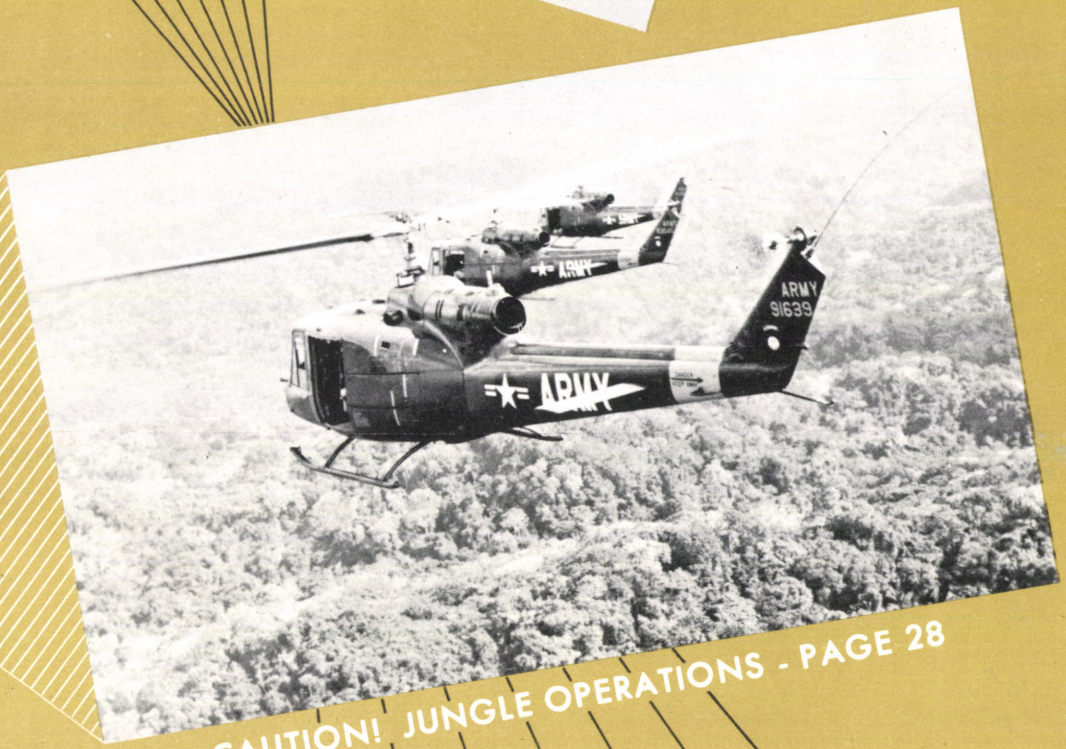
AUGUST 1962

UNITED STATES ARMY AVIATION DIGEST

THE CHINOOK ARRIVES - PAGE 3



CAUTION! JUNGLE OPERATIONS - PAGE 28

SPECTROGRAPHIC OIL ANALYSIS - PAGE 32

UNITED STATES ARMY AVIATION DIGEST

AUGUST 1962 VOLUME 8 NUMBER 8

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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.

The DIGEST is an official Department of the Army periodical published monthly under the supervision of the Commandant, U. S. Army Aviation School. Views expressed herein are not necessarily those of Department of the Army or the U. S. Army Aviation School. Photos are U. S. Army unless otherwise specified. Material may be reprinted giving credit to the DIGEST and to the author, unless otherwise indicated.

Articles, photos, and items of interest on Army Aviation are invited. *Direct communication is authorized to: Editor-in-Chief, U. S. Army Aviation Digest, Fort Rucker, Alabama.*

Use of funds for printing of this publication has been approved by Headquarters, Department of the Army, 27 November 1961.

To be distributed in accordance with requirements stated in DA Form 12.

LETTERS

Sir:

This unit is starting a file on the U. S. ARMY AVIATION DIGEST. Request we be furnished one copy of any DIGEST you may have after January 1959.

Further we suggest future editions of the magazine be prepunched with ¼-inch holes to fit the standard three ring loose leaf binder.

WILLIAM F. MARTIN
1/Lt, Inf
Adm Off

● *Available back issues are on the way. DA Forms 12 and 12-4 should be obtained from your AG publications center and used to request distribution of the DIGEST. After requesting as many copies monthly as you require on the form, submit it to your local AG publications officer. He'll do the rest. Detailed instructions are on the back of the DA Form 12. (National Guard and Army Reserve units use the same method of request.)*

Regarding prepunching of the magazine, unfortunately this would add to our already strained budget. Also these holes would sometimes upset the interior layout of material. Bear with us and use your office perforator.

Sir:

While on a recent flight I had the unhappy experience of having to listen to a fellow Army Aviator, flying a L-26 twin-engine aircraft, monopolize a vital radio channel (and the time of an FAA radio station) for TEN continuous minutes in a most unnecessary and unprofessional manner.

Contacting Millville Radio at 1750Z, he explained that although he originally filed Ft Monmouth as a passenger stop, a passenger had been on the ground longer than expected, so he wanted to close the original flight plan as of 1640Z and open another VFR flight plan as of 1740Z, destination Cairns AAF; direct Anacostia, direct Raleigh-Durham, direct Cairns; 6:30 enroute; 5:00 fuel aboard; passenger stop at Anacostia and a fuel stop at Raleigh-Durham included in total time; 2,500 feet to Raleigh - Durham, 4,500 feet to Cairns, pilot 2 - 1; 3 persons aboard.

You can imagine the confusion and delays on the frequency as the pilot tried to get this maze of information across to the unprepared FAA operator. Reactions of those of us listening on the channel were varied. The situation was both embarrassing and dangerous. During the time the channel was tied up, at least two pilots were delayed in making routine position reports and one pilot tried to tell someone he had an emergency. A safer, more efficient method of filing is available to all aviators. The following special notice is listed in the 10 October 61 Airman's Guide:

FILE FLIGHT PLANS
BEFORE TAKEOFF

Pilots are urged to file VFR flight plans in person or by telephone prior to departure. Radio should be used for filing flight plans only when it is impossible to file in person or by telephone. This procedure is necessary in order to avoid congestion on the already busy air-ground communications channels. These channels should be reserved for essential inflight communications. All pilots will benefit by following this practice.

Radio should be the *last* resort, even if the other methods are not the most convenient or may be time consuming. If it is utilized, the aviator must realize that he is infringing on an already overcrowded channel.

As professional aviators we are expected to use the safest, most efficient methods available

in all operations. Let's file on the ground!

UNHAPPY PILOT

● *Verily*

Sir:

I am writing in response to your request for new articles to be published in the U. S. ARMY AVIATION DIGEST.

In reading the DIGEST, I am sure many of us pay particular attention to the TWX and Crash Sense articles, but this writer cannot help but think that, although many of these "Heads Up and Locked" situations are certainly a part of the human error factor, we in the Army aviation program must certainly have aviators, mechanics, tower operators and the like who have at one time or other committed deeds which have contributed greatly in the prevention of accidents or incidents, thereby placing these individuals in the "Heads Out and Unlocked" category.

Isn't it about time Army Aviation gave recognition to these individuals who have prevented or helped in the prevention of costly accidents? Are we becoming so one way in our thinking that only the bad things that have happened are printed? What about the aviator who lost his tail rotor with the general on board and then successfully executed a safe landing, thereby saving the aircraft, the pilot and a very valuable passenger? Doesn't he (the aviator) deserve a pat on the back?

The Navy and the Air Force, in one of their monthly publications, give recognition to personnel of their forces for acts as stated above. Let us do the same!

As a proposal I suggest a page be set aside each month in the DIGEST, under the title of "Congratulations to . . . . . ," or "AA Professionals," or any title you desire, but let's let these people be heard of.

PAUL W. FRANCE
Captain, TC
Office of the
Senior Transportation
Advisor, KMAG
APO 102,
San Francisco, Calif.

● *Giving such recognition is a problem. Accident and incident reports, ultimately funneled into the U. S. Army Board for Aviation Accident Research, form the basis for TWX and Crash Sense material.*

Unfortunately, there is no reporting system for accidents and incidents prevented. In obtaining such information we must rely on readers such as yourself, unit commanders and unit safety officers. Regretably, few such "well dones" are submitted.

Those that are received must be verified in some manner. Accident and incident reports can in most cases be accepted at face value since they report the detailed findings of an impartial investigation which works to prevent similar future occurrences. An account of a "well done," although written with the best motives, usually represents the view of one person, lacks completeness in detail, and cannot be easily verified for exactness.

In the past, some "well dones" received would have been embarrassing to the recipient, rather than complimentary, after all the facts were known. An excellently handled forced landing, for example, was found to be caused by failure to check the oil filler cap on preflight. Substantiated by a unit commander, operations officer, or unit safety officer, many worthy "well dones" could be published — if submitted.

Sir:

Your warning to crash rescue crews, page 42 of the April 1962 issue, is to the point.

May I suggest you further consider the effects of various head positions on the patency of the respiratory airway, in unconscious accident victims. Respiratory obstruction may be the cause of respiratory failure. Recovery, therefore, may be instituted more by the positioning for artificial respiration, than by its actual administration.

Too often an injured and unconscious person suffocates from the neglect of simple procedures which would have kept open his breathing channels, his airway. This may happen when the head of a seated casualty slumps, cutting off his wind by the compression of the structures in his bent neck. Soldiers trapped in vehicles, unconscious from a blow to the head and without serious injury, can still die from neglect of the maintenance of adequate airway during rescue operations. Or a face-up and unconscious victim chokes from the sucking into his lungs of vomitus, or has his throat blocked by loosened dentures, or closed by the falling back of slack mouth and throat structures. These things can happen even after correct immediate action has been taken, and an otherwise rescued man is left alone on a litter. It can happen if he is transported unattended and still unconscious, supine and face-up in an ambulance. The condition of DOA (dead on arrival) is then attributed to his wounds, rather than to the neglect of him. (ARMY Magazine, Mar 62, p 74.)

John B. De Hoff
Colonel, MC
92d Field Hospital
Fort Gordon, Georgia

THE CHINOOK

advanced battlefield mobility vehicle

Major John C. Geary

THE HC-1B Chinook, the newest addition to the Army Aviation inventory, arrived at Fort Rucker, Ala., on 7 July for service testing by the U. S. Army Aviation Board. Produced by the Vertol Division of the Boeing Company the Chinook is a tandem-rotor, twin-turbine powered medium transport helicopter. The Chinook's power is furnished by two Lycoming T55-L-5 free turbine engines which can develop up to 4,400 shaft horsepower. A rear ramp permits rapid straight-in loading and unloading of troops, vehicles, and cargo.

Although the fuselage is 1½ feet shorter than that of the H-21 Shawnee, the payload compartment (30 feet in length to the ramp hinge line) is 10 feet longer. Seats are provided for pilot, copilot, crewchief or troop commander, and 33 combat-equipped soldiers. With troop seats folded against the compartment walls, 24 standard pole-type litters can be accommodated. The unobstructed interior width is 7½ feet; height, 6½ feet. The payload compartment will accommodate each major component of the helicopter-transportable version of the Pershing missile system. Vehicles as large as the M37 ¾-ton cargo truck can be loaded internally.

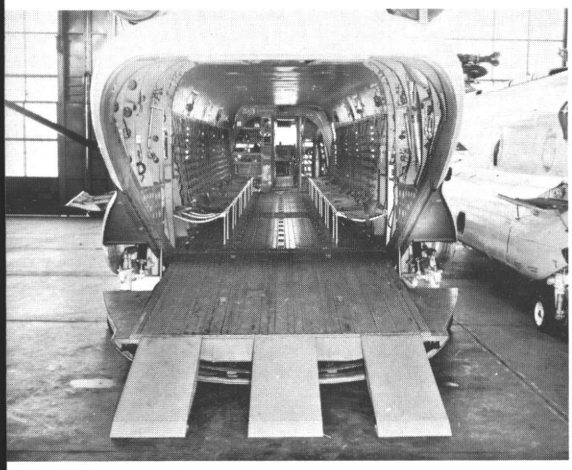
Maj Geary is Chinook project manager, U. S. Army Transportation Materiel Command.

The payload compartment floor is designed for individual wheel loads up to 2,500 pounds in the vehicle treadway area. The remainder of the floor is designed for concentrated loads of up to 1,000 pounds and evenly distributed loads of 200 pounds per square foot. The floor incorporates 87 flush tie-down rings of 5,000 pounds capacity each, plus 8 tie-downs of 10,000 pounds capacity. In addition, four 5,000-pound capacity rings are provided on the ramp.

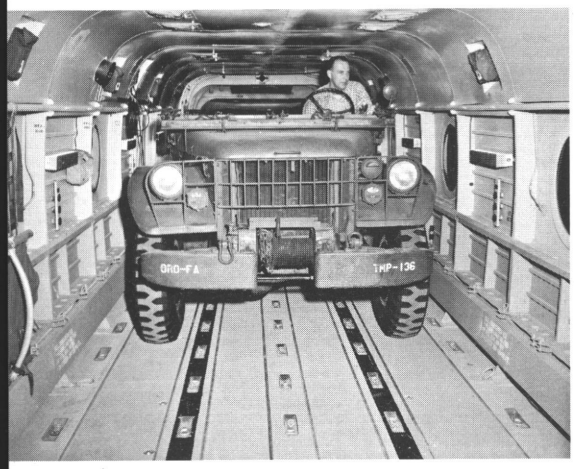
The hydraulically - operated ramp may be left partially or fully open, or may be removed entirely for extra-long cargo, such as pipe sections, antenna masts, etc. Three ramp extensions may be attached at any lateral position for loading vehicles of different wheel tread, and those (like the 106mm BAT rifle) that have a wheel on their centerline. The hatch which covers the upper portion of the rear opening slides into the ramp when the ramp is opened. Hydraulic power for operation of the ramp (and other hydraulically - actuated equipment) is available, even with the main engines and the auxiliary powerplant inoperative, from an accumulator. The accumulator is normally recharged in flight, but may also be recharged by operating the auxiliary power unit, or by using the integral hand pump which is located on the right side near the ramp control valve.

The Chinook has a capacity for 33 combat-equipped troops

Litter installation



Rear view showing payload compartment and tail plates



Onloading ¾-ton truck

Items too bulky to fit within the payload compartment can be transported on the 8-ton capacity external cargo hook. The hook assembly is stowed within a 3 by 3 foot hatchway located amidship between the payload compartment floor and the lower external skin. A one-piece trap door is hinged to lie flat against the floor forward of the hatchway. Since the crewman at the hatchway would normally station himself to the rear of the hatchway for a better view in the forward direction when approaching a load to be hooked up, the trap door, when opened, is out of his way.

The exterior skin panel, which covers the hatchway, is opened by manually turning a handle provided for this purpose. A parallelogram linkage moves this panel downward and rearward so that it rests flat against the belly of the fuselage to the rear of the hatchway when fully opened.

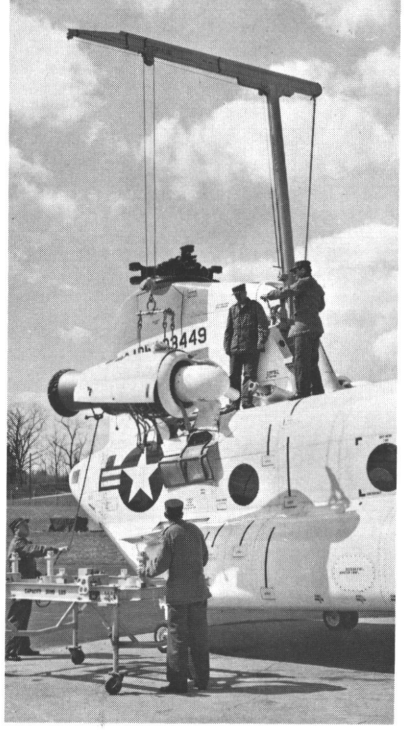
When the restraining strap is released, the external cargo hook swings downward into its operating position. The tongue of the hook is normally in the closed position, making it necessary to merely slip the ring attached to the load rigging past a spring-loaded keeper for hookup. It is not necessary to close the hook after placing the ring into position, as is the case with most hooks currently in use. Thus it is much easier for one crewman within the helicopter to snag the rigging ring with a "shepherd's crook" and place the ring within the throat of the hook, with no assistance from a crewman on the ground under the hovering helicopter. Safety harness, intercom station, and "shepherd's crook" are provided for the crewman adjacent to the hatchway.

The hook assembly is roller-mounted on a concave curved beam which is mounted laterally on trunnion fittings which attach to the subfloor structure. The rollers are free to move laterally on the concave curved supporting beam so that side-to-side swaying of the external load places no rolling moments on the helicopter for which the pilot would have to make lateral control corrections. Likewise the trunnion mounting of the beam provides fore-and-aft rotational freedom of motion to the hook assembly so that longitudinal swaying of the external load places no pitching moments on the helicopter. This arrangement greatly simplifies the pilot's task, particularly in turbulent air, and permits safe high-speed maneuvering with large external loads.

Cargo hook in stowed position

Normal load release is accomplished hydraulically. In the event of utility hydraulic system failure, release may be effected electrically or mechanically.

The Chinook has been referred to as a 2- to 3-ton payload helicopter. These payloads reflect two of the mission requirements in the specifications for the HC-1B, but do not give a complete picture of the Chinook's capability.



Rear engine repairs

Forward engine repairs

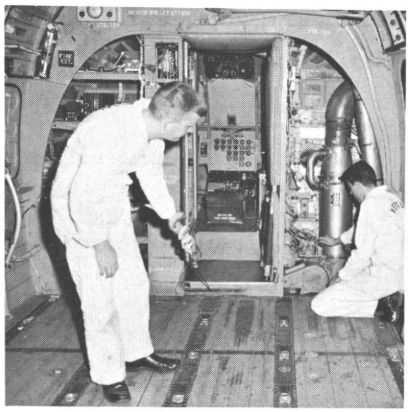
It is anticipated that when conditions limit the takeoff gross weight to that which permits hovering out of ground effect at 6,000 feet/95° F, the Chinook can lift a payload of approximately 2¼ tons with sufficient fuel aboard to fly out a distance of 100 nautical miles and return to the takeoff point without refueling.

If takeoff conditions are less severe, and the gross weight can be increased to that which permits hovering out of ground effect at 3,000 feet/100° F, then the Chinook can lift a payload of over 3 tons, again with sufficient fuel for a 100-nautical mile radius mission.

When ambient conditions permit increasing the takeoff gross weight up to the current maximum of 33,000 pounds, the Chinook can hover out of ground effect at elevations above 3,000 feet on a standard day. Under these conditions, payload exceeds 6 tons for the standard 100-nautical mile radius mission or over 7 tons if fuel is reduced to that required for a 20-nautical mile radius of operation. For ferrying (when the entire payload is auxiliary fuel), the Chinook will be able to fly, nonstop, a distance of approximately 1,050 nautical miles when equipped with an extended range kit.

If these payloads are carried externally, added drag is imposed which would increase fuel consumption and would reduce the distance capabilities cited above.

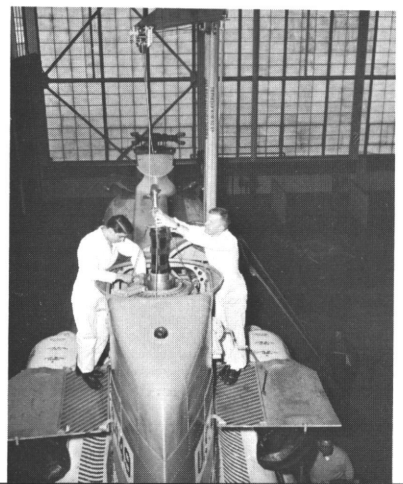
The Chinook incorporates features which enhance its ability to operate under instrument conditions and in light to moderate icing. These features include windshield defogging and deicing and engine air inlet anticing. Blades with fluid deicing are under development and are undergoing test on the rotor whirl tower at Wright-Patterson Air Force Base. The deicing system will be tested on No. 4 HC-1B currently operating in the climatic hangar at Eglin Air Force Base. Blades incorporating the deicing system will be introduced into production as soon as development testing is completed.



Electronic and heater compartments

Instrument flying in unstable aircraft is a difficult, exhausting task. Airplanes, which must always operate at speeds above stalling, can use aerodynamic forces to obtain stability. However, since helicopters must operate at very slow speeds where aerodynamic surfaces are ineffective, some other means of stability augmentation is required to obtain good instrument

Maintenance davit and walkway



Rear ramp elevated

flight capability. The stability augmentation systems (SAS), an integral part of the basic flight controls of the Chinook, provide positive dynamic stability about all axes at all forward speeds from hovering to max flight speed. This permits the pilot to execute coordinated turns without using the directional pedals, and to take both his hands and feet off the controls when it is necessary to divert his attention to navigation and communications.

The SAS obtains its intelligence from rate gyros and static pressure sensors. These intelligence signals are intensified by fully transistorized, miniaturized amplifiers and move hydraulically actuated extensible links in the flight control system in a manner which counteracts any tendency of the helicopter to depart from straight and level flight. Because these links are located on the output side of the irreversible lower boost actuators, all of the motion resulting from their increasing or decreasing in length is prevented from moving the cockpit controls and moves only the upper controls. Thus the pilot is subjected to no annoying control jittering and has no indication that minute control corrections are being fed constantly to the rotors. He senses only that the helicopter flies straight and level like a stable fixed-wing airplane.

The SAS has limited authority so the pilot can easily compensate for a malfunction which might result in a "hard-over" signal. However, the complete dualization of SAS and a self-centering failsafe feature make the occurrence of a hard-over signal very unlikely. A failure in one of the two completely independent systems results in the instant centering and locking of the extensible links of that system. The remaining system, which has sufficient capacity to perform the complete stabilizing function, then takes over the entire task.

As stated above, each of the two SAS is completely independent. Separate gyros, amplifiers, electronic circuitry, hydraulic power source and tubing systems, and duplicate extensible links are provided. Malfunction of either system has no adverse effect upon the stability of the helicopter.

The AN/ASW-12 Universal Flight Control System will be adapted to provide the automatic pilot functions of heading and altitude lock.

In the design of the Chinook, a major effort has been made to achieve minimum maintenance requirements and a lack of dependence upon elaborate ground support equipment. The tools from a standard Army aircraft mechanic's toolbox were displayed prominently on the wall of the Chinook project engineering department at Boeing-Vertol from the start of the project. This display constantly reminded designers that these were tools with which the aircraft must be maintained at operating activities.

Access panels have been provided for all components requiring periodic inspection. These panels are hinged or otherwise attached to the airframe to prevent their being dropped or blown away. Panels which must be opened frequently are equipped with quick-opening fasteners. Fluid levels can be inspected through sight gauges. There is no need to remove, wipe, check and replace several dipsticks.

The requirement for the daily purging of grease from scores of grease fittings has been eliminated on the Chinook. Bearings in the rotor hub assembly are all oil lubricated, and fluid levels are apparent by glancing at sight gauges. Upper control rod ends and bellcranks incorporate dry-lubricant bearings that require no greasing. By contrast, the H-21 Shawnee has 42 grease fittings on the hubs and upper controls that require daily purging.

Integral steps (large enough to accommodate arctic boots) and handholds, located fore and aft on the right side of the aircraft, permit mechanics to reach upper components without using supplemental work stands or ladders. Integral work stands are provided on each side of the helicopter at forward and rear rotor pylons and at convenient level for access to engine controls and accessories. A walkway along the crown of the fuselage allows inspection of the interconnecting drive shafting, control rods, fluid lines, and wire packs housed within the hinged tunnel covers. The walkway also permits maintenance personnel to move between the forward and aft rotor areas without climbing down to ground level at one end of the aircraft and back up at the other end.

Many components requiring periodic inspection are located at ground level: a.c. electrical system distribution center in the forward end of the right-hand pod; d.c. distribution center similarly located in the left-hand pod; the rear of the instrument panel through the nose access panels; forward and rear landing gear through suitably located access panels. Fuel servicing is also accomplished at ground level.

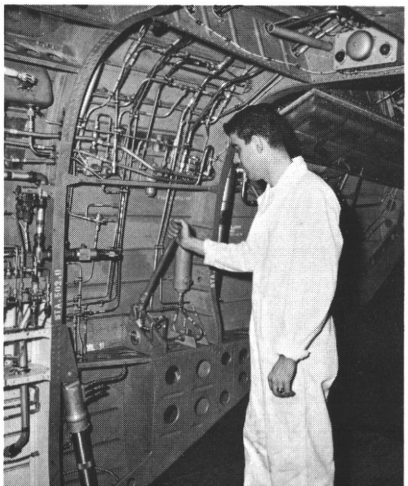
Communications equipment, lower controls, heater, utility winch, and external cargo hook are accessible from within the cargo compartment. No systems or components requiring periodic inspection are under the payload compartment floor or within the walls or ceiling.

The rear loading ramp provides a variable-height work platform which aids in maintenance and inspection of aft rotor transmission, the accessory gear box, and the auxiliary power plant (APP).

Provisions are incorporated in the Chinook for the installation of a hand-powered portable maintenance davit. This lifting device can be installed either forward or aft and used for replacement of engines, blades, hubs, upper controls, rear rotor vertical shaft, and all gear boxes except the rear rotor box (which is lowered onto a dolly, using two small hand hoists). The maintenance davit (probably to be allocated on the basis of one or two per HC-1B unit) eliminates requirements for overhead chain hoists or vehicular cranes for replacement of major components. Since the heaviest component of the davit weighs less than 300 pounds, it can be erected by a crew of four men. Moreover, if a Chinook is disabled in an inaccessible area due to blade damage, engine failure, or malfunction of any other component, a replacement assembly — along with a davit and repair crew — can be flown to the site in another aircraft.

The APP is a T62 gas turbine which drives a hydraulic motor pump. The APP is started by hydraulic pressure from an accumulator. If accumulator pressure is low (as might result from the helicopter standing idle for an extended period), pressure can be built up using the integral hand pump. Battery power is required only momentarily to provide ignition for the APP.

Operating accumulator pump



With the APP operating, its motor/pump functions as a pump providing 3,000 psi hydraulic power, which is used to drive a hydraulic motor mounted on the accessory gear box of the rear rotor transmission.

To check out the various hydraulic and electrical systems, instruments, and equipment before starting the main turbines or turning the rotors, hydraulic power provided by the APP can be used to drive the accessory gear box (AGB) portion of the rear rotor transmission through the hydraulic motor. An overriding clutch between the AGB and the powertrain gearing of the rear rotor transmission permits operation of accessories (i.e. alternators, flight control hydraulic system pumps, and utility hydraulic system pump) with the rotors and powertrain system held stationary by the rotor brake.

Hydraulic motors on the main turbines are capable of starting engines at any temperature down to minus 65° F without supplementary ground starting carts. Thus the problem of higher torque resulting from partially congealed oil coupled with reduced battery capacity at low temperature is eliminated. As with the APU, battery power is required only momentarily to provide ignition when starting the main turbine engines.

The drive system includes the two T55-L-5 turbine engines, right-angle gear box mounted on nose of each engine, high-speed drive shaft which connects each nose gear box to the combining transmission (mounted at the base of the leading edge of the rear pylon), interconnecting drive shafting that runs aft from the combining gear box to the aft rotor transmission and forward to the front rotor transmission, and these latter transmissions which drive each rotor hub assembly.

The drive system is designed to accept the full 4,400 horsepower developed by the two T55-L-5 engines at sea level on a standard day. This results in excess drive system capacity (and some weight penalty) when operating under conditions of elevated altitude and temperature, which reduce the power output of the engines. However, by providing drive system capacity equal to the maximum power output of the engines, the Chinook has impressive alternate gross weight capabilities, as is evident from the earlier discussion of its payload capacity under various conditions. Moreover, by designing initially for the full power of the engines, the Chinook is provided with a growth capability that can take advantage of the increased power that will probably be available from advanced engines.

The use of hydraulic power for various utility functions in the Chinook is without precedent in Army aircraft. Once the decision was made to employ hydraulic starting for the engines (for the reasons previously described), it became evident that the employment of hydraulic power for other functions involved minimum weight and maximum efficiency. For this reason, the utility hydraulic system is also used to power the rear loading ramp, the external cargo hook, the wheel brakes, the rotor brake, the centering lock on the swiveling rear wheels, and the utility winch.

The utility winch, located at the forward end of the payload

compartment, can be used to pull cargo or vehicles into the aircraft, to restrain wheeled items while they are being unloaded by gravity (the floor slopes 3° downward toward the rear), or for lowering and hoisting (personnel or loads weighing up to 600 pounds) through the floor hatchway. The hoist is provided with 150 feet of cable, a level wind, and a two-speed gear shift. When operating in the slow-speed position, speed is variable up to 20 feet per minute, and 3,000 pounds of cable tension is developed without multiple pulley sheaves. In the high-speed position, cable speed is variable up to 100 feet per minute, with up to 600 pounds of cable tension. Single-sheave pulley blocks are provided for attachment to floor tie-down rings so that the lateral location of the cable can be selected for rear ramp loading operations, or for attachment to overhead fittings when using the winch for hoisting or lowering through the hatchway.

Kits are programmed to take full advantage of the Chinook's versatility in performing a variety of missions, and to facilitate operations under various conditions, without incurring unnecessary weight penalties for permanent installation of items not required on all aircraft at all times. These include:

- winterization kit,
- ski kit,
- liquid cargo and extended range kit,
- litter kit,
- air-to-ground towing kit,
- bullet-sealing fuel cell kit,
- armament kit for suppressive fire,
- kneeling kit for rear landing gear,
- static electricity discharge.

The fuselage of the Chinook can be sealed during manufacture to provide an inherent flotation capability, permitting operation from water.

The liquid cargo kit will be designed to permit the Chinook to transport liquids efficiently, or — when filled with fuel — to extend the range of the helicopter by augmenting the 630 gallons fuel capacity of the integral tanks.

The external cargo hook is designed so it can be used for the towing of surface items when installed in a centerline position just forward of the ramp hinge line on the underside of the fuselage. The towing kit will include the fittings for attachment of the external cargo hook in this location and extensions for hydraulic, electrical, and manual release lines from the hatchway to the towing position.

The rear landing gear kneeling kit permits reducing the overall height of the helicopter from its normal 18 feet, 7 inches to less than 17 feet, to permit storage on the hangar deck of Thetis Bay class carriers.

The winterization kit includes thermal insulating blanket to reduce heat losses and enable the heating system to maintain a cabin and cockpit temperature of at least plus 40° F when the outside temperature is minus 65° F.

The bullet-sealing fuel cell kit is designed to provide protection to the lower portion of each tank against 7.62mm projectiles.

PROGRAM BACKGROUND

The Chinook program was initiated in the summer of 1958 when the U. S. Army requested the U. S. Air Force to conduct a source selection evaluation for a new medium transport helicopter. Five companies submitted management proposals, and in September 1958, the joint Army/Air Force evaluation team recommended to the U. S. Army that Vertol be selected to develop this aircraft.

The initial FY 59/60 contract included ten test and evaluation aircraft plus one static test article. In FY 1961, a second contract, which included 18 additional aircraft was negotiated, and a contract for 24 more aircraft was negotiated in FY 1962, bringing the total number of aircraft on order to 52.

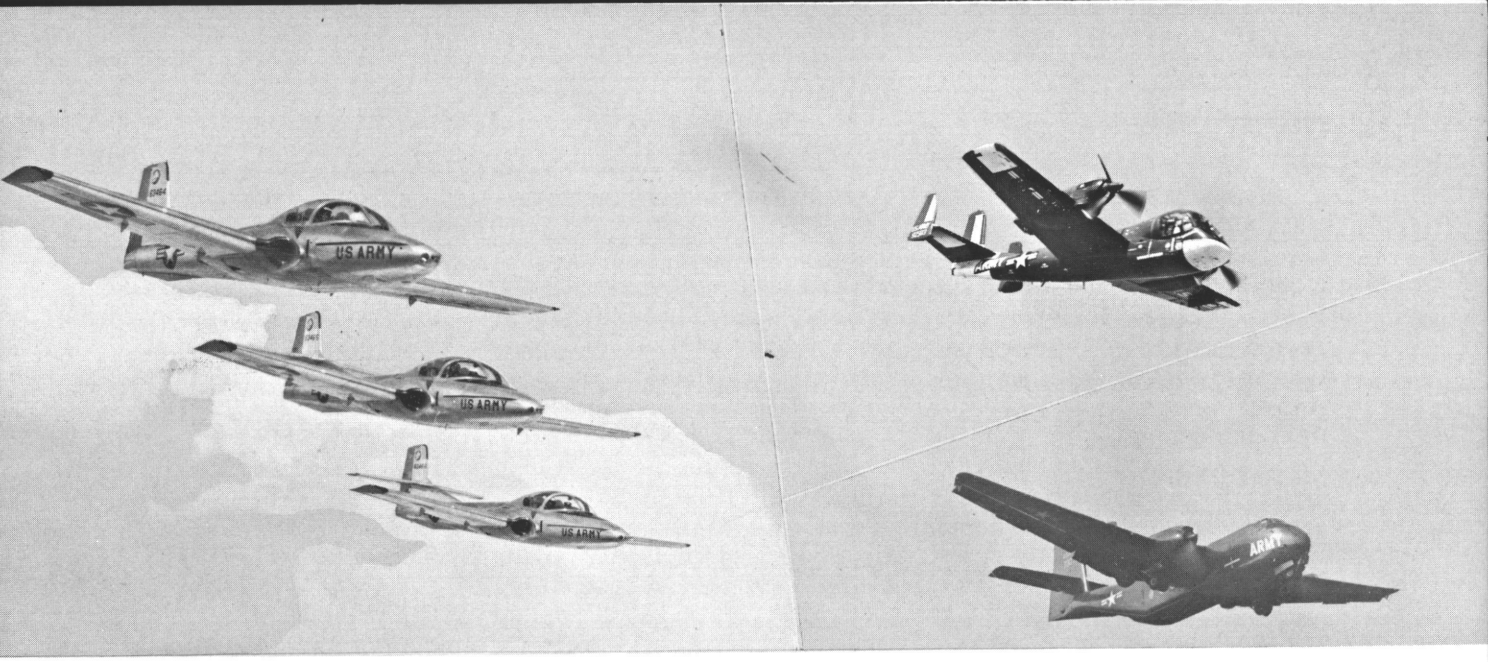
DEVELOPMENT STATUS

The No. 1 HC-1B made its first hovering flight in September 1961. The 150-hour development bench testing of the transmission and the 50-hour tie-down test program were successfully completed in December 1961. The static test article was flown from Philadelphia to Dayton via C-133A Cargomaster in April 1962. The No. 4 Chinook was ferried from Philadelphia to Eglin AFB in May, and climatic hangar testing was started in June.

The No. 8 Chinook is the first HC-1B to enter the U. S. Army user testing and evaluation by the United States Army Aviation Board at Fort Rucker, Ala. No. 10 will also be used in these tests, and will be delivered as soon as the USAF completes the preliminary pilot evaluation of the HC-1B early this fall. At that time No. 9 will be delivered to the U. S. Army Transportation Aviation Test and Support Activity at Fort Rucker for logistical test and evaluation.

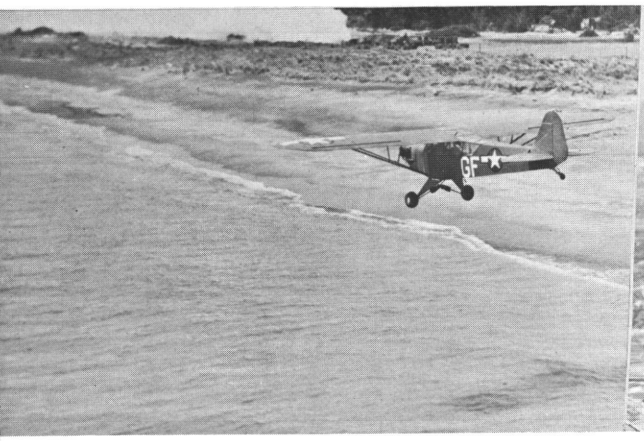
In early 1963, the first 28 Chinooks will have been completed and delivered to operating units. The remaining 23 are scheduled to be delivered during February through November 1963.

(See back page for comparison of HC-1B Chinook with H-21 Shawnee.)



THE ARMY AVIATION STORY

PART III
FIXED WING AIRCRAFT
M/SGT THOMAS M. LANG



THE QUALITY and capabilities of aircraft in the current Army inventory represent a distinct improvement over the hardware that was available the now-historic 6th of June 1942. Considerable progress has been made in both the aircraft and the tactics employed in their use.

If we are proud of the progress made, we may also consider recent engineering discoveries which might augur a new flight of birds possessing both appearance and capabilities we cannot now conceive.

In this issue fixed-wing aircraft will be presented. In later issues the rotary-wing and new experimental models will be reviewed. Then we will try to peek under the curtain to hazard a few guesses on characteristics of future aircraft.

In the early 1940s Stinson's L-1 was first designated an "observation" and then a "liaison" airplane by the Army Air Forces. It was cumbersome, required extensive maintenance, and was obviously impractical for artillery observation. At that time, Army Aviation was envisioned as being solely concerned with adjusting artillery fire. However, a need developed for the L-1 in the China-Burma-India theatre of operations during World War II. The L-1 had a powerful engine and was able to evacuate wounded over the

mountains in the CBI.

In 1941 the Army Ground Forces (AGF) evaluated L-2s, L-3s and L-4s for use as the Artillery's aerial observation plane. Taylorcraft's L-2s and Aeronca's L-3s were small, fabric-covered aircraft used primarily by the AGF for training. By October 1943, L-2s were being produced for the Army at the rate of 100 per month and L-3s at the rate of 50 per month. Contracts expired in early 1944 and were not renewed. Relatively few L-2s and L-3s ever saw overseas service.

Piper's L-4 was the principal combat airplane used by Army Aviation throughout World War II. It was a slightly modified, fabric-covered J-3 Piper Cub with the addition of more plexiglass for better observation.

The Army's first L-4 was accepted in early September 1941 and was given the Army Air Forces serial number AC-42-460. It had a six-volt transmitter and receiver as well as an antenna which could be reeled out and in. This airplane was shielded and bonded and had a wind-driven generator.

The L-5 Stinson had a more powerful engine than the L-4 and incorporated a litter-carrying capability in the B model. It was superior to the L-4 in many respects but, on the other hand, required more space for landing and taking off. Consequently, many AGF commanders opposed adopting it. However, by 1943 ground commanders were requiring the Artillery's light planes to perform many missions in addition to the adjustment of artillery fire. The L-4 was not able to satisfactorily accomplish such missions as medical evacuation, wire laying, and resupply. A need for the L-5 was thus realized, and it was first used in combat by the Army Ground Forces after the breakout at Anzio in 1943. It supplemented rather than replaced the L-4.

Based on combat experience, the AGF decided in 1945 that the desirable characteristics of an air OP plane should include:

- a built-in mount for Field Artillery radios;
- a built-in intercom system;
- a payload, fuel range, and cruising speed equivalent to the L-5 without reducing its ability to operate from small landing strips;
- maximum all-around visibility, including a reversible seat for the observer to permit observation from front and rear;
- landing and takeoff capabilities comparable to the L-1;
- maximum armor protection for pilot and observer without sacrificing characteristics mentioned above.

The AGF set out to obtain such an aircraft. In 1945 a competition was held, and six different models, including the L-5, were submitted by light aircraft manufacturers. Against the recommendation of the Director of Air Training at the Artillery School (who favored the L-5) Piper's L-14 was selected. This larger, four-place airplane failed to incorporate some features which would have made it desirable for Field Artillery aerial observation. Only five were obtained.

Following World War II, the AGF made another attempt to obtain a "super" airplane that would include all of the characteristics mentioned above. A design competition was held and Boeing won with its L-15, the first aircraft built according to strictly AGF specifications.

The L-15 failed to satisfy the AGF in field tests and the contract was terminated after only 10 were accepted. The AGF profited by its experience. It learned that no single airplane could incorporate all of the con-

The Army's first L-14

tradicting characteristics desired by AGF commanders.

The L-15 failure left the AGF with L-4s and L-5s that were rapidly wearing out. A new airplane was badly needed. Consequently a finished-article competition was held and all of the light airplane manufacturers entered. The competition was won by Aeronca with its L-16, one of the best bargains (moneywise) the Army ever got in an airplane. The L-16 was used extensively in training and did a good job for the AGF.

Meanwhile, as the need for command transportation by air became more evident, the need for a larger airplane was realized. Subordinate commanders reporting to higher headquarters needed to take their staffs with them, and use of the two-place airplane was obviously impractical. A finished-article competition was held in 1947 and Ryan's L-17 was selected, even though it had not been designed for use in a combat zone.

This off-the-shelf purchase of the L-17 was intended as an interim solution until another airplane, better suited for military purposes, could be obtained. However, later the L-17 far exceeded expectations in Korea, where it was used extensively for courier work as well as transportation of VIPs. (The L-20 and L-23 replaced the L-17 before the Korean War ended.)

Cessna's L-19 Bird Dog was the first all-metal high wing observation and reconnaissance airplane in the Army Aviation inventory. It was the result of a finished-article competition in 1950. The original contract for 420 L-19s was let in June 1950.

The Army's first Bird Dog, number 01327, was obtained on 20 December 1950. The airplane was used for training in the United States and in Korea. In Korea, it was used to transport President-elect Dwight D. Eisenhower on his tour of inspection in 1951. In March of 1958 this aircraft was retired to the Army Aviation School Museum at Fort Rucker, Ala.

The Army's first L-19

The L-19 first made its appearance at the front in Korea on 16 February 1951. It became the favored ship for reconnaissance and VIP transportation. It provided observers better visibility than its predecessors, and everyone found its heater made it more comfortable in which to fly. Everyone seemed to feel just a trifle safer in the all-metal plane.

Some pilots found the L-19 wanting in aerial photography missions. As one veteran pointed out, aerial photography in the L-19 "was all done on a makeshift basis. The mounts for the cameras were generally unsatisfactory due to poor stability or lack of proper sighting devices." Other pilots reported satisfactory results with the K-20 camera and later the K-24.

The L-20 Beaver was the result of a need for an L-17 replacement to be used to transport equipment, supplies, and troops near the front. It was selected in 1951 as a result of a finished-product competition with eight other airplanes, all of American manufacture.

The first L-20 Beaver obtained by the Army from deHavilland was number 16263. It was delivered to the Office of the Chief of Army Field Forces (now USCONARC) by Lt Col (now Colonel, retired) Jack L. Marinelli and Maj (now Colonel) John W. Oswalt in March of 1951. After tests were completed, the aircraft was used for training. Later it was assigned to the Transportation Aircraft Test and Support Activity (TATSA) at Fort Rucker, Ala., where it underwent logistical tests. On 7 April 1961 it was transferred to the Army War College, Carlisle Barracks, Pa.

Beech's L-23 Seminole was the first twin-engine airplane in the Army Aviation inventory. It first arrived in Korea on 1 December 1952. Its primary mission was the transportation of commanders and staff officers.

Of the several models in the L-23 series, the latest one—the F model—was first flown on 28 August 1958. It entered the

The Army's first T-37s

family of Army aircraft in February 1959.

On 14 March 1955 the Army accepted its first six U-1A Otters of an order for 90 from de Havilland. They were first used as supply aircraft by the Corps of Engineers, which was conducting topographic surveys in Alaska and the Caribbean.

This all-metal airplane is designed for rugged wear and simplicity of maintenance. With a standard seating arrangement it accommodates 9 passengers, or with wall seats it carries 14.

The T-37 is a Cessna jet aircraft which was never procured for general use by the Army. However, three were borrowed from the Air Force and used in a special project (Project LONG ARM) to determine the feasibility of using higher performance aircraft in the Army Aviation program.

The Army's need for a medium tactical transport has been partially filled by de Havilland's AC-1 Caribou. The first three Caribou, numbers 73079, 73080, and 73081 were accepted on 8 October 1959 and delivered on the 17th. Number 73079 was sent to Edwards AFB, Calif., for engineering evaluation; 73080 was given user tests by the United States Army Aviation Board, Fort Rucker; and 73081 was tested by TATSA, Fort Rucker. All three of these aircraft participated in a troop test at Fort Benning, Ga., from 16 April to 15 June 1961.

Caribou 73079 and 73080 were then reassigned to a special project. Caribou number 73081 was reassigned to the Airborne, Electronics and Special Warfare Board, Fort Bragg, N. C.

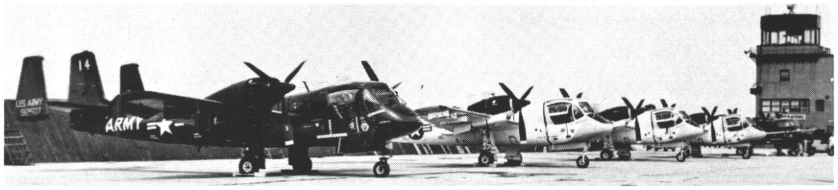
The first two production models of the Caribou were flown from the Downsview, Canada, plant to Fort Rucker early in 1961. Pilots were Capts Thomas H. Hurst and Ephraim A. Berry.

Grumman's AO-1 Mohawk was the result of a design competition for a medium observation aircraft.

On 16 September 1960 two AO-1A Mohawks (numbers 92612 and 92616) were delivered

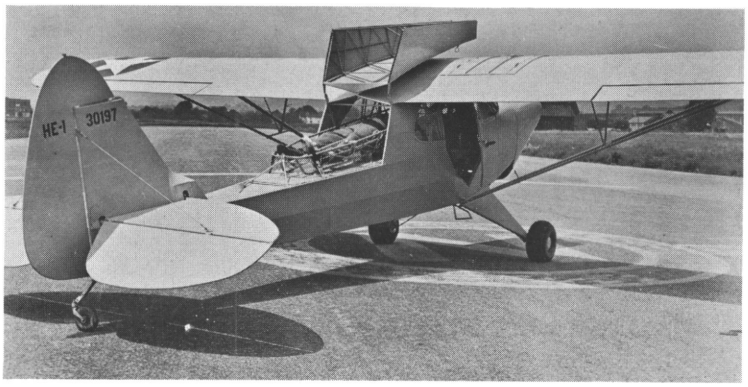
Shown above are the first three Caribous to be delivered to the U. S. Army during a demonstration that preceded the acceptance ceremony on 8 October 1959 at the de Havilland plant.

Shown below are the first 5 Mohawks, 3 YAO models flanked by 2 AO-1AF models at Bethpage, N. Y., in July 1960. Production on the Mohawk, the Army's heaviest fixed-wing aircraft (9,028 pounds empty weight for AO-1AF), began in 1958. The aircraft made its first flight 14 April 1959.



to the U. S. Army Aviation Board, Fort Rucker, for user tests. Mohawk 92612 was flown by Maj Albert Drane and Mr. Joe Givens; Mohawk 92616 was flown by Maj June Stebbins and Capt Al Smith. On completion of the testing, they were transferred to the U. S. Army Aviation School, Fort Rucker, where they are still used in training.

The AO-1B differs from the AO-1A in that it is equipped with side-looking airborne radar (SLAR). The first of these was delivered to the Army on 16 April 1961. The AO-1C is equipped with infrared mapping equipment instead of SLAR. The first C model was obtained in October 1961.



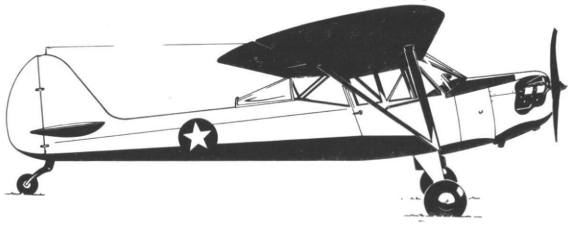
An L-4 converted to serve as an ambulance. In June 1943 at Fort Sill, Okla., Maj Victor E. Frazier installed a trapdoor and litter behind the pilot's seat. This was the only one so modified and the advent of the L-5B obviated the need. At Bougainville L-4s were similarly modified during World War II and later used extensively in the Philippines.

Fixed Wing Aircraft

L-1 *Vigilant*—Vultee-Stinson, two-place (pilot and observer). Observation, reconnaissance, and medical evacuation. Models ranging through F were obtained by the Army Air Forces. This aircraft was formerly designated 0-49. All models were powered by a 295 hp Lycoming engine (R-680-9).

Model	*Total Obtained*	*FY First Obtained*	*Notes*
L-1	142	1942	
L-1A	182	1942	
L-1B	3	1942	Ambulance aircraft.
L-1C	1	1943	L-1A converted for use as ambulance aircraft with one litter.
L-1D	21	1943	L-1A converted for familiarization in glider training.
L-1E	2	1943	L-1 converted for use as amphibious ambulance.
L-1F	1	1943	L-1A converted for use as amphibious ambulance.

L-2 *Grasshopper*—Taylorcraft, two-place (pilot and observer). Observation and reconnaissance. Models range through M (excluding I). The Army Ground Forces and Air Forces both used the L-2. This aircraft was formerly designated 0-57. All models had a 65 hp engine except the L, which was 50 hp.



Model	*Total Obtained*	*FY First Obtained*	*Notes*
L-2	74	1942	Tandem seating; Continental engine (0-170-3).
L-2A	476	1942	Tandem seating; Continental engine (0-170-3).

L-2B	490	1943	Tandem seating; Continental engine (0-170-3).
L-2C	1	1942	Tandem seating; commercially designated DC-65; Continental engine (A-65-8).
L-2D	1	1942	Tandem seating; commercially designated DL-65; Lycoming engine (0-145-B2).
L-2E	1	1942	Tandem seating; commercially designated DF-65; Franklin engine (4AC-150).
L-2F	1	1942	Side-by-side seating; commercially designated BL-65, formerly UC-95; Lycoming engine (0-145-B1).
L-2G	1	1942	Tandem seating; commercially designated BFT-65; Franklin engine (4AC-150).
L-2H	1	1942	Side-by-side seating; commercially designated BC-12-65; Continental engine (A-65-7).
L-2J	1	1942	Side-by-side seating; commercially designated BL-12-65; Lycoming engine (0-145-B1).
L-2K	1	1942	Side-by-side seating; commercially designated BF-12-65; Franklin engine (4AC-150).
L-2L	1	1942	Side-by-side seating; commercially designated BF-50; Franklin engine (4AC-150).
L-2M	900	1943	Tandem seating; Continental engine (0-170-3). Modified L-2A with the addition of spin strips.

L-3 *Grasshopper*—Aeronca, two-place (pilot and observer). Observation and reconnaissance. Military version of commercial Aeronca "Challenger." Models range through J (excluding I). The Army Ground Forces and Army Air Forces both used the L-3. This aircraft was formerly designated 0-58. All engines were 65 hp.

Model	*Total Obtained*	*FY First Obtained*	*Notes*
L-3	54	1942	Tandem seating; Continental engine (0-170-3).
L-3A	20	1942	Tandem seating; Continental engine (0-170-3); fuselage 4 inches wider than L-3.
L-3B	875	1942	Tandem seating; Continental engine (0-170-3).
L-3C	490	1943	Same as L-3B except that radio equipment was omitted; Continental engine (0-170-3).
L-3D	10	1942	Tandem seating; commercially designated 65-TF; Franklin engine (4AC-176).
L-3E	10	1942	Tandem seating; commercially designated 65-TC; Continental engine (A-65-8).
L-3F	1	1942	Side-by-side seating; commercially designated 65-CA; Continental engine (A-65-8).
L-3G	2	1942	Side-by-side seating; commercially designated 65-LB; Lycoming engine (0-145-B1).
L-3H	1	1942	Tandem seating; commercially designated 65-TL; Lycoming engine (0-145-B1).
L-3J	2	1942	Tandem seating; commercially designated 65-TC; Continental engine (A-65-7).

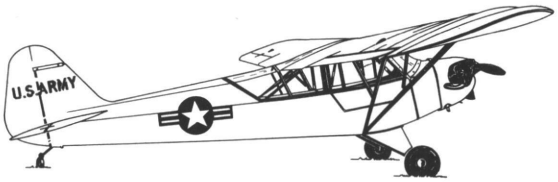
Attention U.S.C. Grads

The Director of Army Aviation is establishing an IBM card file for graduates of the Army Aviation Safety Course at the University of Southern California. The file will be maintained by the U. S. Army Board for Aviation Accident Research, Fort Rucker. Help keep it up to date and accurate by forwarding each change of address and duty assignment to:

Director
USABAAR
Attn: Data Processing Section
Fort Rucker, Alabama

L-4 *Grasshopper*—Piper, two-place (pilot and observer, except for F and G model). Observation and reconnaissance.

Models range through J (excluding I). All have tandem seating except those indicated below. The Army obtained 5,671 of the L-4 series. Records at Piper Aircraft Corporation indicate that between 1942 and 1945 there were 5,424 L-4s produced for the Army. However, Piper did not consider some models of its J series as L-4s while the Army did. The L-4 was formerly designated 0-59. The civilian nickname was "Cub."



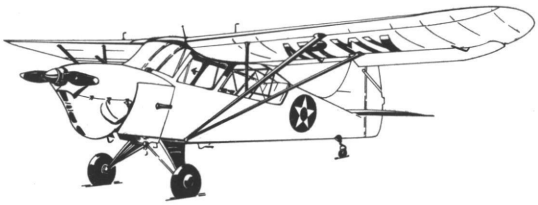
Model	*Total Obtained*	*FY First Obtained*	*Notes*
L-4	144	1942	Commercially designated J3; 65 hp Continental engine (0-170-3).
L-4A	948	1942	Commercially designated J3C-65; 65 hp Continental engine (0-170-3).
L-4B	981	1943	Same as L-4A except radio omitted.
L-4C	10	1942	Commercially designated J3L-65; 65 hp Lycoming engine (0-145-B1).
L-4D	5	1942	Commercially designated J3F-65; 65 hp Franklin engine (4AC-176).
L-4E	16	1942	Two-place, side-by-side; commercially designated J4E; used for pre-glider training; 75 hp Continental engine (A-75-9).
L-4F	45	1942	Three-place, one in front and two in back. Commercially designated J5A; used for pre-glider training; 75 hp Continental engine (A-75-9).
L-4G	41	1942	Same seating as L-4F; commercially designated J5B; used for pre-glider training; 100 hp Lycoming engine (GO-145-C2).
L-4H	1,801	1943	Improved L-4B with a fixed-pitch propeller. 65 hp Lycoming engine (0-170-3).
L-4J	1,680	1945	Same as L-4H except for controllable-pitch propeller.

L-5 *Sentinel*—Vultee-Stinson, two-place (pilot and observer). Observation, reconnaissance and medical evacuation.

Models range through G (excluding D, which was designed but cancelled prior to production). All have tandem seating. This aircraft was formerly designated 0-62. The Army Ground Forces began using L-5s in 1943. All were powered with the 185 hp Lycoming engine except the G model which was 190 hp. Models A through E had engine 0-435-1; model F had 0-435-2, and model G had 0-435-11.

Model	*Total Obtained*	*FY First Obtained*	*Notes*
L-5	1,731	1942	Used by AAF and U. S. Navy.
L-5A	688	1942	Remodeled L-5 with 24-volt electrical system.
L-5B	679	1943	Modified to incorporate litter or cargo carrying capability.
L-5C	200	1944	Modified for K-20 camera and litter.
L-5E	558	1944	Same as L-5C except for drooping ailerons.
XL-5F	1	1944	Altered L-5B with a reworked engine.
L-5G	115	1945	Improved L-5E.

L-6—Interstate, two-place (pilot and observer). Observation and reconnaissance. Procured for use by the Army Air Forces, this tandem-seated aircraft was formerly designated 0-63.



Model	*Total Obtained*	*FY First Obtained*	*Notes*
XL-6	1	1942	Commercially designated S-1B Cadet; 100 hp Franklin engine (XO-200-5).
L-6	250	1943	Commercially designated S-1B[1] Cadet; 102 hp Franklin engine (0-200-5).

L-7A—Universal. These were two-place aircraft. Nineteen were obtained in FY 1943 and sent to France. Each used a 90 hp Franklin engine (0-200-1).

Drawings of these six aircraft unavailable.

L-8A—Interstate. These were two-place aircraft commercially designated S-1A Cadet. Eight were obtained for Bolivia. Each used a 65 hp Continental engine (0-170-3).

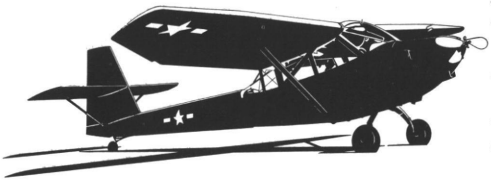
L-9—Stinson. These were three-place aircraft. Eight L-9As and 12 L-9Bs were purchased for the British Navy in FY 1942. The L-9A was commercially designated the AT-19-A Voyager, and the B model was designated 10-A. Both models used a 90 hp Franklin engine. The A model's engine was 0-200-1 and the B's 4AC-199-E3.

L-10—Ryan. This was a three-place aircraft commercially designated SCW (1937). One was leased by the military for a special project in FY 1942. It had a 145 hp Warner engine (50-499).

L-11—Bellanca. This was a six-place aircraft commercially designated 31-50. One was leased by the military in FY 1942. It had a 600 hp Pratt and Whitney engine (R-1340-41).

L-12—Stinson. These were four-place aircraft.

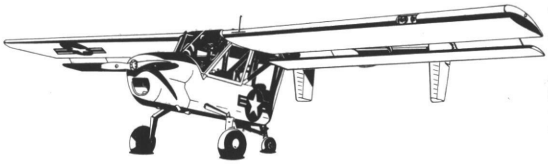
Two L-12s and two L-12As were obtained in FY 1944 by the Army Air Forces for use as trainers. The L-12 was commercially designated SR-5A and the A model, SM-7B. The L-12 used a 300 hp Lycoming engine (R-680-9) and the A model a 300 hp Pratt and Whitney engine (R-985-A).



L-13—Consolidated-Vultee, three-place (pilot and two litters or two passengers).

The Army Ground Forces tested two of these aircraft in 1945 but did not accept them then. Later they were obtained by the AGF; the most ever carried on the Army Aviation inventory were 43 in June 1951. Each was equipped with a 245 hp Franklin engine (XO-425-5).

L-14—Piper, four-place (pilot, observer and two passengers). Utility. The Army Ground Forces obtained five of these aircraft in FY 1945-6. Each had a 130 hp Lycoming engine (0-290-3).



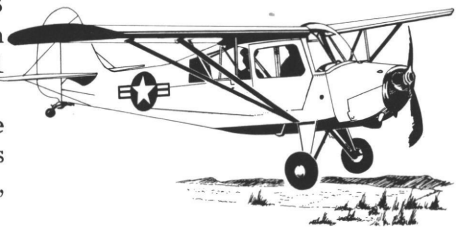
L-15 *Scout*—Boeing, two-place (pilot and observer). Observation and reconnaissance.

The Army obtained 10 of these tandem-seated aircraft in 1949 for service tests only. Eventually they were transferred to the Alaskan Forestry Service. Each had a 125 hp Lycoming engine (0-290-7).

L-16—Aeronca, two-place (pilot and observer). Observation and reconnaissance.

The L-16A was first obtained by the Army in FY 1947 and the B in FY 1948. The most L-16As ever carried on the Army Aviation inventory were 742 on 30 June 1949. The most B models were 61 on 30 June 1948.

A few L-16As were sent to the Pacific in 1950, but most were transferred to the Civil Air Patrol between 1952-4. The L-16Bs were used for pilot training. Both models had Continental engines, the A (0-190-1) being 85 hp and the B (0-205-1) 90 hp.

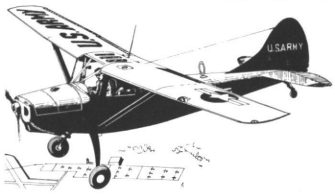


L-17 *Navion*—North American built the L-17A, and Ryan the B. Ryan modified the A and it was redesigned the L-17C. Four-place (pilot and three passengers). Utility.

The L-17As were first obtained by the Army in FY 1947, and the Bs and Cs in FY 1949. The most L-17As ever carried on the Army Aviation inventory were 42 on 30 June 1951. The most B models were 196 on 31 December 1949, and the most C models were 35 on 30 June 1949. These airplanes were used Army-wide until 1957 when they were transferred to flying clubs. All models had Continental engines (0-470-7), but the A model engine was 185 hp, while the B and C engines were 205 hp.

No drawing available.

L-18—Piper, two-place (pilot and observer). Observation and reconnaissance. The first of these aircraft were obtained by the Army in FY 1949. All together the Army obtained 105 B models and 938 C models, most of which were purchased for Turkey. Those not shipped were turned over to Army flying clubs. Both the L-18B and L-18C had 90 hp Continental engines (0-205-1).



L-19 *Bird Dog*—Cessna, two-place (pilot and observer). Observation and reconnaissance. The first of these tandem-seated aircraft were obtained by the Army in late 1950 and early 1951.

Model	*Most Ever Carried On AA Inventory*	*FY First Obtained*	*Notes*
L-19A	1,930 in December 53	1950	Uses 213 hp Continental engine (0-470-11).
TL-19D	306 in December 58	1956	Uses 213 hp Continental engine (0-470-15).
L-19E	326 in December 57	1956	Uses same engine as A model.

As of 31 January 1962 the Army Aviation inventory carried 1,162 L-19As, 299 TL-19Ds, and 266 L-19Es.

L-20 *Beaver*—de Havilland, six-place (pilot, copilot, and four passengers). Utility. The first of these aircraft were obtained by the Army in the summer of 1951. As of 31 January 1962 the Army Aviation inventory included 641 L-20As. Commercially designated DHC-2, this aircraft has a 450 hp Pratt and Whitney engine (985-AN-14B).

L-21 *Super Cub*—Piper, two-place (pilot and observer). Observation and reconnaissance.

The first of these aircraft were obtained by the Army in FY 1952. The most L-21s ever carried on the Army Aviation inventory were 150 A models on 31 December 1951 and 69 B models on 31 December 1953.

The L-21A was used primarily for training and the B was used extensively in the Far East. The L-21A was dropped from the inventory by 31 December 1952 and the B was dropped by 31 December 1954. Both models had 135 hp Lycoming engines (0-290-11).

No drawing available.

L-22 *Super Navion*—Ryan. These were four-place aircraft. Three were obtained by the Army and subsequently designated XL-17D. Each used a 260 hp Lycoming engine (GO-435).

L-23 *Seminole*—Beech, six-place (pilot and five passengers). Utility. The first of these aircraft were obtained by the Army in January 1952.

Model	*Most Ever Carried On AA Inventory*	*FY First Obtained*	*Notes*
YL-23	1 in December 57	1957	Did not appear on AA inventory after December 1957.
L-23A	57 in December 56	1952	Uses two, 260 hp Lycoming engines (0-435-17). None appeared on inventory after December 1959.
L-23B	40 in June 56	1956	Uses same engines as A model; uses metal props instead of wood props. None appear on inventory after December 1959.
L-23C	1 in June 62	1962	Obtained from Air Force for use in special project; uses same engines as A model.
L-23D	168 in June 60	1957	Uses two 320 hp Lycoming engines (0-480-1)
RL-23D	31 in January 62	1959	Radar installed; uses same engines as L-23D.
L-23E	6 in June 56	1956	Uses two 340 hp Lycoming engines (GO-480-C2C6 or GO-480-C2D6).
L-23F	24 in January 62	1959	Uses two 340 hp Lycoming engines (IGSO-480-A1A6 or 0-480-3).

As of 31 January 1962 the Army Aviation inventory carried 149 L-23Ds, 4 L-23Es, 24 L-23Fs, and 31 RL-23Ds.

L-24 *Courier*—Helio. This was a four-place observation and reconnaissance aircraft. One was obtained by the Army in 1952. It was commercially designated H-391. It had a 260 hp Lycoming engine (0-435-17).

L-25 See XV-1, *The Army Aviation Story, Part IV*, next month.

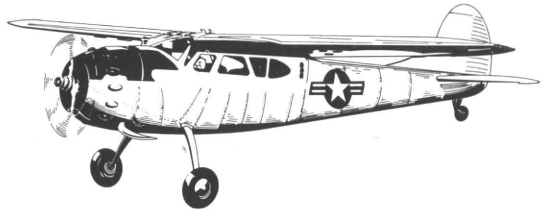
L-26 *Aero Commander*—Aero Design and Engineering Co. Five-place (pilot, copilot and three passengers). Utility.

Models used by the Army range through D, excluding A.

Model	*Most Ever Carried On AA Inventory*	*FY First Obtained*	*Notes*
YL-26	7 in June 54	1953	Commercially designated 520; used two 260 hp Lycoming engines (GO-435-C2B1). None on Army Aviation inventory after June 1957.
L-26B	1 in January 62	1957	Commercially designated 560A; uses two 270 hp Lycoming engines (GO-480-1).

L-26C	4 in January 62	1956	Commercially designated 680; uses two 320 hp Lycoming engines (GSO-480-B1A6).
L-26D	3 in June 58	1958	Modified L-26C; used same engine; none on Army Aviation inventory after December 1959.
RL-26	5 in June 60	1959	L-26D converted to carry SLAR. Uses same engine as L-26D.

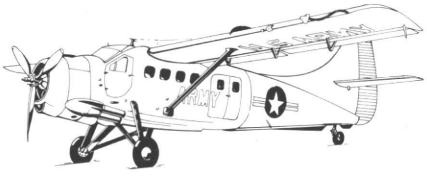
As of 31 January 1962 the Army Aviation inventory carried one L-26B, four L-26Cs, and four RL-26s.



LC-126—Cessna. Four-place (pilot and three passengers). Utility.

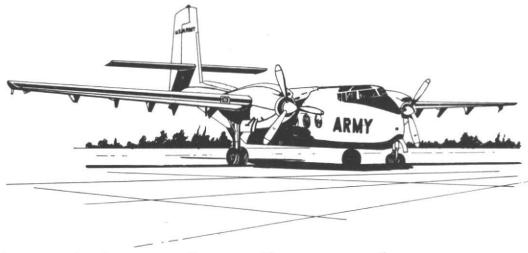
The first of these aircraft were C models procured by the Army late in 1950. The most LC-126As ever carried on the Army Aviation inventory were eight between 31 December 1953 and 31 March 1957, when they were converted to C models. The most LC-126Bs were five between 31 March 1952 and through 30 June 1958. The most LC-126Cs were 64 on 31 December 1961.

The LC-126 series was used primarily as instrument trainers. Each aircraft has a 300 hp Jacobs engine (R-755-2).



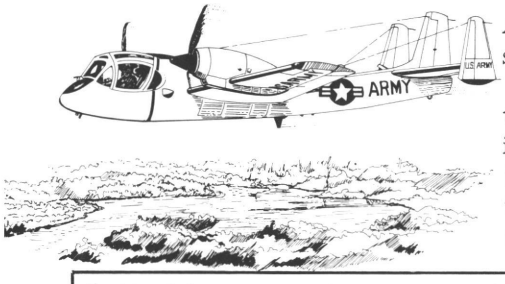
U-1A *Otter*—de Havilland, 11-place (pilot, copilot and 9 passengers, or 2,000 pounds cargo). Light Tactical Transport (LTT).

The first of these aircraft were obtained by the Army in March 1955. As of 31 January 1962 the Army Aviation inventory included 170 U-1As. They are commercially designated DHC-3. Each aircraft has a Pratt and Whitney 600 hp engine (R-1340-59).



AC-1 *Caribou*—de Havilland (pilot, copilot, and 32 passengers, or 24 combat-equipped troops, or 14 litters and 8 troops). Medium Tactical Transport (MTT).

The first of these aircraft were obtained by the Army in October 1959. As of 31 January 1962 the Army Aviation inventory included 25 of these STOL airplanes. These are commercially designated DHC-4. Each aircraft has two 1450 hp Pratt and Whitney engines (R-2000-13).



AO-1 *Mohawk*—Grumman two-place (pilot and copilot or observer seated side by side). Medium Observation Aircraft (MOA).

The first of these aircraft were obtained by the Army on 16 September 1960. As of 31 January 1962 the Army Aviation inventory included 40 AO-1As, 17 AO-1Bs, and 27 AO-1Cs. All models have two 960 hp Lycoming T-53-L3 turboprop engines of the free turbine type. Current plans call for installation of a 1100 hp T-53-L7 engine in the B model shortly after the first of the year.

L-28—This aircraft is commercially designated the Helio "Courier" H-395. It is not in the Army inventory, but is used by the Air Force. The Army had obtained an earlier test model of the Helio Courier which was designated YL-24.

T-37A—Cessna, two-place, side-by-side trainer.

The Air Force loaned three T-37A jets to the Army in 1959 for use in Project LONG ARM (see story). The T-37A uses a 920 hp Jacobs engine (J69-T-9).

The Army Aviation Story, Part IV, Rotary Wing Aircraft, continues next month.

When personnel suffer from psychic fixation, the "cure" is sometimes as shocking and surprising as the cause!

Fixation

Pierce L. Wiggin

HUNCHED INTO a far corner, his thin frame lost in a shapeless gray bathrobe, the old man kicked his right leg out and shoved his bony fists forward. His head moved slowly from side to side as he drew his leg back and let his arms fall. He sobbed hopelessly, twitched, and went through the same motions again. During the three days since his admission he had not moved from the corner, and the jerky spasms were repeated, night and day, with the regularity of a metronome. His tortured eyes burned unseeing through all who approached him. He paid no heed to the screams and cackles of his wardmates; nor did he notice the sound of approaching footsteps.

Their freshly-starched white uniforms rustled as the resident and floor nurse marched briskly through the ward. They slowed their pace as they approached the old man's corner. The resident stopped and watched him go through a cycle. He cupped his chin in his hand, stared at the old man and spoke softly to the nurse: "Has he shown any signs of awareness?"

"No, sir. Three attendants tried to force-feed him this morning, but they couldn't hold him still long enough." Her eyes moved to the patient. "I just don't see how he keeps it up. He hasn't eaten a bite since he came."

"Let me have his chart, please."

The nurse shuffled through the stack of folders she carried, selected one and passed it to the resident. "I'm afraid it won't help much, Doctor Youngblood. The referring physician gave us very little information."

Doctor Youngblood opened the folder and read: "Name: Jackson T. Fullsweat. Age: 35. Preliminary diagnosis: Psychic fixation; cause undeterminded. Background information: Unknown."

He closed the folder and re-

turned his eyes to the patient. "Has anyone tried sedation?"

"Yes, sir. But it doesn't appear to affect him in the least."

"Electric shock?"

"Twice. Yesterday and again this morning. No effect."

"Pentothal?"

"No. Doctor Baldome wanted you to have a look at him first."

"Thanks, nurse. I'll go and have a talk with him now. We'll complete our rounds later." He returned the folder to her and paced back through the ward.

A uniformed guard at the end of the hall opened the heavy steel door and allowed the resident to pass through. Doctor Youngblood hurried along a row of glass-faced doors and stopped at the office of the chief psychiatrist. He opened the door and entered.

Doctor Baldome, a stout, red-faced man was seated at his desk leafing through a massive volume, staring at the pages through thick glasses that magnified his blue eyes. He looked up as the resident approached his desk.

"Doctor Baldome, about the new patient on ward six—"

"You mean the twitcher?"

"Yes. His record indicates he's only 35, but he looks at least 70. That man is suffering some constant, unbearably horrible experience!"

"What do you propose, doctor?"

"I'd like to try sodium pentothal to see if we can dig out the cause."

"Very well. I'll make the arrangements. Meet me there after lunch."

"Thank you, sir."

Doctor Youngblood returned to the wards, completed his rounds and ate a hurried lunch in the staff cafeteria. When he arrived back at ward six, he found Fullsweat strapped to his bed, with the senior nurse and Doctor Baldome in attendance. The patient's face streamed perspiration as he strained against the straps, sobbing and moaning.

At a nod from his chief, Doctor Youngblood took a hypodermic needle from the nurse and moved to the bedside. He swabbed the inside of Fullsweat's elbow and felt the heavy vein rise as the arm muscles contracted. Swiftly, he inserted the needle and began to press the plunger.

He watched the patient and when Fullsweat's eyes closed, he stopped the injection and spoke: "Mister Fullsweat, open your eyes!"

Fullsweat had stopped straining. He opened his eyes and looked up at the doctor.

"Mister Fullsweat, can you hear me?"

"Yes."

"Do you know where you are?"

"No."

"Where did you come from?"

"South Alabama."

"Are you married?"

"Yes."

"Happily?"

"No. My wife left me."

"Why did she leave you, Mister Fullsweat?"

"Said I was too wrapped up in my work to pay any attention to her."

"What kind of work do you do?"

"I'm a flight instructor."

"Do you like your work?"

Fullsweat quivered and failed to answer.

"Has there been anything in your work to upset you?"

"Lieutenant Bhankover!"

"What about Lieutenant Bhankover?"

"Told him about steep turns near the ground. Demonstrated and practiced them again and again. Told him about dividing his attention. Told him it was necessary to fly the aircraft, check his ground track, and be alert for other aircraft. Told him about coordination, and made him practice it over and over, so he wouldn't look at something on the ground and keep shoving the inside rudder. Took him up high and showed him what would happen if he stalled the aircraft with that rudder jammed in!"

"I see. And what did Lieutenant Bhankover do?"

"Graduated and joined a unit. Got sent out to drop flour sacks and simulate bombing runs on ground troops. He pulled the 19 up from his first run, went into a steep turn while watching the ground troops, stalled and crashed!"

Fullsweat began to tremble and Doctor Youngblood pressed the hypodermic needle further. "Were there any others like Lieutenant Bhankover, Mister Fullsweat?"

"Lieutenant Haulbeck!"

"What about Lieutenant Haulbeck?"

"Taught him everything I did Bhankover. Showed him how increasing the bank angle increases the stalling speed. Showed him how much altitude you lose from a stall caused by too much back pressure in a steep turn!"

"Yes. And what happened to Lieutenant Haulbeck?"

"Same thing as Bhankover. He dropped his flour sacks, racked it into a steep turn to get back around for another pass, pulled too much back pressure, stalled and crashed!"

"Were those the only two?"

"No! Lieutenant Throttler!" Fullsweat's eyes rolled back and he sobbed.

Doctor Youngblood gave him more pentothal. "What about Lieutenant Throttler?"

"Taught him everything I did the other two. Showed him how much altitude you lose in a steep turn with no power. Showed him how the 19 would snap over if you stalled in a steep turn and shoved the throttle open. Didn't do any good! He was circling another aircraft on the ground, planning to land. Cut his power, set up a base leg, started overshooting the turn to final and steepened up his bank. He stalled, shoved the throttle open, snapped over and crashed!"

"I see. Were there any more, Mister Fullsweat?"

"Lieutenant Stallspaughn! Demonstrated and practiced downwind takeoffs with him. Showed him how the wind could fool you into thinking you had plenty of flying speed. Showed him how you could start a turn under those conditions and stall when it looked like you had more than enough speed. Told him it was important not to raise the nose when this happened. Didn't do a speck of good! He made a downwind takeoff toward some hills. Must have thought he had plenty of speed and raised the nose. He started a turn, stalled, and spun in from 300 feet!"

Fullsweat began to shake violently. He gnashed his teeth together and groaned. Doctor Youngblood pressed the plunger and got him quiet once more. He felt Doctor Baldome's hand on his arm and turned.

"I think that's enough for this session. Let's give him a rest."

"Yes sir." Doctor Youngblood withdrew the needle, passed it to the nurse, and followed Doctor Baldome through the ward. The two walked through the hall together.

"Doctor Youngblood, what would you prescribe for Fullsweat?"

"To be frank, doctor, I don't know. I've never seen such a deep rooted fixation before. What do you suggest?"

"We had a similar case several years ago — a young surgeon. He'd lost several patients on the operating table. Went into shock and exhibited much the same symptoms."

"What treatment did you use?"

"As I recall, we transferred him to the ward above the nurses' sunbathing balcony."

"And *that* cured him?"

"No. But in a few days he developed a far more enjoyable fixation. Left here one of the happiest men I ever saw!"

You Wrote These Safety Captions

"Ground" nosing does not pay off!
James E. Leonard,
Camp Wolters, Texas

You may be hard nosed but your Bird Dog's not.
Ralph E. Domenic,
Ft. Hood, Texas

What a crazy way to dig a well!
Lt Wm. F. Gabella,
Ft. Eustis, Va.

Army pilots, keep on your toes or you may land on your nose!
J. C. Rickmeyer, TMC,
St. Louis, Mo.

No nose is good nose.
Maj Pete Dolan, TMC,
St. Louis, Mo.

Knows no nose. (Over, Out).
Sgt Edmund E. R. Harris,
24th Div., APO 112

General, it was like this—
Capt Gaylon C. Jackson,
Ft. Snelling, Minn.

Please conserve parking space.
Maj William L. Duncan,
Ft. McPherson, Ga.

Another example of the versatility of the L-19, a post hole digger.

The L-19 can be parked in a minimum of space.

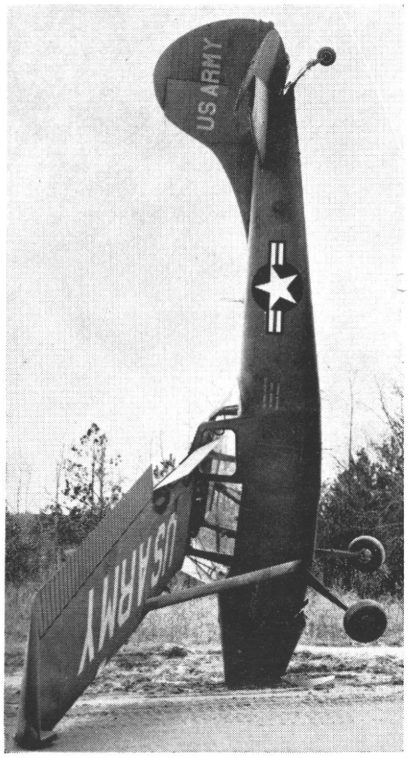
The L-19 has a very delicate control balance.

Sir, do you think we'll have to report it?
Maj J. A. Talbot & Safety Division Personnel,
MATS Hqs. Scott AFB, Ill.

I *thought* he said "cleared for straight-in approach."
Capt G. W. Larson,
Ft. Rucker, Ala.

Watch that first step.
Aviation Section,
Tinker AFB, Okla.

Thanks to all who sent replies. We're sorry that space prohibits our printing every one.—Editor



Would proper employment of modern Army Aviation have prevented the terrible loss of men and equipment in the Battle of the Chongchon River?

Above the Gauntlet

Captain Paul B. Malone, III

AUTHOR'S NOTE: This article uses the situation described by S. L. A. Marshall in his book, "The River and the Gauntlet," as a vehicle for the hypothetical employment of our growing medium of combat support—ARMY AVIATION. The general theme will be prefaced by a resumé of the events leading the 2d Infantry Division to and through "The Gauntlet" in the Battle of the Chongchon River during the Korean Conflict.

* * *

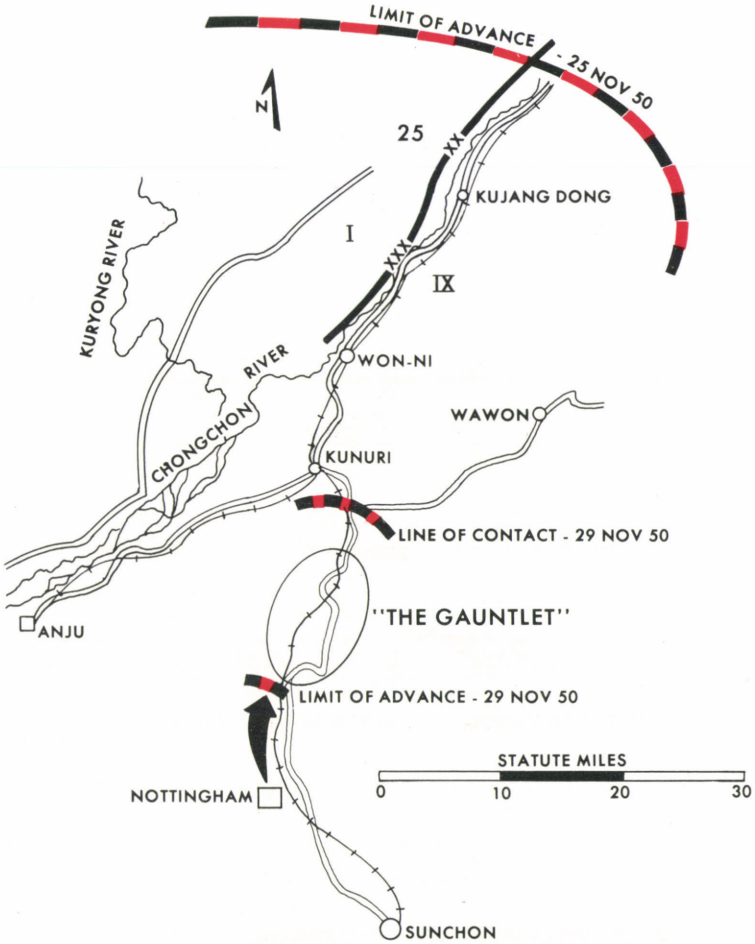
MID-NOVEMBER of 1950 found United Nations Forces in Korea riding the crest of victory after the successful Inchon landing and breakout from the Pusan Perimeter. Divisions plunged northward past the 38th parallel at high speed against sporadic resistance of the disorganized North Korean Army. The Yalu River seemed within easy reach.

The United States I and IX Corps in western Korea hesitated at the Chongchon River and then resumed the advance northward, with the 2d Infantry Division of the IX Corps proceeding along the east bank of the Chongchon River. (See sketch map A.)

Meanwhile the stage was being set for one of the most successful examples of the employment of surprise in military history. Completely undetected by UN forces, hundreds of thousands of Chinese Communist soldiers crossed the Yalu River and proceeded under the cover of darkness to forward assembly areas in proximity to UN forward elements. A gigantic trap was ready to spring.

Unsuspecting, the 2d Infantry Division pushed northward from Kunuri against slight North Korean resistance. On 25 November, Chinese Communist

Map A. General situation



Capt Malone is aide-de-camp to the Commanding General, I Corps (Group) in Korea. He is a master parachutist and a fixed- and rotary-wing aviator.

troops struck forward units of the division. Day and night, the onslaught of massed infantry increased, engulfing and pushing back UN units. By 29 November, the critical situation was fully realized and the 2d Division was authorized by IX Corps to conduct a general withdrawal to Sunchon. No route of withdrawal was specified.

THE DECISION

These were, in brief, the events which set the stage for the destruction of the 2d Infantry Division as an effective fighting force. In short, this division, badly depleted by five days and nights of continual CCF attack, withdrew along 7 miles of a valley road which was surrounded by the equivalent of a Chinese Communist infantry division. This was "The Gauntlet."

Now to briefly summarize events which led to the tragic selection of "The Gauntlet" (see sketch map B) as the division route of withdrawal. In retrospect, the use of the road from Kunuri to Anju (see sketch map A) would have avoided the disastrous results of this trap. The Anju route was, in fact, offered the 2d Division by CG, I Corps (to the immediate west) on 29 November.

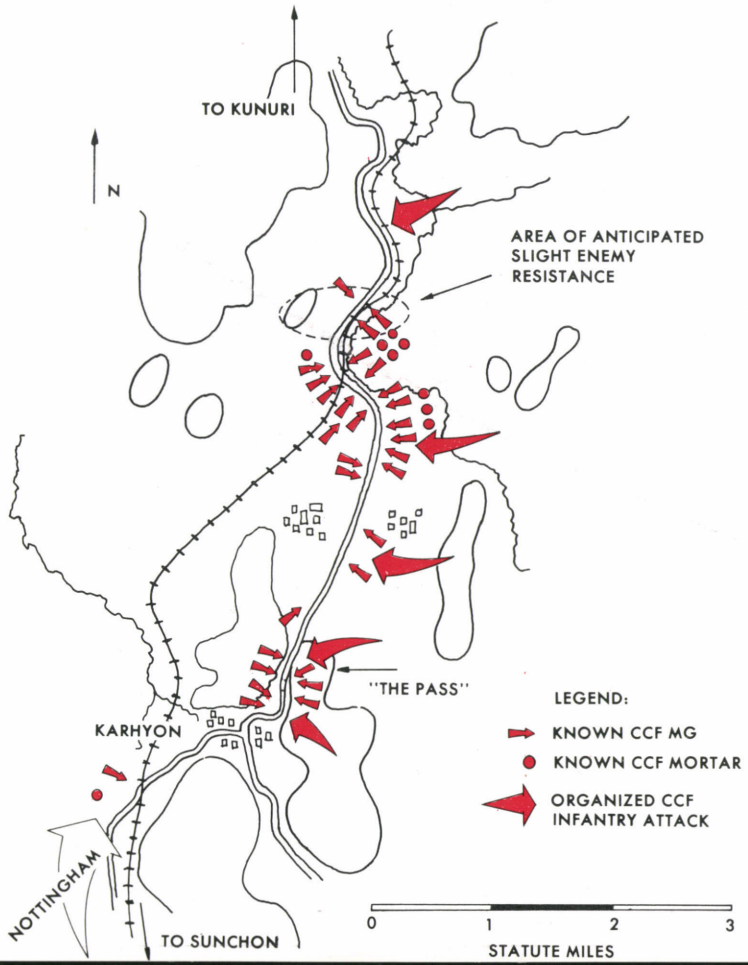
INTO THE GAUNTLET

Under mounting CCF pressure, units of the 2d Division withdrew toward Kunuri. Roads were jammed by refugee and troop movements. Information of the enemy was incomplete and inaccurate; communications were inadequate and, in some cases, nonexistent. The fog of battle had set in. Because of the pressure of the enemy attack and the exhausted condition of U. S. troops, an immediate decision concerning the route of withdrawal was imperative to avoid encirclement and annihilation of the division. Little was known of the situation to the south. The 27th British Commonwealth Brigade, known as Nottingham, was believed to be heading rapidly northward from Sunchon to assist the 2d Division. The ambush of a Turkish convoy in "The Gauntlet" on 29 November indicated that some enemy were along the Kunuri-Sunchon road, but the strength of this force was never determined.

Early morning of 30 November found the division massed south of Kunuri prepared for withdrawal. With reports on the Anju road obscure, and the expectations of a link-up with Nottingham hopeful, the Sunchon road was selected. Infantry units were dispatched along the flanks to "clean up" anticipated slight resistance at the north end of "The Gauntlet." When these efforts stalled, it was decided to barrel through the "thin crust of enemy" and head south. At this point, around noon on the 30th, the tactical unity of many units of the division was lost as individual soldiers jumped aboard any available vehicle heading south . . . and into the trap.

A complete picture of the events which occurred in "The Gauntlet" can be more fully appreciated by reading Marshall's book. From noon on 30 November until the early hours of 1 December when the last few survivors emerged to the safety of Nottingham's forward elements, remanents of the division experienced chaotic devastation. Mortars and countless machine-guns, firing at ranges from 600 to 75 yards, butchered men and vehicles. Destroyed vehicles on the road stalled convoys under direct fire, adding to the destruc-

Map B. Situation in "The Gauntlet"



tion. The scene of chaos was punctuated by numerous acts of heroism by individuals and small groups, but coordinated retaliatory action was not attempted in this situation where survival became an individual problem.

U. S. Air Force fighter bombers raked the hills with armament of all types, but the uncoordinated effort was unable to silence the widely dispersed enemy. As 29 November wore on, enemy reinforcements tightened the grip on "The Pass," where the road climbed a grade and passed through a deep cut at the south end of "The Gauntlet." "The Pass" became a critical bottleneck of "The Gauntlet"; only armored vehicles were able to clear debris and temporarily silence enemy fire. Darkness of the 30th found "The Gauntlet" aglow with the light of burning vehicles, ammunition, and equipment, thus assisting Chinese marksmanship and encouraging actual CCF infantry attacks upon remaining march units.

IN RETROSPECT

It has been generally acknowledged by authorities that the chief cause of the defeat of the Eighth U. S. Army in the Battle of the Chongchon River was the failure of UN intelligence systems to detect or forecast the CCF intervention.

For our purposes, however, let us discuss some of the problem areas which *directly* contributed to the ordeal encountered by the 2d Division.

LACK OF MOBILE, TIMELY, AND RESPONSIVE RECONNAISSANCE. The division reconnaissance effort, restricted to the ground and needed simultaneously in many areas, could not cope with the rapidly developing situation. A large infantry force, referred to as the "mystery column," marching westward toward "The Gauntlet" around the division front was spotted by the Air Force but never identified. Very possibly these were CCF troops heading for "The Gauntlet." UN reconnaissance efforts to the south and west along the Anju and Sunchon roads were obviously ineffective. Behind the "thin crust" at the north end of "The Gauntlet" now waited an undetected enemy division. Even the location of Nottingham to the south was not known by the 2d Division.

INADEQUATE COMMUNICATIONS. Coupled with limitations in gathering intelligence were the difficulties in transmitting available information across the typically mountainous Korean terrain. One of the early elements to escape through "The Gauntlet," a tank platoon carrying infantry, discovered that the entire 7-mile stretch of road was a fire-filled trap. This information, transmitted by FM radio, was never received by the remainder of the division, which was then beginning to roll southward.

Communications were never established with Nottingham to the south. Much of the effectiveness of the Air Force fighter bomber effort, which attacked the flanks of "The Gauntlet" throughout the daylight hours, was lost due to lack of communications with ground units. In some cases, our own troops suffered from these attacks.

MOBILITY LIMITED TO GROUND. Units of the 2d Division entering "The Gauntlet" were operating at reduced combat effectiveness due to fatigue and losses. However, fresh, unengaged U. S. troop units were to the south which, if available, could have assisted materially in this desperate situation. The nature of the tactical situation, the terrain, and the limited road net, however, precluded their participation if traveling by ground means.

LIMITED ARMY AVIATION SUPPORT. Marshall refers to Army Aviation only on a few occasions in the book. These references pertain mainly to fixed-wing liaison aircraft used for individual transportation. No mention is made of the employment of helicopters in the evacuation role. Judging from the book, Army Aviation did not contribute materially to the tactical situation in this conflict.

* * *

COULD MODERN ARMY AVIATION HAVE ASSISTED THE 2D DIVISION IN THIS SITUATION?

Current thinking tends to stress aviation support in conjunction with offensive operations, and rightly so. I wish to illustrate its potential under conditions of adversity. The situation involving "The Gauntlet"—the terrain, the requirement for intelligence, communications, liaison, and mobility, and the criticality of conditions—provides an ideal opportunity employing presently available aircraft. I will discuss this employment using two different situations with varying degrees of aviation support. Current TOEs will be referred to; situations will be oversimplified for brevity and clarity.

SITUATION NO. 1

GENERAL DIVISION SITUATION: The 2d Division is in the vicinity of Kunuri (see sketch map A) on 28 November after retrograde movements under heavy CCF pressure.

AVIATION SUPPORT: The 2d Division Aviation Battalion, depleted by operational losses, now supports at half strength. No aviation assistance from IX Corps is available at this time.

On 29 November, CG, 2d Division is authorized to withdraw to Sunchon. His decision on the route of withdrawal remains critical, but he now has the means to obtain information vital to his decision. Throughout this period of heavy pressure, his fixed-wing aircraft have been constantly over the battle area directing artillery fire, observing troop movements, and relaying radio messages. Reconnaissance helicopters have ranged forward of the front scouting formations detected by fixed-wing aircraft, losing several to enemy fire.

The commanding general is well aware that enemy units of considerable size are in his rear area and that Nottingham has been stalled well south of Kunuri. The "mystery column" has been kept under surveillance during daylight hours. The CG knows firsthand the status of his fighting and logistical units, having visited each frequently in his chopper. His remaining utility helicopters have done yeoman service evacuating numerous casualties out of the battle area and resupplying forward units. The commanding general is in close contact with higher headquarters and supporting units via airborne FM radio relay.

At this point, it is reasonable to assume that this aviation support, though limited, could have given the commander the means to detect the enemy in "The Gauntlet" and avoid the disastrous mistake. Reconnaissance helicopters scouting "The Gauntlet" in conjunction with ground reconnaissance elements could have located at least some of the enemy waiting for the kill. Others investigating the confusion along the Anju road would have learned that the entire division could be routed this way as well as along open routes. *This vital information could have been transmitted to the commanding general in time to save the 2d Division.*

SITUATION NO. 2

GENERAL DIVISION SITUATION. The 2d Division has received IX Corps permission to withdraw to Sunchon on 29 November. For purposes of this example, however, the Anju road is not an alternative; the division must proceed through "The Gauntlet" or suffer encirclement and annihilation in place. Reconnaissance of the Kunuri-Sunchon road has been only partially effective; the size of the force along the road remains obscure.

DIVISION AVIATION SUPPORT. The 2d Division Aviation Battalion has been reduced by combat losses to but a few observation and reconnaissance aircraft.

CG, IX Corps, anticipates major problems in extracting the 2d Division. He has at his disposal several uncommitted battle groups to the south of Sunchon. Also in general support of IX Corps are two transportation helicopter companies plus one air cavalry troop.

During the morning of 30 November, the reality of the division's plight becomes apparent. Reports of enemy strength all along "The Gauntlet" are relayed from subordinate units to division to corps in short order.

CG, IX Corps, surveys his capabilities of assisting the 2d Division. Nuclear attack upon the enemy in this situation is out of the question due to enemy dispersion and their proximity to U. S. troops. Air Force fighter-bomber attacks can indeed assist and are employed in force. These efforts, however, still have not silenced the many dispersed machineguns lining the road and are ineffective at night.

The great need in this situation is the early arrival of fresh, well-organized and well equipped troops on critical terrain in the enemy's rear to distract the enemy and weaken his hold on the killing zone. CG, IX Corps, determines that this capability is available in a combination of infantry and Army Aviation units within the corps.

A warning order is issued at noon on 30 November to "Task Force Rescue." This force consists of one infantry battle group and the corps aviation support elements and is commanded by the battle group commander. By 1300 hours, the task force commander is flying over "The Gauntlet" in an HU-1A with selected members of his staff and the aviation unit commanders. His reconnaissance includes selection of landing areas plus short coordination visits with the CGs of the 2d Division and Nottingham. The scheme of maneuver is quickly planned—that of a hasty heliborne raid.

Further development of this hypothetical situation will require certain assumptions which appear to be logical and are supported by Marshall's book:

- The enemy all along the road has generally sacrificed the high ground to move in for the kill at shorter ranges and better control the route of withdrawal.
- The enemy is throughly preoccupied with activities in "The Gauntlet," hoping to make the most of its skillfully conceived trap.
- Enemy forces consist primarily of infantry troops without vehicular transport supported by machineguns and light mortars.

The plan is developed rapidly as the early afternoon progresses and hasty troop procedure is

conducted. The initial objective of the attack is the opening of the critical bottleneck in "The Pass" and the acceleration of the 2d Division units heading southward. (See sketch map C.) Following this, an attempt will be made to relieve pressures in area E to the north. Raiding units are to withdraw southward under the cover of darkness upon completion of the mission.

The initial airborne assault commences at 1500 hours with simultaneous landings on zones A and B. These landings are preceded by Air Force fighter-bomber strikes, followed by concentrated close-in attacks by armed helicopters of the Air Cavalry Troop. Troop-filled helicopters, following the nap of the earth from the south, unload in clear areas on the high ground. Troops rapidly secure the entire heights surrounding "The Pass" and establish a perimeter defense.

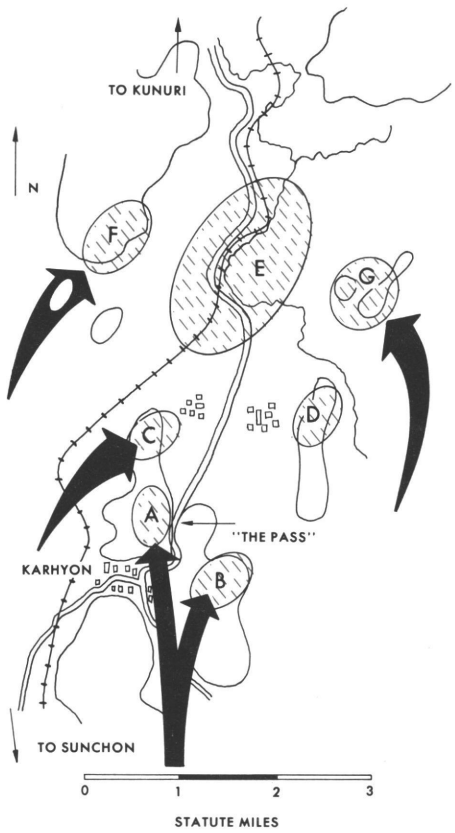
The battle group engineer platoon, attached to the rifle company landing on zone A, immediately moves to the road and organizes a concerted effort to clear the defile of stalled vehicles, using demolitions primarily. Once the heights are secured, the heliborne force supports the rapid forward movement of armored elements of Nottingham which affect a link-up and take up firing positions facing northward from "The Pass." Meanwhile cargo helicopters return to loading areas for one additional rifle company, displacing it quickly to zone C.

The enemy, confused by the arrival of an organized adversary to its rear, immediately relaxes his fire on the south end of "The Gauntlet." At this point, "Task Force Rescue" has begun to accomplish its mission.

The arrival of organized support has an immediate effect upon the embattled units of the 2d Division. The clearing of "The Pass" and the relaxation of fires on the roadway allows for accelerated movement of the division's columns.

The task force aircraft refuel and are directed toward the enemy concentration in the vicinity of area E. Once again, high ground is selected for landing areas. Rifle companies are delivered to landing zones F and G. These troops secure positions upon the high ground and commence long-range fires upon the enemy below. Helicopters then initiate resupply and evacuation operations during the remaining period of daylight. The ARS Company elements, directed by an airborne coordinator above "The Gauntlet," attack all available targets with primary emphasis upon suppressive fire support for the heliborne elements.

Map C. Plan of maneuver



AND THUS IT COULD HAVE BEEN!

It is reasonable to assume that the employment of a force of this size would have assisted materially in reducing pressure on the 2d Division. Fresh troops, under effective leadership, would have had a good chance of success in withdrawing southward to friendly lines during the hours of darkness. Considering the hasty nature of the maneuver, many desirable elements of coordination would have been impossible. Once the element of surprise was gone, helicopter losses would have mounted. In all probability, however, these losses would have been insignificant when com-

Continued on page 41

JUNGLE OPERATIONS

H-23F, Army Aviation's most powerful light helicopter, is equipped with a 305 hp Lycoming engine. This four-place light observation helicopter has joined other aircraft in IAGS work as a specialist for operations where high performance is a necessity.

Captain Alexander R. Zenz

YOU DON'T HAVE to be a Jungle Jim to operate successfully and safely in jungle regions. The planning for all flying is basically the same, but certain simple precautions must be taken for flying over the jungles. Certain inherent hazards are involved. But this type of activity need not be any more dangerous than other kinds of flying, provided plans are professionally prepared and executed.

The 937th Engineer Company (Aviation) operating in support of the Inter-American Geodetic Survey has amassed a wealth of experience in bush flying in the jungles of Latin America. Most of the flying is executed from small unimproved strips and helicopter pads hacked out of the rain forests. Even though our mission is conducting mapping operations, the planning and flying could be the same for conducting tactical operations with widely scattered units.

Planning starts on the afternoon before the flight. Every attempt is made to complete the plans as early as possible to avoid last minute "flaps," but of course, we must be responsive to changes. At this time the engineer supplies the aviation officer with his requirements. This will include types of missions to be flown, such as message or cargo drops, reconnaissance, or transporting cargo and passengers. The engineer will also indicate the locations, amounts to be transported, and priority of missions.

With this information the aviation offiicer can begin his part of the initial planning. By matching the types of missions with the available aircraft he can assign the tasks to the aircraft. He must also assign the pilot for the mission. In Costa Rica it is the practice to rotate type of aircraft and mission every day among the aviators. This serves three purposes: each aviator maintains a high state of proficiency in each type of aircraft; fatigue is reduced by each pilot taking his share of the more difficult flights; and maximum flexibility is assured with every aviator capable of performing any mission.

The landing sites to be used must also be carefully considered. A descriptive file is maintained on every landing strip and helicopter pad. Seasonal changes must be weighed because many strips become dangerously soft toward the end of the rainy season. Occasionally we've experienced a few other unexpected changes. Recently someone plowed up the center of a small field. When the grass grew back this was hidden, almost causing an accident. The lush tropical growth can quickly choke up an otherwise usable landing site. Beaches are often used when operating near the coasts. These must always be carefully reconnoitered and tested for soft spots. Be sure to check the tide tables! One wave from a rising tide can hopelessly trap an airplane in the sand.

The aviation officer must estimate elapsed times for each mission and determine refueling sites, if necessary. Often a fixed-wing aircraft will support helicopters by meeting at a convenient strip for refueling and transfer of cargo and passengers shuttled by the helicopters. He endeavors to fully utilize the capabilities of all the aircraft without exceeding maximum allowable gross loads or other safety requirements.

Weather, as in all flying, is exceedingly important. Generally, in this part of the world, the aviator will be unable to consult a weatherman. He must rely on his experience and the opinion of the natives in the area for an estimate as to what conditions can be expected. Adequate navigational aids are the exception rather than the rule, so normally, instrument flying would be considered venturesome. In the rainy season the flying day is limited by rapidly deteriorating weather, forcing the aviator to plan his flying to avoid any wasted time. The aviator must take advantage of every break in the weather, but must constantly anticipate the capricious changes. Temperature, too, is a factor. The surprising chill of the predawn air will quickly rise to the humid sultriness expected in the tropics, with a corresponding change in density altitude.

Intimate knowledge of the terrain is vital for the aviator. With this, he can plan his routes so that exposure to the more formidable areas is not overly protracted. In addition, since accurate maps are generally unobtainable, he must be able to navigate without having to rely upon them. Recognizing a village, river, swamp or mountain may be the difference between the pilot's sleeping in his own bed or huddling under dripping leaves in the jungle that night. Aerial photographs are useful as supplements and are studied to assist in selecting routes and planning reconnaissance.

While the aviation personnel are preparing their plans, the engineer is gathering equipment and organizing personnel. He places the cargo into bundles marked with their weights and destinations. This avoids confusion and expedites load computations. Any loads to be dropped are packed at this time to reduce lost time in the morning. The aviators routinely reexamine all cargo and brief the passengers before loading.

Finally, after considering all these factors, the aviation officer and the engineer determine takeoff time. This is always subject to change. Even as the pilots are jeeping out to the airstrip in the grey light before dawn, they continually examine the sky in an attempt to evaluate the conditions that would alter plans.

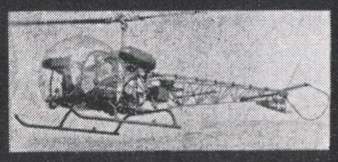
Shortly before the flight the engineers and pilots confer for final coordination. Every pilot knows the flight plans for all other aircraft. Alternate plans are also discussed. Occasionally an aircraft is sent on a weather survey before the remaining aircraft are committed. Flights are promptly changed or cancelled if the meteorological conditions are not favorable. Communications are specified with alternate means preplanned in case of radio failure. This will include both air-to-ground and air-to-air contact. Flight plans are filed and a man is designated to operate the camp radio.

Hollywood depicts Tarzan as being happy in the jungle environment. But even though all aviators assigned to USARCARIB attend the Jungle Survival School, I'm sure that none of us would care to try swinging on vines. So, even though the mechanics are very conscientious in performing maintenance, preflight inspections are not taken lightly and are not restricted to checking the condition of the aircraft. All survival equipment is scrutinized. This includes the survival kits, machetes, radios, and ropes which are always carried. Even though the children in the villages laughingly call us clowns, we are happy to have our international orange flight suits, which are habitually worn with hunting knife, gloves, and boots. In some areas, side arms are also carried for protection against snakes and other animals.

The last phase is the execution of the plan. To implement this, continuous communications are maintained between all aircraft and ground stations. As the operations progress, the aviator is ever ready to make a "horseback" decision and change his mission in the interest of safety. The final result is a safe, efficient and economical operation.

H-13 Sioux is shown making a precision landing on a log chopper pad near Palmer, Costa Rica.

L-19 BIRD DOG H-13 SIOUX U-1A OTTER



TWX

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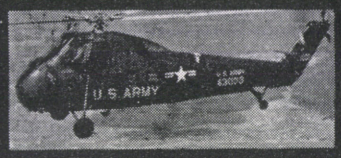
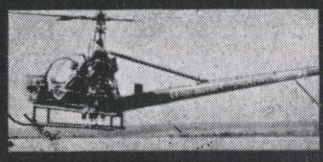




HU-1 IROQUOIS H-34 CHOCTAW H-23 RAVEN

H-13H CRASHED AND BURNED during demonstration autorotation. Aircraft destroyed. Pilot sustained fatal injuries. Caused by loss of bolt which attaches cyclic fore and aft push-pull tube to fore and aft cyclic contro llevel. Bolt was not safetied. (See September Crash Sense.)

H-34C LANDED ON SLING LOAD, causing incident damage to underside of fuselage. Crew thought load had been released before landing. No malfunction found in sling release. Load released normally after incident.

H-21C STRUCK STUMP during landing in mountain camp confined area. Major damage to aft "V" brace on left main gear. No injuries.

H-21C LOST OIL in flight. Aircraft completed forced landing with no damage. Loss of oil caused by materiel failure of oil line fitting (P/N 18932).

H-21B LOST POWER during climb. Engine emitted loud noise and black smoke from exhaust. Aircraft completed forced landing in bean field with no damage. Caused by detonation due to loose spark plugs.

L-20A ENGINE FAILED momentarily, then ran rough after takeoff. Aircraft completed forced landing with no damage. Engine malfunction caused by moisture in magneto.

L-19E STRUCK WIRES during recovery from simulated forced landing. Incident damage to propeller. No injuries.

AO-1C ENGINE FAILED at 16,000 feet. Engine was feathered and aircraft landed without incident. Preliminary investigation revealed planetary gear failure.

L-19 STALLED AND CRASHED after low pass over convoy. Major damage to all components. No injuries.

U-1A FELL THROUGH during approah and landed hard, bukling right gear. Airraft bouned into air, flew approximately 500 feet, and landed on left gear and tailwheel. Major damage to right gear, propeller, and fuselage skin. No injuries.

H-13E HOOKED SKID on tree stump and rolled on right side while hovering. Major damage to main and tail rotors, mast assembly, right skid, ross tubes, and bubble. Small fire confined to engine area. No injuries.

L-20A GROUND-LOOPED during demonstration short fiel dlanding and caught fire. Major structural damage to both wings and fuselage. Fire damage to front of fuselage and cabin. Pilot sustained scalp laceration.

H-13H LITTER DROPPED off during flight. No damage to aircraft. Improper pins used to secure litter carrier to carrier support. No injuries.

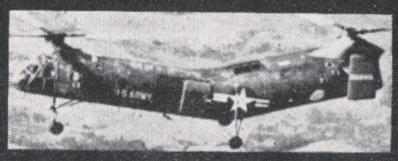
L-19A CRASHED into mountain while maneuvering near ridgecrest. Aircraft bounced over crest, overturned, and came to rest in ravine. Aircraft destroyed. No injuries.

H-13G LOST POWER and settled in wooded area during attempted takeoff from confined area. Major damage to main rotor system, right skid, bubble, and fuel tank. No injuries. Cause of engine failure undetermined pending investigation.

L-19A CRASHED into road embankment and burned. To fatalities. Cause undetermined pending investigation. Weather not a fatcor.

H-13H LOST PEDAL CONTROL while moving forward at hover between two parked helicopters. Throttle was retarde dand autorotation completed with no damage. Caused by failure of the tail rotor drive dowel pin due to corrosion.

AO-1 MOHAWK H-21 SHAWNEE L-20 BEAVER



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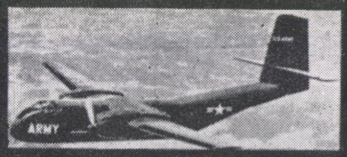


L-23 SEMINOLE H-37 MOJAVE AC-1 CARIBOU H-19 CHICKASAW

H-34C WINDOW CAME OFF in flight and passed through main rotor, causing incident damage to No. 14 pocket of main rotor blade.

L-19E CRASHED during service flight. Aircraft was observed making 180° turn, followed by 90° turn. It appeared to be level for a moment, then dropped and crashed with little or no forward speed. Aircraft destroyed. Pilot sustained fatal injuries. Cause undetermined pending investigation.

L-19E ENGINE FAILED while aircraft turned base for tactical strip landing. Aircraft laned short and overturned. No damage to all components. No injuries.

H-21C WARNING LIGHT (chip detector) came on in flight. Aircraft completed forced landing with no damage. Steel slivers and flakes found on forward magnetic plug.

H-13H FELL THROUGH during power recovery from practice autorotation and landed hard, causing major damage to tail rotor, aft cross tube, and skid leg. No injuries. Weather not a factor.

H-23D STRUCK WIRE during autorotation due to rough running engine. Incident damage to bubble. No injuries. Cause of engine malfunction undetermined pending analysis.

H-34C STRUCK SKID of H-13 with main rotor blade during takeoff, causing major damage. Both aircraft landed with no further damage. Details of damage not listed in TWX crash facts message. No injuries.

L-20A ENGINE SHOOK VIOLENTLY during descent to traffic pattern. Aircraft completed forced landing with no damage. Caused by master rod rupturing No. 5 cylinder wall.

L-20A LANDED SHORT and struck embankment at approach end of runway. Tail wheel severed and minor damage to fuselage skin. No injuries. Gusty surface wind and 3,000-foot density altitude possible factors.

H-13H STARTED UNCONTROLLABLE TURN during attempt to hover. Aircraft was autorotated to hard landing. Major damage to tail rotor components and cross tubes. No injuries. Caused by undersize cotter pin which sheared and permitted tail rotor drive hub bolt to back off. Resultant vibration caused tail rotor gear box to shear.

H-13E STRUCK WIRE during landing approach, landed on right skid and rolled on right side. Aircraft destroyed. Pilot and passenger sustained minor injuries.

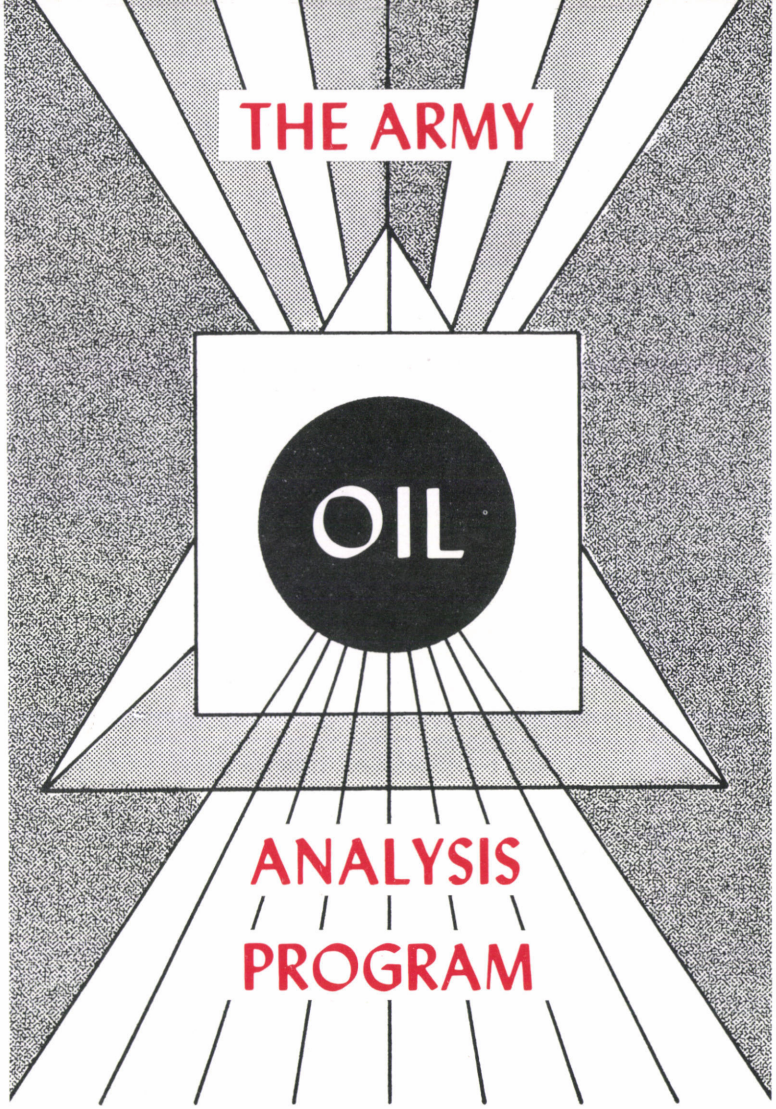
H-37A CLAMSHELL DOOR OPENED in flight, causing incident damage to clamshell door and escape hatch. Caused by improperly secured clamshell door.

L-23D TAXIED INTO FIRE EXTINGUISHER, causing minor damage to right propeller. No injuries.

AO-1 FIRE WARNING light for No. 2 engine came on during flight. Engine was feathered and aircraft landed without incident. Inspection revealed malfunction of fire warning system.

L-20 STRUCK MOUND during takeoff and folded back right gear. Aircraft continued mission, then landed, causing major damage to gear, right wing, tail wheel, and propeller. No injuries.

L-19A STRUCK MOUNTAIN SLOPE at 11,500 feet while attempting VFR flight in IFR conditions. Damage undetermined. Pilot sustained minor scratches.



THE ARMY OIL ANALYSIS PROGRAM

The ultimate goal of TATSA's oil analysis program will be the elimination of predefined TBO for aircraft engines and the prevention of premature failures due to excessive wear conditions.

Lieutenant Robert C. McGee, Jr.

ON 5 SEPTEMBER 1961, a routine oil sample from an H-21C Army helicopter was submitted to the TATSA Oil Analysis Laboratory for spectrographic analysis. The analysis of the suspended metal particles revealed an abnormal concentration of iron, aluminum, copper, silver, and magnesium. In response to the laboratory findings, an examination of the lubrication system by maintenance personnel revealed excessive metal particles in the oil. The engine was removed from the aircraft. Subsequent inspection of the engine revealed that the master rod bearing was defective and was wearing irregularly, resulting in the high silver content. The accessory case was also found to be chafing on the rear of the crankcase, causing iron and aluminum to be picked up by the oil.

There was no indication of engine trouble either by chip detector light or engine performance, but undoubtedly an engine failure would have resulted from continued operation. The early detection of this engine discrepancy by the Oil Analysis Laboratory is just one of the successes of the Army Oil Analysis Program.

Army Aviation has long realized the need for more reliable methods of determining aircraft engine condition. In early 1960, Army personnel were impressed by the success of a program being evaluated by the Navy. This program involved the spectrometric analysis of used aircraft engine oil as a means of detecting engine discrepancies at an early stage of development. In May 1960, the United States Army Transportation Aircraft Test and Support Activity (TATSA) was assigned the responsibility of investigating and evaluating the oil analysis technique to determine its suitability for Army use.

A pilot program was established, using several test aircraft at TATSA and 20 aircraft of the U. S. Army Aviation School. Oil samples were taken by Army personnel, but the actual analysis was performed by the Navy Oil Analysis Laboratory located

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Lt McGee is director of the Oil Analysis Laboratory at TATSA. Before this assignment he worked as assistant project engineer on the development of the Army light observation helicopter.

in the Materials Testing Laboratory, O&R Depot, Pensacola Naval Air Station, Fla. The pilot program was gradually expanded until approximately 120 aircraft from the Aviation School, in addition to several TATSA aircraft, were being monitored by the Navy. (Further, the Navy also assisted the Army by monitoring a large group of H-23D main transmissions in training helicopters at Camp Wolters, Texas.) During the latter phases of the pilot program, Army personnel were assigned to the Navy laboratory for training in preparation for the establishment of the Army's laboratory.

In September 1961, the Army initiated its Oil Analysis Program at Fort Rucker, Ala. A direct reading emission spectrograph was installed in the laboratory and the Army began monitoring the 120 aircraft from the Aviation School, the TATSA aircraft, and the H-23D main transmissions that had previously been monitored by the Navy. From this modest beginning, the program has gradually expanded and TATSA is presently monitoring approximately 1,000 aircraft from activities within CONUS. In addition, the U. S. Air Force has requested TATSA to monitor approximately 200 engines from C-119 aircraft. This program began 1 July.

The principle of spectroscopy is relatively old, having been first discovered by Sir Isaac Newton in 1666. He found that inserting a prism into a beam of light would cause the light to separate into color bands similar to a rainbow. By employing a lens in conjunction with the prism, the colors were further separated into a pure spectrum. In the early 1800s, Joseph Fraunhofer refined Newton's discovery by the addition of a slit as a means of passing the light, which permitted greater resolution of the light rays. In 1859, G. R. Kirchhoff and R. Bunsen developed the first spectroscope and verified William Henry Fox Talbot's theory that a definite relationship exists between various compounds and the color of light produced by the burning of those compounds. Development has continued and, through electronics and automation, metal concentration in oil can now be read directly by means of direct reading electronic instruments.

The spectrographic technique used by the TATSA Oil Analysis Laboratory to analyze an oil sample is based upon the excitation of the metal atoms contained in the oil with an alternating-current spark. A portion of the oil sample is transferred to a plastic cup and positioned in the spectrometer. A constant supply of this oil is supplied to a high voltage discharge gap by a rotating disc electrode which is partially submerged in the oil. As the oil is burned by the spark, light is emitted which is characteristic of the types of metal contained in the sample. This light passes through a fixed aperture slit into the spectrograph where it is collimated and defracted into its component wavelengths by a system of mirrors and a defraction grating.

The intensities of the various wavelengths of light are directly proportional to the concentrations of metal present in the oil. The wavelengths of interest are converted to electrical energy and amplified by a series of photomultiplier tubes positioned in the rear of the spectrograph. The electrical energy generated by each photo tube is stored in a series of capacitors during the excitation period. Upon termination of the spark, the capacitors discharge singly into a small integrating capacitor. The number of discharges of this capacitor is counted by a scaler and transformed into typewriter signals. The printed number of counts are referred to previously prepared calibration curves and the wear metal concentrations are determined in parts per million (ppm). A complete schematic of the spectrometric operation can be seen in illustration.

The results obtained from the sample are then compared to the sample history of the particular engine from which the sample was received. A marked increase in wear metal content is a sign of possible trouble within the engine. One high reading is usually followed by an immediate laboratory request for a resample. If the resample continues to read high, an engine evaluation is requested.

A sample can be analyzed and the using unit can be notified via telephone of the engine's condition within one hour after receipt of the sample. Therefore, the time interval between the date the sample is obtained and the date the user is notified of the engine condition is determined by the time required to forward the sample through the U. S. mail system.

Present laboratory capabilities are limited to predicting that something is wrong with an engine. As information is amassed and experence is gained in the analysis of this information, it may become possible to be more specific in defining the trouble. For instance, it is now known that high iron content probably indicates trouble in piston rings and gears; high aluminum shows excessive wear in pistons and intake valves; and silver denotes master rod bearing problems. Each type of engine, however,

has varying metal compositions for the various component parts so the significance of different levels of contamination can be accurately interpreted only after the development of considerable experience.

By establishing critical wear metal limits for each type of engine, the laboratory has been able to detect 59 discrepancies on 54 aircraft. Thirty-four of these defects were cylinder and piston assembly failures. Other discrepancies detected included: eight defective HU-1 main mast bearings; seven defective H-21 master rod bearings and one defective H-34 master rod bearing; and nine miscellaneous engine and transmission failures, such as cracked crankcases, defective oil filters and engines which were removed due to metal contamination.

Eleven of these defects were found as a result of disassembly inspections. The disassembly inspection reports on these aircraft revealed defective master rod bearings on eight HU-1 mast assemblies. None of these defects were detected by normal maintenance procedures; yet any or all of these discrepancies could have resulted in inflight failures.

A few case histories of aircraft on which discrepancies were detected by the Oil Analysis Laboratory may serve to emphasize the validity of the spectrographic analysis technique.

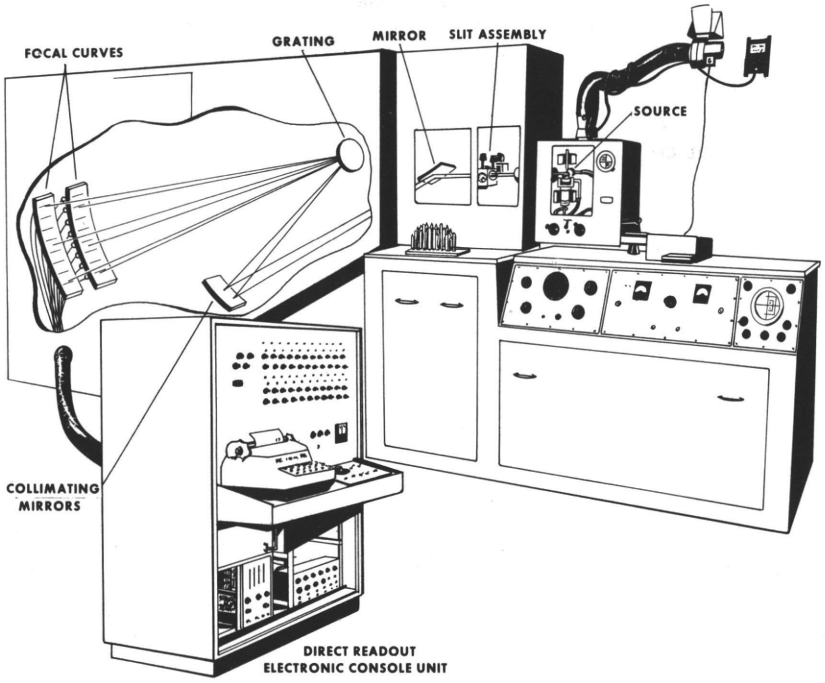
On 21 December 1961, an oil sample from a HU-1B helicopter transmission was submitted to the laboratory for spectrographic analysis. The analysis showed abnormal iron and magnesium content. A normal transmission visual inspection (pull screen, etc.,) was performed by the maintenance personnel and no deficiencies were detected. Repeated spectrographic analysis continued to show excessive iron and magnesium wear metal present in the oil. The transmission was removed and returned to an overhaul and repair depot for a complete teardown inspection to determine the cause of the high metal content. The disassembly inspection revealed that an initial stage condition of failure existed within the main mast bearing. It was reported that continued operation of this mast assembly could have resulted in a mast bearing failure.

On 26 January 1962, a routine oil sample from a H-34 Army helicopter was submitted for spectrographic analysis. The analysis of this sample revealed abnormal wear metal concentrations of iron, aluminum and copper. A routine engine inspection was performed because of the abnormal metal concentrations indicated by the spectrometer. No defects were noted in any oil-wetted components. The carburetor air filter was changed due to excess clogging, the oil was changed and the aircraft was released for flight. The aircraft was hovered for 10 minutes and a resample was submitted to the laboratory for analysis. Despite the fact that this sample had accrued only 10 minutes of flight time since an oil change, the analysis showed abnormal iron, aluminum and copper wear metal concentrations present. After an additional 30 minutes of flight, an engine failure occurred. Upon inspection, the following defects were noted:

- The engine had seized to such a point that all components were locked in place.
- Large metal particles were found in the main sump case.
- The oil had fouled the #1 cylinder.

On 12 February 1962, the engine was changed in accordance with TM-2R-1-15 for excessive metal contamination.

On 2 March 1962, a routine sample on an L-20 aircraft revealed abnormal aluminum content. A resample verified the high metal content, and an engine inspection was performed on 7 March 1962 by the operating unit. No defects were detected. A local area, day, VFR flight restriction was placed on this aircraft because of the laboratory analysis.



On 2 April 1962, after an additional 50 hours of flight, the engine seized in flight, necessitating a forced landing. Subsequently, an engine evaluation revealed the following defects:

- The master rod and #1, #4, #5, #6, #7, #8 and #9 link rods were broken.
- The #8 piston had "swapped holes" and was found jammed into the #9 cylinder.
- The skirts of all cylinders were severely damaged.

On 21 September 1961, the analysis of a sample from a H-21C Army helicopter revealed abnormal wear metal concentrations of iron, aluminum, silver and magnesium. An engine inspection was performed by maintenance personnel of the operating unit. No discrepancies were detected. Subsequently laboratory samples continued to show abnormal wear metal content present in the engine oil. The engine was removed and submitted for a disassembly inspection. The results of the inspection are as follows:

- Oil seal disc P/N 171511 was worn and scored.
- Thrust face of crankshaft front end was worn and scored.

The following comment was extracted from the Disassembly Inspection Summary:

"The evaluation team is of the opinion that continued operation of the subject engine would have resulted in master rod bearing failure."

On 21 September 1961, a routine oil sample from an H-21C aircraft was submitted for spectrographic analysis. The analysis of this sample showed high iron and aluminum contents. An engine inspection was requested because of the presence of these metals in the oil but was not performed. The aircraft had momentarily quit in flight the preceding day and an evaluation had been performed at that time with no defects being noted. Samples continued to show abnormal wear metal contents, and the laboratory recommended that the aircraft be grounded until a complete evaluation could be performed. Because no defects had been detected through normal maintenance procedures the aircraft was released for limited flight. During the first hour of flight, a loss of power was experienced. Examination revealed that the piston rings on the #7 cylinder were broken and had worked out into the combustion chamber, causing extensive damage thus necessitating the removal of the engine from the aircraft.

The accuracy for the Oil Analysis Program after the first ten months of operation has been approximately 70 percent. This accuracy is based upon defects detected through normal maintenance procedures. In addition, nine engines or transmissions have been submitted to an overhaul and repair facility for disassembly inspection and all nine have proved to be defective. Two other transmissions were disassembled locally and both revealed defective components.

Many engine and transmission discrepancies have been detected which could not be detected by normal maintenance procedures. Specifically, the R-1820-103 engine has a known history of master rod bearing failure. This type of failure gives little warning and cannot be detected by established maintenance procedures. Spectrographically, however, several impending master rod bearing failures have been detected in time to correct the deficiencies before failure could occur.

In addition to work on reciprocating engines and transmissions, the laboratory is monitoring several gas turbine engines. Conclusive data on these engines have not been developed as the engines being monitored have had very limited problems in the oil-wetted areas.

A study of all data indicates that the metallic content in engines in normal condition remains relatively constant, regardless of the operating conditions or the addition of new oil after flight. This phenomenon has been a source of considerable study. Personnel of the Naval laboratory at Pensacola explain it thusly, "Apparently the loss of oil together with the wear metals in suspension, coupled with the addition of oil between flights results in establishment of a condition of equilibrium." We have also concluded that engines of the same model have the same average levels of wear metals in the oil regardless of engine operating time. All of these factors combined provide us with the basis used to evaluate oil samples as they are received in the laboratory.

Although the program is still in the study phase, it has proven that the spectrographic technique can be a useful tool in the Army Aviation maintenance program. This technique is also adaptable to equipment outside the aviation field, such as rail, truck and marine engines.

The ultimate goal of the Army Oil Analysis Program, if successful, will be the elimination of predefined time-between-overhaul for aircraft engines and the prevention of premature failures due to excessive wear conditions. If this can be achieved, the TATSA Oil Analysis Laboratory will be only the first of several facilities providing a significant improvement in the preventive maintenance capability of the Aviation Maintenance Program.

We have seminars, UT, formal classes, meetings, et cetera but

What Happened to Hangar Flying?

Captain Robert L. Oliver

IN THE EARLY days of aviation the aviator had no experience to draw on and had to develop his own. As more aircraft were constructed and more pilots were trained, the art of hangar flying developed. Today, with the vast number of pilots and machines, the trend is to shy away from hangar flying. Why? Are we afraid of embarrassing ourselves? Do we think we can live through every flight experience ourselves and thereby become better pilots than our contemporaries?

How long has it been since you and your buddies got together to hash out some of your experiences? How many of you know that a helicopter actually has no ground cushion? That 2750 rpm is a possible cruise control setting for an L-23D? That flaps cause a stall at a smaller angle of attack? That you pull 2 g's in a 60° bank, and your original stall speed is increased approximately 41 percent? I could, of course, go on and on, but these examples illustrate the possibilities in hangar flying. Such discussions will make you want to discover the many points that are so often overlooked in primary flight training, and those which you

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Capt Oliver is with the Combat Aviation Company of the 101st Aviation Battalion, Fort Campbell. He is dual rated and has more than 1800 hours flying time.

can use to stimulate interest in your fellow aviators.

Experience is the best teacher, but expensive, its salary varying as the cost of accidents. Why not learn again what was once taught you? Psychologists tell us that we forget a great amount immediately after we have learned a new subject, but they also state we can relearn a subject more easily and more rapidly, and the second time around the "forgetting" curve is less severe. Who knows what happens as we increase the cycle of learning?

Every unit in the Army operates under a training program. An aviation unit can best train its pilots by the information in the handbooks and from the experience of its own pilots, for an aviator's sole flying job is to make his machine perform in the best possible manner. I realize that the language of the handbook is sometimes technical, and often not enough information is given for an adequate explanation; however, enough information is given to make the pilot at least aware that a situation exists, and it is the pilot's curiosity or quest for knowledge that will make him the old "pro" in this business.

An example of not quite enough information can be shown by a statement found in the handbook for an H-34. The statement in essence is to *never place less than a load factor of two on the machine.* Now, how can you expect to fly if you know that in straight and level flight the load factor is always one, and one is certainly less than two? When this statement was brought to my attention, I had the good fortune of having an expert in aeronautical engineering to explain its actual meaning. But, some good ole hangar flying with your compatriots should reveal the proper meaning to you. The statement really means *never to decrease the limit load factor to two,* and this means that if you exceed two g's you will encounter structural damage. Thus, a gross weight of 16,000 pounds on an H-34 allows you only 1 g for maneuvering, since this weight reduces the load factor to 2 g's and 1 g is used to sustain straight and level flight. I know! You couldn't get the darn thing off the ground if it weighed 16,000 pounds, but the fact remains that an increase in weight decreases your margin of safety in structural strength design.

I would like to relate an experience of a friend of mine and ask your opinion of his experience. Flying an L-23D at 11,000 feet and picking up a little ice, he suddenly began to lose altitude. The carburetor heat was full on and giving an indication at the bottom of the yellow marking on the carburetor heat indicator. To develop more power, my friend decided to remove the applied carburetor heat. When he did, the aircraft picked up airspeed and stabilized itself at 11,000 feet, indicating 150 knots. Does this mean that although correct manifold pressure and rpm is indicated the engine is not developing sufficient horsepower?

Along this same line of thought, an accident occurred to a twin-engine aircraft on takeoff. The pilot and copilot were killed. Ground observers stated that they thought the engines surged several times before the crash. The accident investigation board did not pursue this fact to any great length, although the magneto switches were found to be set on only the right magnetos. The board concluded that the actual cause of the accident was undetermined and the most probable cause was a reversal of aileron controls during rigging. However, as most of us know through experience, an engine will not develop full power on only one magneto, though both rpm and manifold pressure may be indicating properly. The engine simply cannot ignite all the fuel it receives. Could a supply of hot air to an engine cylinder at altitude give the required manifold pressure reading but not the proper density, resulting in an inefficient fuel-air mixture and causing an actual loss of power similar to operation on one magneto?

These are only a few incidents or thoughts that could be used in a session of hangar flying, or even in a formal class as required by your unit training program. The important fact is to let your friends benefit from either your knowledge or lack of knowledge. LEARN TOGETHER! Don't shrug off an experience simply because you can't explain it to yourself. Ask questions. Check the handbook. Discuss it with your friends. Above all, satisfy yourself that you understand what happened.

Be professional! You have heard this remark time and again, but it pays off. I know of several small aviation units that do not have an accident prevention program that you can actually see, but it is there. It's in the form of close association of the pilots assigned, and the results are *no* accidents. They are professionals, and as with professional gamblers, they allow themselves every bit of margin available. When the chips are down, it's that extra margin, gained through more knowledge, that will keep you on the payroll.

A well-planned aircraft accident prevention survey will uncover discrepancies which, if found soon enough and corrected, will help prevent accidents before they happen, but

What Is An Aircraft Accident Prevention Survey?

Captain Joseph H. Masterson

Can YOU pass this test? *TRUE* *FALSE*

1. An aircraft accident prevention survey is an inspection conducted to determine flight safety hazards.
2. Only units with high accident rates should have accident prevention surveys.
3. An aircraft accident prevention survey is made to determine why a particular unit has been having accidents.
4. All findings from an accident prevention survey should be reported to a higher headquarters.
5. Aircraft accident prevention surveys should always be accomplished by personnel from higher headquarters.
6. The same type of aircraft accident prevention survey will apply to any unit.

If your answer to any of these was TRUE, please read on. All correct answers are FALSE.

Let's examine the first statement. The one word that causes it to be false is *inspection.* An accident prevention survey is a *survey,* not an inspection. It is made solely to help an aviation unit with its accident prevention program. The advantage of having an outsider do the actual survey is psychological: he's more apt to be objective and see things the surveyed unit has been overlooking. We constantly use this technique in other realms. Think for a moment. How many times have you asked someone to check your figures, your spelling, your wording, or an oral presentation you're planning to give? The old "two heads are better than one" dictum is the precise spirit and intent of an aircraft accident prevention survey. We use the survey as a second head to help us uncover existing hazards to flight.

Statement number two advocates aircraft accident prevention surveys only for units with high accident rates. Although it is desirable that units experiencing accidents frequently employ this medium to help prevent future accidents, it should by no means be limited only to them.

Capt Masterson is with the office of the Aviation Officer, 6th Army, Presidio. He is dual rated and instrument qualified.

How about the unit or units that are not having any accidents? These units should have surveys to help them continue their accident-free record. Additionally, a survey shows the personnel conducting it how this unit goes about maintaining such a good safety record. It is very possible that new safety techniques may be learned by the survey team, which can in turn disseminate this information to all units.

You may feel that an answer of *true* for statement number three is justified, since an accident prevention survey may uncover some hazard to flight that could have caused previous accidents. We must remember that the aircraft accident prevention survey is not primarily concerned with accidents that have happened, but with *preventing future accidents.* It is true, however, that an adverse flight safety situation which caused an accident in the past may still exist and a later survey will serve to uncover it.

As for statement number four, it is *not* necessary to report all findings of an aircraft accident prevention survey to a higher headquarters, since in most instances discrepancies may be corrected at the unit level. In the event that corrective action is beyond the scope of a unit and assistance from a higher echelon is necessary to eliminate the hazard, the findings pertaining solely to this area would be reported to help obtain fast corrective action.

Statement number five is false because it makes no difference what echelon of command conducts the survey as long as it is conducted and accidents are prevented. I do not mean to imply that the accident prevention survey should not be well planned in advance or the survey team be composed of noninterested, unqualified personnel. For the survey to prove effective, the two elements just mentioned are a must. An example of units on the same echelon of command conducting surveys would be units within an airfield command, through mutual agreement, each sending a survey team to check on the other. Another technique would be to have units of a lower echelon conduct a survey on a higher headquarters unit. This latter type of survey would certainly eliminate the false impression that such a survey is an inspection.

The sixth and last statement is false, since any plan for an aircraft accident prevention survey is a guide. We must all look for additional factors and areas to examine to ensure more effective means of aircraft accident prevention. Additionally, Army Aviation units vary as to geographic location, type of aircraft flown, and mission assigned but are all subject to the same problems of safety and accident prevention. With this in mind, I feel the following outline of a survey guide can be adapted by additions or deletions, to the requirements of a particular unit or organization.

OUTLINE OF A SURVEY GUIDE

A. Accident Prevention Program
B. Pre-Accident Plans
C. Airfield Operations
D. Airfield Maintenance
E. Aviator Training
F. Crash Rescue and Fire Fighting
G. Communication Equipment and Procedures
H. Line, Hangar, and Shop Safety
I. Physical Aspects of Field or Other Facility
J. Airfield Supply

As Army Aviators we realize that with the rapid growth of Army Aviation our equipment becomes more sophisticated and complex. Larger transport aircraft, faster reconnaissance aircraft and the new concept of arming Army fixed wing aircraft and helicopters require that aviation personnel, whatever their function, be technically proficient in their jobs.

A well-planned energetically conducted aircraft accident prevention survey will help to uncover areas where technical proficiency is not up to standard or where unsafe practices are being followed. Discrepancies that are found early enough and corrected will help prevent accidents before they happen.

The basic purpose of an Aircraft Accident Prevention Survey is to prevent accidents before they happen. USE THEM!

NOTE: The latest issue of the Aircraft Accident Prevention Survey is now available. Address your requests to: Director, USABAAR, Fort Rucker, Alabama. Direct communication authorized, AR 15-76.

From the USAAVNS

CDO

A qualitative materiel requirement for a night vision system has recently been prepared by CDO and forwarded to USCONARC for approval. This system will collect the weak natural light present even on the darkest of nights, amplify it thousands of times, and make it available for use by the human eye. The device envisioned takes advantage of the latest technological breakthroughs in light amplification, and is a major step toward a goal of complete visual flight. While the system will not quite turn night into day, it will permit a glimpse into the darkness, and reduce the dangers and restrictions of blind flying.

DOI

Work has started on preparation of the 1963 Army Aviation Annual Written Examination and Study Guide. The 1963 examination will follow the same general format as the 1962 examination, i.e., the questions will follow a logical sequence that an aviator might encounter during a flight.

As in 1962 a miniature Jeppesen Manual will be reproduced for use with the examination, which should eliminate most of the reference problems and increase the subject area for questions.

The 1963 study guide will include the same type of questions used in the examination and will also cover additional areas of interest. The aviator will use his own Jeppesen Manual and a current copy of all other references with the study guide. The only exception to this will be the sectional avigation, and approach charts, which will be distributed with the study guide.

Questionnaires will again be distributed with the 1963 examination. Comments received on questionnaires are carefully checked and assist a great deal in the preparation of the examination. Further comments by aviators are solicited to assist in further improvement of the annual examination.

The target dates for distribution to the instrument examiners are as follows: 1 November 62 for the study guides and 1 January 63 for the examinations.

Dept of Tactics

The first Rotary Wing Machinegun Instructor's Course was conducted by this department 9-20 April 1962.

A thorough analysis of the course has been made. This analysis, coupled with comments by the students, resulted in many improvements in the tactics and techniques to be used with the new XM-1 machinegun system. This information will be incorporated into future courses.

The 2-week course, consisting of 15 hours of ground school and 38 hours of practical exercise, was designed to qualify selected rotary wing aviators as instructors in the techniques of aerial machinegun fire using the XM-1 .30 caliber MG kit.

Some of the typical classroom material presented consisted of: employment of the ACT, reconnaissance and security missions,

from the Falcon's Nest

planning aspects and principles of air-to-ground machinegun fire, armament systems, nap-of-the-earth operations (to include low-level autorotations), low-level navigation, and tactical movement to include approaches, target detection, engagement and disengagement.

The flying portions of the course consisted primarily of static, hovering, bobbing, and running fire at designated targets at varying ranges. Practical exercises were also conducted on nap-of-the-earth flying and low-level navigation.

The primary reference material used during the course was the new TC 1-( ), Machinegun Kit XM-1, still in draft form but being prepared for field review at this time.

Dept of Maint

Every aviator coming to Fort Rucker for transition into the AC-1, AO-1, and L-23 receives a block of instruction in maintenance. The question often comes up, "Why do I need maintenance concerning the aircraft?" The primary reason is safety, and also the possibility the aviator may be a future maintenance officer.

During the AC-1 (Caribou) transition course, maintenance is taught in the first 3 weeks. Here the aviator flies for one-half a

day and has ground school for the other half. The maintenance program of instruction is for 28 hours and covers the following subjects: Description, 1 hour; Flight Controls, 2 hours; Inspections, 1 hour; Instruments and Radio Equipment, 2 hours; Fuel, Carburetor, and Cruise Control, 2 hours; Utilities, 3 hours; Propeller, 2 hours; Electrical System, 2 hours; Weight and Balance, 5 hours; Engine, Ignition, and Components, 2 hours; Hydraulics, Brakes, and Landing Gear, 3 hours; Review of Emergency Procedures, 1 hour; and Examination and Critique, 2 hours.

Students in the AO-1 (Mohawk) transition course also receive maintenance instruction during the first 3 weeks. Here again the aviator flies one-half a day and has ground school the other half. The maintenance program of instruction is for 31 hours and covers the following subjects: Description, 1 hour; Flight Controls, 2 hours; Electrical System, 3 hours; Powerplant, 3 hours; Instruments, Avionics, and Photo Equipment, 2 hours; Fuel System, 3 hours; Oxygen System, 1 hour; Heating and Ventilating System, 1 hour; Utilities, 2 hours; Hydraulics and Pneumatics, 3 hours; Propeller, 2 hours; Weight and Balance, 2 hours; Ejection Seat, 3 hours; Emergency Procedures, 1 hour; and Examination and Critique, 2 hours.

Aviators receiving an L-23 (Seminole) transition have maintenance instruction only during the first 2 weeks of instruction. The schedule is arranged for flying one-half a day and ground school for the other half. The maintenance program of instruction is for 24 hours, and covers the following subjects: Description and Flight Controls, 2 hours; Fuel, Carburetion, and Cruise Control, 3 hours; Instruments and Radio Equipment, 2 hours; Electrical and Ignition Systems, 2 hours; Propeller System, 2 hours; Landing Gear System, 3 hours; Heating and Ventilating System, 1 hour; Oxygen and Deicing Equipment, 1 hour; Inspections, 1 hour; Engine and Components, 2 hours; Weight and Balance, 3 hours; Examination and Critique, 2 hours.

Besides instructing on the limits and operation of a system, instructors stress how a failure would affect the aircraft, and what should be done to correct, or prevent the condition from multiplying.

YOUR HELMET

THE PILOT'S protective helmet was designed primarily to protect its user against head injuries. It can also prevent loss of the oxygen mask in the event of high altitude ejection. The visor lens is a good sunglass, and also affords protection during a high speed ejection. If you know your "Do's and "Don'ts" about helmets, you will be assured of adequate protection when necessary and get satisfactory service and longer life from your helmet.

DO'S:

Do keep chin strap tight when in use.

Do protect your lens. Scratched lens impair your vision.

Store and carry helmet in your carrying case.

Do spread your helmet only far enough to allow ease of donning.

Do be sure your helmet is properly fitted and adjusted for comfort.

Do thread the communication cord behind the shell lacing to prevent excessive flexing.

Ensure that the neck band is not loose.

DON'TS:

Don't carry your helmet by the communication cord.

Don't throw it in your locker.

Don't spread your helmet excessively.

Don't lay your helmet down on the visor lens.

Don't wear a sloppy fitting helmet.

Don't let the communication cord dangle and flop about.

From Safety TIPS, AFLC

Continued from page 27

pared to the overall effects of the successful accomplishment of "Task Force Rescue's" mission.

CONCLUSIONS

The events which occurred in "The Gauntlet" were indeed a tragedy for the United States Army. The problem areas which contributed to the tragedy—primarily inadequate reconnaissance, communications, and mobility—were paramount in this engagement. Modern Army Aviation, properly employed, very probably could have prevented this terrible loss of men and equipment. The support potential of Army Aviation is improving rapidly. Let us be sure that our knowledge of the hardware and training in its use receive proper emphasis. Let us be sure we are ready to exploit this potential throughout the gamut of future military operations.

Mr. Aviation Safety Officer —

personal ingenuity and imagination will be big factors if you want to find ways to cut your unit's accidents to minimum.

What can YOU do?

WHAT CAN YOU do toward keeping your unit's aircraft accidents to the absolute minimum? The answer is that you, alone, can't reach this goal. It's a job that requires a complete program—an *Aviation Accident Prevention Program.*

Outside help—literature, films, posters—is not enough! This program demands the active interest and participation of the entire unit. *YOU* will have to use your initiative and resourcefulness to get them. If you'd like to cut your unit's accidents to the minimum, if you really want to start an aviation accident prevention program, here is how *YOU* can do it.

GET A TARGET

First decide where you want to concentrate your efforts. If 80 percent of the accidents in your area are due to autorotations, don't spend all your time working on instrument takeoffs. Direct your efforts where they are most needed. This is too big a job to worry about improbable accidents. Save that until you've solved *ALL* your current problems.

PERSONNEL

Talk to the right people about the right problem. An Iroquois company could care less about Otter landing accidents. Tower operators are seldom concerned with maintenance problems. Save them for mechanics.

This doesn't mean others aren't concerned with accident prevention. Everyone is! But don't waste their time. Talk to tower operators about traffic control; tell the mechanics how to keep their aircraft in the air; tell the wives about hypoglycemia. Talk to them all—but talk about *THEIR* problems!

MEDIA

How do you reach each and every person in your outfit? How do you get the message across? Here are some of the ways.

TALKS

No drug yet invented will put as many people under sedation at one sitting as a dry safety lecture. Sex them up! This doesn't mean women in their altogether. It means the use of imagination, pictures, slides, appropriate jokes—anything that will keep your audience alert and receptive. Keep them short! Few aviation personnel have escaped the kind of talks in which 10 minutes worth of material was stretched to fill an entire hour. Far better to compress 60 minutes of material into a 10-minute talk.

Be specific and stick to the point! You may think you're covering a lot of ground when you wander from subject to subject, but you've probably lost your audience in the process. If you doubt this, surprise your next audience with a short quiz.

Use training aids as aids and not as props. It's an unfortunate but common tendency for speakers to rely on an overabundance of slides to avoid the research and work necessary to produce a really interesting talk. We saw one speaker who had so many slides he couldn't recognize some of them when they were flashed on the screen. Try to avoid cramming too much information into one slide. It may look impressive to have graphs with many colored lines and mountains of statistics, but it's odds on no one will remember what you intended the slide to show. If you feel you must impress

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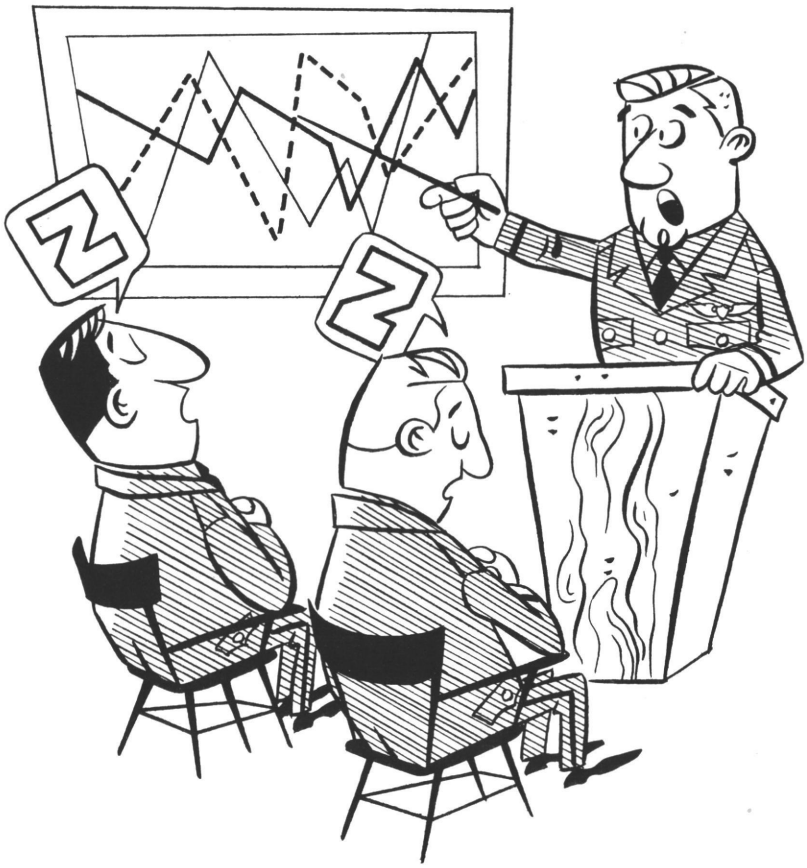
Prepared by the United States Army Board for Aviation Accident Research.



" . . . furthermore, when the flubbus falls, note the corresponding rise in overall ghekus, which adversely affects the point where the blue line interposes a weakening of the brunel base. Accordingly, blah, blah, blah . . ."

your audience with statistical data, use a simple bar graph. Better yet, use a cartoon.

Speak the language of your audience! This doesn't mean that you should ever talk down to anyone. Far from it. What it means is that you must take the trouble to know your audience and gear your talk to a common level of understanding. Simple language is the hallmark of effective speakers.

TRAINING FILMS

Every film made on an aviation subject is a potential accident prevention film for your use. Whether it applies to flight, navigation, weather, communications, or what have you, the film can serve as a basis for a shot of accident prevention to someone in your unit. Your local film library will have a complete listing. Other agencies, such as the FAA, state aviation department, and manufacturers are sources.

ACCIDENT PICTURES

Some people express a distaste for accident pictures, but few can resist looking at them. Because of this, they make excellent attention getters. Use them, but use them right. Caption each picture with an explanation of WHAT happened, WHY it happened, and what can be done to PREVENT its happening again. Stay away from gruesome pictures at all costs.

EXPERTS

Here is real pay dirt. Experts of all kinds abound in your vicinity: flight surgeons, tech reps, maintenance personnel, tower operators, engineers, and many others, all experts in their particular field. You're the prevention salesman. Sell these people and put them to work.

DEMONSTRATIONS

This refers to everything from how to operate a fire extinguisher to the care of parachutes and personal equipment. Demonstrations are a very good way to sex up your talks.

SKITS

As a small Hollywood producer, you can don a beret and dark glasses and find local talent to act out the right and wrong ways to do any job. Too much radio chatter around your area? Put on a skit and dramatize an emergency situation. A get-home-itis skit is especially effective around Christmas.

POSTERS

You'll receive a few through channels, but your own will serve better. Look around and chances are good you'll find an artist, amateur or professional, among your group. Remember the most effective posters are those with few words. Avoid posters that say DON'T!

OTHER SOURCES

If there is a group in the world that helps each other, it is those people in the accident prevention field. If you're near an Air Force or Navy flying base, you'll find their safety officers are men after your own heart. They'll understand your problems and overload you with ideas and assistance.

These are just a few of the ways to get into action. You won't solve a particular problem with one method. Combine several and dig up others. Ingenuity and imagination will be your biggest success factors.

CRASH SENSE

PREPARED BY THE UNITED STATES ARMY BOARD FOR AVIATION ACCIDENT RESEARCH

Crystal Ball

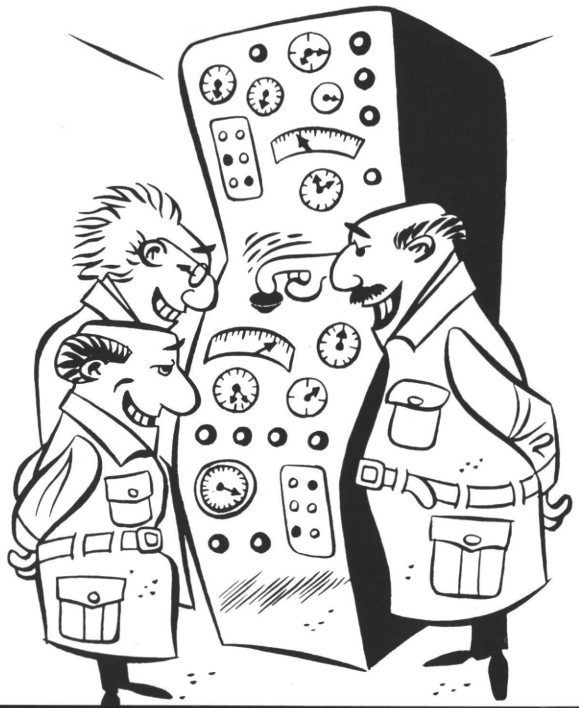
PLANS CALLED FOR CRASH SENSE to publish a look into the future for the month of August 1962. With the magic of modern technology, including the use of a mechanical brain, we hoped to bring you an accurate forecast of the accidents we can expect during the month. This, we felt, would guarantee the ultimate in accident prevention. Forewarned aviators would, for the first time, know what pitfalls to avoid; Crash Facts Message teletypes would rust away from disuse; and those in the accident research business would be forced to seek other employment.

Accordingly, requisitions were forwarded through appropriate channels for the necessary equipment and personnel. Finally, the great day arrived. With a battery of white coated attendants climbing over and through its maze of tapes and wires, the machine was plugged in and its tubes hummed into action. Our question was fed through the intake side and the brain indicated its concentration through a series of whirling dials. Tension mounted as the scientists awaited its answer.

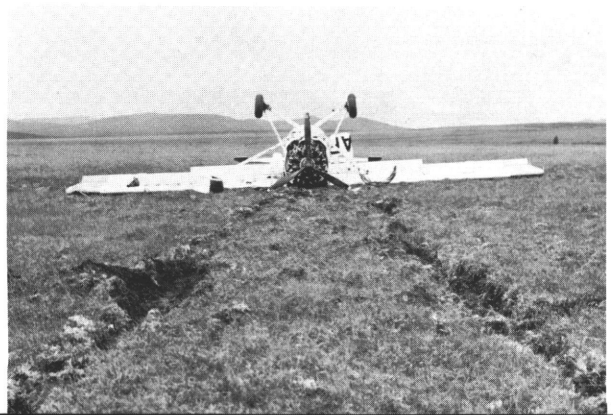
Electricity crackled through the room, scorching the air, and a loud rumbling emitted from the innards of the struggling machine. Suddenly, with a great WHOOSH, it collapsed and a small piece of paper fluttered to the floor. On it were these words: GET A CRYSTAL BALL!

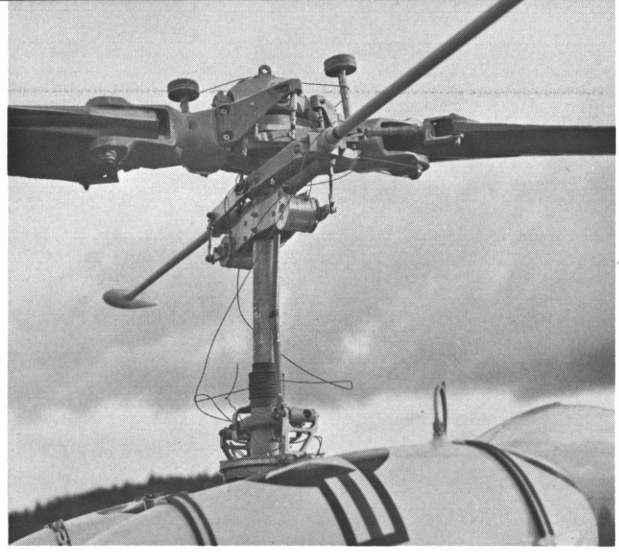
Alas, our crystal ball works only in reverse and we can only relate what has happened in the past. However, the past repeats itself often enough so that what happened last August is a reasonable prediction of what's in store this month. In hopes this can be prevented, here are the major accidents of August 1961:

These, plus a few ever-present Bird Dog groundloops, are the August pictures in our reverse crystal ball. We sincerely hope this look into last year will prove completely inaccurate for this year. With your help, it can be.



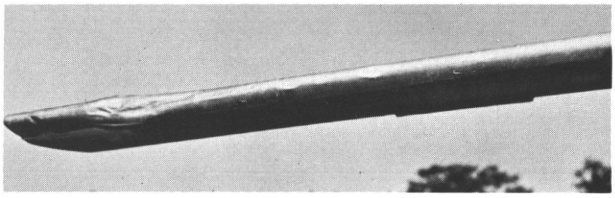
Partial engine failure due to materiel failure of valve head. Aircraft overturned during forced landing on soft, marshy surface.





Wire strike

Downwind approach to pinnacle helipad



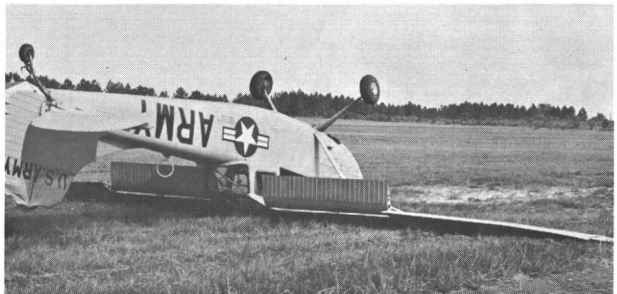
Tree strike

Late power recovery and excessive flare from practice autorotation

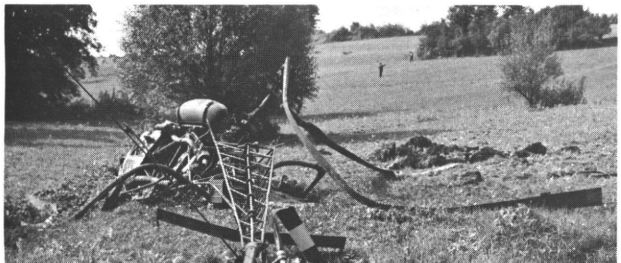
Aircraft struck light pole while taxiing

Fouled spark plugs and burned magneto breaker points

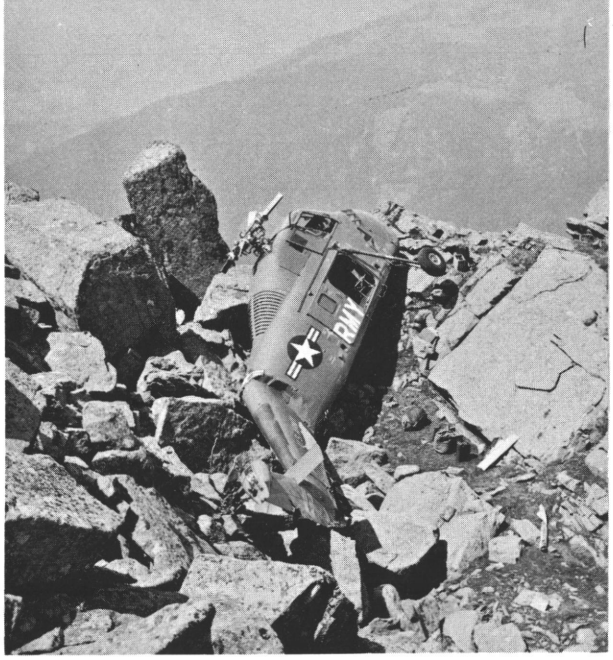
Groundloop in light crosswind



Wire strike



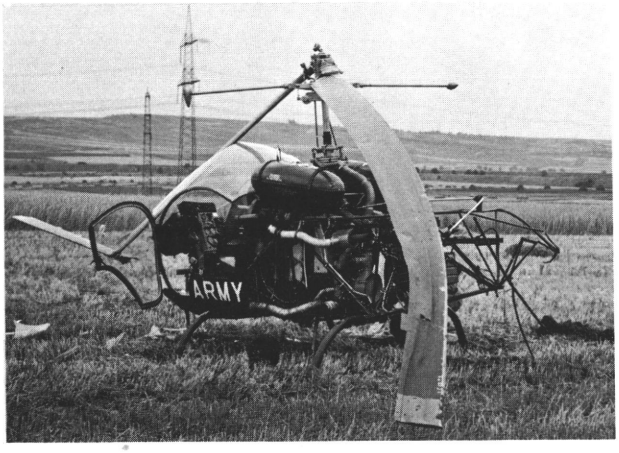
Fuel starvation. Flight was attempted despite fuel warning light which was on prior to takeoff.



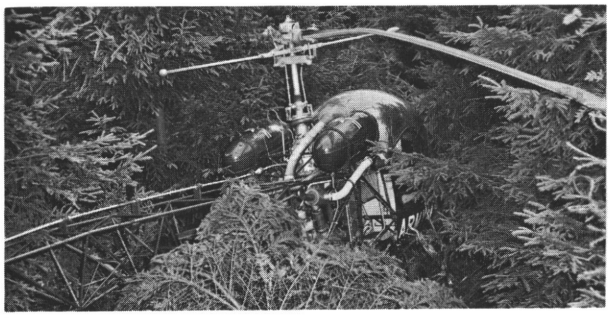
Failure to compute density altitude and check wind

Excessive aft cyclic during practice autorotation

Rolled out of strip boundary during landing and struck hole



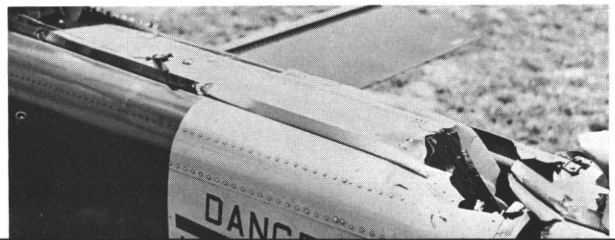
Attempted 180° downwind autorotation from 10 feet

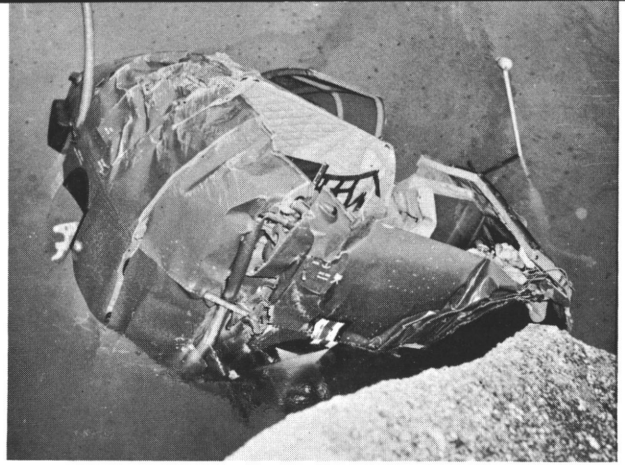


Attempted hovering reconnaissance of unsuitable confined area. Lost rotor rpm and crashed into trees.

Wire strike—incomplete reconnaissance—selected approach path into sun

Hard, tail-low landing — too little collective too late





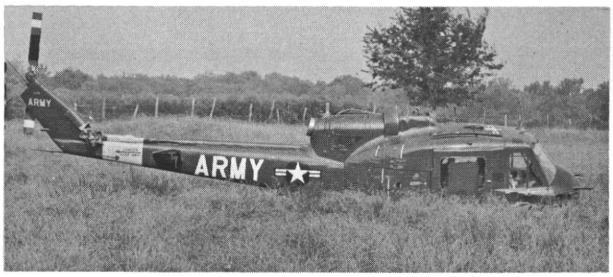
Attempted descending downwind turn into rock cliff at density altitude of 11,000 - 12,000 feet, with gross weight of 5,800 pounds. Wind estimated at 10-15 mph.

Attempted upslope hover with right main gear dragging ground

Attempted hover with low rotor rpm

Engine failure—aircraft struck grass-covered rock, shearing right gear, and rolled on right side. Numerous metal particles found in oil system.

Severe downdraft in mountain canyon

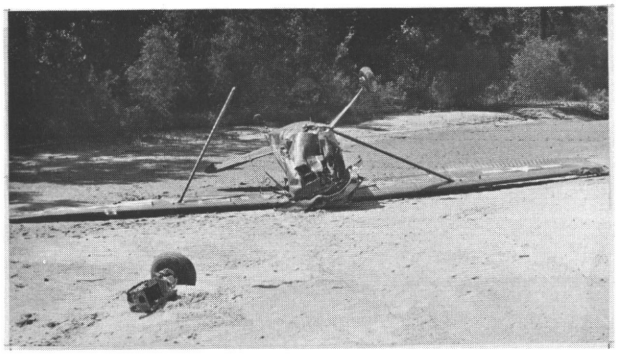


Ground fog

Attempted wing-over and dive from low altitude

Fatigued pilot — settling with power

Tree strike during approach to confined area



Above: Low-level flight over unknown area into sun. Aircraft struck wire and crashed.

Top right: Attempted VFR flight through fog

Helipad location permitted only 12-inch clearance between hovering H-13 and utility pole

Wire strike

Materiel failure of #9 cylinder head in area around exhaust rocker box

Well Done

Flight instructor Edward Blondell (right) at work

A COMBINATION of professional skill, knowledge, and courage has won for a civilian helicopter instructor a "Well Done."

The recipient is Mr. Edward Blondell, instructor for Southern Airways Company (contractor), Camp Wolters, Texas.

Early this year a solo student took off in an H-23D from the main heliport at Wolters and upon reaching an altitude of 150-200 feet experienced complete engine failure. The student immediately entered autorotation and established a landing approach. The touchdown was hard and the helicopter rolled on its side. At ground impact the fuel cell ruptured and fuel spilled over the crash area and was ignited seconds later. The student sustained a back injury and remained in the cockpit in a dazed condition.

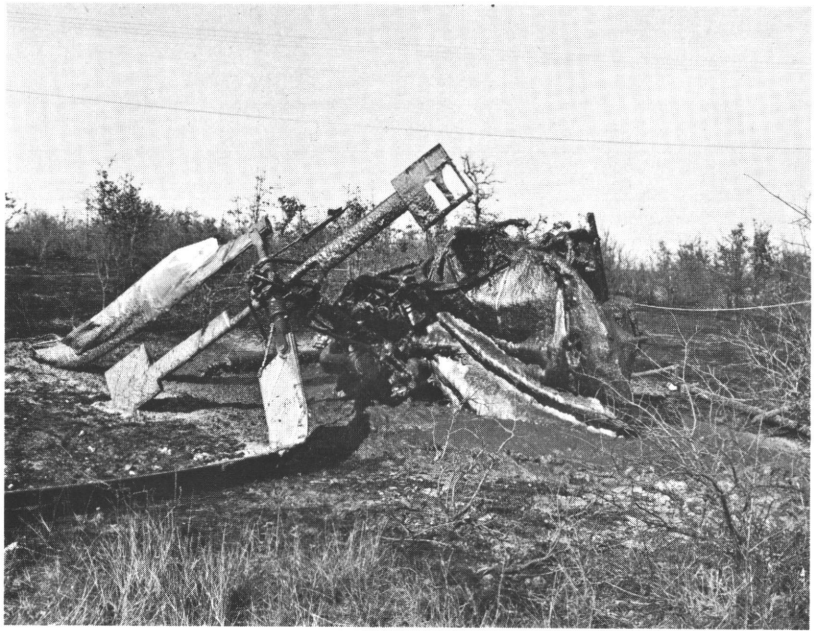
Mr. Blondell, flying another H-23D on takeoff during this time, observed the distressed helicopter going down. He immediately reported it to the tower to initiate the crash rescue system and rushed to be of assistance.

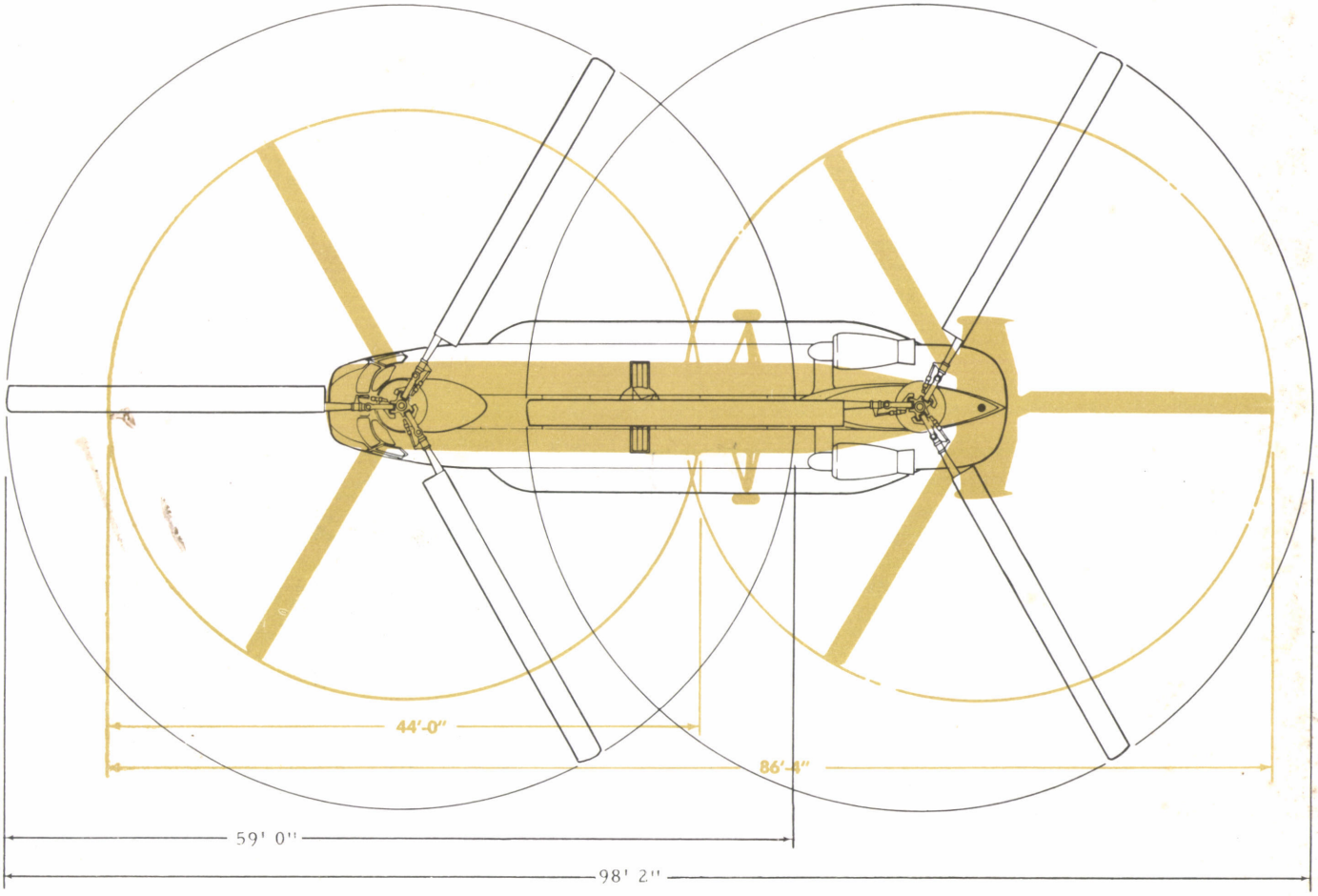
After landing near the crash scene he quickly made his way to the burning helicopter and bodily pulled the student to a safe distance. Fire quickly engulfed the helicopter after the student was clear.

The rescued student later said: "I don't know how long I was on my back until I saw smoke . . . I experienced pain and was unable to move about as I wanted to . . . then I was taken by the shoulders and pulled out."

Mr. Blondell's supervisors, associates, and the injured student were unanimous in agreeing that his alertness and decisive action in this emergency undoubtedly saved a life.

Charred wreckage of Raven after fire





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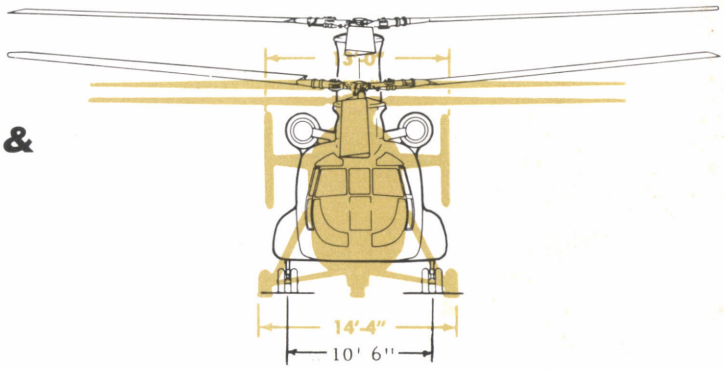
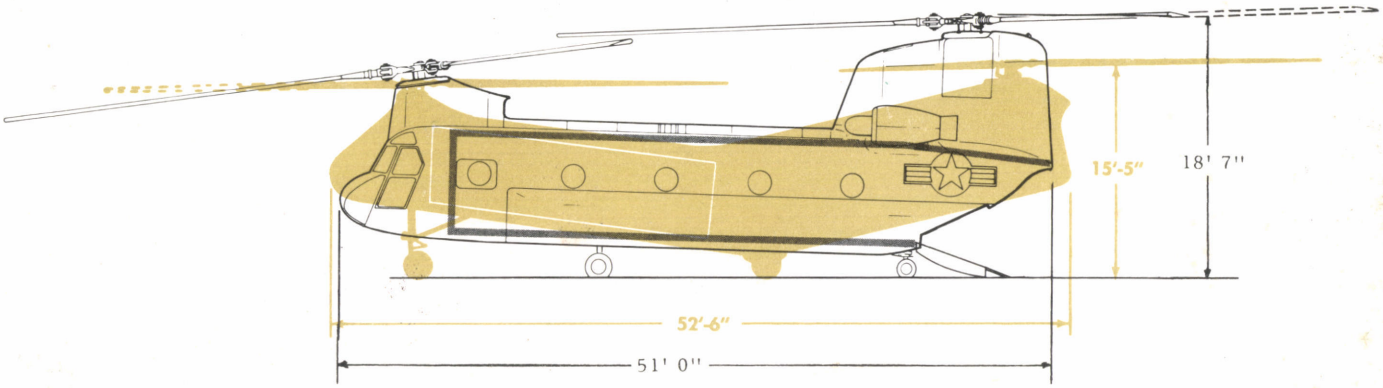
GENERAL ARRANGEMENT & OVERALL DIMENSIONS

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