ballast bar bolt was loose. The threads on the loose bolt had been stripped, and the free-swinging bar had sheared the tail rotor blades eight inches from the tips.

It requires four bolts to secure the ballast bar to the tail boom to withstand the forces generated by normal vibrations. Me-

The Aviator Felt a Severe Vibration



chanics should exercise care against overtorque of these bolts, which may cause thread fatigue and bolt shear during flight.

Aviators should exercise care in their preflight inspection to make certain the ballast bar is installed *properly*.

MECHANICAL ERROR

While the engine was running in his H-13, an aviator called to his crew chief to accompany him on the flight. The crew chief was standing under the rotor blades, holding a long handled screwdriver. In a hurry to respond to the pilot's call, he turned and gestured with the screwdriver to indicate that he was going to throw it to a mechanic-helper standing nearby. When he threw it, it went into the rotor blades. The screwdriver dented the leading edge of one blade and bent the trim tab. The blades were repairable at a cost of $524.

Caribou Delivery Set for 1959

The United States Army is scheduled to receive five of the new twin-engine DHC4 de Havilland transport airplanes by 1959. An order for these aircraft, placed by the Canadian Department of Defense Production on behalf of the U. S. Army, was announced recently.

Basically, the Caribou is an all-weather utility transport aircraft designed to provide rapid mobility for troops, equipment, and supplies in forward battle areas. It will be capable of operating independently of established airport facilities and will be able to land and take off from improvised landing strips as short as 800 feet in length. Estimated takeoff run is 450 feet with zero wind, while takeoff distance with a 10 mph wind should not be over 330 feet.

The Caribou will have a passenger capacity of 27 seats, while a military bench seat arrangement will provide accommodations for 28 combat troops. Cargo payloads will vary from 6,000 pounds, with fuel for 600 miles, to 7,320 pounds with a 200-mile range. Ultimate range with full standard tanks will be 1,200 miles. The Caribou will have provisions for 22 standard Army litters for evacuation of wounded.

While designed essentially for high lift capabilities, the Caribou will have a cruising speed of 185 mph at approximately 51% of takeoff power. Touchdown landing speed will be under 60 mph. Rate of climb at sea level with two engines will be 1,580 fpm; with one engine, approximately 420 fpm. Service ceiling will be 26,000′; single-engine ceiling is 13,000′.

Interservice Cooperation

A recent flight highlighting inter-service cooperation was made when an ARMY H-19 from the Transportation Arctic Group sling-loaded a 12-foot boat over rugged terrain (top and back cover) from Thule AIR FORCE BASE, Greenland, to the U. S. COAST GUARD Loran Transmitting Station (bottom) at Cape Atholl, 20 miles to the south. The rowboat was furnished by the Air Force to be used by the isolated Coast Guardsmen for necessary station maintenance and recreation.