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UNITED STATES 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.
USAR: None.

For explanation of abbreviations used, see AR 320-50.

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Volume 3 October, 1957 Number 10

ARTICLES

Army GCA 5
Lieutenant Donald J. Weigman, *Sig C*

High Flying Bird Dog 10
Lieutenant John R. Dome, *CE*

Master Army Aviator 14

The U. S. Army Aviation Board 15

Analysis of an Aircraft Accident 19

DEPARTMENTS

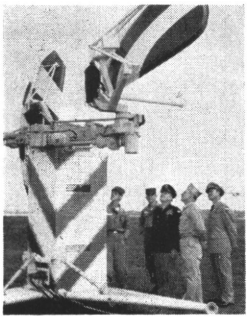
Notes from the Pentagon 2
Major General Hamilton H. Howze, *USA*

Puzzler 25

Books for the Army Aviator 26

The Gray Hair Department 28

COVER



Be it equipment like the GCA unit on the cover or a new concept involving Army Aviation, the United States Army Aviation Board will test it sooner or later. For other news of this lusty young infant see pages 15 through 17 and back cover.

Notes

FROM THE PENTAGON

Meditations On Hel

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

How vulnerable is the helicopter in combat operations? The Army is doing a bit of soul-searching on the matter, and—more practically—has instituted a comprehensive test at the Combat Developments Experimentation Center to find out. But in arriving at an ultimate answer, we should recognize that *all* military materiel is subject to violent destruction by the enemy.

Certainly a tank leading the point of an armored thrust is extremely vulnerable in spite of its heavy armor. Faced with this unhappy fact, the tanker follows certain techniques and maneuvers to reduce his periods of exposure to enemy action. If he can reduce his vulnerability by movement in a two-dimensional plane, the aviator should be able to reduce the vulnerability of his helicopter by movement in three dimensions. True, the tank is heavily armed and armored, but the helicopter is extremely maneuverable, capable of rapid changes in speed, direction, and altitude—and perhaps most important, is not restricted to a predictable ground route.

Before proceeding further, we should consider the planned methods of employment of helicopters which may subject them to enemy fire. Essentially, there are two primary tactical missions in which helicopters may be exposed to enemy fire, not including the important medical evacuation job which helicopters performed so efficiently during the Korean War. These missions are (1) reconnaissance (to include seizure of critical points,

copter Vulnerability

e.g., a bridge) in advance of rapidly moving ground units, and (2) the transport of small combat units and their equipment in forward areas.

Taking the second mission first, we should consider carefully the effect of the recent innovation of arming transport helicopters with light machine guns to provide them with the capability of suppressing enemy fires which may be encountered in forward areas of the battle zone. Equipping helicopters with light armament should materially increase their probability of survival. If mallard ducks were armed with BB guns, marksmanship from the blinds—already suffering from too much recourse to sour-mash Cascade (Mellow as Moonlight—adv.)—would presumably deteriorate still further. The principle applies equally to armed helicopters, which certainly should not *attack* a heavily defended enemy position but which should be able to protect themselves and their cargoes by suppressive fires against light resistance.

Helicopter-borne troop movements will be accomplished at low levels, with flight following valleys and stream beds so the helicopters may take advantage of defilade, concealment, and surprise. Transport helicopters moving small ground units will often follow routes already reconnoitered by reconnaissance helicopters into areas where our supporting ground fires have neutralized enemy resistance.

The reconnaissance helicopter will survive through use of proper tactics. Basically, its best chance is flight close to the ground, taking maximum advan-

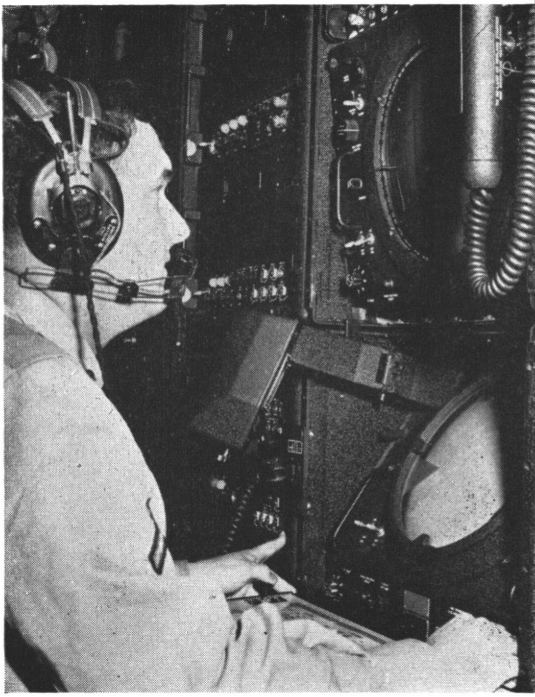
tage of cover, and in good training and lots of practice in reconnaissance techniques. It will no more fly *into* or *over* an enemy position than a reconnoitering jeep or light tank would drive *into* enemy lines: there is no future in either maneuver. The observer-gunner in the helicopter will use his single machine gun for reconnaissance by fire. We should get the picture here of the "zero ground pressure" reconnaissance vehicle flying the fringes of the enemy, with the mission only of *discovering* the enemy, not destroying him.

Of interest of course is the vulnerability of helicopters in terms of square feet of surface presented to an enemy bullet. Studies based on this criteria have compared the vulnerability of helicopters with fixed-wing aircraft. However, in all known cases the comparison was made assuming the helicopter would fly in the normal environment of the fixed-wing aircraft, i.e., at altitudes considerably above treetop level; none of the reports took into consideration the capability of helicopters to operate at very low altitudes, often below treetop level. Estimates of vulnerability stressed speed, with the vulnerability of the aircraft varying inversely to the airspeed. As could be expected, the helicopters came out third best in comparison to the C-119 and the C-123 because helicopters fly considerably slower.

However, the comparatively slow speed of helicopters will permit them to operate at *low* flight levels, enabling them to avoid detection by enemy radar and thus reduce their vulnerability to enemy antiaircraft or guided missiles.

If we are clever enough to make full use of the helicopter's mobility, flexibility, agility, and low-flying capability—and can teach the enemy that the helicopter is a long way from a helpless sitting duck—the helicopter should be no more vulnerable on the battlefield than any other combat vehicle.

Army GCA



Lieutenant Donald J. Weigman, *Sig C*

ARMY AVIATION advanced another step toward all-weather operation with the recent authorization of Ground Controlled Approach units for Army airfields within the continental United States. Although there have been many disagreements between pilots as to which is the best type of instrument approach — GCA or ILS — the versatility of GCA won a place in Army Aviation.

The recent authorization of GCA units does not mean that they have not been used in the Army before this time. One of the first units to be operated solely by the Army on a continuing basis is now in use at the U. S. Army Aviation Center, Fort Rucker, Ala. This unit was obtained early in 1954, when the Army Aviation School was located at Fort Sill, Okla., and moved with the School to Fort Rucker later that year where it was installed at the Ozark Army Airfield.

Officially titled Landing Control Set AN/MPN-11B, it is a self-contained, mobile unit—one of the newer types used by the Armed Forces. All auxiliary and power equipment, such as generators, air-conditioner, equipment spares, and test equipment, are self-contained. Although the Ozark GCA unit is the only set of its type in use by the Army and is the one described in this article, the systems and procedures are basically the same for practically all types of units.

To accomplish the task of providing azimuth and elevation information to aviators landing aircraft during periods of low ceilings and reduced visibility,

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First Lieutenant Donald J. Weigman, Sig C, *is the Air Traffic Control Officer, Airbase Section, the U. S. Army Aviation Center. He became an Army Aviator late in 1953 and is currently rotary- and fixed-wing qualified. 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*

this unit incorporates three major systems—search, precision, and communication.

The function of the search system is to locate aircraft within a 30-mile radius of the equipment. Constant surveillance of the area is maintained so that approaching aircraft can be located, identified, and vectored into position for the final approach.

The function of the precision system is to track aircraft down the optimum glide path during the final approach. The precision system scans the final approach in both the vertical and horizontal planes, providing both course and glide-path information to the aviator.

The communication system performs the vital function of enabling the operator to relay to the aviator the information presented on the search and precision scopes. The operator can select any one of several HF, VHF, or UHF channels.

EXTRA FEATURES

Several "extra" features are included with the GCA set. A moving-target indication (MTI) system functions with either or both the search and precision units to cancel signals derived from stationary targets, thereby reducing ground clutter. Clutter caused by rain, sleet, or snow is reduced electronically.

A VHF direction finding set incorporated into the search system permits rapid identification of aircraft by projecting onto the search scope an electronic strobe, which identifies the target that is in radio contact with the search controller at that moment.

One of the outstanding advantages of GCA is its capability to adapt procedures to meet any situation. An aircraft within the range of the search scope can be vectored to the field, flown in a rectangular pattern, guided around obstructions, or held over a point without the use of other navaids; it can begin final approach at five to ten miles, and even make a controlled approach to a nearby airfield that has no GCA unit. The aviator needs only the basic flight instruments and one radio receiver to utilize this system.

To begin an approach, the pilot normally reports over a known fix. The search controller is then able to rapidly identify the aircraft, since he knows the position of the fix on his scope (fig. 1).

After radio and radar contacts are established, the search controller gives the aviator various headings and altitudes to follow which will position the aircraft on the final approach, usually eight miles from touchdown and at an altitude of 1,000 feet above any obstructions. He also gives the aviator additional information such as field weather, type of approach to be made, length, width, and condition of runway, missed approach procedures, and lost communications procedures. He reminds the pilot of cockpit checks and "wheels down."

As the search controller brings the aircraft into position for final approach, the aircraft appears on the precision scope (fig. 2). Since the precision scope covers only 7° vertically and 20° horizontally, the final controller cannot pick up the aircraft until

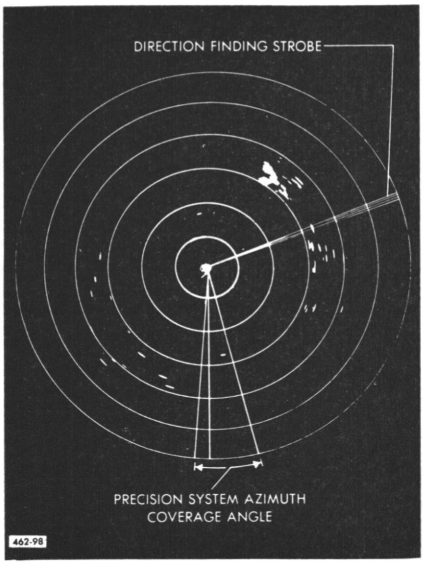

Figure 1

it is almost in line with the runway. He depends upon the search controller to "bring the aircraft" to him, and at a predetermined point, the search controller relinquishes control to him.

Between the eight- and five-mile points, the final controller gets the "feel" of the aircraft as to speed, accuracy of directional gyro, drift, and quality of pilot technique. At approximately four miles, he instructs the pilot to begin his descent.

Directing the aviator to change heading and rate of descent, he guides the aircraft down the centerline of the predetermined glide path, usually 3°. As the aircraft reaches the minimum altitude established for the approach, he advises the pilot that he is passing through "GCA minimums." The pilot should now have visual contact with the airfield. If not, he must execute a missed approach.

The GCA approach "officially" terminates at the specified minimum altitude. However, the final controller continues to advise the pilot of the position of the aircraft in relation to centerline and glide slope until the aircraft is over the touchdown point.

PAR APPROACH

There are many variations of the procedure described above, and a GCA approach does not have to use both the search and precision systems. If there is a fix within the final approach area over which the pilot can report, the final controller may pick up the aircraft and bring it down the glide path without using the search system.

Any approach which utilizes the precision system, either with or without the search system, is called a Precision Approach Radar (PAR) approach.

ASR APPROACH

The search controller can make approaches without the use of the precision system, too. Although the search controller cannot provide any glide path information and cannot match the centerline accuracy of the precision approaches, he can align the aircraft with any runway on the field.

An approach which uses only the search system is called an Aircraft Surveillance Radar (ASR) approach, and weather minimums are usually 100 feet higher than for the precision system.

HUMAN ELEMENT

GCA has more human element in its system than any other type of instrument approach;

consequently, the quality of a GCA approach depends on the proficiency and teamwork of both the aviator and operator.

To minimize the possibility of human error on the part of the operator, careful attention is given to the selection, schooling, on-the-job training, and proficiency of personnel. Applicants are screened for aptitude, intelligence, desire, voice, ability to keep calm, teamwork, good health, normal eyesight, and normal hearing.

At the present time, Army GCA operators receive approximately 20 weeks of training either with the Naval Air Technical Training Unit, Olathe, Kansas, or the USAF Technical School, Keesler AFB, Miss. After completing either of these courses, the new operator begins a period of extensive on-the-job training in the GCA unit.

He must memorize vital information concerning the airfield, such as runway numbers, runway lengths and widths, field obstructions, and traffic patterns. He must know the location of all navigational aids and fixes, airways, control areas and zones, airfields, major obstructions, and populated areas within 50 miles of the airfield.

He must also learn the procedures and equipment in the type of set used, the radio frequencies available in the unit and in the control tower, and the communication lines available between GCA, tower, operations, and Air Route Traffic Control Center.

The most important goal of this on-the-job training is to give the new operator experience, confidence, and a high degree of proficiency by having him actually control a large number of approaches (approximately 200) under the supervision of experienced personnel.

This training period normally lasts from four to six months, depending on the operator and the number of approaches he is able to make. Not until he has demonstrated high proficiency and knowledge is he qualified as an "IFR Controller."

ELECTRONIC MARVEL

The "forgotten man" of GCA, the electronics technician, keeps the GCA unit functioning. Without this technician to maintain the set—an electronic marvel of this day and age—all the proficiency and knowledge of the operator would account for nought.

The repairman must give careful attention to the fine tolerances and alignment of the

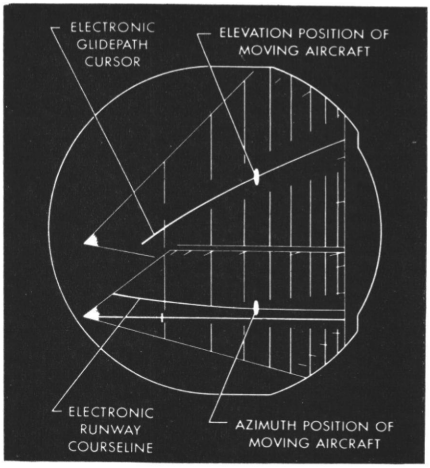

Figure 2

electronic circuits, must always be alert to spot possible trouble before it happens, and must per-

form corrective maintenance before a breakdown occurs.

Assisting the Army to attain an all-weather capability is an interesting job to these operators and technicians. They are adequately rewarded when a young aviator, flying a GCA approach for the first time, enthusiastically endorses this method of letdown.

Emergency Radar Interception

Emergency radar procedure for lost aircraft has aided even the scheduled airlines. Radar is restricted to line of sight, so altitude should be increased before initiating procedure. With operating receiver tuned to 121.5 mc, fly a triangular pattern to the right of two-minute legs with half-needle width turns of 120°. Complete a minimum of two patterns before resuming course. Instructions will be given on 121.5 mc. Without a receiver, fly a triangular pattern to the left in the same manner. If radar contact is established, a Search and Rescue aircraft will be dispatched for interception.

HIGH FLYING BIRD DOG

Lieutenant John R. Dome, CE

ALTHOUGH THE ACTUAL TEST described in the following article was conducted in 1955, no similar experiment conducted at such a high altitude can be called to mind. Lt Dome, the author, and Lt Thomas Long, CE, assigned to the 937th Engr Co, Fort Kobbe, Canal Zone, were given the mission by their Aviation Officer to determine if it were feasible to conduct a triangulation reconnaissance on the high plateau of the Andes Mountains. Successful completion of the reconnaissance required extensive "contour flying" and the ability to land and take off with personnel and equipment from landing strips higher than many aviators have ever flown.

Many tests have been conducted in the United States at Camp Hale, Colo., where the elevation is over 9,000 feet, and helicopters have recently conquered Pikes Peak, but the Army's fixed-wing aircraft are still virtually untried above the 10,000 foot level.—The Editor.

WE WERE ALERTED in September of 1955 to conduct a high altitude test in a *Bird Dog* in preparation for a low-level reconnaissance on the high plain region of the Andes Mountains of Bolivia. The average elevation of this plain is 13,500 feet.

Despite its altitude, the high plateau is vast and flat. No major difficulties were anticipated since each of us had determined, through previous missions, that the *Bird Dog* responded well at that height.

We planned to test the control

First Lieutenant John R. Dome is assigned to the Planning and Projects Section, G-4, U. S. Army Aviation Center, Fort Rucker, Ala. He is fixed- and rotary-wing qualified and has over 2,500 hours in the air. 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

of the aircraft on the ground during takeoffs and landings and to learn the flight characteristics of the *Bird Dog* while contour flying above the 2½-mile-high plain.

Getting our equipment together, we took off from Santa Cruz to fly to La Paz where the runways are long enough to let the *Bird Dog* use a full ground roll.

The runway used in the test was nearly 13,000 feet long and inclined so the east end is about 400 feet higher than the west. Control tower personnel recommended that we make all takeoffs downhill and all landings uphill, regardless of wind direction, which happened to be from the east northeast. The temperature was 10°C. on the surface.

We used a standard *Bird Dog* carrying two aviators and an ARC-5 radio installation (approximately 85 pounds). All tests were conducted with two and one-half hours of fuel in the tanks. Our only other equipment included survival and oxygen gear weighing in at about 20 pounds.

TAKEOFFS

Although we had originally planned to use three-point takeoffs for more positive directional control, we abandoned this idea after noting the large stones on the gravel runway and determined to get the tailwheel off the ground as soon as possible. We also decided to hold our *Bird Dog* on the ground until the air speed indicator showed 60 mph, then to climb out at 70 mph. Using the E6B, we saw that an indicated 60 mph was actually a true airspeed of 77 mph, and with the tail wind, we reached a ground speed of over 90 mph as the aircraft broke ground.

We leaned the mixture for the maximum increase at 1,800 rpm prior to each takeoff, and a maximum of 2,000 static engine rpm was developed. This increased to about 2,250 as the aircraft reached 60 mph.

Takeoffs were made with 0°, 30°, and 45° flaps. Ground runs took about 3,000 feet, because we held the aircraft down until reaching the desired airspeed. On each takeoff, we found that the tailwheel raised at 30 mph. Torque was slight, and gave us no real problem. Control on the ground was another matter. We got very little response from the rudder in accelerating from 30 to 50 mph.

On our takeoff with 45° flaps, the aircraft lifted off at 60 mph. Though we held the nose down to gain airspeed, it remained at 60. The aircraft climbed slowly, and all attempts to increase the airspeed above 60 mph with this flap setting failed. The "apparent" speed was startlingly fast, while the aircraft itself seemed insecurely airborne. We relied on airspeed, rather than "feel," to maintain the *Bird Dog* in flight.

On the 30°-flap takeoff, the aircraft "pulled off solidly" at 60 mph, and we were able to establish a climb at that airspeed. Flaps were retracted shortly after breaking ground, and the aircraft continued to accelerate to 70 mph, climbing steadily. The best control during the ground run for takeoff was obtained with this flap setting.

On the no-flap takeoff, the aircraft broke ground at 60 mph and continued to accelerate to 70; our climb was steady, but shallow. It was hard to maintain proper ground control without flaps. Wheel bounce vibration, common to spring steel landing gear, was severe on all takeoffs. This lack of positive control on takeoffs was partially due to the downwind conditions; however, the recommended flap setting of 30° was still considered the most appropriate.

LANDINGS

Of our total of five landings, we made two in the three-point attitude from a power approach with 45° and 60° flaps. The other three were wheel landings with 30°, 45°, and 60° flaps. The approach airspeed on all landings was 80 mph.

The aircraft had a tendency to "fall through" four or five feet during the two three-point landings but the three wheel landings were normal.

We decided beforehand to rely on the brakes for directional control after touchdown on all landings and noted that the wheel landing with 45° flaps afforded the best overall control.

At 14,500 feet, maximum engine rpm at full throttle was 2,300 and could be maintained with a 25 per cent throttle reduction. The attitude of the *Bird Dog,* with no flaps in level flight at this altitude, was slightly more tail low than the normal three-point position, and the airspeed indicator showed 70 mph at 2,200 rpm.

We obtained a more favorable attitude, and possibly more airspeed for cruising, by blocking the flap handle up until the flaps were lowered about four inches at the trailing edge. This brought the tail up almost to level flight and increased the indicated airspeed to 72 mph.

STALLS

Using different flap and power settings, we conducted stalls at 14,500 feet and found that the indicated airspeed of the stalls was the same as at sea level. We noted two differences, however. The normal "whistling" of the *Bird Dog* approaching a stall was not audible, and the rate of fall after the stall was alarmingly rapid. A normal power increase and release of back pressure on the stick broke the stall but did not arrest the fall. We had to "fly out" of the stall and quickly retract the flaps to regain airspeed.

CONTOUR FLYING

To check the contour flying characteristics of the *Bird Dog* at this altitude, we flew it down a straight, level road with the flaps completely retracted. While holding an indicated airspeed of 100 mph, we tried a slight pull-up to simulate an obstacle in the flight path. The airspeed immediately fell to 80 mph, and full power was added. Since the airspeed continued falling to 60 mph, the contour flying phase of this test was considered to be too dangerous to continue. Vertical currents of air made the successful completion of this portion of the experience doubtful.

At one point, after we had climbed from the road, a strong downdraft caught us and the vertical speed indicator showed

a loss of 800 fpm with full throttle at 60 mph.

SUMMARY

Should it ever become necessary to fly under these conditions in a *Bird Dog*, the following suggestions will prove helpful:

1. Takeoffs should be made with 30° flaps.
2. Airspeed should be flown throughout.
3. Take advantage of rising air currents.
4. All landings should be wheel landings with 45° flaps.
5. Fuel the aircraft for each mission, plus a good reserve.

From the results of the tests we suggest the following modifications when a *Bird Dog* must be flown under these conditions:

1. A supercharged engine.
2. A controllable pitch propeller.
3. Electric flaps (now being installed on all *Bird Dog* aircraft through the SCAMP* program).
4. Elimination of all excess weight within the aircraft.

Though this series of landings should not be used as the sole measure for future operations, we believe normal operations at this altitude are entirely practical for the *Bird Dog*.

**The new Standard Configuration and Modification Program replaces the old IRAN program.*

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MASTER Army Aviator

Colonel Robert R. Williams, President of the United States Army Aviation Board, has been awarded the Master Army Aviator Badge effective 10 September 1957. This is the first Army "one-one" rating given to an officer on active duty. There have been many other "firsts" in Colonel Williams' career since he started flying in 1935 at Baton Rouge, La. See inside back cover.

"Our business is aircraft and allied equipment—our interest extends from its birth to its death . . ." COL R. R. WILLIAMS

Col Williams; Gen Wyman, CG USCONARC; Gen Taylor, Chief of Staff

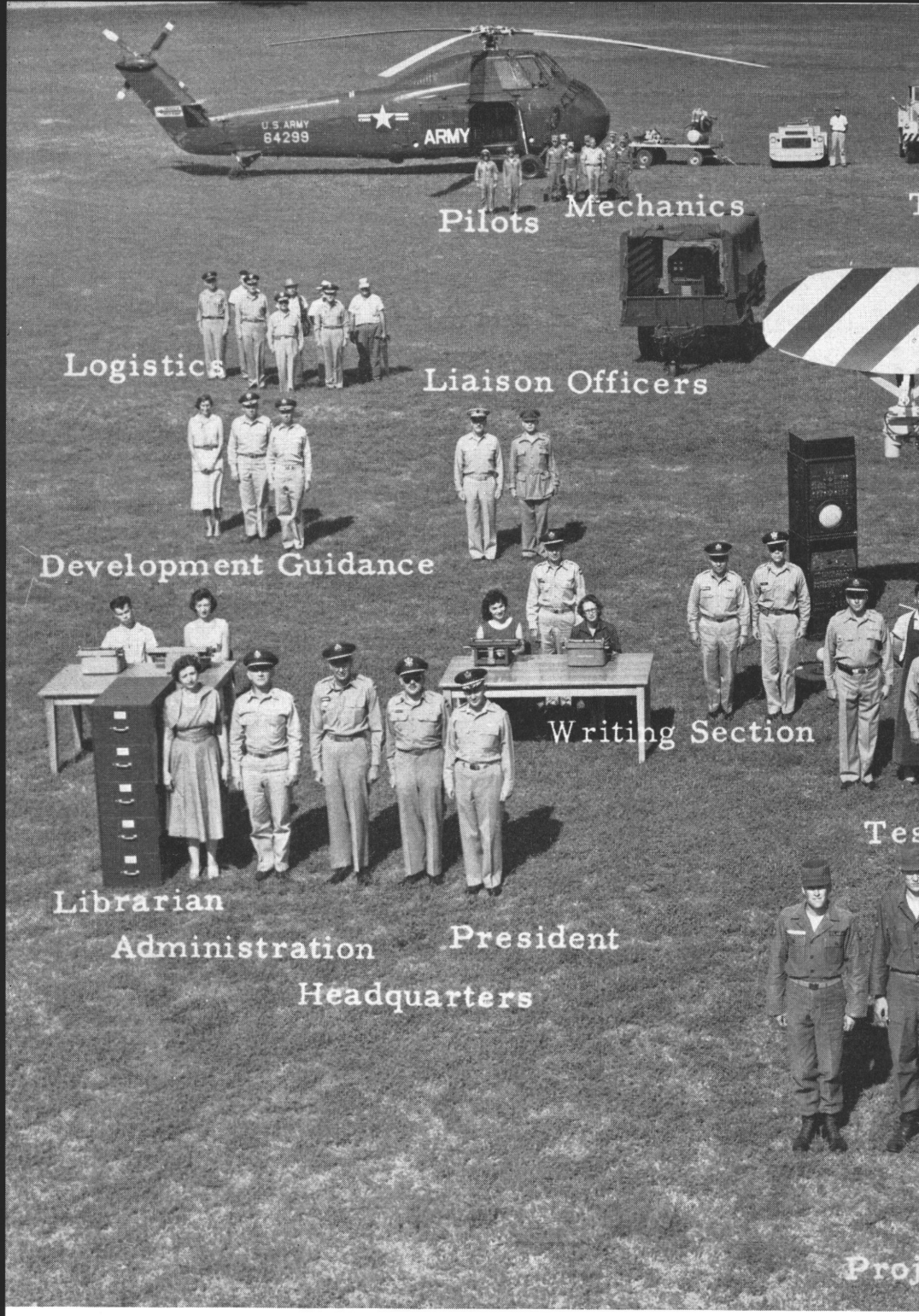
The U. S. Army Aviation Board

The United States Army Aviation Board, Fort Rucker, Alabama, was established as a separate CONARC Board on 1 August 1955. Its mission: to conduct service tests, prepare military characteristics, maintain a review of aeronautical equipment developed by other services and civilian companies for Army application, and to observe and review performance of standard items.

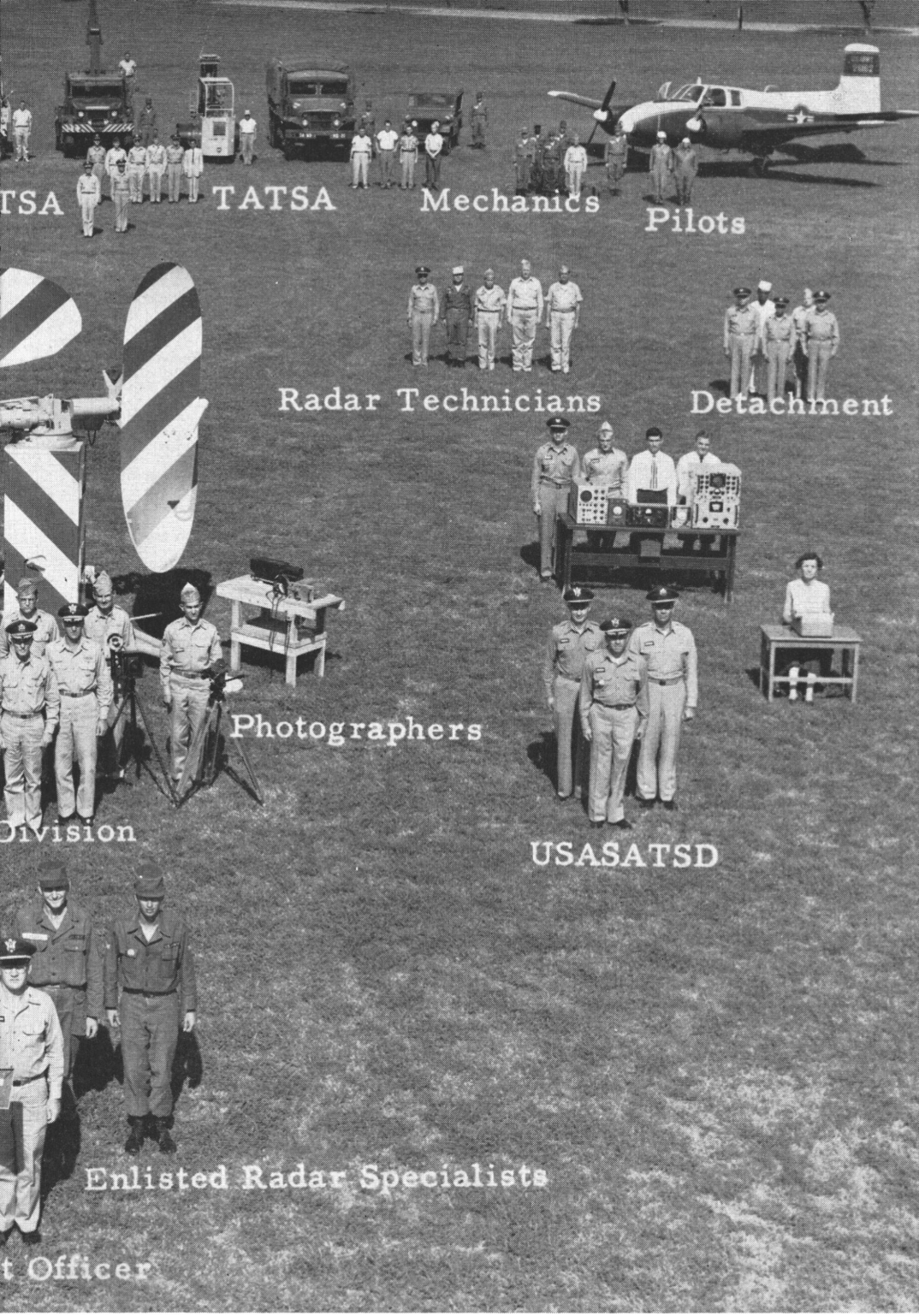
The Board's field of responsibility includes Army aircraft, communication and navigational aids used in controlling aerial flights, and allied equipment.

Major General Ralph M. Osborne, Assistant Chief of Staff for Materiel Developments, Hq USCONARC.

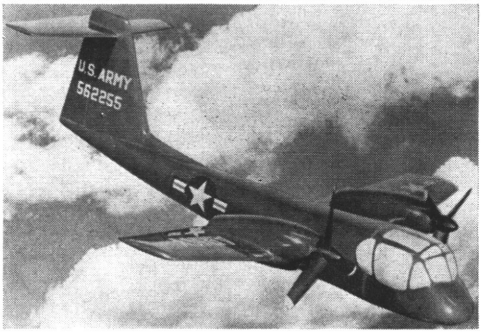
Service testing is one of the most important responsibilities of the Board. Service tests are distinguished from engineering tests in that they evaluate the combination of equipment and military personnel in their normal operational environment. The service test will be conducted, insofar as practical, under simulated combat conditions in order to allow the factors of weather and terrain full play in the test. All conclusions are oriented to the prime purpose of the service test—to determine the degree to which an item of equipment meets the military requirement as expressed in military characteristics.



Test report on lightweight GCA radar held by project officer represents pe of the Board, the technical and maintenance support of SATSD, as well a



nel and major items of equipment as shown. This includes every division e support of TATSA and the civilian contractor for the aircraft involved.



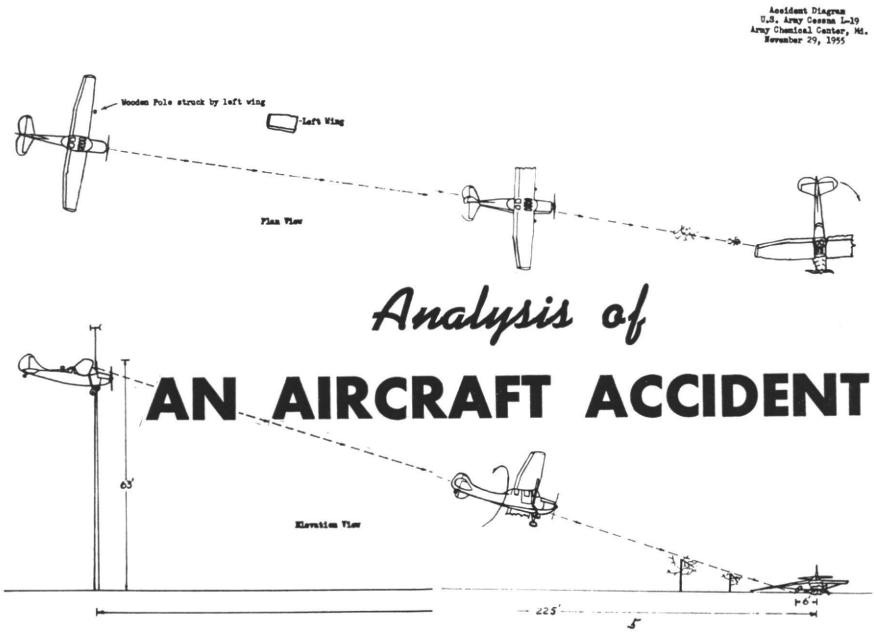
The Board's interest in equipment starts with the conception of the idea for an item and ends when the last of its type is phased out of the Army system. The cycle starts with a requirement for which the Board prepares military characteristics. Technical specifications are followed by manufacturers proposals. Once a specific design is chosen the manufacturer constructs a mock-up. (The Grumman Mohawk, pictured at the left is at this stage now.) Following the mock-up, a prototype is constructed. (The Iroquois is an example of an aircraft in this stage.) On completion of engineering tests, the first of the prototypes for service test is delivered to this Board.

The Board's decisions and the characteristics they develop must be realistic and reflect the best state of the art. To accumulate a backlog of technical knowledge and flight experience in all types of aircraft, every opportunity is taken to check out in something new or different.

From a one-man rocket helicopter to a convertiplane, from a Piper cub to a jet fighter—someone at the Board has flown it.

One of the major current projects of the Board is its instrument program. Its goal is to arrive at the best interim solution to zero-zero weather flying for both fixed- and rotary-wing aircraft. One facet of this complicated problem is the solution of the best instrument presentation possible. Capt Merrill E. Jameson and Major Willie W. J. Barrios of the Test Division of the Board are shown discussing one of the many possible presentations.

A wide variety of items are being tested in conjunction with the instrument program. Included are automatic stabilization equipment, various autopilots, integrated flight systems, instrument landing systems, GCA, doppler radar, radar altimeters, and TACAN.



Analysis of AN AIRCRAFT ACCIDENT

THE ARMY TODAY is faced with an injury problem in flying. This problem demands close cooperation between designers, accident investigators, research scientists, and engineers.

One agency providing design engineers with valuable information in this field is the Aviation Crash Injury Research of Cornell University. It is concerned primarily with what is termed "survivable" accidents.

A "survivable" accident is one in which major portions of the cabin or cockpit structure remain reasonably intact during impact. When the magnitude of crash forces is insufficient to totally demolish an aircraft structure, it is not enough in itself to directly cause dangerous injury or death. Such an accident should be survived.

In the April 1956 issue of the U. S. ARMY AVIATION DIGEST, A. Howard Hasbrook described the objective of Aviation Crash Injury Research (Av-CIR) as follows: "To improve the 'State of the Art' of crash-survival design."

Av-CIR, a function of Cornell University, is sponsored jointly by the U. S. Army, Navy, and Air Force under the direction of Mr. Hasbrook. Other supporting groups include industrial leaders in aviation safety.

This research department obtains comprehensive medical data and related accident details from "survivable" crashes. These related data are then analyzed and the results given to

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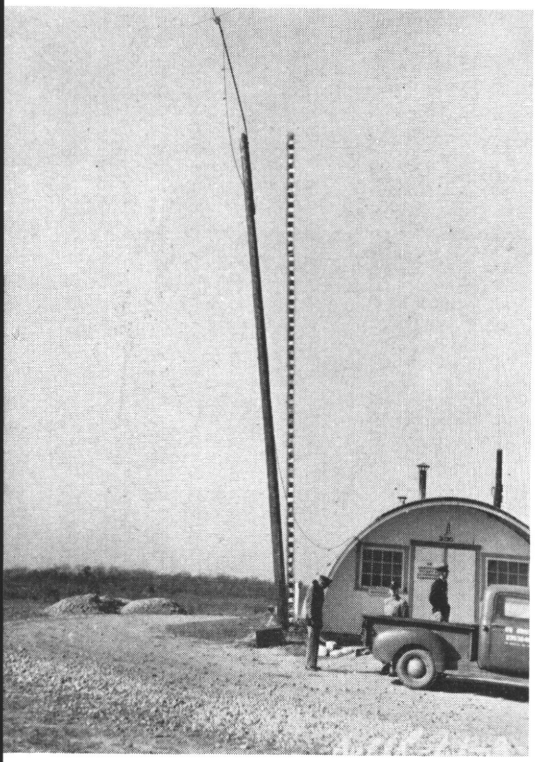
Views expressed in this article are not necessarily those of the Department of the Army or of the U. S. Army Aviation School.—The Editor

engineers for use in designing future aircraft and aircraft components.

Presentation of the following case history will effectively dem-



Overall Displacement of Pole

onstrate how Av-CIR works to improve the "built-in" safety of aircraft.

THE ACCIDENT

While performing a normal patrol mission, a U. S. Army *Bird Dog* aircraft struck a 63-foot wooden pole.

The left wing struck the pole approximately six feet inboard from the wing tip. The angle of bank at the time of impact was approximately 15°, right wing down.

As the left wing panel buckled, the *Bird Dog* pitched down slightly and turned to the left. The aircraft struck soft ground 225 feet from the pole with the nose about 15° down. The left landing gear struck first, followed in quick succession by the nose and cockpit floor, with an impact speed of approximately 70 mph.

During the crash, the aircraft rotated approximately 90° to the right around its vertical axis and slid about six or seven feet to a stop.

Pilot and observer received severe, but non-fatal, injuries. Both sets of shoulder harness were found in the stowed position.

The aircraft did not burn.

MEAN CRASH FORCE

The principal crash force was imposed from a point parallel to the longitudinal axis of the aircraft. There was evidence of heavy vertical force from below.

The total distance of deceleration (including rearward movement of engine and telescoping of cabin structure) was approximately eight feet. Combined with an impact speed of 70 mph, this implies a mean deceleration of 21 Gs in the intact area of the cabin.

Assuming the pilot weighed 170 pounds, he exerted a pressure of approximately 3,570 pounds against his safety belt, which remained intact. He sustained no bruises of the hips, nor any other injuries of the lower torso.

The rear seat safety belt worn by the observer failed at its anchorage point. This "tie-down" failure permitted him to hurtle

forward, striking the front seat. His left foot apparently jammed under the flap handle, causing the complete fracture of all five metatarsal bones.

In this accident, extensively detailed investigation was made of damage to floor structure, seats, and seat anchorages. General damage to the aircraft was thoroughly investigated. At the same time, thorough and detailed medical examinations were conducted on the injured aviators.

RECOMMENDATIONS AND COMMENTS

Searching analysis of these detailed findings resulted in the following recommendations by Av-CIR. The answers to each specific recommendation were made by engineers of Cessna, manufacturers of the *Bird Dog*, with the exception of recommendation four, which was answered by the Chief, Flight Safety Division, ODCSOPS, Department of Army.

1. Increase the strength of the rear safety belt "tie-down."

"Revision of a Civil Aeronautics Administration Regulation requires a stronger safety belt attachment for the observer's position in the instrument trainer. This 'beefed-up' attachment could be incorporated on all *Bird Dog* aircraft by installation of a retrofit kit, consisting of reinforcement angle which would run from the rear door post bulkhead to the canted bulkhead. A reinforcement angle at the attachment fitting could also be included. An ECP [Engineering Change Proposed] could be easily prepared for this installation."

2. Design seats and seat attachments to deform, but not fail completely, under dynamic loads equivalent to required safety belt load factors.

"We feel that the seat design for the pilot and seat floor attachments are equivalent to the safety belt strength. In reviewing the report, it is believed that the force of the observer's body against the rear of the seat back resulted in the complete failure of the pilot's seat legs. We believe the pilot is more protected

Six Inch Displacement of Pole

if the seat fails progressively at the time of impact, since this results in a much lower load factor on the pilot's body. Therefore, we do not recommend any

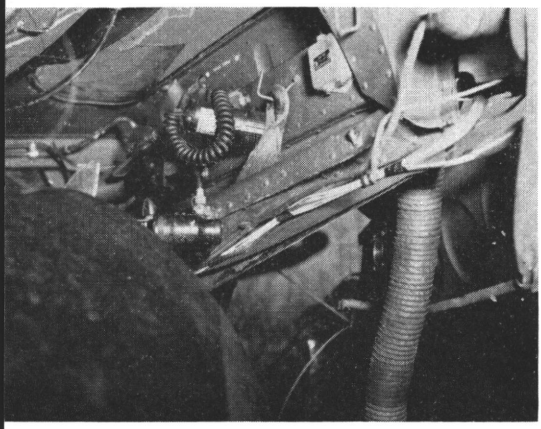
change in seat structure on the basis of this single report."

3. Utilize a type of shoulder

Approach Path to Touchdown

harness that is less restrictive (operationally) and more comfortable in order to promote more routine use.

"The installed shoulder harness is a standard Air Force approved inertia reel. If the harness had been properly used, in

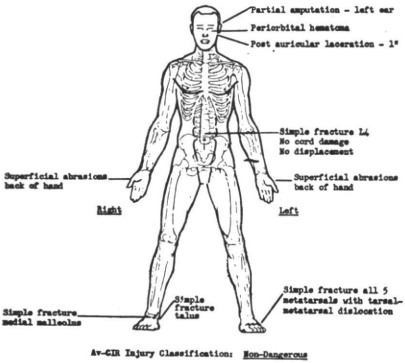


Shoulder Harness in Stowed Position

lieu of being in a stowed position, it is believed that both the pilot and observer would have sustained only minor injuries. In reviewing other Army accident reports, we have found that the shoulder harness, if worn properly, has worked in all cases. Present accident statistics show that the harness which has been provided in all *Bird Dogs* is satisfactory."

4. Require use of lightweight crash helmets by all occupants of liaison aircraft during all missions.

"The Quartermaster Corp is in process of developing a suitable helmet for Army flight personnel. Meanwhile, to provide



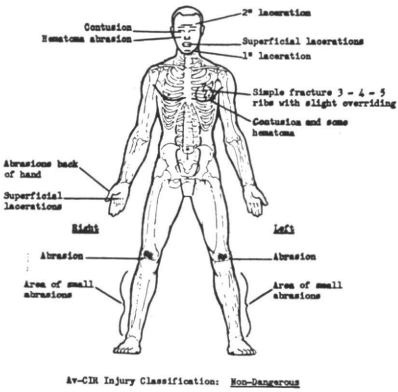
Observer

immediate protection pending completion and approval of the prototype helmet, QMC has purchased 300 APH-5 helmets from the Navy, which will be modified to accommodate Army communications equipment. This is a new type affording excellent crash protection. These helmets became available in August, 1957. QMC is considering an additional procurement of the APH-5 helmet in sufficient quantity for issue to all flight crews of helicopter and reconnaissance aircraft."

5. Increase the strength of

the upper cabin structure and/or design the wing butt attachments to fail during a crash without causing complete collapse of the overhead structure.

"We do not believe that the aircraft warrants structural 'beef-up' for the upper cabin. In reviewing past Department of Army accident reports, we cannot find reason to warrant this heavy, expensive, and impractical rework. We also reviewed the Navy-Marine background for the OE-1 aircraft and have found that 'beef-up' to its structure is



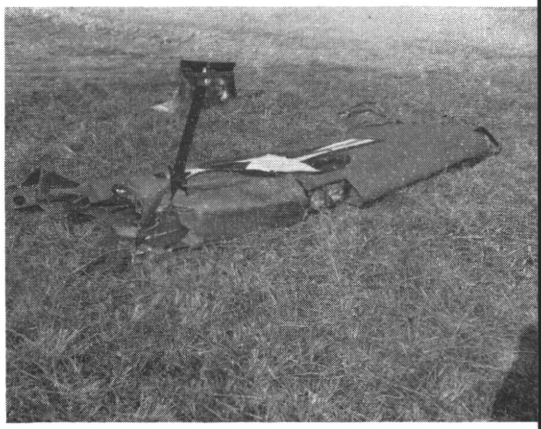
Pilot

unnecessary."

6. Utilize a lightweight, protective (delethalized) shield on the instrument panel, similar to that installed on the *Seminole*.

"A protective instrument panel shield would be a considerable weight increase item. Such a shield would be completely unnecessary if the pilot and observer would wear the shoulder harness and safety belt as provided in the airplane. For this reason we do not recommend such a device on a military airplane."

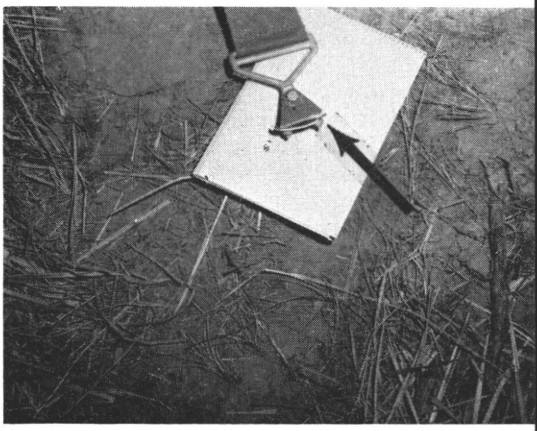
7. Install a lightweight shield over the rear and top of the horizontal (flap) control tube to



Left Outer Wing Panel

prevent jamming of the observer's left foot under the tube.

"Department of the Army has purchased some 1,800 electric flap kits. The flap control tube is



Safety Belt End Still Attached to Fragment

removed from the aircraft when this electric flap system is installed, eliminating this hazard."

CESSNA CONCLUSIONS

"It is noted in the report that

the aircraft stopped within six feet after contact with the ground. Since the airplane speed was approximately 70 mph, deceleration of the airplane was of such magnitude that any type structural 'beef-up' to take care of this type of accident would require a complete redesign of the fuselage which could not be incorporated in existing aircraft by kit form.

"If Army accident statistics indicate a real need for reinforcing the rear safety fitting, it is recommended that the rear seat safety belt attachment reinforcement be incorporated in existing planes."

COOPERATION COUNTS

This is the kind of crash-injury and crash-survival data that is needed on military accidents. Quick action by aircraft engineers resulted from qualitative and quantitative information furnished by Av-CIR, using classifications and terms that the engineers understand. This is the type of Army-Manufacturer-Research Team cooperation that will pay off in safer equipment.

Reference to Library Published

Special Bibliography No. 1 on Army Aviation has been issued as the first publication of the U. S. Army Aviation School Library. This list of references identifies all the unclassified material at the Library on the general subject of Army Aviation and includes detailed references to 500 magazine and newspaper articles from April 1952 to April 1957.

Distribution has been made to departments of the U. S. Army Aviation School and to other Army schools and libraries throughout the United States. Additional copies may be obtained by writing to:

Commandant
U. S. Army Aviation School
Fort Rucker, Alabama
ATTN: Librarian

PUZZLER

AN ARMY AVIATOR departed Ozark AAF, Ala., IFR to Spartanburg (SPA) S. C., with Knoxville (TYS), Tenn., as an alternate. He received a weather briefing prior to departure and was informed the ceiling would possibly be lower at Spartanburg, but should remain above the minimum. The aviator was cleared to Spartanburg airport via R-67 and G-6 airways. His aircraft was equipped with LF, Omni, and ADF. He received a weather broadcast over Royston, Ga., indicating the ceiling at Spartanburg had reached the minimum. Ten minutes from his destination the pilot attempted to contact Spartanburg Approach Control for an approach clearance, but was unable to make contact. After holding over the SPA low frequency range until five minutes past his estimated time of arrival with no contact established, the pilot started a standard approach. He arrived at the minimum approach altitude without breaking out, and immediately executed a missed approach. Air Traffic Control would expect the pilot to:

(Indicate by a √ the proper procedures to follow.)

☐ **Return to the SPA LF/R and attempt another approach, provided he does not go above the minimum altitude and can complete the second approach within 30 minutes from his last estimated time of arrival.**

☐ **Transition to the SPA VOR and immediately execute an Omni approach, provided he does not go above the minimum altitude.**

☐ **Switch to Omni and proceed to Asheville (AVL) via V-53, provided he does not go above the minimum en route altitude, and execute an Omni approach on arrival.**

☐ **Switch over to Omni and proceed to Knoxville (TYS) VOR via V-185 at minimum en route altitude and immediately execute an Omni approach on arrival.**

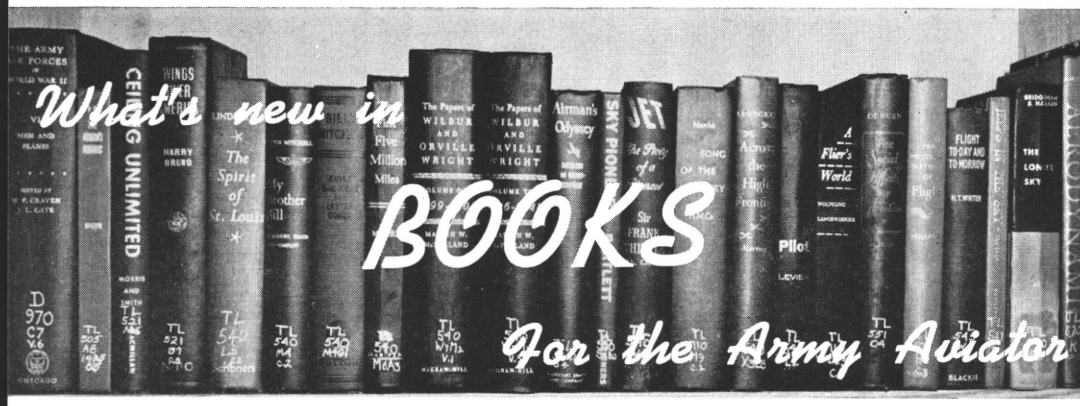
☐ **Proceed to Knoxville (TYS) LF range via B-28 and G-5 at minimum en route altitude or the altitude last assigned en route to SPA, whichever is higher, and immediately execute an LF approach on arrival.**

☐ **Proceed to Knoxville (TYS) LF range via B-28 and G-5 at minimum en route altitude, maintaining true airspeed filed in flight plan and immediately execute a standard LF approach.**

☐ **Proceed direct to Knoxville LF Range by ADF to arrive as soon as possible, and execute any type approach the pilot chooses.**

Reference: Charts 17 and 18 of TM 2557.

The correct solution to the PUZZLER may be found on page 32.



MEN IN ARMS: A History of Warfare and Its Interrelationships With Western Society — R. A. Preston, S. F. Wise, and H. O. Werner (Frederick A. Praeger, Inc., 150 East 52d Street, New York 22, N. Y. $6.50)

Reviewed by
Brigadier General Carl I. Hutton, *USA*
Commanding General
8th Infantry Division Artillery

This book is military history which describes no battles. It is an "enquiry into the social and technical changes which have affected" war. The field for such an enquiry is extremely broad, and the accomplishment of the authors in presenting the subject in 340 pages of text is one of masterly compression. Chapters of standard military history have been reduced to single sentences, and whole volumes have been reduced to paragraphs.

The factors of nationalism, popular governmental forms, technological development, ideological conflicts, and mass communication media have coincided in history with the growth of air power, resulting in the complications of the problem of survival of civilization. The nation in arms is maintained not only in war but in peace. "The great problem for the military planners, as far as we can see, is to reconcile the two needs, military forces for local wars and preparedness for the dreaded recurrence of total war."

This book, then, ends with the assumption that the force requirements for atomic and non-atomic wars are necessarily contradictory, and that a nation must have forces of both kinds. Had the authors included, either in the excellent bibliography or the text, reference to "Airborne Warfare" by Lieutenant General James M. Gavin, the possibility of a different conclusion might have arisen. There is a famous statement from this latter book to the effect that the future of the armed forces lies in the air. With proper development of doctrine and material we may find that the atomic and non-atomic military requirements are not as opposite as they first appear.

Book reviews appearing in this department do not necessarily reflect the opinions of the Department of the Army or of the U. S. Army Aviation School.—The Editor

THE COMPACT HISTORY OF THE UNITED STATES ARMY — Colonel R. Ernest Dupuy (Hawthorn Books, Inc., 70 Fifth Ave., New York 11, N. Y., 1956. $4.95)

Reviewed by
Lt Col Raymond S. Pratt, Jr., *Arty*

This book is an easy-to-read, thought-provoking account of American fighting men and their

women from the American Revolution through Korea. It is a factual story of people that will prove interesting to the young soldier as well as the old and to the Army wife.

The author has skillfully woven into his theme historical factors which have determined the character and efficiency of our Army and its members throughout its history. He presents a clear and sympathetic explanation of the occasional disgraceful episodes suffered by the Army as well as of its heroic accomplishments. Readers of this book will be enriched by the understanding gained and, at the same time, entertained by the very human presentation.

SHIPS IN THE SKY—John Toland (Henry Holt and Company, 383 Madison Ave., New York 17, N. Y., 1957. $4.95)

Reviewed by
Major R. J. Sweezey, Jr., Arty

This book is a highly stimulating, popular history of the great dirigibles and the men who developed and flew them. It concentrates upon the climaxes and human drama inherent in the story of the silver "ships in the sky."

The book begins with the triumphal approach of the *Hindenburg* to Lakehurst Naval Air Station in 1936, which heralded a new age in flight, and ends with its destruction a year later. The book tells of such people as Dr. Solomon Andrews, the stubborn Yankee inventor, who thrilled New York with the first airship that could move against the wind; Santos Dumont, the celebrated Brazilian millionaire who became the rage of Paris and then of all Europe as he pursued an elusive speed record; and Count Von Zepplin who first developed the dirigible as a practical commercial and military weapon, and bequeathed his name to the ships of the sky.

But the heart of the book lies in the contemporary period. Mr. Toland has obviously performed prodigies of research in investigating the triumphs and tragedies of the dirigibles in the United States during the twenties and thirties. He has talked to hundreds of people—passengers, crew members, ground crewmen and eye witnesses—intimately connected with the dirigible story.

As a result, we seem to be in the ship with the crew, feeling, seeing, and hearing what they experienced, when for example, the *Shenandoah* groaned and buckled, caught between two murderous line squalls, or the *Hindenburg* collapsed, a fiery incandescent coffin that sealed the fate of the dirigible. The book has the same kind of stunning veri-similitude as Walter Lord's *A Night to Remember*.

Ships in the Sky is not a technical, scholarly history of the dirigible. Mr. Toland is interested in the human drama, the emotional force that bound crew and general public alike to the ill-fated craft in spite of calamity after calamity. *Ships in the Sky* is a joy to read, both for the dirigible enthusiast and the general reader.

The Gray Hair Department

TWO AIR WEATHER stations 50 miles to either side of the Army Aviator's home base reported VFR conditions as he took off in a *Bird Dog* on an administrative cross-country flight with a ceiling of 3,500 feet and visibility five to ten miles for the first leg.

The route included a narrow defile through high mountains. As he entered the pass, the aviator encountered a light turbulence, but there was no perceptible change in the weather.

About 15 minutes later, as he rounded a turn, a wall of snow appeared. It was impossible to go farther, so he elected to make a 180° turn and return over his previous route. As he started the turn (altitude 1,000 feet above the river bed), he noticed a continuing loss of altitude at 1,000 fpm. He increased power, but the plane continued to settle. Thirty-degree flaps were applied, decreasing the rate of descent to 500 fpm, and full throttle was applied. Airspeed was maintained at 80 mph.

Upon completion of the turn, the aircraft touched down on the river bed and bounced. As it approached the ground again, the aviator cut power and executed an emergency landing. After braking to a stop and turning off all switches, he left the aircraft to survey the damage. He found the main gear sprung and the

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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 Board for Aviation Accident Research. The 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*

propeller bent.

He estimated the wind velocity to be 60 to 70 mph and tried to tie down the *Bird Dog* with stakes from the emergency kit. However, the ground was frozen and the stakes could not be driven into it. Thirty minutes later the wind picked the aircraft up and turned it over, causing extensive damage.

A pat on the back for this aviator. He landed his *Bird Dog* under most adverse conditions with only minor damage. In similar situations, pilots have been killed.

Since the weather in this particular pass was known to be turbulent and less predictable than surrounding areas, special instructions should have been given to the new aviator, emphasizing techniques used by old timers to "stay alive."

One-eighty degree weather changes are common in mountains and can be encountered anywhere at any time. Long, narrow mountain passes should be avoided when possible. A straight line is not always the shortest route to safety.

INVERTED WASHER

A test flight of a *Sioux* was required in accordance with TB AVN-1 after replacement of the main rotor assembly and blades. The Army Aviator scheduled to perform this test conducted a thorough preflight inspection, giving special attention to the replaced rotor assembly.

The aviator started the helicopter, made a normal pretakeoff check, and brought the *Sioux* to a hover. Some cyclic vibration was present and the aviator, before continuing, decided to have the main rotor blades tracked.

After assuring himself the blades were in-track, the aviator proceeded to hover the *Sioux* for 15 to 20 minutes. The cyclic vibrations ceased and several hovering autorotations were accomplished with no abnormal reaction. A normal takeoff was then accomplished for a flight around the traffic pattern.

Slight abnormal vibrations were encountered shortly after the aviator entered an autorotative approach. He immediately aborted the autorotation and made a normal landing. After landing, he reduced power and pitch before stopping the engine.

The Aircraft Touched Down and Bounced

As the mixture was leaned, severe vibrations ran the length of the helicopter with sufficient force to throw the aviator from side to side within the cockpit. He received severe bruises on his left hand from the action of the collective pitch.

These unusual vibrations were caused by the main rotor assembly sliding down the mast and coming to rest on the stabilizer bar assembly.

The Bird Dog Turned to the Right

The subsequent investigation revealed that the split cone washer assembly had slipped from place during landing. This permitted the main rotor assembly to move downward when its weight exceeded lift and centrifugal force.

A series of small marks around the top of the washer assembly indicated that this important part had been installed UPSIDE DOWN.

The installation of the main rotor assembly had been performed by organizational mechanics and supervised by the line chief. Although normally a field maintenance function, permission had been granted by that supporting activity to perform the work locally. In the absence of the unit rotary wing maintenance officer, the line chief approved the job and signed off the entry.

Usually, when a field maintenance installation is authorized to be done at organizational level, a mechanic, specifically trained to perform that type installation, is furnished by the higher activity to supervise the job. This was not done.

The line chief exceeded his authority in approving and signing off the completed installation, and it is doubtful that the rotary wing maintenance officer would have caught the error. It takes years of experience or a similar occurrence to develop an ability to catch these partially hidden errors. Lack of supervision by qualified unit and field maintenance personnel is vividly apparent.

PERFECT LANDING

Two Army Aviators took off in *Bird Dogs* to practice landings at a well-used road strip. The first aviator landed and taxied to an intersection where there was enough room for both aircraft to turn around.

One witness stated the second Army Aviator "made what appeared to be a perfect landing on the two front wheels." Directional control was well maintained for the first 900 to 1,000 feet of the landing roll.

Then the *Bird Dog* turned slightly to the right; the aviator corrected with left rudder and brake. The aircraft responded, and the aviator applied right rudder and brake to realign himself with the road. Even with full application of right rudder and brake, the plane continued to the left, entering a ditch on the left side of the road. As it hit the ditch, the *Bird Dog* nosed up and the propeller struck the ground, causing complete stoppage of the engine.

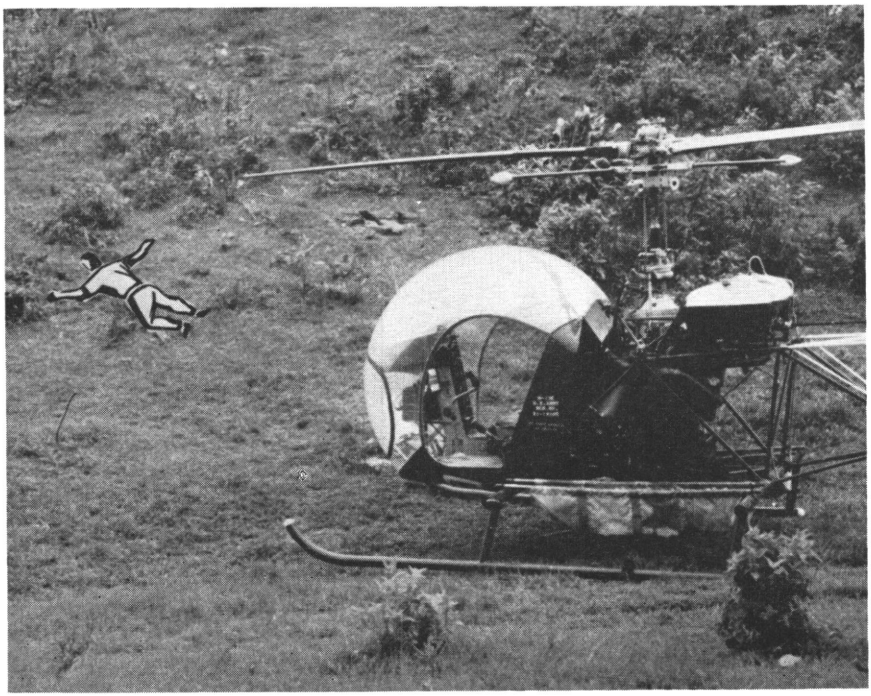
Not once during the entire ground roll did the aviator pull the stick to the rear. Loss of directional control on a wheel landing is probable when the airspeed decreases to taxi speed and the tailwheel has not been lowered to the ground.

SUDDEN DEATH

An Army Aviator was transporting a passenger to a new field, located in a densely forested region, in his *Sioux*. Upon arrival, he was unable to land in the immediate vicinity, so he selected a landing site a short distance away, which was an open field sloping downward to the center from two sides.

The aviator landed in the center of the field into the wind, reduced rpm to 2,200 and locked all controls. Both he and his pas-

He Heard a Loud Banging Noise



senger debarked to unload luggage from the cargo racks.

While the aviator was unloading the left cargo rack, he heard a loud banging noise. He walked to the other side of the helicopter and saw his passenger lying face down on the ground just outside the rotor diameter. The passenger was bleeding profusely from the back of the head. A quick examination showed that he was dead.

A reconstruction of the accident indicated that the passenger unloaded the right cargo rack and walked *upslope,* away from the *Sioux,* in a stooped position. He apparently raised up and was struck on the right shoulder and back of the head by the rotor blade tip.

The aviator had little choice but to land in the center of the field; however, had there been the opportunity to land the *Sioux* to one side, the passenger side of the helicopter should be placed *downslope.* The aviator should then remain at the controls and *tip the rotor arc away* from the passenger until he has completely cleared its path.

If there is any doubt concerning freedom of movement beneath the rotor arc, the engine should be shut down and the passenger remain in the aircraft until the rotor ceases to turn.

Since it is general practice throughout the Army to debark passengers with the rotor still engaged and moving, aviators should place particular emphasis upon instructions to passengers about the dangers involved. This should be done before each flight, regardless of frequency of utilization by a passenger.

Death is final.

Solution to PUZZLER

On the basis of the factual information contained in the PUZZLER on page 25, the recommended solution is as follows:

√ Return to the SPA LF/R and attempt another approach, provided he does not go above the minimum altitude and can complete the second approach within 30 minutes from his last estimated time of arrival.

√ Proceed to Knoxville TYS) LF range via B-28 and G-5 at minimum en route altitude, maintaining true airspeed filed in flight plan and immediately execute a standard LF approach.

Colonel Williams' "Firsts"

He was the first ground force Liaison Pilot to hold an Army Air Corps Instrument Rating (1942).

He was the first Army Aviator to hold an Air Force Green Instrument Card and has held one continuously since 1950.

He was the first Air Officer of the first Army Aviation operational unit, the United States Constabulary Flight Detachment. This same unit was the first Army Aviation unit to operate multiengine aircraft (C-45s).

He was the first chief of the Army Aviation Branch, G-3, Department of the Army. This was the first identifiable agency on the Army General Staff established for the purpose of coordinating and supporting Army Aviation.

He is the first President of the United States Army Aviation Board.

The following requirements are necessary to qualify for the aeronautical designation of Master Army Aviator:

a. Be assigned or detailed in a branch of service authorized Army Aviation.

b. Hold the aeronautical designation of Senior Army Aviator and be currently on flying status.

c. Have been designated as an Army Aviator, Senior Army Aviator, or Liaison Pilot in the United States Army on flying status for a minimum of 15 years; have officially logged a minimum of 3,000 hours flying time as a student pilot, first pilot, copilot, and/or instructor pilot in civilian and/or military aircraft.

d. Commissioned aviators must have held a valid Army, Navy, or Air Force standard or higher instrument certificate for a minimum of five years prior to the date of application and must hold a currently effective special instrument certificate.

e. Be currently qualified in rotary wing aircraft.

LTCOL. A.J RANKIN U.S. ARMY

In the field of jet experience the U.S. Army Aviation Board recently completed an extensive program through the cooperation of the Naval Air Training program. Eight Army Aviators went through the standard Navy jet training program at Olathe, Kansas, and Memphis, Tennessee. These aviators included Colonel Williams, Lt Colonel Rankin, Lt Colonel Byrd, Major Mahone, Capt Cranford, Capt Lefler, Capt Jameson and Capt Brockmyer.