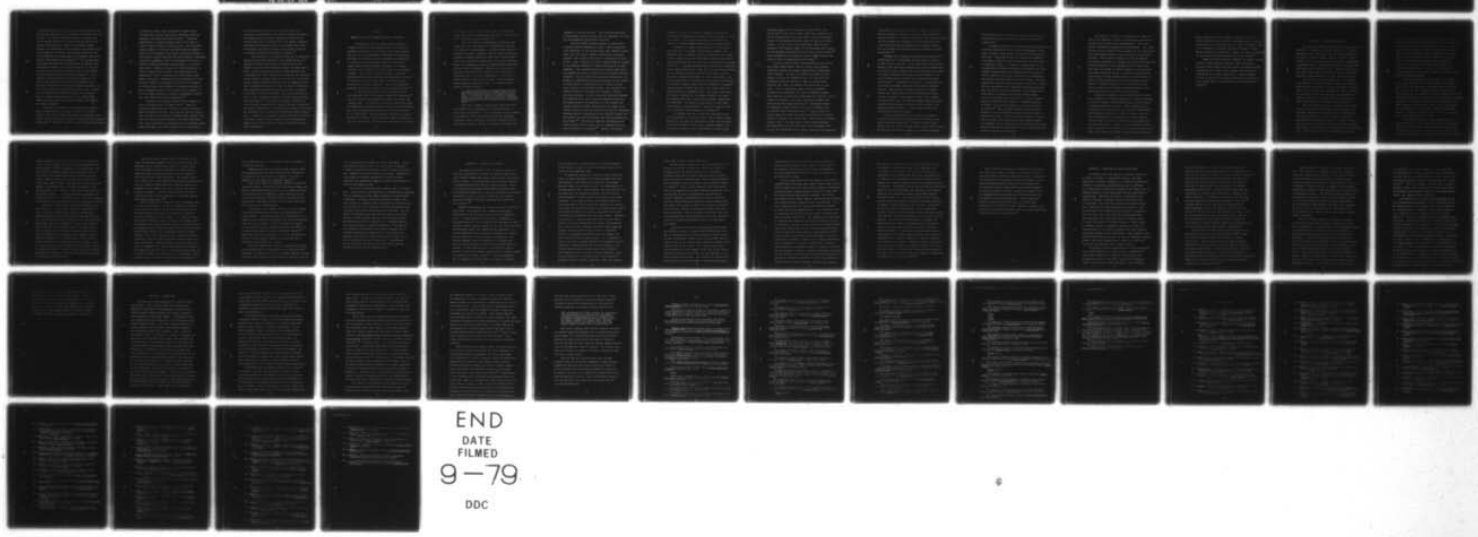
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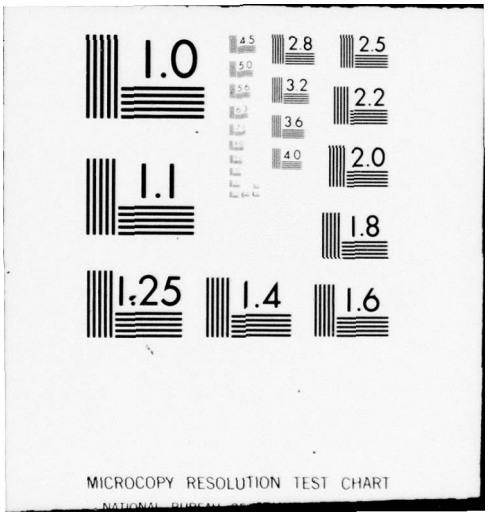
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CPT. MICHAEL H. CRUTCHER

SOVIET TACTICAL AIR DEFENSE

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SOVIET TACTICAL AIR DEFENSE

(An Introduction to the Employment of Antiaircraft Unit Weapons for the Defense of Maneuver Forces).

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FOREWORD

This research project represents fulfillment of a student requirement for successful completion of Phase III Training of the Department of the Army's Foreign Area Officer Program (Russian).

Only unclassified sources are used in producing the research paper. The opinions, value judgments and conclusions expressed are those of the author and in no way reflect officia policy of the United States Government; Department of Defense; Department of the Army; Department of the Army, Office of the Assistant Chief of Staff of Intelligence; or the United States Army Institute for Advanced Russian and East European Studies.

Interested readers are invited to send their comments to the Commander of the Institute.

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SUMMARY

This study examines Soviet utilization of tactical air defense weapons in support of maneuver forces, with primary emphasis on the employment of antiaircraft artillery weapons found in the air defense battery. Primary focus is on the operations of the battery in support of offensive and defensive operations by motorized rifle and tank units, and such subjects as command relationships, training, and reconnaissance are also addressed. Soviet employment principles are evaluated in terms of their potential threat to Army aviation, and the paper concludes that Soviet air defense doctrine is tailored to both offensive and defensive operations of supported forces.

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INTRODUCTION

The October 1973 war in the Middle East was characterized by high loss rates in aircraft; the Israeli Air Force suffered unexpected and significant losses in the hands of Arab-nation forces equipped with modern Soviet-produced air defense weapons systems.[1] The surprise that this development evoked among Western analysts evidences a past failure to adequately evaluate Soviet accomplishments in the field of tactical (or troop) air defense. While a thorough evaluation of Soviet and Warsaw Pact tactical air defense capabilities is especially important for considerations of employment of aviation assets of the North Atlantic Treaty Organization (NATO) air forces, there are also important considerations for ground commanders, who have at their disposal varied aviation assets for combat, reconnaissance, airmobile, and combat-support operations.

The purpose of this study is to provide an introduction to current Soviet tactical air defense principles and their basic application. The term 'tactical' is intended to denote the means of defense of combat maneuver and control elements, as distinguished from industrial or other stationary targets of strategic significance and

which belong more proprly to a discussion of national or territorial air defense.[2] A number of major subjects will be addressed, including Soviet perception of the threat presented by 'enemy' (NATO) forces, reconnaissance techniques, training emphasis, and, briefly, organization and equipment. The discussion of doctrinal employment will focus on the use of tubed antiaircraft artillery weapons in support of maneuver elements, as it is these weapons that will present the principle threat to Army aviation.[3] This discussion will include the principles of offensive and defensive employment, operations in conditions such as night and winter, mountainous terrain, and operation in conditions of nuclear, chemical, or biological contamination. The ground defense role of air defense units will also be discussed.

The two Soviet sources used primarily for this paper are Voennyi Vestnik (Military Herald) and Vestnik Protivovozdushnoi Oborony (Herald of Antiaircraft Defense); because of the material included in these journals--or better yet, that which is not included--this paper will be limited to a discussion of those elements in an air defense battalion, which usually support battalion-sized maneuver units.[4] The discussion of both organization and equipment will be extremely limited due to the lack of information on these subjects in the available Soviet sources. A detailed discussion of the role of interceptor aircraft

will not be included. Western sources have been used infrequently, and it will be specifically noted when information is derived from non-Soviet sources.

SECTION I: GENERAL CHARACTERISTICS

Soviet military writers indicate that Soviet authors expect that those maneuver elements in contact with enemy forces or advancing or defending in the second echelon will be the primary targets of enemy tactical aviation. It is also anticipated that air defense units themselves will be high-priority targets for enemy air strikes. The expected enemy (NATO) possesses high-performance interceptors, ground-attack aircraft, a variety of helicopters, and drone aircraft, and he will utilize electronic warfare measures, air defense suppression weapons, and aerial reconnaissance platforms to carry out his mission.[5] It is almost a ritual that each article begins with mention of the rapidly changing air situation under contemporary combat conditions, this fluidity dictated primarily by the capabilities of modern fixed and rotary-wing aircraft: high speed, maneuverability, destructiveness, and low-altitude approach and attack techniques. It is repeatedly stated that the time available to detect, identify, and engage such targets is minimal, a condition which demands the highest degree of individual proficiency, well coordinated crew action, and the highest degree of psychological preparation.

Enemy airborne forces are expected to have a role in the capture or destruction of point targets behind the forward edge of the battle area (FEBA), often awaiting subsequent reinforcement from the enemy's main forces. The increased role of the helicopter in military aviation is also recognized, including the functions of support aircraft, weapons or reconnaissance platform, and attack transport aircraft. Airmobile forces of up to reinforced battalion strength are seen to be capable of carrying out much the same type of missions as airborne units, although on a more limited scale. It is anticipated that tactical nuclear strikes might precede both airborne and airmobile enemy operations.[6]

The fire-support and antitank roles of the helicopter have received much attention from Soviet authors. Because of its unique capabilities--maneuverability, ease of deployment, and low altitude flight techniques--the helicopter is seen to be well suited to these missions. However, the relatively low speed characteristic of the helicopter is considered to be a factor which greatly increases its vulnerability to ground fires, especially to those of conventional antiaircraft weapons.[7]

In summary of the Soviet perception of the aerial threat to their maneuver forces, it can be said that Soviet military writers have addressed the full spectrum of the threat posed by enemy aviation. Soviet authors are cognizant of the complexity of the mid-intensity

battlefield, including its electronic aspects. They appreciate the capabilities and limitations of the aircraft and weapons currently available, and they feel a need for technical proficiency and intensive psychological preparation of their troops for what they perceive to be a dangerous and complex but not impossible task.

Soviet forces have developed various types of weapons to counter the anticipated threat; when taken as a whole or as a system, these weapons present a highly credible air defense capability. This system includes interceptor aircraft, surface-to-air missiles, tubed antiaircraft artillery, vehicular machineguns, and small arms fire. While an analysis of the various weapons is beyond the scope of this study, there are two antiaircraft artillery weapons which deserve mention because they figure importantly in the discussion of tactical doctrine.[8] These are the 23 millimeter and 57 millimeter guns, which are mounted on both towed and self-propelled carriages.[9] The larger of these weapons has been mounted on a modified T-54 tank chassis providing a twin-barrel, self-propelled, automatic weapon with on-carriage fire control provisions only; its ballistic characteristics are identical to those of the singlebarrel S-60 gun. This weapon has an effective antiaircraft range of 4000 meters. The Soviets have also developed a 23 millimeter self-propelled weapon, the ZSU-23-4 (Zenitnaia Samokhodnaia Ustanovka), which has a maximum effective antiaircraft

range of 2000 meters and provisions for both on-carriage and off-carriage fire control. The weapon has its own acquisition and tracking radars and can be optically sighted.[10] This weapon was used very effectively in conjunction with the SA-6 surface-to-air missile during the Middle East conflict in 1973.[11] A missile of special interest to Army commanders is the SA-7 (GRAIL). A shoulder-held, portable surface-to-air weapon designed to be used against low-flying fixed and rotary-wing aircraft, this missile is also mounted in groups of eight on a tracked carrier and can be fired in salvoes of four or eight.[12] In addition to the weapons, there is associated equipment such as target acquisition and tracking radars, fire direction devices, and other items, which are often located in a number of van-type vehicles. There are also prime movers in the cases of some missiles and towed antiaircraft artillery.

We should not assume, however, that these weapons are not without problems or limitations. One article mentioned the problems of variation in ammunition characteristics, rapid gun-bore deterioration, and electrical problems associated with radar controlled firing of the ZSU-23-4, including the possibility of "runaway" firing in this mode.[13]

Soviet sources contain remarkably little information on the organization of their air defense forces; Voennyi Vestnik limits its discussion to the operations of the

reinforced motorized rifle or tank battalions and does not discuss the operations of air defense units larger than the battery. Air defense troops do comprise a separate arm of the Soviet armed forces, being organized into the Air Defense of the Country. Tactical air defense troops, however, are considered to be a branch of the ground forces and are made up of missile, antiaircraft artillery, and radio-technical units organized into regimental, battalion, battery, and platoon-sized elements.[14] No reliable data concerning the number of firing platoons in missile units was located, however, one article depicted a firing unit consisting of four missile-launchers (SA-2) and a number of vans of radar and fire direction equipment.[15] Units armed with towed antiaircraft artillery weapons are organized into batteries of two firing platoons of three guns each; batteries armed with self-propelled weapons have two firing platoons of two tracked vehicles each. Radars and fire direction sections are organic to the battery. The air defense battalion consists of an unspecified number of firing batteries, a radar company, and command and support elements.

It would be difficult to overestimate the emphasis Soviet authors place on training. Nearly every article refers to the need to improve the level of individual--both officer and enlisted--crew, and unit training and psychological preparation.[16] Attempts are made to make training as realistic

as possible, using a wide assortment of audio-visual training aids, aircraft and vehicle mock-ups, imitative equipment, and manned and drone aircraft. "Socialist competition" is fostered between units in an effort to achieve higher results in training tests. The inherently complex mission of tactical air defense and the complex nature of the equipment used require intensive training in such tasks as target detection and identification, individual training on equipment, and well-coordinated crew drill on missile launching platforms, gun-carriages, and in technical units. Repetitive training is used extensively to achieve requisite skill levels, and cross-training is emphasized to ensure continued unit effectiveness under combat conditions. Recognition of the probability of high attrition rates in air defense units has led to emphasis on officers being fully capable of assuming the duties of their subordinates and on the ability of the subunits of the air defense battalion to operate independently should they lose contact with their headquarters.[17]

Training in the general aspects of air defense is given to troops of all the combat arms.[18] Areas for individual instruction are laid out in several sections to permit concurrent training. One such area for the instruction of troops of all branches included three stations: the first was for individual training in aircraft identification, using silhouettes, and instruction in individual camouflage techniques; the second station was for training in

the selection of positions for observation posts, the techniques of observation, and aircraft warning procedures, with emphasis on the soldier immediately reporting any aircraft detected; at station three, the company commander instructed his personnel in the use of massed small-arms fire against low-flying aircraft, with special attention to repelling airborne and airmobile assaults.[19]

Unit training of air defense forces may be conducted separately from other branches of the ground forces, but emphasis is placed on training air defense units with maneuver units they would normally support in combat operations. Typical training exercises include movement from an assembly area after inspection of personnel and equipment, a road march to a contact point to join the unit to be supported, another road march during which the supported unit must be defended from several enemy air attacks, deployment into temporary positions for firing exercises, resumption of the march, and then deployment into firing positions to cover a river crossing or support an attack against defending enemy forces.[20] Training is frequently conducted at night and under conditions of simulated nuclear, biological, or chemical contamination, requiring the extended (time period not specified) use of protective clothing and special equipment. In addition to attempts to make training as realistic as possible, there is great emphasis on the psychological conditioning of the soldier to function effectively under combat conditions.

SECTION II

RECONNAISSANCE AND GENERAL EMPLOYMENT PRINCIPLES

Reconnaissance of the enemy and the airspace by technical means and visual observation by all troops is considered essential to an effective air defense system. Radar is the principle means of technical reconnaissance, and radar units operate in close proximity to associated air defense units and relocate whenever necessary to ensure optimal radar coverage; such moves are usually carried out by sections at a time to guarantee continuous coverage. The need to be able to operate in spite of enemy electronic warfare measures is recognized, and crews are trained to evaluate the effects of terrain on the effectiveness of their equipment. This is an especially important factor when trying to detect lowflying targets.[21]

Visual reconnaissance is still considered to be very important, and it is organized under all conditions.[22] This is a continuing requirement for both air defense and maneuver units. In defensive situations, observation posts are immediately established upon occupation of the defensive area, and all-round visual observation by trained personnel is established. During movement, observers are designated on all vehicles, and overlapping sectors of observation are established. The observers' missions are to detect

and identify all aircraft in their zone of observation, report all sightings immediately, and conduct reconnaissance of the ground enemy when appropriate.[23]

These two types of reconnaissance--technical and visual--are seen as integral and complementary elements of a system of reconnaissance. Technical means have the capability to detect targets at greater ranges and during periods of reduced visibility, and visual reconnaissance can be more effective in areas where the terrain configuration is favorable to attack by enemy aircraft using low-altitude flight techniques. Based on the principles of all-round observation and timeliness and reliability in reporting, this system of reconnaissance is expected to provide both air defense and maneuver elements adequate warning against enemy air attack. As a Soviet author summed up this perception,

> "...with the assistance of reconnaissance (radar) and target identification stations, radars of the ZSUs (self-propelled guns), and visual reconnaissance, a relatively effective system of reconnaissance of the aerial enemy can be created, and this means a widening of the capabilities of air defense means."[24]

There are a number of operational techniques that are common to the employment of air defense forces in most types of operations. These principles involve command relationships, combat-effectiveness and unit readiness standards, target engagement techniques, movement of fire and support elements, and the emplacement of weapons and

equipment in firing positions. The following discussion is based upon articles dealing with the employment of towed and self-propelled antiaircraft artillery.

The most common scenario depicts an antiaircraft artillery battery attached to either a tank or motorized rifle battalion; if the article deals with offensive operations, the unit may be further reinforced by artillery, engineer, and, tanks in the case of a motorized rifle battalion. Also, elements of a radar company might be attached to the maneuver battalion if deemed necessary by a higher commander. The attached antiaircraft battery comes under the command and control of the supported maneuver battalion commander. Contact between the battalion and battery commanders is established by personal meeting, written message, or radio contact, although there is an effort to keep radio traffic to an absolute minimum. The battalion commander evaluates his mission, the situation, terrain, and time available. He then issues the necessary commands to accomplish those tasks requiring immeidate attention. The organization of reconnaissance of the airspace and security measures against ground attack are tasks of immediate concern to both the battalion and battery commanders. Redundant means of communication and necessary signals are established, and aircraft warning and alert procedures are agreed upon.[25] The battery commander functions as the staff officer for air defense for the supported unit as long as his unit is attached.[26] However, the battery

commander continues to maintain communications with his own battalion headquarters to pass and receive data on enemy air activity. This reporting channel is maintained in addition to normal command channels of the maneuver units.

Standards of combat-effectiveness will vary according to the type unit under consideration, however, all standards have the common objective described by one author as "the capability to carry out combat activity and fulfill assigned missions over the course of a comparatively extended period."[27] A battery equipped with towed guns is considered to be combat effective if it has lost not more than one-third of its primary specialist personnel or weapons, and fire direction equipment and radars are still operational. Any battery-sized unit is considered to be partially ineffective if personnel require special medical treatment or equipment requires special repairs which the unit cannot itself accomplish within a reasonable time. For higher level units, the overall condition of the command element, the status of communications nets, and overall personnel losses must be considered. The status of unit morale is also taken into account in any evaluation. These same criteria apply to an evaluation of the status of a regiment.[28]

Air defense missiles and guns are regarded as part of an integrated air defense system. These weapons engage targets on the immeidate approaches to and in the vicinity of potential targets--troop units, command elements, and air defense positions, while interceptor aircraft engage

attacking enemy aircraft along the forward edge of the battle area.[29] The Soviets expect that their organized system of reconnaissance will allow them to detect and engage targets at the maximum effective range of their air defense weapons. In the case of units armed with towed or self-propelled 57 millimeter funds, it is anticipated that targets will be engaged with bursts of fire of two or three rounds.[30] Units equipped with the ZSU-23-4 usually engage targets with bursts of fire of approximately 200 rounds.[31]

To avoid revealing the firing positions of the entire unit--which would require that the entire unit relocate, individual targets are usually engaged only by designated "duty" weapons. Two guns are usually designated for this purpose, but when the supported unit is on the march and encounters difficult terrain or comes to a major road junction, the entire air defense unit may be put on such alert. Low or slow-flying targets, such as transport aircraft and helicopters, will also be engaged by massed small arms fire and vehicular machinegun fire from all units.[32] Troops are trained to fire their individual weapons from vehicles and from ground positions.[33] High-speed targets are engaged by radar directed fires of air defense units and barrier fires from other units.[34] Group targets of a similar type of aircraft are usually engaged by all elements of the air defense unit, by platoons. In the case of multiple targets, that is the appearance of both high-performance and rotary-wing aircraft, the former will be engaged first as they are considered to be a greater threat to the supported

unit and the air defense unit itself. However, the threat posed by attack helicopters, especially those armed with antitank missiles, is clearly recognized, and selected weapons will be designated to engage these helicopters while the remainder of the battery engages the fixed-wing aircraft. Both air defense and maneuver troops are trained to engage parachutists.[35]

Movement by air defense units from rear areas may be accomplished as an independent tactical move, as part of a larger unit, or by rail. In the later case, antiaircraft weapons, both towed and self-propelled, will be loaded onto the train in such a manner so as to allow them to fire while in transit, optimally utilizing at least one-half of the unit's weapons and its organic fire direction and radar capabilities.[36] Movement by road march is accomplished as any tactical movement, with the usual security measures required. When the unit is moved as part of a larger column, one firing platoon is placed behind the advance element to provide rapid response without undue exposure to enemy direct fire. The battery command element and the remaining firing platoon are usually placed close to the battalion command element. A rear guard sometimes has antiaircraft elements attached.

Constant observation of the airspace by members of both the antiaircraft and maneuver units while on the march is greatly emphasized. If enemy aircraft should appear, they are usually engaged from the short halt, however, the battery may deploy to engage if it becomes necessary.

Self-propelled units may simply increase speed and engage targets while moving, utilizing on-board fire direction capabilities.

An important factor in the movement of air defense units, including radar units, is the route reconnaissance group, which is used in moves from a rear area or within the forward area. Dispatched by the air defense unit commander, this group is sent out a short time before the unit itself is scheduled to move. It conducts reconnaissance of the intended route of march, evaluates the potential positions, conducts reconnaissance for contaminated areas along the route of movement and in the intended area of deployment, and observes any enemy activity in these areas. The exact composition, mission, time of departure, and route of movement are determined by the commander organizing the group. When sent out by a battery commander, the reconnaissance group usually consists of one firing platoon leader, one or two reconnaissance specialists, a radio-telephone operator, and one or two riflemen. Depending upon the situation, the group may conduct its mission on foot or by vehicle.[37] When in close proximity to enemy forces, movement of the reconnaissance group--and the battery--is conducted at night. After covering the battery's intended route of march, the reconnaissance group leader reports his findings, and the group occupies the selected positions, conducts observation of any enemy activity, and assists the battery to occupy the positions.

Positioning of weapons is affected by the time available to the commander, terrain considerations, the mission, and the type of weapon under consideration. There are, however, standard configuration for emplacement. The towed battery may be deployed as two platoons, but the six-pointed star with weapons pointed in the direction of the enemy is standard. Self-propelled weapons are usually employed by platoons, deployed at a distance of not more than one-half to three-quarters of their maximum effective range from each other to provide for mutual support in the event they come under direct air attack. It has been reported that antiaircraft artillery and missiles have been utilized together to take advantage of the characteristics of each weapon.[38] Portable missiles, such as the SA-7, may be used by troops of air defense and maneuver units to supplement the fires of air defense unit weapons.

Associated equipment, such as radars and fire direction equipment, is moved and deployed in a manner analogous to that for weapons, and equipment organic to the battery is usually moved with the unit. Radar companies may be required to move when there is the threat of contamination from nuclear, biological, or chemical weapons, when the unit's positions have been detected by enemy observers, or when there is a threat of imminent enemy penetration of the unit's positions. However, if the situation permits, only a portion of radar assets will usually be moved at one time, in an effort to provide continuous warning coverage.

Radar companies and other support elements of the air defense battalion may also move independently over different routes than the firing units utilize, again "in bounds" when it is necessary to maintain continuous coverage.[39] When moving as part of a larger unit, radars will often be operated at short halts to provide protection for the column.[40]

Radars and fire direction equipment are usually located close to firing elements, however, radars are usually placed at some distance from one another to provide maximum coverage of the airspace and to reduce vulnerability to destruction by a single enemy attack. Engineer support is used to improve the security of positions from observation, ground attack, or the effects of mass destruction weapons.[41]

SECTION III: DEFENSIVE OPERATIONS

In defensive operations, both towed and self-propelled batteries are employed to defend forward echelon maneuver battalions; the selection of type of weapons depends on the type available, mission, terrain, and other related factors. The fires of antiaircraft units are supplemented by protable missile, vehicular machinegun, and small-arms fires within the battalion sector. Antiaircraft units in the first echelon may be required to cover second echelon maneuver elements moving up to first echelon positions.

Air defense is the responsibility of the maneuver unit commander. He must designate primary and alternate positions for antiaircraft elements, designate reconnaissance sectors for his own and supporting units, establish the necessary warning and communications procedures, engagement priorities, and damage control measures to be taken during and after engagement with the enemy.[42]

The self-propelled battery is employed by platoons located not more than 1000 meters from each other. As mentioned previously, the platoons of the towed battery are usually deployed together. Reserve or alternate positions are established, usually at a distance of not more than 500 meters from the primary positions, and they are occupied when directed by the commander of the supported unit. Temporary positions are established usually not

closer than 100 meters to the primary positions for use prior to engagement with enemy forces; these positions are intended to deceive the enemy as to the location of the unit's primary positions. Prior to and during defensive combat, firing platoons relocate as often as necessary to ensure maximal protection for the supported unit; such moves are usually directed by the battery commander. Targets are engaged as they enter within range in the battery's sector of fire. However, fire discipline is greatly emphasized, and single targets are usually engaged only by designated weapons.

Defensive operations against airborne and airmobile attacks are conducted in a similar manner with emphasis placed on the destruction of attacking forces while they are still in the air. Primary targets for antiaircraft unit weapons are any aircraft escorting transport aircraft.[43] Attack helicopters are considered to be a particularly dangerous threat. All units in the vicinity of airborne or airmobile attacks are expected to assist in the elimination of air landing parties. If enemy elements successfully execute a landing, attempts are made to destroy or capture them before they manage to link up.

Antiaircraft weapons are also expected to play a significant role in their own ground defense and in supplementing the fires of the supported infantry or tank unit. Antiaircraft weapons have a number of characteristics that make them suitable for this role: the capability to rapidly

change direction of fire, the high rate of fire characteristic of these weapons, the fire direction equipment which makes possible effective engagement of moving targets, and the variety of rounds available and high muzzle velocity which make these weapons particularly effective against lightly armored vehicles and, in the case of the 57 millimeter gun, against tanks. The mobility of self-propelled weapons is considered to be a distinct advantage in the ground defense role. However, in the case of the ZSU-23-4, the lightly armored chassis does not provide adequate protection for the vehicle from direct fire, and it is repeatedly stated that these weapons are not to be needlessly exposed.

Missile air defense units plan ground defense at the battalion level. In all units, defense is organized all-round, and visual observation sectors are established. Observation posts may be established at some distance from the unit's positions if the terrain does not allow effective observation from those positions.[44] While units located well to the rear of the forward edge of the battle area are not usually very vulnerable to ground attack, there is still the possibility of airborne and airmobile assaults. Effective organization of reconnaissance of the enemy is seen as the means to prevent such surprise attacks. Also, if a unit's positions are compromised the unit will usually be required to move.[45] Engineer support is used to improve protection for equipment and personnel and for the creation of obstacles to enemy activity.

Two tactics which warrant special attention are the use of antiaircraft ambushes and roving antiaircraft units. Employment of the antiaiercraft ambush is favored along likely secondary avenues of approach for enemy aircraft, especially where the terrain permits concealed approach using low-altitude flight techniques. The ambush, which can be made up of either towed or self-propelled antiaircraft units or infantry troops armed with portable missiles, is described as the "combat activity of separate air defense platoons, weapons, or vehicles using surprise to inflict destruction upon an aerial enemy who is attacking from the least expected direction."[46]

Soviet forces can be expected to use the ambush under a variety of conditions. It can be regarded as a measure used to stretch available assets when they cannot fulfill assigned missions, due either to insufficient resources initially available or heavy losses. It is used to cover gaps between sectors of fire of adjacent air defense units, to supplement the ground defensive fires of supported units by engaging tanks or armored personnel carrriers at extended ranges (which seems to be a departure from their primary mission), and to take advantage of the element of surprise to destroy escorting attack helicopters present during air-mobile operations. Ambush positions, sectors of fire, and rules of engagement are usually designated by an officer of the supported battalion staff. The ambushing unit makes use of engineer support and extensive use of camouflage. Operational security is stressed to guarantee the security of

of the ambushing unit and to guarantee that an element of surprise is achieved.

Ambushing units do not usually engage targets unless they approach within the unit's sector from a designated direction or the unit itself is attacked. As a rule, ambushes are relocated after engaging targets.[47]

There are a number of important factors in achieving effective results: timeliness of the decision to employ the ambush, undetected movement of the unit to ambush positions and skillfull use of camouflage, rapid reporting of data on the air and ground situations both to and from the ambushing unit, and skill levels of the personnel and equipment status of the ambushing unit.

In contrast to the largely static role of the ambush, roving antiaircraft units actively seek engagement with enemy aircraft. Operating according to instructions of the supported unit commander, the roving unit moves periodically from one area to another, "actively reacting to changes in the aerial situation, helping to deceive the enemy concerning the true make-up of the antiaircraft system."[48] While such action does contribute to a cover and deception effort, it also provides support to units which may be subjected to preliminary air attacks.

The exact composition, mission, and details of deployment of roving units are determined by the supported unit commander, in consultation with the battery commander. Roving units are often similar in organization to ambushes, but the

use of self-propelled weapons is highly preferable. Operating within an assigned area, each roving unit is assigned a number of preplanned positions, various routes of movement, and a sequence of various actions to be taken. Coordination with nearby air defense and maneuver elements for both logistical and operational support is made by the battalion staff of the supported unit.

The use of roving units does, however, have a few problems. One of these is the difficulty in maintaining an adequate flow of information on the combat situation to and from the roving unit. It may be necessary to operate several radar units within the immediate area to provide the necessary warning interval for the roving unit to effectively engage enemy aircraft; roving radar units may also be employed. The commander of the mobile unit must also be aware of his vulnerability to direct ground, airborne, and airmobile attacks when operating within the forward area. Constant observation of the airspace is greatly emphasized. To coordinate the necessary reconnaissance and security measures and to exchange information on enemy activity, the roving unit commander must maintain contact with maneuver units in the area in which his own unit is operating. Vulnerability of the roving unit is greatly increased when it becomes necessary to move during daylight hours.

SECTION IV: OFFENSIVE OPERATIONS

The primary objective of the air defense system in offensive operations is to create an umbrella under which first echelon elements may attack without major interference from the enemy. The antiaircraft battery usually supports a reinforced motorized infantry or tank battalion. While towed batteries may support first echelon maneuver units, self-propelled weapons have a distinct advantage in firepower and mobility, and it is these weapons that are usually assigned to support offensive operations by units of the first echelon.[49]

Command relationships are similar to those of defensive operations. The supported unit commander has primary responsibility for the defense of his own and supporting units. In consultation with the battery commander, he determines positions to be occupied, the deployment of antiaircraft elements during movement of the unit, and establishes the necessary signals and communications procedures. He is also responsible for the timely transmittal of information on enemy air activity to higher headquarters. The battery commander usually establishes his command post near the firing platoons to achieve the maximum degree of control. If the supported unit is advancing to contact, however, the battery commander may delegate to platoon leader the authority to engage targets.[50] When the supported unit is engaged with enemy forces, the battery commander

plays a major role in deciding when to relocate elements of the battery in order to ensure continuous and effective defense of the supported unit.

An important concern for advancing units, especially tanks, is enemy employment of helicopters armed with antitank missiles; such targets are engaged at the maximum possible range in an effort to reduce the effectiveness of antitank missile fire. This requires that antiaircraft units be deployed as far forward as possible and that they be moved frequently to keep up with any changes in the combat situation. It is expected that self-propelled guns will stay within 400 to 500 meters of the supported unit during the attack and exploitation phases of offensive operations.[51] Antiaircraft elements will also be moved when firing positions have been compromised or come under attack. Employed by platoons at a distance from each other of up to three-quarters of their maximum effective range, self-propelled guns primarily cover principle avenues of aerial approach, however, they may also be used to cover a vulnerable flank or to supplement ground fires of the support unit while executing their primary mission. It is emphasized, however, that these weapons should not be exposed to direct enemy fire. During periods of limited visibility, antiaircraft weapons may be placed closer than 500 meters from supported units to ensure effective operation. Antiaircraft ambushes are utilized along likely avenues of approach, and all elements, especially radar and logistic

units, make extensive use of camouflage.

Soviet authors express the belief that Western air forces are hesitant to direct air strikes too close to friendly units, and Soviet forces can be expected to attempt to push their attacking maneuver and air defense units very close to enemy to push their attacking maneuver and air defense units very close to enemy positions during the attack.[52] After initial objectives have been gained, such as the destruction of enemy defensive positions, and in anticipation of enemy counterattacks supported by air strikes, additional antiaircraft units may be moved up from the second echelon to reinforce existing capabilities and assume the missions of those first echelon air defense units that are required to temporarily assume relatively static positions. This is frequently done when towed antiaircraft units must remain deployed to deal with intensive enemy air activity while maneuver forces are continuing the advance.

Antiaircraft units move with maneuver units during the advance to combat. A major problem during such movement is ensuring that antiaircraft units are able to keep up with the maneuver elements, this being another factor in favor of the use of self-propelled weapons to support first echelon units in the attack. One firing platoon may be placed behind the rifle company in the rear of the column while the remaining fire platoon and the remainder of the body follows the main body. The placement of antiaircraft guns near the head of the column is discouraged because it

complicates fire control procedures and dissipates air defense assets throughout the column.[53] Also, there is the constant consideration of increased vulnerability of these weapons to direct fire if they are located near the head of the column.

If the column comes under air attack, antiaircraft elements armed with towed guns usually engage enemy aircraft from the short halt while the column continues its movement; the antiaircraft elements quickly rejoin the column after the enemy has been destroyed or repulsed. This necessary splits up the column, however, and leaves the supported unit without adequate protection for short periods. It is also frequently difficult for the antiaircraft elements to catch up with the supported unit. The resulting lapse in protection and splitting of the column is inconsistent with the Soviet doctrine.[54] The possibility of increasing the speed of the column and the interval between vehicles is considered, but such actions are not felt to appreciably reduce the effectiveness of the attacking aircraft while they do reduce the effectiveness of antiaircraft fires.[55] A major topic of discussion is the employment of antiaircraft units in support of forced river crossing operations. Such an operation is usually carried out by a motorized rifle battalion, reinforced by tanks, artillery, engineers, and an antiaircraft battery. Standard employment procedures for the battery, upon reaching the designated crossing site, include the immediate deployment of one firing platoon on the near bank to protect maneuver units as they approach

the site; the remainder of the battery prepares to cross the obstacle with the main body of the supported unit. If necessary, firing positions on the near bank can be placed quite near to the bank itself, but the possibility of enemy direct fires makes it preferable to locate these weapons some distance from the river, in defilade positions if possible. Firing positions on the far bank are designated prior to the actual crossing, and elements of the battery cross as soon as possible without unnecessary exposure to direct enemy fire. One firing platoon crosses either with or immediately after the attached tanks and immediately assumes firing positions on the far bank. The remainder of the battery, including the firing platoon that initially assumed firing positions on the near bank, crosses after the main body of the supported unit, if the situation permits. In the event of heavy enemy air attacks, the entire battery or one of its platoons may be required to remain in firing positions on the near bank to provide effective defense. In such cases, second echelon antiaircraft units will be moved forward to assume the offensive mission of these elements, which will remain in position until directed to relocate. Normally, however, the battery will cross as described, and transport organic to the battery will cross at the same time to ensure that towed guns will have their prime movers and that supplies of ammunition and other materials are maintained.[56]

River crossing operations are considered to be important targets for enemy air strikes, and usually all antiaircraft elements engage any attacking aircraft. Frequently, one platoon may be designated to engage helicopters, using optical tracking methods, while the second platoon uses the battery's organic radars and fire direction equipment to engage high-speed aircraft. Antiaircraft units' fires are supplemented with portable air defense missiles fired by personnel of any designated unit. These troops will usually remain with their own units and engage enemy aircraft at the direction of their commander, however, some troops may be detached from their units to provide additional protection for the crossing site.[57]

SECTION V: OPERATIONS IN SPECIAL CONDITIONS

Air defense units are expected to operate effectively at night, in winter, in mountainous terrain, and under conditions of nuclear, biological, or chemical contamination. Training is regularly conducted under such or simulated such conditions to familiarize commanders and troops with the problems peculiar to such operations and for psychological conditioning. Operations at night are considered to be similar to daytime operations, except that higher levels of individual, crew, and unit training, some special equipment, and effective light discipline are required. Anti-aircraft units will usually be located closer to supported units at night than is the case for daytime operations, and towed units will keep their organic transport closer to ensure the ability to relocate rapidly. Reconnaissance of movement routes is frequently conducted at night, and reconnaissance of the enemy is conducted as during daytime, using both technical visual observation. When deploying into new positions during the night, the battery commander, platoon leaders, and radar operators must be aware of terrain features that will obstruct fire or radar signals.

The primary tactical consideration of winter operations is the reduced mobility of units in snow; the mobility of towed units, especially, is greatly reduced below that of motorized rifle or tank units, and the self-propelled weapons again possess a major advantage. Under extremely

difficult conditions, it may be necessary to move towed guns without their associated radars and fire control equipment, but the dangers of such an action are clearly rcognized.[58] Tanks may be used to tow antiaircraft guns, but this slows down the tank and increases the exposure of the antiaircraft gun to enemy direct fire, especially if a meeting engagement should occur. Firing positions under snow conditions may be circular up to 200 meters in radius or the normal inverted "V", pointed in the direction of the enemy and with radar and fire direction equipment to the rear.[59] A method offered to solve the mobility problem and to speed deployment into firing positions under adverse conditions is the use of one or two bulldozers to clear a route and firing positions for the antiaircraft unit. The use of two bulldozers in heavy snow is stated to reduce the time required to deploy from the column into firing positions to that required during normal weather conditions.[60]

The two major problems associated with operations in mountainous terrain are the reduced target detection capabilities and restricted mobility, both due to terrain restrictions. Impaired observation and target detection capabilities greatly reduce the time available to identify and engage enemy targets. Evaluation of potential locations for radars, observation posts, and firing positions by preliminary map and ground reconnaissance is greatly emphasized. Radars are frequently placed on mountain tops having good visibility, or in broad valleys.[61]

Radar operators are trained to evaluate terrain clutter on their screens to distinguish low-flying aircraft. Reduced unit mobility, due primarily to the lack of multiple routes of movement and the necessity to utilize narrow defiles that may be partially or fully blocked by the effects of weather or combat activity, is another serious problem. Additionally, potential firing positions are not so numerous in mountainous terrain. The effects of these problems can be moderated by effective use of engineer support, however, it is still frequently necessary to deploy the platoons of the battery at some distance from each other--sometimes up to two or three kilometers apart. This reduces the effectiveness of the unit's fires and the degree of mutual support obtainable.

Soviet air defense forces are expected to operate effectively in conditions of nuclear, chemical, or biological contamination. This requirement is repeatedly stressed in combined training exercises, and special emphasis is placed on the psychological aspects of training for such operations. In one article concerning the actions of a missile unit under such conditions, the Soviet author stated that "the tried and tested methods for psychological training of missile guidance station crews include intensive drill... and also prolonged work in protective clothing".[62] However, beyond the admonition to be prepared for these conditions, little detail of such training or operational requirements is given. It is clear that air defense troops

are considered to be likely targets for the employment of mass-destruction weapons, especially those delivered by aircraft, and it is recognized that this will require that subunits be prepared to operate independently for extended periods.[63] When time permits, extensive use of engineer support is made in the construction of protective shelters for personnel and equipment, especially for command posts, radars, and communications facilities.

The primary goal of actions taken subsequent to attack by mass-destruction weapons is the restoration of combat effectiveness of air defense units; first priority is the reestablishment of support to first echelon maneuver units, especially those in the direction of the main advance.[64] The loss of command elements and communications facilities is anticipated, and it is recognized that a subordinate commander may be required to function as the command element of its parent unit until such time that the primary command post is restored or a secondary command post is established by the battalion executive officer. One example was given in which a battery commander was appointed to be a deputy commander of a regiment in anticipation of such an attack.[65] The likelihood of mass casualties and major losses of equipment may require the complete reorganization of air defense assets. Collection points will be established in the immediate rear areas for personnel, equipment, weapons, and vehicles, and decontamination points will also be established. As personnel and equipment reach the collection points,

antiaircraft units, primarily platoons and batteries, are formed and moved into forward area positions. Also, mobile repair groups may be sent throughout the area to make minor repairs on weapons and equipment not requiring evacuation to the rear. All these efforts are directed to restoring the combat capabilities of air defense forces to support continued defensive or offensive operations.

SECTION VI: CONCLUSIONS

The above discussion underscores a number of important factors. First, Soviet forces have placed great emphasis on development and deployment of effective air defense weapons systems ranging from fighter aircraft to the employment of individual weapons. Antiaircraft artillery weapons play the primary role in the defense of first echelon maneuver forces. All these weapons--fighter aircraft, surface-to-air missiles, antiaircraft artillery, and individual weapons--are integrated into a system of air defense which is believed to be capable of engaging and destroying any attacking aerial enemy, and information on enemy activity for this weapons complex is collected from a reconnaissance system based on both technical and visual observation. Furthermore, Soviet military authors are fully cognizant of the capabilities and limitations of contemporary aircraft and air defense weapons, and they seek to use those capabilities in a manner that will maximize the effectiveness of their air defense system, while many of the limitations of particular weapons are overcome by the use of varied types of weapons. There are two developments that are, judging from the attention they are given in numerous articles, of major concern tothe Soviets: the use of low-altitude flight techniques and antitank missiles mounted on helicopters. These concerns are evidenced in

part by the constant emphasis on the requirements for constant visual observation under all combat and meteorological conditions, the same degree of mobility for air defense units as possessed by maneuver units, and the engagement of targets at maximum effective ranges to reduce the effectiveness of antitank fires.

Far from considering air defense capabilities solely a defensive means of combat, the Soviets regard air defense weapons as an essential component of a combined arms team which is fully capable of offensive operations. In the Central European combat envirnment, such operations will not be possible without adequate protection from enemy air strikes. Successful offensive operations require air defense units having a high degree of mobility, tactical flexibility, and firepower--requirements that antiaircraft artillery weapons, especially self-propelled weapons, meet quite well; such operations also require that air defense units be prepared to engage with enemy ground forces should such action become necessary. Soviet weapons, doctrine, and training are clearly oriented towards these requirements.

The difficulties for Western analysts lie in trying to determine just how successful Soviet efforts in this field have really been; to attempt an objective evaluation based solely on Soviet open sources would be difficult in its formulation and probably misleading in its conclusions. We can, however, look to the events of the most recent conflict in the Middle East, in 1973, to gain some insight into a

case in which Soviet air defense weapons were used on a major scale. We must keep in mind, however, that the aircraft types involved in the conflict were primarily high-performance fighter and fighter-bomber jets and that combat performance of Arab forces cannot be assumed to equal that of Soviet forces.

First, there can be no question that the Soviet-supplied air defense system was highly successful--at least in the early stages of the conflict. Israeli Air Force losses were initially quite high, however, as has been reported, "only five Israeli planes were shot down in actual combat. Missiles, and antiaircraft guns, which were no less effective than missiles, accounted for the rest (97 additional Israeli aircraft)."[66] (emphasis added). The ZSU-23-4 self-propelled gun made a significant contribution to Arab defensive efforts, especially in the battle over the Golan Heights, where they were used very effectively in conjunction with surface-to-air missiles.[67] While much of the results achieved by these weapons can be attributed to the Israeli lack of electronic countermeasures equipment, we cannot completely discount the characteristics of the antiaircraft weapons themselves. In light of the effectiveness of these weapons against relatively high-speed aircraft, the implications for lower and slower flying Army aircraft are quite serious.

The source of the Egyptian failure seems to be that they failed to aggressively move forward with their air defense after initial objectives had been attained. Once

the Egyptians assumed a relatively static position, under the protection of their air defense system, the Israelis began to attack that system with a combination of air strikes and ground action. Then, having lost a significant portion of its protective umbrella, Egyptain maneuver forces were vulnerable to Israeli air strikes. This Israeli approach to the problem was not without its costs, however, and these costs were increased by the Arab capability to replace destroyed weapons in a relatively short time. To assume that Soviet forces operating in Europe would exhibit the same lack of decisive action would be dangerous at best.[68] Soviet forces can be expected to be a great deal more decisive in the attack and exploitation phases of any operations they might undertake.

What measures can we take to ensure that Army aircraft will be able to operate and carry out their missions in a sophisticated combat environment? The first requirement is to evaluate our aircraft, keeping in mind the nature and capabilities of the Soviet air defense system; how can existing aircraft be improved in terms of mission requirements and aircraft survivability, and how can we design future aircraft to meet these requirements?[69] Additionally, we must determine what electronic countermeasures Army aircraft might require to improve their capabilities to deceive enemy radars. Finally, we must be able to rapidly collect, collate, and disseminate relevant data on the dispositions of enemy air defense forces in a given area of operations; these functions could be carried out in close cooperation

with Air Force units operating in the same area. These measures can be regarded as relatively passive measures intended to reduce the effectiveness of the enemy air defense system and to increase aircraft survivability.

> "The survivability of Army aircraft in a mid-intensity environment is a question that can only be answered by determining aircraft susceptibility to hostile weapons systems and the capabilities of the enemy's soldiers to employ them. We know that threat forces can create an effective air defense umbrella above their ground forces."[70]

More active measures will also be required, including air defense suppression weapons such as stand-off missiles, guided bombs, and terminally-guided artillery projectiles. Aggressive ground action by our own maneuver forces to seek out and destroy those enemy air defense weapons located close to the FEBA will also be required. All of these measures are intended to reduce or eliminate exposure of Army aircraft to ground fires.

Whatever specific actions we may take, we must recognize that the successful employment of Army aviation depends not only upon the aerial situation at twenty or thirty thousand feet where high-performance aircraft will be engaged, but also on our capability to deal with ground-based antiaircraft systems. Soviet antiaircraft capabilities are effective, but experience shows that they are far from insurmountable.

NOTES

[1]"Israeli Aircraft, Arab SAMs in Key Battle," Aviation Week & Space Technology, October 22, 1973, pp. 15-16.

[2]In the Soviet Union, the mission of air defense is carried out by two organizations. Strategic air defense is the mission of the PVO Strany (National Air Defense). Tactical air defense is conducted by forces organic to the nation's ground forces.

[3]Surface-to-air missiles can be used against Army rotary- and fixed-wing aircraft, however, the primary threat to Army aviation is likely to be the more conventional antiaircraft guns.

[4]Voennyi Vestnik regularly includes articles of interest to all combat branches of the service. Vestnik Protivovozdushnoi Oborony is more limited in its approach and contains articles of a more technical nature.

[5]M. Shelekov, "Taktika Aviatsii v Voine v Iugo-Vostochnoi Azii i na Blizhnem Vostoke," (Aviation Tactics in the War in Southeast Asia and in the Middle East), Vestnik Protivovozdushoi Oborony (PVO), No. 6 (1974), pp. 49-52.

[6]F. Gavrikov, "Bor'ba s Vozdushnymi Desantami," (Battle with Parachutists), Voennyi Vestnik, No. 10 (1971), pp. 28-32.

[7]V. Gatsolaev, "Kogda v Vozdukhe Vertolety," (When Helicopters are Flying), Voennyi Vestnik, No. 11 (1973), pp. 69-70. An English translation of this article appeared in the September 1974 issue of U.S. Army Aviation Digest, pp. 8-13.

[8]See, Jane's Weapons Systems, 1971-1972, editors R. T. Pretty and D. H. R. Archer, (London: Jane's Yearbooks), pp. 79-81, 355-356.

[9]"Soviet Anti-Aircraft Gun Takes Toll," Aviation Week & Space Technology, October 22, 1973, p. 19.

[10]Ibid.

[11]Barry Miller, "Israeli Losses May Sour ECM Restudy," Aviation Week & Space Technology, October 29, 1973, p. 16.

[12]Randolph Britt, "The Threat to United States Airmobile Operations," U.S. Army Aviation Digest, p. 19.

[13]Iu. Vavilin, "Povyshat' Tochnost' Ognia," (To Raise the Accuracy of Fire), Voennyi Vestnik, No. 4 (1971), p. 84.

[14]P. Levchenko, "Voiska PVO na Novom Etape," (PVO Forces at a New Stage), Voennyi Vestnik, No. 8 (1973), pp. 57-58.

[15] V. Glushkov and A. Nikolaev, "Zenitnyi Raketnyi Kompleks," (Antiaircraft Rocket Complex), Starshina Serzhant, No. 3 (1973). pp. 21-22.

[16] V. Kislianskii, "Blizhe k Trebovaniem Boia," (Closer to the Demands of Battle), Vestnik PVO, No. 6 (1974), pp. 24-27.

[17] V. Ignatov,, "Zdes' Uchat Bor'be s Vozdushnym Protivnikom," (Here They Study Combat with an Aerial Enemy), Voennyi Vestnik, No. 1 (1974), pp. 80-83.

[18] E. Kuzov, "Chotby Roslo Masterstvo Streliaiushchikh," (To Improve Gunners' Mastery), Voennyi Vestnik, No. 7 (1974), p. 84.

[19] N. Ezhov, "Iz Strelkovogo Orushiia Po Vozdushnym Tseliam," (Small Arms Fire Against Aerial Targets), Voennyi Vestnik, No. 11 (1972), pp. 80-81.

[20] Iu. Solov'ev, "Taktichesko Uchenie Batarei s Boevoi Strel'boi," (Tactical Training of the Battery with Field Firing), Voennyi Vestnik, No. 1 (1971), pp 76-79.

[21] I. Dobrovol'skii, "Na Maksimal'noi Dal'nosti," (At Maximum Range), Vestnik PVO, No. 6 (1974), pp. 36-39. Also see, V. Molchanov, "Vybor Pozitsii RLS v Oborony," (Choice of an RLS (radar station) Position in the Defense), Voennyi Vestnik, No. 7 (1972), pp. 75-78.

[22] V. Grishin, "Vizual'naia Razvedka i Opoznavanie Tselei," (Visual Reconnaissance and Target Identification), Voennyi Vestnik, No. 9 (1974), pp. 94-96.

[23] A. Kudriashov, "Chtoby Vovremia Otkryt' Ogon'," (In Order to Open Fire On Time), Voennyi Vestnik, No. 8 (1971), pp. 85-86.

[24] N. Chuvakin and B. Logvinenko, , "Razvedka Vozdushnogo Protivnika Na Marshe," (Reconnaissance of an Aerial Enemy ((While)) On the March), Voennyi Vestnik, No. 2 (1973), pp. 76-79.

[25] N. Sharapov, "Vzaimodeistvie Zenitnoi Batarei s Podrazdeleniiami MSB v Oborone," (Coordinated Operations of the Antiaircraft Battery with Subunits of the MSB ((Motorized Rifle Battalion)) in the Defense), Voennyi Vestnik, No. 2 (1972), pp. 73-76.

[26] A. Tambovtsev, "Komandir Batarei Organizuet Razvedki," (The Battery Commander Organizes Reconnaissance), Voennyi Vestnik, No. 12 (1971), pp. 63-65.

[27] I. Poliakov, "Boesposobnost' Zenitnykh Podrazdelenii," (Combat Efficiency of Antiaircraft Subunits), Voennyi Vestnik, No. 2 (1973), p. 82.

[28] Ibid., p. 83.

[29]N. Sharapov, "Vzaimodeistvie Zenitnoi Batarei s Podrazdeleniiami MSR v Oborony," (Coordinated Operations of the Antiaircraft Battery with Subunits of the MSR in the Defense), Voennyi Vestnik, No. 2 (1972) pp. 75-76.

[30] See note 8, above, for source on ranges of Soviet weapons.

[31]A. Charaev, "Uchimsia Upravliat' Ognem," (We are Studying to Direct Fire), Voennyi Vestnik, No. 9 (1973), pp. 84-87.

[32]N. Sharapov, Op. cit.

[33]A. Loshchilov, "Po Samoletu Nad Pervym," (At the Plane Over the First ((Vehicle)), Starshina Serzhant, No. 9 (1970), pp. 6-8.

[34]N. Ezhov, "Iz Strelkovogo Oruzhiia Po Vozdushnym Tseliam," (Small Arms Fire Against Aerial Targets), Voennyi Vestnik, No. 11 (1972), pp. 81-82.

[35]I. Drachuk, "Uchim Streliat' Po Tseliam Na Parashutakh," (We Are Teaching to Fire on Parachute Targets), Voennyi Vestnik, No. 1 (1971), pp. 79-81.

[36]M. Anichkin, "Prikryvaia Raion Ozhidaniia i Pogruzki," (Covering the Waiting and Loading Area), Voennyi Vestnik, No. 12 (1972), pp. 76-78.

[37]E. Shcheglov, "Rekognostsirovochnaia Gruppa Zenitnoi Batarei," (The Route Reconnaissance Group of the Antiaircraft Battery), Voennyi Vestnik, No. 10 (1971), pp. 77-81.

[38]Robert R. Rodwell, "The Mideast War: A Damned Close-Run Thing," Air Force Magazine, February 1974, p. 39.

[39]S. Bulyshkin, "Polevaia Vyuchka Zenitchikov," (Field Training of Antiaircraft Gunners), Voennyi Vestnik, No. 12 (1973), pp. 74-78.

[40]N. Chuvakin and B. Logvinenko, "Razvedka Vozdushnogo Protivnika Na Marshe," (Reconnaissance of an Aerial Enemy ((While)) on the March), Voennyi Vestnik, No. 2 (1973), pp. 78-79.

[41]A. Plotnikov, "Na Pozitsii Radiolokatsionnoi Roty," (At the Radar Company's Position), Voennyi Vestnik, No. 1 (1973), pp. 71-72.

[42]V. Mikhailov, "Air Defence of Battalion," Soviet Military Review, No. 8 (1972), pp. 18-19.

[43]F. Gavrikov, "Bor'ba s Vozdushnymi Desantami," (Battle with Parachutists), Voennyi Vestnik, No. 12 (1971), pp. 28-32.

[44]T. Baranov, "Nazemnaia Oborona Pozitsii," (Ground Defense of a Position), Vestnik PVO, No. 7 (1974), pp. 48-51.

[45] A. Plotnikov, "Na Pozitsii Radiolokatsionnoi Roty," (At the Radar Company's Position), Voennyi Vestnik, No. 1 (1973), pp. 71-72.

[46] V. Subbotin, "Kochuiushchie Zenitnye Podrazdeleniia i Zasadi," (Roving Antiaircraft Subunits and Ambushes), Voennyi Vestnik, No. 6 (1974), pp. 81-85.

[47] Ibid.

[48] Ibid.

[49] S. Bulyshkin, "Polevaia Vyuchka Zenitchikov," (Field Training of Antiaircraft Gunners), Voennyi Vestnik, No. 12 (1973), pp. 74-78.

[50] E. Shcheglov, "Komandir Zenitnoi Batarei Upravliaet Ognem," (Antiaircraft Battery Commander Directs Fire), Voennyi Vestnik, No. 3 (1971), pp. 74-71.

[51] V. Mikhailov, "Vzaimodeistvie Zenitchikov i Motostrelkov," (Joint Operations of Antiaircraft Troops and Motorized Infantry), Voennyi Vestnik, No. 8 (1973), pp. 77-79.

[52] V. Subbotin, "Prikryvaia Nastupaiushchikh," (Covering Advancing Forces), Voennyi Vestnik, No. 8 (1971), pp. 83-85.

[53] V. Matiash, "Na Uchenii s Boevoi Strel'boi," (At Exercises with Field Firing), Voennyi Vestnik, No. 8 (1971), pp. 80-82.

[54] Ibid., p. 81.

[55] S. Bulyshkin, "Bol'she Dinamiki Na Zenitnykh Strel'bakh," (More Dynamism in Antiaircraft Firing), Voennyi Vestnik, No. 5 (1973), pp. 77-81.

[56] E. Popov, "PVO i Deistviia Zenitchikov Pri Forsirovanii," (PVO and the Actions of Antiaircraft Troops During Forced ((River)) Crossing), Voennyi Vestnik, No. 5 (1974), p. 85.

[57] Ibid., p. 84.

[58] P. Ivankov, "Po Glubokomu Snegu," (Through Deep Snow), Voennyi Vestnik, No. 3 (1973), pp. 76-78.

[59] I. Mikhailiuk, "Bystree Zanimat' Pozitsiiu," (To More Quickly Occupy a Position), Voennyi Vestnik, No. 4 (1973), pp. 101-102.

[60] P. Ivankov, "Po Glubokomu Snegu," (Through Deep Snow), Voennyi Vestnik, No.3 (1973), p. 77.

[61] A. Kantor, "V Usloviakh Slozhnovo Rel'efa," (In Conditions of Difficult Relief (Terrain)), Voennyi Vestnik, No.9 (1971), pp. 79-82.

[62] V. Kovalyov, "Men & Missiles in Combat," Soviet Military Review, No.4 (1973), pp. 34-35.

[63] V. Iaroshenko, "Samostoiatel'nye Deistviia Raketnogo Podrazdeleniia," (Independt Operations of Rocket Subunits), Vestnik PVO, No. 5 (1974) pp. 36-39.

[64] I. Poliakov, "Boesposobnost' Zenitnykh Podrazdelenii," (Combat Efficiency of Antiaircraft Subunits), Voennyi Vestnik, No. 2 (1973), pp. 83-[illegible].

[65] Ibid.

[66] Chaim Herzog, "The Middle East War 1973," RUSI: Journal of the Royal United Services Institute for Defence Studies, March 1975, p. 12.

[67] Herbert J. Coleman, "Israeli Air Force Decisive in War," Aviation Week & Space Technology, December 3, 1973, p. 19.

[68] Soviet doctrine emphasizes that antiaircraft weapons must displace frequently to keep up with attacking forces. Herzog and Coleman both point out the Egyptian reluctance to venture out from under their protective air defense umbrella. See also, A. J. Barker, "Israel After the Yom Kippur War: Zahal Reflects on the Lessons," RUSI: Journal of the Royal United Services Institute for Defence Studies, June 1974, p. 30.

[69] Harry H. Hiestand, "Military Intelligence and Enemy Air Defense," U.S. Army Aviation Digest, September 1974, pp. 2,3,26.

[70] Thomas M. Tarpley, "Airmobility in Mid-intensity Warfare," U.S. Army Aviation Digest, July 1974, pp. 2-3.

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