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SEPTEMBER 1979
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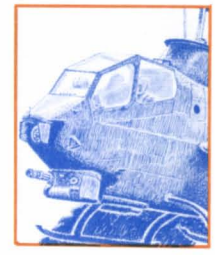
page 2

page 34

1 **CH-47 Chinook Introduction,** Joseph P. Cribbins
2 **Why?** COL James H. Hesson
8 **The U. S. Army Air Logistic Support Requirement,** COL Charles J. Oram
10 **Mountain Waves—A Force Second Only To Tornados,** LTC James D. Simpson (USMC, Retired)
16 **TASVAL,** James Arnold
18 **Joe,** CW2 Micheal J. Vandeveer
20 **No Place To Go,** CW2 Len Constantine
22 **EPMS Corner: Noncommissioned Officer Logistics Program**
23 **Net Call—Scouts Out!** LTC Charles W. Abbey and CPT Henry H. Scheuer
27 **OPMS Corner: Aviation Personnel Update** MAJ Jeremiah O'Fihelly
28 **Watch Your Tail,** CPT John G. Taylor III
32 **Witty One-Liners**
33 **You Have To Trust Somebody**
34 **New AH-1S ECAS Cobras,** 2LT Cynthia Sims
37 **DES Report To The Field: Programing Army Aviation Standardization Evaluation/Assistance Visits**
39 **The IP's Coefficient of Safety**
40 **PEARL's**
42 **Close Air Support—Just Facts,** MAJ Gene N. Patton
45 **Suddenly There's A Valley,** CPT Robert B. Robeson
48 **ATC Action Line**

Inside Back Cover: **Army Aviation Museum**
Back Cover: **Deployment Flight—CH-47C**

page 40



page 42

page 45

Cover: **The first YCH-47D helicopter hauls a 155 mm XM-198 howitzer. The 15,000-pound lift is being made using one of the aircraft's new systems, dual point cargo suspension. CH-47D Chinooks will start replacing earlier CH-47 models in the field in the early 1980s**

Richard K. Tierney
Editor

The mission of the *U.S. Army Aviation Digest (USPS 415-350)* is to provide information of an operational, functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine and other related data.

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I HAVE BEEN directly associated with the CH-47 Chinook from the days when it was a gleam in the eye of the developer. Back then the Army tested the V-107 which later became the CH-46A. During that time it was found that the V-107 payload would not meet Army requirements which included interfacing with the CV-2 Caribou (now C-7) and carrying selected missiles as well as other important Army equipment. Accordingly, the requirement dictated a medium lift helicopter which became the CH-47A with the first aircraft delivered to the Army in 1962.

Here was an aircraft that was concurrently developed, tested and fielded in record time. When the 1st Cavalry Divison (Airmobile) deployed to Vietnam in September 1965, it had a full complement of 48 CH-47A helicopters plus operational readiness float. This helicopter immediately became the mainstay of the 1st Cavalry Division for combat support and combat service support throughout probably the largest operational zone ever covered by an Army division in combat. The CH-47A was followed quickly by the CH-47B as an interim upgraded medium lift helicopter (MLH) and then the CH-47C as the Army standard MLH. Now the CH-47D is being produced as a modification of the A, B and C series.

In 1977 the Army completed a study called HELILOG oriented on helicopter requirements in the logistic role. In the study it was found that the medium lift helicopter in the form of the Chinook played a vital role in support of the Army in the forecast scenarios for contingency or all out mobilization. As a result of HELILOG, now approved by the third iteration of the Aviation Requirements for the Combat Structure of the Army (ARCSA III), the CH-47 company is being reorganized into three platoons with eight ships in each standard platoon. Each company will have integrated direct support maintenance (AVUM) and this capability will be available to any platoon when assigned or attached separately from the company; e.g., to a Division. This support concept will give greatly increased capability to the Chinook and enable its use wherever and whenever needed on the modern battlefield. We are looking forward with great expectation to the introduction of the CH-47D into the inventory. The Army is ready and waiting.

For an indepth look at the Army's CH-47 program I recommend you read LTC James B. Thompson's article, "Self-Deployment of CH-47 Medium Lift Helicopters to Europe," in last month's *Aviation Digest* and COL Hesson's "Why?" and COL Oram's "The U.S. Army Air Logistic Support Requirement" in this issue.

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WHY?

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First flight of the YCH-47D on 11 May 1979
Photography courtesy of Boeing Vertol

CH-47D

WHY A CH-47D? Why modernization? Answers to those two questions and explanations are simple, but nonetheless lengthy.

Reviews of the threat to be countered by a medium lift helicopter defined the requirement for the performance of a CH-47C, but greatly improved reliability, availability and maintainability (RAM), and reduced vulnerability.

Several approaches to meet the need were examined. Naturally it would have been nice to have a brand new helicopter designed from the bottom up, starting with a clean piece of paper. It would have been nice to incorporate all the very latest technology, and maybe even attempt to improve on that. But the Army has a limited budget to develop and field major new weapons systems.

A Cost and Operational Effectiveness Analysis performed in 1975 concluded that modernization of CH-47As, Bs and Cs to a new model (the CH-47D) would achieve most of the goals at a fraction of the cost of developing a new helicopter. Apart from ending up with a better helicopter, the single model fleet will simplify the Army's maintenance and logistics systems.

The CH-47D program was born. The hardware program started on 4 June 1976, with a research and development (R&D) contract signed with the Boeing Vertol Company to design, develop and qualify the CH-47D. Three aircraft were chosen to be remanufactured

The first prototype, a CH-47A, flying a mission in Vietnam in 1969

—a CH-47A, a B and a C model, all of which would be converted to D model prototypes. None of these were "cream puffs" for two reasons:

- Company commanders prefer to "unload" a hangar *queen.*
- One intent of the R&D program was to evaluate the cost and feasibility of modernization, fleet-wide, and so representative aircraft were used. The CH-47A, for instance, entered service in 1969, had more than 3,500 hours on it and survived two tough combat tours in Vietnam.

Following contract signature, the three aircraft were trucked from Harrisburg, PA, near New Cumberland Army Depot, to the Boeing Vertol plant in Ridley Township, PA near Philadelphia. They were received and inventoried by the Army Plant Activity and then Boeing stripped and cleaned each aircraft, and prepared to repair or replace those damaged or worn out parts which were not to be modernized.

Meantime, the Boeing engineering department started design of the seven new subsystems, integration of the updated Lycoming T55-L-712 engine and the many less major design items. The Inboard Profile, on page 6, shows the main areas of improvement, but there are many details not shown which will further increase survivability, productivity, staying power, RAM and crew efficiency —in other words, cost and operational effectiveness.

Let's take the systems one by one. The **fiberglass rotor blades** have many advantages. They have more efficient airfoils, originally developed during the Heavy Lift Helicopter Advanced Technology Component Program, and recently demonstrated on a modified CH-47C. The result is increased lift capability, cruise speed and fuel efficiency. This is all achieved at a lower rotor speed of 225 revolutions per minute which reduces noise and leading edge erosion.

Survivability? The blade has demonstrated a capability to withstand 23 millimeters (mm) high explosive incendiary hits in critical areas and still sustain flight loads. The fiberglass blades provide a lower radar cross section despite an integral metal mesh incorporated to ensure survivability against lightning strikes. And, the new blade will help the maintenance crew considerably—no more corrosion problems or integral spar inspection system checks, and the construction makes it much easier to repair in the field without removal. Also, there are provisions to fine tune the blades dynamically by simple weight adjustments. With the regular trim tabs, the maintenance officer can more easily track the blades and reduce rotor induced vibrations.

All the **transmissions** are brand new designs, but are based on proven technology. New gear materials are combined with advanced tooth profiles, improved bearings and housings and integral (main and auxiliary) lubrication and cooling systems—all to provide improved survivability, fewer components and leak points, and simpler maintenance. New drive system components and improved debris detection and protection systems, including an electrified screen, should greatly reduce false alarms and provide meaningful and reliable warning information to the pilot.

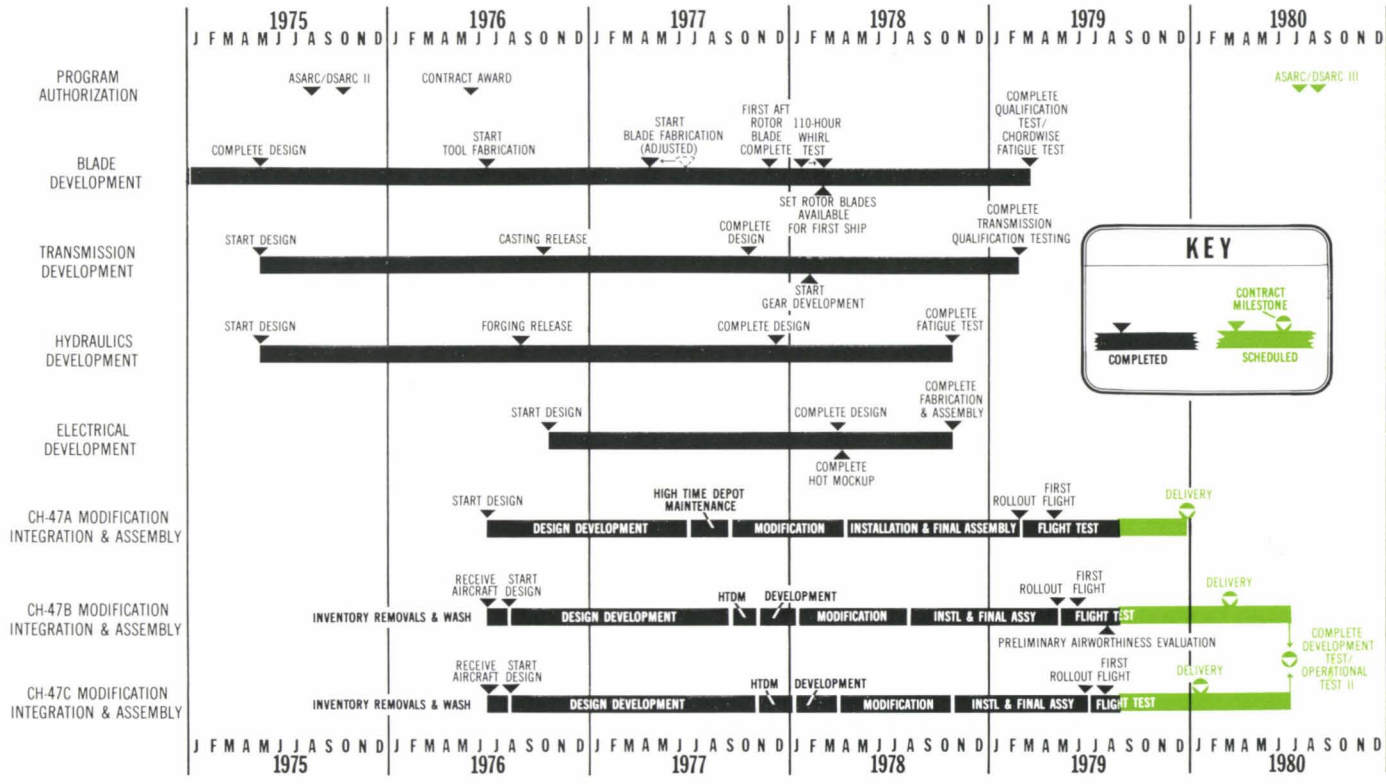
Improved magnesium alloy transmission cases with a corrosion inhibiting coating, and composite sumps capable of withstanding small arms fire, will further reduce transmission maintenance actions, as will the one piece gears (the shaft is integral with the gear) which eliminates fretting at what were previously bolted joints. The result of the new design is increased RAM and full use of engine power available at all altitudes and temperatures, to the maximum of 7,500 shaft horsepower (SHP) dual engine, and the 4,600 SHP single engine emergency rating.

The old **hydraulic system** will be totally replaced by modularized and self-contained separate flight control, and utility, hydraulic systems. Modularization reduces the parts count, leak points and vulnerable area. Separated hydraulic pumps, one on the forward transmission and one on the aft, with separated lines improves the combat staying power while use of MIL-H-83282 hydraulic fluid reduces fire hazards from all causes.

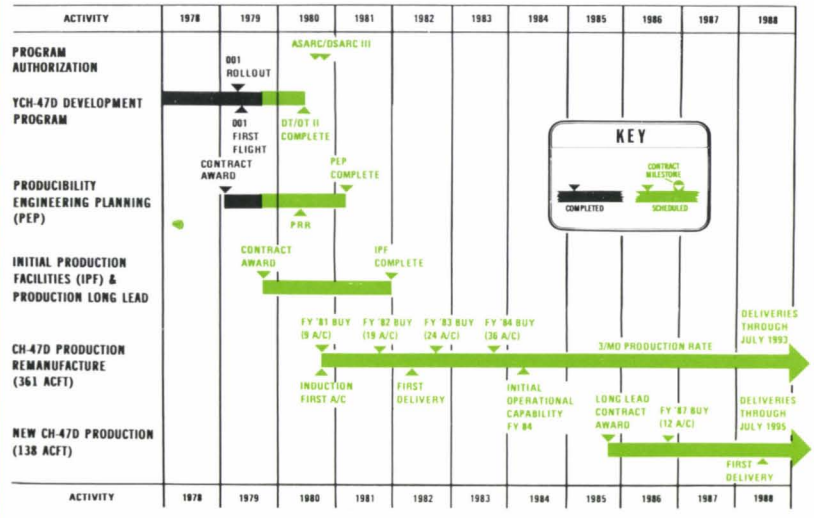
Not all of the **cargo handling system** is new, but the differences are significant. The center hook stays, but it has been upgraded from a 20,000 to 28,000 pound capacity. The curved beam and hook carriage, with the wear prone rollers, have gone. In their place is a newly designed diamond shaped

Second flight of the YCH-47D on 14 May 1979 carrying a weight of 51,000 pounds

YCH-47D DEVELOPMENT SCHEDULE



CH-47D PROGRAM/TEN-YEAR PLAN



The analysis and design of the modernized Chinook began in 1975 and the hardware program started with the contract awarded to Boeing Vertol on 4 June 1976. The first prototype was completed on 6 March and flown on 11 May 1979

aluminum alloy beam with a fixed-hinge mounted swiveling hook. All the operating modes, basic (electrohydraulic), emergency (electropneumatic) and backup (mechanical) remain unchanged. Two 20,000 pound hooks have been added, one forward, one aft. Each is attached to recessed reinforced airframe structure. These hooks may be activated by way of two electric systems or a mechanical backup. They can be used in any combination to carry one, two or three separate loads. This provides unprecedented operational flexibility, and use of the two new hooks in tandem greatly improves load stability, allowing increased cruise speed while slinging large, low density or aerodynamically unstable loads. The result is greater productivity—more ton miles per day.

Operational pilots participated in a cockpit mockup review so that their suggestions could be heard and included. **The overhead console** has been modified, lowered and tilted to make it easier to reach controls, such as the engine condition levers which have been relocated from the center console. In their place are better radios. The circuit breakers have been moved to panels to the side of the pilot and copilot, and the labelling has been improved. Other things have been done to help pilots do their job more efficiently. An instrument landing system has been added to the VHF omnidirectional range, controls and displays have been rearranged, a radar altimeter has been added and the intercom improved. A radar warning system has been incorporated and the identification, friend or foe (radar) improved. But the greatest help to the pilot will be the **Advanced Flight Control System** (AFCS) which will improve aircraft stability and in turn reduce pilot workload for terrain flying with and without external loads and at night under adverse weather conditions. Lower pilot fatigue will show up as a reduced accident rate. Heading and altitude hold with turn command features will increase mission effectiveness and the Built-In Test Equipment (BITE) will improve maintenance efficiency of the AFCS.

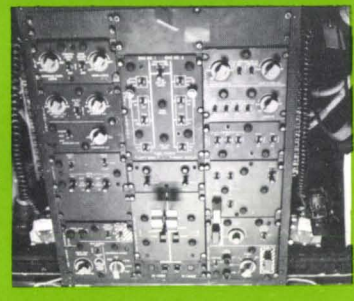
The electrical system features dual 30/40 kilovoltampere (kVA) oil cooled brushless generators of increased power and new solvent resistant wiring. Separation of the aircraft's redundant system, on each side of the cockpit, reduces vulnerability due to electrical failure for either internal or external reasons. A battery charger should reduce the nicad battery maintenance, prevent early battery failures and dangerous thermal runaways.

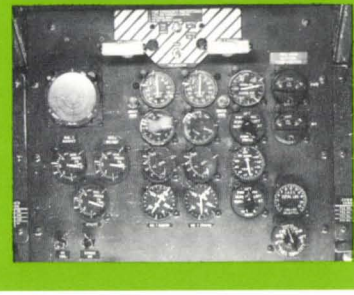
The new auxiliary power unit (APU) is no longer connected to the accessory gear box on the aft transmission. Instead, a 20 kVA generator and a hydraulic starter/pump are mounted on a separate APU gearbox to provide the power required for ground operations, systems checkouts and main engine starting. An electronic sequencing unit (ESU) has been added to control the APU start sequence and operation. This ESU gives the pilot one button to push to start the APU and then the ESU checks APU, and will shut it down in the event of a malfunction during the start cycle. A BITE display will tell the crewchief what went wrong.

The maintenance crew will find a panel in the rear of the troop cabin with gauges and lights to indicate the status of each transmission and hydraulic system.

The aircraft will have the qualified maximum gross weight increased from 46,000 to 50,000 pounds, but the airframe remains basically unchanged except in those areas where incorporation of the new systems necessitates change. Of course all aircraft will

TOP: Overhead panel
BOTTOM: Center panel





BELOW: Copilot panel

BELOW: Pilot panel

have damaged structure repaired or replaced in the remanufacturing process and the whole aircraft will have the intent of all current engineering change proposals applied. Then after modernization they will be coated with infrared reflective paint.

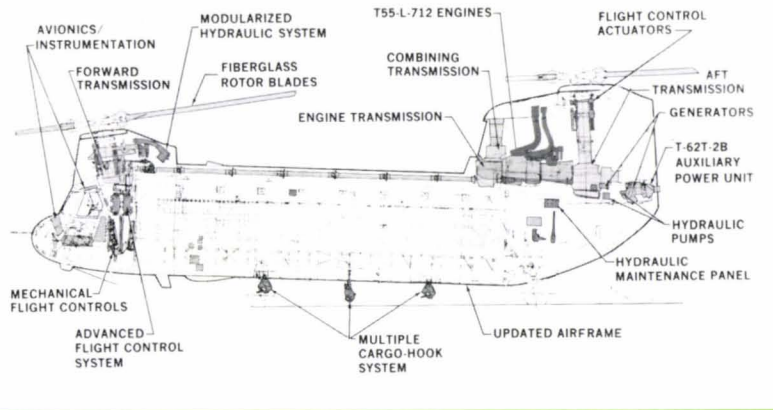
That is a summary of the CH-47D aircraft. Although certainly not all-inclusive, it gives a good idea of what to look for. As for when, first take a look at where we are now.

Development on the prototypes is complete including Clean and Dirty Rag Mechanic Reviews. The first prototype was rolled out on 6 March 1979 and flown 11 May, 4 months ahead of contract schedule and program cost below target. The second and third prototypes have been flown and the Army's Preliminary Airworthiness Evaluation is underway. The aircraft has flown at a gross weight of more than 50,000 pounds, exceeded 180 knots and demonstrated the specification 30-nautical-mile mission carrying a 15,600 pound M-198 howitzer dual point. The program objectives are being achieved, but there is still a long way to go, more development testing II, with one aircraft going to the Aviation Development Test Activity at Ft. Rucker, AL this November and a second following early next year. One aircraft will be tested to environmental extremes, -65 degrees Fahrenheit to +120 degrees Fahrenheit, in the climatic hangar at Eglin AFB, FL and in-flight icing tests will be performed at Minneapolis, MN. There the Helicopter Icing Spray will be flown by pilots from the Army Aviation Engineering Flight Activity to supplement natural icing conditions as necessary.

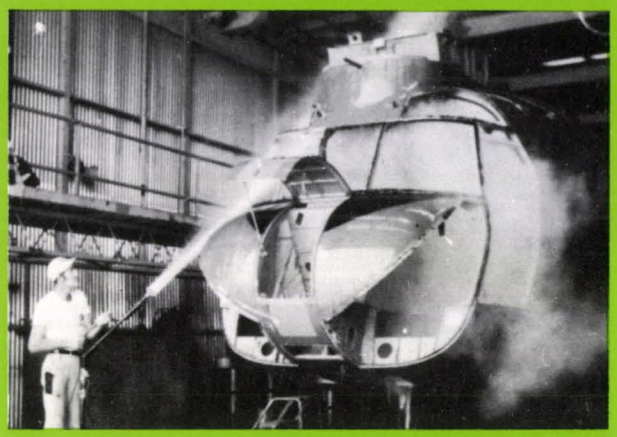
Then on to operational test II with two prototype "D" aircraft going to the 159th Assault Support Helicopter (ASH) Battalion of the 101st Airborne Division, The Screaming Eagles, at Ft. Campbell, KY for real operational tests. There will be no kid gloves, or special treatment. The aircraft will be operated in the field, and maintained in the field as they would in service. The only difference is that masses of engineering and RAM data will be carefully recorded to reveal any potential service deficiencies and measure achievement of operational objectives. And just to make sure that the information is valid, two "C" models will operate alongside the Ds, day and night, flying the same missions and receiving the same type of maintenance. This is the report card that will go in front of the Army and Defense Systems Acquisition Review Councils in September 1980 for a production decision.

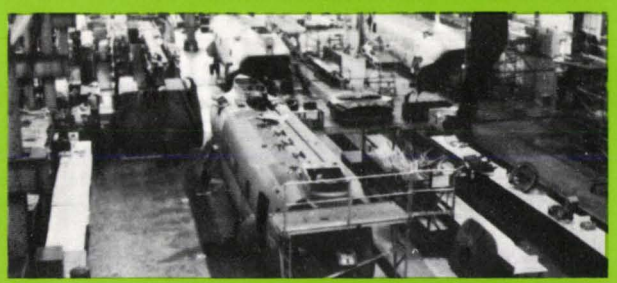
With a favorable decision a 24-aircraft-company initial operational capability will be achieved in February 1984. Then the rest of the fleet of about 400 aircraft will be modernized at the rate of three per month. That is the current plan, but a more efficient production rate of five per month is

YCH-47D INBOARD PROFILE



The first prototype rolls out at a ceremony at Boeing Vertol last March





TOP LEFT: The three aircraft chosen for rebuilding

TOP RIGHT: The three aircraft being shipped to the Boeing Vertol plant

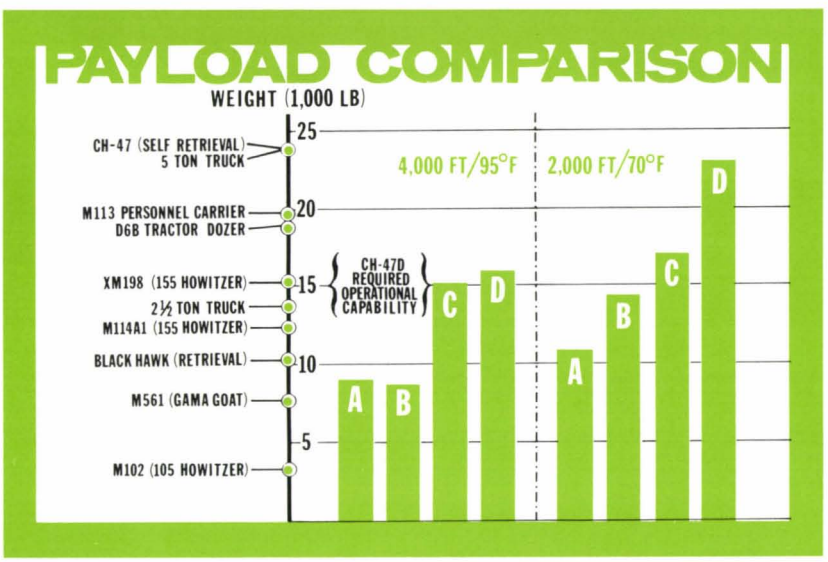
CENTER LEFT: The aircraft were steam cleaned

CENTER RIGHT: Stripped aircraft await modernization

LEFT: The three rebuilt aircraft

being examined. This would get the aircraft to the Soldiers in the field that much faster.

Are you still wondering if it might have been cheaper to make a new medium lift helicopter from scratch? The answer is no! The modernization (or remanufacturing) approach is estimated to have saved up to $700 million in research and development program costs and about $400 million in production—more than $1.3 billion savings in fleet life cycle cost. Maybe the Army is not getting a sleek, glossy new aircraft, but it is getting an aircraft system which will counter the threat when it is needed, and at a reasonable price.



The U.S. Army Air Logistic Support Requirement

Colonel Charles J. Oram
Director of Combat Developments
U.S. Army Transportation School
Fort Eustis, VA

WITH TODAY's extremely tight research and development and procurement budgets, there is a very natural tendency to go after only those systems which directly affect the outcome of the central battle by killing tanks and enemy Soldiers. This desire to optimize firepower has brought us a long way since World War II in the quality of our weapons systems. However, maximizing firepower bears burdens as well as blessings to field commanders, for they must now use every bit of their ingenuity to devise every method they can to feed the insatiable consumption rates of ammunition repair parts and fuel for their weapons systems.

Consumption rates, however, are only part of the problem. The high mobility dictated by the active defense to fight numerically superior forces and win will place a burden on the components of resupply. Tactics will not be dictated primarily by the limits of the weapons and the skill of those who use them but by the ability of the logistics tail to satisfy the required supply rate. The tempo of the battle will be in proportion to the rate at which the weapons are resupplied. Cost and operational effectiveness analyses for weapons systems always have assumed adequate logistics.

CH-47 Modernization Required Operational Capability

In 1974, when the CH-47 Modernization Required Operational Capability document was approved, the various Army committees were in total agreement that an Army air logistic resupply capability was required which could react to surge situations, overcome constraints to other transport modes, and respond to critical situations which require rapid movement of troops, materiel and weapons systems characterized by a rapid, hard-hitting first battle in a European conflict. The Army and Defense Systems Acquisition Review Councils (ASARC/DSARC II) agreed with this need

The Army and Defense Systems Acquisition Review Councils (ASARC/DSARC II)

and approved a program which would provide the Army with a medium lift capability through the year 2000. The decision to pursue modernization was based on a very extensive analysis of how to best satisfy the requirement at the least cost, and it included alternatives such as the CH-53E and the medium lift utility tactical transport aircraft system (UTTAS) interrelationships on the battlefield.

The analysis which led to the need to extend the life of the CH-47 was extensive and looked well into the future. The requirements for CH-47 lift capacity have been supported continually since the 1974 requirement document by other studies. The Helicopter Requirements to Support the Army Logistics Mission in Europe Study, a part of Aviation Requirements for the Combat Structure of the Army III was a detailed look at the European requirement. This study increased by 300 percent the number of CH-47s which will be forward deployed in Europe. It was not just to support CH-47s, but it considered Air Force intratheater airlift and was the basis for approval, as part of the Army force structure of a mix of CH-47 and UTTAS type aircraft to satisfy the identified airlift requirement. The Ammunition Initiatives Task Force also supported the need for CH-47 airlift capability for Class V resupply.

We are now 5 years down the road from the original agreement to improve and extend the life of the CH-47, and it would be appropriate here to exercise our 20/20 hindsite and answer some hard questions:

- About $100 million in research and development funds has been expended to develop the CH-47D. Were these expenditures a mistake? Does the anticipated requirement no longer exist?
- If the need has diminished, what went wrong with our ability to see 5 years ahead and plan rationally within the program objective memorandum cycle?
- The only justifiable reason for changing the requirement would be a drastic change in U. S. Army employment doctrine or a change in Soviet threat which would totally invalidate the use of medium lift helicopters to support the Soldier in the foxhole. Has such a significant change occurred?

Helicopter Requirements to Support the Army Logistics Mission In Europe

Aviation Requirements for the Combat Structure of the Army

Air Force Intratheater Airlift/ CH-47/ UTTAS

The R&D funds were well spent . . . further development . . . entirely feasible

A preliminary look at the requirement in preparation for the CH-47 modernization production decision shows that our estimates 5 years ago of airlift requirements were reasonably accurate. In the future, however, as is being substantiated by Division 86, airlift requirements will increase as new weapons are introduced which have greater firepower and consumption rates.

The CH-47 modernization, discussed in this article and in the article beginning on page 2 is nearing completion of the research and development (R&D) phase. It is 4 months ahead of schedule and on-cost, placing it in a select minority of Department of Defense programs. This demonstrates that the R&D funds were well spent and that further development would be entirely feasible. The modernized CH-47D is the Army's first attempt to reuse valuable aircraft assets rather than bear the financial burden of developing a totally new airframe to do the same job. The CH-47 has been and will be one of the commanders' tools which will provide the mobility and firepower required to fight outnumbered and win.

It became apparent while researching material for this article that the subject of mountain waves is very well known in the mountainous regions but sadly lacking in the remaining regions of the United States. This article is intended to expand the awareness of this phenomenon and its destructive force rather than to focus on a particular question or pose a solution to a specific problem. It discusses what causes the wave, its identifying features, and the wave itself as well as a brief look at a similar wave phenomenon associated with warm dry winds

MOUNTAIN WAVES— A Force Second Only To Tornados

LTC James D. Simpson
U.S. Marine Corps (Retired)

Mountain Wave Characteristics. The meteorological phenomenon referred to as orographic mountain turbulence, lee or gravity waves—but better known as mountain waves—is as old as meteorology itself. It is the phenomenon which occurs under certain conditions when air flow is directed toward a mountain range or rough terrain producing a stationary area for 10 or more miles to the lee side of the range possessing extreme turbulence and very high velocity updrafts and downdrafts.[1]

Characteristics of a typical mountain wave are illustrated in figure 1, pictorially describing the sequence of development. As depicted, the air flows smoothly with a lifting component as it moves along the windward side of the mountain. The wind increases in velocity, producing a venturi effect, and upon passing the crest the flow breaks down similar to the airflow over a stalled airfoil.[2] As the breakdown occurs a much more complicated pattern develops with downdrafts predominating accompanied by associated updrafts and turbulence. Proceeding downwind for perhaps 5 to 10 miles from the summit, the airflow begins to ascend as part of a definite wave pattern.

Additional waves, generally less intense than the primary wave, also may be downwind. "In some areas, as many as six and even more have been reported, resembling the series of ripples which form downstream from a rock submerged in a fast moving stream."[3]

The first wave, because of its more intense action and closer proximity to the mountain, is of primary concern. "The horizontal distance between successive waves usually ranges from 2 to 10 miles depending upon the existing wind speed and atmospheric stability, but wave lengths up to 20 miles have been reported."[3]

Relatively little was known about the magnitude and nature of this phenomenon until extensive research was launched into numerous, unexplained aircraft accidents. While there is still much to be learned, we now know that "the turbulence hazard in mountain waves is of a magnitude comparable with, and maybe greater than, that involved in penetrating a thunderstorm. Estimates are that accelerations of as much as 8g or more could be experienced."[4]

Sailplane pilots long have been taking advantage of the rising air currents on the windward side of a mountain and have greatly contributed toward a better understanding of the mountain wave. During the 1930s, these sailplane pilots observed that strong currents which rose to great heights occasionally were encountered on the lee side of a mountain. In the wake of this discovery, record flights of more than 30,000 feet were recorded by using these strong currents on the lee side of the Alps. In 1952, near Bishop, CA a new record of 44,500 feet was established using the mountain wave on the lee side of the Sierra Nevada Mountains during a period of strong wave activity.[3] Mojave, CA was the site of the current record which is 46,266 feet recorded in February 1961.[5]

The strong currents that rise from the lee side of mountains continue to produce record breaking flights, horizontally as well as ver-

tically. As of May 1977 the distance record was established at 1,015.8 statute miles requiring an elapsed time of 14 hours and 3 minutes along the Appalachian and Clinch Mountain ranges.[6]

When mountain waves are discussed, mountains of great heights such as the Sierra Nevadas, the Great Divide and the Alps come to mind. However, it has been established that any mountain range or ridge line with a crest of 300 feet or higher is capable of producing wave phenomena. This phenomena has occurred at altitudes up to 75,000 feet over a roll of hills only several hundred feet high.

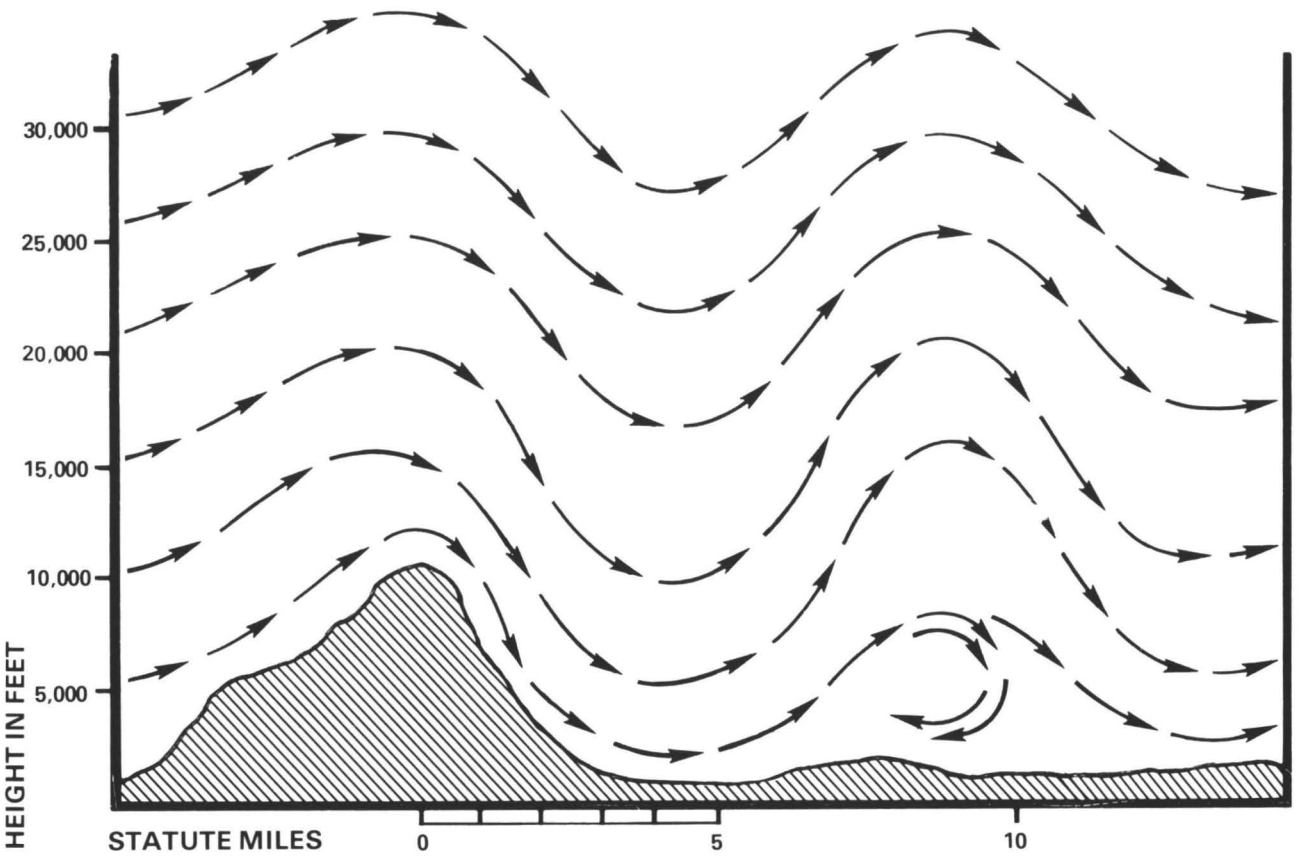
Conditions Perpetrating A Wave. A wave condition arises with a component of the wind at a speed of 25 knots or more at the mountaintop level flowing perpendicular to the mountain range. "The actual wind direction can vary somewhat (with 50 degrees being the maximum deviation from the perpendicular) and still cause a wave, but the strongest waves occur with a strong perpendicular flow. The stronger the flow, the more severe the effects to be expected on the leeward side."[4]

In the western United States where these waves have been observed most frequently, it has been noticed that the strongest waves develop when there is a cold front approaching the mountains from the northwest and/or a trough aloft approaching from the west. This produces a strong westerly flow over the mountain ranges which have a north-south orientation.

There is generally a stable layer or inversion present on the windward side of the range up to an altitude slightly above the peaks with a strong wave. A prefrontal area usually includes this condition. The top of this stable layer is just above the cap cloud and dips to its lowest level at a point directly over the foot of the roll cloud. Without this stable layer, convective instability tends to break up the wave pattern.

The most favorable wind profile for the existence of a high wave has winds exceeding 25 knots at the mountaintop level. There should be a rapid increase in the wind speed with altitude in the level of the mountain range and for several thousand feet above, with a steady

Figure 1. Typical Mountain Wave Pattern



strong flow up to the tropopause. The character of the wave varies with different wind profiles. A very strong increase of wind with height can eliminate the wave leaving only stagnant air in the valley.[4]

As would be expected, the mountain profile has a pronounced effect on the character of a mountain wave. Several topographical variations and their effects on the airstream are depicted in figure 2.

The most notable variations are:

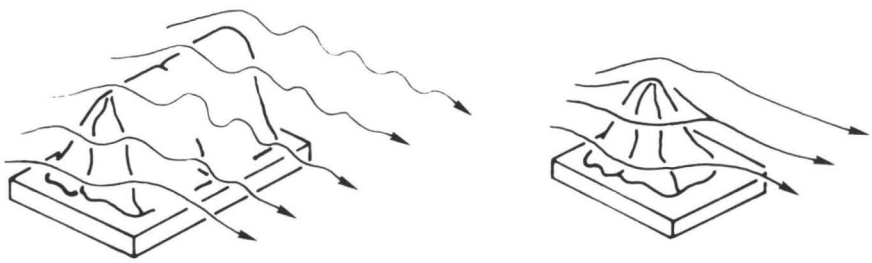
- **Waves will be stronger to the lee of the ridges than to the lee of isolated peaks. They will extend higher and will carry a greater distance downwind (figure 2a).**
- **A concave shape toward the oncoming airstream is more favorable for waves than a convex shape (figure 2b).**
- **Ridges with gentle windward slopes leading to steep lee escarpments are particularly favorable for strong wave activity (figure 2c).**
- **The lee of a pass between two prominent peaks is a favorable area for wave activity (figure 2d).**[7]

The Telltale Signs. The possibility exists for a wave phenomena to develop when the air is too dry to produce any telltale signs. However, this condition is relatively rare and cloud formations remain the best means for identifying the presence of a wave before encountering it. Some typical cloud formations normally associated with the wave which will be discussed in detail are the cap cloud, rotor cloud, lenticular cloud, and in some regions the mother-of-pearl cloud. The clouds and their associated position in the mountain wave airflow pattern are depicted in figure 3.

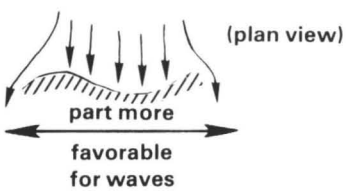
A cap cloud, as the name implies, is a low hanging cloud with its base near or below the mountain's summit and a relatively smooth top only a few thousand feet above the summit. The major portion of this cloud is found on the windward slope where it usually releases light rain or snow. The leeward edge remains stationary, as an apparent wall when viewed from downwind, with fibrous fingers reaching part way down the lee slope before dissipating. At times, the cap cloud will appear to roll over the ridge line and then down the lee slope very much like a waterfall. From downwind, it often resembles a stationary bank of stringy cirrus.

The rotor cloud, which looks like a line of cumulus or fractocumulus clouds parallel to the ridge line, forms on the lee side

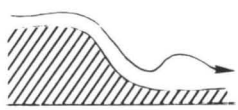
Figure 2. Effects of Topography



a. INFLUENCE OF LENGTH OF MOUNTAIN.



b. INFLUENCE OF CURVATURE AT CREST LINE.



c. INFLUENCE OF GENTLE WINDWARD SLOPE AND STEEP LEE ESCARPMENT.

d. INFLUENCE OF A MOUNTAIN PASS.

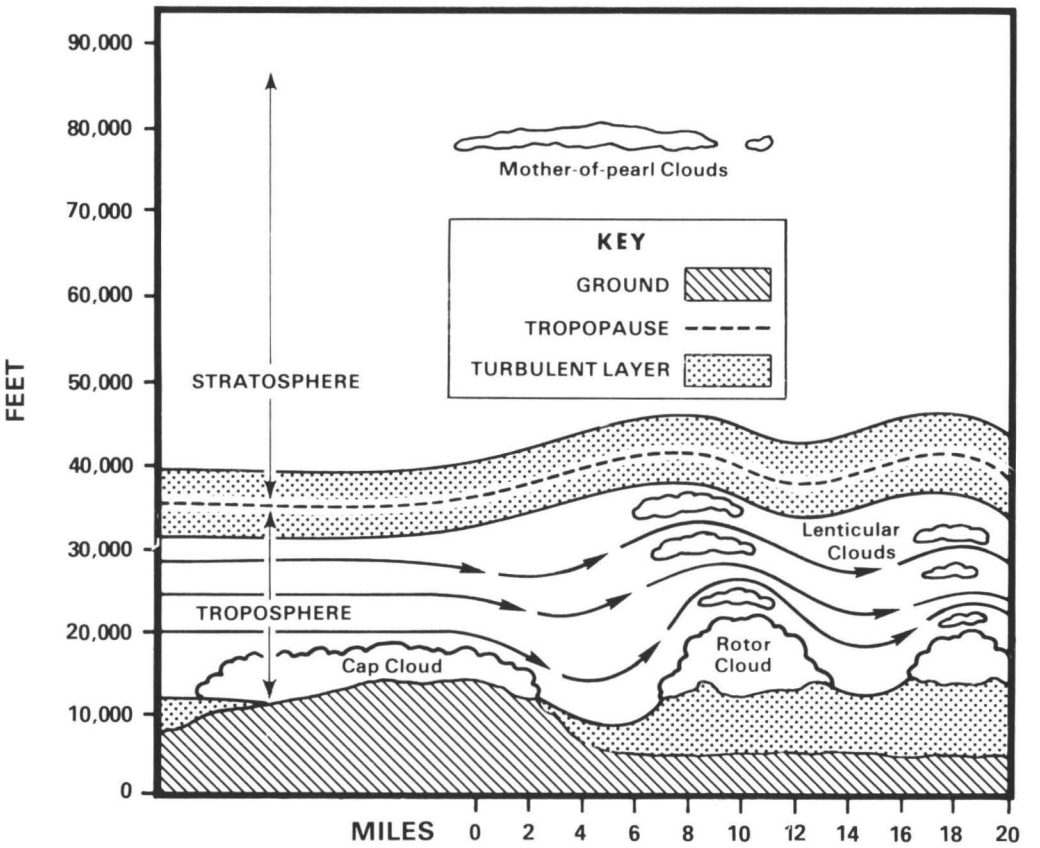


Figure 3. Typical Mountain Wave and Associated Clouds

with its base at times below the mountain peaks and its top extending considerably above the peaks, sometimes to twice the height of the highest peak. "The rotor cloud may extend to a height where it merges with the lenticulars above, extending solidly to the tropopause."[4] Like the funnel of a tornado, this cloud gives visible evidence of violent turbulence.

For those who question the amount of turbulence generated by a mountain wave, consider the case of a sailplane that was stressed for 14gs—it was torn apart during a flight through a mountain wave rotor cloud at Bishop, CA.[2]

The most dangerous features of mountain waves are the turbulence in and below the rotor clouds and the downdrafts just to the lee of the mountain ridges, and to the lee of the rotor clouds.

During investigations of the Bishop Wave, horizontal as well as vertical gusts of 2g to 4g were recorded and 7g was exceeded on one occasion. Downdrafts and updrafts on the order of 2,000 feet per minute were observed, with other instances estimated as high as 3,000 feet per minute.[7]

The rotor, a standing cloud, is continually forming on the windward side and dissipating on the lee side. Although its rotation is seldom visible from the air, this cloud is actually rotating forward toward the mountain in its upper portion and backward in its lower portion.

The lenticular or lens-shaped clouds, which appear in layers between 20,000 to 40,000 feet are relatively smooth and the most spectacular of all the forms identifying the presence of the wave. The layers or tiered appearance of these clouds is consistent with the smooth laminar flow in this section of the wave. "The tiered type structure is due to the stratified characteristic of humidity in the atmosphere and the lifting effect of the wave on the whole depth of the atmosphere."[7] These lenticular clouds, like the rotor, are stationary, constantly forming in bands parallel to the mountain at fairly regular spaced intervals on the windward side and dissipating to the lee.

As many as 10 bands have been observed at one time, extending out 40 or more miles to the lee of the mountain ridge. At other times, only one lenticular might be visible in the lee of the most prominent mountain obstruction.[3]

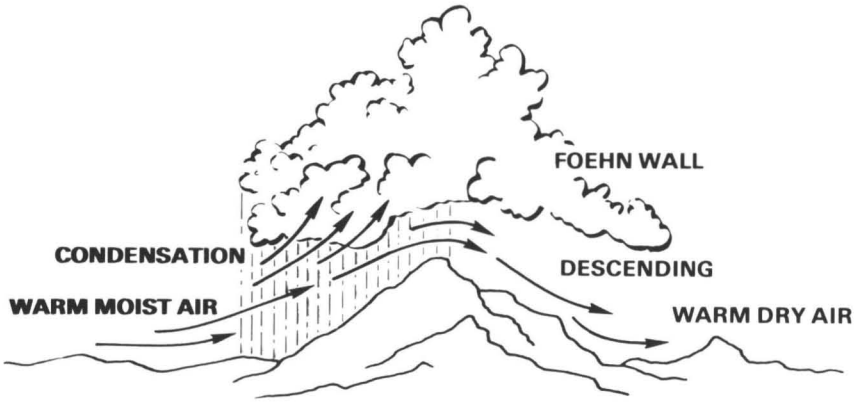


Figure 4. The Foehn or Chinook Wind

At times, severe turbulence may occur above the extremely smooth lenticulars. "The turbulence layers above and below the lenticular level are comparable to ball bearings, allowing the atmosphere between to flow through at very high speeds."[4] For reasons not well understood, at times there is a sudden breakdown from smooth wave flow into vigorous turbulence which occurs throughout the vertical extent of the wave system. When this happens, the highest lenticular clouds reveal very jagged, irregular edges rather than the normal, smooth edges. In most cases, the clouds tilt toward the mountain range as ascent is made through the layers from the rotor cloud to the highest lenticular layers. As a consequence of this tilting, the streamlines are packed closer together in the downdraft side of the rotor. Thus, the wind speed is considerably increased in this area and local jets form, introducing additional hazards.

"Mother-of-pearl clouds are high level, about 80,000 feet, lenticular clouds and have been observed only in the Polar regions."[7]

While the overall context of the cloud formation is stationary over a considerable period of time, the clouds can change position, shape and structure in an extremely short time, and there is continuously a considerable amount of motion in and around the clouds. Extensive clouds can form or dissipate in a matter of seconds.

There are times when the wind is favorable for a wave condition, but there is not enough moisture present for the clouds to form. This cloudless or "dry wave" generates just as much turbulence as when clouds are present, but none of the warning features that the clouds provide are present. The conditions that are favorable for this type of wave phenomena and accepted as an indication of such a development are:

- **Wind flow at mountaintop level of 25 or more knots perpendicular to the ridge.**
- **An increase in wind speed with altitude up to and above the mountaintop, in some cases on up to the tropopause. Within limits, wave action becomes more intense with stronger winds (more than 100 knots in the free air above the ridge) may eliminate smooth wave flow patterns entirely. When this happens, severe and chaotic turbulence may be expected.**
- **An inversion or stable layer (increase in temperature with altitude somewhere below 14,000 feet).**[3]

The Wave. The amplitude or dimensions of the lee wave can be tremendous depending in a complex way on both the topography and the airstream characteristics. "In the Sierra Nevadas, for example, the wave clouds can extend several hundred miles parallel to the ridge lines of a well defined leading edge of clouds."[4]

There may be several wave crests or there may only be one. The amplitude and intensity of the waves decrease as it progresses downwind. The distance of the first wave crest from the mountain peaks varies with wind speed, the type of wind profile, and the lapsed rate. "The crest of the first lee wave downstream of the ridge line is commonly observed to be less than one wavelength away."[7] With regard to wavelengths, observational evidence indicates that they range from 3 to 15 nautical miles, with the average about 6 nautical miles.

Although amplitude of lee waves is of importance, the larger the amplitude the greater the vertical currents, no operational techniques are available to assist a forecaster in predicting amplitude. Generally speaking, maximum amplitude is associated with the layer of greatest stability. The length of the wave has nothing to do with the turbulence associated with the rotor cloud.

With regard to persistence of mountain waves, W. B. Beckwith points out that "once established, wave activity may last for periods ranging from a few hours to 1 or 2 days with the essential characteristics of the waves remaining fixed in space."[8]

One mountain wave project was to investigate the altimeter error associated with the low pressure caused by the venturi effect of high wind over an obstruction. The pilot involved in the project who had occasion to make ski landings on the eastern side of the Sierras reports, "Near the tops of these mountains, after landing at points of known elevation, the altimeter has read as much as 2,500 feet high

if a strong wave is in progress."[2]

Another type of mountain wave phenomena worthy of discusssion in the Foehn or Chinook winds. This same type of wave possesses numerous aliases in respect to its worldwide origin.

Snow Eaters. One of the most interesting of local winds is the Foehn which was first observed and studied in the Alps. It is a warm, dry wind which descends the slopes and valleys of the mountains. Foehns which occur on the Great Plains of North America as well as those which occur in the interior valleys are given the name Chinook, an Indian term, which translates as "snow-eater." The cause of their warmth and dryness is shown in figure 4, but the essential features are:

> **A considerable elevation of land lying between an area of high pressure and an area of low pressure and sufficient water vapor in the air moving up the slope to cause precipitation on the windward side.**[9]

Through adiabatic compression this wind is able to obtain increased temperatures and as this occurs, the relative humidity is lowered. The descending wind arrives at the bottom of the lee side of the mountain containing temperature rises as much as 50 degrees Fahrenheit. Blowing across a snowfield, they can evaporate snow at the rate of 2 feet a day.

During the descent, a great deal of turbulence and mixing of air masses occurs as well as the increased temperatures making this phenomenon a hazard comparable to the previously discussed mountain wave. Because there are fewer telltale signs, it is possibly more hazardous.

The Knowledge Gap. It is alarmingly obvious that there is not enough awareness about mountain waves and what their destructive forces are capable of doing. These forces, according to knowledge gained through extensive study, are said to be second only to tornadoes. Aircraft known to have the structural strength to withstand 14gs have been torn apart attempting to penetrate a fully developed mountain wave rotor cloud.

Contrary to many novices who claim to possess knowledge on the subject of mountain waves, these waves are not found only in those areas where towering mountain ranges occur. They also are found near mountains and ridge lines whose elevations are much less impressive. This phenomena is capable of occurring in any region of the United States, or any other country for that matter, where the topography has ridges with elevations of 300 feet or more. Ridges of this elevation have produced wave action up to 75,000 feet with as many as 6 waves and a wave length of 20 miles.

The destructive force of mountain waves can be averted if one is familiar with the associated telltale signs. The majority of times, this phenomena says to those who are knowledgeable, "Hey, here I am." With a good weather briefing and a little smarts there is no need to fear, or to get caught in, a mountain wave.

Ignorance or failure to recognize the telltale signs of a mountain wave can and have caused numerous aircraft accidents, many resulting in fatalities. If a good weather briefing is not available, be aware of the wind direction and speed as it crosses the mountain or ridges. Should you see the cap cloud formed on the windward side or the rotor cloud on the lee side accompanied by the lenticular clouds, *beware!* These are the phenomenas way of saying, "Turn around, or go around, but don't cross now!" If you ignore this warning you too could be a statistic.

References

1. Joseph J. George, *Weather Forecasting for Aeronautics*, p. 437
2. "Beware the Mountain Wave," November 1958, *U. S. Army Aviation Digest*
3. "The Mountain Wave," March 1957, *U. S. Army Aviation Digest*
4. "Flying Weather in the Colorado Springs Area," *Climatological Study SS967*.
5. Norris McWhirter and Rose McWhirter, *Guinness Book of World Records*.
6. Karl Striedieck, "The Thousand Mile Glide," *National Geographic*.
7. Philip A. Calagrese, "Forecasting Mountain Waves," *Weather Bureau Technical Memorandum FOST-6*.
8. W. B. Beckwith, "Minimizing the Effects of Mountain Waves and Shear Generated Clear Air Turbulence in Airline Operations."
9. Clarence E. Koeppe and George C. DeLong, *Weather and Climate*.
10. Joseph S. Weisberg, Meteorology, *The Earth and Its Weather*.

Editor's Note:
Readers interested in additional information on this subject are encouraged to read Training Circular 1-10, "Mountain Flying Sense," dated June 1978.

TASVAL

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U.S. Army Combat Developments
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Tactical Aircraft Effectiveness and Survivability in Close Air Support Antiarmor Operations

THE LARGEST computer-monitored field experiment ever conducted by the U. S. Army Combat Developments Experimentation Command (CDEC), and probably the U. S. Army, got underway in June and is cranking into high gear.

Ft. Hunter Liggett, CA, is the site for this Department of Defense directed Joint Test of Tactical Aircraft Effectiveness and Survivability in Close Air Support Antiarmor Operations, more commonly known as TASVAL.

TASVAL's background began in early 1977 when Congressional hearings on the defense budget questioned the survivability and effectiveness of various aircraft against armor. Since the desired information was unavailable, the TASVAL Joint Test Directorate was formed.

Initial plans proposed Ft. Hood, TX as the test location. Because of environment and instrumentation difficulties, it was changed to Ft. Hunter Liggett.

The main purpose of TASVAL is to find out how effective U. S. Air Force and Marine Corps aircraft and Army helicopters are when used to fight threat armored forces. Another major purpose is to determine what mix of jet aircraft and helicopters works best.

Since CDEC doesn't have all the people or equipment needed to perform this test, a large variety of additional resources is necessary. The Air Force is flying A-10 jets and later will bring F-4s. The Army is using attack helicopter teams composed of AH-1S Cobra TOWs and OH-58s. In future trials the Marines will provide A-4 aircraft and AH-1T helicopters. Air Force and Marine aircraft will fly in for trials from Lemoore Naval Air Station, about 50 air miles east of Ft. Hunter Liggett.

Army units participating include a reinforced tank battalion, 4th Battalion, 40th Armor, 4th Infantry (Mech) Division, from Ft. Carson, CO, portraying a threat armor battalion, and two I-Hawk batteries from the 5-57 ADA, Ft. Bliss, TX. Also, an air cavalry troop from the 7th Squadron, 17th Cavalry, 6th Air Combat Brigade, Ft. Hood, TX, has been flown in. CDEC's Armor Co. C portrays the friendly ground forces.

General Dynamics' SEL 86 computer will serve as an impartial umpire in this series of mock bat-

A "light" attack helicopter team moves into firing position during the TASVAL test. The AH-1S helicopters (foreground) have a range of more than 3,700 meters with their TOW missiles. The Department of Defense directed test also includes Air Force A-10 and F-4 jets, and Marine Corps A-4 jets and AH-1T and OH-58 helicopters (above) pitted against a threat organized armor force. TASVAL is designed to determine effectiveness and survivability rates of these aircraft

tles. The ability of friendly ground forces backed by aircraft to resist massive attacks by threat forces will be tested.

Soldiers, weapons systems and vehicles are equipped with eye-safe lasers and laser-sensitive detectors to record hits and misses. Weapons "fire" beams of light instead of live ammunition. The laser detectors send signals when hit by a laser beam. All players and weapons are linked by radio waves to the computer. Each laser and sensor is coded, allowing the computer to identify each player and weapon. The computer analyzes the engagement and determines which weapon was fired, who or what was hit and the location of everyone involved.

Within moments the computer sends messages to hit players, shutting off their lasers and informing them of their fate. Without their coded lasers they are effectively out of action.

Plans and preparations have been underway for several months. Testing began in mid-June and is scheduled through this month.

This complex test will provide invaluable data to assist decision-makers in determining what aircraft mixes will work best in any future situations of this type.

Part of the ground force moves into position while a helicopter teams looks on. None of the weapons use live ammunition, all fire beams of light. All equipment—Soldiers, weapon systems, vehicles—are equipped with laser sensitive detectors to record hits and misses

Joe

The intent of this article is not to degrade any certain individuals. The story is true and has made me sincerely conscious of the meaning of professionalism and the Army aviation safety program.

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I WORK AT A large military installation where there are a great number of rotary wing aircraft being flown. I knew one of the men who was killed in a crash at this installation not long ago. This is his story.

It begins back in the early 1970s in the Republic of Vietnam. The man's name is not important, but for this story, I will call him Joe.

We were assigned to an assault helicopter company. Joe reported into the unit about a month after I arrived. He came from a unit which left him behind because he did not have enough time incountry. He was disgruntled about this, but I believe he learned to accept it all as time wore on. He became likeable as his true self emerged late at night in the "haze" of our little club.

We talked a lot of shop in the club and as Joe's "war" stories unfolded, I began to notice they all had one thing in common. *Complete disregard for authority and flight discipline—as I reflect, total disregard for safety.* It seemed he was always doing something against policy or the boss' wishes. He soon was involved in a couple of scrapes that took place within the unit.

We had two aircraft scheduled each day for ash and trash type missions. This meant we were to work for a local compound advisor, usually a full colonel (American) in our area of operation. Joe and I pulled this mission on a regular basis. He was the aircraft commander.

One day we arrived at our duty station just before daylight. Joe went into the compound to see if we had a job. Well, the boss was not expected 'till around 1000 hours. We crawled under the aircraft and went back to sleep. This was common practice and, besides, it was the only shade.

About 1130 a major told us to crank as the boss wanted to go to Saigon. I suppose this may have been the spark that set Joe off, as he had several great plans for winning this war and this was not part of any of them. I could detect he was enraged as we strapped in, but I did not say anything, thinking that perhaps it was best to let him vent it all out prior to becoming airborne. The colonel came out with a lieutenant colonel and two majors. The colonel was wearing pilot wings. They strapped in and we were off for the big city.

Joe was under control for the time being. I had not been to Saigon for a few days and had always loved that city.

We were invited to lunch but chose instead to go downtown and look around. Fulfilling our mission within the mission, we returned to the ship to wait. And wait we did, a full 2 hours.

The passengers returned from "lunch" in "good spirits." Joe noticed and seemed upset about it. We called, got clearance and left town. I was driving along at 3,000 feet when Joe said, "let me have it, I'm going to show these guys what flying is all about."

Defense mechanism started clanging in my head like a low rpm warning device. I suppose Joe could see the anxiety on my face because he said, "Don't worry, I've done this before and it won't kill us." Whereupon he took control and asked me to turn around and start talking to the crewchief.

I balked again; he became adamant that I follow orders and do as he said. I did. He then turned on the force trim, shut off the hydraulics, recycled the master caution switch to turn off all visual warning lights, placed his hand over the segment warning lights on the console and proceeded to turn around to talk to one of the majors.

What took place next was amusing, in a way. The colonel noticed right off that no one was flying the aircraft and that no one was even close to the controls. His first reaction was one of shear terror as his eyes, reddened dark by the "spirited lunch," appeared to double in size. His hands went for his

seat belt. I suppose he decided that if we were not going to control the aircraft, he was.

Joe let him get out of his seat before turning around and flipping off the force trim and turning on the power assist. The jolt of these two systems going into retrophase was enough to throw the colonel quite a bit off balance. Finally he managed to get back into his seat and collect his seat belt back about his body, visibly shaken and I must say a great deal more sober in his appearance. The remainder of the flight was uneventful except for my butterflies and a few stomach problems aft.

I believe I remember a few obscenities uttered toward Joe as the passengers left the aircraft. But Joe calmly picked the aircraft up and said we were going home. I remarked that we were all going to hear about this from the boss, maybe even the big boss. Joe just grinned and said it was all his doing and I was not to be concerned about what an aircraft commander was to do with his aircraft. I soon got the feeling I was just a sandbag in the right seat. My butterflies had turned to moths as we touched down in our revetment at home.

Well, there was a lot of stink raised, Joe lost his aircraft commander orders for a few days, there were a lot of laughs in the club as Joe retold the story about once a week. It all just somehow kind of got lost someplace in the "haze" of the time. All of it, that is, 'till a fateful spring day almost 2 years later when I was back the in States with primary duty flying medevac.

It was a beautiful spring day, not a cloud in the sky. We were ready and waiting close by the ship when the crash alarm sounded. The message read only that an AH-1 Cobra gunship had gone down hard. We scrambled, a little confused, as it was a weekend and the range was closed. We arrived at the crash site in less than 7 minutes (I made a mental note that it was excellent time for flying almost two-thirds distance across the post).

Then below, and strung out for several meters in front of our short final, was what was left of the gunship. The largest piece was the engine with part of what appeared to be the transmission attached, still smoking. Twisted beyond all repair, I could see there would be no survivors. I dropped my rpm to cooling level, frictioned the controls and got out of my ship. I walked over to one of the twisted hulks that was once a man and looked down in horror at the mangled face of Joe.

The accident investigation concluded that the crew was engaged in unauthorized flight, conducting maneuvers outside the flight envelope of the aircraft involved. One of the pilots was not current in the type aircraft being flown and the other had several unauthorized flight violations on his records.

Thank you for the lessons, Joe—if you were here I would buy you a drink.

Author's Note: Some of the people, places and units described in this story are fictitious; however, the lessons learned and the tragic end of Joe's short aviation career are facts

New Training Publication

(UH-1FS Instructor's Guide)

The Directorate of Training Developments, U. S. Army Aviation Center, Ft. Rucker, AL announces the availability of a new training publication titled "UH-1FS Instructor's Guide." This publication was provided by the U. S. Army Research Institute for the Behavioral and Social Sciences (ARI), Ft. Rucker, Field Unit, and is designed to serve as a source of information concerning the use of the UH-1 flight simulator (UH-1FS) in the conduct of instrument training at field locations.

Copies of this publication can be obtained by calling: commercial 255-5990 or 255-3283, or AUTOVON 558-5990 or 558-3283; or writing:

U. S. Army Aviation Center
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Training Literature Management Branch
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Ft. Rucker, AL 36362

The opinions expressed in this article are those of the author and do not necessarily reflect the views of the Department of the Army nor the U.S. Army Aviation Center

A Discussion on Accelerate-Stop Distance

No Place To Go

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IN 1947, WITH THE formation of the U. S. Air Force, the Army lost almost all of its complex, fixed wing aircraft. With relatively few exceptions, the Army retained only small, utility and liaison types. Army fixed wing were "backwoods" airplanes —simple, rugged and relatively slow. They operated from lakes and dirt strips as easily as from paved airfields. Such aircraft served the needs of the existing Army superbly, and their success still influences doctrine and attitudes.

However, aviators today find themselves in machines radically different from the L-19 (0-1 Bird Dogs) or the U-1 Otter of a generation ago. The modern evolutionary forces of time and technology have greatly changed the nature of Army aviation. Rotary wing assets have largely displaced the need for "backwoods" airplanes. Fast, efficient and sophisticated, today's fleet of fixed wing aircraft are geometrically more complex than their predecessors.

Progress is not without its price. FLIGHTFAX in an article in its 15 November 1978 issue points out the disproportionate number of Army fixed wing accidents and fatalities. Why? Have we as operators failed to adjust to the complex needs of these complex machines? Are these losses preventable? Can we continue to operate as we have in the past? The article continues with the following statement, "as our fixed wing aircraft become more sophisticated, flying higher and faster, the probability of an increase in the number of fatalities when accidents occur is almost a certainty."

Surely, the continuing cost of fixed wing mishaps and accidents is not acceptable. Certainly, many of these losses are preventable. Many efforts currently are being made to enhance the safety and success of the Army's fixed wing operations. One approach under consideration is improved takeoff planning, which includes the use of accelerate-stop criteria.

Despite an impressive amount of information required for the Takeoff and Landing Data (TOLD) Card relatively few parameters concerning the departure airfield are considered. Basically, if the runway available is equal to the anticipated takeoff ground roll and if obstacles can be cleared in the event of an engine failure, then the departure airfield meets the existing criteria. Little consideration is given to the possibility of aborting a takeoff. Should this be a cause for concern?

You may remember from high school physics the following formula for kinetic energy (KE):

$$KE = \tfrac{1}{2}MV^2$$

M = mass of the object
V = speed of the object

An aircraft rolling down a runway must conform to this formula as well. Let's compare the past with the present. A U-1 Otter pilot will takeoff at 63 knots. The pilot of a U-21 Ute at the same gross weight will accelerate to 97 knots for take off. Since the weight and density of both aircraft are roughly equal, we can assume that the value of $\tfrac{1}{2}M$ is the same for either aircraft. However, the effect of the higher speed in the U-21 is significiant. The product of $(63)^2$ is 3,969; the product of $(97)^2$ is 9,404. Therefore, the U-21 has *2.37 times the energy* at takeoff as the U-1! Should something go wrong at this critical point of operation, the disasterous potential of so much additional energy should be obvious.

The higher speeds of current fixed wing aircraft create an additional problem. Speed deprives the pilot of precious time—time to evaluate, time to consider and time to act. At 97 knots, the runway moves behind us at a surprising rate—164 feet per second. If we take 2 seconds to identify and evaluate a problem and then use another second to physically react, we already have lost almost 500 feet of runway —runway that we may need to stop!

As the operator, how do we find the distance required to safely abort a takeoff? This data can be extracted from the charts in the performance section

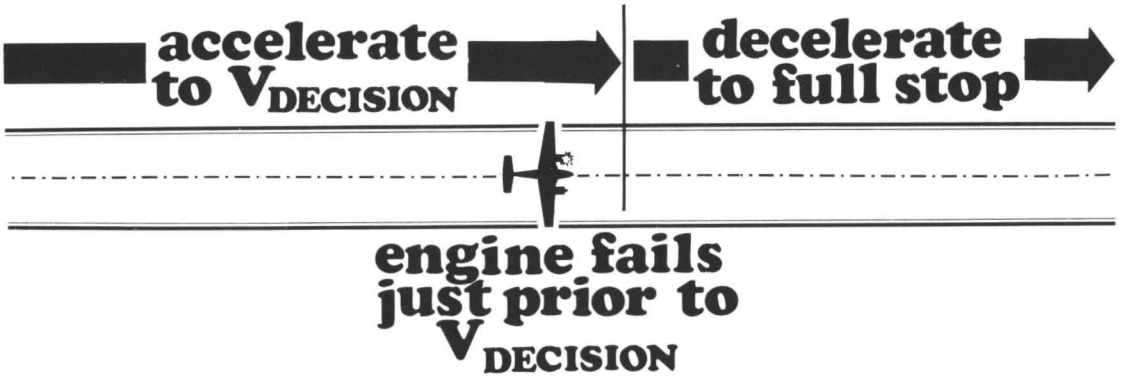
of the operators manual (dash 10). However, first we must understand three new terms:

- **Decision speed ($V_{Decision}$):** A predetermined speed below takeoff will not be continued if thrust of an operating engine is lost. (It follows that takeoff *may* be continued once $V_{Decision}$ is achieved.)
- **Accelerate-Stop distance:** The total distance required to accelerate to $V_{Decision}$ and then stop using full braking and available reverse thrust, assuming failure of an engine just prior to $V_{Decision}$ (see figure on page 22).
- **Overrun:** An area beyond the runway, no less wide than the runway and centered upon the extended runway centerline, able to support the airplane during an aborted takeoff, without causing structural damage to the airplane; and designated by the airport authorities. (In accordance with TM 5-803-4, this area will be 200 feet by 125 feet, minimum at standard Army airfields.)

The crews of the OV-1 Mohawk and C-12 Huron series aircraft will find charts in the performance sections of their operators manuals specifically addressing accelerate-stop distance. The crews of T-42 Cochise, U-8 Seminole and U-21 series aircraft will need to estimate accelerate-stop distance from the existing information in their manuals. The fixed wing office of Directorate of Evaluation/Standardization suggests the following method:

WT COMPUTATION			
BASIC WT (OIL INCL)			
CREW & FLT EQUIP			
EMER OR OTHER EQUIP			
FUEL WT			
OPERATING WT			
PAX-BAGGAGE-CARGO			
TAKEOFF WT	(MINUS R/U FUEL)		
CRUISE DATA			
PA	OAT	WIND	
WT		PWR	
KIAS		KTAS	
FUEL RATE		SE CEILING	
BLOCK SPEED & FUEL REQUIRED			
ITEM	TIME	FUEL	DIST
R/U-T/O			
CLIMB			
CRUISE			
DESCENT			
APPROACH			
TOTAL			
LANDING DATA			
WT	V_{ref}	$V_{ref}+20$	
CEIL	VISB	OBS	
TEMP	WIND	ALT	
INST APP	RWY	LDG RUN	

TOLD (FW)	
PA	OAT
WIND	RWY
T/O WT	LDG WT
T/O PWR	
T/O GRD RUN	
ACC-STOP	
V_{mc}	
$V_r - V_{lof}$	/
$V_x - V_y$	/
V_{yse}	
V_{ref}	
LDG GRD RUN	



• Determine ground roll from the normal takeoff chart.

• Determine landing distance with flaps full down.

• Sum these two distances and add a 500-foot constant.

The resultant value is the estimated accelerate-stop distance. Let's go through a sample calculation. Assume that we are in a U-21A at maximum gross weight. The airfield is at sea level, temperature and pressure are International Civil Aeronautics Organization standard.

(a) Takeoff ground roll = 1,950 feet.

(b) Landing distance with full flaps (note: 9,168 pounds is maximum weight on chart) = 1,900 feet

(c) Sum of the two values above plus 500-foot constant, 1,950 + 1,900 + 500 = 4,350 = estimated accelerate-stop distance.

If the runway in front of the aircraft plus the available overrun is equal to or greater than 4,350 feet, you are reasonably assured that a safe aborted takeoff can be accomplished. Remember that this is an estimated value only. Actual distances required will be affected by many variables (i.e. pilot technique, braking coefficients, condition of equipment, pilot reaction time, etc.).

The application of accelerate-stop criteria is an effective tool that can enhance the safety of fixed wing operations. It is a prudent consideration in all Army operations. However, we also must realize that the requirements of the mission may not allow us this margin of safety. The application of accelerate-stop criteria *is not a requirement* under existing Army doctrine. As always, it remains for the commander and the pilot-in-command to exercise good judgment.

EPMS CORNER

Enlisted Personnel Management System

Noncommissioned Officer Logistics Program

EVER WONDER why Noncommissioned Officer Logistics Program (NCOLP) members get promoted ahead of their contemporaries? Maybe it's because of the extra training they get from the program or the possibility of better assignments. Regardless of the reason, being an NCOLP member pays off.

Latest statistics from the recently released promotion list to E7 reveal that members of the NCOLP fared much higher than their contemporaries Armywide. Figures indicate that while the Armywide selection rate was 31.4 percent in the primary zone, members in the logistics program had an 89.3 percent selection rate. Secondary zone selections were even better, with a 17.4 percent selection rate for our logisticians versus a 6.3 percent selection rate Armywide.

For information on how to improve your promotion potential and to apply for membership in the NCO Logistics Program read Chapter 13, AR 614-200.

The following is a request for your help based on a problem recently presented to the Aeroscout Branch at the U. S. Army Aviation Center, Ft. Rucker, AL

NET CALL— SCOUTS OUT!

LTC Charles W. Abbey and **CPT Henry H. Scheuer**

Hanchey Division
Department of Flight Training
U.S. Army Aviation Center
Fort Rucker, AL

PREDICAMENT. You are a U. S. citizen working under a letter of agreement with the Mexican Government in the very mountainous and thickly forested area of the Sierra Madre Occidental Mountains in the southwestern section of the Mexican state of Durango. The coniferous trees in this region grow to heights of up to 125 feet, and elevations range from 5,000 to 12,000 feet. Your job is to assist the Mexican authorities in the locating of the many illegal poppy and marijuana fields in the area which are to be destroyed by the Mexican Army.

Initially you and your team, flying Bell 214 helicopters, were very successful—the poppy fields were large and you could use infrared and other detection equipment to locate the fields. In a short time the peasants who were planting the fields learned of the efficiency of your detection devices and started making new fields very small—only about 20 meters in diameter and in difficult areas, thereby defeating the equipment's capabilities.

Since the native vegetation is so thick and the terrain so rugged, with literally thousands of small ravines and steep draws, you now have to fly at treetop level to visually locate and identify the fields. The primary means of transportation for the few peasants who inhabit the area is the burro; therefore, there are no roads and few vehicular tracks through this forbidding terrain. Instead, numerous game and cattle tracks, which crisscross the area, commonly are used by people afoot for getting from point to point. Due to this proliferation of trails, it is very difficult to "backtrack" suspicious trails to possible fields.

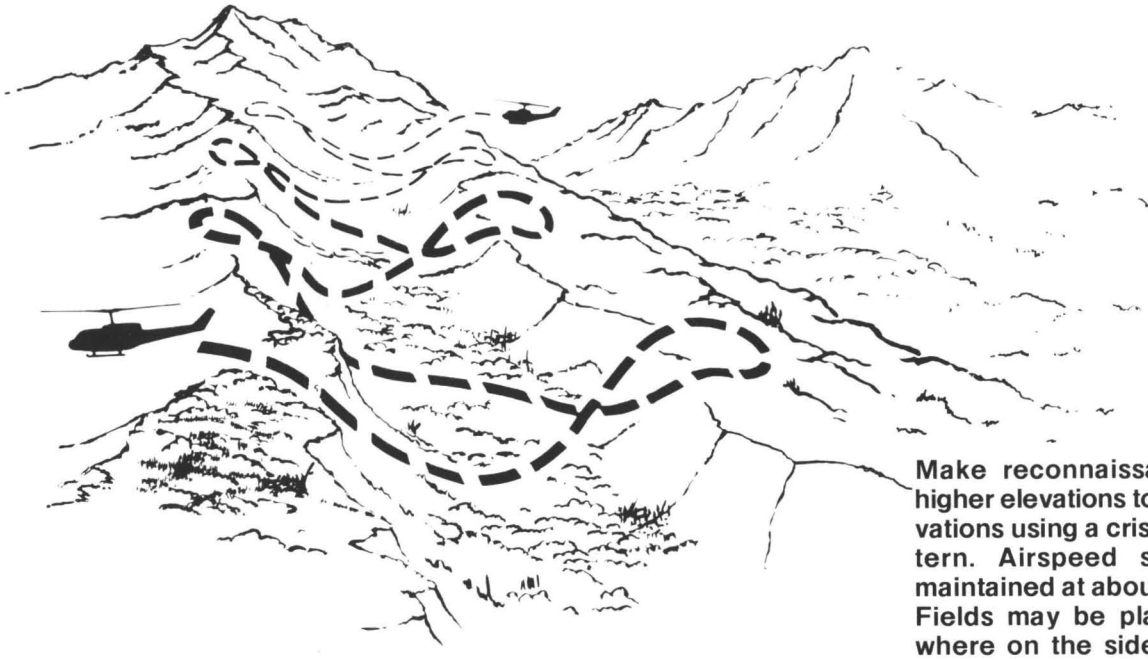
You have divided the area into sectors, to be systematically searched every 3 weeks—draw by draw and ravine by ravine. You and your partner's helicopters have begun using the high/low search technique (one aircraft stays low, generally starting at the bottom of the draws and slowly flying the contour of the draws, while the other provides a high "cover" and observes from about 200 feet) as a method to better locate the small cultivated plots. This technique had been fairly productive until you had begun to annoy the peasants and two distressing factors were thrown in:

- The peasant farmers started taking random rifle shots at you.
- The locals got wise and started stringing wire across the draws, resulting in several wire strikes and loss of one aircraft.

This situation should now begin to sound familiar to aeroscouts who saw service in Vietnam or Cambodia: How can you reduce your chances of taking rounds and hitting a wire but still be very effective at finding the maximum number of those nasty old poppy fields (or whatever)?

Dilemma. This sort of a question recently was presented to the Aeroscout Branch and Hanchey Division at the Aviation Center. Our "solution" will be presented shortly. What is important about this situation is the suggestion (and perhaps the realization) that many of the aeroscouting techniques and skills learned, relearned, developed and refined in Vietnam for the counterinsurgency mission rapidly are being lost or forgotten with the retirement of each "old," experienced scout pilot or scout observer.

Although U. S. Army combat training today is oriented primarily toward a European battlefield scenario where the scout will be faced with locating



Make reconnaissance from higher elevations to lower elevations using a crisscross pattern. Airspeed should be maintained at about 50 knots. Fields may be planted anywhere on the sides or even the bottom of the draw

formations of armored vehicles at significant standoff distances, we still must not allow ourselves to forget the lessons learned about scouting for the *individual* clue—a person with a rifle, a motorcycle print on a stream, bank, a grass trail, et. al. History teaches that the U. S. Army must be prepared and trained to fight against any type of enemy. Toward that end the recapture of some of the aeroscout's tricks of the trade seems wise.

On page 25 is a self-addressed postage paid survey aimed at all of you "old bold" scout pilots and observers. Please take a few minutes and describe some of your experiences and search techniques which were successful for you. (Can you believe it—someone is actually *asking* you to tell some war stories?) We want your *tricks*—how you learned them; *why* you were good. We want other Army scouts to know what *you* know. Seriously and importantly, the information gleaned from your responses will be compiled by the Attack/Aeroscout Branch for use in the Aeroscout Course at the Aviation Center and for possible inclusion in either a training circular or field manual. Also, if your response is good, some of the tips or information received may be developed into a future article for the ***Aviation Digest*** or other professional publications. So please fully explain your thoughts. One ex-scout sent a cassette tape with slides to make clear his thesis.

Our solution to the (poppy) field dilemma. How did we do it? Well, CW3 Harry Stevenson (an "old bold" scout pilot, and a member of the Aeroscout Branch) gave the following solution: Since the aircraft have to work at very high elevations and density altitudes, power requirements are near the maximum. If a wire were hit, the aircraft would very probably not have sufficient power to pull away—even if the controls were not damaged. A helicopter hovering at slow speed provides an ideal sniper's target.

Flying straight down the draws (high elevation to low elevation) presents problems with maintaining tailrotor clearance, as well as the fact that you are flying perpendicular to the direction that the wires are strung. So to solve this problem and to avoid hovering out of ground effect at slow airspeeds, we suggest maintaining about 50 knots indicated airspeed and make a crisscross pattern (see figure). This makes it very difficult for someone trying to shoot at you through the vegetation due to the short time you can be observed, while still providing the scout sufficient time to accurately locate the cultivated clearings.

By flying this crisscross pattern, the crew also has a better opportunity to look for wires from varying angles and altitudes increasing the likelihood of spoting the wires before they snare the helicopter. We also recommend use of body armor and the addition of a wire cutting device to the aircraft similiar to the type being tested by the Canadian Forces. Added tip: If the majority of the search can be done early in the morning, dew often glistening on the wires assists in early detection.

Aeroscouts, give us a hand!

SURVEY-SCOUT TIPS

This was the problem/skill.

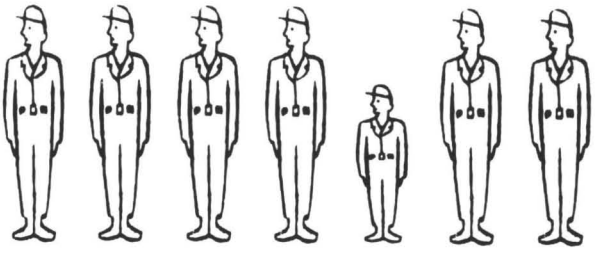
This is how we did it.

Name

Phone (AUTOVON)

Home Address:

Attention unit commanders:
We would appreciate your distributing as many copies of the questionnaire as possible. Responses may be returned in a franked envelope.



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Officer Personnel Management System

OPMS CORNER

Aviation Personnel Update

Major Jeremiah O'Fihelly
Officer Personnel Management Directorate
U.S. Army Military Personnel Center

Changes In Aviation Management Branch. The recent decision by former Army Chief of Staff, General Bernard E. Rogers, pertaining to the career pattern for commissioned aviators has resulted in the establishment of a new office with an old name within the Officer Personnel Management Directorate (OPMD) at U. S. Army Military Personnel Center (MILPERCEN). Aviation Management Branch, with LTC(P) George A. Morgan as chief, is now an assignment branch of Combat Arms Division for all company grade aviators except those in Transportation Corps and Medical Service Corps; these officers will be managed as in the past. An earlier article prepared soon after announcement of the new career pattern indicated that Combat Support Arms Division, OPMD, would manage aviators to be assigned to 15M (Military Intelligence) positions. Effective on 1 August, however, all Specialty 15 company grade aviators will be managed by Combat Arms Division.

The office in Professional Development Division formerly known as Aviation Management Branch is now called the Aviation Plans/Programs Branch, with Major William B. Leonard III, as branch chief. This office retains all those functions pertaining to personnel actions ("gates," flight pay, flying status orders, suspensions, etc), aviator strength management, Aviation Career Incentive Act Programs, Army Aviation Engineering Test Pilot Program and the Army astronaut program. The branch is also the proponent for personnel regulations and circulars pertaining to aviators.

New Regulations Distributed. Two revised personnel regulations pertaining to aviators have been distributed Armywide. AR 600-107, "Medical Restrictions and Suspensions From Flight Duty, Nonmedical Suspensions, Flying Evaluation Boards, and Flight Status Review System," effective 1 September 1979, is a complete revision of the regulation. Commanders, operations officers and personnel administrators/managers should become familiar with their responsibilities pertaining to the flying status of their assigned aviators. Also distributed was AR 600-108, "Aeromedical Consultation/In-Flight Evaluation," 15 July 1979, effective 15 August 1979.

Aviators Without Current Physicals To Be Grounded. Army aviators who fail to take an annual flight physical are subject to suspension from flying status and loss of flight pay. In recent months MILPERCEN has received numerous inquiries concerning the status of aviators assigned to other than operational flying duties whose flight records contain an expired report of physical examination.

AR 95-1 requires each aviator to undergo an annual flight physical within 90 days prior to the end of his or her birth month. This requirement applies to all aviators, including those who do not have an aviation specialty (15, 71, 67J, 51C) or have not met "gate" requirements of the Aviation Career Incentive Act of 1974, unless the aviator already is indefinitely suspended from flying status. Details are contained in DA Message R211300Z Jun 79, and AR 600-107, 1 Aug 79, which also outlines actions to be taken at each level to suspend those aviators who fail to maintain readiness standards.

Army Aviators Complete U. S. Naval Test Pilot School, Produce Honor Graduate. Of four Army aviators to complete successfully the U. S. Naval Test Pilot School recently, Major Larry B. Higgins was named outstanding student in graduation ceremonies at Patuxent River, MD. Major Higgins was selected from among 26 graduates of all services because he displayed outstanding ability, aptitude and motivation toward flight testing and leadership. Also completing the rigorous 11-month course of academic and test flight training were Majors Charles F. Adams and Bartholomew D. Picasso III, and CPT Marvin L. Hanks.

from AEROSPACE SAFETY
Captain John G. Taylor III
USAF/RAF Exchange Program

Watch your tail

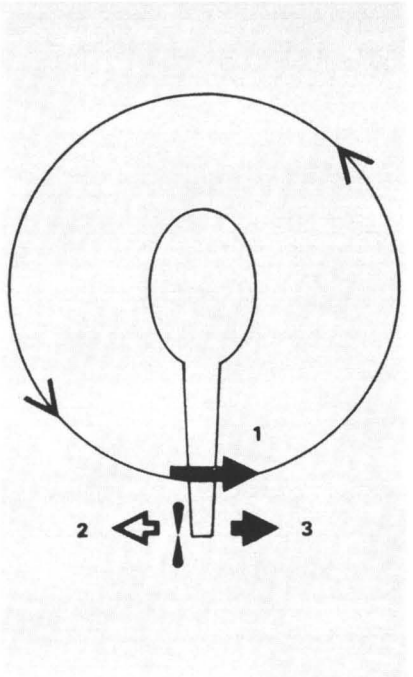
USAAAVS

"RECOMMEND THE aircraft commander be downgraded to fixed wing only!" This message was sent after the aircraft commander had his third tail rotor strike during training operations in Southeast Asia. The aircraft commander mentioned was a very experienced pilot with many hours flying, but he had been wrenched from the security of the large fixed wing world and sent to fly helicopters in SEA. In all his hours of flying he had never had to worry about his tail, but the time had come.

In researching for this article, I not only reviewed the areas commonly known by helicopter pilots, but I also came across terms like tail rotor drift, tail rotor roll, tail rotor droop, and tail rotor breakaway. This article will not only be an introduction for interested fixed wing pilots and a review for current helicopter pilots but it also may have a new angle or two for the dedicated older rotor-heads.

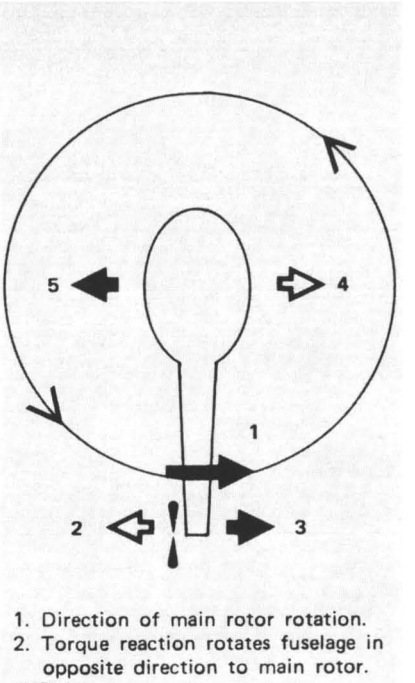
TAIL ROTOR FUNCTIONS

As you may know, a helicopter is maintained in flight by the rotation of its main rotor blades. Newton's Third Law states "that for every action there is an equal and opposite reaction." On American single-rotor helicopters the main rotor system rotates counterclockwise, and because the main rotor uses fuselage-mounted power, torque is generated which tends to rotate the fuselage in the opposite direction. There are several ways of countering this torque reaction, but this article will address only the use of a tail rotor. The tail rotor's primary function is to compensate for torque reaction, but it is also required for heading control, maintaining trimmed flight and to stop the fuselage from rotating in autorotation.



1. Direction of main rotor rotation.
2. Torque reaction rotates fuselage in opposite direction to main rotor.
3. Tail rotor counteracts torque reaction and provides positive heading control.

FIGURE 1.—Torque Compensation



1. Direction of main rotor rotation.
2. Torque reaction rotates fuselage in opposite direction to main rotor.
3. Tail rotor counteracts torque reaction.
4. Tail rotor pushes entire helicopter into a right drift.
5. Pilot applies left cyclic to prevent right drift.

FIGURE 2.- Tail Rotor Drift

Torque compensation. Compensation for torque is accomplished by a variable pitch, antitorque rotor (tail rotor), located at the end of a tail boom extension at the rear of the fuselage. Driven by the transmission at a much higher rpm, the tail rotor produces thrust in a horizontal plane opposite to the torque reaction developed by the main rotor (fig. 1). Since torque effect varies when power changes are made, it is necessary to vary the thrust of the tail rotor. This is done with the tail rotor pedals which allow the pilot to alter the tail rotor thrust by changing the pitch on the tail rotor blades.

Heading control. In addition to counteracting torque, the tail rotor also permits control of the helicopter heading during taxiing, hovering, and sideslip requirements during takeoffs and approaches. Application of more control than is necessary to counteract torque will cause the nose of the helicopter to swing to the left. Conversely, less pedal than required to counteract torque will permit the helicopter to turn in the direction of torque, to the right. To maintain a constant heading at a hover or during takeoff or approaches, the pilot uses the tail rotor pedals to apply enough pitch to the tail rotor to neutralize torque and possible weathervaning effect in a crosswind.

Trimmed flight. Heading control in forward trimmed flight is normally accomplished with cyclic control, using a coordinated bank and turn to the desired heading. Whenever power changes are made during flight, tail rotor pedals must be adjusted accordingly to maintain trimmed flight.

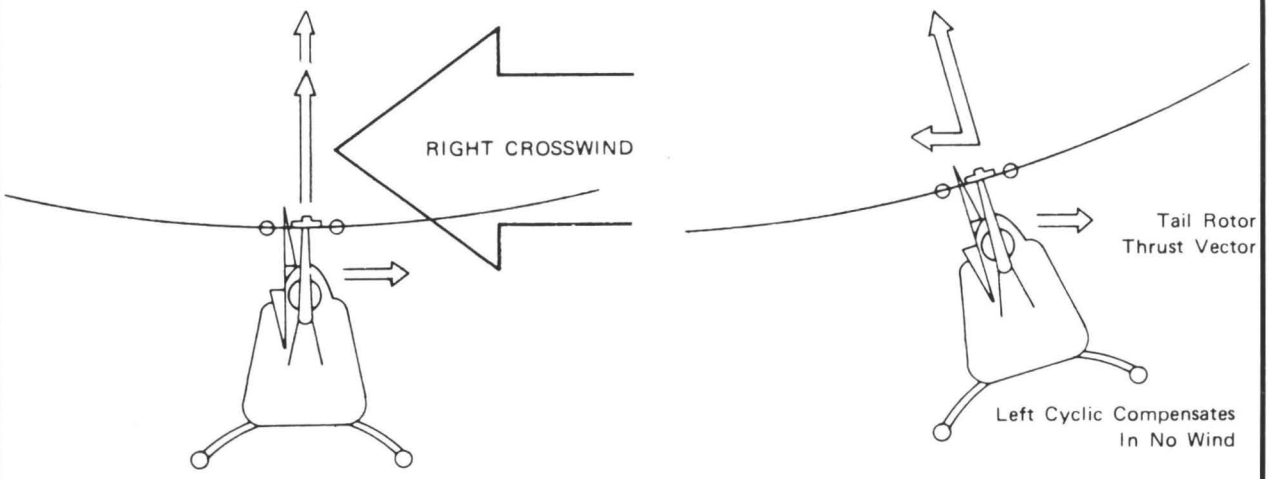
Autorotative flight. When the rotors are being turned purely by the reaction of the rising airflow as the aircraft descends and with no assistance from the engine, there will be no torque reaction. However, friction will cause the fuselage to rotate in the same direction as the main rotor. Directional control is maintained by changing the pitch on the tail rotor to such a degree that the tail rotor produces a thrust in a direction opposite to that required when the rotor is being driven by engine power. The tail rotor blades are symmetrical in shape and are capable of being turned (feathered) to produce plus or minus pitch values.

TAIL ROTOR PHENOMENA

Now that we are aware of the wonders a tail rotor can do for us, what are some of the phenomena associated with the tail rotor?

Tail rotor drift. When hovering, the helicopter has a tendency to move laterally (to the right) due to the tail rotor thrust component (see fig. 2). This tendency is called tail rotor drift and can be overcome by a pre-set tilt in the rotor hub or by the pilot tilting the main rotor slightly to the left. This lateral tilt results in a horizontal force to the left equal to and compensating for the tendency of the helicopter to drift to the right (see fig. 2).

Tail rotor roll. Unless it is unbalanced, a fuselage suspended by a semi-rigid rotor system should hang level laterally (see fig. 3A). However, the mast is often rigged to have a forward tilt to provide a level fuselage in forward flight which also results in a tail-low hover (see fig. 3B). Some helicopters also have the tail rotor gearbox positioned below the main rotor hub. If the horizontal thrust of the tail rotor acts below the main rotor hub it will result in an unbalanced couple between the tail rotor hub and the main rotor hub (points of thrust application) tending to tilt the left side low during hover (see fig. 3B). This tendency is called tail rotor roll. So, although the helicopter has been loaded within the lateral center of gravity limits, it will still hover with the left side low. This roll can be minimized by positioning the tail rotor high



NOTE: All figures in this article are hand drawn from figures in U.S. Army Field Manual FM 1-51, Rotary Wing Flight. Some portion of each Army figure has been changed to better prove my points.

FIGURE 3.—Tail Rotor Roll

enough (on a pylon) to reduce the couple, but this minimization point will only hold true for one position in the flight regime. Every time you change the nose up-down attitude of the aircraft the roll will either increase or decrease. The attitude is also dependent upon the gross weight and the density altitude at which the helicopter is operating, for as the weight or height increases so does the requirement for power for the main rotor and therefore the tail rotor. More tail rotor thrust creates more tail rotor drift which requires more left cyclic to arrest and therefore an increase in the left rolling tendency called tail rotor roll.

TAIL ROTOR PROBLEMS

The tail rotor not only performs wonders, has phenomena, but it also causes problems. Most tail rotor problems are associated with its power demands which can lead to tail rotor droop and tail rotor stall.

Tail rotor power. In order to produce tail rotor thrust, lift must be produced in a horizontal direction. The production of this lift causes drag which causes an increased power requirement. An increase in the power required by the main rotor must result in an increase in the power required by the tail rotor to maintain heading. In small helicopters approximately 5 percent of the available power is coupled to the tail rotor, whereas large cargo helicopters have to have up to 20 percent of their power available to the tail rotor.

Tail rotor droop. We are aware that the tail rotor is connected to the main rotor transmission at a constant ratio and, therefore, for each given rpm of the main rotor there is also a given rpm for the tail rotor. Since main rotor demands automatically regulate engine power output, the engine may be unable to provide enough power to meet the main rotor demands. If the main rotor demands more power than the engine has available, the main rotor rpm will begin to decay and, therefore, the tail rotor rpm will also begin to decay. As the tail rotor rpm decays so will the tail rotor thrust decrease, unless more pitch is applied to the blades. This will require more power from an already overtasked power system, leading to more decay and ultimately insufficient thrust for the tail rotor to maintain heading, causing the nose of the aircraft to yaw abruptly to the right. At this point, attempted tail rotor pedal corrections of more left pedal have only made the situation worse. The pilot's only action should be to unload the main rotor power requirements, thereby allowing the main rotor rpm to increase and in turn allowing the tail rotor to increase its rpm and ultimately its thrust to stop the yaw. Hopefully the pilot will have enough altitude to accomplish the necessary main rotor unloading and get into the flight regime of translational lift. Most flight manuals have graphs which allow the pilot to predict at what main rotor rpm he will begin to lose his tail rotor effectiveness. This rpm will be dependent upon temperature, density altitude, and aircraft gross weight.

Tail rotor stall. The same yawing movement caused by tail rotor droop can also cause the tail rotor to stall. When the nose of the aircraft swings abruptly to the right, the pilot's initial reaction to increase collective and apply more left pedal will aggravate the situation. Not only is the tail rotor losing rpm but also by the pilot applying more

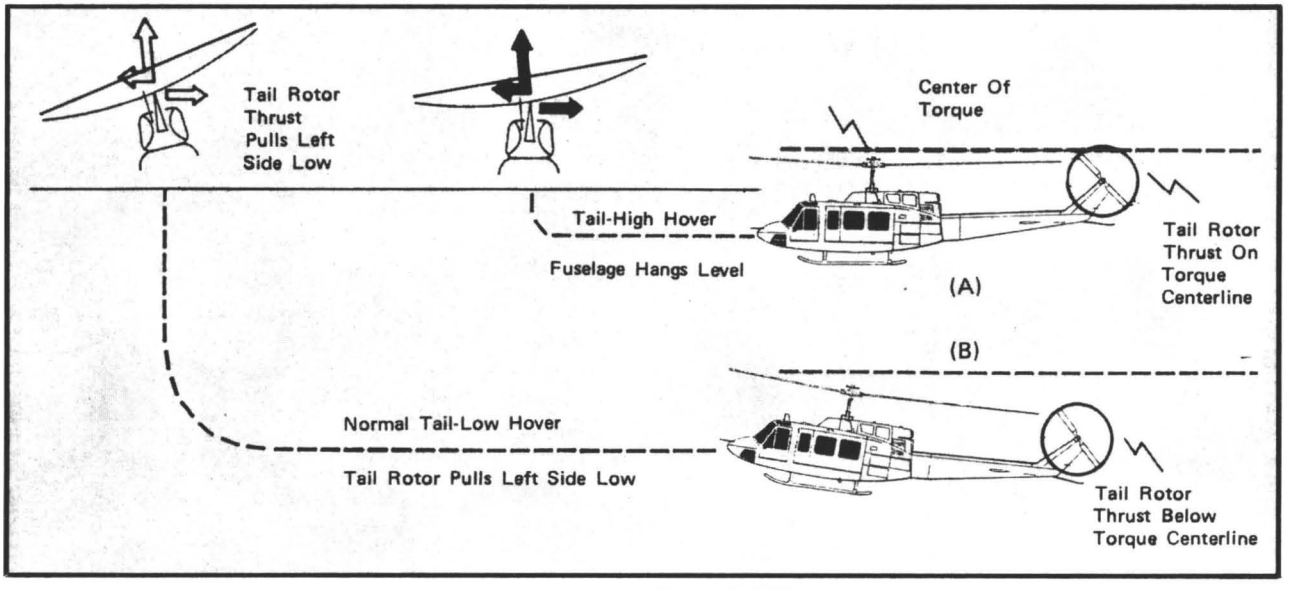


FIGURE 4.—Right Crosswind Effect

left pedal, he is increasing the angle of attack of the tail rotor blades and the rotor itself is passing through its own turbulence. Combinations of these factors may cause the tail rotor to stall.

Tail rotor droop/stall recovery. Anticipation of conditions that could cause main rotor droop should begin during preflight planning and then early recognition of main rotor droop is essential to safely initiate corrective actions. If main rotor rpm begins to decay rapidly during high power applications, then lower the collective, increase airspeed, initiate a right turn to unload the tail rotor, and go around while there is sufficient altitude. Attempts to salvage an approach to a hover or landing will only increase your chances of an accident.

Crosswind considerations. Right crosswind. Because of the requirement to tilt the rotor to the left to stop tail rotor drift, a small crosswind from the right may alleviate the amount of left cyclic and therefore level the main rotor disc, reducing the power required by canceling the horizontal component (fig. 4), but in most cases this benefit could be canceled by the requirement of additional left pedal to prevent weathervaning. This additional power requirement would increase as the crosswind increases until the wind approaches 10 to 12 knots, and then the power requirement would reduce as the main rotor system encounters translational lift.

Left crosswind. Airflows from the left can produce difficulties with directional control. With a 5- to 15-knot wind from the left, the tail rotor can be experiencing recirculation problems, where it is actually moving in the same direction as its induced airflow and into its own turbulence. The result is frequent changes in the pedal position, which is uncomfortable for the pilot trying to be accurate with his heading control. But a crosswind from the left rarely causes power problems because the tail rotor pitch setting is low. A phenomena called tail rotor breakaway can be caused by a left crosswind due to blanking of airflow to the tail rotor by the tail rotor pylon (most American helicopters have the tail rotor mounted on the left side of the tail rotor pylon). The result of this airflow blanking can be a loss of directional control and excessive power demands.

We have discussed how useful a tail rotor can be to counteract torque, maintain trimmed flight, and provide heading control throughout the helicopter's flight regime. Despite its good points, there are also some bad ones: tail rotor breakaway, tail rotor droop, and tail rotor stall, all of which can be caused by excessive power demands. I must stress that flying within the authorized flight envelope of your aircraft will allow you to avoid all these tail rotor problems and that there is much that can be done to anticipate excessive power demands during preflight planning. Only anticipation and early recognition in flight will allow the pilot sufficient time, hence altitude, to recover the situation. But none of these precautions will be of any use to you if you allow your tail rotor to strike an object and damage or lose it. So BE AWARE and do not allow yourself to be "DOWNGRADED TO FIXED WING ONLY."

Witty one liners

U.S. ARMY SAFETY CENTER

Here are some handy one-liners which could prove useful to aircrews. Feel free to use them (no charge) the next time you shirk responsibility, take a shortcut, skip a procedure, or "don't have time."

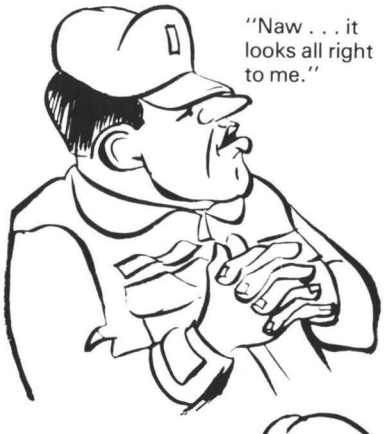
"Don't sweat the details."

"We'll get a late takeoff if we wait to have it fixed now."

"I've been flying a long time and haven't lost an aircraft yet."

Witty sayings just before an accident

- "We don't do things that way here!"
- "That procedure doesn't apply to us."
- "It looks O.K. to me."
- "I think it will be all right."
- "It's VFR today anyway."
- "We'll get a late takeoff if we wait to have it fixed."
- "They didn't write it up on the last flight."
- "You do the inside and I'll do a quick walkaround."
- "Don't sweat the details."
- "That shouldn't bother us."
- "2500 hours in this bird; I don't need the checklist anymore."
- "It'll be close, but we can make it."
- "I haven't had much time to hit the books."
- "This bird can take it."
- "We've got plenty of gas left."
- "If I wore all that survival gear, I'd really be uncomfortable in the cockpit."
- "We'd never get done if we did everything the book says."



"Naw . . . it looks all right to me."

"I haven't had much time to hit the books."

Quick answers for the accident board:

- "The weather was supposed to come up."
- "But the tower told me to expedite!"
- "But I've done that thousands of times."
- "There was plenty of fuel at the fix."
- "I'm sure I looked at the lights . . ."
- "I didn't have time to finish the checklist."
- "We've never done that before, and we haven't lost one."
- "Uh, a handbook change; I don't think I saw that."
- "I was sure we could make it."

We know the above won't cover all possible foul-ups, but we're sure that aircrew imagination can fill the gaps. Seriously, we pass these on in the hope that the next time you catch yourself cutting corners, you'll remember this article and maybe your name won't be listed in an accident report that reads CAUSE: PILOT ERROR.

—adapted from AEROSPACE SAFETY

"But I've done that thousands of times before and . . ."

"That rule (procedure) doesn't apply to us."

from Aviation Mechanics Bulletin

U.S. ARMY SAFETY CENTER

You have to trust somebody

DURING A RECENT accident investigation hearing, one of the men who was testifying made a statement which gave cause for considerable thought. In discussing his work with fellow men at his particular job, he said, "In our work, you have to trust somebody!" Never has there been an industry in which that statement was more true. Consider the trust that each worker has to have in the man who was involved in the operation just preceding his. This is true from the start of the design of a component, its manufacture, testing and installation in some unit, and then its use and maintenance.

Each time a pilot advances the thrust levers for starting a takeoff, he is putting his trust and that of the entire crew in the skill and judgment of the mechanics who signed off the aircraft as being airworthy. And those men have placed the same kind of trust in the component specialists who overhauled a unit, bench-tested it and tagged it as serviceable before it went out to stock. The final check was based on tests made with units which the specialist was confident would work properly. And thus the line of trust goes on.

The passenger who buys a ticket on XYZ Airline is also, consciously or otherwise, putting all of his trust in the integrity of the airline's coordinated operation, the safety and reliability of its aircraft, the skill and judgment of the pilots, and even in the sincerity of the smiles with which the flight attendant welcomes him aboard.

Knowing that his fellow men can say of him, "His sincerity and integrity are only exceeded by the reliability of his work," is the trait that most men hold highest in esteem. Such a man will do his best to maintain the trust placed in him, and yet will always have a little nagging concern lest, being human, he will fail that trust sometime, in some way.

That is the reason any man who conscientiously does his job to the best of his ability is never sensitive to having his fellow workers check on the accuracy, completeness, and reliability of his workmanship. When mechanics make a double engine change on an airplane, and check their own work against the worksheets, they expect it to be inspected and signed off by fellow workers, the inspectors. Now, even though all these men have full confidence in their ability for having done their job properly, they know that the airplane is going to be flight-tested and signed off again before it will be put into service to carry the airline's passengers. But certainly no one has greater trust in the skill and integrity of the men who did the jobs preceding theirs than the pilots who are taking it on the test flight.

In all of aviation, each person must be trusting someone else, and yet they must continue to check and crosscheck against that trust, just on that "one chance in a million" that the other person has acted like every other human being has at some time and "goofed" without realizing it.

Certainly no team in aviation has to trust each other more to do their jobs than do a pilot and copilot during a rough approach to bare minimums on one of those proverbial "dark and stormy nights." Even with that trust, each is constantly checking against the other to insure that that trust has not been unintentionally violated. For at times such as those such violations of trust could be permanent!

In the aviation business "Everyone has to trust somebody!" . . . but everyone should keep just enough of a hint of suspicion that that "somebody" may at some time slip. Too much trust in all those "somebodies" might also go under another name called "complacency." Trust, with just enough suspicion to keep making that little extra check on each other, is called "teamwork." Trust, personal integrity, and teamwork are what has made aviation great . . . and the mechanics are vital members of that team.

New AH-1S ECAS Cobras

2LT Cynthia L. Sims
Public Affairs Office
6th Cavalry Brigade (Air Combat)
Fort Hood, TX

Photos by David Scott

THE 6TH CAVALRY Brigade (Air Combat) recently broke a major testing barrier when it test fired 2.75 inch rockets from the new AH-1S ECAS Cobras equipped with Navy LAU-61 rocket launchers.

Previously, the AH-1S ECAS (Enhanced Cobra Armament System) could not fire 2.75 inch rockets because it was not equipped with a rocket management system (RMS). It could only fire 20 mm and tube-launched, optically-tracked, wire-guided (TOW) missiles which limited its overall required mission. The RMS has not been installed because the system is still undergoing testing.

To save time and money the 6th Cavalry Brigade commander, Colonel Robert F. Molinelli, hit upon the idea of modifying and testing the ECAS with a Navy rocket launcher, the LAU-61, in place of the RMS. The LAU-61 had been used effectively on Cobras in Vietnam and could be modified easily for the ECAS.

The armament system also is a part of the Department of Defense's inventory, and is easily adapted to the aircraft. The Troop Support and Aviation Readiness Command (TSARCOM) issued a temporary safety of flight "go ahead" and the testing preparation began.

An instructor pilot from A Troop, 4th Squadron, 9th Cavalry, was chosen as the test pilot based on his experience and knowledge of the AH-1S ECAS. Colonel Molinelli then requested Redstone Army Arsenal, Huntsville, AL to find a solution to this problem. The LAU-61 was selected because its intervalometer is wired into the rocket pod rather than into the internal wiring of the aircraft. This enabled the use of the LAU-61 without any additional wiring or added control boxes. If modifications were made on the aircraft, it would have cost a lot more money and manhours, not only to install the system, but to remove it when the RMS was received. Since there was no major modification, the LAU-61 was wired into the existing M-18 minigun system.

The preparation, testing and installation was done by Mr. Melvin Bartlett, an armaments specialist from the 2.75 inch Project Managers (PM) Office, Redstone Arsenal, and Soldiers from the Armaments Section of A Troop. The A Troop armaments officer was instrumental in arranging, preparing and supervising the installation. The wiring and preparation began about 3 days prior to the initial test date. Mr. Bartlett and the armaments team installed the system on the aircraft on a Monday, and then started putting together the switchology of the aircraft and testing all the circuits to make sure the weapons fired correctly.

Before approval was given for the test firing, further testing was conducted on the helicopter circuitry. Flash cubes to be used in the testing were taken to the U.S. Army Training and Doctrine Command Combined Arms Testing Agency (TCATA) to see how much amperage the bulbs used in comparison to the amount of amperage needed to fire 2.75 inch rockets. They were found to use

When using the Navy rocket pod, the LAU-61, the cockpit control panel had to be altered to accommodate the pod's internal firing mechanism. This is in contrast to the "200" series pods used on previous models

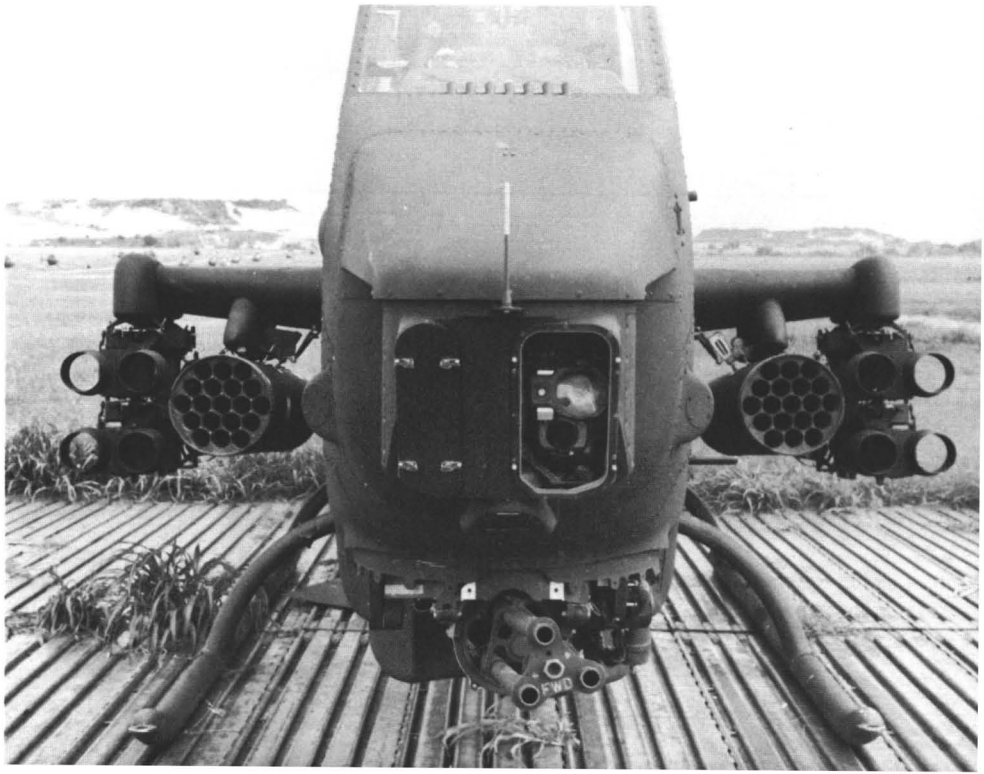
only a minutely different amount. The armaments team then connected the flash cubes to the rocket pods to test the circuitry for stray voltage which might cause accidental rocket firing. This ground test was successful and the system was declared safe for rocket loading.

Since it was an untried test firing and an untried circuit, and even though it passed the flash cube test, the team was concerned that anytime a switch was pushed or a radio turned on, it might fire one of the rockets. During testing, there was concern that when the armament switch was ignited the rockets salvo (fire simultaneously)—but testing worked out well. There was also some danger of a change to the aircraft's flight characteristics, but this also did not prove to be a problem.

The armaments crew underwent training on all of the loading and safing procedures under the supervision of Mr. Bartlett who devised the pilots' procedures and armament loading procedures. The danger of the rockets firing while being loaded was minimized because of added safety features on the LAU-61. The launcher has two ground safety features for ground personnel—a shorting pin and a load position switch that prevent amperage from going into the rockets contact. The only difference in the installation of the LAU-61 as compared to the installation of the M200A1 is an adapter cable which must be installed between the M-18 gun connector and the launcher input connector. Otherwise, normal standard operating procedure is used. The cable is not available in the Army inventory, but was manufactured by the 34th Support Battalion Electrical Shop.

The ECAS equipped with 2.75 inch rockets is more effective. The 2.75's fire faster than the old M-200 rocket pods which fired about six rockets a second. The LAU-61 launcher fired 38 rockets in about

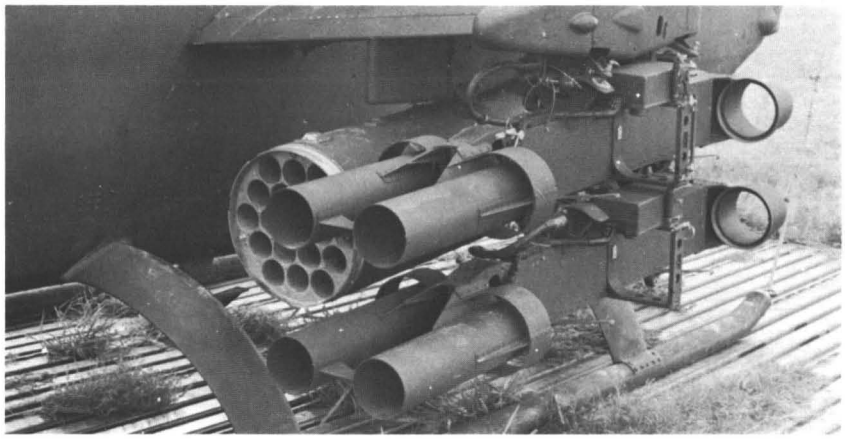
Viewing the production "S" model Cobra from the "business end" shows how the Navy rocket pods LAU-61 complete the weapons systems and make the Cobra combat ready even while the advanced rocket management system is still undergoing tests



2 seconds. Cobras basically are antitank aircraft and the 2.75 greatly enhances their mission. They force tank crews to "button up"—making the tanks more vulnerable to Cobra TOW missile attacks which must be fired within a distance of 3,750 meters. The 2.75's can be fired from 5,500 meters enabling the TOW equipped helicopter to move in to attack.

There are some minor problems with the system. The Navy used the LAU-61 in Vietnam in an expendable fashion. Rockets were fired from the launchers and when expended the launchers were jettisoned (or released) from the aircraft. In present Navy and Marine testing, the launchers still are being used this way. The LAU-61 can be used over and over again, but cannot be repaired in case of failure. If seven to nine tubes should fail, it is not economical to continue using the launchers.

The LAU-61 is available to the Marine Corps, Air Force and Navy, but not to the Army, for release out of stockage. There are some options, however, that the Army can take to obtain the launcher. One is an intergovernment transfer of funds (Navy to Army) submitted through a Department of the Army or Department of Defense Form "MIPR." This can be submitted through the PM's office. The form allows for transfer of funds from Army Materiel Development and Readiness Command to U. S. Army Forces Command.



Mounted beside the TOW launching system, the LAU-61 rocket pod is at home as a member of the Cobra fire team

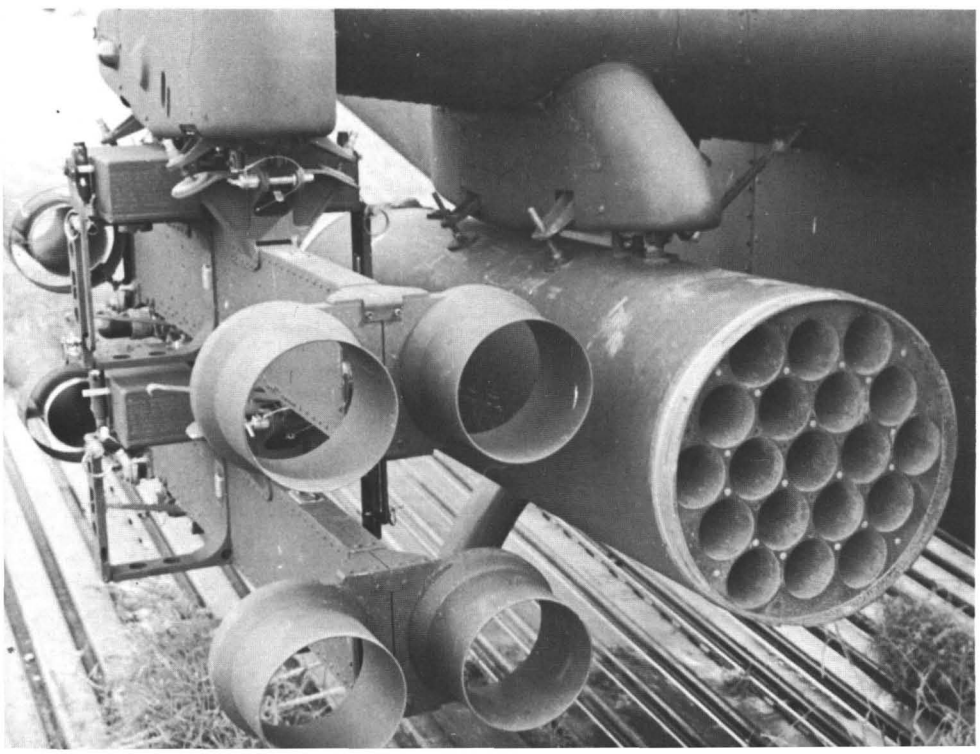
Another option is through procurement equipment missiles, Army (PEMA), or operation and maintenance, Army (OMA) funding. Mr. Bartlett explained that the description should be limited to "launchers and support equipment" or "replacement for launchers and support equipment of field support." He also estimates the cost for the LAU-61 at $47,600 for 28 launchers or $1,700 each. The four test sets that go with the launchers are estimated at $3,000 or $750 for each, with a total estimate from $50,600 to $60,000. More information can be obtained by contacting:

Commander
ATTN: DRC DM-RK
Redstone Arsenal, AL 35809
AUTOVON 746-4231

Since initial tests there have been four ECAS Cobras equipped with the LAU-61 and test fired. Overall, the testing was a success, with more than 200 rounds fired with direct hits on targets in all phases of aircraft firing—including running fire, diving fire and hover fire using both single and ripple modes during day and night conditions. There have been no major problems with the system.

Until the rocket management system is scheduled for release (estimated 1982) the LAU-61 emplaced on the AH-1S ECAS Cobra can sufficiently provide a 2.75 inch rocket capability. This type of research and testing is what keeps the 6th Cavalry Brigade (Air Combat) the forerunner in Army aviation.

The LAU-61 was chosen for the AH-1S (P) Cobra because of its self-contained intervalometer, it adapts easily and it is economical



U.S. ARMY

AVIATION STANDARDIZATION

Directorate of Evaluation/Standardization

REPORT TO THE FIELD

DES welcomes your inquiries and requests to focus attention on an area of major importance. Write to us at: Commander, U.S. Army Aviation Center, ATTN: ATZQ-ES, Ft. Rucker, AL 36362; or call us at AUTOVON 558-3504 or commercial 205-255-3504. After duty hours call AUTOVON 558-6487 or 205-255-6487.

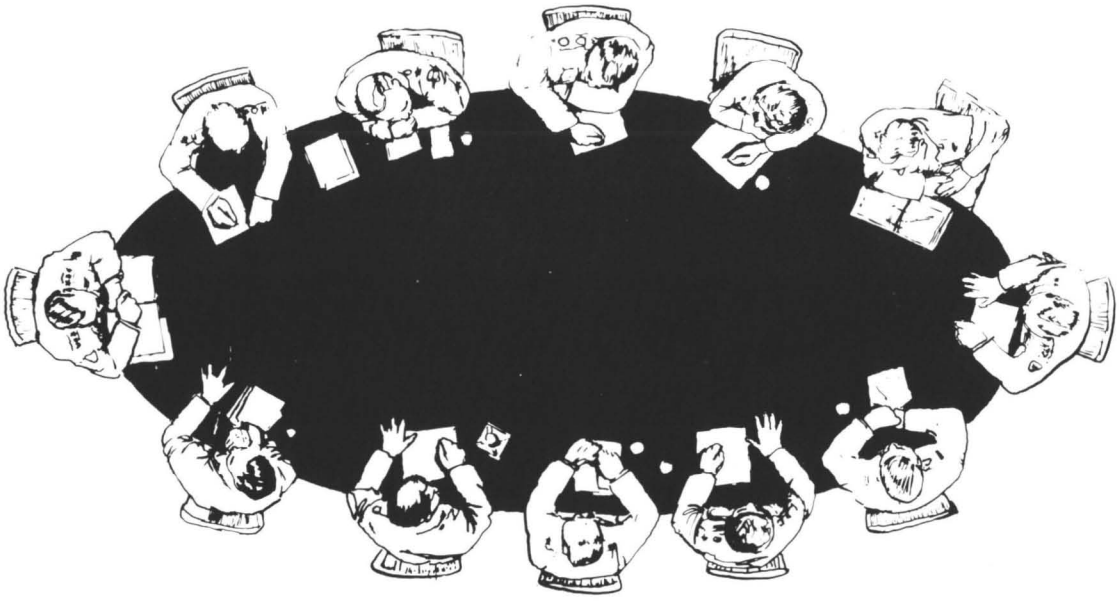
Programing Army Aviation Standardization Evaluation/Assistance Visits

IN 1972 THE Chief of Staff of the Army, alarmed at the increasing number of aircraft accidents attributed to the lack of standard flying techniques and their associated loss of materiel and human resources, asked major Army commanders for suggestions to reduce these needless losses. One of their recommendations was to establish a centrally managed flight standardization program. The U. S. Army Aviation Center (USAAVNC), Ft. Rucker, AL was designated proponent agency for the implementation of this program.

One of the features of this program is the assessment of proficiency of aviators Armywide. This task is accomplished in coordination with major Army commands (MACOMs) during the conduct of assistance and evaluation visits. The Aviation Center informs and advises Headquarters, Department of the Army (HQDA) and MACOMs of the status of aviation standardization activities and the implementation of aviation standardization policies and procedures Armywide.

To accomplish these functions requires an intricate scheduling arrangement with many interested Army agencies/activities to ensure smooth and timely worldwide visits by DA aviation standardization evaluation/assistance teams in conjunction with ongoing MACOM evaluation programs. The primary purpose for combining the visits is to minimize the disruptions to training at installations, including U.S. Army Reserve (USAR) and Army National Guard (ARNG) flight support facilities, caused by frequent visitors. Other advantages gained from combined visits are the complementary support provided the MACOM evaluation teams by the USAAVNC Aviation Standardization Teams (most MACOMs do not have standardization instructor pilots (SIPs) assigned to their staffs) and the opportunity for the visited organizations to be looked at in most functional areas at one time instead of a fragmented look-see over several visits.

Now that the requirement for aviation standardization evaluation and assistance visits is known, the



question arises, "How is an effective schedule involving worldwide visits by DA Flight Standardization Teams developed?" The planning cycle begins in the Directorate of Evaluation and Standardization (DES), USAAVNC, in December of each year. The DES informs the MACOMs, National Guard Bureau (NGB), Office of the Chief, Army Reserve (OCAR), Office of the Chief of Engineers (OCE), the numbered armies in the Continental United States (CONUSA) and DA Deputy Chief of Staff for Operations and Plans (DCSOPS) that a "squaring session" for the next fiscal year evaluations will be held in February. The MACOMs and CONUSA are requested to submit, prior to February, their proposed schedule of visits and other events that would require DES flight standardization support. When received, the Plans and Operations Branch, DES, combines all the proposed visit dates into a yearly flow chart. This becomes the "strawman" for the squaring session. Included in the strawman are the few separate evaluation visits to be conducted by DES and USAAVNC and the Instructor Pilot Course training dates which impact on the availability of DES SIPs for worldwide travel. (DES is charged with administering all end-of-course flight evaluations for DA IP producing courses at USAAVNC.)

In February, representatives from MACOMs, NGB, OCAR, OCE, CONUSA and DA DCSOPS gather at the Aviation Center to finalize the proposed schedule. Each month's requirements are reviewed collectively and changes made, where necessary, to arrive at a workable schedule that is mutually supporting. Quite frequently, it becomes a "give and take" proposition where conflicts arise. Considerations include dates of major field training exercises; significant events that may affect availability of aviation assets at installations to be visited; seasonal factors in certain geographical locations (for example, winter/spring fog in Korea); and the DES manpower capability to support the requirements of the MACOMs and USAAVNC training.

The "squaring" session is not simple and short. On the contrary, it usually takes a full working day to resolve the complex 12-month proposed schedule of visits. However, at the end of the day, representatives return to their headquarters with a tentative schedule that is within the capability of DES to support. As previously stated, the "squared" schedule is only tentative because of an important missing factor—funding. Since the schedule is for the new fiscal year, DES must submit in the USAAVNC Command Operating Budget Estimate (COBE) the travel dollars needed to support the tentative worldwide schedule of visits. Likewise, the MACOMs and other participating organizations also must submit funding requirements in their COBE. The schedule may be subject to further scrubbing when the funding authorization for the new fiscal year is received, depending upon the level of travel dollars allocated.

The execution phase of the program begins in the new fiscal year. It involves close and continuous coordination by DES with all commands involved to ensure that detailed planning is accomplished for each visit. Final plans for each visit are formulated with the MACOM and the installation to be evaluated during the 30-day period prior to the visit.

Through programing and execution of the DES assistance/evaluation visit schedule, the USAAVNC is assisting in reaching the goal of the Army Aviation Standardization Program. That is: To improve unit readiness, aviation safety and professionalism by using standard procedures and techniques.

The IP's Coefficient of Safety

DURING THE 5-year period from fiscal year (FY) 1974 through 1978, Army aviators were involved in 509 aircraft accidents. The Directorate of Evaluation and Standardization, located at Ft. Rucker, AL, is studying this accident record to determine the correlation between the Army's standardization program and the Army's aviation accident prevention effort. For the purpose of this study the data of FY 1977T and 1977 was combined into fiscal year 1977.

Generally, there was a decline in the accident rate during this period. FY 1974 generated the highest rate at 7.08 accidents per 100,000 flying hours and dropped to a low of 5.79 during the combined FY 1977T and 1977. FY 1978 reversed the declining trend and registered an aberrant rate of 6.21.

The Army's instructor pilot (IP) community has been a significant contributor to this declining accident record. IP-induced accidents ranged from a high of 33 percent of all accidents in FY 1974 to a low of 22 percent in FY 1978. While IP-induced accidents also show a general decline, they accounted for 143 of the 509 total accidents, or 28 percent. Admittedly, IPs work in a high risk environment, and their "coefficient of safety" becomes rather tenuous at times.

A central theme that emerges from narratives of the majority of the 143 IP accidents is the deterioration of maneuvers beyond the level of competence of the IPs. It would appear that if some personal assessment of capabilities on the part of our IPs had been made, the accidents may not have materialized.

If you, the IP, are able to recall a maneuver that almost got away from you, or a hard autorotative landing that terminated with the collective tickling your armpit, you can visualize where your level of competence left you at the mercy of the machine and the environment. You know that you could have been a statistic in the IP accident record. This is unnecessary; IPs need not go to the brink of disaster every time they wish to make a teaching point.

Good instructors set limits to deviations for all maneuvers. Once they set their own limits, they need not be surprised to find that their levels of competence and ability appear to have improved. This is a natural result of knowledge that they are working within parameters that will not be embarrasing to them and eventually will enhance the learning process. In this way IPs have diminished the risk of their environment and increased their "coefficient of safety."

PEARL'S

Personal Equipment & Rescue/Survival Lowdown

If you have a question about personal equipment or rescue/survival gear, write Pearl, DARCOM, ATTN: DRCPO-ALSE, POB 209, St. Louis, MO 63166

CBR

There are some instances where our aircrewmembers need protection in a chemical, biological and radiological (CBR) environment. The overgarment now available for aircrewmembers is the suit, chemical protective, NSN 8415-00-177-5007, line item number U57960, available from S9T at a current cost of $34.00.

Fire-Water

Because of a fire at the facility of the manufacturer of the water purification tablets, NSN 6850-00-985-7166, the Defense Personnel Support Center (DPSC) has advised that production of the tablets will not resume for about 9 months.

Based on the above information you *should not* routinely discard your water purification tablets. Lot samples should be tested after 2 years to determine serviceability and lots extended for 2 years if determined to be serviceable.

Without National Stock Numbers

Have you ever needed a replacement part for your equipment and found the part without a national stock number (NSN)? Some of the time we scrap the end item because the replacement part NSN has not been established in the Army Master Data File (AMDF).

There is a way to get the replacement parts that you need without NSNs. In block numbers 65 and 66 of the DD Form 1348 enter the code "2A." This will alert the buyers that the item you require does not have an NSN, but is required. Send as much information as possible with your requisition, such as the manufacturer's code and part number, the noun name of the item required, and how or where used. Also include the end item NSN that the part will be used on.

Chin Up

Some of the chin straps, NSN 8415-01-057-3502, of your SPH-4 flight helmets are defective and will not keep your chin up or the helmet on your head in the event of an air crash.

The chin straps that we are concerned about were manufactured by contract DLA 100-78-C-0854. The defective chin straps manufactured under this contract should be returned. However, replacement chin straps are in short supply, so return only defective chin straps.

The defect is in the snap fastener and can be recognized because the end of the shank or barrel on the button portion is not adequately rolled to effect a secure hold on the socket position of the snap. The snaps come apart when snapped and unsnapped. View the snap from the socket (female) side. If the end of the button shank has a thin edge or the socket teeth are showing in lieu of a wide, neatly rolled edge enveloping the socket teeth the snap fastener is defective and the chin strap should be returned to: Defense Depot Mechanicsburg, ATTN: DDMP-JQ (Mr. Rutecki), Mechanicsburg, PA 17055.

Due to the low dollar value of the chin strap ($1.75) credit is not being issued for the replacement chin strap which you must requisition.

Of Interest

Both the technological and tactical advancements, during the late sixties, in the art of detection, location and retrieval of survivors have served to minimize the relative importance of color visibility of clothing and survival equipment (life preserver, flight coverall, survival vest, etc.) in the overall concept of rescue. Surveys taken by the Naval Safety Center of accident data have shown that the leading factor in the location of downed personnel was predominately through the successful use of such active aids as emergency radios and beacons, distress signals and flares, strobe lights, mirrors and helmet reflective tape.

Elaine Chiboucas
Photo by Tom Greene

Carelessness Is . . .

By: An Unknown Author

The ENEMY—I am more powerful than the combined armies of the world. I have destroyed more men than all of the wars of the nation. I massacre thousands of people in a single year. I am more deadly than bullets. I have wrecked more homes than the mightiest of guns. I steal in the United States alone more than $500,000,000 each year. I spare no one and I find many victims among the rich and poor alike, the young and old, the strong and the weak. Widows and orphans know me to their everlasting sorrow. I loom up in such proportions that I cast my shadow over every field of labor. I lurk in unseen places and do most of my work silently. You are warned against me, yet you heed me not. I am relentless, merciless and cruel. I am everywhere—in homes, on the streets, in the factories, at railroad crossings, on land, in the air and on the sea. I bring sickness, degradation and death. Yet few seek me out to destroy me. I crush, I maim, I devastate. I will give you nothing and rob you of all you have. I am your worst enemy.

I am carelessness

CLOSE AIR SUPPORT-

Major Gene N. Patton
U.S. Air Force Representative
Fort Rucker, AL

OF THE FIVE missions of tactical fighter aircraft, close air support (CAS) has evolved the most since the introduction of the military airplane. It has changed with technology as well as improved employment procedures. This evolution continues with the latest employment tactics called the Joint Air Attack Team (JAAT). These tactics are based on new aircraft, weapons and teamwork that meld both Army and Air Force armor killing systems into the best possible force. Justifiably, these new concepts receive a great deal of attention. However, Army aviators need to be as familiar with the weapons systems and tactics of all CAS players as they are with their own.

The basic concept for close air support involves the forward air controller (FAC) who coordinates the tactical fighter fire support with the ground maneuver unit. FACs have been with us since World War II. They first appeared mounted in jeeps or tanks with the leading elements of Army units. In Korea and Vietnam they were airborne, controlling almost all close support airstrikes with similar tactics. Now the low threat environment enjoyed by AT-6s in Korea and the 0-1s, 0-2s and OV-10s in Southeast Asia is gone, along with the FACs long-winded briefing. No longer do fighters circle a target waiting for a FAC to launch a 2.75 inch white phosphorus marking rocket. These procedures would be suicide on the modern battlefield.

JUST FACTS

To counter the awesome threat of a European battlefield scenario, the Air Force has changed CAS employment concepts. A forward or ground FAC in a jeep, track vehicle or possibly scout helicopter acquires targets and initiates the commander's immediate close air support requests. Another Air Force pilot, called the airborne FAC, serves as a tactical air coordinator—airborne (TAC-A) located to the rear of the high threat area. The TAC-As coordinate initial target servicing for the forward FACs. These airborne pilots select initial points (IPs), attack headings and provide target briefings for the fighters. They work as traffic cops' controlling the flow of attacking fighters into and out of target areas. The airborne TAC-A releases a flight of fighters to attack from the IP and clears them to the tactical operating radio frequency. As the fighters are en route, the forward FAC designates targets with artillery, AH-1 Cobra fire or laser energy. The forward FAC is silent except to adjust or abort the fighter's pass, so consequently communication is kept to the absolute minimum. These tactics work well even in a communication jamming environment, and the Air Force uses them in all CAS training.

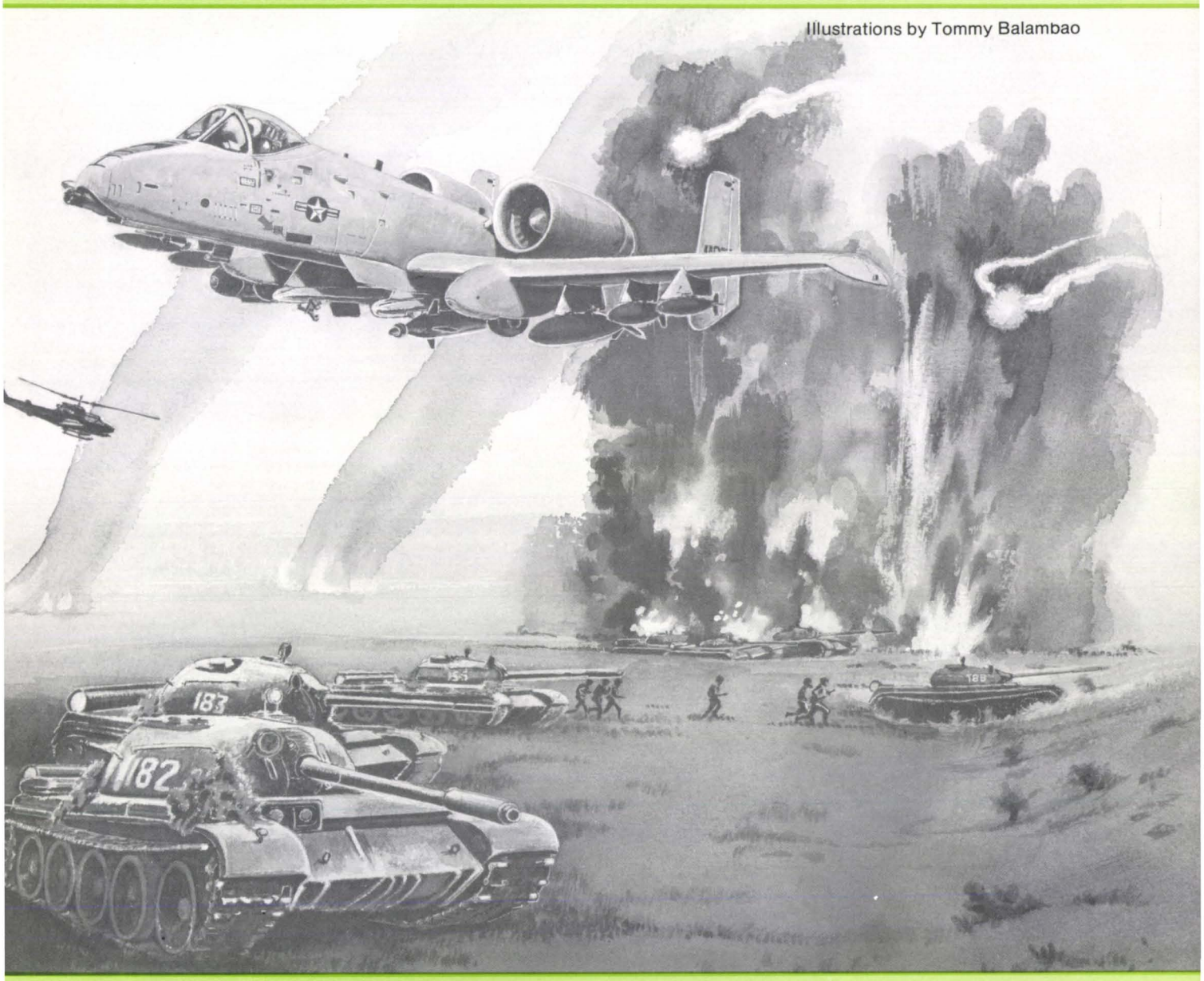
Much has been written about A-10 ("JAAT," *U. S. Army Aviation Digest*, January 1979) employment procedures and techniques; however, the backbone of the fighter inventory remains the F-4 Phantom. The A-7 F-111, and Reserve/Guard F-105s, A-37s, A-7s and F-100s augment this aircraft. These fast movers employ some concepts that differ from A-10 techniques, although initial procedures are the same.

Fighters rendezvous outside the high threat area with the airborne TAC-A, who briefs them on target type, location, IP location, run-in heading and distance (IP to target). Pilots require no other information to attack except the location of friendlies if they are a factor. Target area tactics vary with aircraft type, and remain the sole responsibility of the flight leader, who determines formation, sequencing and attack parameters. Normally the fighters leave the initial point at minimum altitude. They use terrain masking, onboard radar jammers, radar threat warning receivers, chaff and high speed (the F-4, 500 knots plus) to enter the battle area. Three to four miles from the target, depending on aircraft, they popup to 3,000 to 5,000 feet.

Unlike the A-10, these pilots use this low popup maneuver to acquire the target and gain altitude for the bombing pass. A-10s only fly up to get line of sight to the target, since they normally do not employ bombs. As the popup starts the leader calls to alert the FAC. This radio call also keys attack helicopters and ground elements to start covering/target-designating fires or laser designation if available. After the popup, exposed tracking time of the target is minimal. Weapons release is followed by a jinking recovery to low altitude to egress the target area. "Speed is life" is an old fighter pilot adage that applies to air-to-air as well as air-to-ground employment. Maintaining high speed is necessary to be able to maneuver against surface-to-air missiles, antiaircraft artillery or threat aircraft.

The fast movers usually at-

Illustrations by Tommy Balambao



tack in elements of two aircraft flying either line abreast or staggered trail. Often flights will split before the popup to compound the gunner's tracking problem. If the target requires multiple passes, the fighters normally will reattack from the IP. The Air Force considers these tactics optimal against the threat of modern mobile and sophisticated air defense weapons. In contrast, the Vietnam era wheel attack from an orbit over the target is useless. Neither the FAC nor fighter crews can survive using this exposed procedure on a modern battlefield.

Weapons carried by tactical fighter aircraft have changed along with delivery tactics. The Air Force has replaced napalm and early high dud-rate cluster munitions (CBUs). The weapons that won their hearts and minds in the delta are largely ineffective against a mobile armor threat. Consequently, in addition to regular bombs and improved CBU, fighters now carry lethal doses of such exotic weapons as Maverick, Rockeye or smart bombs.

The only CAS missile normally used by the Air Force is the AGM-65 Maverick, an electro-optical (TV) guided launch and leave weapon. Its shaped charge warhead is specially designed to penetrate advance design armor. Additionally, the TV

tracker can home in on and kill moving as well as stationary vehicles. F-4s, F-111s, A-10s and A-7s all carry this weapon, and an improved night, all-weather infrared tracker is soon to enter the inventory.

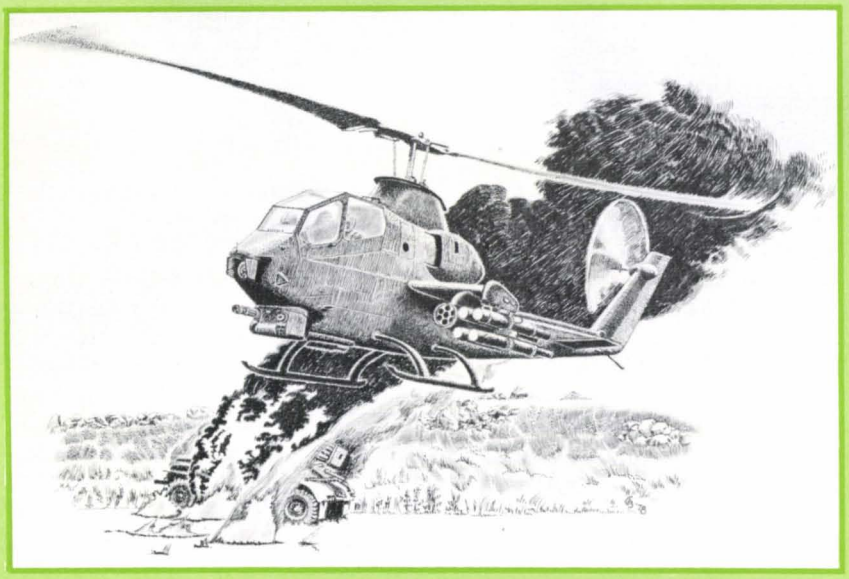
The MK20 Rockeye is a cluster munition that can provide multiple armor kills on a single attack pass. Each canister, when dropped, opens during the fall to scatter 174 separate armor penetrating, shaped-charge bomblets. All tactical fighters can deliver the flexible, free-fall Rockeye in a dive or level, in even marginal weather.

Smart bombs are 500 or 2,000 pound bombs mated with a laser guidance kit. Any fighter can carry these weapons for delivery when teamed with a ground or F-4 mounted laser designator. Highly accurate, pilots can loft these guided bombs from extreme ranges for increased standoff survivability at no loss of first round hit capability.

These modern tactics and high technology weapons are part of the answer to the present and future threat. JAAT and combined arms training are the rest of the solution. But where do Army aviators fit into USAF fighter employment concepts? Scouts or attack helicopters pilots or any aviator can aid the FAC, or in an emergency, coordinate CAS. The tactical helicopter pilot's superior target acquisition capabilities and mobility augment the ground FAC.

As targets develop, Army pilots can call either the forward or airborne FAC for close air support with techniques similar to those used for calling in artillery. Each unit's communications/electronics operating instruction (CEOI) book contains the FAC's radio frequencies. Just like the fire support teams (FISTs), the FACs only need target type and location as a start. They then coordinate the CAS fire support. As the attack starts, Army pilots can relay information to adjust fighter passes, to estimate bomb damage, or to attack new targets of opportunity. In this role the Army aviator acts as an extension of the FAC's capabilities.

Without an Air Force tactical air control party of FACs, Army pilots or FIST elements must coordinate fighter fire support. They initiate the fire support by radioing their unit operations center to get the basic request started. This request is just like a call for artillery fire. Once on-station, fighters only require target type, location and elevation to start work. A-10 drivers speak in terms of 1:50,000; other fast movers require an easily recognized initial point with heading/distance to the target. With this minimum information they will leave the IP when cleared and call as they start to popup to attack the target. Army pilots can then provide last minute adjustment or abort information. Working fast movers with these simple procedures is not difficult for a FAC or an Army aviator, but only realistic training will ensure success under the stress of combat. Certain Army and Air Force units already have conducted this joint training.



Since June 1978 the 1st Squadron (Air), 17th Cavalry, Ft. Bragg, NC has conducted an aggressive JAAT program. It started with the basics developed from JAWS II flown at Ft. Hunter Liggett, CA, but developed new tactics while training exclusively with A-10 squadrons. The A-10 is, however, still in the minority of possible close air support fighters. In exercises Army pilots must be ready for both A-10s and higher performance jets.

The expertise for employing all Air Force fighter assets is found in the tactical air control parties attached to Army units. These fighter qualified FACs can answer questions and help meld Air Force and Army systems into a true combined arms team. So prior to the next exercise get with your unit FACs, and pick their brains for tactics information. Time spent by pilots, both green and blue suit, at this operational level ensures future success in exercises that may be for real.

Suddenly There's A Valley

Captain Robert B. Robeson
U.S. Army Readiness Region VIII
Nebraska Army National Guard
Lincoln, NE

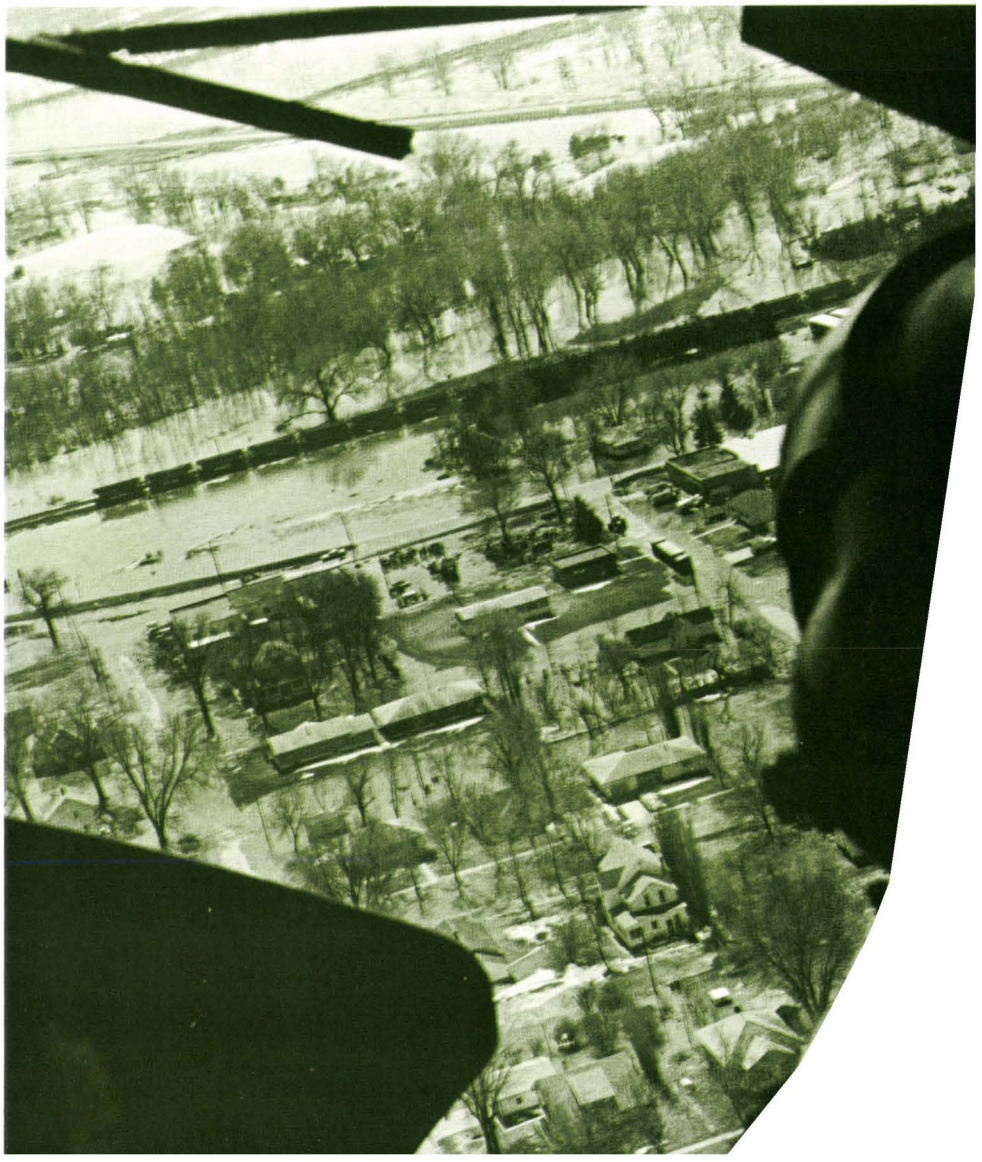
Photos by
111th Public Information Detachment
Nebraska Army National Guard

FROM THE AIR it looked like a scene from the movie "In Search of Noah's Ark." In fact, an ark wouldn't have been that out of place in Valley, NE on 20 March 1978—it could have served a useful purpose.

At 2,000 feet the view was like gazing down upon scattered pieces of a broken mirror. Water and gigantic chunks of ice reflected in every direction. Houses and buildings were islands and all around them was the sea. Closer to the ground, the Platte and Elkhorn Rivers overflowing into the surrounding countryside and cities had the ugliness of a trapped rat that has gnawed its own foot in an effort to escape.

Ever since, residents of Valley have been telling and retelling hundreds of stories about this tragedy along the Elkhorn River, and probably will for years to come. Some of the incidents will never be forgotten—or the uncertainty and fear the people of that area endured. The "Flood of 1978" is and will be compared, by those who were there, to past and future disasters in the state. But few will ever forget.

Being involved in a massive flood, in many respects, is like getting married or flying in a war zone. You watch it happen to your



Houses and buildings were islands and all around them was the sea. North Bend, NE (right) was among hardest hit by the "Flood of 1978"

friends, ask questions about it, but in the end you have to experience it yourself before your mind can truly comprehend.

For the Army Aviation Support Facility in Lincoln the story really began on 14 March 1978 when its National Guard aircraft and crews officially were activated to support civil authorities by performing reconnaissance of eastern Nebraska rivers and streams for locations and status of ice jams. Their period of active duty lasted until 3 April. By then, 39 pilots and 46 enlisted crewmembers and aircraft maintenance personnel from the flight facility had flown 303 hours and used more than 17,000 gallons of jet fuel. They had evacuated more than 325 civilians. A large number of personnel from other Nebraska units also assisted in administrative functions, command and control, and person-to-person assistance with ground vehicles.

The actual damage was officially estimated to be $90 million by the Nebraska Civil Defense Office. President Jimmy Carter designated 22 Nebraska counties as federal disaster areas.

Former Governor J. J. Exon, and Major General Edward C. Binder (The Adjutant General of Nebraska) toured the flood areas and directed much of the daily operation from Guard helicopters. The governor described the Platte flooding as the worst in 40 years on that normally docile river.

The real test for aviation personnel came in Valley, the hardest hit area of all, when more than 300 of the 1,600 residents were evacuated by air late Monday afternoon (20 March). Flight crews evacuated them to nearby Waterloo where they were loaded into buses and taken to Boys Town emergency shelter in Omaha, about 10 miles farther.

A spokesman for the Omaha Weather Service office said that ice cakes as big as cars were causing most of the flooding as the Platte and its tributaries backed up behind the huge ice jams. While Guard helicopters performed aerial reconnaissance, evacuated personnel and resupplied those working feverishly on the ground, contractors in civilian helicopters were dropping dynamite charges onto the ice jams. The frequent explosions gave the area a combat zone atmosphere.

Valley, NE (above) suffered most serious flooding. Flight crews evacuated 300 of the 1,600 residents to emergency shelters by late afternoon on 20 March. Below, scene of the Elkhorn and Platte Rivers near Yutan, NE

With so many civilian, military and private aircraft in the vicinity, and so much water below, there were thoughts among Guard pilots of what would happen if complete attention weren't given to the task at hand—like getting your tailboom twisted and your teeth jarred—or worse! Even for those who've left a trail of sweat many times from Chu Lai to Da Nang with the fuel gauge bouncing around on zero, a flyspeck on the windshield still had the ability to double the heartbeat, considering the constant clutter of other aircraft circling the small, deluged towns below.

For some of the people involved, it was a "white knuckler" all the way. For others, it had the quality of those many days in combat when there is no past nor future—only present time. The damage below was immediate and appalling. The view through the windshields was filled with water, *lots of water.* But this helped to lend an aura of urgency to the flying.

When you can smell the sweat-dampened clothing of your passengers, sense their relief at being rescued and their frustration toward a situation beyond their control—you begin to identify with them. You go through a stage of suffering with them—even if it's only for 10 to 20 minutes during each trip. A new sensitivity to the problems of others seems to come from it all.

Subconsciously, without understanding the full significance of any similar situation, pilots adopt basic rules of flight. Somewhere, in the unknown recesses of our minds, we've discovered that our ability rises and falls with the essential problems that contront us. What we *can* do depends largely on what we *have* to do.

The flight facility personnel used their freedom of movement through the air to help others and to assist in bringing order out of disorder.

The achievements of the people on the ground—the fire and rescue squads, the Coast Guard in their amphibious vehicles and other volunteers—and Army aviation emphasizes the often forgotten possibilities, however tentative, of prevailing over one's immediate circumstances against seemingly insurmountable odds. This was the way it happened in Nebraska. The Guard's pilots and crews found out again, as so often before, what they could do when local emergencies required their assistance.

Army aviation has come a long way since the days when a helicopter looked like a mosquito trying to carry a flashlight bulb. I'm sure people along the Platte, Elkhorn, Big and Little Blue, and Loup Rivers who remember this flood appreciate the capabilities and potentials of Army helicopters now more than ever before.

Things can go along without a hitch for Guard pilots in this state that is so flat it sometimes appears to be an unnatural act. And then (as the song goes), "Suddenly There's A Valley," and all of their aviation skill, knowledge and training is required almost instantaneously. Army aviation in the National Guard, like everything else this side of the Garden of Eden, is not infallible, but, like an old friend, it's there when it's needed and it gets the job done right!

Shakespeare, in Henry IV, could very well have been talking about flight facility personnel in Lincoln when he wrote, ". . . but I tell you . . . out of this nettle, danger, we pluck this flower, safety." For more than 325 people in and around Valley, NE know and appreciate Army aviation, and that's a part of what it's all about.

Above, right, another view of the isolated town of Valley. Below, North Bend, NE. Massive flooding caused by ice jams lent an aura of urgency to the flying

ATC ACTION LINE

UNITED STATES ARMY COMMUNICATIONS COMMAND

System Errors / Readback

System Errors

According to Federal Aviation Administration (FAA) Air Traffic Service Technical Bulletin No. 79-3, there were 355 system errors reported by air traffic control (ATC) terminal facilities in calendar year 1978. The shocking thing about this number of system errors is that it is 20 percent higher than 1977.

The breakdown of major cause factors is: Judgment—49 percent; Attention—39 percent; Communications—12 percent. About 25 percent of these errors occurred on the airport surface. Many of these involved the action of ground control in authorizing aircraft or vehicles to use an active runway without approval of local control. En route facility system errors for 1978 (218) remained about the same as for 1977 (217). Curiously, the frequency of major cause factors associated with these errors parallel those of the terminal facilities.

En route system cause factors were: Judgment—42.2 percent; Attention—35.4 percent; Communications—22.4 percent. The greatest single offender in these errors was the lack of effective judgment. It is a strong possibility that pilot errors, if categorized, would bear a close resemblance. Add controller and pilot errors together and the need for continued attempts to increase professionalism is obvious.

Readback

The FAA has come up with some real "hairy" examples of failures to detect errors in clearance readback. These examples point out the need for pilot and controller alertness. In cases involving communications difficulties, many problems could have been avoided by following the rule, "When in doubt, find out!" Examples:

- Two aircraft with similar call signs waiting for departure on different runways. The controller cleared one for departure and both responded to clearance but responses were garbled. *Both Took Off On Intersecting Runways!*
- Pilot repeated wrong altitude in response to a clearance. Controller did not detect wrong readback.
- Controller issued pilot clearance for altitude change. Pilot did not acknowledge. Thereafter controller assumed pilot would change altitude.
- Controller told aircraft after landing to turn off the runway at a specific point. The pilot did not understand the clearance, did not turn off at the desired point and the controller cleared another aircraft to land while the first was still on the runway.
- Controller gave an aircraft a vector heading of 220 degrees. Pilot read back, "Maintain 220" and controller did not catch the discrepancy until the mode C readout indicated the aircraft was descending.
- A flight service station specialist issued clearance for a climb from the Center to an aircraft and another aircraft acknowledged for the climb. The specialist failed to detect the error.
- An aircraft was instructed to climb and maintain 8,000 feet and a frequency change issued. Another aircraft in the vicinity acknowledged the clearance. The first aircraft then advised that the second aircraft evidently accepted the clearance meant for him. By the time action was completed the second aircraft had already passed through another aircraft's altitude.
- Controller issued descent clearance to aircraft to maintain 15,000 feet. Pilot read back 10,000 feet, controller rogered and released aircraft to another facility.

As we said—when in doubt, find out!

Readers are encouraged to address matters concerning air traffic control to:

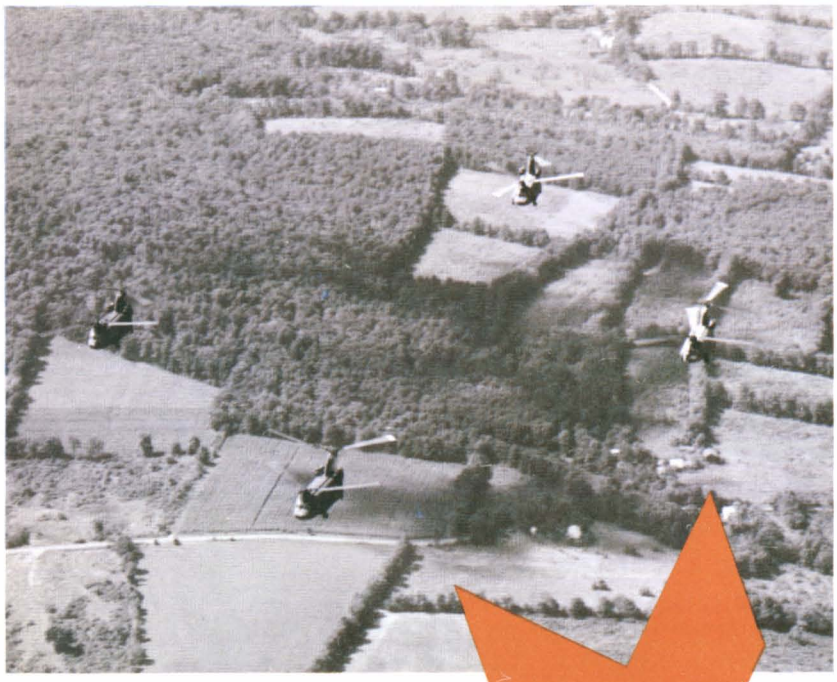
Director
USAATCA Aeronautical Services Office
Cameron Station
Alexandria, VA 22314

Museum Plans Announced

IN JUST 20 years the helicopter industry, with the help of the military services, has progressed from Igor Sikorsky's splendid VS-300 helicopter to the giant crane cargo helicopters of today. A large part of that remarkable history can be "seen" at the U. S. Army Aviation Museum at Ft. Rucker, AL, where the world's largest collection of helicopters of all types are on public display. In the past 10 years more than 1,000,000 visitors have enjoyed seeing and learning first-hand how these remarkable aircraft were developed.

Plans now are moving ahead to construct a new museum building to house this $60,000,000 collection of aircraft and Army aviation memorabilia. The Army Aviation Museum Foundation, Inc., a nonprofit organization is managing the project. More information can be obtained by writing to the Army Aviation Museum Foundation at P.O. Box H, Ft. Rucker, AL 36362.

proposed building
U.S. ARMY AVIATION MUSEUM
FT. RUCKER, ALABAMA



(Left): Four CH-47C Chinooks after departing Fort Carson, CO on first leg of Operation Northern Leap. (Below): CH-47C Chinook touches down at Heidelberg Army Airfield in Germany exactly 2 weeks after the four Chinooks set out from Fort Carson on their record breaking flight across the Atlantic. For more about Operation Northern Leap and the CH-47Cs self-deployment capability see the *Digest*, page 6, August 1979

CHINOOKS MAKE HISTORY