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AVIATION DIGEST

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NIGHT OPERATIONS

UNITED STATES ARMY AVIATION DIGEST

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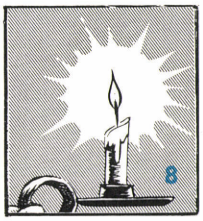

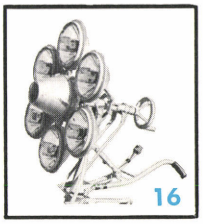

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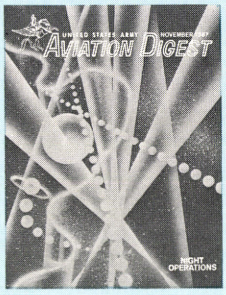

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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LETTERS

Sir:

While reading the June 1967 issue of the AVIATION DIGEST, I came across the article "A Colorful Quarter-Century of Army Aircraft." Your article was very interesting and ever so colorful. I saw the original "Grasshopper" patch worn by the first liaison pilots at Fort Sill.

Could you possibly send me two of your colorful patches? I am presently collecting patches and some crests, but my main interest is in patches. Anything to help my collection would be greatly appreciated.

Thank you for your time and assistance.

SP4 CATHERINE M. KAHL
U.S.A. Combat Developments Command
Fort Belvoir, Virginia 22060

Sir:

Reference the article "A Simple Protective Revetment for Parked Army Aircraft" in the August issue of the AVIATION DIGEST. . . .

Maybe so, but those helicopter units subject to fast reactions because of emergency or contingency missions cannot afford the time required to "manhandle" the aircraft into and out of such revetments, even if they had the ground handling wheels in sufficient quantity—which few units have. A truly simple and effective revetment that permits safe hovering into and out of is the ⌐type used by many units in RVN with complete success. Granted, the degree of protection afforded these aircraft is somewhat less, but this is more than offset by the time saved during rapid reaction launches.

LTC FRED H. FARNER
Dept of Rotary Wing Training
Fort Rucker, Ala. 36360

Sir:

Outside the door of my hooch, there lives a Great Spider. One evening I watched fascinated as he carefully dropped a line from the gutter to the rose bush, another to the clothes pole. Then round and round he went as he wove his trap.

Sure enough along came a moth, happy, carefree, and unsuspecting. When he blundered into the web, the Great Spider was on him in a flash. He made short work of the soft parts and dropped the moth's wings to the ground.

I think often of this little episode as I fly over the countryside. Everywhere down there another Great Spider has laid an enormous web of wires, cables, and poles, hoping to catch me, the moth.

COL F. M. McCULLAR
Aviation Officer
Eighth U. S. Army
APO San Francisco 96301

Sir:

The gun pilot and his gunship, the armed UH-1, found a place in the small scale operation in Vietnam of 3 years ago. He was originally used in the role of helicopter escort but rapidly branched into the fields of reconnaissance, observation, and air support. The jobs of all members of a fire team require good judgment, knowledge of ground as well as air tactics, and exceptional gunnery proficiency combined with courage and sober aggressiveness.

With the big buildup the armed helicopter has been employed successfully with large U. S. units in the same roles it played before. It has proved itself so well in the eyes of American commanders that top priority has been placed on procurement of a more sophisticated weapons system to do the same jobs better. This aircraft will be classed as an attack helicopter (AH) and is to be Bell's HueyCobra (AH-1G). Also, future plans call for development of an Advanced Aerial Fire Support System (AAFSS) which will be capable of flying more than 200 knots and delivering a wide range of ordnance.

Now that the permanency of the armed or attack helicopter, the gunship, has been established in the Army a look should be given to the selection, training, and MOS designation of the gun pilot.

The gunnery program at the Aviation School to date consists of a brief ground school on the weapons systems now mounted on the UH-1 and gunnery practice shooting the machineguns on the M-16 system both in the flex and stowed positions. A scant 6,000 rounds is allotted each student. No practice is given with the 2.75" rocket or the M-5 grenade launcher. This short gunnery orientation is given to all rotary wing aviator classes, including the medical service corps officer who will never fly the systems, by the Department of Tactics.

The commander of an aviation unit in Vietnam would still select the pilot to fly his gunships, but he would now have the advantage of a well trained nucleus from which to choose. In addition he would maintain the option of training any aviator in his unit as a gun pilot and award him the MOS. An important ramification of such a system would be the ease with which gun pilots could be assigned to slots both in CONUS and Vietnam requiring their skills.

As for those persons who have served as gun pilots in Vietnam and are now serving elsewhere, there is no way to award the MOS. However, upon volunteering for the gunnery school, if established, they should make known their prior experience which would give them top consideration for the course.

Should such a program be implemented, the time spent on gunnery in flight school could be cut to a short orientation lecture. Adequate gunnery ranges, already planned by the Aviation School, could be established and most important the quality of the gun support would be measurably improved.

CPT JAMES D. VANCE, JR.
Dept of Rotary Wing Training
Fort Rucker, Ala. 36360

Sir:

It is amazing how people in different parts of the world are thinking of the same thing at the same time — in the realm of scientific thought. The news being full of liaison and helicopter planes, I was looking in the Sunday section about pilots in Vietnam — skimming over the trees and surprising the enemy on the other side of the hill — and thought what a *noiseless* motor would do in such a situation! (It would be the ultimate answer to the question.)

And the need for a quiet-sounding plane is well understood in your May issue in "The Fine Art of Aerial Observation." This is what I call "reading over the shoulder" of people. It pictured exactly what I was thinking.

SP 5 CLIFFORD E. TEELING
Hq Co, USACDCEC
Fort Ord, Calif. 93941

Night Is Our Friend

A unit that is purely daylight oriented is asking for trouble because it is going to be in a tight bind when forced to operate at night. It will then be too late and a lot of embarrassment can be caused by the chaos resulting from "inadvertent" night operations

Major William W. Fraker

IN THE DEVELOPMENT of doctrine for the employment of Army aviation from our combat experiences in Vietnam, it has become increasingly apparent that aviation units must have the capability to conduct tactical operations at night under the airmobile concept. The successes now being achieved in the internal defense operations against the Viet Cong have forced the enemy to rely, more and more, on cover of darkness to provide them with the tactical advantage required by their doctrine.

The ability to conduct internal defense operations is not complete unless our general tactical units are provided with the capability to deploy their forces by helicopter at any hour. Either because of reluctance of the aviation unit commanders or because of the successes now enjoyed in conduct of daylight operations, many of the aviation units now in Vietnam are tactically unacquainted with our potential friend, night.

I well remember the years past that we had to listen to a large group of people who stated emphatically that daylight helicopter troop lifts were suicidal, and that one man with an automatic weapon would destroy the entire flight of helicopters while killing all of the troops as they milled about in the middle of this open field. Had these people been correct, the entire 1st Cavalry Division would have been eliminated any number of times. The voices I speak of are growing fainter and will soon fade away. So it will be with those voices of doom on night operations.

The major problem encountered when attempting any type of night operation, particularly in contested areas, is in overcoming fear brought about by the unfamiliarity with darkness. This fear coupled with the normal uncomfortable feeling of simply being exposed to hostile fire is usually more than one's constitution can willingly withstand. Yet, how many aviators have ever refused to go into the hottest landing zones encountered in Vietnam during daylight hours when the situation really warranted it? None that I know of. Going into these places has been done many times before and is, therefore, familiar and expected.

If a close look is taken at flight records in any unit, it will be apparent that those persons who like to fly at night, fly at night. The reverse of this is also apparent. A unit having a small number of aviators doing practically all of the night flying is a unit which needs to concentrate on night flying for those aviators who do not fly at night.

To say that large-scale night operations in a contested area are not feasible is to completely overlook the majority of operations by the Viet Cong. "Charlie" is effective with his night operations for four major reasons. First, he runs a lot of night operations. Second, he plans well, rehearses well, and executes well. Third, he has had little or no competition in the field of night operations. Fourth, darkness provides him with the natural concealment he needs to effect surprise.

Some wag will add the fifth reason, which is that Charlie does not use helicopters. Good point, but if he did use helicopters, the ideal time for him would still be during darkness when most of us are following the same pattern that we have followed since childhood. This is the pattern of coming indoors because it is too dark to play, the boogeyman will get you, or it is time to take your bath and watch television.

Not wanting to give the impression that I am cynical, I will say that I am extremely proud of all the night operations that have taken place in RVN and that I have tremendous respect for all the personnel who participated in them.

My only question is, why did they virtually cease after the first few? Was it because they were not worth the effort, or was it really

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Major Fraker is assigned to the U. S. Army Aviation School Element, Hunter Army Airfield, Ga.

Night operations can turn the tables on "Charlie"

because of the widespread objections voiced by the majority of those who participated? I wonder if the first few daytime helicopter-landed assaults in RVN were as successful and well executed as the majority of them are now? I doubt it! My point is that had these night operations continued, the experience gained as well as the confidence built up by the individual aviators would have resulted in night helicopter operations that would be just as effective as daylight operations.

Whether we care to admit it or not, we continually allow ourselves to become so stereotyped in our tactics that Charlie can sit in his tunnel and predict to the exact minute when the landing zone prestrike will stop, when the final recon is made, and when the "slicks" will touch down. You say that I am wrong? Look at the sequence of events on the last 20 operations orders you have used. Look a little closer and see how many times you have used the same landing zones on consecutive operations in the same areas. If I am wrong, then thank your lucky stars that you were assigned to the unit you are in because it is exceptional and so are your commanders.

Now that I have thoroughly infuriated most of you, I will give my reasons for doing so and my opinion (like noses, we all have one) on how an aviation unit can gradually become proficient at night combat operations. My reasons are simply that a unit which operates during daylight only is much less than 100 percent effective and is not exercising its full capacity. A unit that is purely daylight oriented is asking for trouble because it is going to be in a tight bind when forced to operate at night. It will then be too late and a lot of embarrassment can be caused by the chaos resulting from "inadvertent" night operations.

This type of operation is usually initiated by a telephone call during the best part of an enjoyable party and is characterized by very fragmented fragmentary orders. The unit that is well trained will function well and the other type unit will be embarrassed. A more serious reason for proficiency in night operations is the difficulty that one encounters in explaining to compatriots of dead American advisors, or to a hard-hit American unit, why it took you 6 hours and sunrise to come to their aid. Army aviation is organized to be immediately responsive to the ground commander. Immediately responsive means just that and is not restricted to daylight hours.

How can the infeasible become feasible? Aviation commanders must realize that this taboo about night operations is a training problem and not a limitation that must be lived with or ignored completely. The training required can be accomplished with no additional load placed on the unit if half of the day missions are flown at night. Look for missions to fly at night and make certain that these missions are necessary and in aid of the persons supported.

Mail runs, resupply, liaison, countermortar patrol, Firefly, beer runs to isolated compounds, or any other missions that your unit performs in the daytime are ideally suited to this transition from day to night operations. Aviators will be cooler and more relaxed because they have a reason for flying at night and because the missions are old hat to them. They will benefit by gaining confidence and night flying proficiency. They will become expert on night navigation. Some among them will become fanatically in favor of night flying.

If you say, as a unit commander or operations officer, that your unit does not need to do this, then answer these questions. How many of the base camps or compounds that your unit supports can be sketched from memory? How many can be clearly described by their appearance at night? How many of them have your aviators landed in at night without using landing lights? Can your aviators fly to, locate, and land at these locations under pressure of low

ceilings, poor visibility, and hostile fire at night? The trite expression that lives depend upon these abilities takes on real meaning when it becomes a harsh reality.

Single ship missions will give way to section and platoon missions as confidence and ability grow. A demand for these missions will be generated by the very fact that you are flying missions at night. The next problem will be arranging for a company night operation, and here is where the company commander will usually be stymied. He must either wait until a mission of this nature is given to him or he must stir up his own. If the training sequence has been successful thus far, chances are that the aviation battalion commander has been favorably impressed. His wholehearted support is required for continued success and for execution of company sized operations at night.

Now you must beat the bushes and find a ground unit that is willing to conduct a night helicopter assault. Usually, it is not too difficult to find a commander of a ground unit who is aggressive and willing to experiment, either from boredom or from professional desire to find and destroy the enemy. Once he has been found, we now have an integrated team. Regardless of methods or reasons, the coordination, planning, rehearsal, and execution must be as thorough as possible and nothing left to chance.

Here we borrow a page from Charlie's book. We select an objective that will easily fit our capabilities. We obtain all the intelligence that it is possible to get. We use sand tables and brief and rehearse. We plan for weather conditions that best suit us and, if necessary, wait for them. We continue to refine our plans and to rehearse over and over again. We have everything in our favor before we execute our plan, and we have contingency plans which will meet all anticipated enemy reactions to our assault.

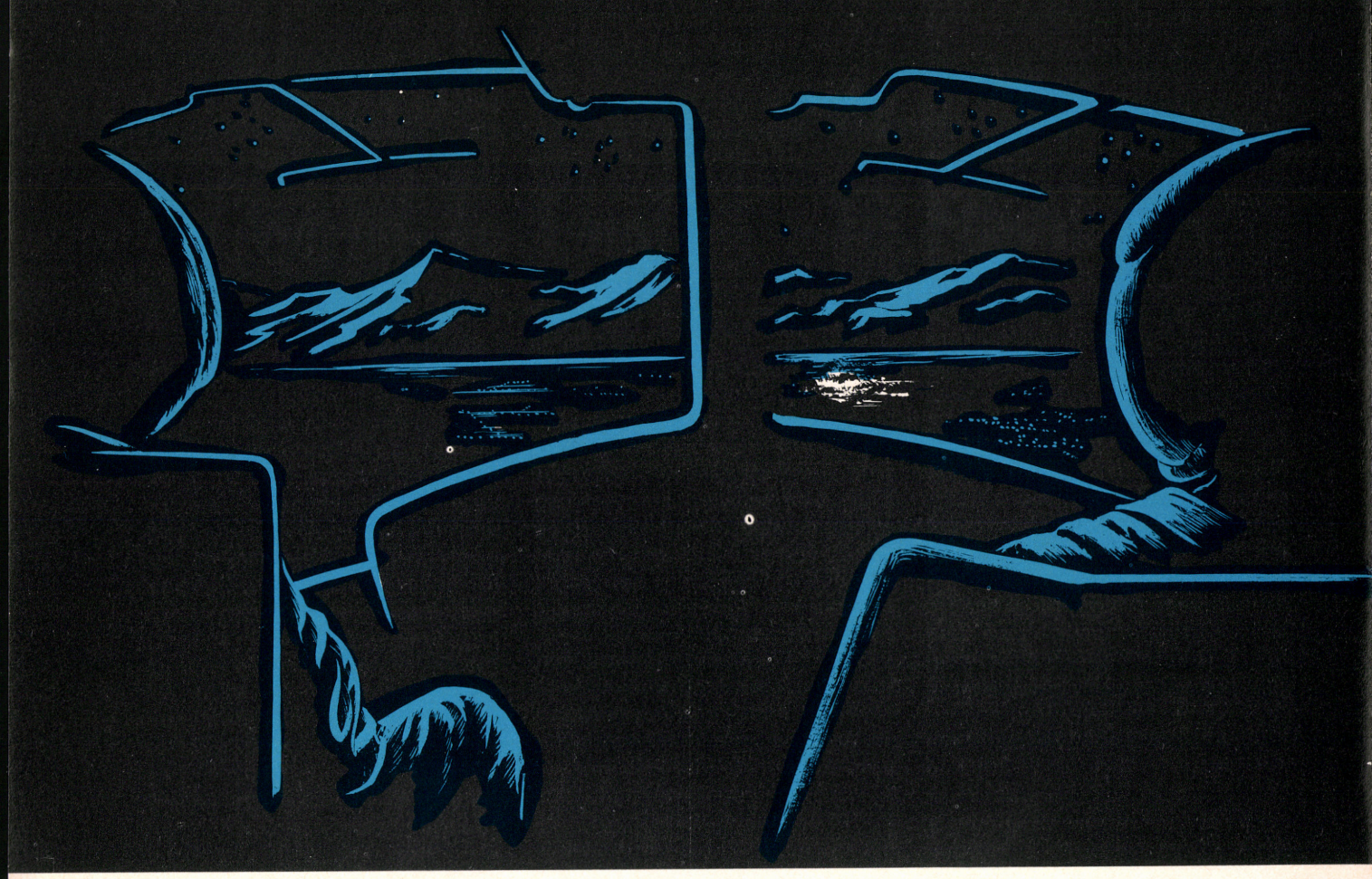
We shuffle our sequence and have our prestrike after the landing has been completed. Instead of using a single landing zone, we would use a wagon wheel pattern with our objectives at the hub. We would then split our force into squads and platoons for better control in the darkness and land them on each spoke of the wheel. They attack down the spokes, which are canals, roads, trails, and dikes leading into the hub. This will disperse our helicopters while landing, make it possible to have all helicopters land simultaneously in smaller landing zones, and confuse the enemy while blocking his escape routes.

Areas between the spokes are to be covered by armed helicopters with a Firefly or helicopter flare ship for on-call illumination. As the assault force nears the hub, they are drawn closer together and reduce the possibility of the enemy escaping. They are closer together and can shift more rapidly to counter breakthrough attempts. A reserve force will orbit nearby to be committed if the situation requires reinforcing along any spoke.

At a selected point along the spokes, the assault force will halt and the out of sequence prestrike can now be made on the objective. This will allow time for final assault preparation while the enemy is being further confused and reduced. At this point, there are two courses of action: one, we can attack; or two, simply consolidate our encirclement of the objective and wait for daylight. Course of action two is for units not quite convinced about night operations.

Simple? No. Problems? To the best of my knowledge, the above procedure has not yet been attempted. However, remove the helicopters from the plan and you have a "Ho Chi Minh special" that has been presented night after night for a number of years. Night is our friend whom we have yet to meet.

Planning for night operations must be as thorough as possible



Cleared To Land . . . To Flashlights

Captain William S. Griswold

SIDEBOARD 6, this is Playboy 22, two miles out. Request landing instructions. Over."

"This is Sideboard 6. Enemy situation negative, wind 270 at 5, landing azimuth 225, field elevation 95 feet, land to flashlights in a T. You are cleared to land."

As the pilot of Playboy 22 you are now entering one of the most difficult phases of a night landing to a minimum lighted area: lining up your aircraft on the proper landing azimuth. Other aspects of the landing are hairy enough, but when your landing heading is correct, about half your problems are over.

Consider these ailments of an improper landing azimuth. Most important of all, landing areas are set up keeping the wind direction and barriers in mind. If the azimuth is 225, barriers probably prevented a heading of 270 from being used. So when you use an azimuth other than the one given, you are not guaranteed barrier clearance on a normal approach angle.

Another difficulty is that the lighting device used on the ground will not appear to be correct. A T viewed from as much as 20° off will not look like a T but like an undefined blob of lights. If flashlights and/or a glideslope are used they will be invisible, unless you are just about on the money, due to the narrowness of their beams.

Here are some suggestions for arriving on the desired landing azimuth. We'll assume you have a functioning RMI (radio magnetic indicator), which cuts the mental gymnastics to zero. If you want to land 225 and from your present heading it would be easier entering a base leg, roll out on a heading (315 or 135) so that the

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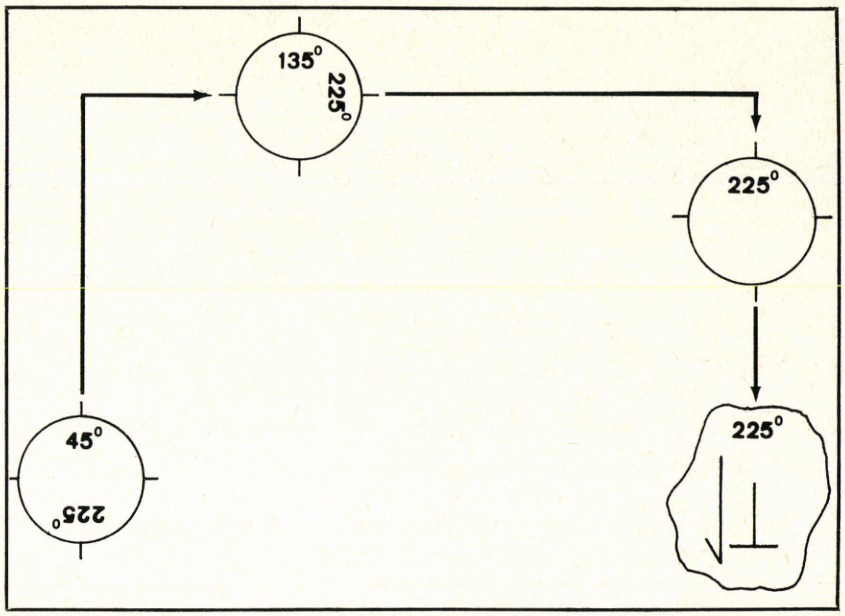
Captain Griswold, an ex-Army aviator, has transferred to the U. S. Coast Guard.

landing azimuth (225) is either at the 3 o'clock or 9 o'clock position on your RMI. The 3 o'clock position puts you on a right base; the 9 o'clock position puts you on a left base. Then, when the lights from the T wink at you through the side window, a 90° turn to final will put you within a few degrees of your desired 225°. A minor correction or two will line you up exactly, and you can divert your attention completely to the approach.

Let's assume that a downwind leg would be easier to enter. Set the landing azimuth (225) in the 6 o'clock position. Then roll it to the 3 o'clock spot for a right base or 9 o'clock for a left base, giving you a 90° turn to base, and proceed as before to final.

This leaves the straight-in approach, where I offer the following two suggestions: If the landing area is visible far enough out to get set up on the proper azimuth, plan your straight-in approach, making alignment corrections as soon as possible. However, the case may not be such and your first sighting of the area may be too close in to salvage a straight-in approach. If so, turn to the handiest downwind leg and execute a pattern as discussed before. The main point is to allow enough room to get lined up properly and avoid those last minute heading changes on short final.



Should you be so unfortunate as to have an inoperative RMI or none at all, adding or subtracting 180° or 90° is one solution. This isn't too bad on cardinal headings, but most of us have to take a little time getting most reciprocals. And I assure you, it's worth it when you prevent a loused up landing to flashlights.

I doubt that there is an aviator in the sky who doesn't face landing to a minimum lighted area with some degree of apprehension. Perhaps using this method of arriving on the proper landing azimuth will simplify things and reduce some of the uneasiness.

As stated before, coming in on the proper heading will eliminate many problems and enable the pilot to concentrate on the task of making a smooth approach to those awfully dim lights. So give it a try the next time you're out at night. It'll work whether you have a T of flashlights or a 10,000-foot runway.

BURNED

MANY CASES of smoking by crewmembers, maintenance personnel, and passengers in and around aircraft on the ground and during takeoffs and landings have been reported. In one case a pilot and his crew were seen cooking their rations over an open flame in the rear of a UH-1.

AR 95-1 prohibits smoking within 50 feet of an aircraft on the ground. It prohibits smoking in an aircraft during all ground operations; during and immediately after takeoff; during fuel transfer operations; immediately before and during landings; any time gas fumes are detected; and when oxygen is being used. It is the aircraft commander's responsibility to see that these rules are enforced.

NIGHT MAINTENANCE PRO AND CON

Captain Malcolm Bamford

LIKE TO GET quick reactions? Want to be known as a route-step? Enjoy seeing repercussions from both up and down the chain of command? Propose night maintenance, step back—wait—and quite promptly all these good things will come about—guaranteed! After all, there are *always* 17 reasons why it won't work!

Sure it's done! There's absolutely nothing new about it. Nearly every commander and maintenance supervisor has done it. Many times it is the only way to keep operationally solvent. Often night or two-shift maintenance is profitable immediately after a period of heavy or sustained operations, when there are component changes and an accumulation of minor discrepancies to work off. Usually at this point, reduced aircraft availability will be the indicator pointing to night maintenance consideration.

Some factors bearing on the situation are: mission of the unit; status, training or operational, reserve or committed; facilities; level of maintenance; labor force, military/civilian; and security. Many more considerations will make themselves known as you look into the program.

For this discussion, let's make a few reasonable assumptions.

You are a maintenance supervisor in a field maintenance detachment, supporting an airmobile company. The bulk of the operation is conducted during daylight hours. Equipment log books contain a good quantity of writeups that involve, primarily, manhours. Aircraft availability is slowly approaching the minimum

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Captain Bamford recently retired from the Army.

acceptable level. Aborted or delayed missions are beginning to show up due to pilot squawks on aircraft. Maintenance personnel are "putting out" on a normal daily schedule.

Time to hitch up the trousers and move out, isn't it? Now back to the old drawing board.

Since you can't fly and maintain simultaneously, the bird and the mechanic must be joined when the mission allows it—in this case, at night. Now I'm not saying that the mission should be flown regardless of aircraft condition. I'm assuming that maintenance hasn't slipped *that* much! If it has, you're already in trouble (and I'm sure *someone* has invited your attention to it!).

Many aspects of life in the unit are affected during night maintenance operations. The administrative load is less during the maintenance working hours. It is surprising how seldom the phone jangles at night. The personnel office, PX, cleaner, barber shop and others are closed. You have potentially cleaner, more productive manhours.

On the other side of the ledger, consideration must be given to safety precautions, increased supervision and morale. Sleep is difficult for many people during daylight hours, especially during the heat of the day. Aside from personal considerations, this can have an adverse effect on workmanship and safe practices, which in turn points up the need for tighter supervision. Available hot coffee, soup, and sandwiches in a clean sheltered area can take the sting out of the morale problem to a large degree.

How about the daytime maintenance requirements? A small crew can be kept on a day shift to handle minor maintenance, do the administrative work, requisition and follow up on parts.

Perhaps now we should also look over the modified version of night maintenance, the two-shift system. Thought should be given to overlapping the shift for continuity. Supervisors and mechanics have the opportunity to communicate and coordinate shift activities to keep the work moving. Who knows, they might even discuss business?

If after careful evaluation, you have settled for night work, a short conference with your supported unit CO and his organizational maintenance supervisors is in order. A coordinated effort on the part of all concerned will assure the desired results.

In closing, let me add a word of caution. You may well find yourself running out of work within a short period of time. Aircraft availability up, shop equipment up to snuff, and aviators flying "solid citizen" aircraft with a little more peace of mind. If so, you now may be considering full-time day maintenance.

So what's new? We've been doing THAT for years!

Available refreshments can take the sting out of night work

The Night I Jumped

Major Allen C. Bennett

WELL, WHADAYA know, it did open." For some reason this was my first thought when my descent was slowed by the opening of the parachute. I know that the possibility that the parachute would not open hadn't consciously entered my mind before this moment. If it had, I'm sure I would have hesitated longer before jumping, but when that engine quit on the O-1A, my only thoughts were to get the door off and get out as quickly as possible.

It was too dark to see the canopy above me. I felt, rather than saw, the most beautiful sight I'd ever experienced. The feeling had been with me for about an hour that this mess I was in was going to end in my having to bail out. I'd run out of experience, which was considerably lacking, and when the O-1A ran out of fuel, the foremost thought in my mind was to leave the aircraft.

It was a dark miserable night, and the mistakes I had made earlier led to this situation. I had made a vow that from now on I would doublecheck weather at every opportunity. I didn't care how many so-called "milk runs" I would be assigned in the future, I vowed I'd always refuel at every stop to have that little extra to take care of unusual circumstances.

I remember running my hand along the instrument panel to cut the switches and rolling in some forward trim. I forgot the mag switch and also felt the headset pull off as I went out the door. This was the climax to a long list of errors that began accumulating on takeoff for the return trip home.

I'm not a qualified jumper. The only training I'd had was a briefing in flight school on how the parachute should fit and where the D ring was located. Oh yes, include the quick briefing on how to inspect for first echelon maintenance.

I don't mind admitting that a little apprehension crossed my mind when I first pulled that D ring and nothing happened. Actually this turned out best for my benefit. I was about two steps out the door when I pulled the D ring. If the parachute had opened then, it probably would have wrapped itself around the seat I had just vacated.

The second time I pulled the D ring it was all the way to full arm's length and things started happening the right way. The opening shock was really mild to what was expected. This can be attributed to little or no prop blast from the aircraft and the fact I had been tightening up the parachute harness for the past 30 minutes. In my anxiety I had tightened the leg straps until circulation was almost cut off.

Then things started happening for the worse again. I started swinging back and forth in the parachute. I worried about how this swinging was going to affect me when I hit the ground. I started pulling on risers above me, but the swinging back and forth increased, if anything. In fact the oscillation was so bad I began worrying about tipping the parachute over. I decided to leave well enough alone and settled back for my approach. I heard the aircraft crash, and this was the only sound I heard for some time on that cold, dark night.

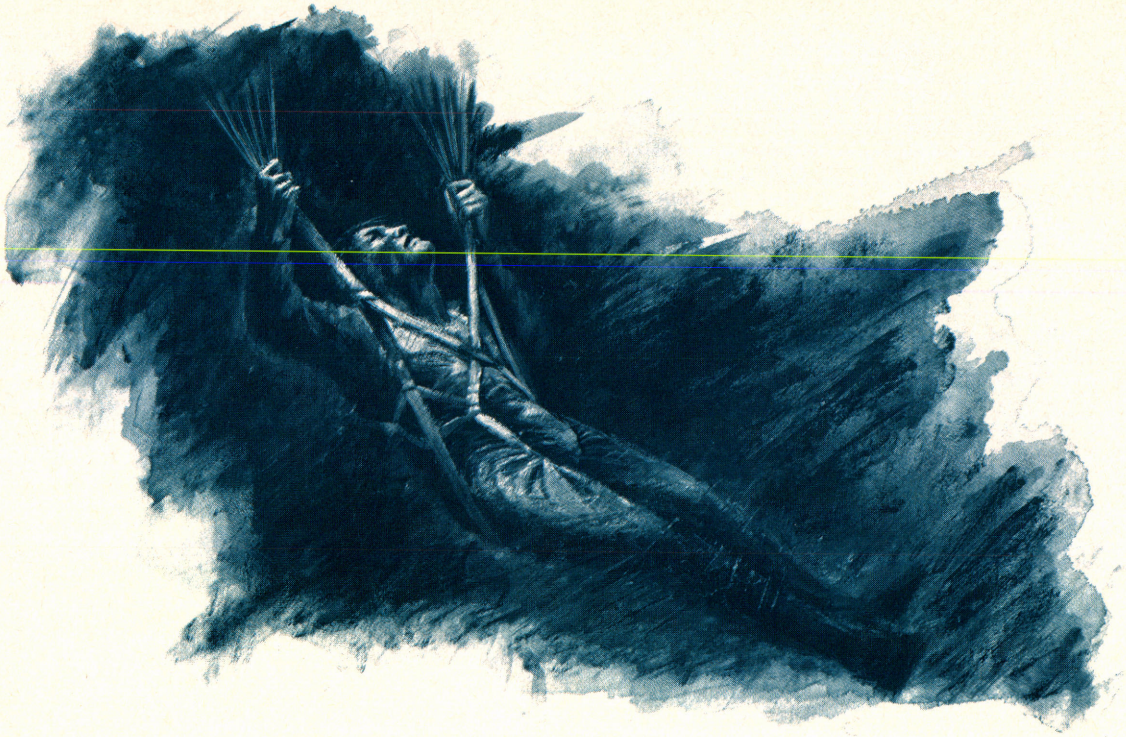
The first indication of arriving near the ground was when tree branches started slapping my legs, body and face. I immediately started groping and scrambling for something solid to hold. Luckily my descent ended with me hanging in the tree and unscratched. I managed to climb over to the tree trunk and release the parachute harness. I decided it was time for a break before going any further.

Now I'm not admitting I was nervous, but after three attempts I did get a cigarette lit. My flashlight and coat were in the aircraft. When I flipped the cigarette to the ground, I was able to guess my height in the tree as about 6 feet. The tree was an oak with numerous branches, so the process of getting down wasn't difficult.

After encountering briar patches, barking, snarling dogs, and a barbed wire fence, I managed to find a farm house whose occupant agreed to take me to a telephone. In just minutes, state police were at my location and delivered me to the nearest military installation. After undergoing a thorough examination by a medical doctor it was determined that I wasn't physically affected by this ordeal.

I've talked with many experienced paratroopers about the procedures, or lack of procedures, I used that night. In addition, many articles and manuals have been researched and the most concrete conclusion I've reached is that I

Major Bennett is now serving in Ethiopia.



It was too dark to see the canopy above me

was extremely lucky. This fact was reiterated again in an article I read recently that stated, "According to statistics, one out of every two emergency parachute jumps results in death or injury."

Most emergency bailout procedures in the aircraft manuals stop when you leave the door. Jump procedures for parachutists deal mostly with ideal conditions. In an emergency situation, aviators usually will have to bail out in varying and sometimes extreme conditions. In addition to saying avoid the situation if possible, I would like to point out some of the mistakes I made and observe a few of the basic rules. That night I learned two lessons that will remain with me always, and I've mentioned these already.

First: *Refuel at every opportunity.* You'll never be able to pick your emergency. If I'd even thought about having to bail out that night, I wouldn't have gotten above 6 inches.

Second: *Check and recheck weather.* In marginal conditions this should be continuous. A 180° turn that night would have saved a few grey hairs, an aircraft, and a lot of anxiety.

I should have stayed on the ground that night and played poker, and today I'd probably be a millionaire. Like one of my friends said later, "After everything you did wrong, you could have jumped into anything and come out smelling like a rose."

Seriously, human beings are humans and will have to react to unusual situations. Here are a few basic rules I learned that would give an individual a better chance of surviving.

Maintain a good physical condition. This hasn't anything to do with the situation I faced. However, in any emergency the person in the best physical condition has the best chance of surviving.

Clear yourself from the aircraft. Some experts recommend counting to certain numbers by thousands; others even suggest not putting your hand on the D ring until you're actually falling. You're welcome to any system you choose. Me, I want to know for sure the D ring is with me when I go out the door, and that I'll be able to find it when the time comes to pull. Actual cases are on record where the D ring was never pulled. Just make sure you're clear and pull the D ring to full arm's length.

It's possible to stop swinging under the chute by pulling certain risers. This is pretty hard to do on a dark night when visibility is zero and you can't tell what direction you're swinging. However, *oscillation can be dampened by pulling on opposing risers.* In other words, pull on one of the front risers and at the same time pull one of the opposite risers on the rear.

At night with zero visibility, *assume the landing attitude as soon as the parachute is open.* According to the proposed revision to TM 57-220, to assume the proper landing attitude the jumper must:

- Check his direction of drift and slip in the opposite direction (into the wind).
- Lock the risers to his chest, and press his elbows to his sides.
- Keep his head erect, eyes on the horizon.
- Keep his legs straight and his knees unlocked.
- Keep his feet and knees together, and the balls of his feet pointed slightly towards the ground. Moderate muscular tension must be maintained in the legs, as they must absorb a significant portion of the landing impact. The jumper must avoid becoming stiff or tense.

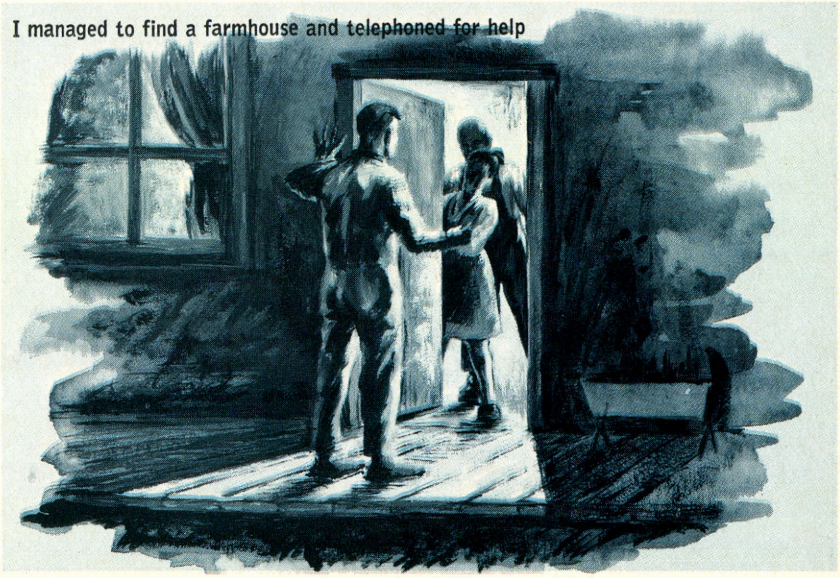
With reference to the first two points, it is highly recommended that the slip not be executed unless the winds are above 15 knots. If a slip must be taken, the jumper should reach high on a set of risers and take a vigorous slip into the wind by pulling the risers well down to his chest. This slip should be taken at approximately 100 feet above the ground and held until contact is made with the ground. Airborne students receive detailed training in this maneuver, but it is not recommended by non-airborne qualified aviators unless the winds are high.

The landing is the critical part of any jump. This is where most injuries occur. Most experts agree that night jumps are easier on the body because you have less tendency to stiffen. On day jumps you'll have to force yourself not to look at the ground as it approaches.

Protect the face and throat area if landing in trees. All articles and manuals I've read state that landing in trees should be avoided if at all possible. I'm sure that I would have been injured that night if I hadn't landed in a tree, especially with the high winds (42 knots) reported in that area. But don't try catching hold of branches or stopping your descent. Keep your feet and knees together with hands under opposite armpits, palms facing outward. Hold your elbows high and rest your head on arms. Again, that came from TM 57-220, Technical Training of Parachutist.

The last point I'd like to stress is *know your equipment.* I'm not speaking of parachute packing. Those boys know their stuff; you can trust them. I mean know how each item works. For example, if I had landed on the ground I'd have been dragged by the chute for sure with those winds. I didn't know exactly how the quick release worked and it took me a few minutes to get out of the parachute harness. Know each feature and if necessary operate it once or twice to make sure you do know how it works.

Again, avoid emergencies by being an expert yourself. If you do encounter an unusual situation know what and how you're going to react and *know your equipment.*


I managed to find a farmhouse and telephoned for help

NIGHT MEDEVAC

CW2 Terrell R. Clark

WE HAD TWO UH-1Bs stationed at Quang Ngai for support of the 2d ARVN Division and surrounding outposts.

At 2200 hours on March 20, 1966 a call was received at the tactical operations center (TOC) from the American advisors at Minh Long outpost. A gasoline stove had exploded, and a member of the team suffered second and third degree burns from the waist up. It was feared the advisor might die from shock before morning, so TOC requested us to make an immediate medevac.

I was one of the standby pilots for the night, so my copilot and I quickly planned our mission to the outpost. Minh Long sits in a small valley 25 miles SSW of Quang Ngai. We estimated the weather to be 2,000 broken with about 4 miles visibility with haze and ground fog. The outpost was estimating 1,800 overcast with haze and no fog.

I had flown to Minh Long a hundred times in the past few months and knew it was not an easy outpost to get to during good weather, let alone at night with low ceilings and reduced visibility. The real problem was that there was only one way into and out of the valley that we could even consider using at night. This was along a river that flowed out of the valley through a narrow pass about 3 miles long. The sides of the pass were about 2,800 feet MSL, so going over them was out of the question. However, about halfway up the pass was a hilltop that went to only 1,500 MSL.

Before we left, we talked with the people at the outpost and arranged for them to start firing flares for us when given the word.

By flying at 400 feet we located the river shortly after takeoff and followed it up to the mouth of the pass. When we reached the pass, we climbed as high as possible, which was 1,800 feet MSL due to the overcast. At the same time we told the outpost to start the flares coming. As the pass was almost a straight line, we had no difficulty in seeing the flares.

As we continued into the pass, the ceiling started dropping, so we approached the hill at about 1,650 feet MSL. It appeared as though we would clear the hill by about 100 feet when the lights went out! The outpost said they had run out of flares at the mortar tubes, but they were getting more right away. It probably wasn't dark for more than 20 seconds, but it seemed like years! As the next flare ignited, we were passing over the hill with about 100 feet to spare. We all heaved a sigh of relief and proceeded into the outpost where the patient was waiting for us on the pad.

Rather than attempt a return through the pass, I elected to make a spiraling climb out of the valley. I entered the overcast at 1,700 feet with 40 knots of airspeed and sustaining 1,500 fpm rate of climb. After we passed through 3,000 feet MSL, I rolled out on a heading of 090 to take us out of the mountains and planned to climb until we broke out on top, or reached 6,000 feet. This would put us well above any mountains in the area. At 4,500 feet we broke out on top and turned on course for the Marine Hospital, located about 20 miles north of Chu Lai.

After unloading our patient, we took off and returned to Quang Ngai by using the NDB located at the airfield. The doctor accompanying us on this mission reported that had the evacuation been postponed until morning, the patient would not have survived.

CW2 Clark is with Tactical Instrument Flight 3, Dept of Rotary Wing Training, Ft Rucker, Ala.

Combat Night Flying

Captain Burton H. Kaplan

THE JUNGLE and roads appear to be a pool of blackness; the lights from the ammunition dump glare from below. All is quiet and you are bored with the monotonous 2-hour night mission in your Bird Dog. To pass the time away, you slowly climb from 2,500 to 12,000 feet, smoke a pack of cigarettes, and then return to your original altitude. You notice how many more radio stations you are able to pick up at altitude and that the Philippine music is coming in loud and clear and is so relaxing.

After all, you had a very full day at the beach under that glaring sun—and you wish you hadn't broken your sunglasses a week ago. The coffee you had with the Mohawk crews tasted good, and the two packs of cigarettes haven't phased you in the least. The meals are the same day after day and the tropical climate isn't very stimulating to your appetite, so you have been skipping your meals this past week.

At the end of the mission you report "All quiet in war zone D" and crawl into your bed unwashed, exhausted, cursing the plumbing system. You toss and turn the rest of the night and wake up drenched, averaging only a couple of hours of sound sleep, to start your day again and place an X on the calendar reminding you that you have only 180 days to go in Vietnam. Two nights later you are missing in action, having gone down in war zone D.

A careful analysis of this aviator's past missions revealed numerous negative reports from his combat missions. The activity of the Viet Cong was well known in this area; yet he failed to notice any.

The main reason for so many negative reports is that this aviator was actually blind; that is, he had developed "night blindness." He could not have seen the enemy even if he flew his aircraft 200 feet from them.

The Army aviator has a general understanding and appreciates his daytime visual capabilities. After all, he wouldn't be an aviator if he didn't pass those stringent eye examinations. His visual acuity is 20/20. This means that he can see at 20 feet what most people see at 20 feet. However, at night, visual acuity is reduced to less than 20/400. This means that at night he can see at 20 feet what most individuals in daylight can see at 400 feet.

Often the night aviator does not prepare himself properly for night flight. He may take off, fly and land without incident, but visually is blind outside his cockpit. Not being dark adapted, he would see a lighted match at 3 miles instead of the 26 miles distance he could see if he were perfectly dark adapted.

An explanation of the biochemical changes that take place in the eye at night would not provide any practical knowledge. Instead, I will list some prerequisites one should follow before attempting a night reconnaissance mission.

- Know your territory. Fly over your section during the day. Identify all manmade objects.
- Sleep soundly for 6-8 hours. Fatigue decreases your visual acuity at night.
- Eat four light meals during the day and some chocolate bars before your flight. Low blood

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CPT Kaplan is a resident in aerospace medicine, Drexel Institute of Technology, Philadelphia, Pa.

sugar decreases night vision. A supplemental supply of vitamin A may be necessary because of poor dietary habits. However, see your flight surgeon before attempting any self-medication, including aspirin and APCs.

• No alcoholic beverage of any kind 24 hours before flight. Alcohol acts on the nervous system as a depressant (as little as two beers or two ounces of whiskey).

• Smoking should be cut to a minimum. Tobacco in any form contains carbon monoxide and nicotine which interfere with the oxygenation and nervous tissues in your body, decreasing visual acuity at night by as much as 20 percent.

• Dark adapt your eyes by staying in a dark area for a least 30 minutes before takeoff.

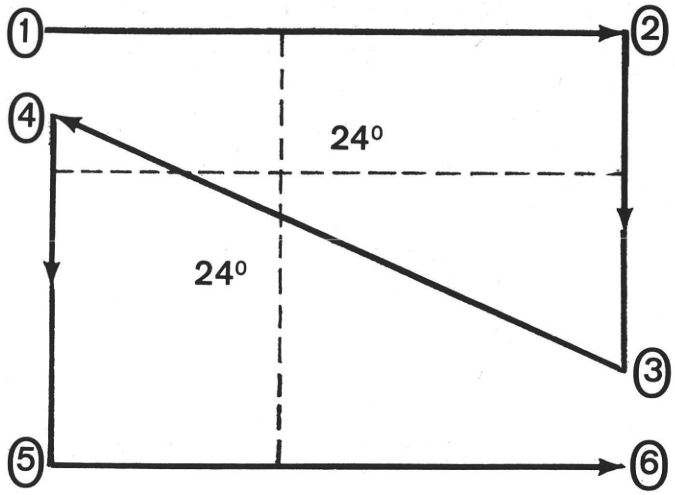
• Wear your aviator sunglasses constantly during the day. Avoid, especially in tropical climates, glare, bright sunshine. Subjects tested have a higher threshold to illumination than those who are not exposed to glare, reducing their night visual capability.

• Do not go above 5,000 feet sea level in altitude. Low oxygen tension lowers night vision. Most Army aircraft do not have oxygen systems.

• Once in flight, scan and pause the area with your eyes (fig. 1). Remember your day visual system is blind (fig. 2) and you have no central vision, so if you want to recognize anything, pause and sight with your peripheral vision and not your central. You will not be able to see any color, so you must recognize unusual movements, silhouettes, shades of grey, or contrast.

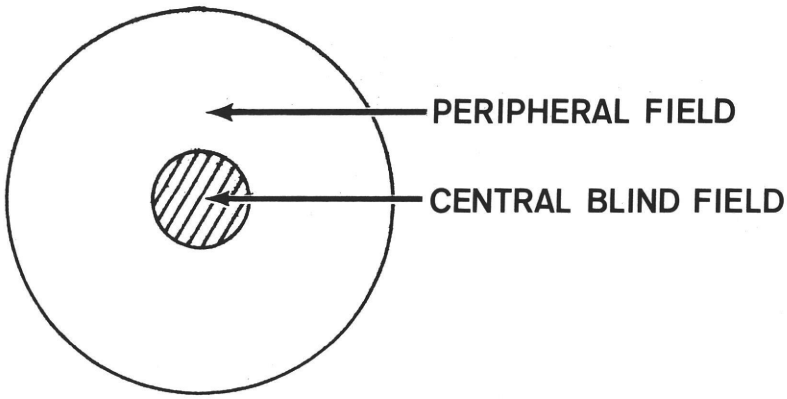
• If exposed to white light, close one eye to keep it dark adapted.

If you will follow these 10 simple rules you will not be blind at night—and might see the enemy before he sees you!



ROUTINE METHOD OF SCANNING. THE EYES MUST BE KEPT MOVING FROM POINT TO POINT. (TEXT AV. PHYSIOLOGY, J. A.GILLEY 1965)

Figure 1 ↑ Figure 2 ↓



CENTRAL BLIND SPOT AT NIGHT. YOU MUST SIGHT WITH YOUR PERIPHERAL VISION IN ORDER TO SEE AND IDENTIFY AN OBJECT.

FIREFLY

When Firefly began pinpointing VC sampans in bright beams of light, enemy loss reports began to read like this: "30 blasted out of the water, two fleets destroyed," "68 sampans sunk," "large fleet of 30 and 40 footers smashed"

A searchlight built at Ft Rucker with the center lens covered with a yellow fog filter

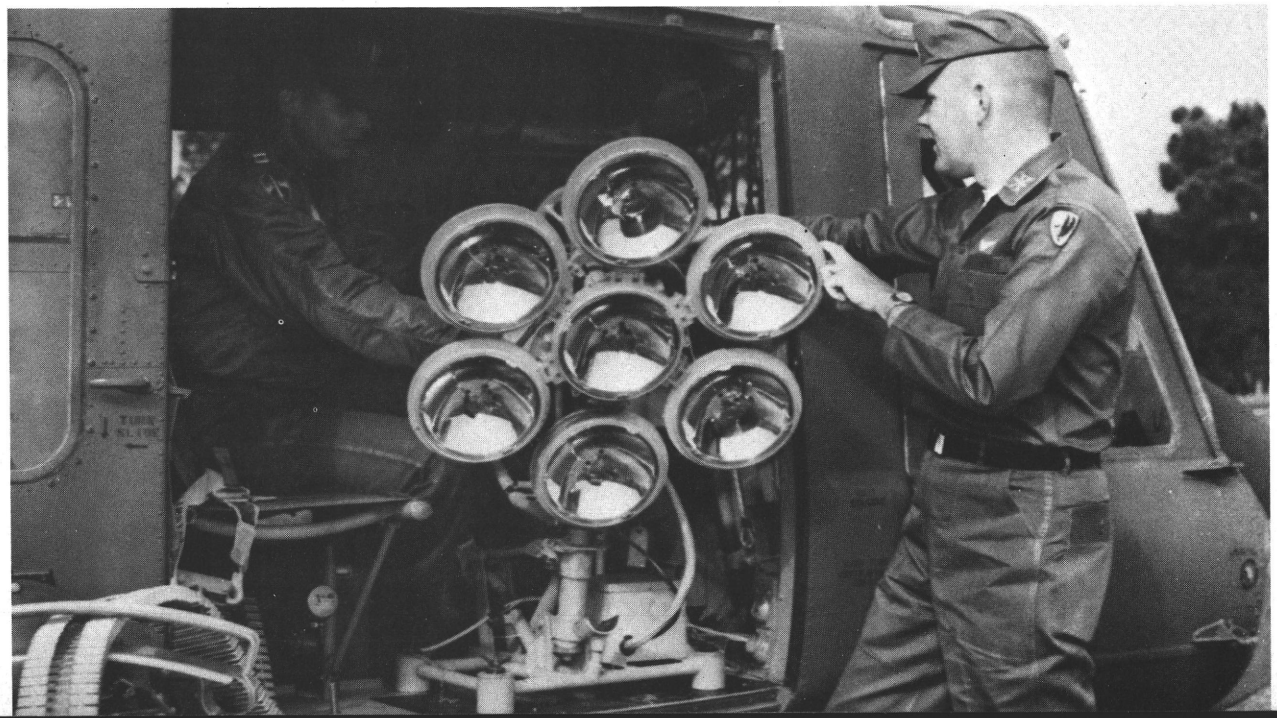
IN THE BEGINNING of the Vietnam conflict, the domination of ground areas was a seesaw affair. During the day the land was largely controlled by friendly forces, but at night the Viet Cong took over. Under cover of darkness, they could move their troops around and resupply them at will.

Then the "Lightning Bug" (now called Firefly) appeared, and the VC's tremendous advantage of being able to resupply themselves at night was taken away. This nickname for a new cluster searchlight device for helicopters came from American servicemen who were reminded of fireflies as the helicopter's searchlight blinked on and off.

With the Firefly pinpointing the enemy sampans in a bright beam of light, reports of night helicopter operations to clear VC traffic on the waterways began to read like this: "30 blasted out of the water," "two fleets destroyed," "68 sampans sunk," "large fleet of 30 and 40 footers smashed."

One report stated that more

At Ft Rucker, Aviation School instructors discuss the merits of a locally built Firefly . . .



than 65 enemy sampans loaded with enough supplies to support a battalion-sized operation was sunk. Another reported that while sinking 38 sampans several secondary explosions occurred, indicating that the boats were carrying ammunition or other explosives. The next day the river was strewn for two miles with wood shreds, oil slicks, blasted cloth, and along the bank were twisted motor parts.

Losing supplies this way is a doubled-edged blow to the Viet Cong. The equipment and supplies have traveled hundreds of miles only to be lost just as they are being delivered. The efforts of many people supporting the VC are cancelled out at the most effective time and place.

Development of the Firefly began in May 1965 when the Army Concept Team in Vietnam received from an international engineering firm plans for a cluster of lights that could be mounted on a helicopter for use in night operations. The light was built with local material and turned over to the 197th Aviation Company, the only armed helicopter company in Vietnam at that time. (See "Searchlight for Helicopters" in the U. S. ARMY AVIATION DIGEST, January 1966.) The 197th, now the 334th, immediately started developing tactics for using the new light.

An accurate evaluation of the effectiveness of the Firefly cannot be made at this time because only the Viet Cong know what it has really done to them. However, an indication of its effectiveness is shown by the fact that after July 1965, Viet Cong operations in the ARVN III Corps area fell to a new low. The 25th ARVN Infantry Division enjoyed its calmest period of the year and the number of Viet Cong deserters who turned themselves in more than doubled.

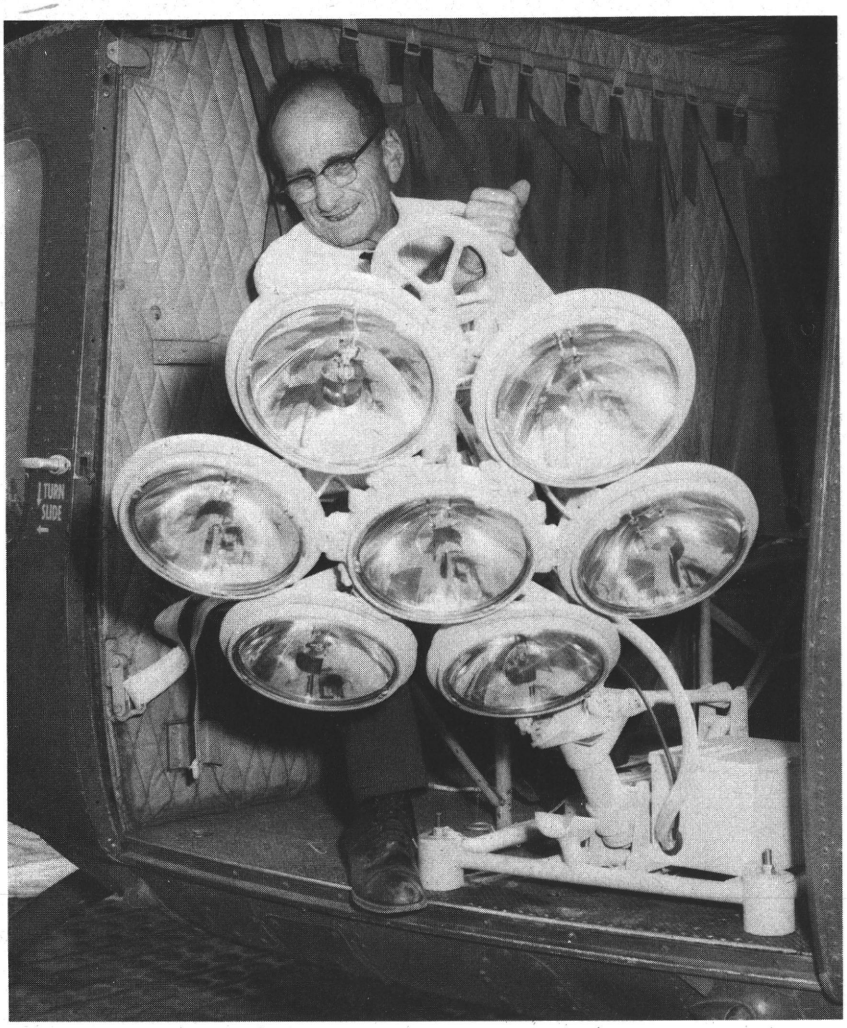
These deserters stated that lack of ammunition, weapons, food, and medical supplies, coupled with the unacceptable risk of concentrating or moving any significant sized unit was a direct result of the sinking of many sampans and the loss of men, equipment, and supplies.

The light developed in Vietnam has seven C-123 aircraft landing lights on a metal frame. The frame can be mounted on any UH-1 helicopter and operates on the aircraft power supply. It has approximately 1.2 million candle power, can be swiveled in almost any position, and the light beam can be adjusted from pinpoint to floodlight beam width. It is normally mounted on a UH-1 armed with the M-16 armament system consisting of four 7.62 mm machineguns and fourteen 2.75″ folding fin aerial rockets.

When the Firefly went out on a hunt it was accompanied by a "Frog" armed ship. It is armed with a combination M-5/XM-3 armament system, consisting of the nose turret mounted 40 mm grenade launcher carrying 150 rounds of ammunition and 24 2.75″ aerial rockets. This armament system has proved to be a most effective sampan destroyer.

The last member of the group is the "Big Stick," an unarmed helicopter with a door-mounted .50 caliber machinegun. It carries 1,400 rounds of ammunition and several spare barrels for the machinegun. This has proved to be a most effective sampan perforator

In Vietnam, a battalion commander briefs General Harold K. Johnson and his staff on the Firefly



A. E. (Pop) Cutchen of Page Aircraft Maintenance with the Firefly he built for training aviators at the U. S. Army Aviation School

and its large tracers somehow discourage all but the bravest Viet Cong from shooting at the Firefly.

The Firefly had never been shot down in Vietnam and had been hit only twice [up to April 1966], while armed helicopters actually attacking targets with all lights blacked out have been shot down and hit more frequently.

In the summer of 1966, key personnel from Fort Rucker, Ala., went to Vietnam to determine if graduates from the U. S. Army Aviation School were being satisfactorily trained. While there, they were shown the Firefly and were greatly impressed.

Anxious to give the students as much practical training as possible, they asked that plans for the light be sent to Fort Rucker. When the plans arrived, Page Aircraft Maintenance, Inc., was given the job of making a light to be used by the Department of Tactics in its training program. Eventually the plans reached the Special Projects section headed by Mr. E. A. (Pop) Cutchen.

Since the original plans were in French, the only thing to do was draw up new plans. Only common materials, the kind that can be found in most Army aviation mechanic shops, were used. That way, any unit that needed one of the lights could build its own.

One improvement was to put spotlight canopies behind the lights. The original version had naked sealed beam glass lights which were subject to shorting out when wet. Also, the plain lights with no backing leaked light through the reflectors. Canopies prevented this. The best canopies are from UH-19s and CH-21s.

Canopies are only one of the many changes and improvements made. One noticeable difference from the original Firefly version is that Rucker's makes liberal use of brass instead of aluminum.

When the Special Projects shop completed its version of the light, school personnel tested it and made further recommendations for improvements. For one thing, the light was too hard to handle and it was suggested that instead of one control stick the light should have dual handles similar to those on a bicycle. It was also suggested that a helper spring be installed to make it easier to lift the light back into the helicopter.

When these and other suggestions were incorporated, the school found it had a greatly improved light. It weighs only 47 pounds and can be operated safely and easily by one man. It has seven 600 watt bulbs which provide a million and a half candle power.

On the UH-1, the light connects with the power source from the reverse current relay regulator which provides 300 amps. But the Fort Rucker Firefly uses only 140 amps, leaving plenty to operate the rest of the helicopter's systems. Like the headlights on an automobile, as long as the engine is running the light's batteries will not run down. By pulling circuit breakers on the light itself, selection of one to seven lights at a time can be made.

Besides the hunt and seek function, the light also can be used as a rescue light or a work light. For instance, the helicopter can hover over a wrecked aircraft while rescuers remove injured victims or as mechanics make emergency repairs.

Soldiers who have worked under the Fort Rucker light say it is no brighter than if they were working under the sun, and the glare is no worse. At 800 to 1,000 feet, the light on the ground is about like that of a lighted football field. When closed tight the light's beam will extend a quarter of a mile in diameter on the ground. Or when opened up, it will cover a wider area, depending upon the height of the helicopter. If fog is present, amber fog light lenses are installed by a spring hook attachment to each lamp, reducing glare and cutting through the fog.

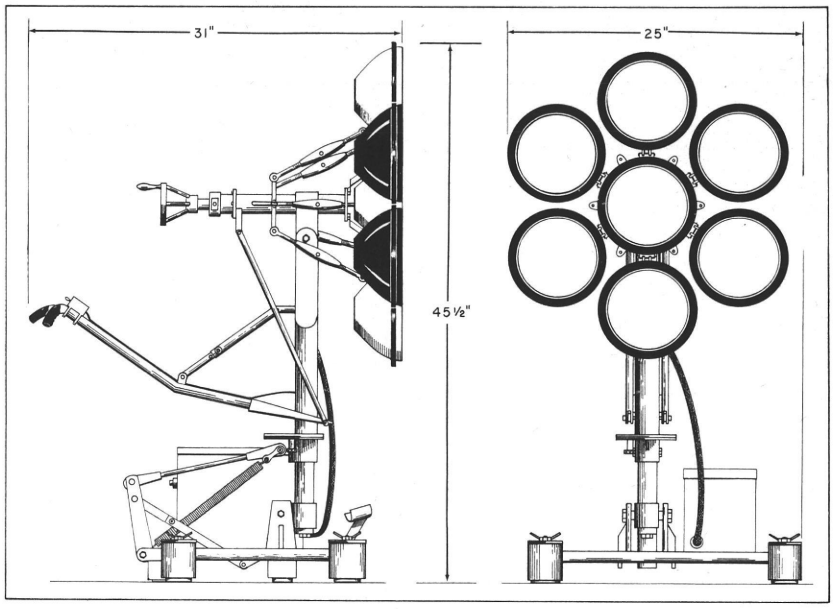
All the materials used in the Fort Rucker light are available to aviation units. Units interested in obtaining more information or blueprints needed to build such a light should contact the Department of Tactics, or the U. S. ARMY AVIATION DIGEST, U. S. Army Aviation School, Fort Rucker, Ala. 36360.

Pop Cutchen says that once an idea like this gets started it's hard to stop. He says all sorts of modifications and new ideas crop up. Reaching into his private filing cabinet (his inside coat pocket) he pulled out two small photographs of another light under development. This one had a stock and a handle like a gun.

"This light," he said, "can be used just like a gun, either in an aircraft or separately using a battery pack for power. It has 1 million candle power and uses 3,150 watts. It weighs only 19 pounds and will operate on the battery pack for 33 minutes.

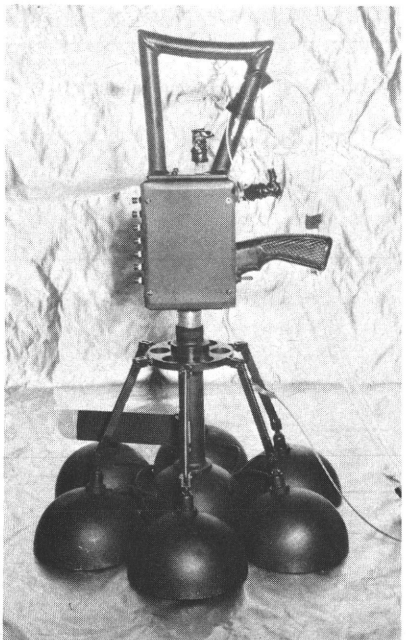
"A sentry could use one to investigate suspicious noises. Or he could use it in connection with a 'snooper scope' which can be mounted on top. When he located something of interest with the 'scope' he could then turn on the light for a better view.

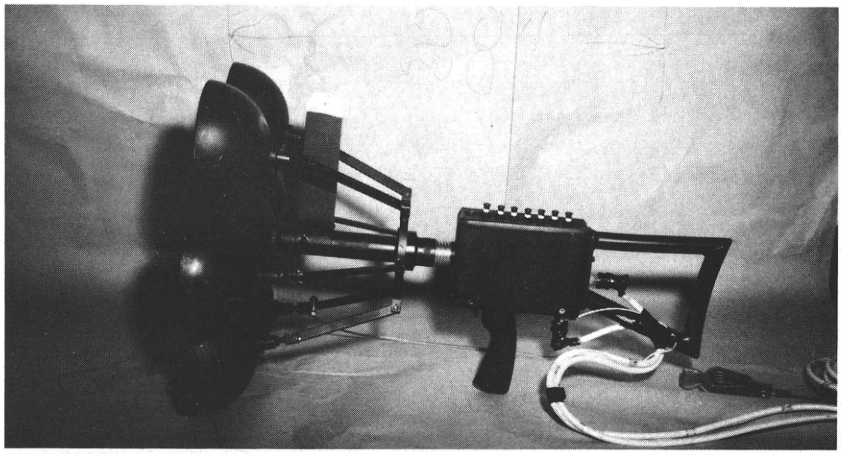
"We are still testing this one but indications are that it will work satisfactorily."



A drawing of the Firefly built at the U. S. Army Aviation School

A light that can be used like a gun (below) is under development at the Aviation School





At the U. S. Army Aviation School

Turbine Engine Facility Proposed

The Department of Maintenance Training has started action for a 19-cell turbine engine runup facility to be constructed at Guthrie Army Airfield close to other maintenance facilities

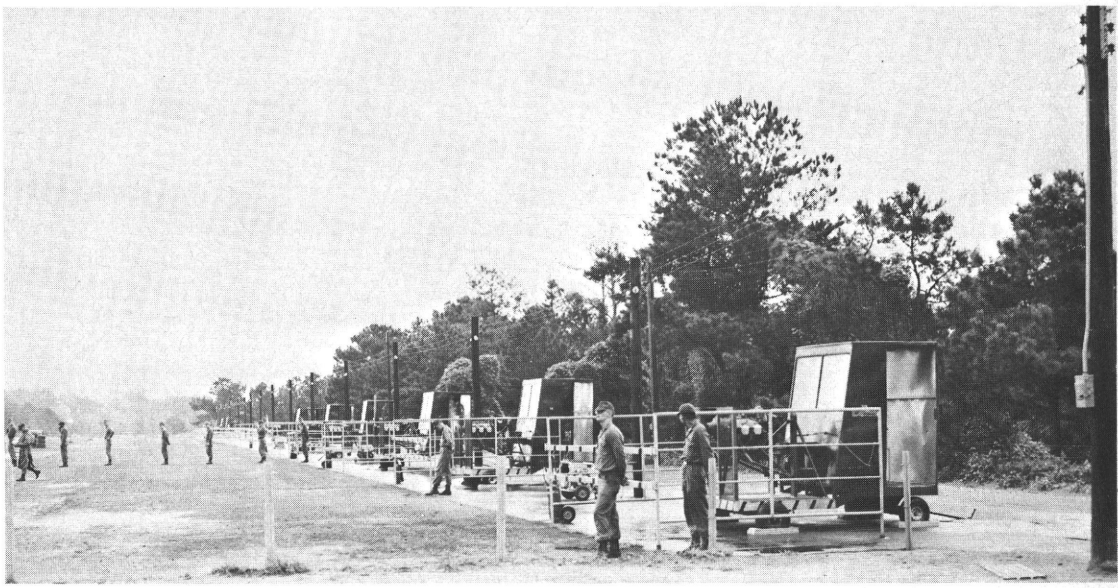
Captain Peter R. Harris

THE DEPARTMENT of Maintenance Training, United States Army Aviation School (USAAVNS), has the mission of training enlisted personnel in the maintenance of Army aircraft. Introduction of the turbine engine in ever increasing numbers into Army aviation has resulted in new training requirements and a shifting of emphasis from piston-driven engines to turbine engines.

To stay abreast of times and provide up-to-date instruction, the Department of Maintenance Training (DOMT) is constantly reviewing and improving the training program. After several years of experience on turbine engines (OV-1 and UH-1) and extensive studies, the Department of Maintenance Training has identified the following areas of training that must be included on operational turbine engines:

1. Engine start and shutdown.
2. Engine operation — normal temperatures, pressures, etc.
3. Engine trim adjustments.
4. Fuel flow adjustment.
5. Bleed band adjustment.
6. Acceleration calculations.
7. Engine troubleshooting to include the following malfunctions:
   - Starting fuel nozzle.
   - Starting fuel solenoid.
   - Fuel control.
   - Main fuel solenoid.
   - Bleed band system.
   - Torque boost system.
   - Anti-icing system.
   - Lubrication system.
   - Ignitors.
   - Bypass filters.
   - Use of the Jet-Cal Analyzer.
   - N1 rpm check and EGT check.

Having identified the requirement for additional instruction of aircraft mechanics in the 67A10, 67N20, 67H20, and 67V20 courses, DOMT has reviewed various training devices that could be used to present this instruction. It was recognized in early discus-



The only runup facility at Ft Rucker is for reciprocating engines which do not offer any practical experience with turbines for maintenance students

sions that lecture-type instruction is no substitute for practical instruction, and that a military construction project should be developed to provide a facility for conducting practical instruction on operational turbine engines. DOMT has started action for a 19-cell turbine engine runup facility to be constructed at Guthrie Army Airfield close to other maintenance facilities.

The 19 engine cells, with control rooms, will be comprised of two T53-L-3/7 OV-1 engines, five T53-L-11/13 UH-1 engines, and twelve T63 OH-6 engines. The engine cell will house the engine and a loading device mounted on a portable stand and be connected to a control panel located in the adjoining control room.

Noise levels will be maintained at a low level, internally below 92 decibels in the frequency range of 150-300 hertz. This is necessary to prevent instruction without undue interference and to locate the facility conveniently with respect to other classroom facilities. This will require sound attenuation and loading devices that operate at a low noise level. The control rooms and classroom will be air-conditioned and the engine rooms ventilated to provide good free air circulation. Safety considerations dictate that the exhaust be routed out of the cell and up to a level above roof height.

Turbine engine simulators (2A27 trainer) as presently used by Fort Rucker are available; however, they are expensive. A simulator comparable to the facility proposed would cost approximately $3,300,000, and would not provide the realistic and practical student training available with the proposed engine runup facility. Partial aircraft fuselages could also be used for this training; however, they would require rotors or propellers for engine loading and would require extensive paved parking areas with secure tiedowns. Safety problems, availability of the aircraft fuselages, climatic weather conditions, and lighting problems for nighttime use have ruled against this type of training device.

Operating turbine engines are essential for training turbine engine mechanics. The engine runup facility as proposed is preferred in lieu of an actual aircraft for instructional purposes because of safety (no rotors or propellers), economy (builtin safety devices will protect the installed equipment), prolonged equipment life (foreign particle ingestion will be minimized and the equipment will be protected from the natural elements), better use of student training time (double shifting, nighttime operation, and operations under adverse weather conditions will be possible), and better trained students (small classes with individualized instruction in a controlled environment).

The proposed facility will be used by 800 in-resident students being trained in the 67A10 Basic Maintenance Course, and 568 in-resident students in the higher maintenance skill levels (67H20, 67N20, 67V20). All maintenance students will be given instruction in the correct procedures for starting and stopping the turbine engine and preservation of the engine for shipment.

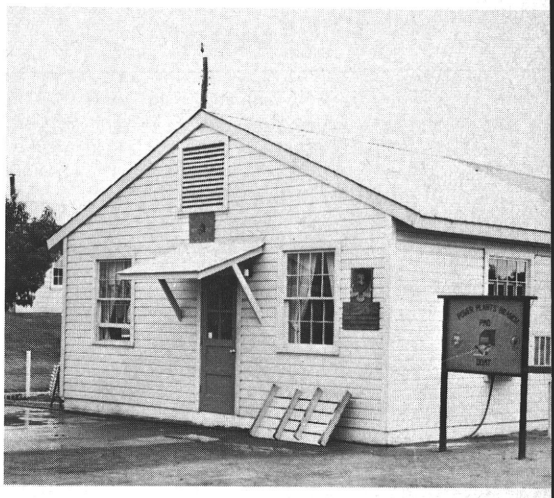
Basic maintenance students (67A10) will be initially familiarized with an operating turbine engine and given practical instruction in normal and abnormal operating temperature and pressure ranges, vibration analysis and related equipment, minor troubleshooting, and use of the Jet-Cal Analyzer.

Higher maintenance skill level courses (67H20, 67N20, 67V20) will train mechanics on an operating turbine engine in hot-end disassembly, inspection, repair, reassembly, and operational adjustments—location, removal, inspection, replacement, and operational adjustment of accessories and components. These advanced maintenance students will also be given practical instruction in fuel flow adjustments, bleed band adjustments, engine trim, and troubleshooting.

Troubleshooting instruction will be accomplished by introducing faults most likely to be encountered in normal operation. Students will be required to systematically analyze an operating engine, locate the fault, and either make necessary adjustments or replace the discrepant item.

It is difficult to assess the impact that this facility will have on student morale and motivation, but it will be significant. With the rapid turnover of enlisted maintenance instructors and, in some cases, relatively inexperienced instructors, this facility will make a significant contribution to the training level of Army aviation aircraft mechanics.

The small building below is the only structure available for classroom work



Captain Harris is with Master Plans and Facilities Support Division, Director of School Support, Ft Rucker, Ala.

Divarty Night Party

A decision was made to move a battery of artillery within range of the embattled troops to provide support throughout the night. This required a night move

CW3 William R. Day

ALTHOUGH WE will speak in some generalities, this article is intended to cover one mission: tactical movement of a field artillery battery in a combat situation, under the cover of darkness.

For many of you this will be old hat, but some may benefit from reading of this experience, if and when they find themselves faced with a similar situation. Although we are to deal with a single mission, I feel we should review some of our previous training and circumstances which brought us to this mission.

The CH-47A helicopter has been used for management and resupply of the artillery organic to an airmobile division. It does perform many other tasks; yet, this is still its primary mission in the airmobile division today.

With testing of the airmobile concepts completed in the fall of 1964 and the airmobile division a reality, it was decided that the Chinook was sound maintenance wise and reliable enough to perform its mission. Also, it was felt aircrews and artillery personnel had achieved a degree of proficiency in their training that they, along with the Chinook, could be committed to a combat zone in support of the airmobile division.

Upon arrival in Vietnam, the mission of the Chinook in the 1st Cavalry Division remained to move and resupply the artillery as required. We continued our support to them and maintained constant liaison, always striving to improve our support. As combat experience was gained, we employed new and improved techniques to better accomplish our mission. In the next few months we flew all types of missions in the division. We flew in daylight and darkness whenever there was a requirement and with a great deal of success.

After six months in combat, we still had not had a requirement to move a major element of the artillery from one firing position to another during the hours of darkness. During these months we had moved them many times, and had resupplied around the clock, but movement of the firing battery had always been during daylight hours.

This mission in its entirety had to be planned and executed during the night. To set the stage for this, I would like to give you some of the events that led to the decision to re-deploy this artillery battery.

The 1st Cavalry Division had a scout company out in search of the enemy, and during the afternoon light enemy contact was made on several occasions. Just before darkness, they encountered heavy enemy contact. As things had developed during the afternoon, they were in contact with the enemy, out of range of supporting artillery and other friendly forces, and night was approaching.

The size of the enemy force was still unknown, and with darkness falling, it would be difficult to reposition the supporting artillery and bring them within range for a fire mission. Also, if a reserve ground force had to be committed, it would be even more difficult to airlift them into a position where they could give the scout company some relief. So, a decision was made to extract the scout company. They were to break contact with the enemy, move to a selected clearing in the trees near their present position, and stand by for an airlift out.

One of our lift UH-1 battalions assembled a flight of Hueys and requested one Chinook from our battalion for the extraction. When they arrived at the pickup zone, the scout company was to move to the clearing in the trees for

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UNITED STATES ARMY

Divarty Night Party

immediate loading and departure. The flight arrived at the pickup zone, radio contact was established, and the infantry personnel gave the enemy situation negative at present time.

As it was beginning to get dark, the flight leader didn't see the clearing in the trees in time for an approach without a go-around. So he instructed the Chinook to land first since he was at the rear of the flight, and the Hueys would circle and land behind him. As the Chinook approached for landing, the scout company moved to the center of the clearing for loading. Just before touchdown the enemy moved out of the woods line and opened fire on the Chinook. The aircraft was damaged to an extent that it couldn't be flown out, but the crew had not suffered any casualties. After inflicting heavy losses to the enemy with their machineguns, they exited the helicopter and joined forces with the infantry.

At this time a decision was made that no further attempt would be made to airlift the company or Chinook crew out until daylight. Gunships were put on station overhead, along with rocket ships and Air Force A-1Es, and a CV-2 Caribou resupplied our forces with ammo and food by paradrops.

Only light contact with the enemy was made during the day

The enemy was still probing and the size of his force still unknown. A decision was made to move a battery of artillery within range for their support. Details of the mission had to be worked out, i.e., map reconnaissance, area selection, unit selected for securing a landing zone, aircraft needed, aircrews alerted, etc.

Of course all of this took time, and we received the mission to move a selected battery of artillery to a landing zone that would be cleared within a short while. The time now was approximately 2230 hours. With a pickup zone established and a landing zone proposed, we knew the requirements and details would be worked out with the artillery commander at the pickup zone.

To move the battery and ammunition needed would require 12 sorties. We moved to the pickup zone with six Chinooks with plans for each to fly two sorties.

When we arrived at the pickup zone we immediately realized some of the difficulties we were going to experience. The ground was dry and dusty, which created a problem for landing and hovering. Of the 12 sorties that would be required to complete the move, ten were sling loads that would require us to hover long enough to make the hookup and take off. This was almost impossible in the dark and the amount of dust we had to contend with.

Light discipline was essential as the enemy could be close enough both at the pickup and landing zones to reach us with ground fire during our approach. We elected to use our top anti-collision light so other aircraft could be seen but deny the enemy knowledge of our approach pattern until we were close into the landing zone. The pathfinders would have small lights placed on the ground over the intended landing point, and we would use our own landing lights on short final approach and touchdown.

We coordinated loading and flight plans with artillery personnel; loaded the two internal loads and spotted the sling loads that were to be lifted. With the distance we had to move we decided to refuel between sorties, and arrangements were made with our forward supply point to accomplish this. Now we were to await instruction that the security forces had landed, cleared the area, and we were clear to commence the movement.

At approximately 0200 hours we received instructions. The infantry, engineers, and pathfinders had landed; the area was secure; and we were to proceed to the landing zone as planned. The pathfinders would give us our instructions and vector us into the landing zone.

The first two ships with the advance party were to proceed 5 minutes ahead of the rest of the flight. They took off, leaving the other four to hook up their sling loads and provide the 5 minutes separation. With the amount of dust we were stirring up, we could only hook up one load at the time. Even then it was almost impossible to maintain ground reference long enough to complete the load hookup. At times we would have to fly out of the dust, give it a chance to settle, then return for the load. With the first six sorties finally loaded, we proceeded to the landing zone.

By now the moon had settled in

the west, and that small amount of light that we needed so badly had disappeared. Although the skies were clear, we had a considerable amount of smoke and haze, making navigation and flying VFR almost impossible. We had requested flares be dropped over the landing zone, causing constant illumination. After takeoff and reaching our en route altitude, we could see the flares for about 15 to 20 miles, thus solving our problem of navigation to the landing zone.

As we approached the landing zone, radio contact was made with the pathfinders, and we were informed that a C-47 was dropping flares directly over the intended landing zone. Enemy situation at present was negative, landing would be to the west, and some trees were still standing in the landing zone. The operator also informed us they had a light gun that would be flashed on request and could be seen about 5 miles out, in the direction of landing.

From the time we could see the light gun being flashed, we could also see a clearing in the trees from the flare illumination. Now everything looked good, and we did not foresee any difficulty completing the approach and landing. We were loaded to maximum gross weight and particular attention had to be given to aircraft handling during this time.

As we continued our approach, again the pathfinder reminded us of the scattered trees still standing in the landing zone. When we were within a few feet of the treetops, we switched on a landing light and saw some of the trees that were still in the landing zone, standing about 100 to 150 feet high. Some were directly in our flight path, but we were able to turn and slip and descend between the trees to complete the landing.

Because of the approach angle in the darkness and the deceptiveness of the trees in the landing area, a great effort was required of both pilots. Even so, we lost one ship from the mission due to an overboost on the engines on the first landing.

Our first six sorties were completed now, and we returned to the forward supply point for refueling. Back at the refueling point we had requested and gotten a searchlight erected and beamed straight up in the sky. For our return flight, this light served as a navigational aid and also gave us a reference so we could maintain VFR flight.

During our return flight to the refueling point, we decided to proceed with the mission with all deliberate speed. As two aircraft were serviced and refueling completed, they would continue with the mission. As it turned out we only had four flyable aircraft after the first flight. One was down for an overboost, and another had other mechanical troubles.

After refueling, we returned to the pickup zone and got our loads for the second flight. Considering all the conditions that we were operating in, we felt the mission was progressing well. We approached the landing zone the second time to find it in a darkened condition. Radio contact was established with the pathfinders and we were informed landing instructions were the same, but without the aid of flares. The C-47 had expended his load and was gone for resupply.

With the benefit of the previous landing, we made a successful approach to the darkened landing zone and returned to the forward supply point for refueling. There we found we had only two Chinooks flyable, due to mechanical troubles. We had two sorties remaining, and they were picked up and delivered to the landing zone by those two left flyable.

As we departed the landing zone, having completed the mission and on the radio informing the artillery battalion commander of this, we could see light breaking over the horizon in the east. Having worked the past few hours in complete darkness, dust, smoke, and haze, this was a sight to behold and some relief for the aircraft crews that were still in the air.

The success of this mission, as any other, rested with the aircrews of this flight and the artillery personnel. Just what action should be taken when you receive a difficult mission cannot be determined, but we can do some things to better prepare ourselves. To mention a few, we can work hard to perfect our own flying skills, learn the capabilities of our aircraft and other crewmembers. We can increase our knowledge of the operation of the ground elements that we support and be sure they know and fully understand their mission as pertains to the air movement. Also we should increase their knowledge of capabilities of the aircraft they are working with.

It goes without saying, experience does help; and on this mission every pilot had from 7 to 10 years in Army aviation and a lot of that in cargo type aircraft. Even so, back at our forward command post over a cup of coffee, we all agreed we had possibly just completed the most difficult mission of our aviation career.

When the crew from the downed Chinook came in a while later and mentioned they had been receiving artillery support since about 0230 hours, although neither they nor the infantry had seen or heard a Chinook flying, they all knew we were out there rendering any support we could. This certainly added to the feeling that we had accomplished our mission with a job well done.

Night Expedient Lighting

. . . their bird mushes unceremoniously into the landing zone, the engine rpm going down, down, and their skids coming up, up

CW2 Dwight G. Palmer

REDHAT 6, this is Viper 23, 3 miles north of your station for landing."

"Roger 23, we'll put out a light for you."

Lieutenant Nighthawk leans into his shoulder harness as he scans the darkness ahead of him. "Where is that confounded LZ? I know it's out there somewhere among all those trees!"

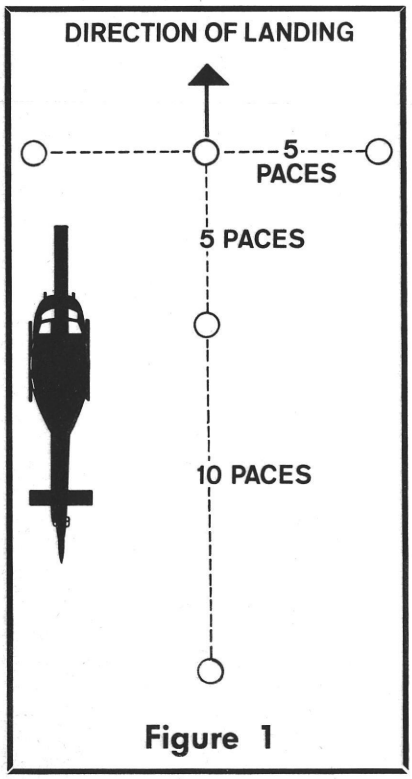

Figure 1

"Viper 23, this is Redhat. You just passed over us. See the light?"

Lieutenant Nighthawk puts his Huey into a 180° turn and retraces his flight path. "There it is, lieutenant," calls the copilot, W1 Joe Newcomer.

"Rog Joe, I got it," answers Lieutenant Nighthawk as he catches sight of the pinpoint of light on the ground.

Simultaneously a radio call crackles in his earphones, "You're right over us 23."

Lieutenant Nighthawk makes another turn and begins his approach down the long corridor of darkness toward the feeble point of light. "Hey Joe, am I cockeyed or is that light moving down there?"

"Looks like that Yo-yo with the light is running around the LZ."

"Man, I wish you'd hold still down there."

"Holy mahogany trees, lieutenant, pull up!"

"Pitch, pitch!"

There is a long moment as the heavily loaded Huey strains for altitude. Lieutenant Nighthawk and Mr. Newcomer sit transfixed as their bird mushes unceremoniously into the landing zone, the engine rpm going down, down, down and their skids coming up, up, up — right around their ears! Crunch!

The next morning, by the dawn's early light, Lieutenant Nighthawk and Mr. Newcomer stand sheepishly by the wreckage of their bird. With downcast eyes they watch the "Redhat" mess sergeant valiantly attempting to pour the cargo of fresh eggs into a bucket! The only choice now is to scramble them.

This accident was caused by the simple fact of using minimum lighting that was just plain too minimum! It all boils down to an optical phenomenon called "autokinetic illusion."

If you sit in a darkened room and look at a small point of light on the wall, you will find that, even though the light remains physically stationary, your eyes see the light as a moving point. However, if you place two lights side by side in the same situation, they will remain steady to your vision. This same phenomenon can occur in dark LZs; therefore a single light for night landings is out. Period!

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Personnel at the U. S. Army Aviation School use a system of minimum lighting that is very effective and can accommodate single ship or formation landings. The secret is simply that of arranging lights or light reflecting materials in a geometric pattern at the intended touchdown point.

For single ship night operations, the basic lighting pattern is the "T." The T is formed by placing 5 lights in the figure of the letter T, with the crossbar of the T indicating the landing heading (see fig. 1).

Lights for the T can be smudge pots (like the highway department uses), tin cans filled with sand and fuel, or flashlights taped to sticks. These expedient lights should be anchored to the ground, and if fire pots are used, a fire guard should be on hand. Fire pots will burn quite vigorously when subjected to a dose of rotor wash!

When placing a T of flashlights (especially the hooded GI type), bear in mind the approach angle of the aircraft. Don't place the beams horizontal to the ground or shining straight upward. An angle of 10° to 20° is best, keeping in mind that a normal stagefield approach is on an angle of 8° to 10°. Sitting on an angle of 10° to 20°, the lights are visible much farther out on the approach path.

Another effective method of lighting taught by the U. S. Army Aviation School is use of a panel illuminated by vehicle headlights. The panel is placed at the touchdown point and secured to the ground. It should be "pitched" like a pup tent, so it will reflect light from the headlight beam. The vehicle is placed at a 45° angle to the panel with the headlight beams focused on the panel (see fig. 2).

Vehicle-panel marking can be

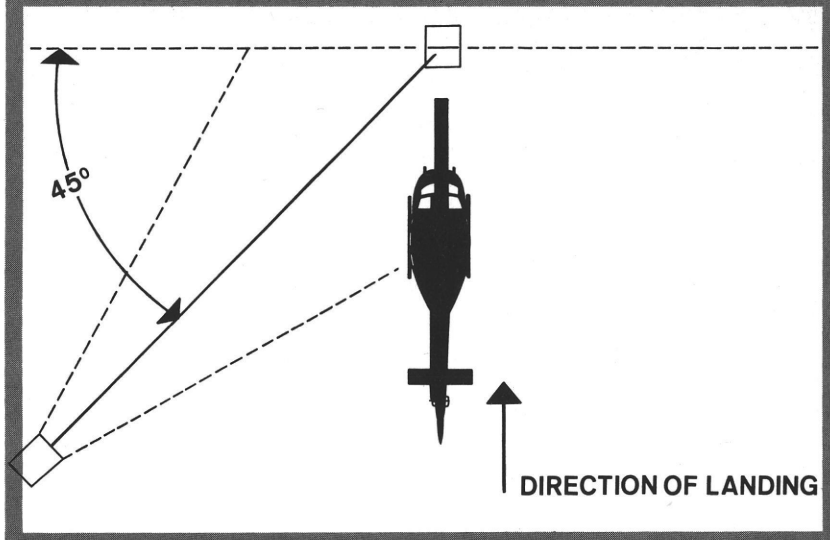

Figure 2

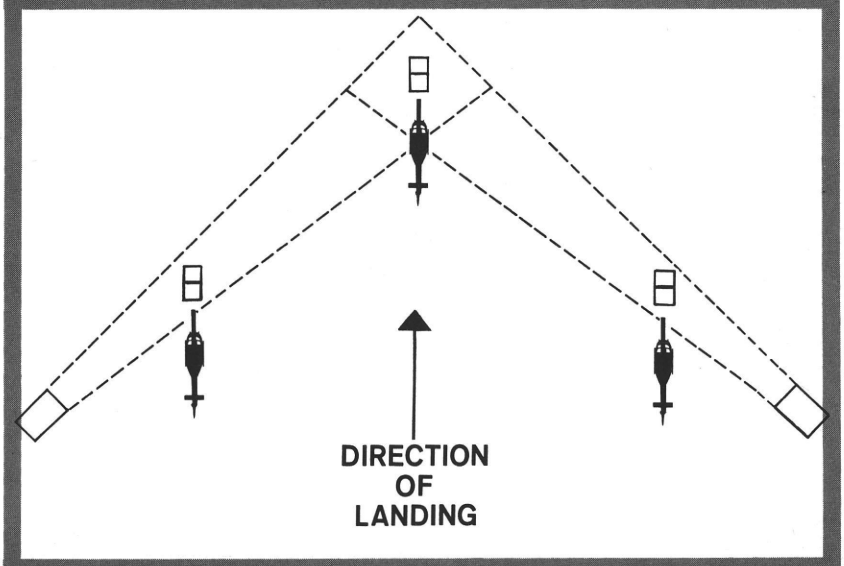

Figure 3

Night Expedient Lighting

expanded to accommodate a night formation landing by adding a second vehicle and two additional panels. To land a "V of 3" the vehicles are placed on a 45° angle to each side of the point panel, and the two additional panels are placed, one in each headlight beam, a distance of two or three rotor diameters from the point panel (see fig. 3).

Remember that cloth panels must be pegged down to the ground. Piling rocks on the corners will not hold them down when a Huey hovers nearby! A point for the aviator to keep in mind: approach the panel at an angle of 45° to the headlight beam. It is very disconcerting for personnel in the truck when a helicopter attempts to fly down the headlight beam and snips off the vehicle's radio antennas!

Flare pots or flashlights are placed in the inverted "Y" configuration for night formation landings (see fig. 4). In this configuration the stem of the Y points out the direction of landing. The lead ship of the formation lands to the center of the Y and his wingmen land to their individual lights placed 45° to either side.

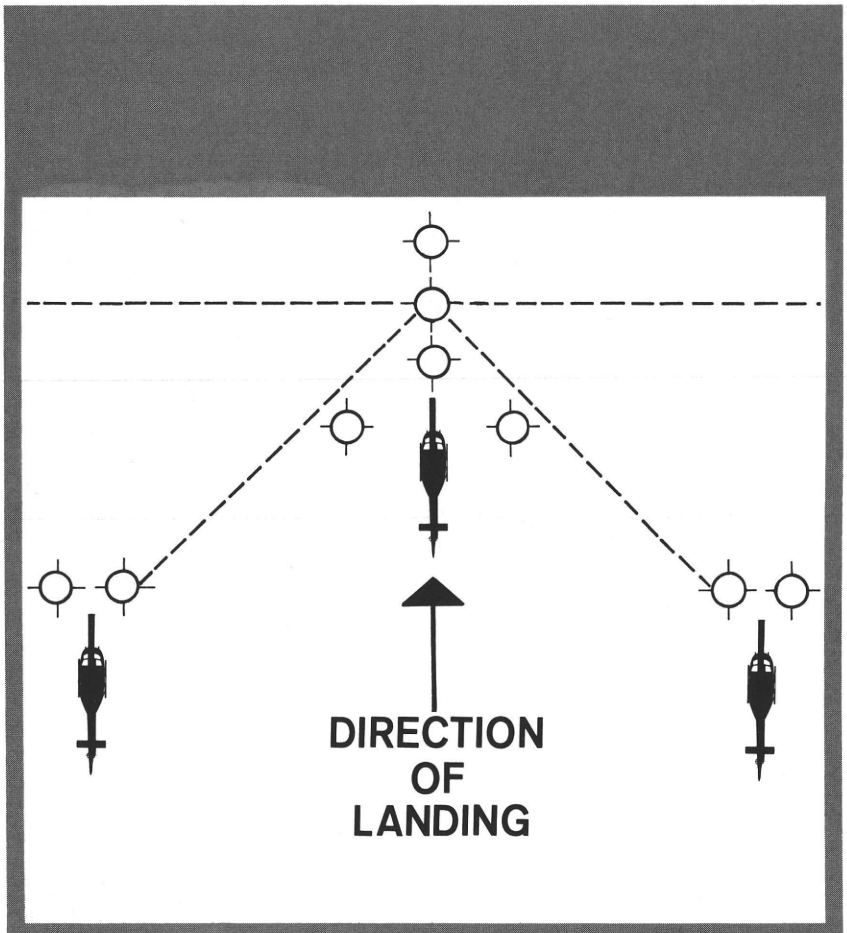

Figure 4

It is wise for the aviator to land his aircraft 10 meters or so back of the fire pots. Landing directly behind the fire pots will cause them to burn very brightly, possibly blinding the pilot, or it will blow them out completely, resulting in loss of ground reference at a rather critical moment!

On all minimum lighted landings it is important that the ground personnel determine the safest axis of approach, taking into consideration the longest axis of the LZ, the wind and obstacles in the flight path. From this information a landing azimuth is determined and passed on to the pilot. If for some reason the pilot does not follow the prescribed landing azimuth and varies it a few degrees either way, he will find that the relatively simple pattern of lights will become an almost unrecognizable hodge-podge.

According to the book, the most common errors associated with minimum lighted approaches are misunderstanding the lighting configuration on the ground and failure of the aviator to correctly align the aircraft on the desired approach heading. Therefore, the aviator and the ground crew should be thoroughly familiar with the lighting configuration that is to be used.

The best watchword for night minimum lighted approaches is probably "caution." Please don't confuse it with "complacency." If things don't look just right on approach, remember you have two defensive weapons: the landing light and the go-around.

NIGHT ARTILLERY ADJUSTMENT

Captain David L. Forte

"THE HOURS OF darkness belong to the guerrilla."

This is one of the teachings pounded into the head of the communist terrorists. They are told that the night affords the shroud of concealment they need to stage sneak attacks, resupply their units, and generally operate with complete freedom.

Lately this situation is changing, although not drastically at present. The OV-1 Mohawk provides the combat commander with infrared and radar surveillance, as well as night photography capabilities. Various USAF, Navy, and Marine aircraft provide similar capabilities. Night illumination to outposts under seige, after-dark rescue missions, and other night operations is furnished by a variety of Army, Air Force, and Navy fixed and rotary wing aircraft. Some helicopters now carry large light clusters that illuminate an area on the ground the size of a football field. Gradually the situation is changing. Gradually the night is being taken away from the insurgent.

One of the old tried, true, but

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A 105 howitzer lights up the night when fired during recent exercises

still popular methods of denying the guerrilla freedom of movement during the night involves the cooperation between aviation and artillery. In this method an O-1 Bird Dog is usually used because of its endurance, but any aircraft that can fly slowly can do the job as well, including the Huey and the new Cayuse.

Let's follow a typical surveillance and artillery adjustment mission using this method and see how it's done. In this particular case, the S-2 of a Vietnamese sector was visited one night by a little Vietnamese man who lived in a VC infested area. He was one of the many loyal South Vietnamese forced to live among the Viet Cong. And like many of them, he reported what he heard and saw whenever he could.

He told the Vietnamese intelligence officer that he had overheard two VC talking and they had said that on the following night their company would move to a new assembly area. The move would be made at night to take advantage of the darkness.

The Vietnamese S-2 passed the information to his counterpart, the S-2 advisor. The advisor checked to ensure the accuracy of the information and passed it to the S-3 advisor to be acted upon.

After a careful map reconnaissance it was decided that the proper spot to hit the VC was at a crossing of two trails. The terrain was such that the VC would have to use this crossing. It was an ideal crossing because at this point there was a sort of clearing and the trails could be seen from the air.

It was decided to use an O-1 to keep the crossing under surveillance and to direct artillery fire. Consequently, the commander of the nearest O-1 flight section was called in for conference.

The pilot assigned to the mission was already familiar with the area. He was also experienced in directing artillery fire. Even so he still had to reconnoiter the area around the cross trails and, of course, register the artillery. This is a ticklish job; the pilot must do both in such a way that the VC won't suspect what's up.

Before he left on this chore he had himself briefed on the location of the 105 mm howitzers that would do the firing, the registration points, concentrations, known points, reference lines to be used in making corrections, and the location of the cross trails that were to be fired on.

He also had himself thoroughly briefed on the tactical situation, paying particular attention to the location of friendly troops, local friendly villages, and other no-fire areas.

Lastly, he checked into the communication details to be sure there would be no trouble getting through to the Fire Direction Center (FDC).

In making his recon he tried to give anyone on the ground the impression that he was just another aircraft flying back and forth looking for movement below. He did pass over the area of the cross trails but seemingly gave

it no special attention. In registering the artillery, he had them fire on registration points some distance from the cross trails. These were so located that it would be a simple matter to shift onto the target.

Satisfied that he would have no trouble locating the cross trails in the dark and directing the artillery on the target, he now turned his attention to preparing his aircraft for the night mission. He took extra pains to see that his little Bird Dog was in good shape, giving special attention to the landing lights and other night flying aids that are sometimes overlooked on daylight flights. Lastly, he removed the 2.75" rocket tubes from the shackles and replaced them with MK-24 flares.

Fortunately the weather was good and the pilot was able to forget this aspect of flying while maneuvering his aircraft into the air. At 4,000 feet, he leveled off and about five minutes away he reduced power and started his descent. He contacted the FDC and found that they were ready to fire on his command. When he was sure he was over the target area and at an altitude of approximately 2,500 feet, he released his first flare. Having blacked out the aircraft as soon as he left the field, now the harsh light almost blinded him. But below he could see the target.

About 30 people were running down the trail and jumping into the bushes by the side of the trail. The pilot immediately called for fire on the target and heard the FDC say, "Shot."

In seconds there was a burst of artillery below. Previously it had been agreed that, unless otherwise instructed by the pilot, the first round would be a white phosperous for rapid identification of its point of impact, and that HEVT would be used in effect. The round was a little to the left of the cross trails but the range was almost perfect.

The pilot asked for right 50, repeat range and fire for effect. He was rewarded with an immediate "Shot."

In the meantime, the flare had burned out. The pilot climbed slightly and dropped another. The light revealed that a number of VC had tried to take advantage of the temporary darkness to run past the cross trails and into an area where there was better cover. Suddenly the trail and trail junction became engulfed in fire and smoke that just seemed to come rolling in from nowhere. The pilot saw several bodies fly up in the air and drop back down into the fire. The artillery fire was so intense that the little Bird Dog shook from the concussion of the incoming rounds.

The pilot ended the mission after four volleys had been fired. He dropped a third flare but couldn't see much. A thick blanket of smoke and dust covered the target area. He thought he could see two bodies lying in a small clearing, but again they might have been logs. But the artillery was dead on center and covered a wide area.

This is only one example of how the night is being taken away from the guerrilla. Others are using different aircraft and equipment. Sometimes the illumination of the targets is by searchlight, illuminating shells or cluster lights. More sophisticated methods allow the observer to see without visible light.

Even the old method described above using a Bird Dog aircraft can be varied to make it more effective. If two aircraft are available, one can be used to drop the flare while the other is used by the observer. This allows him to see the target from the side instead of directly overhead. Sometimes it is possible to have the target fired upon before the flare is dropped. This keeps the guerrilla from being forewarned.

Even better methods are being developed. Some are on the drawing board while others are being tested. At the present time the Mohawk is being updated with new and better intelligence gathering equipment. Other improvements are sure to follow.

"Foreign Legion"

ON 24 September, the 145th Combat Aviation Battalion, sometimes referred to as "America's Foreign Legion," marked its fourth birthday as the oldest combat aviation battalion in the Vietnamese war zone. Its battalion colors were unfurled at Tan Son Nhut Air Base in 1963.

The 145th, originally composed of the 118th and 120th Assault Helicopter Companies, lays claim to the "Foreign Legion" title since from its inception it has never served in the continental United States nor in any of its overseas possessions. The 118th is still a part of the 145th, but the 120th has been reassigned to another unit.

To round out the current organization, the 68th, 190th, and 335th Assault Helicopter Companies have been assigned. Also the 334th Armed Helicopter Company, the U. S. Army's only gunship company, is a member of the 145th. A fixed wing reconnaissance capability is supplied by the 74th Reconnaissance Airplane Company.

U-8F LANDIN

Captain E

ON 23 FEBRUARY 1967, I was conducting a transition training flight in a U-8F at Fort Richardson, Alaska.

We took off from Bryant AAF at about 2330Z and proceeded to Anchorage International Airport to make touch-and-go landings. The student completed one landing and then I demonstrated one. Then several approaches were made, with waveoffs from the tower because of other traffic.

On the last approach, when the gear was lowered we noticed that the nose gear indicator was "in-transit" and the light in the gear handle was on. The gear was then raised and the nose gear still indicated "in-transit." A go-around was initiated and we proceeded to Bryant AAF. En route to Bryant we recycled the gear then extended the gear manually, both with negative results.

Several passes were made past the tower at Bryant with the gear first raised then extended, and one pass was made while porpoising the aircraft. Personnel on the ground and in the tower reported that the nose gear was "in-transit" and swinging slightly.

We later learned the landing gear components work on the jack-screw principle (similar to a scissors jack for automobiles) and therefore bouncing and porpoising was useless. If the gear itself is extended but the position indicator switch on the gear is stuck, bouncing may unstick the switch so a down-and-locked condition will show on the indicator. This effects the indicator switch only,

G -- GEAR UP!

gle W. Scott

and in no way will alter the position of the gear.

After a radio conversation with the USARAL U-8 standardization pilot, we removed the panel between the copilot's seat and rudder pedals and found the drive chain intact and working properly. During this work, we changed seats. Bryant then notified Elmendorf AFB of a gear-up landing and requested they commence blowing snow on the runway. Upon radio contact with Elmendorf tower, we advised them that we would like the snow started at 1,000 feet past the approach end of runway 05 and continued for 4,000 feet.

Several more maneuvers were attempted: abrupt pullups and dives, dives with sudden applicacation of full flaps and gear, sudden stalls, slips, and hard yaws pumping the rudder pedals. As a last effort, we made a gear-down approach to runway 33 at Elmendorf and attempted to jar the nose gear down by bouncing the main gear on the runway. After all attempts the nose gear still indicated "in-transit" and we decided that we would have to land gear-up.

We then began to prepare the aircraft for the gear-up landing. Loose gear was secured, the door safety chain unhooked, navigation radios were turned off, and we ran through the gear-up landing procedure several times. During

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this time, another U-8F flew alongside of us and looked at our nose gear, with further confirmation that it was free swinging. This also allowed us a good look at the undercarriage of a U-8F with the gear up.

We made two practice approaches with power on at Elmendorf using about 2750 rpm and 12 inches MAP (manifold absolute pressure), which we estimated was about equal to a zero drag, feathered prop configuration. We then climbed on downwind, turned off the heater, shut down the number 2 engine, feathered the number 2 prop, and bumped the number 2 starter until one blade was straight up. The number 2 magnetos, generator and fuel were turned off and the starter selector was turned to number one.

As we approached the point on final where we could feather number 1 and have the prop vertical before touchdown, I pulled the power back to 12 inches MAP to test what our feathered glide path would be. It appeared that we were short and would have to carry power on number 1 too long to get the blade stopped before touchdown. I then initiated a single-engine go-around.

A second approach was commenced, maintaining a higher turn to final. When we had the field made, I pulled off the power on number 1 engine; the student cut the idle cutoff and feathered the prop. While I turned off the fuel to number 1, the student turned off the number 1 generator and magnetos and bumped a prop blade straight up. We advised the tower that we were going to land this time and turned off the UHF radio. The final approach was made at 100 knots with zero flaps. On very short final, I put down 40 percent flaps and the student turned off the inverters and battery while he locked his shoulder harness.

It is recommended that the battery switch be left on as long as possible to maintain communications. The copilot can then disengage the switch when it is no longer needed.

Touchdown was very smooth. I could feel the nose gear touch first, fold back, and then the main gear touch. I estimate that we touched down on about the first 500 feet of snow. Directional control was good using rudder. As we started to lose rudder control I used brakes for directional control only and steered left once to avoid a thin patch of snow. When the aircraft came to a stop, we rechecked all switches and exited. When we moved to the rear of the aircraft, it rocked back, bending the inboard flaps up at the point closest to the fuselage. The flight terminated at 0332Z.

COMMENTS ON THE PROBLEM

• Tools: A small tool kit, as recommended in the "Crash Sense" section of the September 1964 issue of U. S. ARMY AVIATION DIGEST, would have been invaluable to enable us to remove the floor panels. We modified a survival knife to remove the panel screw. It made the task extremely difficult.

• Jarring the nose gear down by bumping the main gear on the runway: This is very difficult and as previously stated is an unsuccessful maneuver. The U-8F must be flown quite fast, and power must be kept up to keep the nose from falling and letting the props hit the runway. We used 30 percent flaps and 90 knots for the touchdown and succeeded in only "skipping" the aircraft on the runway. I recommend that this procedure not be tried.

• Gliding characteristics: The U-8F glides quite nicely when clean, but a little steeper than I expected. I wish we had an *exact* power setting to simulate the drag of a feathered prop configuration. This would have helped us make more accurate practice approaches. It seemed to me that the 2750 rpm and 12 inches MAP were quite close.

• Preparation for the approach: So much happened on the downwind leg of our first attempt that I didn't have time to concentrate on the glide angle. It would have been better to have made a higher pattern or longer downwind while feathering the first engine and preparing for the final approach.

• Single engine go-around with a hanging nose gear: It took intermittent applications of takeoff power to climb to pattern altitude during the single engine go-around, due to the drag of the hanging nose gear. Climb power on one engine was not quite sufficient. I held between 95-100 knots and used no flaps for the climb.

• Use of snow: The 4 to 6 inches of snow was ideal. I don't know if foam would have been better or worse, but if snow is available, use it.

• Flap damage: We could have saved the flaps, if we had retracted them before departing the aircraft. However, if there is the slightest chance of fire, I would not turn the battery back on; the flaps are cheaper. In our case, we simply were in a hurry to exit the aircraft, and forgot that it would rock back.

• Use of shoulder harness lock: Copilot's was used, but the pilot's was not. Earlier, we tested our shoulder harnesses in the locked position and decided that the pilot could lock his on downwind and the copilot on final, after aligning the prop. However, in making the go-around, I forgot to lock mine.

Navy Test Pilot School Open To Army

Major Paul G. Stringer

THE NAVAL TEST Pilot School is one of four schools of its type in the free world. Graduates of the school are members of the astronaut team and are involved in major aircraft development programs. Army graduates are currently conducting evaluations of the CH-47B, the U-21, the XC-142, the X-22, and the HueyCobra.

Graduation marks the completion of 8 months of intensive training in aircraft testing, which has included approximately 455 hours of academic instruction plus 110 hours of flight testing. Evaluations of many types of jet and reciprocating engine airplanes as well as helicopters have gone into their training. Army students completed a 6-week jet transition program in the Navy T-1A airplane before starting the academic program.

The academic program provides the test pilot with the technical background of flight testing. With this knowledge, the test pilot combines test data with experience to evaluate the aircraft's ability to perform its intended mission under operational conditions.

Classroom work fills half of each day, while the other half is devoted to the test flight program. Technical courses include basic mathematics, calculus, mechanics, technical report writing, and aerothermodynamics. Aircraft performance is discussed in courses covering jet engines, instrumentation, and flight performance. The flying qualities of the aircraft are discussed in classes in longitudinal and lateral direction stability and control and dynamic stability for both helicopters and fixed wing airplanes.

An interesting facet of the stability and control phase is a series of flights in a variable stability B-26 airplane which is provided by Cornell Aeronautical Laboratories. This airplane has been modified by installation of a computer which manipulates the control surfaces of the airplane in response to control movements by the pilot to simulate many different aircraft.

The manner in which the airplane responds to the pilot's control movements is dictated by the instructor through a control panel connected to the computer. The B-26 with its computer responds similarly to any airplane from a light attack aircraft to a massive transport such as the C-5. In this way a pilot has an opportunity to observe and evaluate the effects of different characteristics on his ability to control the aircraft. Future plans of the school look forward to a variable-stability helicopter to perform this function in the VTOL realm.

The final test of knowledge gained during the course is provided by the Navy preliminary evaluation which each student accomplishes during final weeks of the school. In this evaluation the student flies an aircraft which he has never flown before and writes a report covering the flying qualities and performance of the aircraft. He is allowed a maximum of 6 hours or four flights to gather data for the report. The completeness of these reports is a tribute to the long hours of preparation and analysis performed by the student and thorough instruction provided by the school.

Nine Army aviators are selected each year to attend the Navy Test Pilot School. Army aviators in the grade of lieutenant colonel and below are eligible for consideration. Those selected for and entered into the program incur a four year service obligation whether or not they successfully complete the course.

Aviators selected to attend the course normally have completed a tour in Vietnam. To meet prerequisites of the school, an applicant must have completed college algebra, physics, and calculus, be dual rated, on active duty with a current instrument rating, and have been a rated Army aviator for a minimum of three years. Although a college degree in engineering is not required, it is desirable.

TC 350-53 covers complete information concerning the Navy Test Pilot School. Applications are made to the aviator's career branch and must include a transcript of college credits and a copy of the aviator's DA Form 759. Those selected to attend are notified by their career branch.

Major Stringer completed Navy Test Course, Class #45. He is now attending the Command and General Staff College, Ft Leavenworth, Kansas.

HUMAN EYES HAVE many qualities on a par with mini skirts and windy corners. Intelligent and robust males, including emperors and linebackers, have been drawn to the altar by the magnetism of flirting and promising eyes. Through an ingenious arrangement of rods and cones, the same eyes are equipped to recognize colors, shapes, and distances *under the right lighting conditions.*

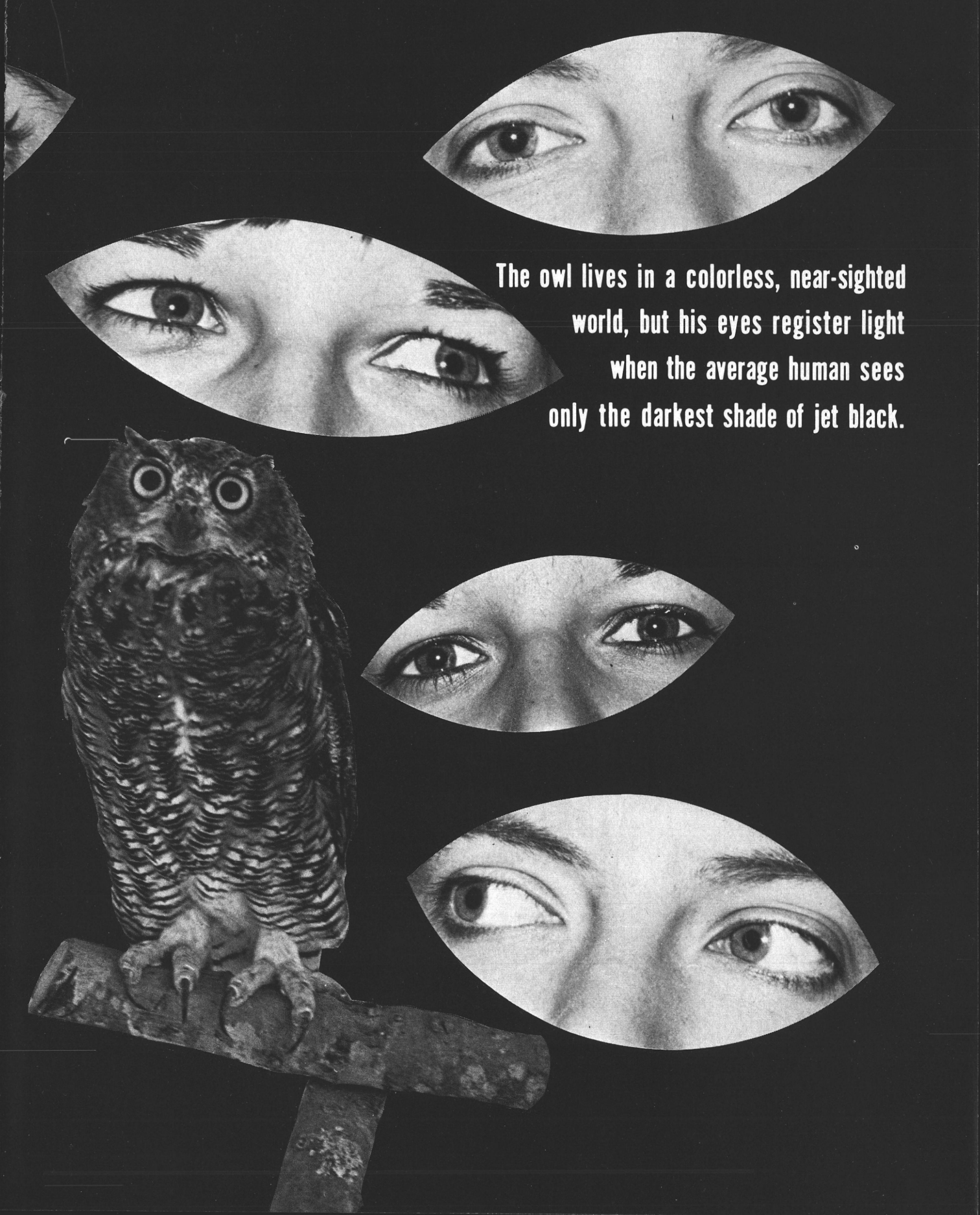
Our nocturnal friend, the owl, on the other hand, comes equipped only with rods and lives in a colorless, near-sighted world, *but his eyes register light when the average human sees only the darkest shade of jet black.*

Owls have two seeing advantages over humans that put them far out in front after dark. First, they're more used to night operations. While apprentice owls probably have to be shoved into night flying (who doesn't?) to start, they think nothing of it after they've completed their checkouts. Darkness becomes their natural habitat.

The second advantage is in the structure of their

EYES IN THE NIGHT

the following 28 pages prepared by the United States Army Board for Aviation Accident Research


The owl lives in a colorless, near-sighted
world, but his eyes register light
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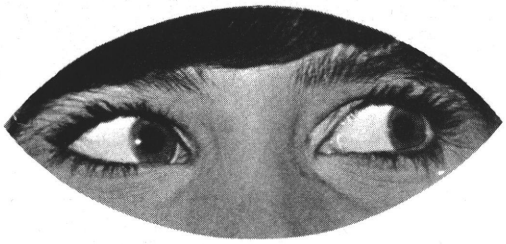


EYES IN THE NIGHT

eyes, pretty much like your own from outward appearances. They have a pupil-lens arrangement to focus on an object and let light through to form an image on the back of the retina. This retina has a mass of very small brain nerves which transmit the image for information and action to whatever portion of gray matter that ought to know about it.

The difference between you and the owl is in the *kind* of nerves in the retina. Yours has two varieties — CONES and RODS. The cones do most of your daylight and illuminated seeing. They register depth and color, but are generally insensitive to dim lighting and see little or nothing in the dark. Your rods, when properly adapted to darkness and not subjected to white lights, do most of your night seeing. They are very sensitive to low intensity light, but tell very little about color and depth.

Owls, who go about their pm activities with only one type of seeing nerve, the rods, can't help being nocturnal hot rocks. Long habit and specially adapted vision make night flying second nature to them.

Not so the human being—

Half Light To Dark

Two OH-13 pilots were assigned a flight to move their helicopters from landing zone to a safe area at dusk. The flight was in mountainous terrain and the route selected required flying through a mountain pass.

Pilot of lead OH-13: ". . . As we approached the pass, I maintained the lead and he fell back in trail to allow me to check the route and pass before going through. I told him I was going to fly over the road. The pass was open and I flew through it. The ceiling was about 100 feet, with 3-5 miles visibility. . . . I told the other pilot that if he had any doubts about making it through the pass to abort and not try it.

"After flying down the road for about 1,000 meters, I started a left orbit to wait for him. He started transmitting, saying, 'I don't know, I don't know—' or words to that effect. Before I could advise him to abort, I saw an explosion. . . ."

"What had the weather been like from the LZ to the pass?"

"There was a heavy haze, lifting to form a cloud. The ceiling was too low at the north pass, so we decided to follow the highway to the other pass."

"Were you flying in formation?"

"No, we were not in any type of formation. I had finished refueling first and was the first to take off. He followed soon after. . . ."

"Did you have any trouble seeing the ground?"

"There was no problem with ground contact. I was flying about 50 feet above the trees and following the road."

"What happened when you got to the pass?"

"When we reached the pass, I saw that it was open, called the other pilot, and told him I was going through."

"What was the weather like then?"

"The ceiling was not well defined, maybe 100 feet. It was still that haze lifting to form a cloud bank. The peaks on both sides of the pass were in the cloud bank, but the pass itself was clear. I continued to follow the road right through the pass."

"What did you do after you saw the explosion?"

"I flew back to the pass and landed in a clear spot just off the road. My passenger jumped out and ran toward the pass. There was a convoy coming through the pass, so I got out and flagged them down and used their radio to report the accident."

"How much light was there when you went through the pass?"

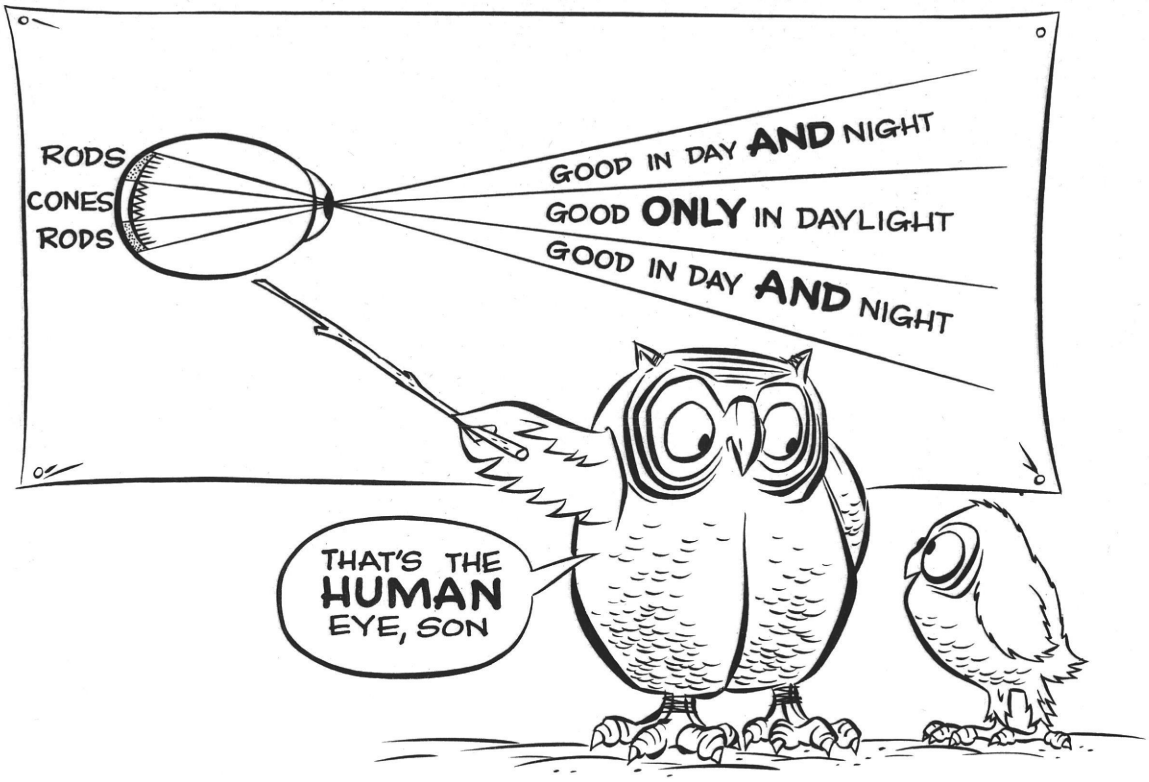
"When I reached the pass, it was half light, but when I came back and landed it was dark."

"What time was it?"

"About 1930."

"Did you have any lights on?"

"I had turned on my navigation lights early,



but turned them off because of the reflection on the haze and bubble of the aircraft."

The helicopter was destroyed and the pilot killed. The investigation board found that the attempt to fly through marginal flight conditions in a helicopter not equipped for instrument flying was the cause of the accident, stating: "The loss of ground reference due to darkness, haze, and mist resulted in the crash."

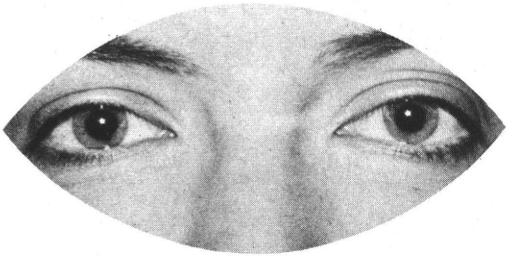
Owls have two seeing advantages over humans that put them far out in front after dark . . . the difference is in the kind of nerves in the retina

No Horizon

Flight surgeon: "Two days prior to this accident, we had a tail rotor failure on one of our helicopters aboard the ship. The aviation safety officer went to the ship to obtain statements from the crew about the tail rotor failure. For some reason, the investigation proceeded beyond statements to the point that the aircraft commander felt he must demonstrate the hazards inherent in flying off and on a carrier at night. Takeoff time was 2245. . . . They came onto the deck from a lighted area, went to the aircraft, and got in their seats.

"The crewchief asked if he should go along. The aircraft commander replied, 'No, I'm only going to fly around the ship and take off and land three times to show him what it's like to fly off a ship at night.' The aviation safety officer flew as pilot.

"The pilot had some difficulty in getting his seat belt buckled. The crewchief used a flashlight to



EYES IN THE NIGHT

assist him. His inertia reel was faulty in that it remained in the locked position. He remarked that his seat belt and shoulder harness were very tight.

"The aircraft commander ran the engine up to 6600 rpm. There were no lights on the ship, except for small bow and stern markers. The red panel lights were on. The pilot set his altimeter at zero and his artificial horizon at level. We do not know what the aircraft commander did. The artificial horizon on the pilot's side was defective. The aircraft commander told the pilot to walk through the takeoff with him. The pilot lightly grasped the cyclic and collective, and had his feet resting on the pedals. The aircraft commander brought the aircraft to a 5-foot hover and the deck officer signaled clear to take off.

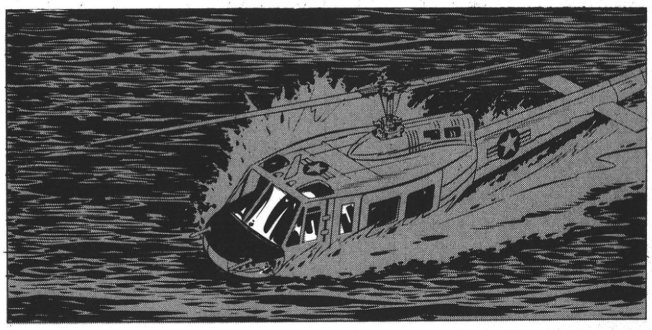
"The aircraft moved forward and the pilot went immediately to his instruments. About 10 seconds after takeoff, he felt a slight shudder which he thought was translational lift. Then he experienced a mental flash and felt as if he was tumbling through water. He did not feel that he was unconscious.

"He released his seat belt and surfaced, panicked momentarily, but soon came to his senses. He then tried to automatically inflate his life vest, but was either too confused or the wire was too strong. He was too confused to manually inflate his vest. He thought he had pen flares in his pocket, but later learned he had left them on the ship. He floated for 15-20 minutes and was rescued about 100-200 yards from the site of the accident. He sustained minor injuries.

"The aircraft commander was found 36 hours later, still strapped in his seat, at a depth of 40 feet. His helmet had come off. He had sustained a severe crushing blow to his face. . . .

"The pilot never felt that anything was wrong. He didn't feel that there was any mechanical failure and the crewchief, who watched the aircraft, said it took off in the usual manner, then seemed to 'fly down a wire' into the ocean. He thought it hit in a level attitude. Why did it do this? The answer to that is simple. The aircraft commander did not establish a rate of climb, therefore the crash was inevitable. Why didn't he climb? All we can do is guess. Did he fix on his instrument panel and neglect to climb? Did he fix on the pilot's instruments? Did he experience vertigo? Was he watching the pilot? Was he looking out of the aircraft, trying to find a horizon? How much did the flashlight affect his dark adaptation? I believe he fixed on the instrument panel and simply forgot to climb until it was too late.

. . . the pilot never felt that anything was wrong. How much did the flashlight affect his dark adaptation?



"The gun sight became a swinging missile. As the aircraft commander's helmet was torn off, the gun sight crashed into his face, killing him instantly. From the location of the wound and its severity, I do not think his helmet would have helped if it had stayed on his head. . . ."

Among the flight surgeon's recommendations were: "Persons flying at night should wear red goggles for at least 30 minutes prior to takeoff. All personnel should check survival gear before each flight. The pilot, a safety officer, 'thought' he had his pen flares, but they were back aboard the ship."

The investigation board recommended the use of landing or search lights when taking off from ships. However, the Naval Aviation Safety Center states that the use of landing lights over water leads to vertigo and disorientation. The Navy SH-3A, NATOPS, manual requires a climb to at least 300 feet on takeoff heading before making a turn. It states that this climb must be made with either a visible horizon or on instruments. Landing or searchlights will not be used.

Disorientation And "Who's In Control?"

Helicopter copilot: ". . . someone called us to begin to form a daisy chain. The leader turned his landing light on and off and we spotted him and started toward his position. Other aircraft were doing likewise. The pilot was flying and I was watching for other aircraft. . . .

"As we began to enter the daisy chain from the left side, I felt the pilot overflew another aircraft too close, but I just pointed to it, not saying anything. At this time, I noticed a highway to our right front and decided to try and locate our position on the map. I began looking at the map on my knee board. When I looked at the pilot again, he seemed to have his head down and appeared to be shaking it. I asked if he was okay and got no reply. I asked again and received a partial transmission. I thought he said, 'Take it,' so I took the controls and looked outside. I sensed something wrong, but

". . . the pilot overflew another aircraft too close, but I just pointed to it, not saying anything . . ."

couldn't pinpoint it. I noticed the highway again and saw the cars crossing the bubble from left to right. Again, possibly as many as three times, I asked the pilot if he was okay. I don't remember getting a reply.

"By this time, something was definitely wrong. The airspeed indicator registered 55 knots, but there was a whine beginning to develop, and the rpm was 2800. I pulled a little aft cyclic, checked the airspeed, and it was 80 knots. Again, I pulled aft cyclic, with no response. I pulled power and found the power control okay. From this point on, I can only record impressions. It seemed that we rolled to our left and increased airspeed. Then the whine seemed to decrease and we rolled right. During this time, I still had collective response. I tested it twice. I also called and reported, "Experiencing difficulties.' I followed this transmission by a few seconds with, 'Aircraft out of control.'

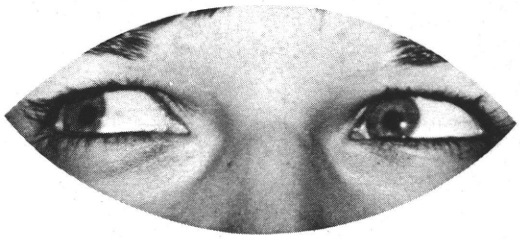
"Just before entering the trees, I pulled full aft cyclic and full pitch – with the needles joined, I believe. Then came the initial impact that stunned me. As soon as I unfastened my seat belt, I yelled to the pilot, 'Get out!' He seemed dazed, so I grabbed his arm and helped him out my door. We ran approximately 20 meters out to a small clearing. . . ."

Pilot: ". . . I was following another aircraft and flew too much left, and couldn't seem to control the aircraft, so I told the copilot to take control. He asked me how I was and I told him I was okay. He said he was having cyclic trouble, then said the ship was out of control. I then got back on the controls and tried to fly the ship, but couldn't seem to get full control.

"We started down and when we were approximately 100 feet off the ground, I tried to control the airspeed, and then pulled in collective to slow the rate of descent into the trees.

"Upon impact, I was temporarily stunned, but tried to get out of the aircraft as soon as possible.

EYES IN THE NIGHT



I didn't get my door open, so I went out the other side. . . ."

Flight surgeon: "Two student pilots were on a night cross-country flight, one acting as copilot for the other. It began to weather in and the order was given to form a daisy chain in order to fly out of the weather area. The pilot overshot the aircraft to his front, his aircraft began to settle, and he briefly lost visual reference. He immediately gave control to the copilot who had been looking at his map. The aircraft continued to settle and both student pilots then came on the controls. They felt the aircraft nose would not come up and that they were settling nose low. Finally, they set-

. . . the pilot overshot the aircraft to his front, his aircraft began to settle and he briefly lost visual reference . . .

tled into trees, pulling pitch, and landing very hard in a small opening. The pilot sustained a head laceration on impact due to helmet loss and his head acting as a near flung missile.

"Review of the accident explained one major problem, that of the appearance of nosing over. The student pilots had been assuming a hill upslope as horizontal, which explains the feeling of nosing over as they tried to land horizontal. Additionally, it was felt they were in a low airspeed descent in a downwind condition. Examination of the aircraft at the impact site showed it struck tail first, which goes along with excessive aft cyclic for what appeared to be a nose down condition, but in reality was a nose high condition. . . . The prime accident factor was disorientation. . . . A contributing factor was the sudden weather condition which obviously unnerved the student pilot. . . . The helmet loss merits flight surgeon comment. It was directly due to an improperly fitting nape strap. The point of proper helmet fitting is emphasized and re-emphasized, time after time, but these incidents continue to occur. It would appear that each helmet fitting would need to be periodically evaluated by the flight surgeon."

Bright Light

UH-1B pilot: ". . . We were picking up the aircraft from the south parking area because the first aircraft we were assigned had been grounded by maintenance. This was the first time that I had flown from this area of the field.

"We started the engine and made ready for takeoff. When the copilot contacted the tower, we were told that we were cleared to hover and would be number three for takeoff.

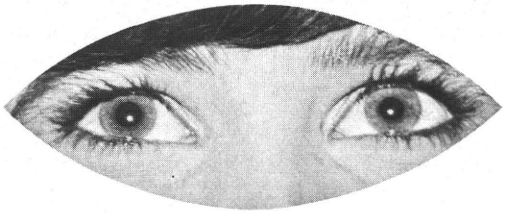
"I picked the aircraft up to a hover and began to move forward. At this time, the tower called and instructed me to put my navigation lights from steady-dim to steady-bright. The copilot did something with the switches that caused the lights to go out. It was very dark, so I turned on the searchlight to regain my ground reference. I moved a short distance and the tower, or someone, called and said, 'Turn off searchlight.' I turned off the light and could not see anything. The copilot said, 'I can't see.' Then I felt the aircraft strike the ground. I attempted to pick it up with collective pitch, but it struck the ground again and rolled on its left side. . . . I called to the copilot to jump and I remained inside to turn off the switches. I then got out through the right cockpit door and the aircraft was burning as I made my exit."

"It was very dark, so I turned on the searchlight . . . I turned the light off and could not see anything. Then I felt the aircraft strike the ground . . ."

Flight surgeon: ". . . After shutting down, both the pilot and copilot got out through the broken window of the right door, jumped to the ground, and moved away under their own power. The only injuries sustained were to the copilot, who grazed his scalp on a remaining fragment on the window pane through which he made his exit, and a slight knee sprain as a result of jumping from the top of the overturned aircraft to the ground. A small fire in the engine was extinguished immediately. . . .

"It was established that the pilot had noted some difficulty when testing the navigation light during preflight, but he failed to tell his copilot who would be operating the light during the flight. . . .

"It was established that the pilot assumed the tower had issued the command to turn the searchlight off, which, when extinguished, resulted in temporary blindness and disorientation. He failed to keep the searchlight burning, once it was on, forgetting that his night visual accommodation would be totally lost and that he would be temporarily blinded by the white light. . . ."



EYES IN THE NIGHT

". . . the light went off as suddenly as it had come on, and I lost all visual contact with the ground"

Blinded

UH-1D pilot: "We responded to a med evac mission . . . I was flying the aircraft when we arrived over the area at about 2340. As I turned downwind, our landing zone was well lighted by two flares that the ground unit had set off.

"I started a circular descending turn into the area. Our rate of descent was normal under the circumstances surrounding the mission. We were on final approach when a searchlight farther up on the perimeter was turned on and struck us directly in the face. Since I could still see well enough to complete the landing, I continued the approach.

"Then the light went off as suddenly as it had come on, and I lost all visual contact with the ground. Knowing that our rate of closure was still high, and that we had not been too high off the ground when I lost visual reference, I applied collective pitch to stop our descent, planning on going around for another approach. The aircraft commander was also pulling pitch. However, we were too close to the ground for the pitch to take effect, and we struck with a hard, but not really severe, impact. We bounched back into the air, and both the aircraft commander and myself were on the controls while we stabilized the aircraft."

The right skid was broken off and a stump tore a hole in the belly of the aircraft. It was flown to a helipad and landed.

Witness: "That particular searchlight on that point of the perimeter is responsive to requests from units manning the east barrier line. We've often used the light to illuminate our part of the barrier, and thought it would be of assistance to the medevac aircraft during landing.

"The terrain in that area is such that a point of trees a few hundred meters north of our position prevents the light from actually coming down into our troop line. It will play on the outer edge of the barrier line, however.

"Since we were still in shadows, we didn't realize the light was blinding the pilot, or we could have cut it off much quicker, or left it off entirely."

Analysis: ". . . No real difficulty was encountered until the searchlight was turned off. Its glare had destroyed the pilot's night vision. Due to the sudden change from bright light to darkness, both pilots experienced loss of visual ground reference.

"Proper corrective action was taken. However, due to the high rate of closure and the proximity of the aircraft to the ground at the time the problem developed, the corrective action was ineffective.

"Had the use of the searchlight been coordinated between the ground unit and the medevac aircraft, the light could have been employed in a manner beneficial to the operation."

due to the sudden change from bright light to darkness, both pilots experienced loss of visual ground reference

Unlighted Strip And Ground Fog

UH-1B aircraft commander: ". . . At approximately 0605, still under cover of darkness, we arrived over a town. While orbiting the town and flying in position number three, I saw that the airfield was not lighted. At the same time, I found I could not see the aircraft in front of us. . . . I called and requested him to turn his navigational lights to steady bright. When the lights were turned on, we saw we were too close to the aircraft. To avoid getting closer, the pilot widened his right turn toward the north and started a steep glide of approximately 1,500 feet per minute.

"My interests were now doubled. I had to keep looking to my right so as not to lose the other helicopter and the field. I also had to monitor the rate of descent.

"At approximately 200 feet, I noticed we were suddenly in the fog or haze, and forward and downward visibility became very poor. The horizon was no longer there, but I could see the navigation lights of the two helicopters that were now on final on my right.

"At this time I noticed that we were at a lower altitude and turned my attention to the instruments to see how we were doing. At that moment, I saw the water coming up at a fast rate and immediately took hold of the controls to lift the helicopter up. I came up on the collective and applied aft cyclic, but to no avail.

"The helicopter hit the water in what seemed to be a level attitude and immediately started to tumble. It came to rest upside down at what I estimate to be 200 meters from shore.

"After climbing out of my side, I went aft to get the rest of the crew out, but the men were on the way before I got there. . . ."

Analysis: "The airstrip was covered by a thin layer of ground fog and it was unlighted. This presented an unnecessary obstacle to the pilots, which could have been corrected by a prior request for lights.

"Weather was a factor in the accident. Visibility near the surface was reduced. The aircraft descended to this altitude far enough away from the shore so that the land mass was lost to the pilot's view and the water and fog blended together. Had the approach been made closer to the airfield, visual references may not have been lost.

"The pilot failed to tell the aircraft commander of his unfamiliarity with the area. He continued to make an approach to a strip he had not located. Had the pilot been willing to communicate his troubles to the other aviator, the accident may have been avoided.

"The aircraft commander allowed the pilot, who was flying from the left seat, to attempt a landing from a right hand entry into an unlighted airstrip under marginal weather conditions. He was aware that the pilot was newly trained and that his proficiency in the aircraft was less than his own.

"Both pilots paid too much attention to the number two aircraft and lost sight of their intended touchdown area. Once they lost sight of the aircraft, they were disoriented.

"No preflight weather briefing was given."

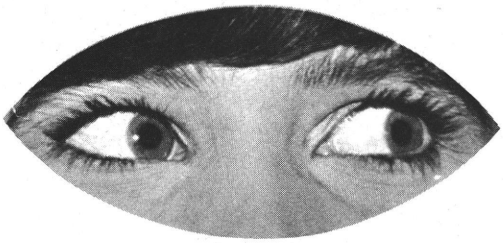
Dark Night And Poor Visibility

UH-1B crewchief: ". . . We took off to try and locate the target area and to check the weather. As we got close to the target area, I didn't know where the target actually was. I remember seeing a river on the right. . . . Seconds later, I saw the trees and felt the impact. The aircraft commander yelled something just as I saw the trees. It happened so fast I don't believe there was time to avoid the trees. It was instantaneous.

"The weather was bad — misty and poor visibility. We were all looking out the window because of our concern about the weather."

Takeoff time was approximately 0200. The helicopter crashed into a mountain, killing the pilot and gunner, and seriously injuring the aircraft commander and crewchief.

Analysis: "It is the opinion of the board that the aircraft commander and pilot, in their desire to complete the mission, proceeded into an area of



EYES IN THE NIGHT

poor weather conditions at an altitude below the highest terrain features. The aircraft had to remain below the clouds to maintain visual contact with the ground and complete the mission. Both aviators became disoriented due to the dark night and poor weather and the pilot flew directly into the hillside without ever realizing that he was off course."

Flight surgeon: "Immediately after the crash, the crewchief crawled either through the wreckage or up out of the left cargo door and forward to the nose of the aircraft. . . . On awakening the next morning, he found the pilot's helmet bag and canteen near him. The canteen was empty. The helmet bag contained a candy bar and a compass.

"The crewchief then crawled on around the aircraft and found the aircraft commander, who, although he was conscious, was confused. They crawled to the edge of the clearing created by the clipped trees so they could be sighted by search aircraft. There were maps scattered about the area. They collected what maps they could, made a panel from them, and placed it in the clearing. This did not help because they did not have the panel far enough into the clearing. The crew of the search aircraft first sighted a tree which had been cut down, and, on the second pass over the area, spotted the aircraft commander waving a piece of paper. They saw no panel. . . .

"The crewchief had three cigarettes and some matches. He smoked the cigarettes during the day. He did not build a fire because he recalled that he had smelled JP-4 after the accident and was afraid he might set the aircraft afire.

"After staying in the area 30 hours, they decided to start moving downhill in search of water. They shared the chocolate bar, then started. The aircraft commander went about 3 meters and the crewchief went about 250 meters before they stopped because of exhaustion and pain.

"When they were rescued, the aircraft commander was carried uphill on a stretcher to the LZ which had been cleared above the accident site. The crewchief was evacuated by a CH-47. . . .

"There were full canteens, smoke grenades, and first-aid kits in the aircraft, but it was physically impossible for the survivors to return up the 45° incline to the aircraft once they had reached the clearing. The 45° incline also explained why they could move downhill so readily.

"They had no survival kit, no survival radio, no flares, no dye marker, or signal mirror on board the aircraft.

"When asked what one item he would have asked for if he could have received it during the survival situation, the crewchief replied that he would have asked for water.

"They were without weapons during their 34-hour survival situation. Their weapons, like their other gear, were in the aircraft."

Windshield Ice

An OV-1B pilot recently had a narrow escape from a night weather phenomenon which could prove equally hazardous during daylight. He started his takeoff from a controlled airfield at night and did not see a C-47 on the runway until he was within 100 feet of it. He pulled the Mohawk off the runway and the antenna on its tail hit the left wing of the C-47. Fortunately, there was no damage to either aircraft. The message reporting this near accident stated: "Weather was a factor. Ice was building up on the windshield faster than the defroster could remove it."

Tired Eyes

A combination of fatigue, long hours on the job, and a desire to get home caused the pilot to do a below average preflight . . .

An O-1A crashed on takeoff at 2118. The aircraft was destroyed, the pilot killed, and the passenger sustained serious injuries.

When the board investigated the wreckage, they found the fuel selector switch on the auxiliary tank. Inspection of the carburetor revealed only a few drops of fuel on the unmetered side and there was only a minimum amount of fuel in the auxiliary tank. The aircraft was not refueled before takeoff and had flown a total of 03:20 since last refueling.

Although the pilot had completed an extensive training program in the O-1A in the 45-day period preceding the accident, and was considered to have been satisfactorily current in the aircraft, 930 of his 1,269 flying hours were in CV-2s. The CV-2 fuel selector handle selects tanks in a manner directly opposite to the O-1A.

Cause factors:

"Engine failure, most probably due to fuel starvation.

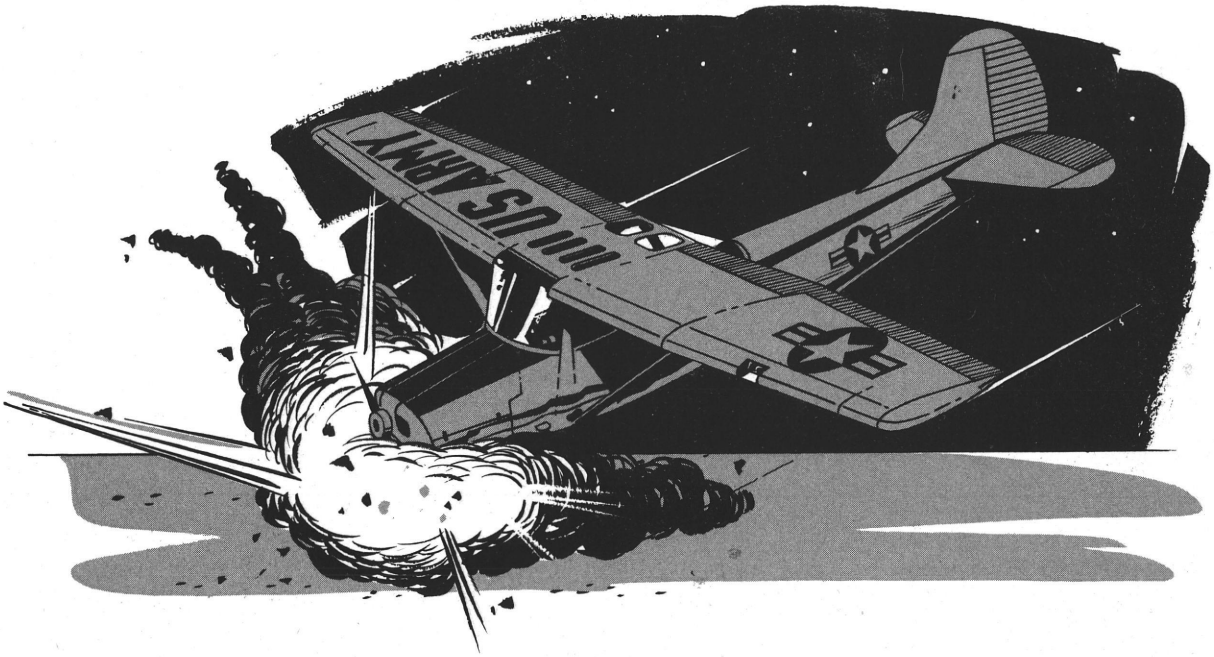
"Failure of refueling crew to service the aircraft, even though the aircraft was on the ground over 1 hour at an airfield and for approximately 3½ hours at a manned strip.

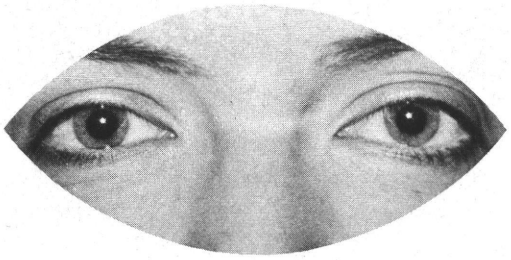
"The pilot was fatigued, having worked 16 consecutive hours.

"Selection of the auxiliary fuel tank for takeoff when there was insufficient fuel in that tank to permit takeoff.

"Failure of pilot to follow established forced landing procedure."

Flight surgeon: "A combination of fatigue, long hours on the job, and an understandable desire to get home may have caused him to do a below average preflight check of the aircraft. It is not known if the fuel filler caps were actually removed and a light directed into the tanks to see if they were full. It is not known if the flashlight found in the cockpit after the accident was used to look at the fuel gauge to see if the tanks were full."





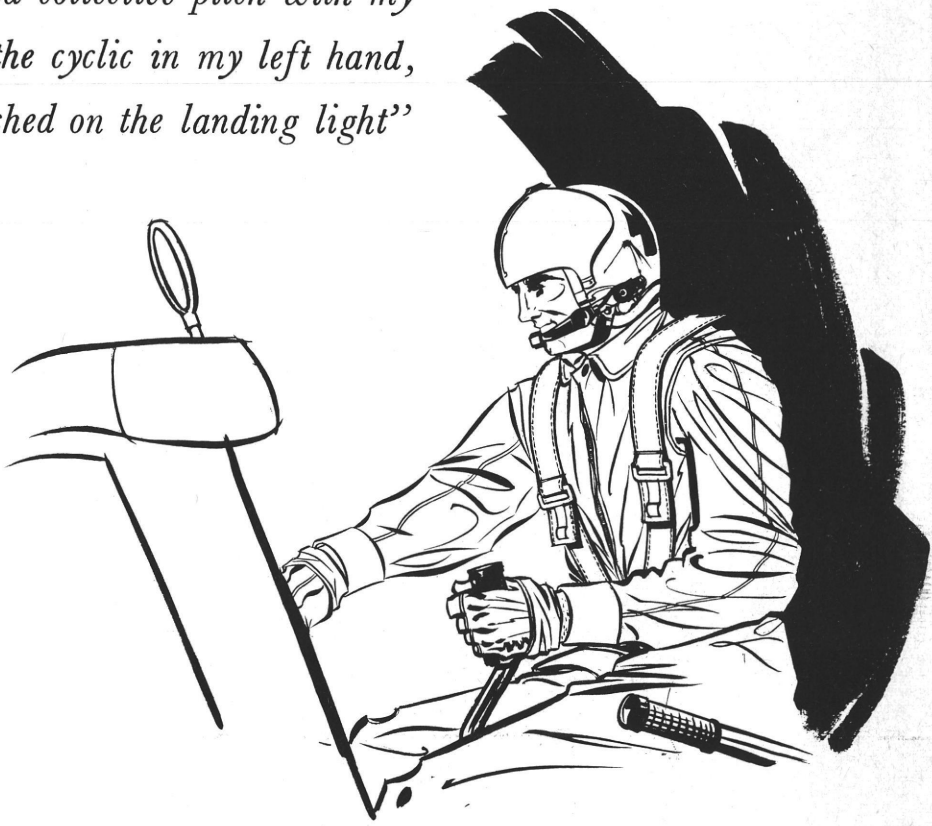
EYES IN THE NIGHT

Attention vs Fatigue

OH-13 pilot: "I left for a night cross-country flight at 1825. . . . My total time for this flight was 1 hour and 30 minutes. After refueling, I departed north at 2010. . . . My altitude proceeding north was 6,500, and after turning around I dropped to 5,500, then to 4,500 feet. I calculated that my ground speed was only half of the ground speed I had maintained proceeding north. I proceeded straight for the airport at 4,500 feet and 60 knots, realizing I had 300 feet clearance from the ground. . . .

"I could see the airport (beacon light) and city

". . . I maintained collective pitch with my left knee, took the cyclic in my left hand, and leaning forward, switched on the landing light"



lights in the background. . . . I twice switched on my landing light to see if there was a reflection from the ground. . . . At one time I noted there were weeds or rushes, but at neither time did I gain a sense of being closer to the ground. There was some reflection from the moon, which was partially obscured by high thin clouds (overcast). However, my visibility didn't seem hampered. I can't recall whether I checked my altimeter after leveling off at 4,500 feet. . . .

"I had no mental warning or apprehension before contact with the ground. Immediately prior to contact, I maintained collective pitch with my left knee, took the cyclic in my left hand, and leaning forward, switched on the landing light. In the next instant, I switched the landing light off and made contact with the ground simultaneously. The vision from the landing light appeared as a small spot directly under the fuselage and I remember some confusion.

"Immediately after contact, the nose came up and the plexiglass split and moved away up to the right side. I was conscious of being held with the shoulder harness, but felt no violent restriction of forward movement. I also seemed to sense the aircraft roll to the right and skid to a stop. I released my seat belt and exited the aircraft. . . ."

Flight surgeon: "The physiological factor of fatigue was present. The pilot was aware of bodily tiredness during the few minutes prior to the accident. He had attended three classes and 3 hours of study in school and had been flying 2.7 hours when the accident occurred. This factor contributed to a preoccupation with planning what he would do after landing so that he could go home as soon as possible.

"This preoccupation let him lose altitude without being consciously aware of it. However, he did turn on the landing light on three occasions prior to the accident in an attempt to see the ground, indicating a subconscious awareness that there was a problem developing. He did not recognize the significance of being able to identify small objects on the ground until after the accident. This state of awareness of physical surroundings, but not comprehending their significance, is typical of the temporary loss of higher integrated functions caused by fatigue."

Conclusions:

"The aviator did not follow his filed flight plan.

"He failed to maintain proper altitude.

"It is the opinion of the board that the aviator became overcomplacent, when he had the airport beacon in sight. He diverted his thoughts from flying and inadvertently flew into the ground."

Concentration

OH-23C pilot: "After a 0022 runup, I maneuvered downwind to a takeoff position, using the entire takeoff area. . . . I brought my rpm up to 3100 and began my takeoff from a 2-3 foot hover. There were wires at the end of the field 10-12 feet high. I was aware of the wires and made certain that I had sufficient altitude to clear them. After clearing the wires, I noticed a rapid loss of rpm and the helicopter began to settle rapidly into the open hillside east and north of the wires. I attempted to regain the lost rpm that had dropped to below 2700, but was unable to do so prior to impact.

"The helicopter struck the ground with the skids level, but the right skid hit the sloping ground, causing the aircraft to tilt approximately 20° to the left. When the left skid hit, it caused the main rotor blade to warp downward and strike the tail boom, shearing about 4 feet of it. . . ."

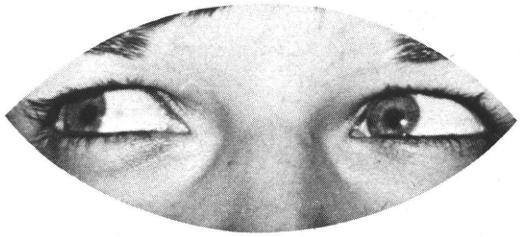
Analysis: "The aviator was concentrating on clearing the low wires which bordered the landing site on the east, and his attention was directed outside the cockpit for too long a period. His rpm had decayed beyond recovery before he became aware of it."

Two Pairs Are Better Than One

. . . *when there is communication*

OV-1B pilot: "At 2140, I cranked the engines and taxied to the approach end of runway 13. I called the tower for taxi-takeoff instructions and was given 13 and the wind from 140 at 6 knots. I went through the runup and called the tower ready for takeoff. I was cleared into position and for

EYES IN THE NIGHT



takeoff. I pulled into position, added power to 40 pounds of torque, then added full power.

"I glanced down at the airspeed two or three times, and as it reached 100 knots, I started to rotate. At the same time, I looked back down the runway and saw the barrel. It looked like a 30-gallon barrel lying on its side. . . . I pushed right aileron and pulled back harder on the stick to get over the barrel. Right after the barrel passed the left side, I heard, more than felt, a thump. I immediately retracted the gear.

"I called the tower and reported that I had hit what looked like a barrel on the runway. I noticed that my left gear was not indicating up. The tower asked me to make a low pass to check the gear. They then had me make another pass, but they didn't notice anything out of the ordinary.

"I could see back under the left wing, and the jack pad door was loose and flopping in the wind. About 6 inches of the gear could be seen below the wing. . . .

"As I was climbing to 8,000 feet, I decided to see if the left gear would come down and lock. I cycled the gear through two or three times and it locked each time. It still wouldn't lock up. I noticed no unusual control pressure, vibrations, or that the aircraft acted any different than normal.

"When I reached 8,000 feet, the indicated airspeed was 150 knots at cruise power. It should have been between 170 and 180 knots. This was the first indication of anything abnormal, except for the gear not indicating up. . . .

"I called the tower for landing instructions . . . landed without incident, and stopped on the active. . . . After I stopped, the large dent in the leading edge of the left horizontal stabilizer was found. The shrink rod and scissors were also broken. The lower front half of the lower gear door was missing."

Technical equipment operator: ". . . We armed the seats, and, as we began to roll, I noticed the plug to my flight helmet's headset was not plugged in. About halfway down the runway, I fumbled with the cord, trying to find the plug so I could plug into the communications set. After I found the cord was wrapped around my left earphone, I left it alone, planning to untangle it after we were airborne.

"It was at this time I saw a large object off to the left approximately 50 meters ahead of us. I figured the pilot was aware of the object and could only communicate with him by shouting or by touching him since my headset was disconnected.

"When I first saw the object, I figured it was a cardboard box. But as it passed out of my line of sight, I thought it could have possibly been a 20-30 gallon barrel lying on its side. That's when I heard a dull thud and I knew the left main gear had struck the object. I didn't yell or touch the pilot for fear he would look over at me to see what I was looking at.

"We were off the ground shortly after striking the object and I removed my helmet, unwrapped the headset cord and plugged it in. . . ."

The OV-1 hit a 55-gallon drum that had apparently been blown onto the runway by a passing helicopter.

The lesson to be learned from this accident is that two pairs of eyes are better, *but only when their owners can readily communicate.* Aside from the seeing aspect, the reader may wonder what the technical equipment operator would have done if the pilot had found it necessary to call over the intercom for him to eject. *Communication checks should be made on the ramp before the airplane begins to taxi.*

the following was adapted from a Navy pamphlet, NAVAER 00-80T-77 entitled

Night Vision for Airmen

YOU WOULDN'T be in aviation if you didn't have good eyes. But *having* good eyes and *seeing well* are as different as *having* a fine gun and *shooting well*. This is doubly true at night.

Most people do not know the facts about night seeing. Many people don't even know that there is anything to learn about it.

But from the moment you climb into a plane until the moment you climb out of it you depend on seeing. The more you see and the faster you see it, the healthier you'll remain.

You will never see as well at night as a tomcat, but you can learn to do a better job of seeing at night. Aside from the obvious fact that you can't see as much in darkness as in daylight, there are three reasons it takes thought and training and practice to get the most out of your night eyes.

1. Your mind and your eyes are a team. To see well, you must concentrate on seeing and put effort into it. If you don't, you don't see.
2. Your eyes are so built that you have to learn to use them in a different way at night.
3. Your eyes tell you so little and familiar things look so different at night that it takes practice to recognize the things your eyes see.

MIND AND EYES ARE A TEAM

That's the first thing to remember. If your eyes are on one thing and your mind is on another, you don't notice what your eyes see. Only when both your mind and your eyes are on *seeing,* only when they team up, do you see well. This teamwork is absolutely essential. If you are figuring out a way to make a million silver dollars while your eyes are busy scanning the sky, you won't see anything. But if suddenly a flare lights up the sky and catches your attention, you will forget about the million dollars. Even then, with your attention on seeing, only a few things can enter the *mind's eye* at one time. What does this add up to? It means that you must know what you are looking for and you must keep your *attention* on seeing.

NIGHT EYES

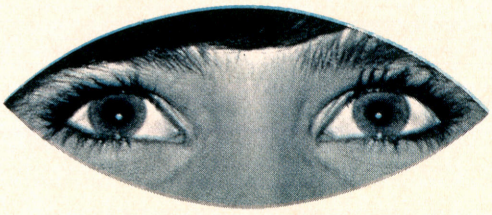
The light-sensitive nerve ending at the back of your eyes are of two kinds—cones and rods. The cones, millions of them, are concentrated in the center or bulls-eye area. The rods, more millions of them, are concentrated in a ring or circle around the cones.

Broadly speaking, you see with the cones in daylight and with the rods at night. There is no sudden boundary. In daylight you depend on the cones to do most of your seeing. In full moonlight, the cones and rods divide the work. In starlight, the cones quit work and the rods alone do all the seeing. As the cones lose their efficiency in dim light, the rods take over. They can detect light at 1/5000 of the intensity at which the cones go blind.

NIGHT BLIND IS QUITE BLIND

As everyone knows, when you go from a brightly lighted room into the dark you can't see anything at all until your eyes adjust to the dim light. First the pupils of your eyes open up to let in all the light there is. Then the cones begin to adjust to darkness. After 6 or 7 minutes your eyes have become 100 times more sensitive and you can see a little bit. The night seeing rods adjust much more slowly, but when they have become adapted are 100,000 times more sensitive than they are in sunlight, and you can see a lot if you know how. This takes time – at least 30 minutes for the rods to adjust to the darkness.

On the other hand, when you go from darkness to bright light your eyes adapt after only a minute or two of dazzle. They adjust so fast that 10 seconds of bright light destroys much of your ability to see in the dark and you have to start all over again to get your night eyes back.



EYES IN THE NIGHT

Since you can't see in the dark unless your eyes are adapted, since it takes 30 minutes to adapt your eyes and only seconds to lose the adaptation, the first principle of night seeing is: *Adapt your eyes and keep them adapted.*

ADAPTATION

The obvious way to adapt your eyes is to sit in the dark for 30 minutes before every night flight. The obvious way is also dull.

Science has discovered, however, that while you can see with the cones in red light, the rods react to red light much as they do to darkness. This means that if you stay in a red-lighted room or wear red adaptation goggles in ordinary light, the rods will adapt while you use the cones to read or play cards. After a half hour in this synthetic night, your eyes will be ready for the real thing.

After your eyes are adapted, continue to avoid all but red light. Even the flare of a match or a brief flash from a flashlight will seriously interfere with your dark adaptation.

Use as little light as possible in your aircraft. Practice blindfold drills. Pilots should train themselves to do all manual operations without light.

You can't read instruments or charts without light, but you can use as little as possible. Always study your charts thoroughly before a flight so that you won't have to pore over them in the air. Staring at instruments tires the eyes and may reduce seeing efficiency as much as 50 percent. Whether you are flying with white-lighted or red-lighted instruments, look at them as briefly as possible and keep all lights turned low.

If there are times when you must use white light in a pinch, preserve the adaptation in one eye by shutting it. When you open it again in darkness you will be able to see with it while the other eye is re-adapting.

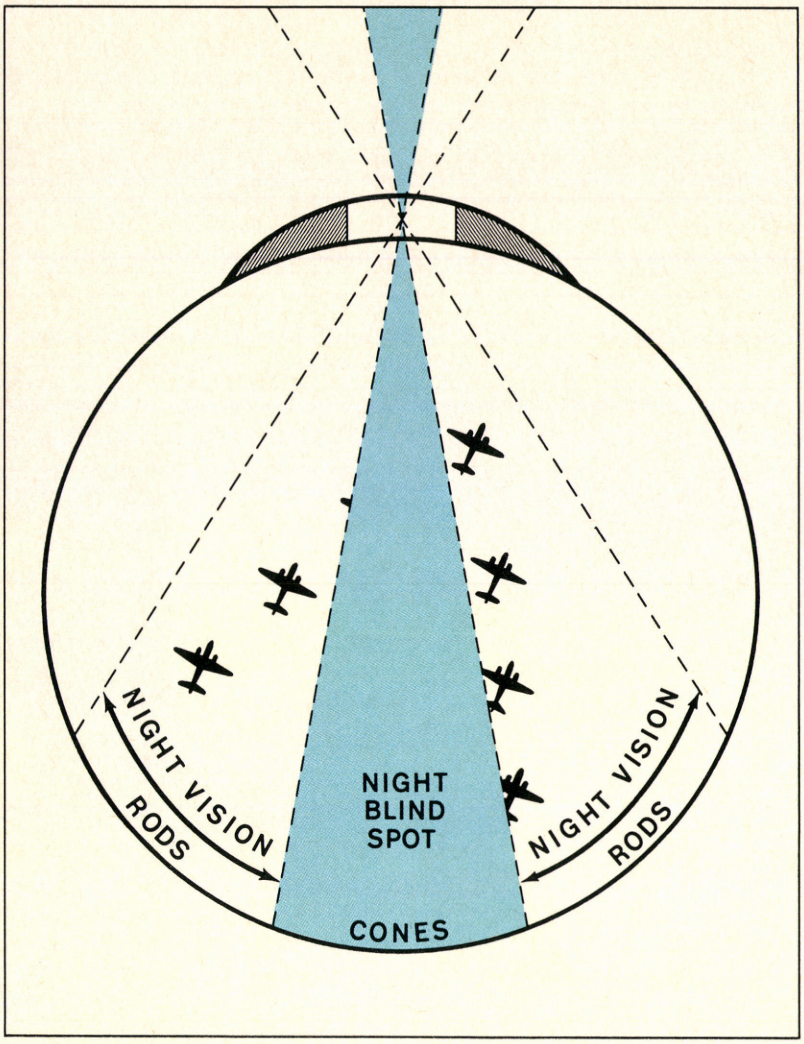
After you have adapted your eyes and learned to keep them adapted, your night seeing problems have just begun.

When something catches your attention out of the corner of your eye, ordinarily you turn your eyes toward the object to get a better look. This is the right way to look in daylight, when the point of sharpest vision is at the center of the eye. It's all wrong at night. When you look directly at an object you are trying to see through your night blind spot in the center of your eyes. Night vision is impossible at the center of the eye. To take advantage of the rods at night, always look slightly *away* from the object you want to see!

When you catch an object out of the corner of your eyes, try to hold your eyes just a bit off center and you will have the object at the point of maximum sensitivity. If your eyes move irresistibly toward the object, let them swing through so that you can pick it up again at the other side of your eyes.

If you see an aircraft and then lose it, don't try to bore through the darkness to find it again. Instead of staring at the spot where you lost it, move your eyes around the spot in a circle, focusing always slightly away from that point. If it's there you will pick it up again by looking to one side of it or over or under it. It takes practice but it works.

Learn to move your eyes frequently in dim light. The rods tire quickly and are at their best only for short periods. As you search, don't sweep the sky at random; *scan* by searching a small area carefully, then jumping your eyes to the next area. You can't see anything while your eyes are in motion, but they are sensitive just after moving. Move them in short jumps so that you see all parts of the search area in succession. Do it slower than you would in daylight. Blink your eyes if an image becomes blurred.



the light sensitive nerve endings at the back of your eyes are of two kinds, cones and rods . . . broadly speaking, you see with the cones in daylight and with the rods at night . . .

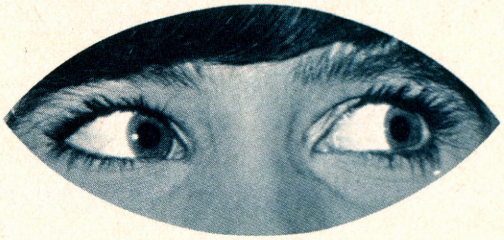
Since this kind of seeing is not, by any stretch of the imagination, second nature, you will have to practice it until it becomes automatic. Remember that every bit of training and practice you give to night seeing will repay you in better seeing.

In daylight you see the color and detail of an object, as well as its size and the contrast it makes against its background. From a lifetime of experience and practice, you interpret what your eyes pick out and thus identify the things you see. You use your night eyes in the same way, *except that your night eyes see no color and little detail.* Therefore, you depend entirely on the size of an object and the contrast between the object and its background to see it. This means that familiar things look quite different from the way they look in daylight. Since you have not had as much practice in night seeing as in day seeing, they are also harder to identify.

The eyes of a pilot experienced in day flying may be no better than the eyes of a passenger on his first hop, yet the pilot *sees* more because he knows what to look for and how to interpret what his eyes tell him. In the same way, the man with night flying experience can see more than men with no night experience. He not only knows *how* to look, he knows what planes in the air and objects on the ground look like from the air at night.

Your eyes furnish you with so little information at night that you must be able to interpret the smallest clues in order to see the objects your eyes pick out.

Night conditions are so varied it is impossible to go into detail on night recognition. The main thing



EYES IN THE NIGHT

is for you to use every night flight to learn more about night seeing.

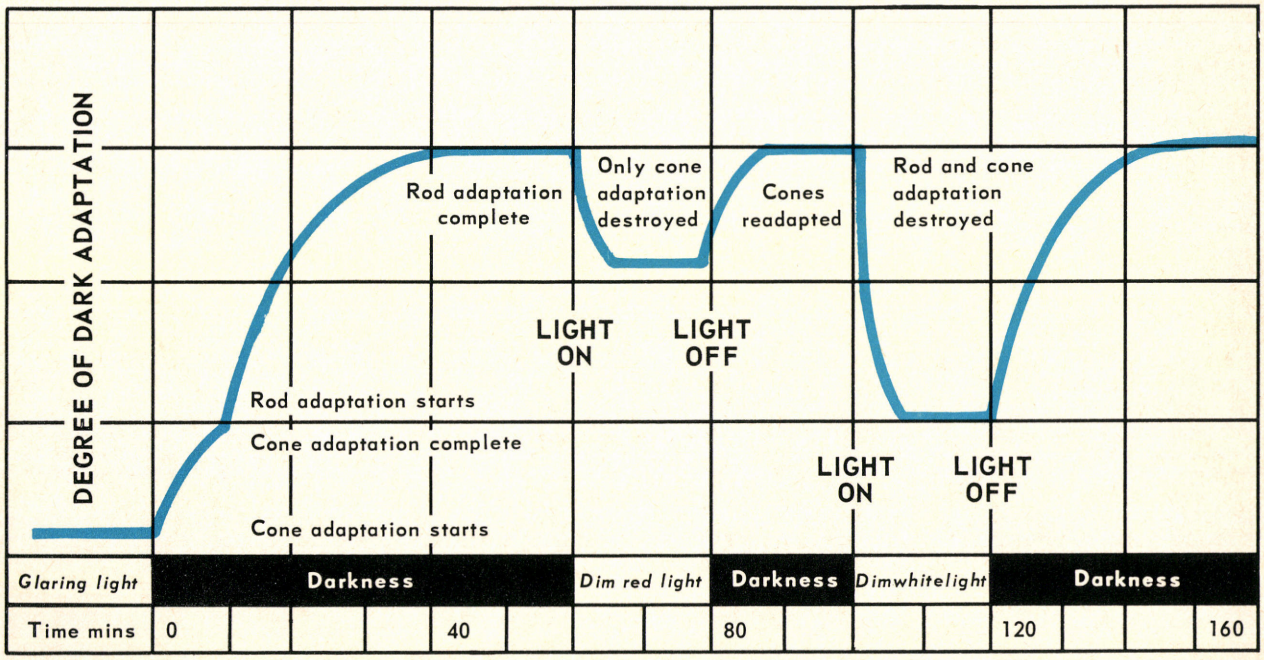
It is hard to estimate distances at night. Nevertheless, if you search methodically, you can develop a scanning routine for night visual searches. The idea is to avoid the extremes of blank staring or sweeping the sky. Divide the lookout sectors with your crewmembers so that, with each man responsible for scanning a limited field, all visible areas are covered.

The average aircraft is not large enough to be seen much beyond 600 feet in clear starlight. It is visible within that limit only if you are above or below it so that you have a chance to see it in plan view. From ahead or astern it presents too small an area. That's why you must know the plan of any you are likely to encounter.

VERTIGO

A common experience in night flying is vertigo, dizziness, spatial disorientation, or whatever you want to call it. It is sometimes worst just after a takeoff from a lighted runway. The sharp change from dazzle to utter darkness brings on an eerie feeling of everything going cockeyed. To aid in overcoming vertigo you must learn to trust your instruments completely. Failure to trust the instruments will only lead you astray and exaggerate the feeling of uncertainty growing out of conflicting sensations.

EFFECT OF RED & WHITE LIGHT ON DARK ADAPTATION



MOVING AND STATIONARY LIGHTS

There are a number of other things you must guard against in night flying. Often, when you are in formation, you can't see anything of the aircraft ahead of you except its tail light. It is hard to judge distance from a single point of light in a night sky. The brightness of the light is the only clue to its distance, and atmospheric conditions can alter that brightness. It is also sometimes difficult to distinguish aircraft lights from fixed lights, either stars or ground lights.

Even more important, it is known that if you stare too long at a single fixed point of light against a dark background, it may appear to wander. This apparent wandering of a stationary light is known as *autokinetic movement*. It will help greatly if you keep your eyes moving. Fix on a light long enough to place it, but don't stare. If you can see stars or landmarks, shift your focus from time to time. When you can see neither stars nor landmarks, shift your eyes from the tail light ahead to your instruments or some cockpit feature and back again. These eye movements will help to keep your eyes sharp and to maintain your orientation.

CLEAR VIEW

It is even more important at night than in daylight to keep your windshield and windows clean and unscratched. Tests prove that a thin film of oil or dirt on a windshield will reduce visibility by more than 50 percent. Haze, fog, dirt, scratches — anything which absorbs or scatters light — reduce contrasts and makes seeing harder. You can't do much about haze or fog, but you can keep the plexiglass spotlessly clean. Make sure that there is no glare or reflection from the instrument panel in your windshield.

OXYGEN

At night, vision is the first thing affected by a lack of oxygen. If your job in the air calls for sharpness of night vision and if oxygen is available, use it from 5,000 feet up.

Your night seeing margin is so small that the slightest lack of oxygen affects your seeing. At altitudes over 5,000 feet, instrument markings seem dimmer. You begin to turn up the panel lights in order to see better. The more you turn up the lights, the less you can see outside. You impair your night adaptation, just as lack of oxygen is making your eyes less efficient.

At 12,000 feet, without oxygen, you can't see nearly as well as on the ground. At 16,000 feet, your sight is seriously impaired. Even though you don't realize how much it is affected, you can't see as far and your vision becomes fuzzy around the edges.

If you wait until you reach 16,000 feet before using oxygen, it will take several minutes before your eyes reach full efficiency again. Don't wait until you reach 16,000 feet. If you need your night eyes, use oxygen from 5,000 feet up.

VITAMINS

If you are a victim of a vitamin shortage it will impair your night vision. All publicity to the contrary, however, neither extra doses of vitamins nor a carload of carrots will improve your seeing if you are eating a normal amount of the right foods — fresh fruits, vegetables, butter, milk, cheese, eggs, liver, fish. If you are where fresh foods are short, or, if you think you aren't getting enough vitamins, ask your flight surgeon for vitamin pills.

SMOKING AND DRINKING

Both heavy smoking and heavy drinking may reduce your seeing ability. Excessive smoking may affect your ability to distinguish the color of faint lights. Alcohol is bad, not because teetotalers and prohibitionists think so but because it slows the absorption of oxygen through the tissues of the lungs. A hangover may double or triple the amount of light you need to see something.

DRUGS

The vast majority of drugs are harmful in the seeing department. Stay away from them, except on the advice of your flight surgeon.

FATIGUE

Fatigue impairs vision — particularly night vision. It also makes it harder to keep your mind on your job, slows coordination and results in poor judgment. If you are overtired you may get careless and satisfied with half-efficiency. If you do have to keep going when you are bushed, remember the dangers of fatigue. And when you can, get sleep.

For tired eyes, incidentally, the best remedy is also the obvious one — sleep. If there is anything wrong with your eyes that sleep won't cure, see your flight surgeon.

COMFORT

Comfort, as much as is possible, is also a necessity for good seeing. If you are half-frozen, cramped, or if your gear is bothersome, you don't see as much because you can't concentrate as well. You aren't flying a Hollywood divan, so the extremes of comfort aren't always possible. But avoid the discomfort you can by taking proper care of your gear and using it as it is intended to be used.

HELICOPTERS
...THEIR SPEED LIMITATIONS

AS HE ROLLED the Huey into the run, he heard a call that the ground fire was heavy. He steepened his dive more than usual and pulled out all stops. The target was not visible but he had an aiming point in sight. He could hear several small arms rounds plink the aircraft as his rockets were away.

Now to get out of there. As he commenced the pullout, the Huey began to vibrate and shudder. The nose seemed to come up rather easily. Then, as it rose more rapidly, he eased in forward cyclic to stop it. The Huey pitched up and rolled left uncontrollably. He saw he was losing rpm and the vibration was becoming more severe as he cautiously dropped the collective. As the airspeed decreased, so did the vibration. At tree-top level, skillful and cautious control movements effected a recovery. Badly shaken, he headed out for home base trying to organize his thoughts as to just what had occurred and the possible cause.

The speed limitations on conventional helicopters constitute a barrier that has been pushed back and only recently penetrated . . .

H. E. Roland, Jr.
Institute of Aerospace Safety
University of Southern California

Speed limitations on conventional helicopters constitute a barrier that has been pushed back and only recently penetrated. An understanding of the cause and effect of these limitations, which are inherent to the nature of the lift and forward thrust of the helicopter, is essential to the development of a safe, competent pilot.

These speed limitations consist of aerodynamic phenomena occurring on both the retreating and advancing blades. To appreciate the factors which are causing them, it would be well to first look at the flow pattern over the rotor disc in forward flight. Figure 1 illustrates the velocity variation over the disc with forward velocity.

The velocity of the blades due to rotation is depicted as the longer of the two arrows or the larger velocity. This must be true of all helicopters in which the rotor disc is providing thrust. Added to the rotational velocity on the advancing blade side of the rotor disc is the velocity of forward flight. On the retreating blade side of the disc, this velocity is subtracted from the velocity of rotation, since this velocity is in the reverse direction on this side of the disc.

Because the lift of a wing is proportional to its velocity, it is apparent that one side of the rotor disc will have greater lift than the other side if the only influences on lift are as shown in figure 1. However, lift is not only proportional to the velocity of the wing but also to the angle of attack. This is the angle at which the relative wind is striking the chordwise axis of the wing. If there were some way to vary angle of attack to compensate for the velocity variation between the retreating and advancing blade side of the rotor disc, the thrust of the two sides could be made equal.

The flapping of the helicopter blades is the primary method which is presently used to accomplish this effect. The rigid rotor does the same job by continuously feathering the blades between the advancing and retreating blade sides.

It is interesting to note that if the blades are free to flap, no control is necessary to assure that precisely the correct amount of angle of attack change is accomplished. Suspension of the weight of the helicopter from the hub of the rotor causes forces to be generated which create the correct amount of flap to equalize the lift with angle of attack changes.

In the center of the rotor disc are three areas which are not contributing to the thrust of the rotor. In general these areas are caused by the inflow which is down through the rotor and the fact that near the hub the rotational component of

velocity is not great. The small circular area radiating from the center of the hub is an area of reverse flow or a region in which the forward velocity of the helicopter is greater than the velocity of rotation. The airfoil and the components of the airflow in this region are shown in figure 2.

Immediately outside the reverse flow region the rotational velocity is greater than that of forward flight. However, the relative wind is still approaching the airfoil from the upper side. This area is stalled in a negative sense due to the high angle at which the relative wind is approaching the airfoil. The airflow components are shown in figure 3.

Outside the negative stall region is an area of negative lift. In this region the additional velocity due to the greater radius and the additional flapping action have further decreased the angle of attack. The flow is shown in figure 4.

The next and major region of the retreating blade side of the rotor disc is the region which produces positive thrust. This region must produce sufficient thrust to balance the entire advancing blade side of the disc even though the advancing blade is operating at a higher velocity. The retreating blade side of the disc is able to do this by operating at a higher angle of attack. Figure 5 illustrates the flow in this region.

At the very edge of the rotor disc on the retreating blade side is found a region which is being stalled in a positive sense. At this extreme radius, the action of the flapping is sufficiently great to cause an extremely high angle of attack. Figure 6 illustrates this region.

Consider then what will occur as the forward velocity of the helicopter increases. The disparity in lift between the two sides of the rotor disc becomes greater due to the velocity differential. As this occurs, flapping action of the rotor blades must become greater to equalize the lift, and this in turn will cause an increase in the retreating blade stall area. It will also cause an increase in the central areas of the rotor disc which are not contributing to positive thrust. The increase in blade stall area may continue until thrust on the retreating blade side is no longer capable of equaling thrust of the advancing blade side of the disc. At this point, control will be lost and pitchup will occur.

The reason for pitchup may be developed from an understanding of the principle of gyroscopic precession. The rotor is a large gyroscope. Therefore, forces applied to the rotor do not result in deflections at the point of application but at a point

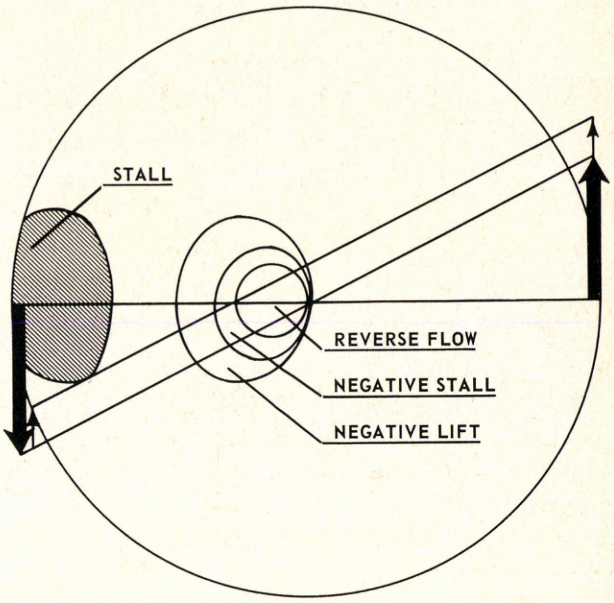


FIGURE 1

90° displaced in the direction of rotation. Figures 7 and 8 illustrate this effect.

At the time of loss of control due to retreating blade stall, there is a disparity in thrust between the retreating and advancing sides of the rotor. This can be thought of as a net force down on the retreating blade side and up on the advancing blade side of the disc. Due to precession, this will result in pitchup of the rotor. Figure 8 depicts the situation in question.

Now that the cause of the pitchup is understood, how can the onset of the situation be recognized and corrected? The stall of a helicopter blade, as any wing, is accompanied by buffet. So the onset of retreating blade stall problems will be accompanied by vibration or roughness. It will always occur at high speeds. Therefore, the combination of high forward flight speeds and roughness signals the onset of retreating blade stall. The tendency of the nose of the helicopter to come up is an indication that the critical stage of this phenomenon has been reached.

Since the situation is caused by high angle of attack on the retreating blade side, any flight condition which causes high angle of attack will increase the possibility of retreating blade stall problem. The items which cause retreating blade stall are:

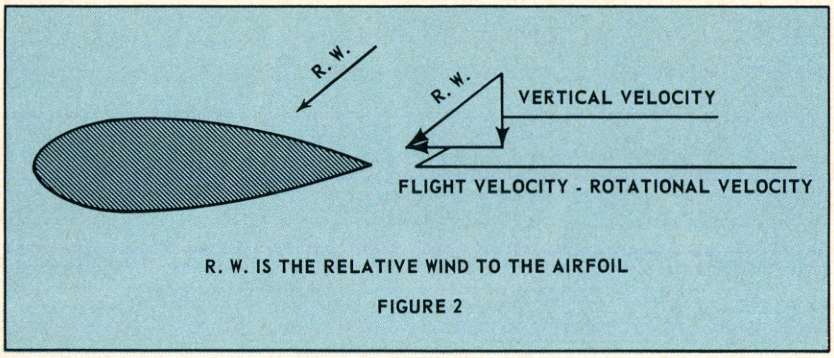


FIGURE 2

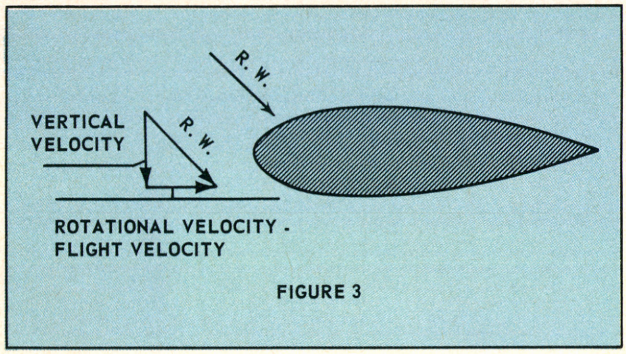


FIGURE 3

An understanding of the cause and effect of these limitations is essential to the development of a safe, competent pilot . . .

High speed
High gross weight
High density altitude
Maneuvering flight
Low rotor rpm (accompanied by up collective)

Gusts or abrupt control movements may also bring on critical increases in the stalled region.

Recovery techniques will then involve action which will decrease the angle of attack. Down collective, if the altitude or flight condition will permit, will give immediate relief from critical retreating blade stall problems. Increasing rotor rpm which will permit decreased collective would be an indirect corrective action. Reducing g loadings which may be on the aircraft would also be of assistance. Since high speeds are a primary cause, reduction in forward velocity would be a permanent cure. Remember, however, that reduction in velocity takes some seconds and loss of control must be corrected immediately.

If the retreating blade stall problem is allowed to progress to the point where pitchup begins to occur, care must be taken not to apply forward cyclic. Forward cyclic will increase the angle of attack on the retreating blade side of the disc and further aggravate the problem.

Thus, stall of an area of the retreating blade side of the rotor disc provides a positive limit on the forward velocity of a helicopter which is providing thrust equal to weight through the rotor. Approximately 200 knots seems to be the limit with our present rotor systems. If the rotor is unloaded as in the compound helicopter and the weight of the helicopter transferred to a fixed wing, the stall of significant areas of the retreating blade does not occur until higher speeds and then is not of great importance.

Advancing Blade Compressibility

Another limit on forward speed of the conventional helicopter is occurrence of a compressibility phenomenon on the advancing blade side of the rotor disc. This phenomenon is labeled as a compressibility problem because, due to the high speed of the flow, the air undergoes a certain amount of compression. It is this compression which causes all the trouble.

At low speeds, airflow is considered incompressible. This is not precisely true. It is so very nearly incompressible that pressures in the flow may be predicted with satisfactory accuracy by considering it so. As the speed of flow reaches and exceeds the speed of sound, a rather sudden increase in amount of air compression causes problems in development of lift with the rotating wing.

To more fully understand what is occurring, it

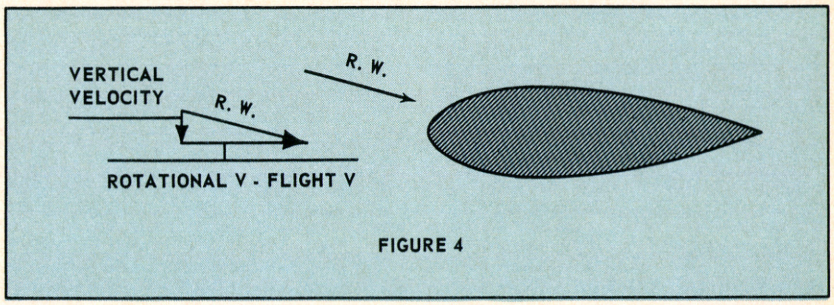


FIGURE 4

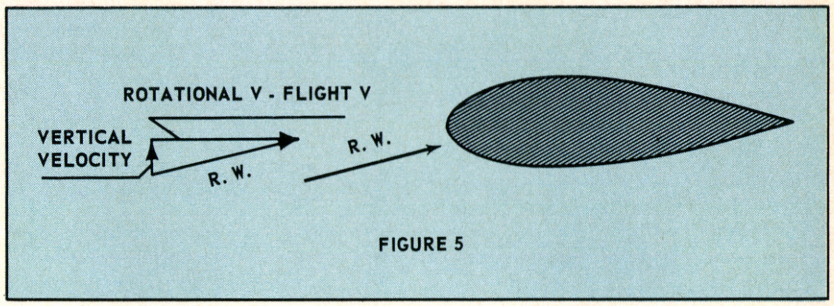


FIGURE 5

would be well to examine the mechanism by which nature causes the flow of air around an airfoil to generate lift. Figure 9 illustrates the flow around symmetrical airfoil at an angle of attack.

As the air flows over the top of the airfoil depicted in figure 9, it must flow faster than over the bottom, as distance over the top is greater than that over the bottom. This increase in velocity results in a decrease in pressure within the flow. This principle is used in the atomizer spray, a device which shoots a high velocity jet of air over a small tube which is immersed in a liquid reservoir. The low pressure created by the high velocity jet sucks up the liquid and it is atomized in the high velocity jet of air which caused it to rise up the tube.

Difference in pressure between the top and bottom of the airfoil causes a net upward force to be generated. This force is labeled lift in the general case of the fixed wing. Examining figure 9, it can be seen that the greater the angle at which the airfoil is inclined to the flow, the greater the velocity and thus the pressure differential, and so the greater the lift. This angle is called the angle of attack and it has been said previously that lift is proportional to angle of attack. However, if the angle of attack is too large, the flow cannot adhere to the upper surface and it separates from that surface in a turbulent, irregular manner. This causes an abrupt decrease in the amount of lift generated by the wing as it suddenly increases the drag.

Figure 9 also shows a small amount of separation at moderate angles of attack. This small amount of separation is always present. The angle of attack at which there is a marked increase in amount of separated flow is called the stalling angle. This always occurs at the same angle regardless of velocity of flow.

As air flows up and over the top of the airfoil, its velocity increases to the point of greatest apparent thickness of the wing and then begins to decrease so that at the trailing edge of the wing, the velocity has returned to that of velocity of the wing through the air. As velocity of flow increases and decreases, so does pressure.

Looking again at figure 9, it can be seen that as the flow proceeds from the thickest part of the airfoil and towards the trailing edge, pressure within the flow is steadily increasing. Normally, air flows from regions of high pressure to regions of low pressure. On the aft portion of the wing the reverse is found. The reason that the air is able to continue in the face of these adverse circumstances is that it has so much velocity imparted by its flow over the thicker portion of the wing. Like rifle bullets particles of air are fired into the region of higher pressure. They are able to penetrate this region as long

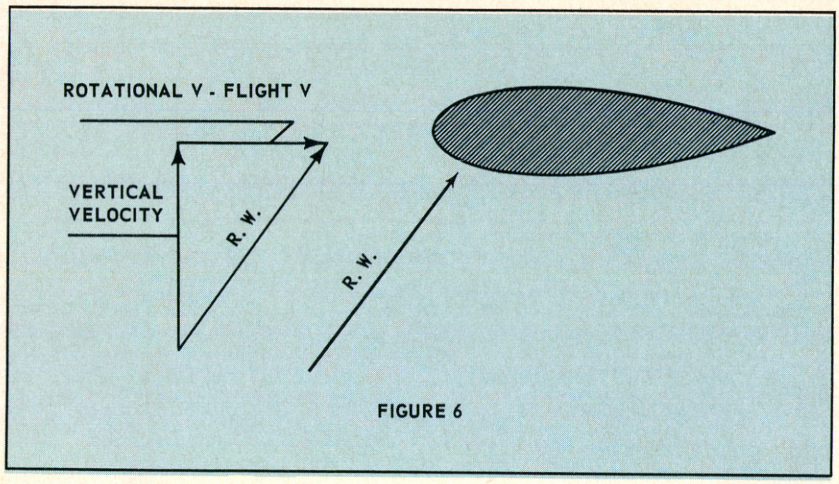


FIGURE 6

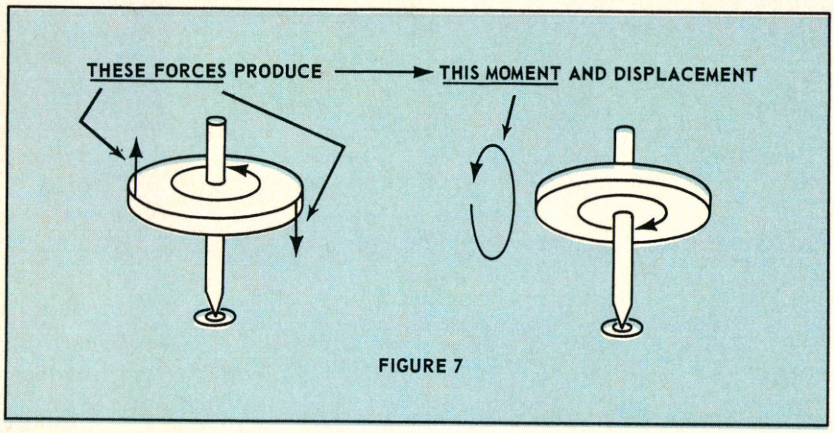


FIGURE 7

the reason for pitchup may be developed from an understanding of the principle of gyroscopic precession . . .

as it remains moderate, which it does at moderate angles of attack. However, at larger angles of attack adverse pressure increase is so great that the particles are unable to penetrate it and they separate from the wing surface in a turbulent manner, attempting to flow back up the surface in some areas. As stated, once this has occurred, lift decreases and drag increases.

The velocity of sound is not a static quantity, as is the stalling angle of attack of a particular airfoil shape, always occurring at the same angle regardless of speed of flow. The velocity of sound depends upon temperature. As temperature increases, so does the velocity of sound. A decrease in temperature, which occurs with altitude, will cause the velocity of sound to decrease from 660 knots at sea level on a standard day to 614 knots at 20,000 feet. A very cold day will cause the velocity of sound to decrease to 609 knots at sea level or whatever altitude the temperature occurs.

As the airfoil reaches higher velocities through the air, the velocity of air over the thicker portion approaches the speed of sound. At some airfoil velocity less than sound, the velocity of air over the airfoil will be equal to sound. The nature of supersonic flow is such that air is able to accelerate to supersonic velocities easily, but in the process of slowing, an unusual phenomenon called a shock wave will form.

On one side of the shock, flow will usually be less than the speed of sound. The shock wave forms the boundary between supersonic and subsonic flow and is the mechanism by which the flow is able to slow to subsonic velocities. Through the shock wave, changes in the properties of the air take place very quickly. The velocity decreases very suddenly.

The velocity decrease is accompanied by an increase in temperature and pressure. Thus, as the air particles flow through the shock wave, they encounter a sudden increase in pressure and an accompanying decrease in energy. So at the very point at which they need additional energy to penetrate into the region of adverse pressure, they are given less energy.

The situation is intolerable to the airflow and it will normally separate. If the wing is particularly designed for supersonic flow, this separation may be avoided. However, the helicopter airfoil is not so designed and the separation will occur.

Recalling that this separation occurs only following formation of a shock wave, figure 10 illustrates successive growth of such a wave as the velocity continues to exceed the speed of sound by a greater margin.

As the supersonic region of flow grows on the top of the airfoil, strength of the separated region grows with it. This quickly causes severe loss of lift and increase in drag on that portion of the airfoil over which the flow is greater than the speed of sound by a moderate amount. Due to effect of the radius of the blade on the velocity, this separation will start at the tip of the blades as they pass through the advancing blade portion of the disc and advance from this portion of the disc, gradually encompassing a greater share of the advancing blade disc area.

As the region of shock-induced separation grows, increased drag and loss of thrust begin to have an appreciable effect on operation of the helicopter. These effects manifest themselves very much as does retreating blade stall. However, they are frequently masked because retreating blade stall is inevitably occurring at the same time.

If advancing blade compressibility occurred separately, it would be accompanied by roughness and a nose down tendency of the helicopter, because loss of lift is on the side. Due to gyroscopic precession, this will cause a down motion of the leading edge of the rotor disc which is acting as a gyro. Normally the effects of retreating blade stall will predominate in such a manner that pitchup is the primary effect of high forward speeds. As rotor rpm of new helicopter designs continue to increase, this could reverse.

Advancing blade compressibility then manifests itself in much the same manner as retreating blade stall, with roughness and loss of control. It occurs primarily as the result of high speed but will be aggravated by all of the following factors:

High speed

Aircraft are under development which should provide us with a flexible, safe flight spectrum which encompasses the entire speed range from hover to the vicinity of 500 knots

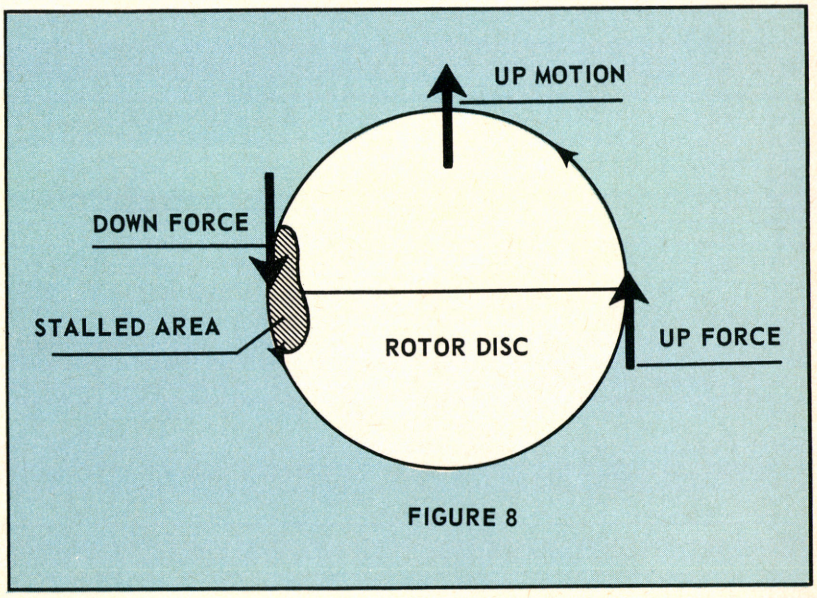


FIGURE 8

High rotor rpm
All conditions which cause high rotor angle of attack
High gross weight
High density altitude
Maneuvering flight
Gusts
Abrupt control movements
Low temperatures

Correction of this condition may be effected primarily by reduction of speed, but reduction of angle may also cause some reduction of the problem. Aft cyclic, which tends to increase angle of attack on the advancing blade side of the rotor disc, will aggravate the condition.

Thus, a helicopter operating with the loaded rotor is limited by twin aerodynamic phenomena. Remedies may be applied but they must be limited if the helicopter is to retain satisfactory moderate speed and hovering capabilities. At the very best, the effects of these phenomena may be only delayed and not avoided. The solution lies in either stowing or conversion of the rotor for high speed flight, or the unloaded rotor which only needs provide a modest moment for control and not the primary thrust needed to overcome both drag and weight. Such aircraft are under development and should provide us with a flexible, safe flight spectrum which encompasses the entire speed range from hover to the vicinity of 500 knots.

The onset of these aerodynamic limitations must be recognized and the corrective action properly applied if our newer high speed aircraft are to be safely operated.

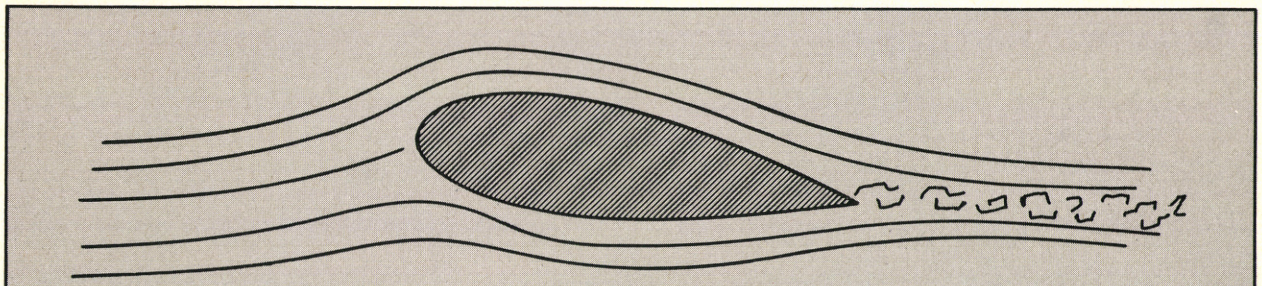


FIGURE 9

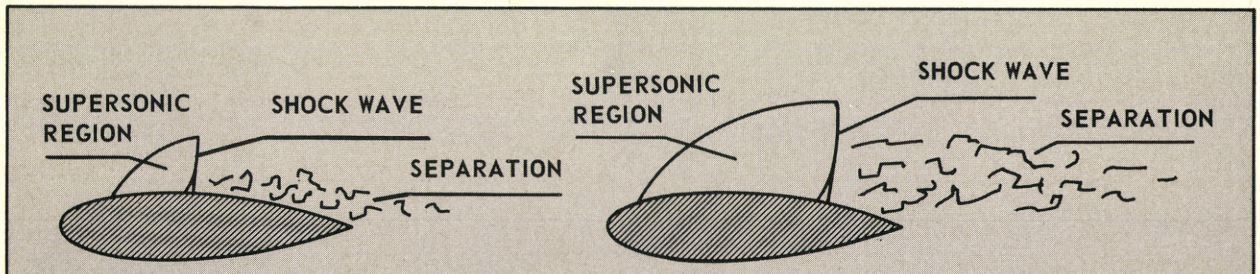


FIGURE 10

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Eyes, **your** eyes, must be considered the single most vital item of your personal equipment—**if used correctly.**

Would **you** start a night flight—

- After exposure to bright lights within 30 minutes before flight time?
- Using a flashlight with no filter to complete forms, preflight, and cockpit checks?
- Using bright lights of ¾ ton truck as guide to runway?
- With runway light intensity so high it had to be turned down to reduce distracting glare?
- Using light in black background at far end of runway as focal point?

One pilot did and ground looped into a major accident.

To get the most out of your eyes at night:

1. Adapt your eyes and keep them adapted.
2. Use your mind and your eyes as a team—concentrate your attention on seeing.
3. Learn to look **off center** and to **scan** in short jumps.
4. Know and use the techniques which give your eyes a break.
5. Know what you are looking for and what it looks like at night.
6. Practice blindfold drills.
7. Use oxygen from 5,000 feet up.
8. Let up on the light up—avoid smoking—before and during flights.
9. Watch your physical condition and keep in training.

pearls NIGHT VISION

The head on closure rate
of aircraft requires
a sharp lookout...

"If you waste seconds
deciding what to do...

it is no longer necessary
to take corrective action...

because you are going
to be straining yourself
unnecessarily...

and are going to die all
tensed up!!..."