GUERRILLA AIR DEFENSE

Antiaircraft Weapons and Techniques for Guerrilla Forces

James "Doc" Crabtree

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by James "Doc" Crabtree

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Warning

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Chapter1

The Air Threat

In the 20th Century, air power has come to play important roles in warfare. Air transport, interception, reconnaissance, and Strategie taombing are just a few of the missions carried out by aircraft. Of primary concern to the guerrilla are the roles of counterinsurgency (COIN) and close air support (CAS).

The British pioneered the practice of using aircraft against guerrillas following World War I. Using aircraft, they were able to police up their huge colonial empire against the threat of native uprisings in the Middle East. Bombing and strafing natives far from the cities and forts effectively crushed their resistance.

In recent years, helicopters, tacticaljets, and even some propeller aircraft have been employed to fight insurgents. In South West Africa and Angola, South

African helicopters and paratroop aircraft were used in concert to fight South West African People's Organization (SWAPO) insurgents. In Argentina, the government employed specially designed twin-turbo-prop Pucara COIN aircraft against guerrillas. And, of course, the Union of Soviet Socialist Republics' (USSR's) war in Afghanistan led to the massive use of attack helicopters and close air support jets to attack Mujihadeen guerrillas in a variety of ways, using rockets, bombs, air-dropped mines, and helicopter assault troops.

The lesson for the guerrilla is clear: air power must be recognized as a factor in the struggle. The government against which the insurgency is struggling will have the advantage of comparatively vast resources at its disposal, including army aviation and air force assets. And even small numbers of aircraft can have a great impact on the struggle. Let's look at how aircraft are employed against the guerrilla.

Aircraft can be used to locate insurgents, either through high-altitude reconnaissance or low-level observation. There is little the guerrilla can do about high-altitude spy aircraft and, in fact, it is often wise to leave low-altitude scouts alone as well. Unless the scout aircraft can be brought down with certainty, all the guerrilla will be doing is giving away his position. Passive air defense measures are the best means of protecting insurgent forces against scout aircraft.

Many countries now use remotely piloted vehicles (RPVs)—sometimes called unmanned aerial vehicles, or UAVs—to conduct battlefield reconnaissance. These radio-controlled aircraft are easily recognized—they are small and often similar in appearance to large remote-controlled model planes. Most are prop fixed-wing modeis, although some modeis have jet engines or are rotary-winged in design.

RPVs can be used to fly patterns over a suspect area.

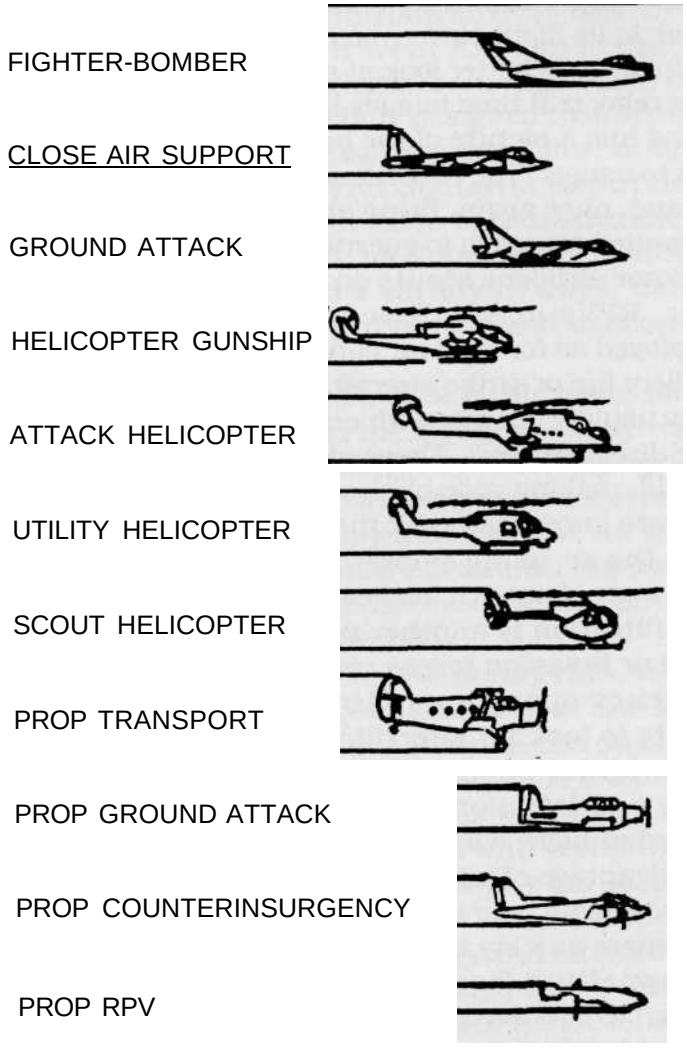
A sure sign that an RPV has spotted something is a break in its flight pattern in response to the Controllers desire to get a better look at something. Television cameras relay real time images back to the RPV Controller, giving him a picture of the battlefield without exposing him to danger. The RPVs small size makes it difficult to hit and, once again, firing at them only serves to draw unwanted attention to guerrilla positions.

Some airborne scouts do pose a direct threat, however. RPVs or small scouting aircraft might be employed as forward air Controllers (FACs) that call in artillery fire or strike aircraft to hit insurgent positions. They usually operate with enemy ground forces to provide direct support. These aircraft orbit above the battlefield, making wide circles or racetrack patterns, but they are known to break the pattern and mark targets from the air using smoke or flares. If FACs foolishly stick to a set pattern, it is easier to engage them.

Infiltration is another purpose for which government or invasion forces use air power in counterinsurgency operations. Aircraft are used to insert scouts to look for guerrillas on the ground far from areas under enemy control and with a minimum Chance of detection. These operations are often performed at night when regular military forces will have the advantage of night Vision devices.

The enemy may use air assault, in which heliborne troops are quickly inserted into an area of operations by rappelling from the helicopter or using "fast ropes," which are Special sleeved ropes soldiers can grip and slide down. If conditions at the landing zone permit, the helicopters may opt to land and discharge their troops, or the enemy may mount an airborne Operation. This is the insertion of paratroopers—either overtly or covertly—into the area of operations. There are many missions such troops could perform.

And finally, there is the direct attack against insur-



VARIOUS AIRCRAFT TYPES

gent forces using ground attack aircraft. These aircraft can be divided into three types: jets, props, and rotary-wing aircraft. Each type has its own strengths and weaknesses.

Jets are fast and powerful and capable of carrying heavy loads at high speeds. Some Single, well-equipped ground attack aircraft are capable of destroying almost any military target. The U.S. Air Force's A-10 Thunderbolt II "Warthog" ground attack plane is an excellent example of such a jet. But because of its speed, its pilot must make decisions in a fraction of a second, and this can reduce the plane's effectiveness in an observation role.

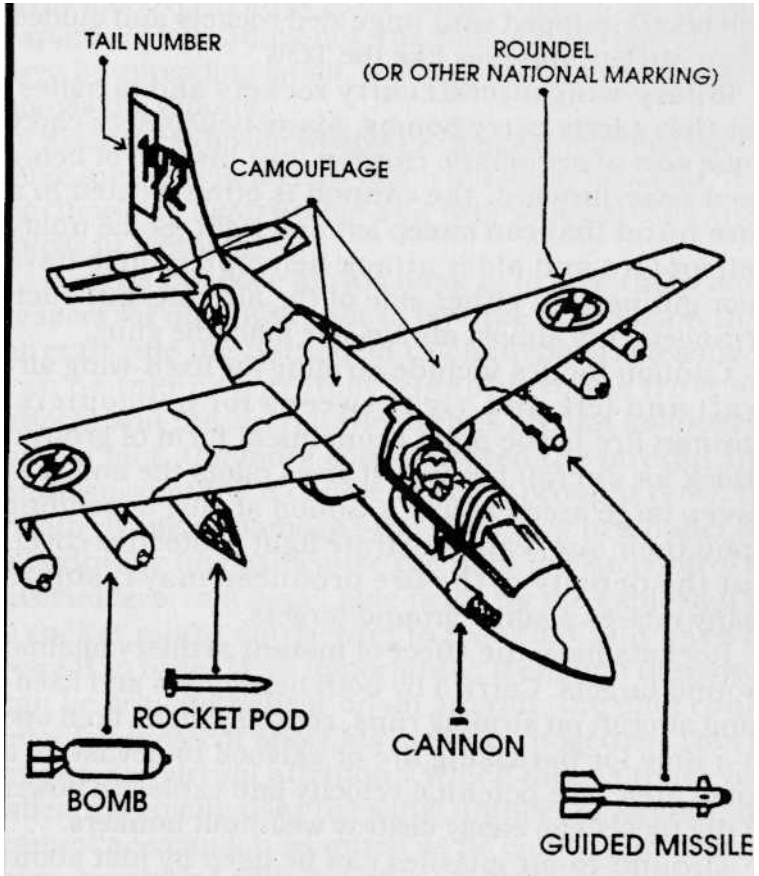
Propeller-driven aircraft can fly at much slower speeds and can be used to both find and destroy enemy insurgents. Propeller aircraft also have the advantage of being able to operate from primitive airfields close to remote areas where insurgents might try to hide. Argentina's Pucara is such an aircraft, having proven its worth during the Argentine guerrilla conflict; however, the relatively slow speed of this propeller-driven aircraft makes it an easier target.

Helicopters are a proven COIN weapon. They have all the advantages of prop aircraft, plus the ability to hover. (Some Soviet helicopters cannot hover; they rely on wing pylons to provide necessary lift.) The versatility of helicopters has resulted in the development of many different designs, most of which are useful in COIN operations: light helicopters for scouting the enemy, Utility helicopters for transporting troops, and helicopter gunships for strafing and rocketing guerrillas. Some helicopter modeis can do all of these jobs when properly equipped.

In order to Support friendly troops in a ground-attack role, aircraft have been equipped with a variety of weapons. Fixed-wing aircraft in the ground attack role are almost always equipped with some sort of

NAME	TYPE	ARMAMENT	MISSION	SPEED
A-10	Jet	Cannon, Rockets, Bombs, Missiles	Attack	436 mph
AH-1	Helicopter	Cannon, Rockets, Missiles	Attack	175 mph
AH-64	Helicopter	Cannon, Rockets, Missiles	Attack	184 mph
Alpha Jet	Jet	Cannon, Rockets, Bombs, Missiles	Multi	644 mph
F-15E	Jet	Cannon, Bombs, Missiles	Multi	Mach 2.5
F-16	Jet	Cannon, Rockets, Bombs, Missiles	Multi	Mach 2
Mi 8	Helicopter	Rockets, Missiles, Machine Guns (MGs)	Multi	161 mph
Mi-24	Helicopter	Cannon, Rockets, Bombs, Missiles	Attack	192 mph
Mig-21	Jet	Cannon, Rockets, Bombs	Multi	Mach 2
Mig-27	Jet	Cannon, Rockets, Bombs, Missiles	Attack	Mach 1.7
Mig-29	Jet	Cannon, Rockets, Bombs	Multi	Mach 2.3
Mirage	Jet	Cannon, Rockets, Bombs, Missiles	Multi	Mach 2.2
Mirage	Jet	Cannon, Rockets, Bombs, Missiles	Multi	Mach 2.2
Peace-maker	Prop	Cannon, Rockets, Bombs	COIN	162 mph
Pucara	Prop	Cannon, Rockets, Bombs, MGs	COIN	310 mph
Su-25	Jet	Cannon, Rockets, Bombs, Missiles	Attack	527 mph
UH-1	Helicopter	MGs, Cannon, Rockets	Multi	136 mph
UH64	Helicopter	Cannon, Rockets, Missiles	Multi	184 mph

CHART OF AIRCRAFT CAPABILITIES



AIRBORNE WEAPONS

cannon, harking back to the days when early aircraft strafed troops with machine guns. Later, planes were adapted to carry bombs, but since then aircraft have also been equipped with unguided rockets and guided air-to-surface missiles like the TOW.

Rotary-wing aircraft carry rockets and missiles, but they rarely carry bombs. Many helicopters carry soine sort of automatic cannon, but instead of being fixed nose-forward, the cannon is often located in a nose turret that can sweep left and right. Some Utility helicopters and older attack helicopters also have door gunners on either side of the aircraft, but such arrangements almost always use machine guns.

Cannon tactics include strafing for fixed-wing aircraft and left-and-right sweeps for helicopters. Cannon fire is the most economical form of ground attack for aircraft because it gives pilots the ability to sweep large areas at will. Cannon Shells, depending upon their size, can penetrate light protective Cover, but the density of the fire produced may result in many misses against ground targets.

Rockets have the effect of instant artillery against ground targets. Carried by both helicopters and fixed-wing aircraft on strafing runs, rockets can be fired one at a Ume for harassing fire or salvoed to devastate a small area. The potential velocity and explosive power of the rocket can easily destroy well-built bunkers.

Ground-to-air missiles can be used by just about any type of aircraft flying today. They can be guided through a number of different means by either the launching aircraft or by a second aircraft. These missiles are usually designed to destroy a Single, heavily fortified or armored target. If ground-to-air missiles are in short supply, a pilot will think twice before "wasting" such an expensive weapon on guerrillas.

Bombs have been used ever since aircraft were first flown. Some are guided by reflected laser energy,

but it is not unusual for bombs to be "dumb" weapons that are simply dropped in the general direction of a target. Antipersonnel bombs can be used to spray shrapnel over a large area, while cluster bombs are capable of spreading destruction over an even larger area by spreading small, golf-ball-sized submunitions across the ground.

Another airborne weapon is napalm. Spread over a large area and ignited in just a few short seconds, it is particularly destructive and was well used by U.S. forces in Vietnam.

But the purpose of this book is to give the reader respect for air power, not to give the impression that aircraft rule the battlefield unchallenged. Measures can be taken to protect friendly troops from air attack, and the aircraft themselves are not invulnerable. In fact, the more sophisticated the aircraft the more susceptible it can be to being brought down by relatively minor damage—the mere nick of a bullet on a hydraulic line can cause the pilot to lose control of his rudders, or a small hole made by the explosion of a rocket might cause him to lose fuel and have to retreat to base. More importantly, if enough firepower can be brought to bear on an aircraft, the pilot could miss his target or abort his mission altogether. This is known as "Virtual attrition," which means that even when the enemy uses the same number of aircraft, he cannot accomplish as much as he could if he did not have to contend with guerrilla air defense.

Two examples of the success insurgents have enjoyed against superior forces are the Vietminh (and later, the Vietcong) and the Mujihadeen in Afghanistan. In Vietnam, the insurgents defeated the French colonial forces despite their superior firepower and their ability to airlift paratroopers almost anywhere within Indochina. In Afghanistan, Muslim freedoin fighters managed to break the grasp of Soviet occupa-

tion forces and later forced them to withdraw. Both of these guerrilla struggles are important for the lessons one can draw from them.

Following World War II, the French attempted to reclaim their colonial possessions. A resistance movement called the Vietminh emerged to contest the control of the provinces that today make up Vietnam. The French had first employed air power against an insurgency known as the Red Soviet revolt, which was made up of several communist enclaves that were established in the countryside in 1930 and 1931. Despite the fact that the French's use of air power did not quickly put an end to the guerrilla war, they turned to the same COIN tactics.

Vietminh guerrillas had many advantages. They could hide in the jungles and highlands of Indochina and then sally forth to strike the French at will. When the French attempted to follow them back into the jungle, they ran into booby traps like the infamous punji stake or found that their enemy had simply disappeared into the native population.

One French attempt to win the war came during Operation Lea, a 1947 air and ground offensive against the Vietminh's main stronghold northwest of Hanoi. They hoped that by capturing the Vietminh's leadership and the bulk of their organized forces, they might end the war in one stroke.

Two columns approached the stronghold on the ground, while a third "column" of paratroopers was dropped directly over the Vietminh strong point. Artillery and armor supported the infantry, and the combined ground forces were supported by an entire fighter group. The French possessed overwhelming firepower.

Thanks to their use of the air and a lack of effective air defense, the French's surprise was total. They nabbed several Vietminh leaders and narrowly rnissed capturing Ho Chi Minh himself. However, the

bulk of the guerrilla forces managed to escape the trap to fight another day.

Following this battle, the Vietminh concentrated on improving their firepower. Soviet and Chinese weapons began replacing the old Japanese and French weapons in the hands of the guerrillas. Some of these weapons were antiaircraft (AA) guns—mostly light automatic weapons. There would be no repeat of Operation Lea.

For their part, the French eventually settled on the idea of luring the Vietminh into a conventional, set-piece battle in which French firepower and use of the air, two areas in which they had overwhelming advantages, could be brought to bear to destroy the bulk of the insurgent forces with one blow. The place the French chose to land this blow was an outpost deep in insurgent territory called Dien Bien Phu.

Dien Bien Phu dominated several land routes and made it difficult for the insurgents to harvest their cash crop of opium. The Vietnamese People's Army (VPA) answered the French challenge by building up their forces around the fort until it was surrounded and cut off from all routes except one—the air route. The 10,000-man garrison was reduced to being resupplied from the air.

The French had every reason to believe that they would be able to maintain Dien Bien Phu by airlift. They possessed ample transports and thought they had the edge in firepower. But the VPA supply line was able to survive attacks by World War II vintage aircraft, and VPA forces were able to manhandle artillery pieces into positions around the fort and rain Shells on the defenders. Then the Vietnamese turned to the problem of cutting the French aerial lifeline.

The VPA insurgents launched an artillery attack against the fort's runway and then followed it up with an infantry assault. The capture of the runway meant that

VIETNAMESE AIR DEFENDER

the French forces could only be supplied by parachute.

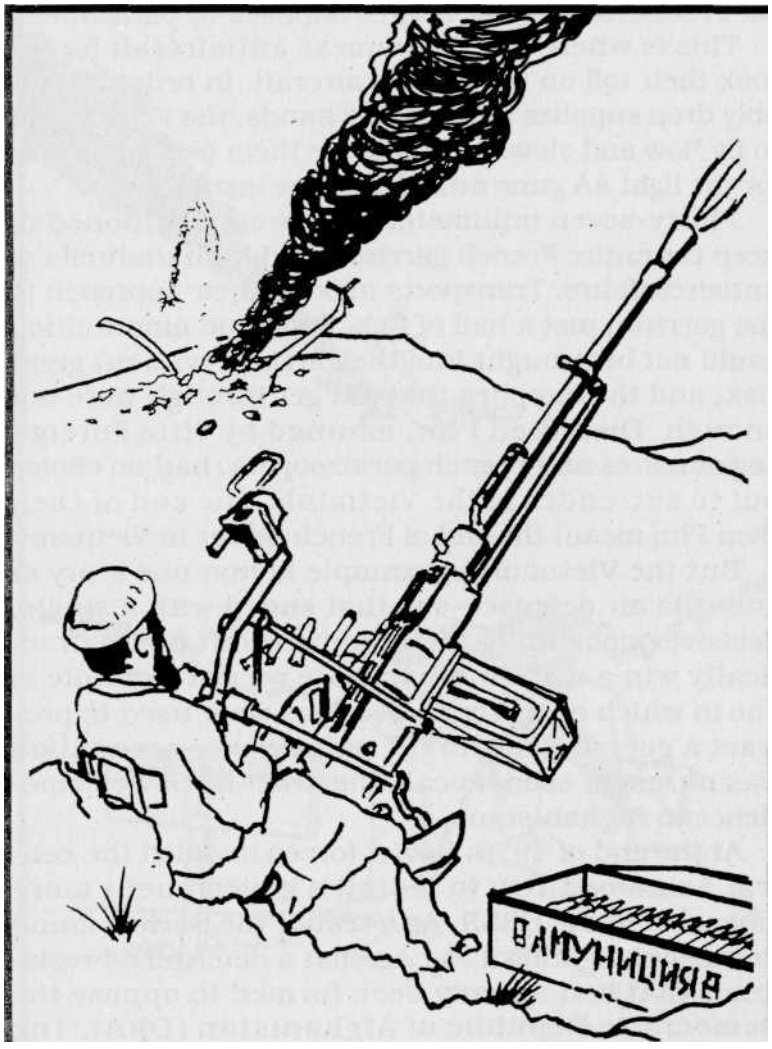
This is where the Vietnamese antiaircraft forces took their toll on the French aircraft. In order to reliably drop supplies into friendly hands, the French had to fly "low and slow," which made them perfect targets for the light AA guns available to the insurgents.

Thirty-seven millimeter guns were positioned to keep the entire French garrison under an umbrella of antiaircraft fire. Transports making their approach to the garrison met a hail of flak. Food and ammunition could not be brought into the garrison without great risk, and the supplies that did get through were not enough. Dien Bien Phu, manned by elite Foreign Legionnaires and French paratroopers, had no choice but to surrender to the Vietminh. The end of Dien Bien Phu meant the end of French power in Vietnam.

But the Vietnamese example is just one story of guerrilla air defense—one that ended with a Single, decisive opportunity to use antiaircraft fire to practically win a war. Another more recent example is one in which antiaircraft weapons were used to protract a guerrilla war to the point where occupation was no longer economical. This was the Soviet experience in Afghanistan.

At the end of 1979, Soviet forces invaded the central Asian country to install a government more amenable to the USSR. As a result, the Soviets found themselves fighting a war against a determined resistance that had already been formed to oppose the Democratic Republic of Afghanistan (DRA). The Mujihadeen ("fighters of the faith") rose up to fight against godless Communism.

The Soviets employed motorized rifle divisions and airborne troops to rapidly secure Afghanistan, or at least the major population centers and military facilities. Soviet motorized rifle formations had heavy armor and artillery support, and even airborne units



MUJIHADEEN AIR DEFENDER

had air-dropped and air-transportable armored vehicles. And to support the ground forces, the Soviets brought in helicopters and fixed-wing attack aircraft. The Afghani insurgents faced a modern and formidable combined-arms force.

In the beginning, even the small arms possessed by the resistance were not entirely reliable. This Situation changed as better weapons were smuggled in by the West and as Soviet military equipment was captured from the Soviets or their DRA Army troops. The Mujihadeen went from using rifles and light machine guns to employing heavy antiaircraft machine guns and other automatic air defense weapons.

Soviet helicopters were used more often as communist ground forces found it difficult to deal with the Mujihadeen's ability to disappear into the rugged mountains of their country. To the Afghanis, and indeed to the world, the Soviet helicopter came to symbolize the ruthless use of force against a relatively primitive people.

Although the Afghanis might have been primitive, they were also brave and wise warriors with a long history of dealing with invaders. Knowing they could rely on no one but themselves, they learned to deal with the enemy on his terms. They destroyed modern fighter-bombers and attack helicopters where they stood the best Chance against them—on the ground. The Mujihadeen also protected themselves as well as they could against the dreaded enemy air attacks and then began harassing Soviet helicopters and fighters with small-arms fire and rocket-propelled grenades as they flew above the countryside. Every once in a while, the guerrillas would get lucky and bring down an aircraft, but more often they succeeded in degrading the Performance of Soviet pilots.

Then the Afghanis graduated to man-portable air defense Systems (MANPADS). The first shoulder-fired

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surface-to-air missiles (SAMs) the Afghanis were able to acquire were Soviet-made Strela-2s captured from DRA Army defectors, who also taught them how to use them. These were not very effective; the Strela-2 (known as the SA-7 Grail in the West) is a revenge weapon and can only be used against an aircraft that has already passed overhead. The infrared (IR) seeker used by the missile can be easily deceived by clouds, set astray by the sun, or tricked by air-dropped flares. And on top of all these faults, they were available only in small numbers. A more effective weapon was needed and in numbers great enough to cause the Soviets to take notice.

The weapon that answered the Mujihadeen's prayers was the American-made Stinger missile. The Stinger is an all-aspect weapon, which means it can be used against an aircraft whether it is approaching or leaving. Its seeker is more sensitive and harder to fool. The Stinger turned the tables and made the hunters the hunted in the skies over Afghanistan.

The Soviet occupation forces found themselves virtually under siege within the cities, and that included their air force. Aircraft entering and leaving the airport in Kabul were fair game for the insurgents, and Soviet pilots routinely dropped flares as they flew in and out. There were reports that Soviet pilots refused to fly certain formations, and the communist helicopters and jets began flying at far higher altitudes, which degraded their Performance.

The failure of the Soviets to secure the countryside with air power doomed their occupation of Afghanistan. By 1988, the USSR had had enough—the Soviets left the Afghanis to sort out their future for themselves. It was a great victory for the Mujihadeen.

As this book was being written, the Chechen rebels fighting for independence in Russia succeeded in downing a Russian Su-25 "Frogfoot" using small-

arms fire. With the determination that comes from a belief in the righteousness of a cause and the right tactics, the guerrilla can persevere against air attack . . . and eventually win.

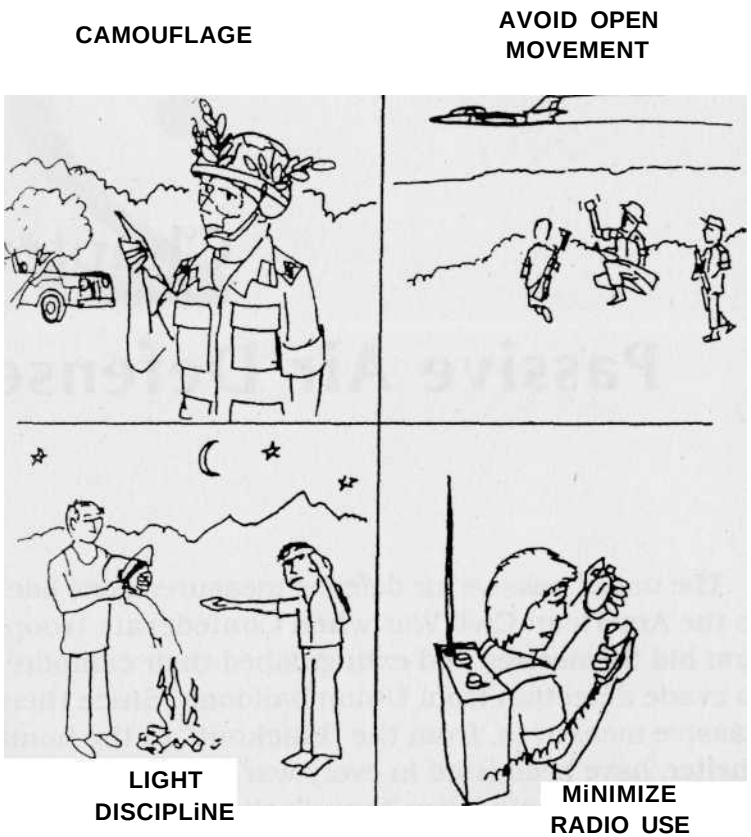
Chapter

4

Passive Air Defense

The use of passive air defense measures goes back to the American Civil War when Confederate troops first hid themselves and extinguished their campfires to evade detection from Union balloons. Since then, passive measures, from the "blackout" to the bomb shelter, have been used in every war in which aircraft have played a role, even though their use posed no danger to hostile forces.

Passive measures must be used by guerrillas. What the enemy cannot see, he cannot attack. And if he does attack, he cannot hit what his bombs cannot reach. Guerrilla forces are usually limited in resources, and passive measures allow them to conserve what they have. They are the guerrilla's first line of defense against air attack.



ATTACK AVOIDANCE

Passive measures can be divided into two different categories: attack avoidance measures and damage limiting measures. Attack avoidance measures limit detection from the air, while damage limiting measures minimize the effects of air attack.

Attack avoidance measures are extremely valuable. Usually, these are simple tasks that require little effort, and yet, if consistently followed, they will often protect friendly troops from air attack better than any heavy machine gun or missile by making certain that an attack doesn't occur at all.

Camouflage, of course, is an important attack avoidance measure. Even if a pilot cannot spot a guerrilla position from the air, an aerial imagery Interpreter might after analyzing aerial photographs taken by the pilot. Colors that do not belong in the environment, Sharp edges, and individual fighters can all be spotted from the air, but Camouflage can protect guerrillas and their activities from detection.

First of all, everything in the field should be painted in nonreflective flat colors. Most military items captured or purchased or otherwise supplied to a guerrilla force will already be properly painted, perhaps including a Camouflage pattern, but civilian items useful to the fight also have to be painted. And it goes without saying that the colors must match the environment. If paint is not available, mud or sand can be smeared across equipment to subdue it.

If available, Camouflage nets should be used. Aside from providing additional color, nets also break up the shape of vehicles, tents, equipment, and permanent structures. Equipment camouflaged with such nets tend to blend in with the local environment, making them very difficult to identify through aerial photographs and virtually impossible for a pilot to detect while flying at high speed and altitude.

If nets are not available, items from the environ-

ment must be used. Sand can cover bunkers bullt In the desert, and scrub brush can be planted on the roof. Similarly, weathered dead wood can be placed on or near equipment in the forest In order to break up its Silhouette. And vehicles can be parked in the tree line, using its natural canopy and shadows to hide them.

Vehicle Windows and mirrors must be covered with cloth or whatever means are available. The reflection of light on a window can be seen from the air as a bright flash, which can get the instant attention of a pilot. Sometimes it is enough to lift the hood of a vehicle so that it blocks the windshield and to lower the Windows.

In areas where guerrillas have established control, the guerrillas will naturally leave signs of their presence. Paths in the open will leave a brown line that can be seen from the air, and trash dumps can be detected in aerial photographs. Guerrillas must move under the cover of trees, even if it is not the easiest path. Debris and garbage must be disposed of in ways that will be hard to detect.

Individual fighters must also be concealed. Camouflage uniforms are best, if available, but the fighters can also wear shades that blend in with the environment. If there is a distinctive dress among the locals, guerrillas might also wear that to minimize suspicion.

Another detection danger is movement. Movement catches the eye. While aircraft are in the area, fighters should get to the ground and freeze, and vehicles should be stopped until it is safe or detection is certain and active air defense measures are necessary. Moving at night minimizes the possibility of detection, even against an enemy armed with infrared and night Vision equipment.

In regions where there is a distinct change **in** seasons, it is necessary to adjust Camouflage accordingly. Whitewash should be used to make green-painted items match the snow-covered background, and guerrillas should wear white smocks over their clothing. Basically, they should do whatever it takes to minimize the chances of detection.

Light discipline is important in attack avoidance procedures. At night, relatively dim sources of light can be detected at great distances. As in the earliest instances of air defense, the blackout should be used upon the detection of aircraft—all lights should be shut off, and campfires and cigarettes should be extinguished.

Today, there are several ways that freedom fighters can be detected, in addition to simple Visual detection. One is infrared (IR) detection, and another is radio detection. Attack avoidance procedures must be extended across the spectrum to include these possibilities.

Infrared devlces are employed by modern armies and air forces to detect heat sources, or the lack of them, caused by human Intervention. Such devices vary in their effectiveness: more primitive ones are good for little more than finding campfires, while far more sophisticated modeis have fine resolution and can see individual soldiers in enough detail to identify which side they are on.

When such devices were first used in Vietnam to locate tunnel entrances, the Vietcong developed a Special System of dispersed exhaust air vents. These served to slightly cool the air leavlng the tunnels and to get rid of it at some distance from the actual tunnel entrance. Any permanent tunnel System should have such a way of getting rid of warm air or smoke fumes.

There are habits that will minimize IR detection. Upon hearing enemy aircraft, fires should be put out or not used at all if unnecessary. Smokeless fires are

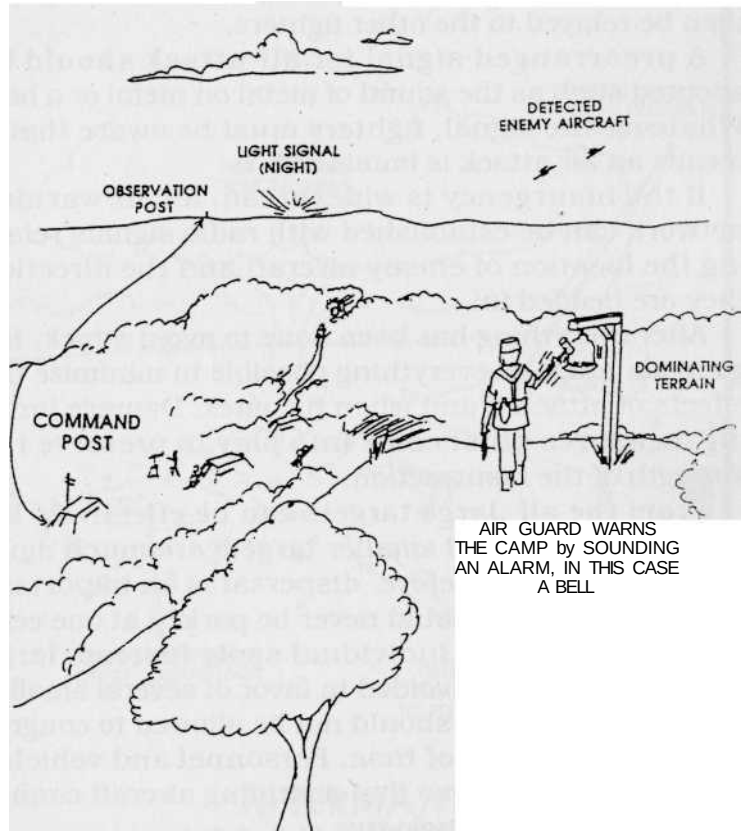
still detectable in the daylight, and even extinguished fires will have an IR signature. Vehicle engines should be run at a bare minimum, and if recently used, they should be cooled by whatever means necessary. Vehicle engines should not be run at all at night, as this is when IR detection devices are most likely to be used.

It is the sarae with radio detection. There are numerous radio detection devices, many of which are airborne, but the danger from radio detection is constant. In fact, distant ground-based stations might be able to safely intercept and identify a guerrilla transmission Site through a technique called triangulation.

If radios are not used, say, because of the use of runners or land lines for Communications, the danger of detection is somewhat reduced. But if radios are used to maintain Communications with friendly units, to give Orders, or to keep in contact with distant allies, the danger is substantial. The longer the transmission the more likely the enemy will locate the exact position of the transmitter. And the more likely that a bombing or strafing sortie will be launched against the site, as air attack is the swiftest means of response.

Signal discipline is therefore the order of the day Transmissions should be short and broken up in'three- or four-second bursts. Whenever possible transmissions should take place away from base camps or permanent Sites to draw attack on the remote site instead of an important base location. And, of course, radios should not be used at all if unnecessary.

An early warning network should be set up day and night, not just to coordinate passive air defense measures but also to prepare active air defenses for action. An air guard should be established to warn the base camp against air attack. Set up on high



AIR GUARD WARNS THE CAMP by SOUNDING AN ALARM, IN THIS CASE A BELL

EARLY WARNING

ground and away from the activities of the camp, an air guard can listen for the sound of approaching jets or rotors and spot distant aircraft. The warning can then be relayed to the other fighters.

A prearranged signal for air attack should be adopted such as the sound of metal on metal or a bell. Whatever the Signal, fighters must be aware that it means an air attack is imminent.

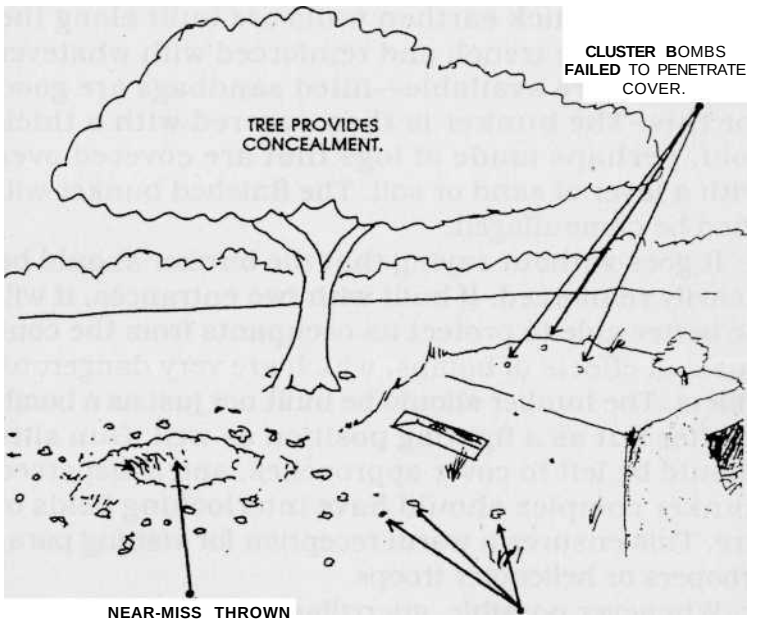
If the insurgency is widespread, an air warning network can be established with radio Signals relaying the location of enemy aircraft and the direction they are headed in.

After everything has been done to avoid attack, the guerrilla must do everything possible to minimize the effects of attack if and when it comes. Damage limiting measures must come into play to preserve the strength of the insurrection.

From the air, large targets can be effectively hit many times. Several smaller targets are much more difficult to hit; therefore, dispersal is an important practice. Vehicles should never be parked at one central location but at individual spots instead, large bunkers should be avoided in favor of several smaller ones, and guerrillas should not be allowed to congregate for any length of time. Personnel and vehicles should be staggered so that a strafing aircraft cannot hit all of them in a Single run.

The effectiveness of dispersal cannot be overstated Smaller targets are harder to spot and give little satisfaction to enemy forces when they are destroyed. By spreading out assets, the guerrilla forces the enemy to disperse his firepower as well.

Bombs, rockets, and cannon fire can cause severe damage to troops in the open. But it is possible to protect military stores and guerrilla fighters not engaged in the air defense battle. Bunkers are ideal for this purpose.



AFTERMATH OF AN ATTACK.

BUNKERS

Earthen bunkers can be constructed with hand tools and guerrilla labor. First, a good position is found, preferably where there is good overhead concealment from Vegetation. Next, a shallow trench is dug. Then, thick earthen walls are built along the outside of the trench and reinforced with whatever materials are available—filled sandbags are good for this. The bunker is then covered with a thick roof, perhaps made of logs that are covered over with a layer of sand or soil. The finished bunker will then be camouflaged.

It goes without saying that the bunker should be heavily reinforced. If built with two entrances, it will be better able to protect its occupants from the concussion effects of bombs, which are very dangerous killers. The bunker should be built not just as a bomb shelter but as a fighting position as well. Gun slits should be left to cover approaches, and a dispersed bunker complex should have interlocking fields of fire. This ensures a warm reception for visiting paratroopers or helicopter troops.

Whenever possible, guerrillas should use caves or deep tunnels for shelter. During the Vietnam War, insurgents were able to protect themselves inside tunnel complexes, even when attacked by B-52 strikes that obliterated everything on the surface. The main drawback to elaborate tunnels is the immense effort that goes into their construction. The cost in effort might make a guerrilla force stand and fight prematurely to keep possession of the tunnels rather than give them up during a withdrawal.

Tunneling should not be attempted if the soil is too soft or too close to the water table. And if tunnels are built, they must be reinforced and braced to prevent a collapse under bombing.

These are all measures that can be taken to minimize damage from air attack or prevent the possibility

of air attack at all. But eventually a guerrilla force must face the possibility of air attack and actively defend itself. The next chapter looks at how to accomplish this.

Jhapter

Active Air Defense

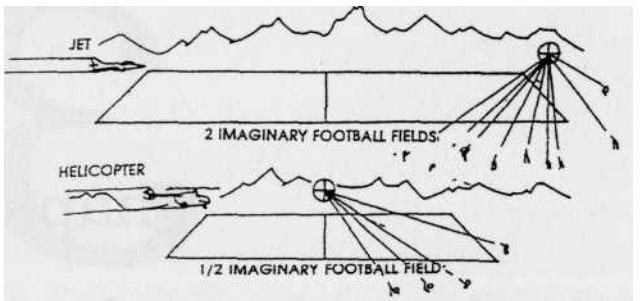
It is foolish to attempt outright to deny enemy or invasion forces the use of the air by employing the types of weapons available to the guerrilla. Instead, the guerrilla must pick and choose the time and place he wishes to contest enemy use of the air.

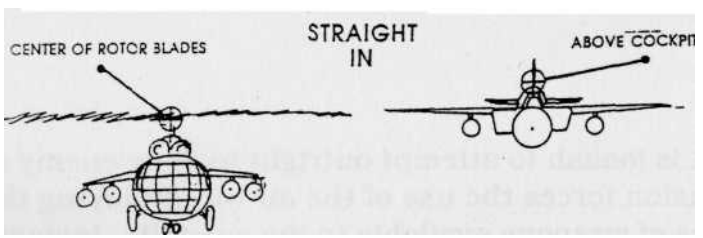
Of course, the logical place to defend is the guerrilla base area. This is where much, if not all, the guerrilla's air defense weapons will be stored. The weapons should be available with a plan for their use.

The simplest weapon available for air defense purposes is the guerrilla's rifle. A lone guerrilla with a Single rifle is not much of a threat to an aircraft, which is why teamwork and volume fire are the keys to effectively engaging enemy aircraft.

Volume fire is created when all available rifles are

CROSSING





SMALL ARMS AIMING POINTS

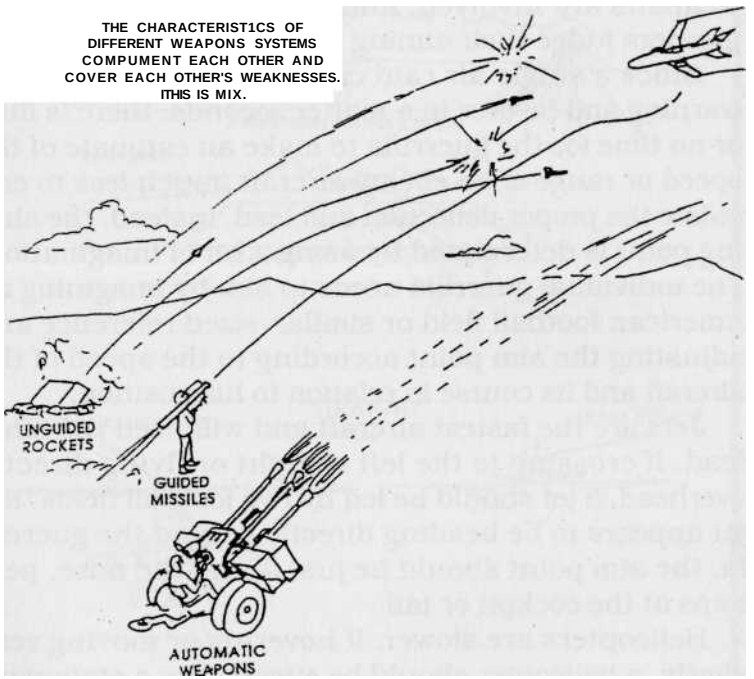
aimed in front of the nose of an aircraft. The result of such an intense use of small arms is a relatively dense mass of bullets in the path of the aircraft—in front of it, behind it, and, with any luck, right through it. The effectiveness of volume fire is dependent upon the type of weapons involved, how many weapons are involved, and how well the individual gunners judge their aiming point.

Since a Single air raid can begin with little or no warning and be over in a matter seconds, there is little or no time for the guerrilla to make an estimate of the speed or ränge of an enemy aircraft, much less to calculate the proper deflection and lead. Instead, the aiming point is determined by using a bit of imagination. The individual guerrilla needs to aim by imagining an American football field or similar-sized reference and adjusting the aim point according to the speed of the aircraft and its course in relation to his position.

Jets are the fastest aircraft and will need the most lead. If crossing to the left or right or flying directly overhead, a jet should be led by two football fields. If a jet appears to be heading directly toward the guerrilla, the aim point should be just above the nose, perhaps at the cockpit or tail.

Helicopters are slower. If hovering or moving very slowly, a helicopter should be engaged as a stationary target. If moving faster, a helicopter must be engaged by giving it a half a football field lead if it is crossing the guerrilla's position. If the helicopter is moving directly toward the guerrilla, the aim point should be the hub of the rotor blades—the drop of the rounds will land them in the engine and the cockpit.

Individual fighting positions for air defense weapons must be prepared, just as fighting positions for antitank or infantry weapons must be prepared. But requirements for air defense weapons are slightly different from, say, a machine gun used for ground defense.



MIX

There are certain principles of air defense that ensure that the tactics used, regardless of what form they take, are effective. These are mass, mix, mobility, and Integration. Here is how each works.

Mass is the simplest of these principles. It means the concentration of air defense weapons in order to have the greatest chance of a hit. Although this is a simple idea, it flies in the face of guerrülas who are tempted to "fritter away" antiaircraft weapons to many different points. The problem is there will never be enough weapons to defend everything, and by trying to do so the available weapons' effectiveness will be diluted.

It is better to rely on passive air defense measures and small arms to defend points of secondary interest, while dedicated air defense weapons are devoted to a few primary Sites. Although the guerrilla will rarely be able to concentrate air defense fire to a level comparable to that of a conventional force, as he will lack long-range, high-altitude missile Systems, he will be able to create a volume of fire intense enough to make it extremely hazardous for enemy aircraft to operate.

One example of the use of mass is the flak trap Using a flak trap is a deliberate attempt to destroy enemy aircraft and, in effect, take the initiative from him. Vietcong gunners massed automatic weapons at likely helicopter landing zones during the Vietnam War, successfully bringing down many American helicopters. (Flak traps are discussed further in Chapter 4.)

The next air defense principle is mix. Whenever possible, different antiaircraft weapons should be used in conjunction with each other. For instance, automatic weapons and shoulder-fired missiles can be used to defend the same target. In this way, the two weapon types compliment each other—missiles can hit targets at higher altitude and moving at faster speeds, while automatic weapons can hit

slower targets and those closer to the ground.

Mix compounds the enemy's problems when he tries to deal with air defense measures. If the enemy flies at a higher altitude to get above the antiaircraft cannon fire, the missles will get him. If he drops altitude to try to lose the missiles, the guns will get him. And if he forgets which is the greater danger or hesitates in making a decision, he'll get hit by both.

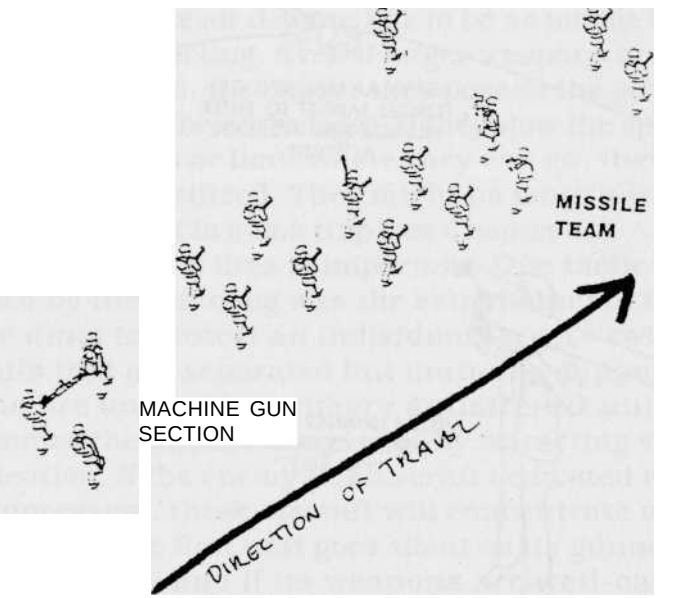
The guerrilla can use mix to compensate for the use of improvised weapons as well. Unguided rockets can be used in conjunction with the few shoulder-fired missües available to confuse enemy pilots. When flying at high speed, it is virtually impossible for a pilot to tell the difference between a guided and an unguided missile. And while far less accurate than a heat-seeking missile, an unguided rocket has two advantages over a homing missile: it cannot be fooled by infrared countermeasures such as flares, and it can be fired at an aircraft at approach, whüe crossing, or as a chase weapon (older infrared missiles are tail-chase weapons only). This is also true for conventional missiles based on other guidance principles such as laser or remote control.

By using mix, the guerrilla forces the aggressor to prepare for any contingency. His planes and helicopters must carry flares and other infrared countermeasures in case there are heat-seeking missiles, and he must carry air-to-surface missiles to counter heavy antiaircraft guns. When near the target, the aggressor must maneuver in order to evade small-arms fire and unguided rockets and potentially throw off his aim. It may turn out that what the guerrilla lacks in mass he can make up for in mix, making it his greatest air defense asset.

Needless to say, mobility is an important air defense concept when applied to guerrilla warfare. Some antiaircraft weapons must be light enough to be

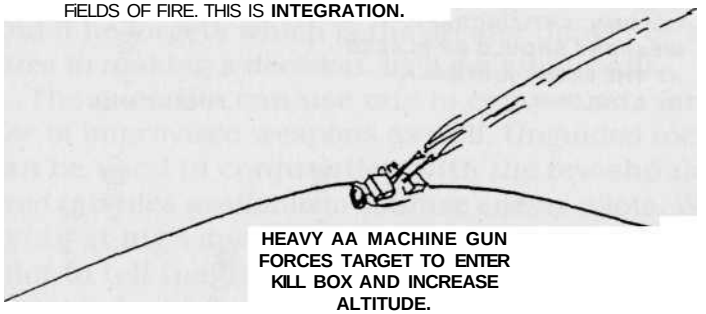
STRAFING AIRCRAFT WILL **RUN** THE LENGTH OF A COLUMN. ANTIAIRCRAFT WEAPONS SHOULD BE PLACED AT THE FRONT AND BACK OF A COLUMN.

POINT MAN

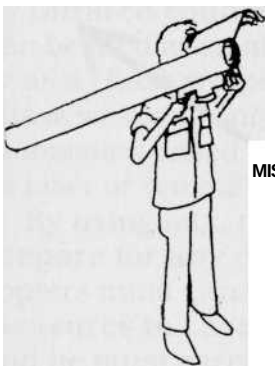


ON THE MOVE

EACH WEAPON **HAS ITS OWN AREA OF** RESPONSIBilTY, COLLECTIVELY **PROVIDING** TOTAL COVERAGE **AND INTERLOCKING** FIELDS OF FIRE. THIS IS **INTEGRATION.**



HEAVY AA MACHINE GUN FORCES TARGET TO ENTER KILL BOX AND INCREASE ALTITUDE.



MISSILE GUNNER WAITS FOR TARGET TO ENTER HIS "KILL. BOX."

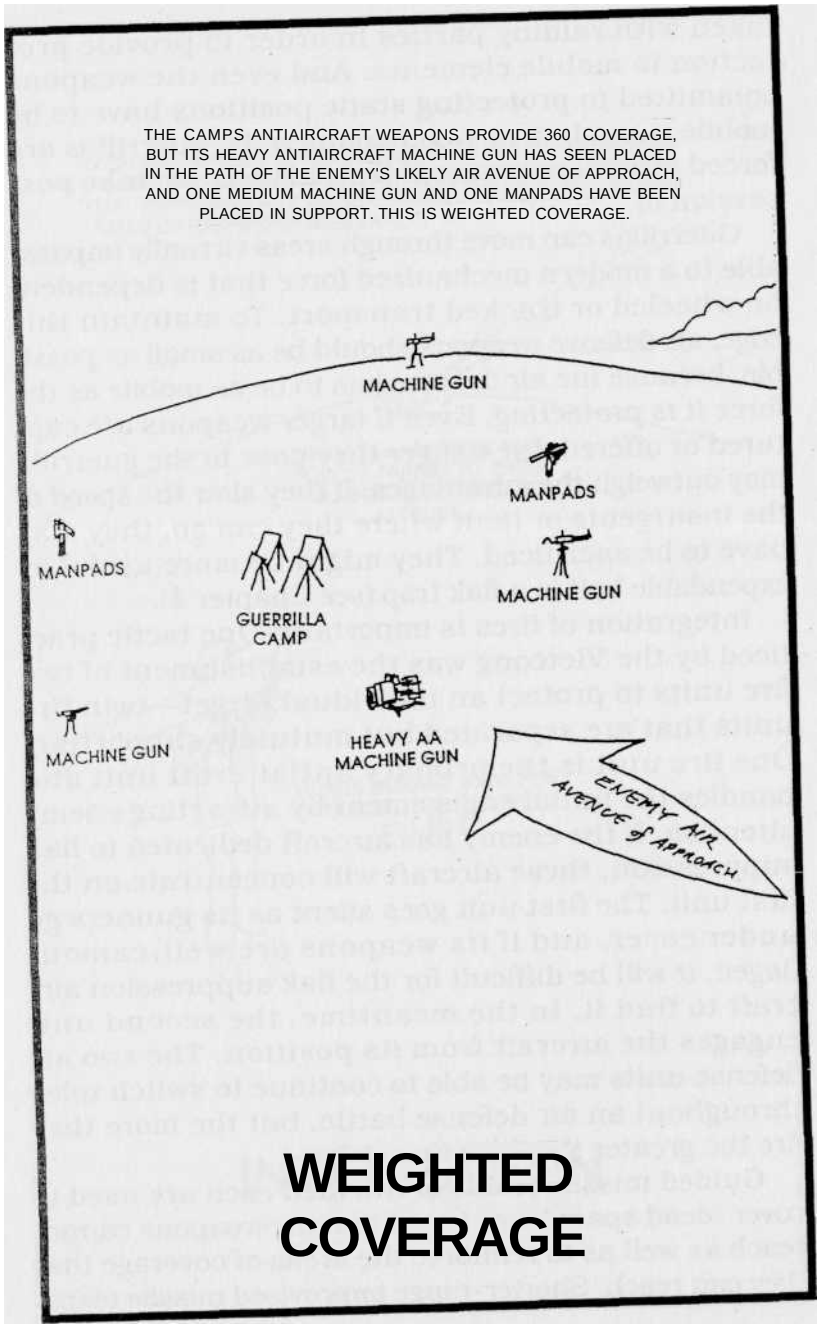
INTEGRATION

taken with raiding parties in order to provide protection to mobile elements. And even the weapons committed to protecting statte positions have to be mobile enough to be taken along if the guerrillas are forced out of an area or if they advance to take possession of new territory.

Guerrillas can move through areas virtually impassable to a modern mechanized force that is dependent on wheeled or tracked transport. To maintain this edge, air defense weapons should be as small as possible. because the air defense has to be as mobile as the force it is protecting. Even if larger weapons are captured or offered, the danger they pose to the guerrilla may outweigh the advantages. If they slow the speed of the insurgents or limit where they can go, they may have to be sacrificed. They might be more useful as expendable bait in a flak trap (see Chapter 4).

Integration of fires is important. One tactic practiced by the Vietcong was the establishment of two fire units to protect an individual target—twin fire units that are separated but mutually supportine One fire unit is the primary antiaircraft unit and handles the initial engagement by attracting enemy attention. If the enemy has aircraft dedicated to flak suppression, these aircraft will concentrate on the first unit. The first unit goes silent as its gunners go under cover, and if its weapons are well-camouflaged, it will be difficult for the flak suppression aircraft to find it. In the meantime, the second unit engages the aircraft from its position. The two air defense units may be able to continue to switch roles throughout an air defense battle, but the more they fire the greater the detection risk.

Guided missile teams of two men each are used to cover "dead space" that the automatic weapons cannot reach as well as to reinforce the areas of coverage that they can reach. Shorter-range improvised missile teams



are placed along the enemy's likely avenue of approach where they have the best Chance of interception. Air avenues of approach are identified by studying how enemy aircraft fly: Do they fly low through Valleys, or do they follow roads and highways? Do they fly into a target area using the same route each time? By studying the enemy's patterns and using that knowledge, the guerrilla can use short-range missiles to their maximum effect.

Guidelines for air defense employment involve many concepts. They are: balanced fires, early engagement, weighted coverage, mutual Support, overlapping fires, and defense in depth.

The use of balanced fires ensures 360-degree coverage around a protected point. If there are no identifiable air avenues of approach (which will probably be the case in the desert or plains), this coverage should be equal in all directions, if possible.

Early engagement means placing antiaircraft weapons where they can hit enemy aircraft at the earliest possible point. The longer an enemy aircraft is under fire, the better the chances of a hit. Also, the guerrilla will want to fire on the aircraft before it releases its ordnance. Before bomb or missile release, the pilot may have to fly straight and level for a few moments, making the aircraft an easier target. After release, the pilot will be free to maneuver in any way he sees fit, making the target harder to hit.

Weighted coverage is the principle of placing air defense weapons along the enemy's most likely avenue of approach or facing the enemy's front. This makes it likely that the guerrilla will hit the enemy with intense firepower as soon as he makes an appearance and minimizes the wasteful positioning of weapons where they are unlikely to find targets. This would seem to conflict with the balanced fires principle, but this isn't necessarily so. Individual weapons can be part of a 360-degree defense and yet simulta-

neously placed so that their Optimum coverage is right in the path of the enemy.

Mutual coverage is simply the positioning of air defense weapons so that they compensate for each other's weaknesses. Primarily, mutual coverage is concerned with placing weapons where they can cover the dead space of other weapons. For instance, if a heavy antiaircraft machine gun is placed on high ground overlooking a valley floor, there may be areas below the gun's lowest elevation that are free from fire. To compensate, an improvised antiaircraft gun is placed where it can cover this dead space.

Overlapping fires is the placing of air defense weapons close enough together so that their engagement envelopes overlap each other. In this way, an enemy aircraft is under continuous fire the entire time it is near the defended point—before the aircraft leaves the ränge of one weapon, it has already entered the ränge of another.

And finally, there is the guideline of defense in depth. This means placing air defense weapons so that the closer an aircraft gets to the target, the more fire it comes under. This will be possible only to a limited degree for the guerrilla because he will have too few weapons to defend an entire liberated area.

Training cannot be overlooked. Without it, an effective defense will be virtually impossible, regardless of what is available to mount it. Specifically, antiaircraft gunners will have to be trained on their individual weapons and know their weapons' capabilities and limitations. They should understand air defense guidelines and principles, even if they do not directly decide how their weapons are employed.

It is difficult to conduct gunnery training with guerrillas. Ideally, live-fire exercises against drones is the best method for perfecting technique, but it is unlikely that guerrillas will have ammunition to spare

for such training, nor will they have drones. Instead, gunners will have to rely on dry-fire training by tracking imaginary aircraft or modeis to practice engagement sequences, like North Vietnamese defense forces did during America's Vietnam War. The final training will come when the guerrillas are under fire against actual targets.

In general, all guerrillas should be trained in aircraft recognition in order to understand the threat posed by specific types. The WEFT (wings, engine, fuselage, tail) guide is useful for teaching aircraft recognition by observing the distinctive characteristics of each type. For instance, a MiG-21 would be described as a delta-winged, single-jet-engined aircraft with a cigar-shaped fuselage and a swept-back tail.

Air defense guidelines and principles should be adapted for use by the guerrilla and modified to whatever degree is appropriate to the Situation. At first it may be difficult to comply with all of them due to a minimum of air defense weapons. But as time goes by, it will be possible to employ them to effectively mount a defense that will deter the enemy air force, minimize its effectiveness, and destroy its planes in significant numbers.

Mounting an effective defense can be expressed in three simple words: adapt, adopt, and improve. Adapt to the conditions presented by enemy air power by using both passive and active air defense measures; adopt the weapons left behind by the enemy and provided by friendly powers to provide air defense firepower; and improve available weapons by whatever technical and tactical innovations are available.

An enemy who possesses air supremacy has the initiative in the air. But employing flak traps, which will be discussed in the next chapter, can give the guerrilla the opportunity to fight enemy air power with an advantage.

Chapter

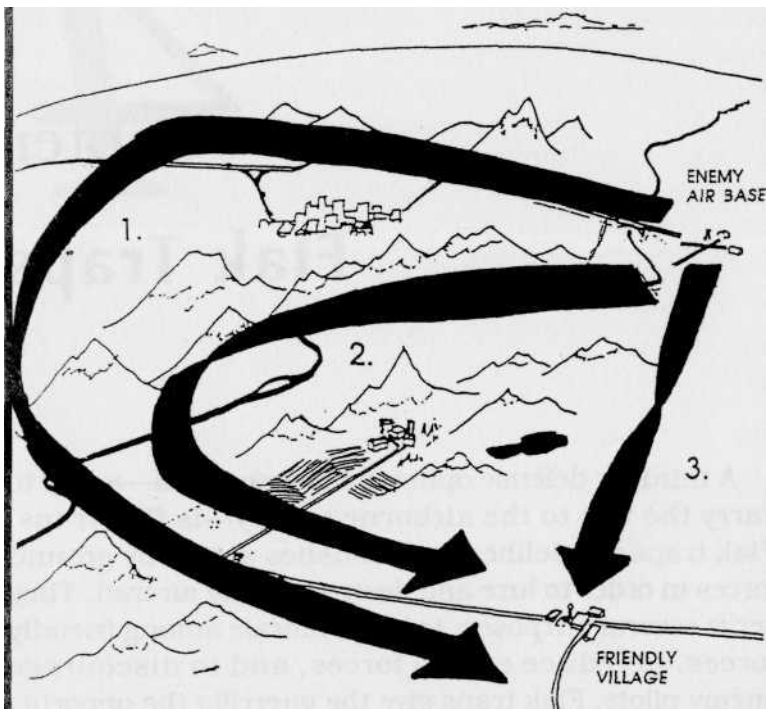
Flak Traps

A third air defense Option for the guerrilla—a way to carry the war to the airborne enemy—is flak traps. Flak traps are deliberate ambushes set up by ground forces in order to lure and destroy enemy aircraft. They serve several purposes: to build morale among friendly forces, to reduce enemy forces, and to discourage enemy pilots. Flak traps give the guerrilla the opportunity to seize the initiative for a short period of time.

Flak traps are usually designed to look nonthreatening in order to lure in unsuspecting pilots. The bait has to be something that will provide a worthwhile target, such as a fake base camp or a storage area, but it should not be an obvious lure. Attempts should be made at Camouflage, though they can be flawed attempts. Gun and other weapon positions should be

POSSIBLE ENEMY AVENUES OF APPRCACH
8ASED ON:

1. "ROAD RUNNING"
2. TERRAIN FOLLOWING
3. DIRECT ROUTE



AVENUES OF APPROACH

planned out in advance, but weapons should be camouflaged extra well by keeping them in nearby caves or under overhangs where they are hidden but can quickly be moved into position.

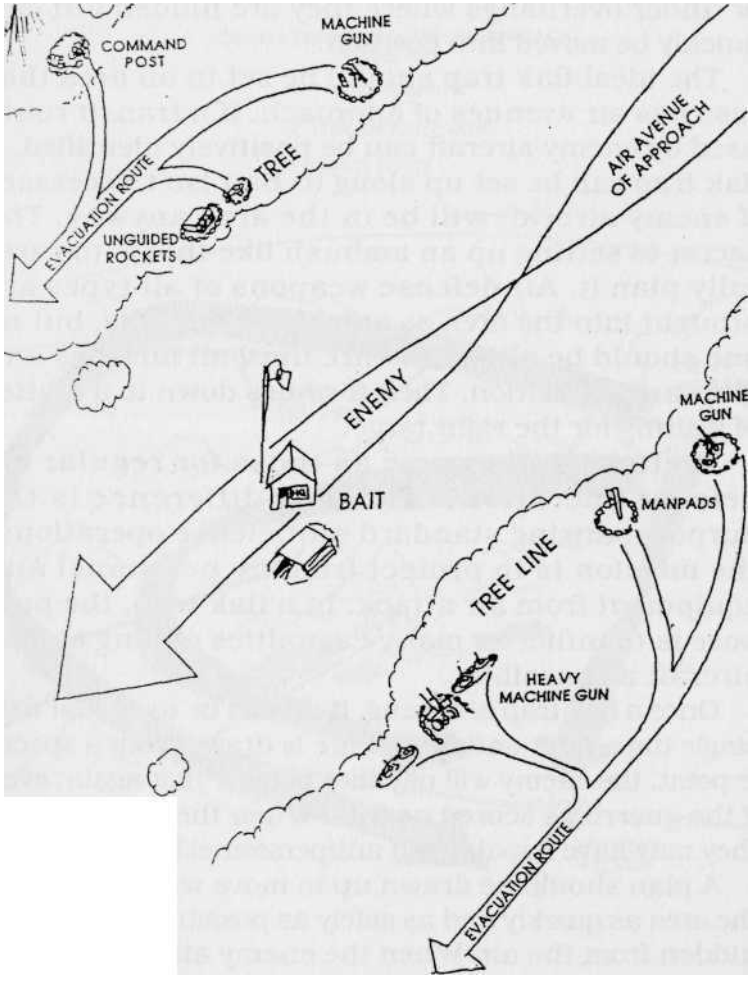
The ideal flak trap should be set in an area that restricts air avenues of approach. If a transit route used by enemy aircraft can be positively identified, a flak trap can be set up along it. Bait isn't necessary if enemy aircraft will be in the area anyway. The secret to setting up an ambush like this is to carefully plan it. Air defense weapons of all types are brought into the area as quickly as possible, but no one should be allowed to fire until all missiles and guns are in position. Then it comes down to a matter of waiting for the right target.

Tactics are the same as those for regulär air defense operations. The only difference is the purpose: during Standard air defense operations, the mission is to protect friendly personnel and equipment from air attack. In a flak trap, the purpose is to inflict as many casualties among enemy aircraft as possible.

Once a flak trap is sprung, it should be used just that Single time. After antiaircraft fire is drawn from a specific point, the enemy will pay that point a visit again, even if the guerrülas scored no hits. When they come back, they may have napalm and antipersonnel bombs.

A plan should be drawn up to move weapons out of the area as quickly and as safely as possible along paths hidden from the air. When the enemy aircraft return, they will waste their bombs on abandoned positions.

A similar Operation can be used against helicopter püots who employ road running or the "iron compass" navigation technique—a technique of using railroad tracks as navigational aids that was first used by air mail pilots. Pilots with little navigation skill or inferior Instruments sometimes develop the habit of following



FLAK TRAP

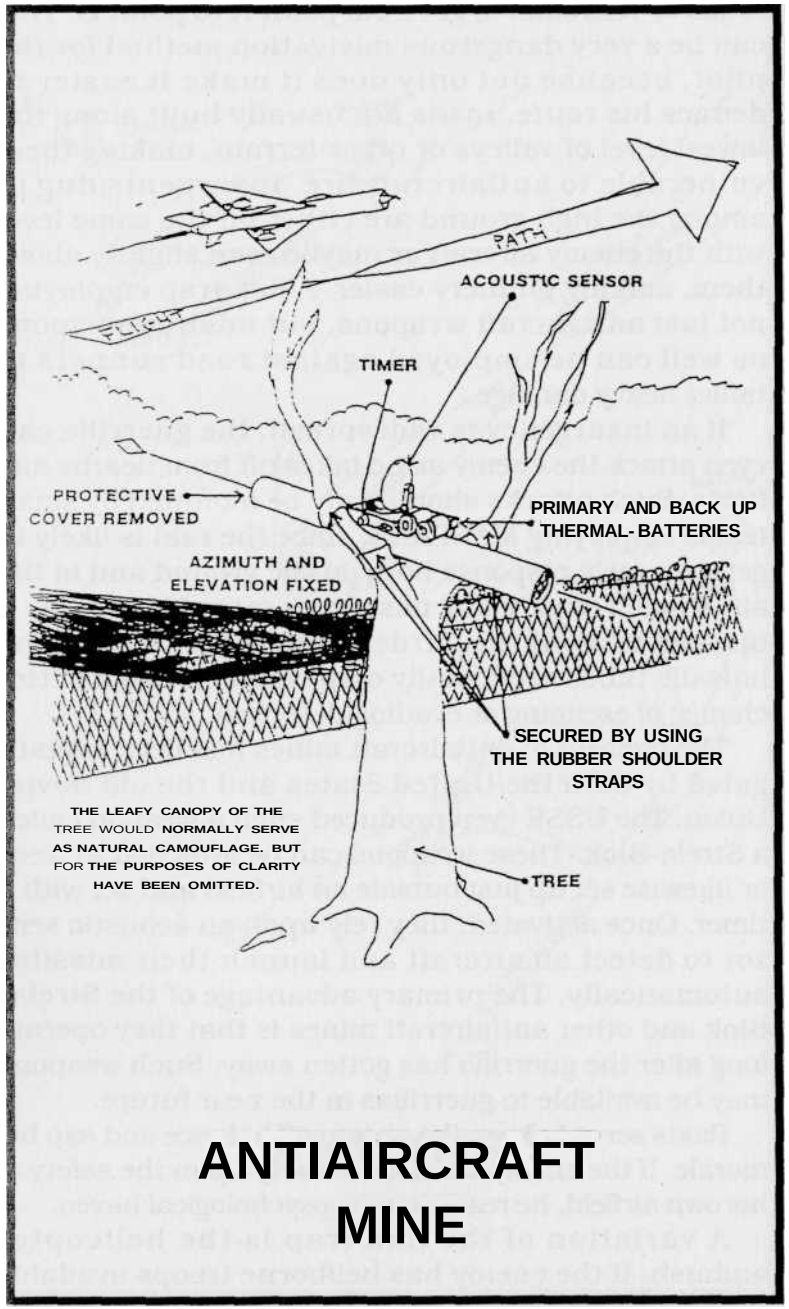
roads or railroads to get from point A to point B. This can be a very dangerous navigation method for the pilot, because not only does it make it easier to deduce his route, roads are usually built along the lowest level of valleys or other terrain, making them vulnerable to antiaircraft fire. Insurgents dug in among the high ground are either on the same level with the enemy aircraft or maybe even slightly above them, making gunnery easier. A flak trap employing not just antiaircraft weapons, but infantry weapons as well can be employed against road runners to inflict heavy damage.

If an insurgency is widespread, the guerrilla can even attack the enemy as he takes off from nearby airfields. Such attacks should only be mounted by small teams employing MANPADS, since the raid is likely to get a massive response both on the ground and in the air. A small team using missiles is more likely to get a hit, and without the burden of heavy machine guns (missile tubes are usually disposable) it has a better chance of escaping or evading detection.

The concept of antiaircraft mines has been investigated by both the United States and the old Soviet Union. The USSR even produced such a weapon called a Strela-Blok. These weapons can be attached to trees or likewise set up just outside an airfield and set with a timer. Once activated, they rely upon an acoustic sensor to detect an aircraft and launch their missiles automatically. The primary advantage of the Strela-Blok and other antiaircraft mines is that they operate long after the guerrilla has gotten away. Such weapons may be available to guerrillas in the near future.

Raids serve to keep the enemy off balance and sap his morale. If the enemy cannot even rely upon the safety of his own airfield, he really has no psychological haven.

A variation of the flak trap is the helicopter ambush. If the enemy has heliborne troops available



ANTIAIRCRAFT MINE

for COIN operations, the guerrilla may plan on setting up helicopter ambushes. These will hamper future enemy operations and create morale problems among these elite" troops.

Helicopters land troops on the ground by designating certain areas as landing zones, or LZs. An LZ will be an open level space with as much clearance from trees as possible so that helicopters can approach and touch down with little danger to their rotors.

Helicopter operations will be conducted for a variety of reasons, such as to place a Company along a suspected resupply route, to insert a recon party or as part of an overall air assault Operation. One of the ways to counteract this possibility is to be ready for the enemy when he lands. A check of the map will identify areas that the enemy might attempt to use as LZs, and these points can be prepared by the guerrilla to provide a warm welcome for the enemy.

The easiest way to prevent the enemy from using an LZ, or at least making him pay a high price for doing so, is to plant minefields in the open space where helicopters are bound to deposit their troops If a soldier is injured or killed by a mine as soon as he eaves the aircraft, it will cause the remaining troops to hesitate or maybe not leave the helicopter at all bven if the troops manage to get off the helicopter their movements will be limited when they discover they are in the middle of a minefield.

Antipersonnel mines are sufficient for this task but it may be useful to place some antitank mines among them as well. Some helicopter pilots will land their machine firmly on the ground to deposit troops Depending on the type of antitank mine employed this might create enough pressure to set the mine off destroying both helicopter and passengers A rod detonator commonly used with antitank mines is ideal for such operations. Any recovered dud bombs

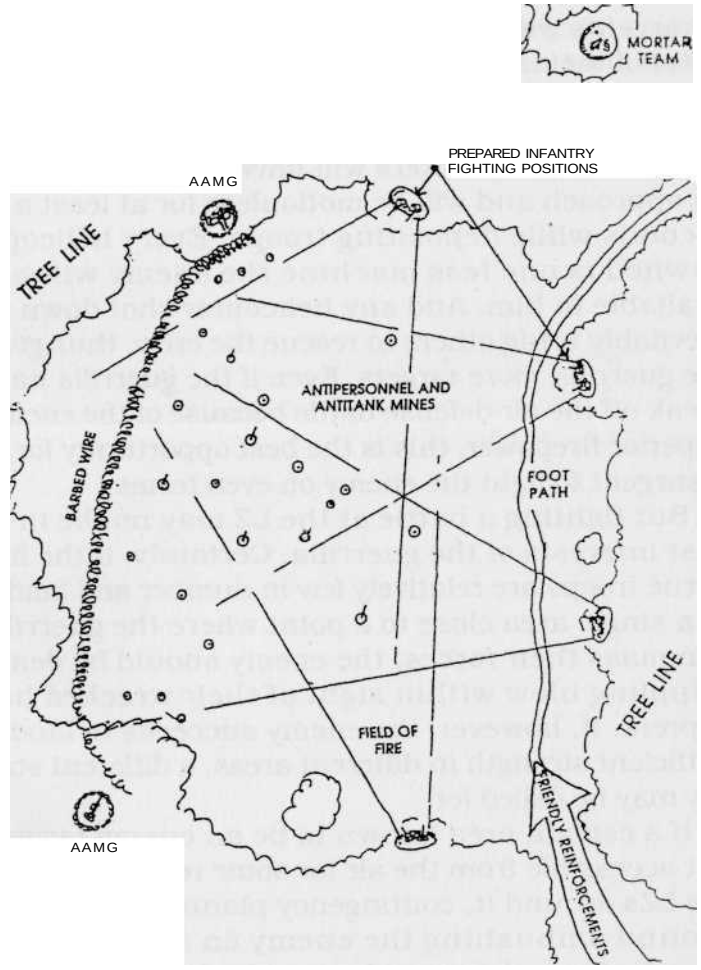
could be made into improvised mines when buried nose up in the ground and fitted with new detonators and rods.

Other antipersonnel devices can be hidden in the grass of a potential LZ, such as barbed wire, punji stakes, and knee-deep post holes. All of these can be employed to make it difficult for the enemy to successfully deploy from his aircraft; however, it is possible to overdo it Pits should not be dug, as they could actually be used as cover by the enemy, even if stakes or spikes have been put in them. Likewise, the idea of planting poles is of limited value. While they might make it difficult for helicopters to land, especially if explosives are attached to them, they are also an indicator to enemy intelligence of the presence of guerrillas. If poles canbe placed on short notice in a way that would take the enemy by surprise, they might be worthwhile.

Fighting positions can be prepared in advance around the perimeter of the LZ in the tree line, if one exists Some of these should be manned in advance to provlde harassing flre and take advantage of the initial confusion caused by the antipersonnel devices and to pin the enemy down until more guerrillas can be brought up to man the remaining fighting positions.

Once manned, the fighting positions will form interlocking flelds of fire that will sweep the LZ, pinning down and küling the heliborne force before it can establish itself on the ground. Mortar fire and any artillery available will be used to inflict the maximum amount of punishment possible on the enemy. Artillery fire can be carefully planned for maximum effect, if it is available.

Once engaged, the enemy might call in other aircraft for support, such as helicopters and fixed-wing aircraft, to bomb and strafe the insurgents besieging their heliborne force. A trick the Vietnamese used is "hugging." or moving so close to the air assault unit



HELICOPTER AMBUSH

that enemy aircraft cannot be used to attack the insurgents without running the risk of hitting their own troops. While this allows the enemy to engage the insurgents with all of their small arms, it negates the effect of their heavier weapons.

A helicopter ambush is the best opportunity the guerrilla will have to bring down the enemy's aircraft, because the helicopters will have to fly low and slow on approach and will be motionless for at least a few seconds while depositing troops. Every helicopter downed is one less machine the enemy will have available to him. And any helicopter shot down will inevitably bring others to rescue the crew, thus giving the guerrilla more targets. Even if the guerrilla has to break off the air defense battle because of the enemy's superior firepower, this is the best opportunity for the Insurgent to fight the enemy on even terms.

But fighting a battle at the LZ may not be in the best interests of the guerrilla. Certainly, if the heliborne troops are relatively few in number and landing in a Single area close to a point where the guerrillas can mass their forces, the enemy should be dealt a crippling blow within sight of their wrecked helicopters. If, however, the enemy succeeds in landing sufficient strength in different areas, a different strategy may be called for.

If a certain area known to be an enemy target is not accessible from the air for some reason but there are LZs around it, contingency planning can revolve around ambushing the enemy en route from the LZs. In fact, this may be an ideal strategy if the enemy's route is predictable and there is an identifiable choke point at some point along it. In this type of action, guerrillas near the LZs would cause as much damage as they could on the enemy as he landed, then fight a withdrawal along the enemy's route, inflicting as many casualties as they can.

Once they hook up with other guerrillas manning the choke point, they can reduce the enemy further and perhaps even counterattack.

So far, I have discussed the methods of air defense—the tactics. In the next chapter, I will look at the means of air defense—the weapons.

5Chapter

Dedicated Antiaircraft Weapons

Antiaircraft weapons have their own unique characteristics and requirements. Some weapons, such as antiaircraft machine guns, are close relatives to the machine gun familiar to every infantryman, while surface-to-air missiles are totally different in design and use from anything the guerrilla is likely to be familiar with. Some weapons that are likely to be used in an insurgency are examined in this chapter.

Automatic weapons are effective for air defense at close range. What they lack in "reach" and "punch" they make up for in volume, spraying hundreds of bullets into the path of the aircraft. We will be looking at several types of automatic weapons in use in the 1990s, but first let's discuss the qualities and concerns involving all these weapons.

Automatic antiaircraft weapons are almost certainly going to be more sophisticated, or at least more complicated, than a simple infantry machine gun. Care and servicing are important. If they have been provided by a friendly outside power, arrange for formal training in their use and maintenance. If such weapons are captured, enemy prisoners should be persuaded to teach the insurgent force how to maintain them. Any manuals that are captured or otherwise made available should be studied carefully.

One maintenance problem that is likely to arise as a result of the exceptional rate of fire used in automatic antiaircraft weapons is barrel wear. Each round fired will cause barrel wear, which in turn will cause a gradual degrading of the weapon's accuracy. Many such weapons have barreis that are designed to be removed and replaced easily.

To keep available weapons up to their maximum effectiveness, the number of rounds fired by each weapon should be kept track of. Granted, keeping track of the number of rounds fired per barrel may be difficult in the heat of battle, but the number can at least be guessed at and barreis replaced according to the recommended Service lifetime. If this is impractical because of a lack of spares available, the number will enable the guerrillas to use barrels with the lowest number of rounds and replace the most worn barrels with the newest captured or provided.

Rounds for these weapons may have to be manually linked by the gunner into a belt, but often they come pre-linked. A typical belt might include a sequence of tracer, armor-piercing, ball, ball, ball ammo. When fired, the weapon's tracer stream not only gives the gunner an idea of the true path of the rounds, but also serves to unnerve enemy pilots who have to fly through the hail of bullets to reach their targets. These two advantages outweigh the disadvantage that the tracer stream also makes it easier for the pilots to spot the location of guns when they fire.

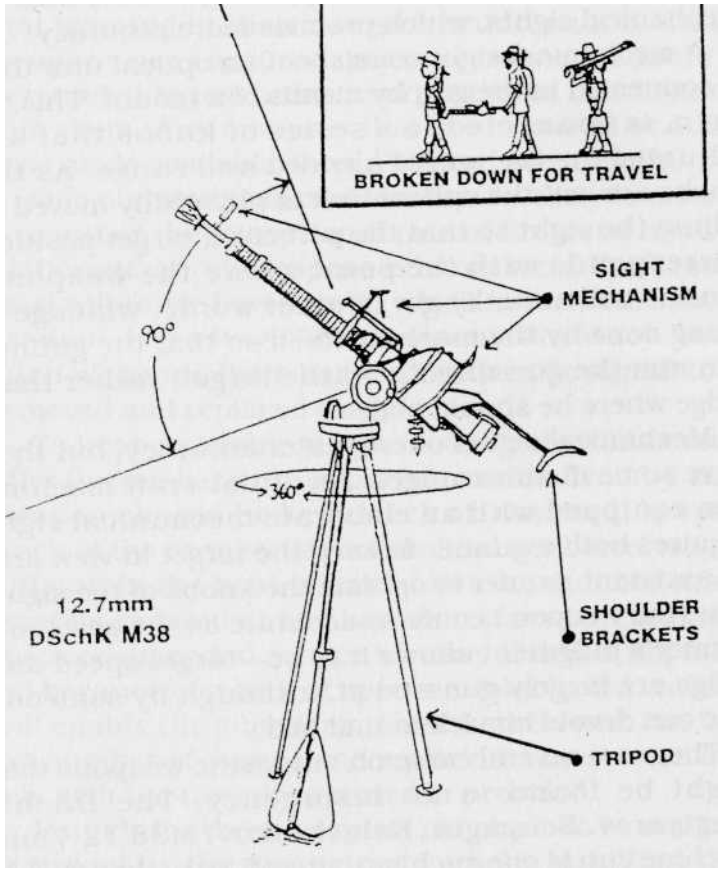
Gunnery with such weapons can be of two types: 1) simple "iron" sights in which lead is figured (or, more likely, guessed at) by the gunner, and 2) mechanical sights, which promise more accuracy.

A mechanical sight consists of an optical unit that is connected to the gun by means of a mount. This, in turn, is connected to a series of knobs that are adjusted for the target's speed and range. As the knobs are set, the optical unit is physically moved to adjust the sight so that the perceived target position corresponds with the point where the weapon's rounds will actually go. In other words, windage is being done by the machine itself so that the gunner can aim the gun directly at the target, rather than judge where he should aim.

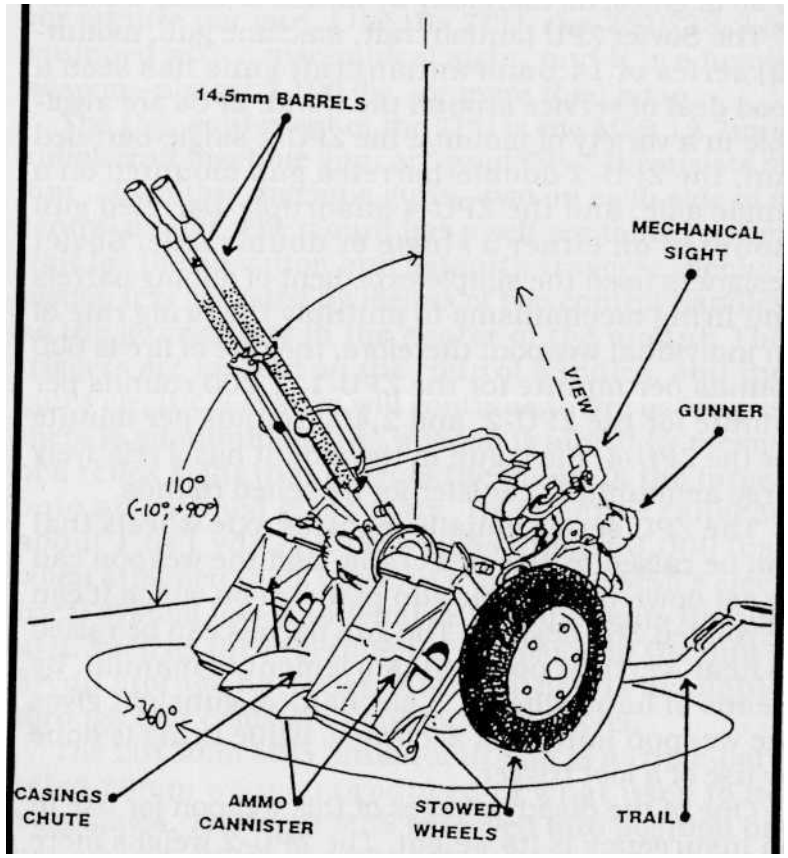
Mechanical sights offer greater accuracy, but they have some disadvantages. An antiaircraft machine gun equipped with an elaborate mechanical sight requires both a gunner to keep the target in view and an assistant gunner to operate the knobs of the sight. Plus, the weapon is only as accurate as the assistant gunner's judgment allows it to be—target speed and range are largely guessed at, although by someone who can devote himself to that task.

There are several common automatic weapons that might be found in an insurgency. The DSchK (Degtyarev, Schpagin, Kalashnikov) M38 12.7mm machine gun is one such antiaircraft gun, though it is designed as a dual-purpose weapon. When equipped with a Standard tripod, it can be used in the antiaircraft role. Because they are found on many Russian vehicles, it is possible to salvage M38s for antiaircraft purposes. The DSchK has a range of 1,094 yds. against aerial tar gets. It weighs 69 Ibs., not including the tripod.

A Czech quad Version of the DSchK is the M53



TRIPOD-MOUNTED MACHINE GUN



HEAVYAA MACHINE GUN

antiaircraft machine gun. Mounted on a two-wheeled carriage, the weapon operates on a stabilized platform. It can be turned 360 degrees but elevated only to 90 degrees, all manually by means of hand wheels.

The Soviet ZPU (antiaircraft, machine gun, mounted) series of 14.5mm antiaircraft guns has seen a good deal of service around the world. ZPUs are available in a variety of mounts: the ZPU-1 single-barreled gun, the ZPU-2 double-barreled gun mounted on a Single axle, and the ZPU-4 quadruple-barreled gun mounted on either a Single or double axle. Soviet designers used the simple expedient of adding barreis and firing mechanisms to multiply the firing rate of an individual weapon; therefore, the rate of fire is 600 rounds per minute for the ZPU-1, 1,200 rounds per minute for the ZPU-2, and 2,400 rounds per minute for the ZPU-4. Each gun in the mount has a relatively large ammunition canister for its belted rounds.

The ZPU series usually features axle wheels that can be raised by use of a crank, and the weapon can be set down on a stable gun platform on which it can be rotated 360 degrees. The gun barreis can be raised to near-vertical position. Movement is manual, by means of hand wheels. A mechanical gunsight gives the weapon improved accuracy, while firing is done by use of a foot trigger.

One of the disadvantages of this weapon for use in an insurgency is its weight. The ZPU-2 weighs more than 1,400 lbs., while the ZPU-4 is a whopping 3,990 lbs., making these weapons difficult to move without some sort of tow vehicle. However, they can be manhandled to a small degree, and their weight does make the weapon mount a very stable gun platform.

The ZPU-2 has been mass-produced by the People's Liberation Army (PLA) of communist China as the Type 58, and a variant of the ZPU-4 is also available from the PLA.

Another, heavier Soviet weapon is the twin-barreled ZSU-23-2. A 23mm gun, the ZSU-23-2 can fire 1,000 rounds per minute per barrel, or 2,000 rounds per minute per gun. Like the ZPU, the ZSU-23-2 is equipped with a mechanical sight, and it is a heavy weapon—almost 2,100 lbs., or more than a ton.

The U.S. equivalent of the ZPU is the M55 12.7mm antiaircraft machine gun, or "quad fifty." It consists of four .50-caliber machine guns—two on each side of a central mount. The mount has a self-contained power unit for the elevation and azimuth traverse mechanisms. It is operated by means of two control handles as the gunner sits in the center of the mount. The triggers are located on the control handles, and the gun's electrical system will continue to fire as long as there is ammunition. The weapon is aimed by means of a reflex sight that reflects the image of the target onto an inclined glass plate. Its effective ränge is about 1,641 yds., and it weighs almost 3,000 lbs. when attached to its wheeled trailer. The M55's electrical System has maintenance requirements unique to it, such as the prevention of corrosion in the unit's 6-volt storage batteries. Ammunition is available through four canisters—one for each barrel.

The 20/3mm M55 antiaircraft gun is a triple-barreled 20mm weapon produced in what used to be Yugoslavia. The Yugo M55 is moved into position on two wheels, which are lifted off the ground after the antiaircraft gun's outriggers are lowered into place. The gun can fire 2,100 rounds a minute from its three combined barrels, but each of the three cylindrical canisters holds only 60 rounds.

There are three versions of the Yugo M55: the A2 is operated entirely manually, the A3 is outfitted with a motor for powered traverse and elevation, and the A4 B1 has powered traverse plus a computerized sight in place of Standard mechanical sights. Firing is done by

NAME	Caliber	RPM	MAX RANGE	MAX ALTITUDE	WEIGHT
DSchK M-38	12.7mm	500	1,641 yds	1,094 yds	261 lbs
M53 (CZK)	12.7mm	80x4**	7,111 yds	6,126 yds	1,380 lbs*
M55 (U.S.)	12.7mm	150x4**	1,641 yds	1,094 yds	2,145 lbs*
M55 20/3mm	20mm	700x3	6,017 yds	4,376 yds	2,420 lbs
M75 20/1mm	20mm	700x1	6,017 yds	4,376 yds	573 lbs
M167 (U.S.) VULCAN	20mm	3,000	2,407 yds	1,313 yds	3,400 lbs
Oerlikon GAI-BO1	20mm	1,000	3,282 yds(?)	2,188 yds	890 lbs
Oerlikon GBI-AO1	25mm	160**	3,282 yds(?)	2,735 yds	970 lbs*
Type 56	14.5mm	550x4	2,188 yds	1,641 yds(?)	4,600 lbs
Type 58	14.5mm	550x2	2,188 yds	1,641 yds(?)	1,450 lbs
Type 75 (T)	14.5mm	550x1	2,188 yds	1,641 yds(?)	310 lbs
Type 75-1 (W)	14.5mm	550x1	2,188 yds	1,641 yds(?)	360 lbs
Type 80	14.5mm	550x1	2,188 yds	1,641 yds(?)	470 lbs
ZPU-1	14.5mm	140x1**	8,752 yds	5,470 yds	900 lbs*
ZPU-2	14.5mm	140x2**	8,752 yds	5,470 yds	1,400 lbs*
ZPU-4	14.5mm	140x4**	8,752 yds	5,470 yds	4,000 lbs*
ZSU-23-/	23mm	200x2**	7,658 yds	5,579 yds	2,000 lbs

* Without Trailer ** Practical Rate of Fire

Note that when maximum altitudes and ranges were not available, effective ranges and altitudes were substituted.

AUTOMATIC AA GUNS

foot pedals. Their range is 2,735 yds. with a vertical reach of about 2,188 yds. The weapon weighs more than 2,100 Ibs. unloaded.

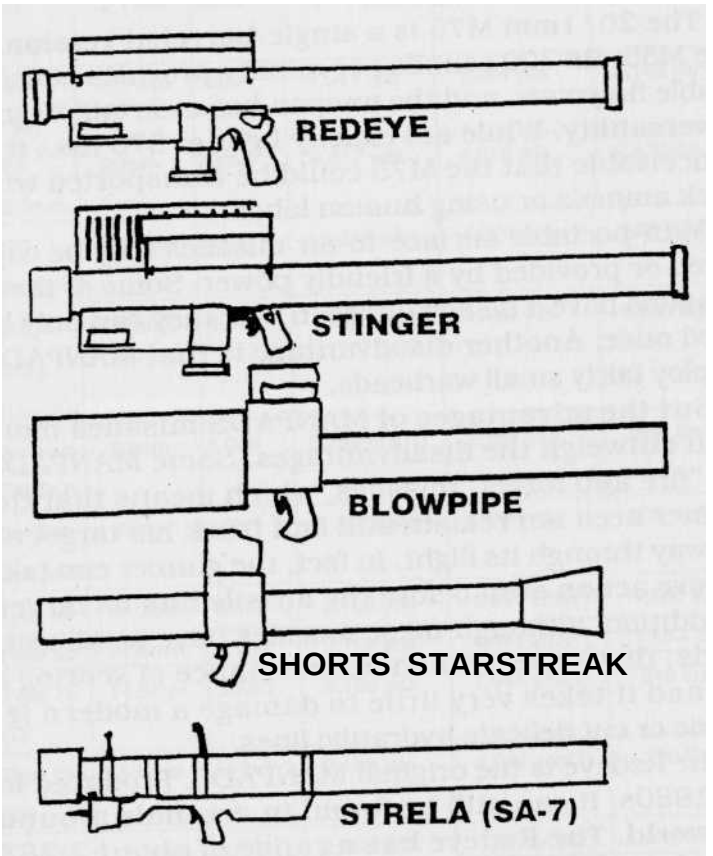
The 20/ lmm M75 is a Single-barreled Version of the M55. Its 700 rounds per minute provides considerable firepower, and the weapon has a certain degree of versatility. While not exactly light at 573 Ibs., it is conceivable that the M75 could be transported with pack animals or using human labor.

Man-portable surface-to-air missiles may be captured or provided by a friendly power. Some of these weapons have a disadvantage in that they can only be used once. Another disadvantage is that MANPADS employ fairly small warheads.

But the advantages of MANPADS missiles more than outweigh the disadvantages. Some MANPADS are "fire and forget" missiles, which means that the gunner need not remain still and track his target all the way through its flight. In fact, the gunner can take evasive action even before the missile hits its target. In addition, although these missiles have small warheads, they have a much better chance of scoring a hit, and it takes very little to damage a modern jet engine or cut delicate hydraulic lines.

The Redeye is the original MANPADS. Produced in the 1960s, it can still be found in arsenals around the world. The Redeye has a range of about 3,282 yds., but it is a tail-chase-only weapon. The hot exhaust of a jet engine is needed for the primitive seeker head to home in on, and it can only be used against an aircraft that has already passed overhead on the way to its target.

To prepare the Redeye to fire, the gunner must remove the protective Cover from the front of the launch tube and install the cylindrical battery, which screws into place at the bottom of the tube and forward of the hand grip. The gunner then raises



VARIOUS MANPADS

the optical sight from its stowed position folded alongside the missile's launch tube until it snaps into place.

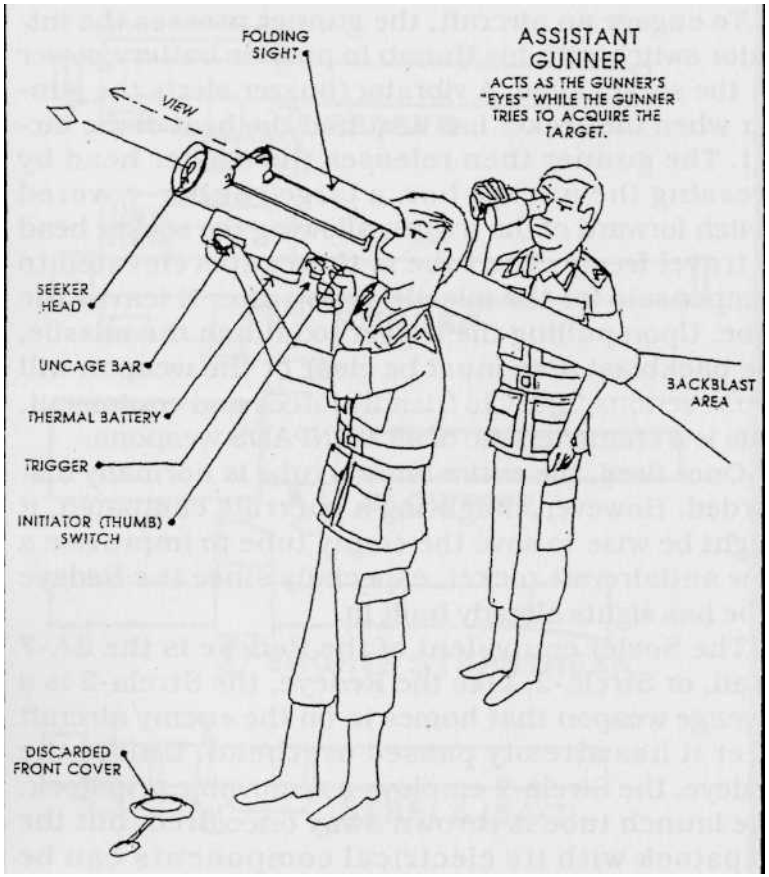
To engage an aircraft, the gunner presses the initiator switch with his thumb to provide battery power for the seeker head. A vibrator/buzzer alerts the gunner when the seeker has acquired the heat of the target. The gunner then releases the seeker head by pressing the uncage bar, a large rubber-covered switch forward of the trigger, allowing the seeker head to travel freely. The tube is then superelevated to compensate for the missile's drop after it leaves the tube. Upon pulling the trigger to launch the missile, the backblast area must be clear or the weapon will cause serious injury to friendly forces and equipment. This is a characteristic of all MANPADS weapons.

Once fired, the entire launch tube is normally discarded. However, if fighting a guerrilla campaign, it might be wise to save the empty tube to improvise a new antiaircraft rocket, especially since the Redeye tube has sights already built in.

The Soviet equivalent of the Redeye is the SA-7 Grail, or Strela-2. Like the Redeye, the Strela-2 is a revenge weapon that homes in on the enemy aircraft after it has already passed overhead. Unlike the Redeye, the Strela-2 employs a removable gripstock. The launch tube is thrown away once fired, but the gripstock with its electrical components can be attached to a new tube and used many times over.

To prepare to fire the Strela-2, the gunner removes the protective cover and installs a battery, in this case a small cylinder that attaches to the front of the gripstock. Instead of a one-piece sight, there are separate front and rear sights that unfold alongside the missile tube.

To engage an aircraft, the gunner turns a friction switch on the battery, activating it **and** providing



MISSILE GUNNER

power for the seeker head. Once the seeker has acquired the target, a green light will illuminate in the sights and a tone will be generated. Pulling the trigger halfway uncages the seeker head so that the gunner can superelevate the launch tube. Once in position, the gunner pulls the trigger the rest of the way, and the missile is launched.

One danger in using the Grail is the eye hazard posed by the missile. Later model missiles, and even the Redeye, employ a booster motor to get the missile started. The booster motor shuts down before the missile leaves the tube, allowing the missile to coast a short distance before the sustainer motor kicks in. It also prevents the gunner from having a live rocket motor firing only two feet from his face. But the safety feature of a booster motor is not present on the Strela-2, so goggles are absolutely necessary when launching the missile.

A helmet-mounted device called a Pelengator has been designed as an early warning device for use with the Strela-2. The helmet antenna picks up the radar emissions and other RF (radio frequency) sources from aircraft, and a set of earphones gives that information to the gunner. This can be a very valuable device, as it gives the gunner non-line-of-sight acquisition of aircraft and some early warning ability. It may be adapted to other antiaircraft weapon systems, too.

Strela-2s were used by guerrillas during the Vietnam War to inflict damage on American aircraft. One area in South Vietnam was called SA-7 Alley for the prodigious use of Strela-2s.

There are several copies of the Strela-2, notably the Egyptian Sakr-Eye and the Chinese HN-5. These are superficially identical to the Soviet-made missile, although the Sakr-Eye was designed with a night-vision device and optical sight. This gives it a big advantage, even over more sophisticated MANPADS

such as the Stinger. Older versions of the Strela-2 have a maximnum range of about 3,938 yds.; improved versions can hit targets at a range of about 6,126 yds. Their maximum altitude is about 4,923 yds.

The Strela-3, code named SA-14 Gremiin, is a more advanced version of the Strela-2 and compensates for many of the Strela-2s weaknesses. Although it is still a tail-chase weapon, it is a deadlier one with a seeker head capable of ignoring infrared sources that might fool a first-generation MANPADS System.

The most notable difference between the Strela-2 and Strela-3 is the forward-mounted battery: the Strela-3's is spherical instead of cylindrical. This is no doubt part of a product-improvement program, as the Strela-2's battery had a run time of anywhere from 10 to 60 seconds, and the Strela-3's battery run time is probably more consistently about 60 seconds. Preparing the Strela-3 to fire appears to be identical to the Strela-2. Its range is about 6,564 yds., and its maximum altitude is about 6,017 yds.

The American-made Stinger is a second-generation MANPADS. Famous for its success in the hands of Afghani rebels, the Stinger is an all-aspect weapon capable of hitting aircraft as they approach, as they cross, or as they leave the gunner's defended area. It is harder to fool with flares. It has a range of around 3 miles and a ceiling of around 5,107 yds. In the hands of a good gunner it is a real helicopter killer.

Unlike its predecessor, the Redeye, the Stinger has a detachable gripstock. The gripstock includes the folding sights, the trigger, the battery well, and a folding antenna unit on the right side. The antenna connects to an IFF (Identification, Friend or Foe) System, which transmits a code to an unknown aircraft. A friendly aircraft will have the correct response code. However, the guerrilla is in a Situation where he must consider every aircraft to be hostile; an IFF System is

unnecessary and even dangerous, as enemy aircraft may be capable of detecting its Signal.

Indeed, the most extensive use of Stingers took place during the Soviet occupation of Afghanistan—a Situation in which the need for an IFF system was nonexistent. The Stinger was well liked by the Afghanis, who stated that a Mujihadeen needed only two things: the Koran and Stingers.

Preparation and firing of the Stinger is identical to the Redeye. After expending the missile, the gunner removes the gripstock to attach it to the next round. The next round need not necessarily come from a MANPADS System. Stinger rounds are being adapted for use on board helicopters for the air-to-air role, and a vehicle-mounted version of the Stinger, called the Avenger, places Stinger rounds on either side of a turret. Removed from these mounts, the tubes can be attached to a gripstock and be made ready for use. Assuming these versions are exported, it may be possible to capture such rounds from shot-down aircraft or captured vehicles.

The next Russian MANPADS is the Igla, known in the West as the SA-16. This missile system is distinctly different from the Strela series, although the Igla shares the characteristic gripstock design and folding sights. It uses a battery similar to the Strela-3's, but its warhead is cone-shaped. The control and launch sequence is also similar to that of the Strela-3. The Igla is an all-aspect weapon with a ränge of up to 4.3 miles and an altitude of up to 3.7 miles. It is designed to be less susceptible to simple infrared countermeasures (IRCM).

Infrared gunnery is different from other types of weapons. When tracking an aircraft, it is necessary to keep the missile aimed over the horizon—heat reflected from the earth or plants might lure the missile from its target. Obviously, the sun is an intense heat source capable of diverting the missile, but less obvi-

ous is the danger posed by clouds. Clouds can reflect enough heat to fool the missile's guidance System, and enemy aircraft might deliberately try to lose a heat-seeking missile by flying through the clouds.

A gunner can avoid typical IR spoofing by waiting until a target is in sight before initiating the battery unit. The missile's battery will only last about a minute, but while it runs it keeps the seeker head cool enough to "see" its heated targets. The gunner then visually acquires the target and aims until the missile responds with a tone, showing that the seeker head "sees" the target. If there are clouds or other potential IR sources along the aircraft's path, the gunner waits before releasing the seeker head to track independently prior to super-elevating and launching.

The same tactic works against the IRCM of choice: flares. Pilots will often drop flares if they are aware that their aircraft is being tracked by heat-seeking missiles, either singly or in patterns. Flares are hotter than the exhaust of aircraft and will therefore provide a "better" target for the missile. If a gunner holds fire until the aircraft stops dropping flares, it could defeat enemy IRCM.

Another factor a missile gunner must be aware of is the safety procedures involved in using coolant batteries. Such batteries generate an enormous amount of heat when in Operation. After firing, a gunner must remove the battery by unscrewing it by its insulated collar and then allowing it to drop to the ground.

Fumes are also a hazard involved with such weapons. When firing or changing batteries, a gunner should hold his breath for a few seconds until the fumes dissipate. The gases involved in supercooling are usually not toxic, but they can still cause breathing problems.

The British Blowpipe is a MANPADS similar in size

to the heat-seeking missiles commonly used for air defense, but it is command-guided instead. The gunner acquires his target in the optical sight attached to the missile round, removes the safety catch, and pulls the trigger, activating the batteries. Once fired, the gunner keeps both the target and the missile's tail flare in sight, correcting the missile's course by means of a thumb-controlled Joystick. Corrections are transmitted to the missile by means of a radio in the optical sight package. The gunner must continue to track the target until the missile scores a hit.

The Blowpipe is superior to heat seekers in that IRCM are virtually ineffective against it. However, its two drawbacks are the amount of time the gunner must remain in the open tracking the target and its Problems in tracking crossing targets.

The Blowpipe's optical package, which includes the trigger mechanism, detaches from the tube so that it can be used again and again. The ränge of the Blowpipe is more than 2 miles.

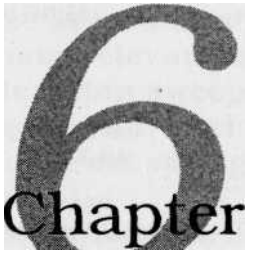
The Starstreak is a more sophisticated weapon. It uses a laser system that is incorporated in the optical package to guide the missile to its target. Once launched, the gunner needs only to keep the target in sight—the missile does the rest. The missile travels at very high speed, and its warhead consists of three explosive darts that separate prior to impact. The three darts spread out slightly, increasing the likelihood of a hit. The missile relies primarily on kinetic force to cause damage rather than the explosive force of its tiny warheads.

These are by no means the only air defense weapons that might be available to the guerrilla; other weapons are in development, and weapons that today may be unobtainable to a guerrilla force might someday reach their hands. But the weapons discussed here are typical in Operation and principle of a

NAME	TYPE	WEIGHT	MAX RANGE	MAX ALTITUDE
HN-5	IR Homing	35 lbs	4,376 yds	2,735 yds
Chinese copy of the Strela-2		Minimums:	875 yds	55 yds
IGLA	IR Homing	33 lbs	6,564 yds	6,017 yds
NATO SA-14 "Gremiin"		Minimums:	656 yds	11 yds
MATRA MISTREL	IR Homing	44 lbs	6,564 yds	4,923 yds
Employs a tripod launcher		Minimums:	328 yds	16 yds
	Laser	185 lbs	5,470 yds	3,282 yds
(with stand and sight) Breaks down into major components for travel		Minimums:	219 yds	Oyds
	IR Homing	29 lbs	3,610 yds	3,282 yds
First generation MANPADS		Minimums:	656 yds	27 yds
	IR Homing	33 lbs	4,814 yds	2,626 yds
Egyptian copy of the Strela-2		Minimums:	875 yds (?)	55 yds
	Command	38 lbs	3,829 yds	2,735 yds
Uses radio commands		Minimums	547 yds	11 yds
	Command	53 lbs	6,017 yds	3,282 yds
3-tube launcher available		Minimums:	547 yds	11 yds
Shorts STARSTREAK	Laser	(?)	7,658 yds	4,376 yds
Uses high-velocity darts		Minimums:	328 yds	11 yds (?)
	IR Homing	35 lbs	6,017 yds	5,251 yds
Second generation MANPADS		Minimums:	219 yds	33 yds
	IR Homing	29 lbs	3,938 yds	3,282 yds
NATO SA-7 "Grau"		Minimums:	492 yds	27 yds
STRELA-2M Improved "Grail"	IR Hominc	31 lbs	6,126 yds	4,923 yds
		Minimums:	492 yds	16 yds
All weights include launcher. Ranges and weights are approximate. Many types are still classified.				
MANPADS				

wide range of weapons, and familiarity with them will enable one to understand and adapt to similar missiles and guns.

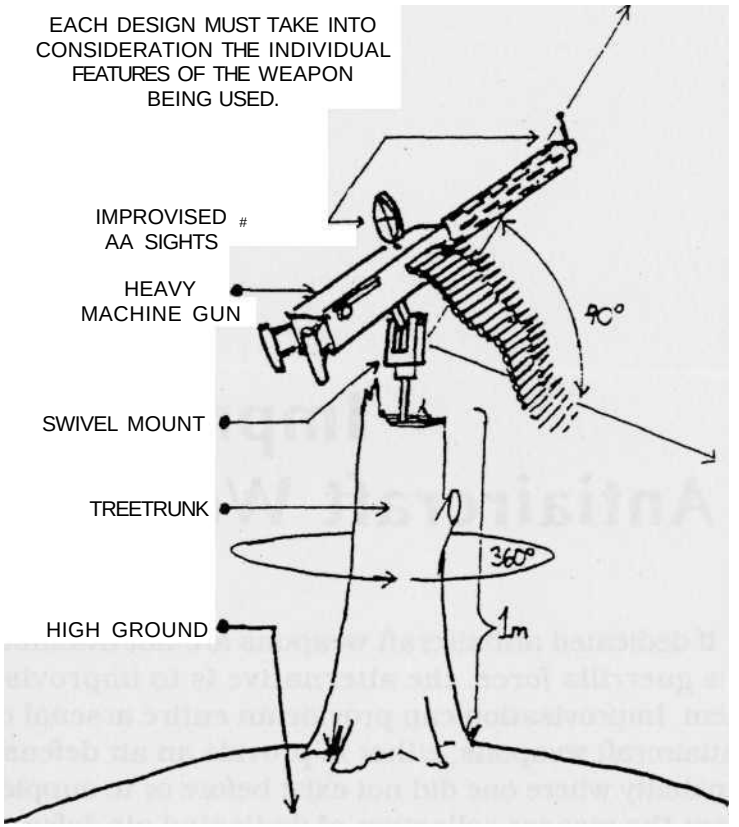
But a guerrilla war is a poor man's fight. What a guerrilla cannot obtain he must either do without or improvise. And as shown in the next chapter, it is possible to improvise effective antiaircraft weapons.



Improvised Antiaircraft Weapons

If dedicated antiaircraft weapons are not available to a guerrilla force, the alternative is to improvise them. Improvisation can provide an entire arsenal of antiaircraft weapons, either to provide an air defense capability where one did not exist before or to Supplement the meager collection of dedicated air defense weapons available to the movement.

The easiest antiaircraft weapon to improvise is the antiaircraft machine gun. Machine guns that are provided by sympathetic Outsiders or are captured can be employed against jets and helicopters. If the guerrillas successfully engage enemy armored vehicles, the heavy turret-mounted coaxial machine guns found on them can be adapted for use as AA weapons. Even shot down helicopters and jets might provide



IMPROVISED AA MG MOUNT

cannon for use as antiaircraft guns. This may be the wisest use of such guns, particularly since ammunition for them will be very limited

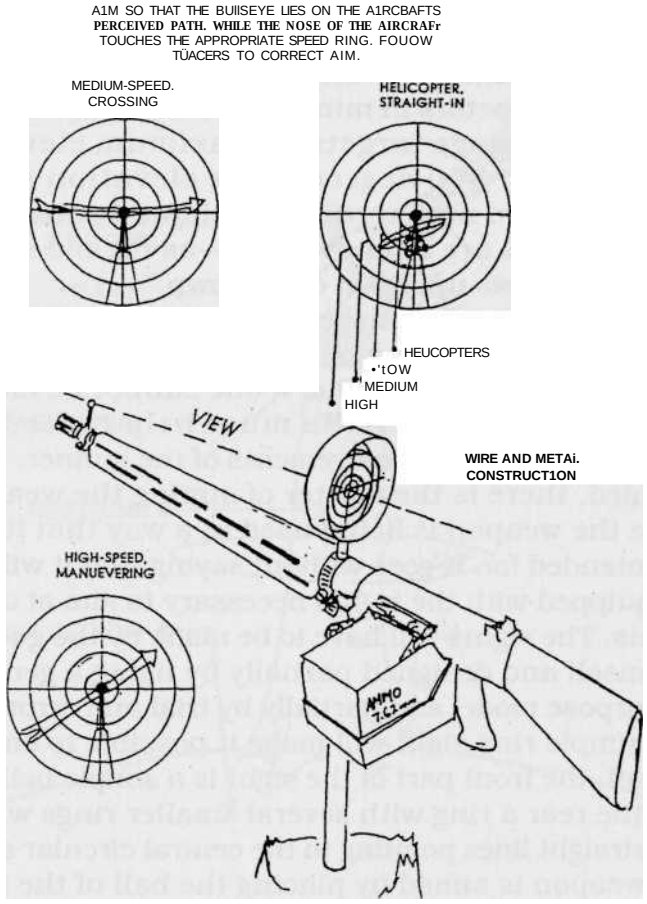
When improvising antiaircraft mounts for automatic weapons that were originally designed for use against ground targets, the guerrilla must keep several important factors in mind. First, the weapon must be able to engage targets at maximum elevation sweep and at 360 degrees. The elevation sweep should be from near vertical to below Operator level Vertical shots are not advisable-as the old saying goes, "what goes up, must come down."

Second, ammunition feed should not be affected If the machine gun does not have an organic ammunition carrier, improvise one. If one cannot be improvised, a second guerrilla must help to feed the weapon, following the movements of the gunner

Third, there is the matter of aiming the weapon Since the weapon is being used in a way that it was not intended for, it goes without saying that it will not be equipped with the sights necessary to aim at aerial targets. The sights will have to be made by the guerril la himself and designed partially by using a general, all-purpose model and partially by trial and error

A simple ring sight will make it possible to engage aircraft; the front part of the sight is a simple ball and pin, the rear a ring with several smaller rings within and straight lines pointing to the central circular sight The weapon is aimed by placing the ball of the front sight within the central ring of the rear sight. The front ball will be lower than the rear central circle, causing the barrel of the weapon to fire at a higher elevation than the aim line. This is necessary since the weapon will be firing at a higher angle than normal.

The height for the rear and front sights will have to be determined during trial fires employing tracer bullets-this will be good only for an Optimum engage-



IMPROVISED GUNSIGHT

ment range and windage adjustments will have to be made for aircraft flying closer or farther than the optimum range. Adjustments will also have to be made for aircraft passing left to right or right to left of the guerrilla's front. By using the incremental rings of the rear sight, lead can be crudely computed.

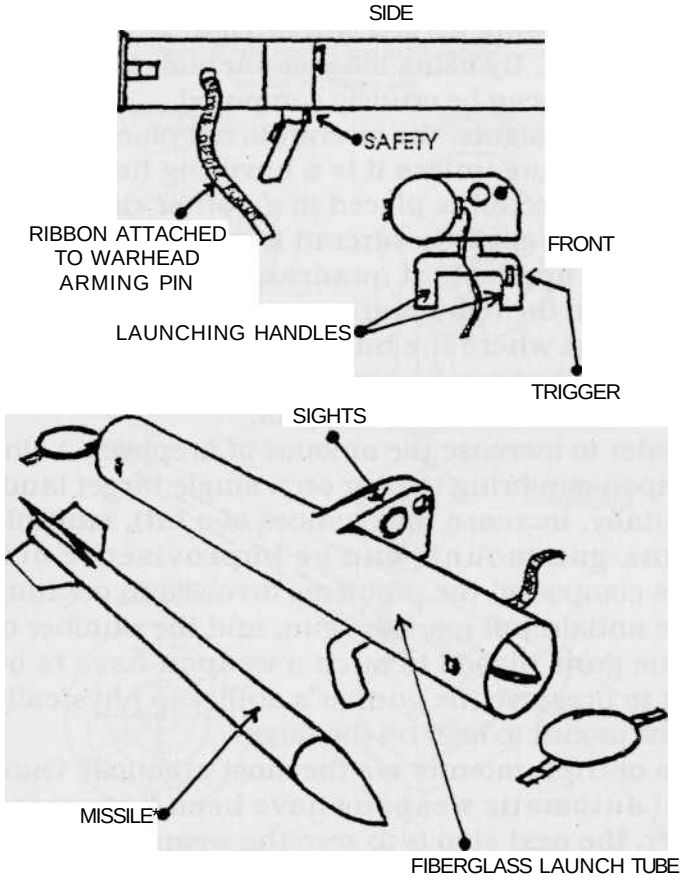
Using these sights, the aircraft is not placed in the center of the ring unless it is a hovering helicopter. Instead, the aircraft is placed in an outer ring to the lower left quadrant if the aircraft is approaching from the left, the upper right quadrant if the aircraft is receding from the right, and so on. The center point is the aim point where the bullet will meet the target. This is crude but can be compensated for by the use of tracers and manual adjustments.

In order to increase the amount of firepower a single weapon can bring to bear on a single target (and, incidentally, increase the chances of a hit), multiple machine-gun mounts can be improvised. Such mounts compound the problems involved in creating a single antiaircraft machine gun, and the number of machine guns placed in such a weapon have to be limited to preserve the gunner's ability to physically bring the mount to bear on the target.

Twin or triple mounts are the most practical. Once several automatic weapons have been harnessed together, the next step is to zero the weapons so that their fire converges at an optimum engagement range. A centrally mounted sight will make it possible to aim the improvised antiaircraft weapon and bring the maximum amount of firepower to bear on a single target.

To provide a good mix of weapon types and to make it more difficult for the enemy to counteract guerrilla air defenses, automatic weapons should be supplemented by other types of weapons. Missiles should be considered an option.

It costs governments millions to design and con-



IMPROVISED AA MISSILE

struct surface-to-air missiles, but this does not mean that such weapons are necessarily out of reach for the guerrilla. In fact, the use of improvised antiaircraft rockets by guerrillas preceded the use of dedicated weapons by government militaries.

In 1928, U.S. forces were involved in combating Nicaraguan guerrillas led by Augusto Sandino. During one air raid by American planes, the guerrillas struck back using skyrockets armed with sticks of dynamite. Although the rockets were unsuccessful (the dynamite failed to explode), it was historically the first occasion of rockets being used to attack aircraft.

Today, high-powered model rocketry and amateur science kits make it possible to create missiles for air defense from scratch. Fuselage tubes can be either purchased or improvised using materials intended for other purposes, and fins can be cut from thin, light wood. (The USSR's first surface-to-air missile prototypes used wooden fins.) In recent years, such designs were seriously considered by the Irish Republican Army (IRA) for use against British helicopters.

For propulsion, once again, model rocket engines can provide a solid-fueled motor for flight. However, regular commercial rocket engines provide thrust for only a few seconds. Hobby engines could be modified to provide longer burn times by clustering them and connecting them end to end. This is, of course, dangerous and should only be done in a controlled environment.

Aside from the construction of a basic rocket body, there are at least two other components needed to make an improvised surface-to-air missile, neither of which will be found in a hobby rocket. They are the missile warhead and the fuze.

The easiest way to construct a missile warhead is to use plastic explosives, if they are available. The explosive can be molded to fit the plastic or wooden nose cone of a kit rocket or into shapes designed to

inflict the maximum damage to enemy alrcraft. In this way, hollow-shaped charges can be made that will penetrate the light armor of aircraft, or shrapnel-spreading cones can be molded that will punch holes in thin metal. If plastic explosives are not available, the next best designs will have to use readily available explosive charges. The warhead should be tested for balance to make certain it will not throw off the trajectory of the finished missile.

Warheads can be of two different types. The first is a shaped Charge. This is the best design only if the guerrilla is relying on a contact fuze to destroy the target. However, such a Charge would almost certainly have to be custom made for the rocket warhead. The second is a shrapnel Charge, which is designed to inflict damage by employing high explosives to propel pieces of metal fast enough to penetrate the light metals and plastic used in aircraft construction. Unlike a shaped Charge, a shrapnel Charge does not necessarily have to be in the nose of the missile but can be located almost anywhere in the missile tube.

Since it is dangerous to make an armed explosive device, particularly one that will be mobile, a safety should be incorporated into the warhead design. A pin type device would be best—something that could be removed just before flight. The ideal design should have a marker, or reminder, attached to the pin and placed so that it physically blocks the sight. This will ensure that the Operator can not launch the missile without first arming the warhead.

Depending on the technical expertise of the guerrillas, a more sophisticated arming device could be made—one that incorporates a mechanism that only arras the missile after it has flown some distance from the user. This is the safest design.

The most difficult part of improvised SAM construction is the creation of an effective fuze. The easi-

est type of fuze to make is **a** contact fuze, which detonates the warhead by the physical effects of the rocket hitting the aircraft and can be either mechanical or physical. Although it is the easiest fuze to make, it is also the least effective, as the chances of hitting a maneuvering aircraft with a Single rocket is slim, even with the best gunner and the best guidance package.

The next best device is a timed detonator. The missile warhead is preset to explode a certain number of seconds after launch. The main drawback to this design is that the gunner must wait until the aircraft is within the preset ränge, and the less accurate the gunner is with the interception ränge, the farther off the missile will be from the target when it explodes.

One of the best fuze devices for antiaircraft use is the proximity fuze. Invented during World War II, the proximity fuze employs a simple radar principle. In effect, the warhead emits **a** radio Signal that bounces off the enemy aircraft, telling the warhead that it is getting closer. The moment the Signal teils the warhead that It is beglnning to move away from the aircraft, it detonates.

If the weapon is close enough when it explodes, the shrapnel will damage important hydraulic Systems and might even penetrate the cockpit. The main difficulty is in designing and making a proximity fuze. During World War II, it took the United States and England tremendous efforts to build the first one, while Germany never did succeed in making such a device.

The next device is a heat-seeking warhead. As described in Chapter 5, the infrared seeker homes in on the heat of an aircraft engine. This is an extremely sophisticated device because it actually consists of two separate mechanisms: a homing device that keeps the warhead aimed at the heat source and **a** servo mechanism attached to the rocket's fins for course corrections. The best feature of this type of

rocket is that it is a fire-and-forget missile.

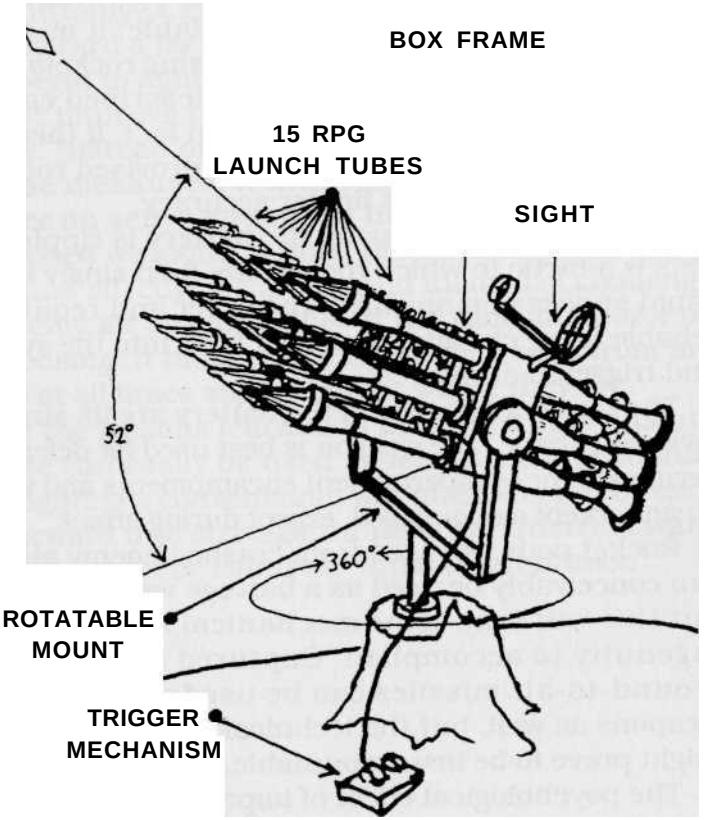
If a servo mechanism is available to guide the missile but a heat-seeking device is not, there are a few other options available to the guerrilla. One is the wire-guided missile, which sends commands over a wire filament or a thin fiber optic cable that is connected to the missile and trails out behind it as it flies. The missile is guided to the target by employing a joystick (which can be purchased as a video game accessory). The stick tells the missile to nose up or down and move left or right. One drawback is that the gunner must remain in position and focused on the target in order to hit it.

A variation of this type of guidance is the use of radio. A remote-control device like that used by model airplane enthusiasts can be employed to give course corrections to the missile. This allows the gunner to remain under cover while guiding the missile in, but the frequencies used by the remote control unit can be jammed easily.

The radio-guided missile is aimed in the general direction of the target and launched. While the missile is in flight, its controller changes pitch and yaw to put it on course for the aircraft. It is still possible for a near miss with this type of weapon, so it may be worthwhile to incorporate a command-detonated warhead that can be set off by the gunner.

Slow, low altitude aircraft such as helicopters can conceivably be engaged by using a battery of antitank rockets, such as the RPG. If there are enough of these weapons to spare, a frame can be constructed to hold them all facing in the same direction. Simultaneous triggering can be mechanical, employing rods or some other device to pull all the triggers at once, or if the necessary skills and knowledge are available, a multiple firing circuit can be wired.

By using a sight similar to the ones used in impro-



RPG BATTERY

vised missiles, the battery can be aimed at a Single target or in the midst of a formation. Although the rockets require a contact kill, the use of groups of eight or more multiply the possibility of a lucky hit. Better yet, there might be several hits, making it more likely that the aircraft can be brought down. Effectively, the rocket battery is a barrage weapon.

If antitank rockets are not available, it might be possible to rig up such a weapon using rockets similar to the improvised MANPADS described earlier. This is a preferable arrangement, in fact, if there are no proximity fuzes available for improvised rockets, thus substituting mass flre for accuracy.

Another tactic for using the battery is ripple fire. This is a tactic in which rockets are fired singly but in rapid succession one after the other and requires a reliable firing circuit that can be built into the System and triggered at will.

The main drawbacks of the battery are its size and awkward shape. The weapon is best used for defense of permanent or semipermanent encampments and where it can be kept camouflaged, except during attack.

Rocket pods salvaged from crashed enemy aircraft can conceivably be used as a barrage weapon as well, but this will take some mechanical and electronic ingenuity to accomplish. Captured air-to-air and ground-to-air missiles can be used as antiaircraft weapons as well, but the technical problems involved might prove to be insurmountable.

The psychological effect of improvised rockets and missiles cannot be discounted. Enemy pilots are not going to have time to discern whether an incoming missile is a heat seeker or a simple rocket with a contact fuze, and they will have to react at the price of bombing and strafing accuracy. In fact, if both improvised and dedicated antiaircraft rockets are available, both should be used. By integrating both types of

weapons in a concerted defense, they Supplement each other's strengths and cancel out each other's weaknesses. For instance, a helicopter dropping flares might be able to fool a Strela missile but will be ineffective against an unguided rocket armed with a simple proximity fuze.

Eventually, a successful guerrilla movement will move toward a far more conventional war. As its soldiers begin to fight on the same terms as its enemies, it must improve its air defenses to protect its own troops. Instead of relying primarily on passive air defense measures, it must move toward a greater reliance on active measures. Instead of emphasizing improvised weapons, it must provide itself with dedicated and effective weapons. And instead of challenging enemy air strength only at the time and place of its choosing, it must protect friendly troops from air attack at all times and no matter where they are.

But the lessons learned in fighting a guerrilla air defense can easily be used to defend a conventional force fighting a conventional war and can even be carried forward into Strategic air defense. Guerrilla warfare itself might be called an "antiaircraft primer."

Appendix

Problems of Antiaircraft Gunnery

The difficulty involved in hitting aircraft in flight is a problem that has evolved as air threats have evolved. A short study of this evolution will provide insight into the problems of antiaircraft gunnery.

The earliest air threat was posed by fixed observation balloons during the French Revolution. French balloons gave the Republican forces the ability to see beyond enemy lines. Balloons were never used in great numbers, but they did represent a new dimension in warfare.

The Austrians, who were at war with France at the time, recognized the "unfair" advantage the balloons gave to the French and became determined to eliminate them. Since the antiaircraft gun had not been invented yet, the Austrians improvised by taking

some of their cannon and sticking their trails into a ditch to raise the angles of the barrels high enough to fire on the balloons. At this time, antiaircraft gunnery was a two-dimensional problem. Since the target remained in one spot—it was tethered—it was only a matter of firing a shot so that its trajectory intersected the balloon.

There are three important lessons to be learned from this early exercise in air defense. First, the earliest antiaircraft weapons had to be improvised. Second, despite the relative simplicity of the problem, the Austrians were not able to hit the French balloons because they lacked a way to track their shot while it was in flight. And third, despite their lack of success in hitting the balloons, the Austrians were able to come close enough to scare the balloons out of the sky. A successful air defense doesn't necessarily need to destroy aircraft in order to accomplish its goal of protecting friendly forces from observation and attack from the air.

The next step in antiaircraft evolution occurred during the Franco-Prussian War of 1870. Prussian forces surrounded Paris and placed it under an extended siege. The only way left to get in and out of the city was by free balloon. The Prussians became determined to cut off this line of Communications as well.

A firm by the name of Krupp was contracted to design a breech-loading "balloon gun" to destroy French balloons traveling in and out of Paris. The balloons did not change their altitude but traveled in a "path," moving linearly relative to the gunner. This made the problem three-dimensional. Target speed was so slow that the need for leading the target was minimal.

During World War I, dedicated heavy antiaircraft guns engaged relatively fast-moving airplanes. Such aircraft not only moved along a path but also in altitude and had great control over where they could go. It was necessary to predict where an enemy airplane was likely to be and determine how long it would take a shell to reach that point. Antiaircraft gunnery had become a four-dimensional problem.

Since enemy aircraft remained extremely maneuverable, there were two primary options to ensure aecurate fire on aerial targets, without resorting to complex Computers or mechanical predictors. The first was a method invented during World War I: creating barrage boxes. In this method, weapons are pre-sighted and fixed so that when they are fired, they fill a volume of space (a "box") with Shells. The main drawback of this method is that it requires a large number of weapons to make it work. It is unlikely that a guerrilla force would use this method, except perhaps at night or in inclement weather when targets are hard or impossible to see. Without radar or infrared, this is the only means the guerrilla has of responding.

The other method is to make liberal use of tracer rounds to track Shells after they have been fired and correct aim while engaging the aircraft. The drawback to this Option is that the gunner is reacting to the maneuvers of the target. Unless the gunner is very good (or very lucky) and the pilot is unskilled (or very unlucky), the chance of making a hit is not very high. But the gunner still provides nuisance value against the enemy and Virtual attrition of enemy air power.

The minute details of antiaircraft gunnery vary from weapon to weapon, as each antiaircraft gun has its own unique characteristics. The best tactics for a guerrilla-type air defense will evolve as the capabilities of the guerrilla change and as guerrillas learn more about the tactics and abilities of their enemy's air force.

Problems of Missile Gunnery

One might think that since man-portable missiles are primarily self-guided, or seeking, there is little in the way of gunnery involved in missile use. This is true only to a small degree. The effective use of missiles requires skill just as the use of automatic weapons requires skill.

Infrared-guided missiles correct their course as they fly to their target. As long as the gunner provides the lead angle and elevation Standard to his particular weapon, the missile will do all the work. The gunner's main concern is when to launch.

First, the gunner should hold fire until the target is within range. He should always know the range of his weapon, both its minimum and maximum range, and be skilled at gauging distance. Missiles are expensive

and liable to be scarce—a gunner will not want to waste them.

Second, the gunner should hold fire to avoid IRCM and natural infrared sources that might fool the missile's seeker. This will require a great deal of discipline, especially if he is under air attack. But by waiting for an aircraft to finish dropping its flares or for a plane to pass IR-scattering clouds for blue sky, the gunner will be increasing his odds for making a hit tremendously.

In defending a fixed location, the gunner should choose a firing position that will minimize any possible infrared interference from local terrain. This will not be possible while on the move, as every second will count during an unexpected air attack.

Missile gunners need to be trained in the dangers and needs of their weapons. The biggest danger posed by the man-portable missile is its backblast area; being in the area immediately behind the rear end of the missile tube can cause burns and other bodily injury. Equipment might also suffer damage. Other dangers are the fumes produced by the rocket motor and the cooling System as well as the heat generated by thermal batteries when the missile is activated. While under attack there might be many different things going on all at once, but the gunner must keep in mind the dangers posed by his own missile.

The gunner should act as part of a team, and the other half of his team is the assistant gunner. The assistant gunner is responsible for identifying targets and guiding the gunner to his target while his Vision is limited by the weapon itself. This should be done by means of voice commands, such as "Ten o'clock, helicopter!" or "Three o'clock, jet crossing left!" The assistant gunner can keep track of other aircraft while the gunner engages his target, and he can also confirm that the backblast area behind the gunner is clear.

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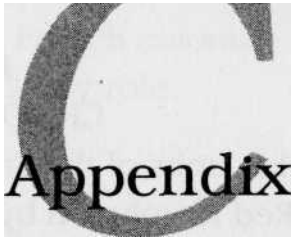
Problems of Missile Gunnery

If an effective early warning system is in place, a gunner may have many minutes to prepare for an attack. However, the enemy will try to take an insurgent force by surprise whenever possible, and even the most incompetent air force will succeed in this at least every once in a while. The ability to react quickly is an important asset for a missile gunner. By going through dry runs, possibly with an expended launcher, a missile gunner can prepare his weapon and engage a target in only a few seconds.

Good training will make the difference between a successful gunner who gets frequent hits and a gunner who wastes precious rounds.



A Selected Chronology of Guerrilla and Improvised Air Defense

1792-1802
FRENCH REVOLUTIONARY WARS
Saw the first use of balloons in combat. Also saw the first improvised antiaircraft guns.

1861-1865
AMERICAN CIVIL WAR
First use of passive air defense measures to defeat aerial observation.

1914-1918
WORLD WAR I
Improvised AA machine guns were used to Supplement dedicated heavy AA artillery.

1918-1920
CHAOS IN GERMANY
Flak units of the Freikorps helped suppress the Red Revolution by using their weapons in the ground mode.

1918-1921
RUSSIAN CIVIL WAR
Bolsheviks employed air defense weapons against White and Interventionist aircraft as well as against ground targets.

1927-1934
NICARAGUAN INSURGENCY
Guerrillas employed skyrockets armed with dynamite against American aircraft.

1935-1936
ITALO-ETHIOPIAN WAR
Ethiopian forces fought Italian invaders. King

Haile Selassie personally manned an antiaircraft gun in defense of his country.

1946-1954
INDOCHINA WAR
Vietminh guerrillas overthrew French colonialists. Air defense played a key role.

1956-1975
VIETNAM WAR
Insurgents in the Republic of Vietnam managed to down Vietnam Air Force and U.S. Armed Forces aircraft using antiaircraft guns and shoulder-fired SAMs. This marked the first use of missiles by a guerrilla force. Communist use of air defense helped to negate the heavy firepower available to American forces.

1966-1988
NAMIBIAN WAR FOR INDEPENDENCE
Saw extensive use of Soviet-made heavy AA machine guns and SA-7 missiles by Namibian insurgents and Angolans against South African helicopters and jets.

1969-1994
NORTHERN IRELAND
During this low-level insurgency, Irish Republican Army terrorists attempted to secure an improvised surface-to-air missile made from a model rocket kit.

1980-1988
AFGHAN WAR
Mujihadeen insurgents defeated Soviet invaders and Afghani Republican forces. Liberal use of American Stinger missiles negated Soviet air power.

1990-1995
YUGOSLAVIAN CIVIL WAR
Bosnian Serb insurgents succeeded in downing an American F-16 in the United Nations-imposed "no fly zone."

1994-1995
CHECHNYAN WAR
Insurgents succeeded in engaging and shooting down at least one attack aircraft.

From the Vietcong to the Afghan Mujihadeen, well-prepared guerrilla forces have employed a variety of ingenious tactics to defeat their enemies' air superiority. *Guerrilla Air Defense* shows you exactly how these guerrilla forces pulled off successful antiaircraft defense operations.

Author James "Doc" Crabtree, a former U.S. Army Air Defense Artillery Officer, includes current, detailed Information on the following:

- limiting detection from the air and minimizing the effects of an air attack by using passive air defense measures
- employing such active air defense tactics as balanced fire, early engagement, weighted coverage, mutual support, and overlapping fire
- setting up flak traps to lure in and destroy enemy aircraft
- using and maintaining antiaircraft weapons provided by sympathizers or captured from enemy forces
- improvising machine guns, surface-to-air missiles, and antitank rockets for antiaircraft use

If guerrilla forces can deny their opponents the advantage of attacking from the air, they'll no longer have to defend themselves against "death from above."