HERALDING A NEW ERA

AIR DEFENSE TRENDS

US ARMY
AIR DEFENSE SCHOOL
Fort Bliss, Texas 79916

JANUARY 1969

AIR DEFENSE TRENDS
US ARMY AIR DEFENSE SCHOOL
Fort Bliss, Texas 79916

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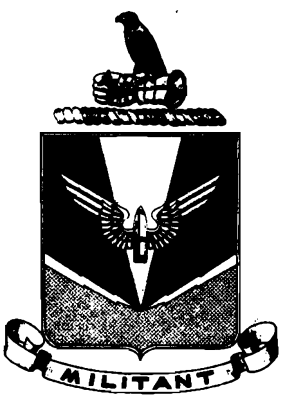
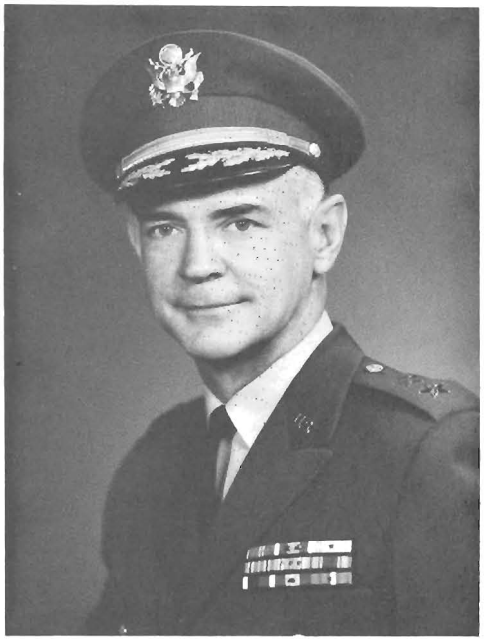


Air Defense Trends is an instructional aid of the United States Army Air Defense School; it is published when sufficient material of an instructional nature can be gathered.

It is not the guns or armament
or the money they can pay,
It's the close co-operation
that makes them win the day.
It is not the individual
or the army as a whole,
But the everlastin' teamwork
of every bloomin' soul.

—*J. Mason Knox*

Introduction



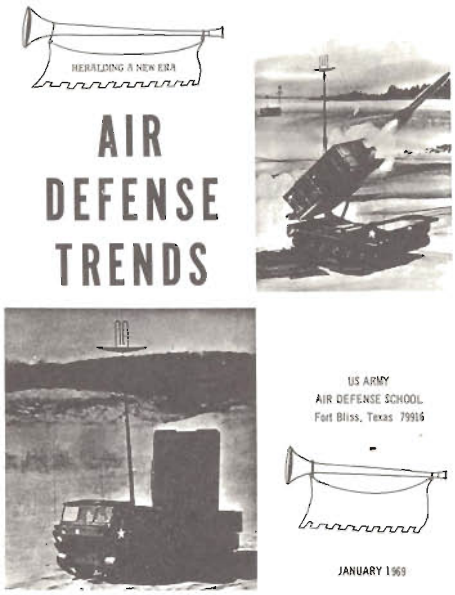
Major General Richard T. Cassidy
Commandant

With the recent separation of the air defense artillery from the field artillery, the US Army Air Defense School has assumed new responsibilities in its traditional role of service to the field. This, the first issue of Air Defense Trends, *hopefully will open a stimulating and mutually productive dialogue.*

The Sentinel program and imminent deployment of Chaparral/Vulcan with divisions have increased Army-wide interest in missile and air defense. This new interest and the new weaponry with which air defense artillery units are to be armed make the exchange of ideas and technical factual information between the US Army Air Defense Center and Fort Bliss and deployed commands even more important than it has been.

Air Defense Trends *welcomes ideas from the field on any subject and from air defense artillerymen of all ranks and experience.*

RICHARD T. CASSIDY
Major General, USA
Commanding

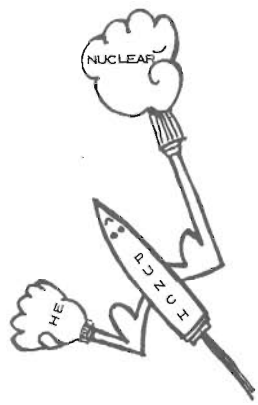


COVER Presently in the advanced phase of development is this dual-punch air defense system known as SAM-D (Surface-to-Air Missile-Development). Most of us are keenly aware of the immediate need for improvement in defense of the field army against the ravages of high-performance aircraft, and SAM-D will more than fulfill that need. The system is designed to destroy both enemy aircraft and short-range missiles.

Prime contractor for SAM-D is the Raytheon Company, Bedford, Massachusetts. Principal elements of the system consist of a fire control group, battery control group, and launcher group, each mounted on a separate vehicle.

The fire control group contains a radar, weapon-control unit, communications equipment, and main power unit. The radar is a multifunctional, phased-array type that will detect and track targets and track and transmit guidance commands to missiles in flight. The phased-array technique eliminates any need for the radar antenna to move either in azimuth or elevation.

The battery control group will coordinate firings within a battery and also serve as a communications center. It has a computer to handle high-data rates, process and coordinate information between radars, and relay fire control information.



The vehicle that houses the launcher group will carry several of the single-stage, solid-propellant missiles which come in launching-shipping containers or canisters. Each missile is mounted on teflon-coated launch rails within the canister. At launch, the motor blast shatters a rear plastic cover and the missile breaks through a forward plastic cover to deliver its lethal punch at supersonic speed. The system can fire missiles from their canisters either singly or in closely sequenced salvos at selectable azimuths and elevations. The missile provides a dual punch in that it can be armed with either a high-explosive or nuclear warhead. It is segmented into nose, warhead, guidance, motor, and control sections.

Several unique features are being built into SAM-D that will please commanders and maintenance personnel alike. These features include built-in test equipment (BITE), redundant circuitry, reliable solid-state devices, a "wooden round" missile requiring no on-site maintenance, and backup maintenance and supply facilities to perform repairs close to the origin of failure. Probably the most unusual feature is the absence of cabling between principal elements. Operators will be trained to use the built-in fault isolation equipment and replace certain faulty components, thus insuring quick action in correcting malfunctions.

SAM-D is designed for both battlefield and continental air defense. The system can be deployed on the battlefield as a battery to provide circular defense coverage or as a firing section to provide sector coverage. A firing section may consist of one fire control group and from one to four launcher groups, and may be detached from the major control elements for autonomous operations. A battery will include approximately 12 tracked or wheeled vehicles carrying a balanced assortment of fire control, launcher, battery control, and communications groups. Tracked vehicles will be for oversea use only. The high mobility of the battery is immediately evident. In the continental air defense role, SAM-D may consist of any combination of elements that is most effective in a particular air defense mission.

Within the next few years, we may expect to see the strange forms of SAM-D elements appearing overseas and at CONUS sites because SAM-D will eventually replace both the Nike Hercules and Hawk missile systems.

AIR DEFENSE TRENDS

An instructional aid of the United States Army Air Defense School, Air Defense Trends is published only when sufficient material of an instructional nature can be accumulated. It is designed to keep air defense artillerymen informed of unclassified tactical, technical, and doctrinal developments because it is essential to national defense that all levels of air defense command be kept aware of these developments and their effect on the air defense posture.

Distribution of this publication will be made only within the School, except for distribution on a gratuitous basis to Army National Guard and USAR schools, Reserve component training and ROTC facilities, and as requested by other service schools, ZI armies, US Army Air Defense Command, Active Army units, major oversea commands, and military assistance advisory groups and missions.

Qualified individuals may purchase copies of Air Defense Trends by writing to The Book Store, US Army Air Defense School, Fort Bliss, Texas 79916.

All articles, regardless of source, are coordinated as appropriate with departments of the School, the US Army Combat Developments Command Air Defense Agency, and the US Army Air Defense Board at Fort Bliss, Texas. This coordination is effected to obtain an "air defense community" position before publishing the information.

We join a grateful and indebted nation in saying CONGRATULATIONS *to* NASA *and the astronauts of Apollo 8 upon the brilliant success of their lunar orbital flight.*

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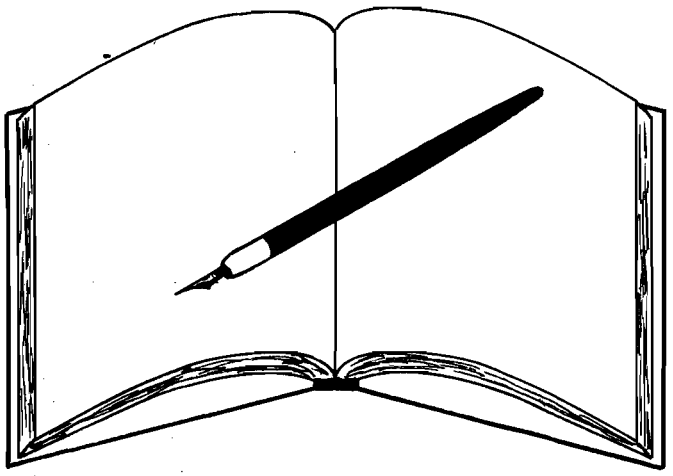

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Articles appearing in this publication do not necessarily reflect the opinions of the US Army Air Defense School or the Department of the Army.

EDITORIAL

Virtually every air defense artilleryman has spent or will spend a part of his career at Fort Bliss—either as a student or in a duty assignment. Many will be here several times during their terms of service. It seems appropriate therefore that we tell something about Fort Bliss and its environment in the inaugural issue of Air Defense Trends.

Historically, Fort Bliss dates back to the Mexican War when, in 1846, Colonel Alexander Doniphan and his Missouri volunteers planted the American flag in the land across the Rio Grande River from El Paso del Norte which was later to be named Juarez after the renowned statesman who was President of Mexico for 10 years. No attempt was made to establish a post until November 1847 when a Regular Army detachment under Major Benjamin Beall (pursuing a band of unfriendly Indians) set up camp at the site and remained several months.

The post of El Paso was established "on paper" by War Department General Order Number 58, dated 7 November 1848. It was one of a series of frontier garrisons being activated in territory acquired by the defeat of Mexico to protect settlers and traders. The post of El Paso was established in fact in September 1849 when, after enduring desert heat and dust for 3 months, Brevet Major Jefferson Van Horne, in command of Companies A, B, C, and E of the 3d Infantry Regiment, arrived from San Antonio. No permanent facilities were developed, however, since it was not yet determined which district would police the area. Hence, in August 1851, all troops except a guard for local properties were relocated at Fort Fillmore near Las Cruces.

In January 1854 a permanent post of adobe buildings was established near the original site and was reinforced by four companies of the 8th Infantry under command of Brevet Lieutenant Colonel E. B. Alexander. At the time, the post was named El Paso, but in March 1854 it was renamed Fort Bliss in honor of William Wallace Smith Bliss, Adjutant General, who had died 7 months earlier.

In March 1861, Fort Bliss was lost to the Confederate Army and remained in Confederate hands until August 1862 when it was retaken by the 1st California Cavalry. The withdrawing rebels burned most of the structures, and the post was not fit for occupancy.

In October 1865, at the close of the Civil War, Fort Bliss was reoccupied and rebuilt. But only 29 months later the post had to be relocated due to the eroding effects of the Rio Grande. The new post (1 mile farther east) was named Camp Concordia. In March 1869, it was renamed Fort Bliss. During this time the town of El Paso had sprung up and was growing.

In 1877 the post was again abandoned, but troops had to return the next year to combat the wave of lawlessness that followed their departure. Quarters in the town of El Paso were substituted for the ruined buildings on post until September 1880 when a new post was completed at the location now known as Smeltertown (fig 1).

The railroads pushing westward to El Paso were granted right-of-way in and near Fort Bliss, eventually forcing another move, this time to the present site which was occupied in 1893.

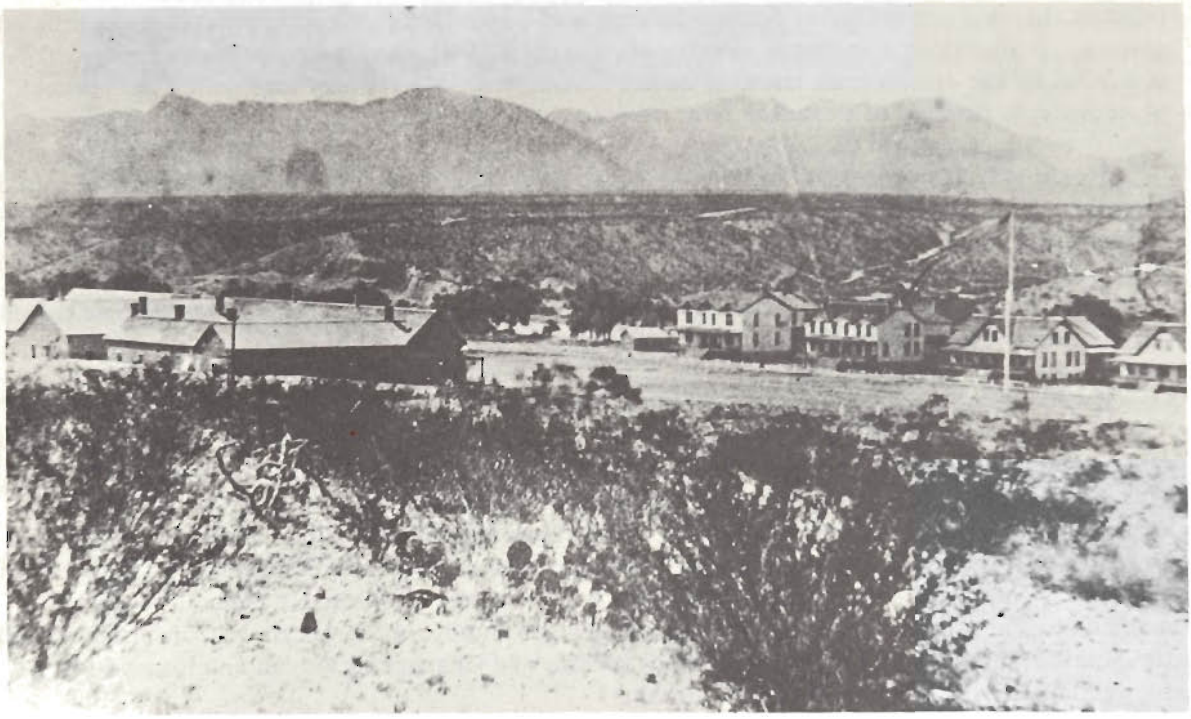


Figure 1. Photograph of Smeltertown location of Fort Bliss, 1878-1890.

Brigadier General John J. Pershing assumed command of Fort Bliss in 1914, 2 years after it had been designated a cavalry post. It was from here that Pershing led the 1916 Punitive Expedition into Mexico in pursuit of Pancho Villa (fig 2).

Figure 2. Troops on parade in the City of El Paso in October 1916.

In World War I, Fort Bliss served mainly as a training station for men of all ranks who were to take up the fight in France. At the end of the war, Fort Bliss was made the key point in the western sector of border defense and control, which contributed to its continued growth. It remained a mounted cavalry station until 1940 when the post was partially absorbed by the antiaircraft training center. Antiaircraft Artillery was then a new branch of service, a product of evolution from the old Coast Artillery.

World War II marked the exit of the horse from Fort Bliss and the entrance of the guided missile. The missile evolved from activities carried on during the war. The first antiaircraft missile was conceived at Fort Bliss in 1944, the same year the AAA School moved to Bliss from Camp Davis, North Carolina. By 1945 a guided missile battalion was activated. A year later the Antiaircraft Artillery and Guided Missile Center was activated, now called the US Army Air Defense Center and Fort Bliss.

Rapid technological advances in the guided missile field culminated in the Nike Ajax in 1953, the present US Army Air Defense School in 1957, and Nike Hercules and Hawk by 1958. Students from Allied Nations have been training at Fort Bliss since the early days of World War II when they received gunnery training. With the changeover to guided missiles, the Allied training program was stepped up. Each year hundreds of Allied students arrive at Fort Bliss to receive instruction on the Nike Hercules and Hawk systems. More than 13,000 students from 55 Allied countries have been trained at the Air Defense School. Today, in addition to the usual training, Fort Bliss is engaged in advancements in weaponry that include the Sentinel missile for destroying enemy ICBM's and Chaparral/Vulcan and Redeye for forward area air defense of the field army.

Through its most recent years of development, Fort Bliss has become home to such air defense units and agencies as the US Army Training Center (Air Defense), 1st Advanced Individual Training Brigade, 6th Artillery Group (Air Defense), 15th Artillery Group (Air Defense), Range Command, US Army Air Defense Board, Human Resources Research Unit, German Air Force Training Command, and Defense Language Institute Support Command. The present garrison contains some 35,000 troops.

During the 100 years of Fort Bliss history, the towns of El Paso and Juarez have been transformed into cities. El Paso, once an area inhabited by Indian tribes, then a stopping place for miners in the 1849 gold rush, and later a center for the cattle industry, is today a thriving city of more than 300,000 people astride major highways, railroads, and air routes. Fruit, vegetable, cotton, and pecan farms (covering some 80,000 acres of irrigated land in the Rio Grande Valley) form a $60 million farming industry. This, combined with income from several major industries, a large military payroll, extensive construction programs, and a lively tourist trade makes El Paso one of the most dynamic and fastest growing cities in the United States.

El Paso is a "soldier's town." The rapport between the military and the El Paso citizenry is excellent. Hence, many of the social activities of the city are planned with the soldier in mind. Among the cultural attractions are symphony orchestra performances, civic ballets, little theater plays, professional theater plays, melodrama, frequent appearances by top professional entertainers, art museums, and the El Paso Centennial Museum.

Public recreational facilities include swimming pools, parks and playgrounds, a roller rink, numerous baseball and softball parks, an archery range, eight golf courses, theaters and drive-in theaters, seven radio stations, three television stations, an annual rodeo, college football and basketball, and the Southwestern Sun Carnival.

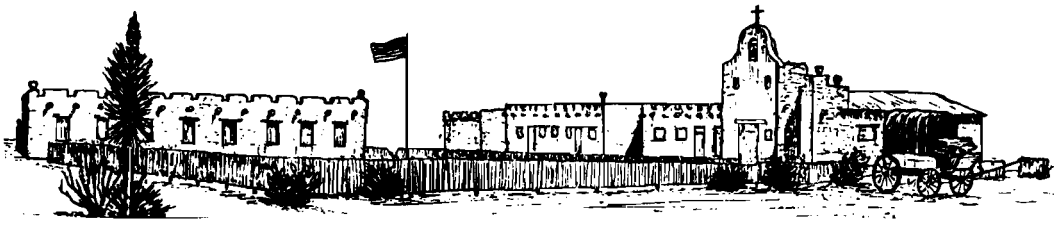
Fort Bliss' entry in the 1968-69 Sun Carnival Parade, which won first place in the military category.

El Paso has 240 churches and 111 schools of various types and levels, including the University of Texas at El Paso which conducts evening courses at Fort Bliss for resident college credit. Eleven modern, multimillion-dollar shopping centers are distributed throughout the city, but its sprawling nature makes it difficult to move about without a car.

Contributing greatly to El Paso's attraction to tourists, and a keen attraction to the residents, is the city of Juarez, Mexico, across the Rio Grande with its 550,000 people. Here one may find a variety of interesting cultural attractions. Artisans, architecture, and products provide an interesting pastime for the visitor. Music, food, drink, and entertainment are available around the clock. One may find all the attractions that are to be expected in a lively border town.

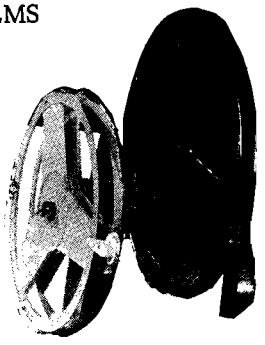
A tour at Fort Bliss, whether long or short, can and should contribute to the soldier's liberal education along with his professional education.

USAADS Instructional Notes



OFFICE OF DOCTRINE, DEVELOPMENT, LITERATURE AND PLANS

AIR DEFENSE ARTILLERY TRAINING FILMS



THE SCHOOL REQUESTS RECOMMENDATIONS ON CHANGES OR ADDITIONS TO 44-SERIES TRAINING FILMS.

Training films are a valuable aid to an instructor, definitely reinforcing his instruction. They parallel field manuals, demonstrations, and other training media in importance. Training films often provide the most effective and economical means for teaching a subject. By their use, troop and equipment demonstrations, for example, can often be reduced or omitted. Department of the Army air defense artillery training films are designed to support individual and unit training conducted at the US Army Air Defense School, US Army Training Center (Air Defense), and in company-size and larger air defense artillery units Army-wide.

Training films covering air defense artillery subjects that satisfy the training requirements of air defense artillery units can best be insured by constructive recommendations from these units. With this in mind, the US Army Air Defense School annually, in September, solicits all major air defense artillery commands for comments on the adequacy of air defense artillery training films. Specifically, this School requests recommendations for training films to cover new techniques and procedures, new equipment or modifications of equipment, and voids in audiovisual material to support individual or unit training.

Recommendations from air defense artillery commands are integrated into the training film requirements generated within the School. This consolidated list is then submitted to US Continental Army Command (USCONARC) for inclusion as the air defense artillery portion of its recommendations to the Department of the Army for category I productions. These production requirements are a portion of the overall Department of the Army motion picture and television production program (DAMP/TVPP) established and operated under the provisions of AR 108-6.

The motion picture and television production program is divided into six categories. Category I, which covers the individual and unit training requirements for Army-wide use, is the category that this School develops and programs concerning air defense artillery subject matter. Category II covers the research, development, test and evaluation, and new equipment introductory film requirements. Public and command information films are assigned to category III. Category IV includes religious, professional medical, and civilian personnel requirements, while category V is assigned recruiting publicity requirements. Category VI contains all requirements not included in the first five categories.

The Deputy Chief of Staff for Personnel is the designated proponent for categories I, IV, and V requirements. Category II proponent is the Chief of Research and Development. The Chief of Information is the category III proponent. These staff agencies are responsible for the receipt, review, coordination, evaluation, and approval of all requirements in their respective categories. Requirements in each category are consolidated and forwarded to Assistant Chief of Staff for Communications-Electronics (ACSC-E). The ACSC-E is responsible for the review, coordination, and supervision of the overall DAMP/TVPP and its submission to the Department of the Army motion picture and television production board for review and final approval. Additionally, ACSC-E is the proponent for category VI films.

The Commanding General, USCONARC, has been assigned the responsibility for review and coordination of all category I production requirements and their submission to the Deputy Chief of Staff for Personnel.

In fulfillment of this mission, USCONARC has designated each service school as the requesting agency for all category I training films pertaining to those subject areas for which that school is responsible. This responsibility includes the formulation and submission of training film requirements to USCONARC annually as well as the production support required to complete these films. In many cases, this responsibility results in the submission of training film requirements covering subjects not taught in the particular service school. For example, training films on crew drill for a weapon system, most helpful during advanced individual training, are programed and produced by this School.

Regarding this School's annual request for recommendations concerning new or revised training films on air defense subjects, it is hoped that major commands will ask subordinate commands for their recommendations. Such action, it is felt, will develop a training film program that will most adequately serve the training needs of air defense artillery units.

Although formal solicitation for recommended changes or additions to the 44-series of training films is made only once each year, recommendations are welcomed at any time. You determine a need for a training film on a subject not covered by an existing film. If the need is urgent, this School will forward a supplemental request; otherwise, your recommendation will be added to the next fiscal year program.

We are here to serve your needs as regards training films and hope that you will provide us with your requirements. In this way we can achieve a program that best answers the needs of air defense artillery units on an Army-wide basis.

STATUS OF TRAINING DEVICE PROJECTS

1. Redeye Moving Target Simulator (MTS) X12A11. A small development requirement (SDR) was submitted to United States Continental Army Command (USCONARC) 17 December 1963, and approved by Department of the Army (DA) 20 May 1965. The development contract was awarded to the Aircraft Armament Instruments Corporation, Cockeysville, Maryland, 27 June 1966. The contract was negotiated and executed by the US Naval Training Devices Center, Orlando, Florida. Funding for development and technical monitoring was provided by Redeye Project Office, US Army Missile Command (USAMICOM). Two prototypes are scheduled to be delivered to Fort Bliss for use in Engineer test/service test (ET/ST) and subsequent Redeye training use by US Army Training Center (Air Defense) (USATC (AD)). Development problems extended delivery dates for the first prototype from October 1967 to October 1968. Installation at Fort Bliss was completed in November 1968. Government acceptance is scheduled for December 1968, initiation of ET/ST training in January 1969, and ET/ST in February 1969. The second prototype is scheduled for delivery late in 1969. Funding and development approval for four production models is expected in FY 70.

2. Redeye Tracking Head Trainer XM49. The development of the tracking head trainer XM49 was initiated by School letter to USCONARC on 1 October 1965 and approved by USCONARC on 12 October 1965. Action was initiated to provide training capability not provided by the Redeye weapon simulator XM42 then under development. The XM42 was developed under the requirements of an SDR submitted March 1963, DA approved November 1963, and contracted for by USAMICOM April 1964. Development of the XM42 resulted in an item that did not meet the intent of the SDR, and the XM49 requirement was submitted to provide an additional means for proper training. As a result of subsequent actions, Assistant Chief of Staff for Force Development, Department of the Army, directed that the XM42 trainer development be terminated and the XM49 be developed to meet the requirements of the SDR. Interim XM49's have been developed and provided to the training agencies as a gap filler until the "ultimate" trainer can be tested, type-classified, and delivered. Interim devices are designated as follows: XM49, a block II external configuration (scope sight) with block II electronics; XM49E1, block III external configuration (open sight) with block II electronics; XM49E2, block III external configuration with block III electronics; and XM49E3, block III configuration and electronics with a readout device to indicate gunner performance of selected functions, and a manually pumped recirculating gas unit for cryogenic cooling of the seeker. The XM49's through E2 models have an internal storage bottle for cryogenic gas which is recharged from an external source after each 40 to 50 operations, and used gas is vented to the atmosphere. The XM49E3 collects the used gas in a low-pressure chamber, and provision is made for manually repressurizing the gas for reuse. Repumping is required after approximately five operations. The status of the XM49 development is that interim models are being used in USATC (AD) and the XM49E3 proof test units were scheduled for ET/ST beginning in December 1968. Production deliveries are scheduled to begin in April 1969.

3. Redeye Handling Trainer XM46. The Redeye handling trainer was developed under the requirements of the same SDR used to develop the XM42 and the XM49. Requirements, as stated, were for a device that could be used either as a dummy handling trainer or a tracking simulator. The decision was made to develop a separate item for handling training. The XM46 trainers have been in use since the start of training at USATC (AD) and are in production for delivery to field units.

4. Chaparral Handling Trainer. An SDR was submitted to USCONARC October 1965, approved by USCONARC, and submitted to US Army Combat Developments Command (USACDC) November 1965. USACDC submitted the SDR to DA on 2 August 1967. It was approved as "abbreviated performance characteristic" by DA on 11 December 1967.

5. Chaparral Simulator/Evaluator. An SDR was submitted to USCONARC October 1965, approved by USCONARC November 1965, and submitted to USACDC. The SDR was approved by DA on 18 April 1968.

6. Chaparral Mount Simulator. This simulator is a device to be used with the Redeye MTS and Chaparral simulator/evaluator for operator training at USATC (AD). An SDR was submitted to USCONARC in April 1966, approved by USCONARC, and submitted to USACDC in April 1966. It was approved by DA on 18 July 1968. Development was held in abeyance until service test of the MTS.

7. Vulcan Mount Simulator. This simulator is to be used with the Redeye MTS for operator training at USATC (AD). An SDR was submitted to USCONARC June 1966, approved by USCONARC, and submitted to USACDC June 1966. It was approved by DA on 18 July 1968. Development was held in abeyance until service test of the MTS.

8. SAM-D: Training Round/Handling Trainer; Operator/Tactics Trainer; and Organizational Maintenance Trainer. Preliminary draft of proposed SDR was submitted to USCONARC December 1968.

9. Training Film: Infrared Radiation and Detection. Expect release of SDR by January 1969.

10. Aircraft IR Kit. A script was prepared for first reel in 1968. Balance of the script is in preparation.

11. Simulator Evaluator Air Defense Systems AN/MPQ-42. A qualitative materiel requirement (QMR) was prepared by US Army Air Defense Command in coordination with USACDC. A QMR was approved by DA 28 February 1966. No funding has been provided and development is doubtful.

12. Target Missiles and Ancillary Items.

a. A draft of abbreviated performance characteristics (APC) for a low-cost, booster-propelled gunnery target was submitted to USACDC by USCONARC on 9 July 1968. The APC is at DA awaiting approval. The APC was initiated by US Army Air Defense Center and Fort Bliss (USAADCEN and Fort Bliss)/US Army Air Defense School (USAADS).

b. A QMR for variable speed training target was approved by DA on 29 May 1968. Original requirement (SDR) was prepared by USAADCEN and Fort Bliss/USAADS in 1965.

c. A fuze augmentation (initiation device SDR for Chaparral) was approved by DA approximately August 1968 and development funding is expected for FY 69. The SDR was originated by USAMICOM.

OUTSTANDING MAINTENANCE—THE MARK OF THE PROFESSIONAL

This statement can be applied to individuals, small units, and larger units, to include theaters. It is not meant to detract from the other functions that a unit must accomplish and which fit together to make a superior land combat force. It is meant to focus attention on maintenance, which is a vital element of logistics that sometimes forfeits its important position to more glamorous aspects of operations.

In a recent address to the Association of the US Army, the Honorable Stanley B. Resor, Secretary of the Army, stated that with the rising cost of Army equipment, maintenance is becoming more and more important. The Command and General Staff College teaches that logistics needs the same degree of attention and planning as does operations.

A high standard of maintenance has always been axiomatic for air defense artillery. With the advent of highly sensitive electronic equipment, the demand for maintenance to a degree of quality not previously attained was brought vividly to the forefront. To the professional soldier, good maintenance means keeping equipment operational by following the prescribed schedules and technical manuals to the letter. Air defense artillery has recognized and accepted this challenge.

When the Hawk system was introduced into the Army, its inherent mobility emphasized a need for professional maintenance under changing tactical conditions. The lessons learned in maintaining Hawk involved principles which, simply stated, are: if you want to accomplish your mission, allow enough time; insure that you have proper tools, properly trained personnel (both supervisors and doers), and authorized parts; and accomplish maintenance skillfully. Some of the management tools which the Army has provided are at times both the maintenance supervisor's best friend and his worst enemy. We are referring here to The Army Equipment Records System (TAERS). When this system was first introduced, few people really knew how to use it or the proper perspective in which it was to be placed.

The purpose of TAERS is to maintain a valid data base and to reduce the amount of paperwork associated with equipment as much as possible. It helps the maintenance man and supervisor make logical decisions. For example, it points out that a 3/4-ton truck which has had many job requests in a short period of time is either too expensive to keep in the field or may have manufactural defects. Operational checks, such as operational readiness evaluations, emphasize the importance of maintenance and TAERS.

The antidote to maintenance problems is the strict application of good leadership fundamentals and management techniques. Correct application of these antidotes is indicated during an inspection by the condition of unit and individual equipment. The results reflect professionalism.

NONRESIDENT INSTRUCTION DEPARTMENT—A STOREHOUSE OF KNOWLEDGE

The instructional mission of the Nonresident Instruction (NRI) Department of the US Army Air Defense School is to provide nonresident instruction to officers and enlisted personnel of all components of the Army in the exercise of command, training, deployment, and employment of Army air defense artillery (ADA) units. Nonresident instruction parallels, as closely as possible, corresponding resident courses of the US Army Air Defense School.

The Instruction Program of the NRI Department includes support of US Army Reserve schools, ROTC instruction, National Guard and Reserve unit staff training, and the Army Correspondence Course Program. The principal and most important functions of the NRI Department are the preparation and administration of the Army Correspondence Course Program of the US Army Air Defense School.

The Army Correspondence Course Program of the US Army Air Defense School includes all phases of air defense instruction. Career development and special courses offer a wide range of subject area study designed to meet the needs of the individual. Two recent changes to the Army personnel management system allude to the advantages of self-improvement through participation in the Army Correspondence Course Program—the establishment of a separate air defense artillery career branch and the development of new and uniform procedures for selecting enlisted personnel for promotion. These changes require careful appraisal of an individual's potential for advancement and assignment to air defense duties.

Successful completion of correspondence courses can add up to 30 promotion points under the new procedure. In addition, successful completion of courses can assist enlisted personnel in improving their MOS evaluation test scores. Results of evaluation tests are recognized and weighted by promotion boards and are considered by commanders in their evaluation reports. The Assistant Commandant of the US Army Air Defense School, in a recent letter to ADA units in the field, emphasized the promotion advantages of correspondence course participation under the new promotion procedures.

Officers and enlisted personnel desiring to take correspondence courses or to secure educational materials should see their Military Education Adviser or write to the Commandant, US Army Air Defense School, ATTN: Director, NRI Department, PO Box 5330, Fort Bliss, Texas 79916.

LOW ALTITUDE AIR DEFENSE DEPARTMENT— BACK TO SCHOOL FOR 24B20, 24F20, AND 22J20

MULTILEVEL: AN ENTRY-LEVEL AND CAREER-LEVEL COURSE FOR HAWK MAINTENANCE TECHNICIANS

The Low Altitude Air Defense Department of the US Army Air Defense School is conducting experimental entry-level and career-level courses for Hawk maintenance technicians in a program called "Multilevel." As designed, the Multilevel program includes an

entry-level program of instruction for the first-term enlistee or draftee and a career-level program for the reenlistee with 2 or more years of active duty.

The entry-level program is oriented to teaching job-required skills rather than basic electronic theory. The career-level program is designed to teach detailed theory instruction and advanced maintenance techniques. In other words, the entry-level graduate can maintain equipment; i.e., perform unassisted weekly check procedures, troubleshoot to a plug-in part, properly use all unit test equipment, and read detailed and functional schematic diagrams. The career-level graduate can read and derive electronic calculations from detailed schematic diagrams and perform system-integrated troubleshooting, wire harness, intra-chassis, or piece part repair. He can apply his troubleshooting ability to equipment other than that specifically assigned to his section by utilizing his detailed knowledge of electronic theory.

Impetus for the Multilevel program was provided when the following problem areas were defined:

a. Training time versus useful service time. The increasing complexity of modern electronic weapons without corresponding innovations in electronic maintenance instruction has caused a number of disparities in the training of maintenance technicians. Maintenance courses in the service schools have generally increased the length of instruction and difficulty of subject matter to meet this complexity. Training time, cost, and student attrition rates have increased compared to useful service time remaining after graduation. To reduce the training time and cost and to improve the effectiveness of training electronic technicians, the Department of Defense suggested that electronic maintenance courses be programed on a two-phase basis, entry-level and career-level. The entry-level phase would be organized on an equipment-centered basis, functionally oriented to teach troubleshooting and repair procedures rather than theory. The career-level training would be directed toward teaching the technician a knowledge of fundamental electronic theory. The Department of Defense also assumed that functionally oriented or equipment-centered courses would permit training and use of technicians with lower aptitudes than now possible. This would facilitate a substantial reduction in the length of formal school courses accompanied by at least a 20-percent reduction in the annual cost of teaching electronics.

b. Inability to diagnose equipment failures. In a study on the Army logistics system conducted in October 1967 by an Army board of inquiry (commonly referred to as the Brown board), the board found that a large number of electronic maintenance personnel lacked the ability to diagnose equipment failures correctly. The principal reasons for this conclusion were that school training courses were based on theory, diagnosis was not sufficiently emphasized, and curriculums were not derived from valid job requirements. Instead, the training leaned heavily on theory of equipment operation, the assumption being that such knowledge enabled the man to generate approximate diagnostic procedures for any problem that arose on the job.

c. MOS structure. The current Hawk maintenance MOS structure provides little opportunity for a systematic progression in skill through a career field; rather, the bulk of the technical training that a man receives comes during his first 6 months in the Army. The skill level differentiation between 20 and 40 is normally based on a change in rank

rather than on acquired knowledge. The shortcomings of this system, as stated by the Brown board, are as follows: "a) training dollars are lost on a large number of single enlistment personnel; b) single enlistment personnel are often trained in skill areas they will not utilize; c) a rather low stable level of maintenance skill is produced Army-wide; and d) career personnel do not receive training in the progression necessary for application to the changing job requirements of their career fields."

After analysis of the outlined problem areas, the Low Altitude Air Defense Department developed a program of instruction which had the following objectives:

a. Reduce the cost and training time for the entry-level electronic maintenance technician.

b. Equal or improve the efficiency of the entry-level and career-level Hawk maintenance technician.

c. Establish a definite standard for the 20 and 40 MOS skill levels commensurate with normal career progression.

In November 1967, the Low Altitude Air Defense Department conducted initial tests of the entry-level program. The Hawk Continuous-Wave Radar Maintenance Course was chosen for the test class. The 13-week experimental course was taught without the requisite basic electronics course. The Multilevel program was designed to incorporate procedure-oriented, functional context, training methods of instruction. For example, instead of stressing a knowledge of electronic theory, troubleshooting procedures were analyzed by experts and signal flow was diagramed into an observable logical sequence. Students were trained to recognize normal and abnormal equipment indications (cues) and to follow documented procedures (responses) in isolating malfunctions to a plug-in part. (Figures 1 and 2 show some of the Multilevel training devices.) Basic electronics was included in instruction when the student realized he needed this instruction to continue, but the extent to which it was taught was limited by the student's need. For example, students were taught to recognize multimeter indications rather than how to derive electronic values by using Ohm's law. Instruction emphasized job preparation and made maximum use of practical application. A 40-man end-of-course proficiency test was incorporated to examine the student's ability in performing daily and weekly check procedures and to check his efficiency in using the documented troubleshooting procedures; i.e., could he isolate the malfunction.

Multilevel students were compared with those in a conventional 26-week course who were programed to graduate at approximately the same date. The identical end-of-course proficiency test was administered to both classes. Test results demonstrated that the entry-level students were as proficient as electronic maintenance graduates of the conventional course in checks and adjustments (fig 3) and that they were more efficient in their ability to troubleshoot malfunctions (fig 4).

In addition, evaluators (averaging 5 years' on-site experience) of the end-of-course proficiency test, plus feedback questionnaires from entry-level graduates assigned to Hawk units, indicated that the test class graduates were superior to the conventional class graduates and recommended continuation of the Multilevel program.

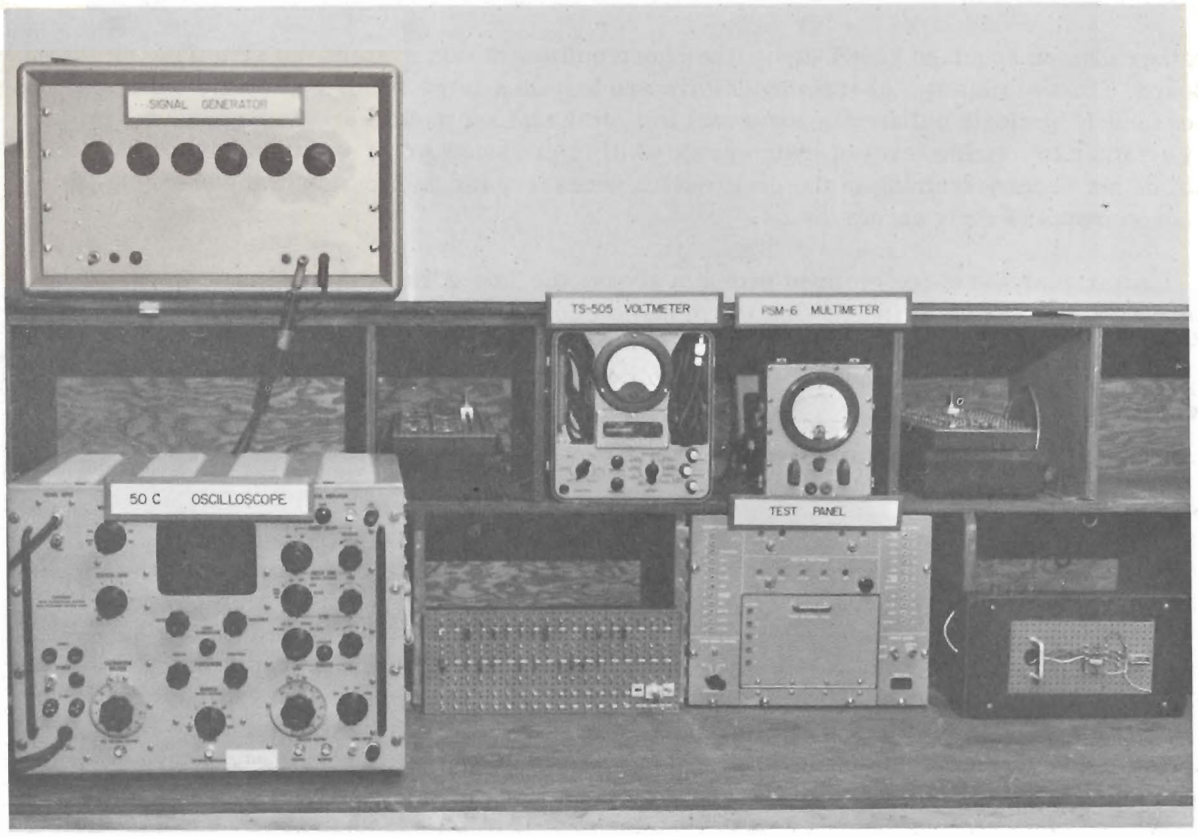


Figure 1. Test equipment.

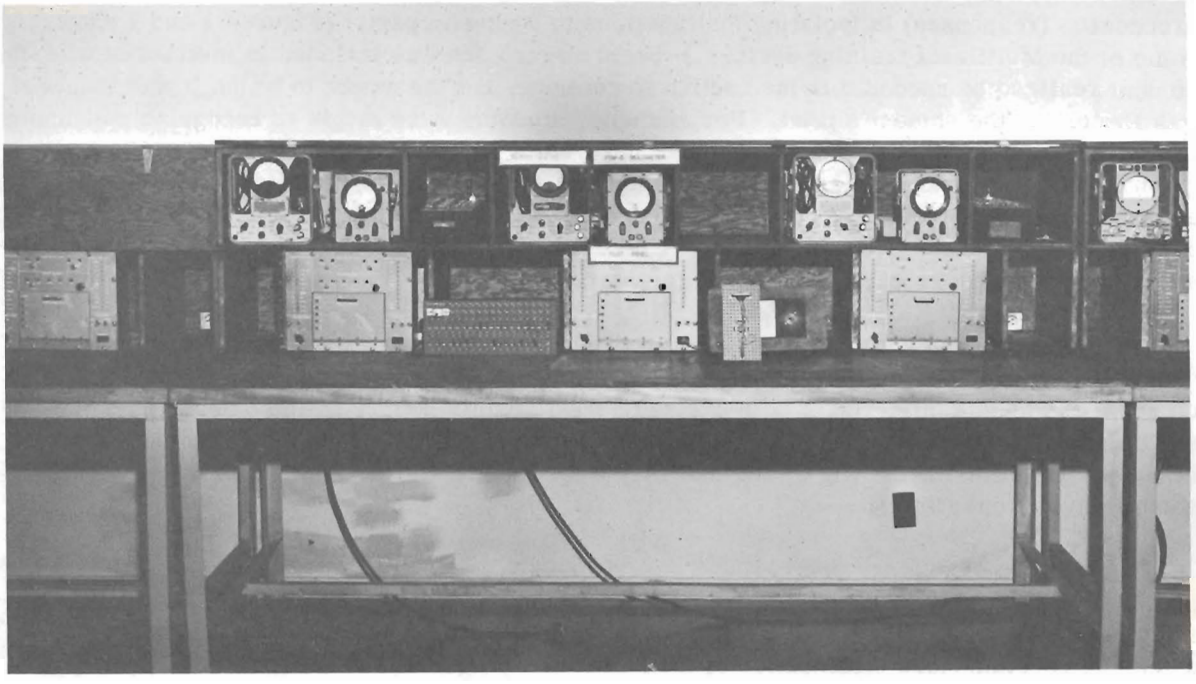


Figure 2. Test panel.

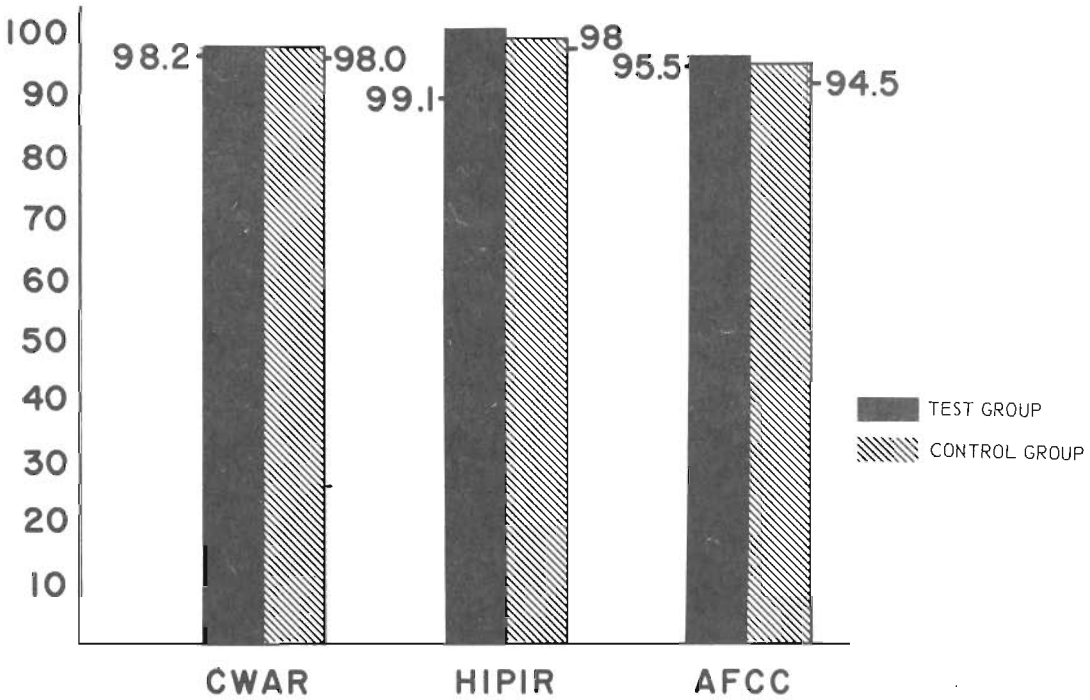


Figure 3. Results of end-of-course test.

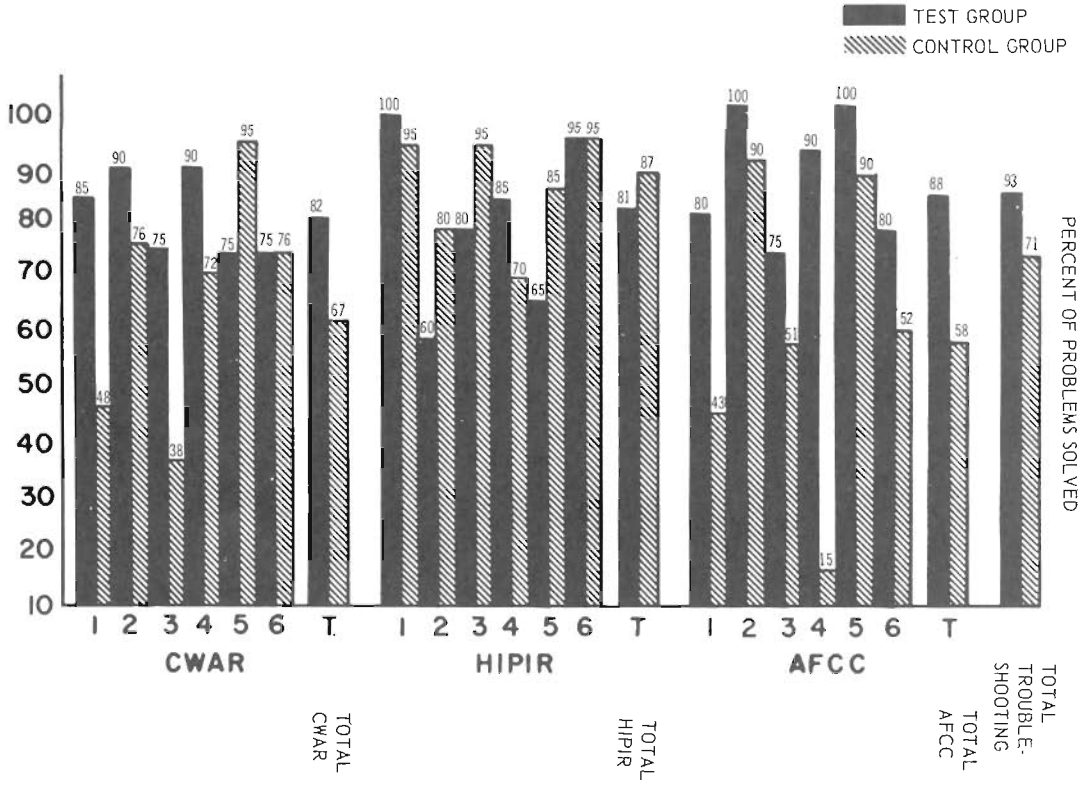


Figure 4. Results of troubleshooting test.

At present, the Low Altitude Air Defense Department is conducting a second test of the entry-level program. This test is designed to incorporate lessons learned during the first test and to gather further data concerning the feasibility of the entry-level program. Implementation of the entry-level and career-level programs for all Hawk maintenance MOS training is tentatively scheduled for 1971. Those personnel who have completed the entry-level course and who reenlist will attend the career-level course. All personnel who have not attended the entry-level course should have progressed through normal promotion to the 40 proficiency level by the implementation date of the career course. As necessary, selection and assignment control of Multilevel graduates will be provided by Office of the Deputy Chief of Staff for Personnel, Department of the Army.

NOTES FROM THE US ARMY AIR DEFENSE BOARD

BACKGROUND

The Board was established in 1942 at Fort Monroe, Virginia, as the Antiaircraft Artillery Service Board. In May 1942, theBoard moved to Camp Davis, North Carolina, and in August 1944 to Fort Bliss, Texas. In October 1947, the Commanding General, US Army Ground Forces, discontinued all service boards, simultaneously establishing a series of Army Ground Force boards. During this time, the Board was designated as the Antiaircraft Service Test Section of Army Ground Forces Board No. 1. When the Antiaircraft and Guided Missile Center was established at Fort Bliss, Texas, the Antiaircraft Service Test Section was released from Board No. 1 and assigned to the Guided Missile Center with the designation of Army Ground Forces Board No. 4, and later, Army Field Forces Board No. 4.

Effective 1 January 1957, the Board was redesignated by the United States Continental Army Command as the US Army Air Defense Board to insure uniform terminology throughout the air defense establishment.

The mission of the US Army Air Defense Board is to plan, conduct, and report on service, military potential, check, and confirmatory tests related to the suitability of air defense equipment for Army use.

The Board participates in engineering/service tests and participates in, supervises, and monitors troop tests as directed by the Commanding General, US Army Test and Evaluation Command. It advises proponent agencies and developers during their development and study of air defense equipment. The data and information derived directly from test experiences provide the basis for such advice.

The Board has the responsibility to perform tests and evaluations of air defense weapon systems, air defense fire distribution systems, air defense electronic countermeasures and counter-countermeasures equipment and devices, target missile devices, and atomic demolition munitions.

It coordinates and uses resources to the maximum extent in accomplishment of the mission; provides representation for inprocess reviews as directed by the Commanding General, US Army Test and Evaluation Command; assists in the review of training literature and selection of training aids; assists in the preparation of maintenance packages; observes and reviews the performance of selected standard items; and plans, directs, and controls a program in test methodology to insure proper testing and reporting in current and future years.

SELF-PROPELLED HAWK

Service testing of a self-propelled (SP) Hawk platoon will begin soon in the Dona Ana maneuver area of Fort Bliss. The US Army Air Defense Board, as an agency of the US Army Test and Evaluation Command, will conduct the test which will require 6 weeks and will take place under conditions expected in peacetime and wartime service.

The SP Hawk platoon increases the mobility and flexibility of the conventional Hawk battery—a unit already acclaimed for its capability to relocate and prepare for an engagement in record time. The self-propelled Hawk (fig 1) is basically a self-propelled, full-track vehicle equipped with a 60-kilowatt generator mounting a modified launcher with three ready Hawk missiles. The three vehicles in each platoon carry a total of nine missiles and tow two radars and a fire direction central. The compact and independent fire unit is expected to move across terrain impassable to wheeled vehicles and to be emplaced in less time than the basic Hawk battery.

A rigorous schedule, based on the realities of known and expected field service, will test the equipment against design specifications and determine the effectiveness of soldiers to operate and maintain the platoon. Travel over hundreds of miles of road, ranging from paved highway to trails, is designed to test structural strength, collect fuel and oil usage data, and determine the extent of maintenance and repair. The time required to prepare the system for action and fire upon attacking high-performance aircraft will be of special interest. Other tests will measure the reaction time of men and equipment from the moment of target detection to missile lift-off.

Present planning envisions two self-propelled Hawk platoons, equipped with the new full-track vehicles, and one towed Hawk platoon in each Hawk battery. Three self-propelled batteries and a headquarters battery will form a battalion.

Battalions converted from basic Hawk to self-propelled will realize an increase in the number of fire units and ready missiles. Two officers, one warrant officer, and approximately 30 enlisted men will man the new self-propelled Hawk platoon.

The report of the service test will be a primary basis for equipment improvement and is a part of the Army's program to insure that new equipment issued to troops is effective, dependable, and safe to operate.

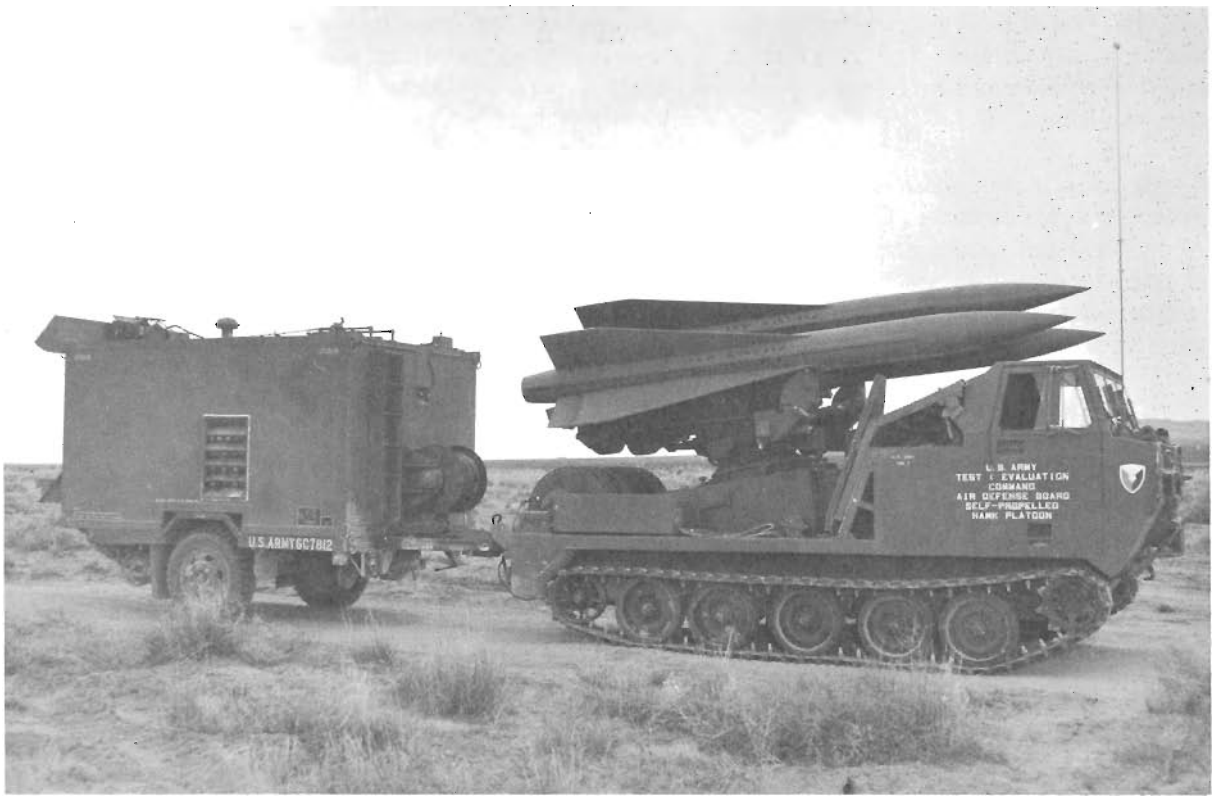


Figure 1. Self-propelled Hawk (US Army Air Defense Board photograph, Fort Bliss, Texas).

VULCAN FORWARD AREA AIR DEFENSE WEAPON SYSTEM

The Gatling gun, highly feared weapon of the Civil War and Indian War eras, is once again a member of the US Army arsenal. The old handcrank, however, has been replaced by an electric drive motor; the horse-drawn carriage has given way to a modern tracked vehicle; and the former crude sight is now a radar-equipped fire control system.

The modernized, modified version of the Gatling gun, called the Vulcan (fig 2), is the Army's newest approach to forward area air defense for the field Army. The Vulcan with its 3,000-round-per-minute rate of fire is designed to protect frontline units from attack by low-level enemy aircraft and is capable of adding a significant punch to the ground fire of supported units.

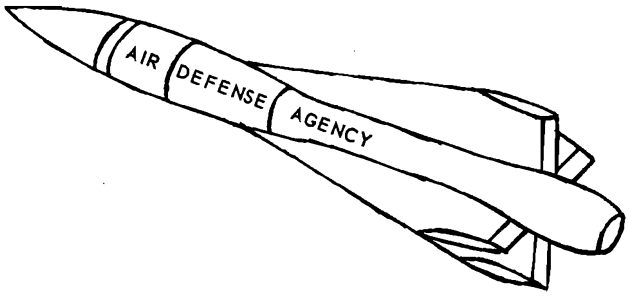
The Vulcan, built from existing systems, will be available in both self-propelled and towed versions. The self-propelled version consists of a modified Air Force 20-mm aircraft gun mounted on a modified M113 armored personnel carrier. The Vulcan can be moved where needed by road, cargo airplane, or helicopter.

Figure 2. Vulcan (US Army Air Defense Board photograph, Fort Bliss, Texas).

The US Army Air Defense Board, an agency of the US Army Test and Evaluation Command, is currently service testing the self-propelled Vulcan system. Testing of the towed version will start shortly. Service testing is conducted by military personnel of the US Army Air Defense Board to test new equipment, under field conditions, before issue to Army units.

When testing and deployment of the Vulcan have been successfully completed, the Vulcan weapon system should represent a formidable defense against enemy air and ground attack.

NOTES FROM THE US ARMY COMBAT DEVELOPMENTS COMMAND



BACKGROUND

The US Army Combat Developments Command Air Defense Agency (USACDCADA) was organized at Fort Bliss on 1 July 1962. This Agency is part of the US Army Combat Developments Command (USACDC) established in the 1961 reorganization of the Army.

The USACDCADA is charged with determining how air defense artillery (ADA) units should be organized and equipped and how they should fight in the future. It also formulates and documents doctrine and future concepts for ADA in both CONUS and oversea operations.

The USACDCADA maintains close coordination with its sister agencies and with other Services to insure compatibility of ADA concepts with combined arms concepts of the present and future. Liaison with the Army Materiel Command is maintained to keep abreast of industry capabilities to insure that USACDCADA-developed requirements stand a practical chance of being technically possible. The Agency also works closely with the major US Army commands and high-level military and civilian agencies. It coordinates all major actions with the US Army Air Defense School, the US Army Air Defense Board, and other air defense organizations at the US Army Air Defense Center and Fort Bliss to take advantage of the wealth of knowledge and air defense expertise found at these establishments.

Agency end products include combat developments studies, doctrinal 44-series field manuals (FM 44-1, FM 44-1A, FM 44-2, FM 44-3, FM 44-95, and FM 44-96), tables of organization and equipment (TOE), and statements of materiel requirements. Notes on some of the activities follow.

STUDY EFFORTS

The Agency recently published the final draft of the Combat Developments Command Basic Derivative Study Air Defense-75 (AD-75). This study, distributed October 1968, develops air defense doctrine, materiel requirements, and organization to support military operations in different tactical environments and intensities of conflict within the time frame 1970-1975. It defines air defense roles and missions and establishes command, control, and coordination requirements, to include the relationships between Army, other Services, and other country air defense elements. The study visualizes future air defense requirements and provides a method for rapid determination of air defense force levels for contingency operations. It also compares air defense force requirements for a number of hypothetical military operations projected during the time frame.

Work has been started on a target missile study to determine and update the ADA requirements for target missiles and/or other devices to be used for service practice and systems test and evaluation.

The Agency is assisting Headquarters, USSTRICOM, with the analysis of air defense of an isolated airbase by providing computer simulations of various levels of air defense.

Agency analysts are currently in the process of defining a joint interceptor/SAM computer model which will be developed within the next 12 to 18 months. This model will be capable of analyzing the tactical interactions which occur in the joint SAM/interceptor environment with emphasis on command, control, and coordination.

FIELD MANUALS

The Agency is currently revising two of its doctrinal field manuals. FM 44-1, US Army Air Defense Artillery Employment, the basic air defense manual, will be revised and in the hands of troops in the fall of 1969. FM 44-1A, the classified supplement to FM 44-1, is also under revision and will be in the field in the spring of 1969.

ORGANIZATION

New MOS 224B, Chaparral/Vulcan system technician, was approved by DA with an effective date of 1 April 1969. This new warrant officer position, authorized one per Chaparral/Vulcan battalion, will provide the battalion-level system technical expertise and the maintenance coordination and evaluation capability lacking in the present Chaparral/Vulcan organization. Specifications for the new MOS will be published in Change 11 to AR 611-112. The accompanying DA circular will provide implementing instructions. The new Chaparral/Vulcan system technician was included in Change 1 to TOE 44-326T, Headquarters and Headquarters Battery, Air Defense Artillery Battalion, Chaparral/Vulcan, Self-Propelled. This TOE change was recently forwarded to Headquarters, Combat Developments Command, for approval.

MATERIEL

The Agency over the past years has initiated the statement of requirements for the SAM-D, self-propelled Hawk, Improved Hawk, Advanced Nike Hercules, Chaparral, and Vulcan weapon systems and the US Army air defense command, control, and coordination (C^3) systems. Responsibilities for these and other systems began some years ago with the initial combat developments studies that established the basis for the materiel requirements. The USACDCADA is now providing "user" inputs during all phases of system development and will continue to provide such guidance for the life of the systems.

NOTES FROM THE HUMAN RESOURCES RESEARCH OFFICE

HISTORICAL SKETCH

HUMRRO—the Human Resources Research Office of the George Washington University—was established in 1951 to carry out an integrated program of human resources research for the Department of the Army. HUMRRO specializes in research in the fields of training, training device requirements, motivation, and leadership.

Dr. Meredith P. Crawford

Dr. Meredith P. Crawford, director of the Human Resources Research Office since it was established in 1951, was presented the Distinguished Civilian Service Medal by the Secretary of the Army in 1961. He previously served as a professor of psychology (1940-450 and dean of the Junior College, dean of instruction, and dean of the College of Arts and Sciences (1945-51) at Vanderbilt University. During World War II, Dr. Crawford served in the US Army Air Corps, rising to the rank of lieutenant colonel. He holds a B.A. degree from Vanderbilt and M.A. (1932) and Ph. D. (1935) degrees from Columbia University. He is affiliated with numerous professional groups.

The general purpose of HUMRRO is to improve human performance, particularly in organizational settings, through behavioral and social science research, development, and consultation.

This "mission" involves HUMRRO scientists in (1) research and development on specific training and education problems; (2) refinement of the technology of training and education; (3) research on leadership and management, and on training for these; (4) studies of techniques for motivating training and performance; (5) studies of human performance in operational systems; and (6) teaching the technology of training and education.

HUMRRO, which is one of the largest organizations of its kind in the United States, is the principal source of training research and development for the Army (fig 1).

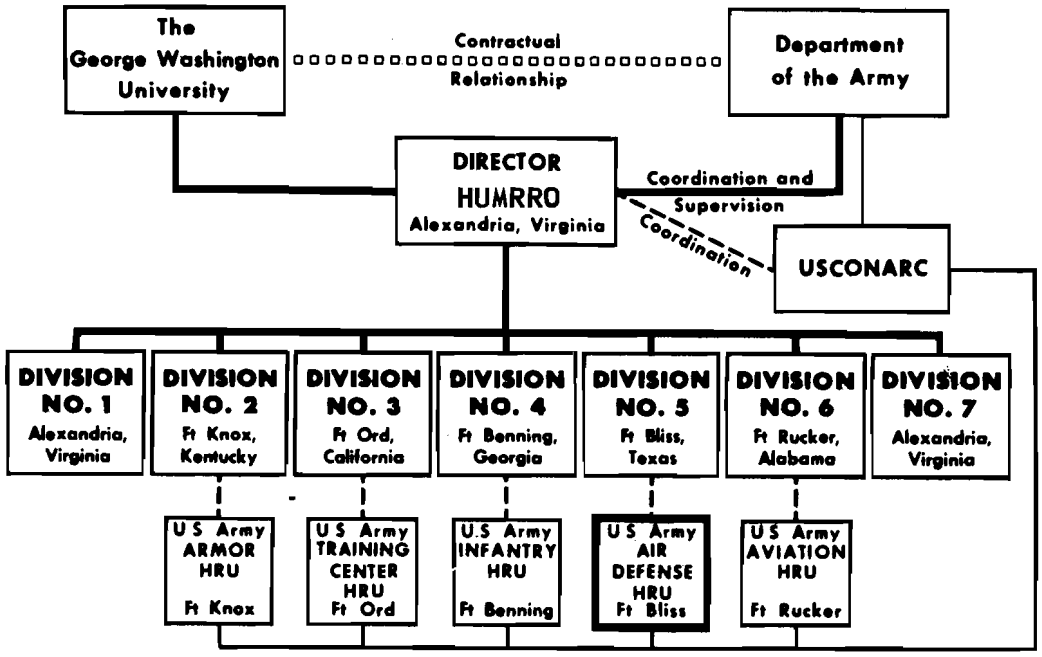
For more than 16 years, HUMRRO scientists have been discovering, developing, and applying human factors and social science principles and techniques for improving Army training and operational performance. They have developed methods for teaching military skills and knowledges, for insuring retention of these skills and knowledges, and for optimizing their actual use by men performing military duties.

HUMRRO was established at the specific request of the Department of the Army to provide it with a highly specialized human factors research capability with the kind of flexibility required for fresh solutions to novel and complex problems.

Experience during the first few years of HUMRRO operation revealed that the training context, in general, provided the most effective approach for attacking problems in motivation, morale, and leadership, as well as the problems in instructional method and content.

The improvement of individual and unit performance—primarily through training and education—has become the dominant theme in the research and development activities directed toward the overall HUMRRO mission. In accordance with the prime contract, particular research goals for each fiscal year are specified in an Annual Work Program which is mutually agreed upon by the Army and HUMRRO.

Like other members of the Army's human factors research team, HUMRRO scientists focus on the individual soldier and on groups of soldiers in teams and units—on the man in the Army's many man-man and man-machine weapon systems.



This chart depicts the HUMRRO organization and its relationship to the Army. The nature of HUMRRO's relationship to the Army is such as to give research personnel access at several echelons from Headquarters, Department of the Army, through major operating commands, to schools, training centers, and operational units.

Figure 1. Organization chart.

HUMRRO scientists believe strongly that man continues to be the most important factor in any Army operation—that man will always play the predominant and final role. Men, not machines, win or lose battles. The importance of the individual increases with the complexity of the weapons he employs.

Over the years, the HUMRRO staff has represented a unique and productive resource for the Army, combining a wide range of scientific and military expertise and experience. One major advantage of a continuing research organization like HUMRRO is that it has become a repository not only of reported research, but also of unrecorded information on research problems and methods.

Because of HUMRRO's intimate and extensive relationship with the Army since 1951, its scientists have gained a considerable knowledge of the Army's personnel and training systems and have developed skills and techniques especially adapted to research in the Army. Consequently, the Army has in HUMRRO an investment in personnel and organizational know-how which is of cumulative value and increasing potential.

From the Field

HELPFUL HINTS

Editor's Note:

As a service to interested air defense units, Air Defense Trends will publish helpful hints as they are received from the field. All contributions will be considered by the editorial staff, and those of interest to others will appear in an early issue.

BATTERY B, 3D BATTALION (NIKE HERCULES), 1ST ARTILLERY

Figure 1 shows one method that has been used and proved successful for the camouflage of vans in a Nike battery. The technique was designed to camouflage the control vans for both the fire control area and the launching area in a Nike firing unit.

Fifty-five-gallon drums and sandbags are used as support for a wooden frame over which a camouflage net is stretched. The drums are placed around the van and wooden poles inserted into each drum. The support poles are held in an upright position by placing sandbags around the bottom of the poles inside the drums. A lattice-like frame is then constructed and secured to the tops of the poles. A camouflage net is then draped over the frame and staked to the ground.

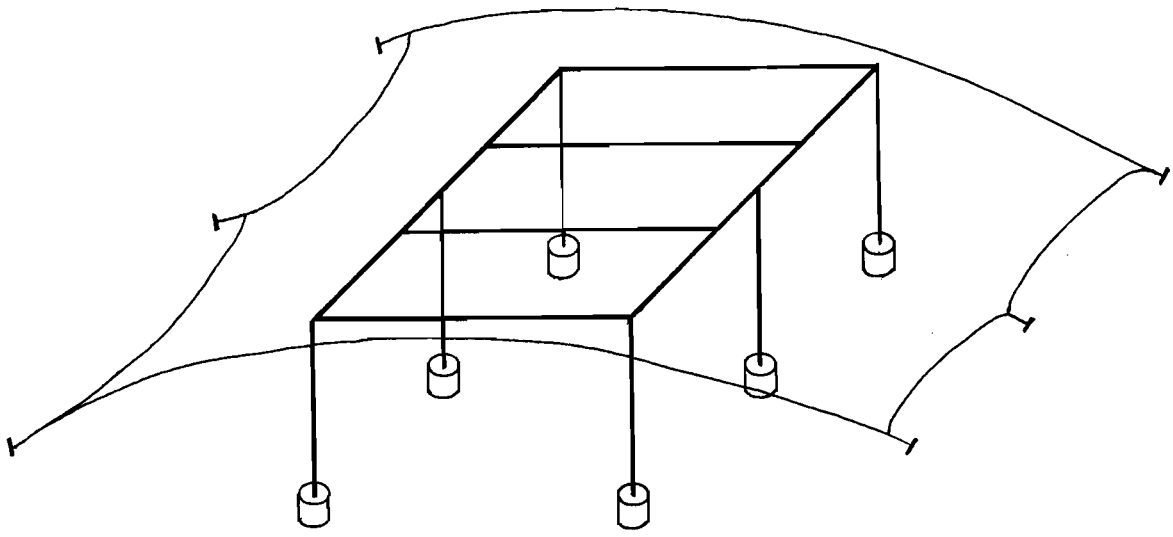


Figure 1. Camouflage of vans.

BATTERY D, 2D BATTALION (NIKE HERCULES), 52D ARTILLERY

Consolidated prescribed load list (PLL) equipment was stored in a Butler building. Excessive moisture and improper insulation required that extra precautions be taken so that spare parts could be kept serviceable while not in use. By utilizing space in the alternate battery acquisition radar (ABAR) building, this unit was able to solve the PLL storage problem.

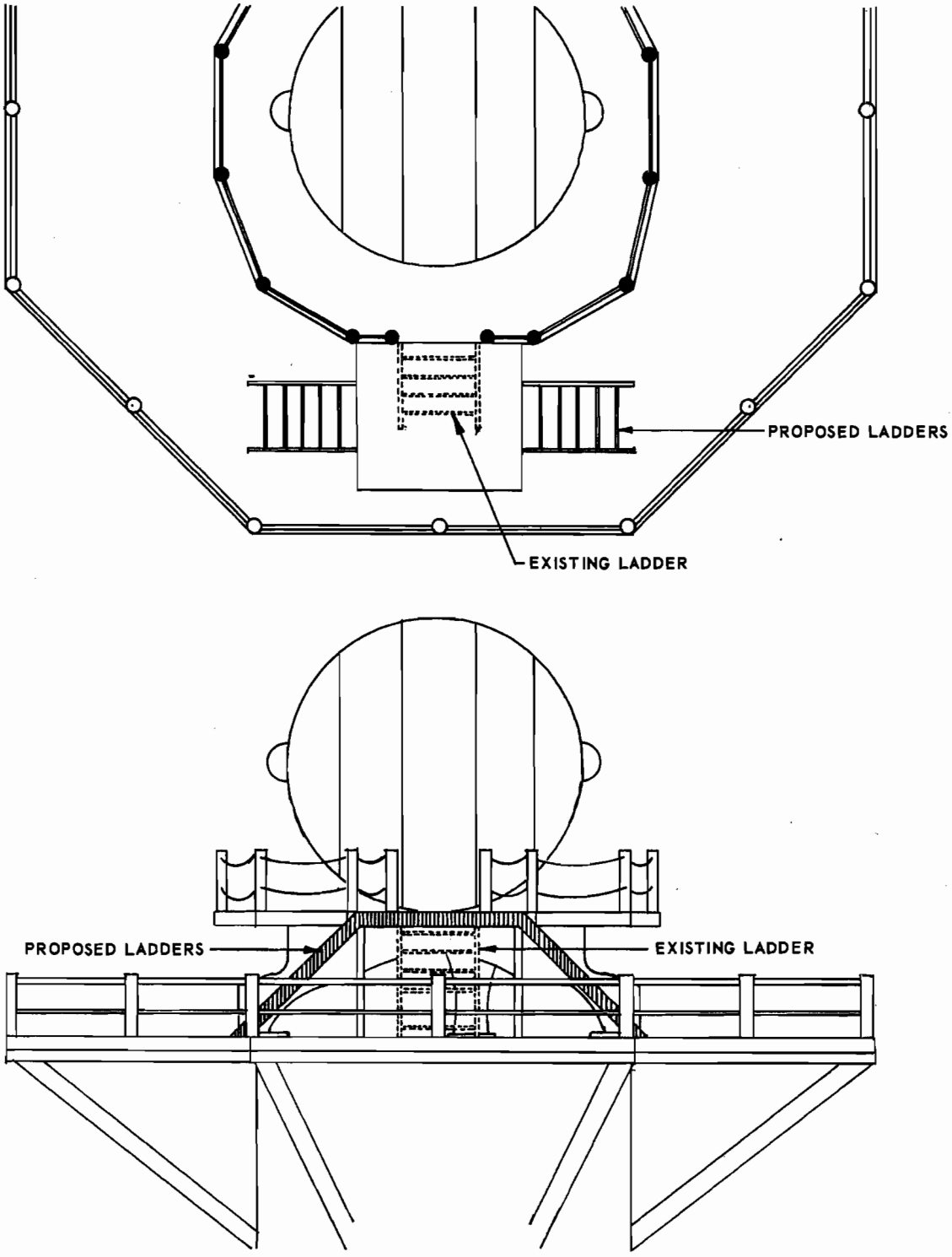


Figure 2. Platforms.

Since the establishment of the site, additional power requirements created a shortage of tactical power for electrical equipment during severe weather conditions.

By eliminating nonessential electrical equipment (hall lighting, air conditioners, stove, etc.) and by manually operating all large ac motor-driven equipment (water pump, boiler motors, sewage plant motors, etc.), the electric power requirement was reduced with the result that all equipment remained operable and adequate living conditions were maintained during severe weather conditions.

The steepness of ladders leading from the radars make it dangerous for an individual carrying the equipment; thus, these ladders present an extreme safety hazard. Platforms are being built, as shown in figure 2, that will make it possible to have two ladders. These new ladders will be built along the sides of the radars, thus reducing the degree of steepness.

2D BATTALION (NIKE HERCULES), 166TH ARTILLERY

The AN/MPQ-T1 (target simulator) has the capability of producing simulated identification, friend or foe (IFF), returns associated with simulated acquisition targets. This feature has severe limitations, however, in that the T1 operator does not know what modes and codes are being used by the identification officer during target challenging.

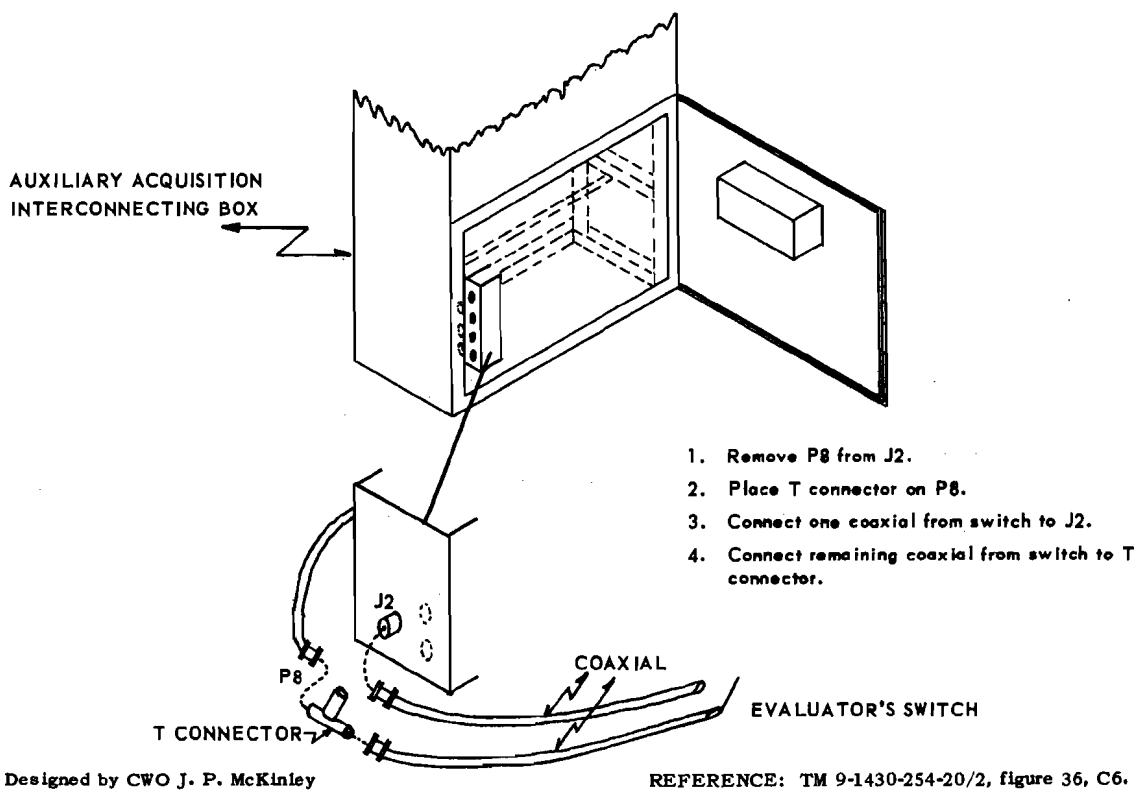


Figure 3. Spring-loaded switch.

The evaluator, positioned in the director station, must therefore inform the T1 operator to give or not give a response on each sweep on the plan position indicator (PPI). The critical degree of coordination required with this procedure often causes erroneous responses and a breakdown of the training.

Full control of the IFF responses can be given to the director station evaluator using the switch shown in figure 3. This modification interrupts the IFF returns from the T1 until such time that the evaluator, by closing the spring-loaded switch, causes a response to appear on the target. The switch and its associated coaxial cables and T connector do not interfere with the normal IFF returns. The switch, which can be inserted and removed in a matter of minutes, greatly enhances training.

A Branch is Born

Lieutenant Colonel Frederick C. Dahlquist and Major David G. Sanford
Air Defense Artillery Branch, Office of Personnel Operations, Department of the Army

NEW AND OLD

New and eager, proud and proficient, the new Air Defense Artillery Branch comes into the Army as a combat arm with over 7,000 officers and warrant officers on its rolls. With a link to its Coast Artillery Corps heritage, the new branch will continue to perform its ever-alert mission of first-line defense of the Nation—at home and abroad.

WHY

Establishment of a separate Air Defense Artillery Branch is a natural and logical step. Actually, it was demanded by the professional requirements of both field artillery and air defense artillery. For field artillery, the needs of Vietnam required officers experienced in the employment of tube artillery. For air defense, the highly technical and demanding environment of missile science required an officer corps highly trained and experienced in the exactitudes of missilery.

HOW

The need for separation was emphasized by the expansion of the capability of field artillery to meet the Vietnam crisis and concurrently maintain free world air defense artillery deployment. Current officer personnel policies and their effect upon current artillery combat operations in Vietnam, as well as the responsiveness of the Artillery Officer Corps to meet future military requirements, were explored and evaluated. In 1967 the Department of the Army decided to establish separate advanced courses—air defense artillery and field artillery. This decision was followed by the final decision to establish a separate branch for air defense artillery. It was recognized that a growing division of doctrine, mission, training, equipment, and techniques was evolving within the single Artillery Branch as a result of the scientific advances within the military. This diversion of interests required a manpower pool with specialized characteristics to be applied against these needs. It was concluded that two career branches could provide an improved response for the existing dual mission of the Artillery Branch and could better meet the anticipated professional requirements of future weapon systems as well as constitute a savings in men and money.

In June 1968, the separation was established by DA General Order 25. The immediate problem was to identify which officers were to be in air defense artillery and which in field artillery. A comprehensive survey of officers' files and personal preferences was made by the Artillery Branch Career Management Office. Each of the 25,000 files was individually classified as either air defense artillery or field artillery. A circular was then published listing those officers classified as air defense artillery.

A separate office also was established for the career management of air defense artillery officers below the grade of colonel within the Officer Personnel Directorate, Office of Personnel Operations, Department of the Army. Colonel Joseph C. Fimiani was selected to become the first chief of the newly established Air Defense Artillery Branch, which took

its first step on 1 December 1968 and which manages the records of some 7,000 officers and warrant officers. Colonels will continue to be managed by the Colonels' Division, Officer Personnel Directorate, Office of Personnel Operations. Enlisted personnel are not affected and will continue to be monitored by the Enlisted Personnel Directorate, Office of Personnel Operations, Department of the Army.

PRESENT

Today's challenge is the continued employment of Nike Hercules and Hawk weapons in CONUS and in other critical defenses throughout the free world; the combat usage of the twin 40-mm, self-propelled gun M42 in Vietnam; and the deployment of Chaparral/Vulcan weapon systems.

Today the Air Defense Artillery Branch can look to the career development of its officers with a great deal of anticipation and enthusiasm. The Branch can concentrate more objectively on a balanced career for its officers, knowing that its prime responsibilities lie in one path—that of missilery and radar electronics.

FUTURE

Sentinel and SAM-D are tomorrow's challenge. The quality and quantity of effort that will be demanded by these latest weapon systems are but a continuation of the demand for high quality and outstanding leadership demanded of air defense artillerymen in the past.

Putting emphasis on missiles and radar electronics will lead to a more stable career pattern and thus a more competitive record for its officer corps. Assignments will include proper and adequate schooling for Branch assignments as well as Branch immaterial assignments that the Branch will be required to fill. Records will then speak for themselves and be placed in competition with those of other branches for certain worldwide assignments, senior staff assignments, professional level schooling, and promotions. Selection for senior service schools and promotions will continue to be by Department of the Army board action on a best-qualified basis.

The future, then, is unlimited for the Air Defense Artillery Branch. Its personnel can walk tall with the knowledge that their branch will lead the way in the field of missilery for the Army and that they are members of an elite group.

Standard Tactical Missions for Air Defense Artillery

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Editor's Note:

The matter of standard tactical missions is in the developmental stage both technically and doctrinally. The material in this article is therefore in the nature of a proposal and should be regarded as such.

Now that air defense artillery (ADA) has been cast in the role of a separate combat support branch, certain inherent requirements come into sharper focus. One such requirement involves ADA terminology. Field artillery, engineers, and Army aviation assign standard tactical missions to units that are placed in support of maneuver forces. Up to now we in ADA have talked only about area, vital area, and small unit defenses. This practice will no longer suffice. With the Chaparral/Vulcan battalion organic to each division, ADA commanders more than ever before will coordinate ADA tactical employment directly with maneuver force commanders. It is essential, then, that ADA commanders talk a common language with maneuver force commanders.

To accomplish this, ADA must adopt standard tactical missions similar to those currently used by other combat support branches. The ADA organizations from fire unit to brigade may be assigned one of four standard tactical missions, general support (GS), general support reinforcing (GSR), reinforcing (R), and direct support (DS). The adoption of these standard tactical missions in no way changes tactical ADA employment concepts, but does provide standard terminology which both supporting and supported unit commanders can easily understand.

Before discussing the tactical missions, let's define some basic terms or phrases. The force ADA headquarters is the highest ADA organization headquarters in the force. For example, the force ADA headquarters of a Vulcan battery of a Chaparral/Vulcan battalion of the corps ADA group is the corps ADA group headquarters. The immediate ADA headquarters is the next higher organization in the ADA chain of command of a specific unit. The immediate ADA headquarters of a Vulcan battery of a Chaparral/Vulcan battalion attached to corps is the Chaparral/Vulcan battalion headquarters. The reinforcing ADA unit is that ADA unit assigned the reinforcing mission. The reinforced ADA unit is the ADA unit being reinforced. Figure 1 provides a ready reference to missions and functions of ADA units.

An explicit responsibility, related to several tactical missions, is that liaison and communications be established as directed with Air Force control installations and with other ADA general support units. The headquarters with whom liaison and communications are effected will be designated by the ADA commander having operational control. For example, the ADA group commander at corps will designate, to all of his ADA units having a general support or general support-reinforcing mission, the organization(s) with whom communications and liaison will be established. An ADA unit with a reinforcing mission would receive this requirement from the reinforced ADA unit commander. Generally, communications and liaison will parallel coordination links between Army ADA and Air Force control installations as shown in figure 2.

Let us now discuss the four standard tactical missions. The maneuver force commander will actually assign these missions based on the recommendation of the force ADA commander. These missions will then be published in the force operation order. Subordinate ADA commanders have the authority to organize their resources for combat and to assign tactical missions, providing such action does not reduce the control retained by the commander who originally assigned the mission.

General support. An ADA unit assigned the tactical mission of general support provides ADA fires in support of the force as a whole. Units with this mission remain under the operational control of the force ADA commander and provide maneuver force commanders with a means of directly influencing their air defense fires. This is the normal mission of ADA units in the theater army air defense command. For a theater ADA unit (exclusive of field army), the headquarters of the area AD commander, who is usually an Air Force officer, is considered the force ADA headquarters. This officer controls Air Force air defense units and is the force AD commander. Normally, the area AD commander will delegate authority for operational control to regional commanders for units within their regions. Theater ADA units will then be under the operational control of the regional commanders, but operational control responsibility ultimately is with the area AD commander. Liaison and communications will be established as directed with Air Force control installations and with ADA GS units to insure coordination of ADA fires across communications zone boundaries. General support is also the normal tactical mission of field army Nike Hercules and Hawk units, corps Hawk units, and divisional Chaparral/Vulcan battalions. Suppose that the ADA group at corps has two attached Chaparral/Vulcan battalions, both of which have been assigned the tactical mission of general support of the corps. The ADA group commander retains operational control (and deployment authority) for both battalions and provides general deployment guidance as he outlines the corps commander's priorities for air defense. The battalion commanders would do the actual positioning of individual Chaparral and Vulcan fire units with the group commander giving final approval. The two battalions would establish liaison and communications with each other, with group headquarters, and with other ADA general support units designated by the group commander. Since the ADA group has the general support tactical mission, the group would establish liaison and communications with the Air Force control and reporting post (CRP) operating in the corps area (fig 2). In this case, the Chaparral/Vulcan battalions would not need to establish liaison and communications with the CRP.

General support reinforcing. An ADA unit given the tactical mission of general support reinforcing furnishes ADA fires for the force as a whole and in addition reinforces the defenses of an adjacent ADA unit. Liaison and communication requirements are the same as those for general support, except that both are established additionally with the reinforced unit. A unit with this tactical mission remains under the operational control of the force ADA commander. Reinforcement is normally accomplished through designation of engagement priorities, with the provision that targets designated by the force ADA commander will take precedence over those, except for self-defense, designated by the reinforced unit. This is not an exception to the rule for target selection which requires that the most immediate threat be the first target engaged. We assume that a target designated by the force ADA commander constitutes the more immediate threat to the force as a whole. This is a tactical mission for the corps Chaparral/Vulcan battalion or one or more of its batteries. It is also the normal tactical mission given a self-propelled Hawk platoon which is needed to augment the fires of the divisional Chaparral/Vulcan battalion.

Reinforcing. An ADA unit assigned the tactical mission of reinforcing augments the fires of another ADA unit. The reinforcing unit remains under command of the commander assigning the tactical mission, but is under operational control of the reinforced unit. Communications and liaison are established between the reinforcing and reinforced unit. (Generally, it is not necessary to establish liaison or communications with other units because that action is the responsibility of the reinforced ADA unit.) The reinforcing unit is deployed by the reinforced unit commander. Example: A Vulcan battery of a corps Chaparral/Vulcan battalion is assigned the tactical mission of reinforcing a divisional Chaparral/Vulcan battalion which is in turn supporting the division as it prepares to launch the corps main attack. The commander of the reinforced Chaparral/Vulcan battalion has operational control of the reinforcing Vulcan battery. The Vulcan battery establishes communications and liaison with the reinforced battalion headquarters and any other elements as directed by the reinforced Chaparral/Vulcan battalion commander. Since the Chaparral/Vulcan battalion commander has deployment authority over the reinforcing Vulcan battery, and because corps Vulcan units are towed, the Chaparral/Vulcan battalion commander has decided to deploy these units in defense of small vital areas in the division rear. This will release a corresponding number of his organic self-propelled Vulcan units which might well be assigned the tactical mission of direct support of the brigade making the division's main attack.

Direct support. An ADA unit assigned the tactical mission of direct support provides close and continuous air defense to a designated combat or support element and must coordinate its air defense with that element. The direct support ADA commander deploys his unit in order to defend the supported element. Once an ADA unit is placed in direct support of a maneuver element, it should normally remain in support of that element in subsequent operations. This system will facilitate teamwork. A direct support ADA unit remains under the command and operational control of its immediate ADA headquarters. Although the direct support tactical mission is most frequently applied to place an ADA battery in support of an infantry, mechanized, or armored brigade, the mission is also proper for a single ADA squad, platoon, battalion, battalion group, or group in support of a single combat or combat support element.

Whenever the standard tactical mission cannot accurately and completely convey the commander's intent, the mission may be modified. Care must be taken not to degrade the ability of the unit to fulfill the air defense responsibilities of the mission. The direct support tactical mission is especially sensitive in this regard and normally should not be modified. It is quite common to modify the standard tactical mission of ADA units in general support. This fact is especially true for theater army air defense units and those units assigned to the US Army Air Defense Command.

Attachment is not a tactical mission but a status. An ADA unit attached to a force for an operation is under the command and operational control of the force to which attached. The force commander is responsible for providing administrative and logistical support to the attached ADA unit. As an exception, logistical support for ADA-peculiar items will be furnished through the attached ADA unit's regular logistical channels. ADA units are attached to a force only when operational control requires a command relationship between the force commander and his supporting ADA commander; e.g., an ADA unit attached to a task force moving to an area beyond effective communication range of its immediate ADA headquarters.

When air defense officers completely understand these standard tactical missions and fully explain them to maneuver force commanders, the Air Defense Artillery Branch will have taken a significant stride toward achieving standardization of basic air defense terminology.

An ADA unit with a mission of:	Is under the operational control of:	Establishes liaison and communications with:	Is deployed and assigned sectors of fire, as required, by:	May assign to subordinate AD units the tactical mission of:
General support	Force ADA headquarters	1. Air Force control installations, ADA GS units, and other units as directed by the force ADA headquarters. 2. Supported unit.	Force ADA headquarters	GS
General support reinforcing	Force ADA headquarters	1. Air Force control installations and ADA GS units, and other units as directed by the force ADA headquarters. 2. Supported unit.	Force ADA headquarters	GS, GSR
Reinforcing	Reinforced ADA unit	1. Reinforced ADA unit. 2. As directed.	1. Reinforced ADA unit. 2. As directed.	GS, GSR, R
Direct support	Immediate ADA headquarters	1. Supported unit. 2. Air Force command and control installations and ADA GS units as directed by the immediate ADA headquarters. 3. As directed.	1. ADA unit commander. 2. As directed.	GS, GSR, R, DS

Figure 1. ADA unit mission and functions.

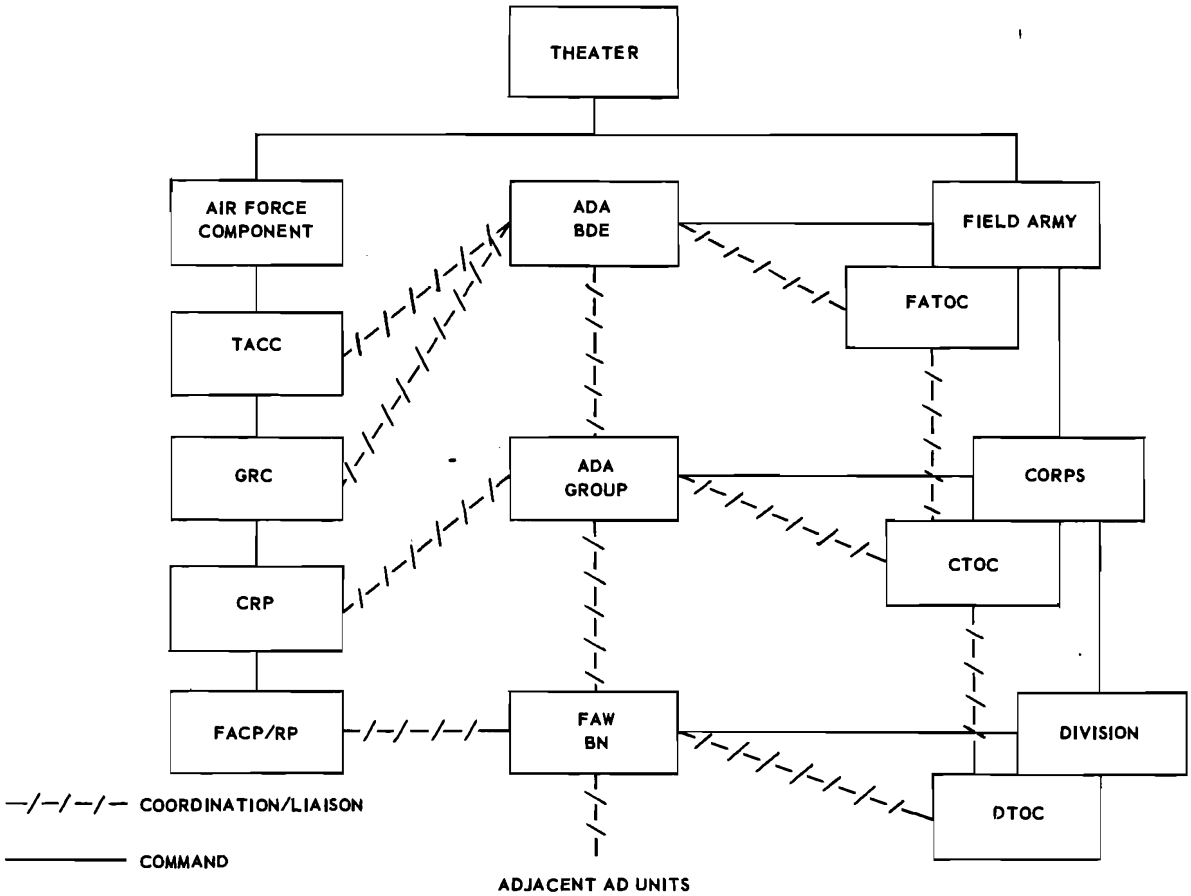

Figure 2. Army and Air Force coordination links.

Hawk Has Wings

First Lieutenant Theodore L. Robertson

In present-day and envisioned future tactical operations, air movement of Army units is highly emphasized. Such movements are occurring in Vietnam and have now encompassed Hawk guided missile units. Hawk is designed to be a highly mobile air defense element of a field army or corps. Mobility is one of its greatest attributes (figs 1 and 2).

Figure 1. Airborne assault (artist's concept).

Surface movements are indispensable ingredients of field training exercises, command post exercises, and operational readiness tests. Sea movement was utilized in the deployment of two Hawk battalions to Vietnam. Air movements, however, have been virtually nonexistent over long distances due to the magnitude of transportation requirements. It has been estimated that an airlift of a single mobile Hawk battalion would require approximately 136 C-141 and 8 C-124 aircraft. It is readily apparent that an armada of this size would be difficult to assemble. Nevertheless, combat operations today demand flexibility that is available only through air moves.

Recently, elements of the 8th Battalion (Hawk), 7th Artillery, 6th Artillery Group (AD), Fort Bliss, Texas, were engaged in a tactical air movement. As the air defense member of Strike Command, it was necessary that this battalion develop plans and train its personnel for rapid deployment by air.

Figure 2. Hawk missile, airborne.

The planning phase involved the production of automated data for unit moves (ADUM), a computerized list of all table of organization and equipment and other authorized major items of equipment that is used as a nucleus for planning all air movement. Detailed instructions for the preparation of ADUM's are contained in USCONARC Pamphlet 700-1.

Once the ADUM had been finalized and approved by the computerized airlift planning systems (CAPS), United States Continental Army Command, air movement training began. Extensive liaison was established with various elements of the Military Airlift Command (MAC) and the Tactical Air Command (TAC). Working relationships with planning officers and aircraft loadmasters enhanced preparations for actual movement. To further the unit's progress, selected officers and noncommissioned officers attended a 2-week air movement school at Fort Eustis, Virginia, where they worked with experienced Air Force personnel on various loading arrangements using C-124, C-130, and C-141 cargo aircraft (figs 3 and 4).

These loading exercises revealed that:

a. Pintle hooks mounted on metal plates and then temporarily mounted on the front bumper of 3/4-ton and 2-1/2-ton trucks are imperative for quick and efficient loading. These simple devices permit prime movers to push the varied Hawk tactical equipment, such as the pulse acquisition radar (PAR), into a C-124 aircraft. The PAR weighs approximately 7,750 pounds in its air-transportable configuration. Pulling it up a ramp incline of 17° to the main cargo floor, with a vertical height in excess of 9 feet, is extremely difficult. The sway of the PAR as the prime mover creeps up the ramp is difficult to contain. A more suitable method is to push the load aboard with the prime mover while pulling it with the aircraft winch. Diminished sway and easier loading results.

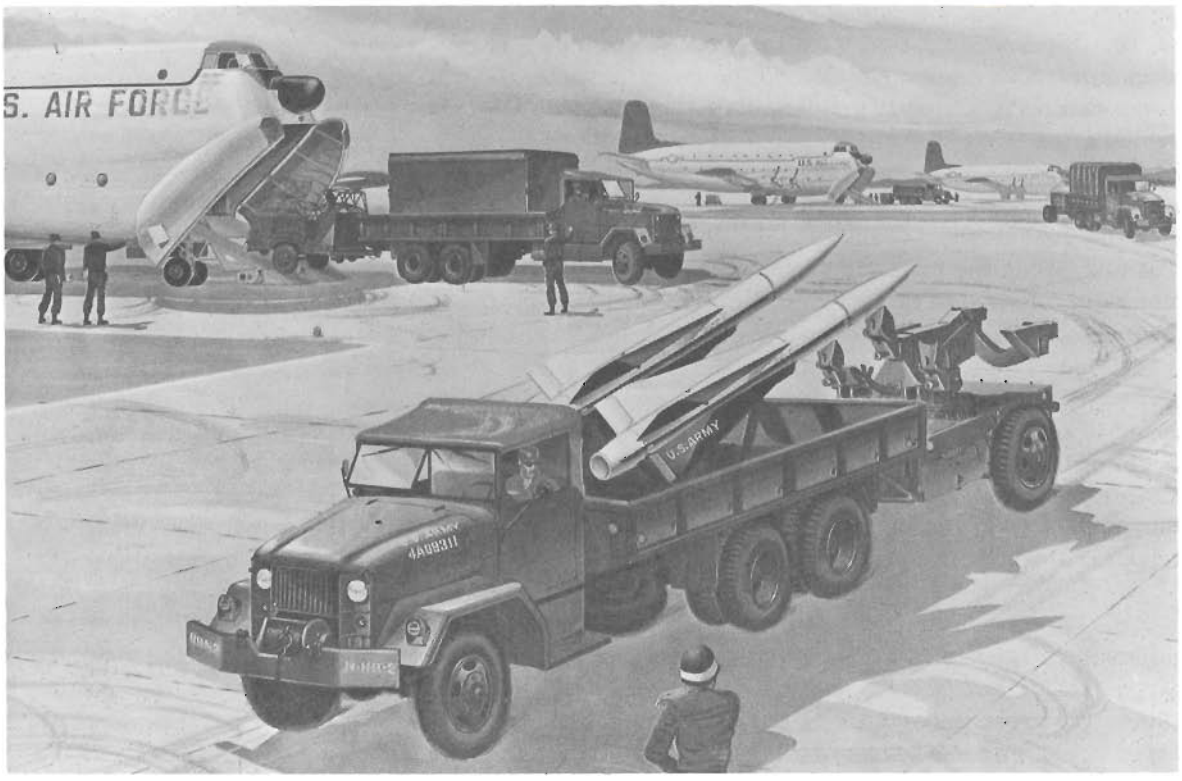

Figure 3. Strike mobility (artist's concept).

Figure 4. Hawk missile equipment being loaded on cargo aircraft.

b. Special attention must be given to planning for oversize equipment. Numerous items of mobile Hawk equipment exceed the heights of the cargo compartments. Some of these items can be sufficiently reduced in height by a few minor adjustments. The PAR can be loaded after the antenna and feedhorn are removed. The 5-ton wrecker meets the height limitations only after reducing the air pressure in the tires. However, trailer-mounted vehicles and the high-power illuminator radar (HIPIR) require partial dismantling. Trailers must be considered as separate loading entities. The HIPIR must be disengaged from its trailer. When the problem of vertical dimensions is solved, we turn to another problem—moving the load into the aircraft. Suitable pallets must be obtained to facilitate on and off loading. Additionally, necessary material-handling equipment must be secured.

c. Integrity of load teams must be developed and maintained. Teams should be composed of personnel who deal with the equipment in everyday training, maintenance, and operations. This should eliminate any problems in basic equipment handling. Each individual then should be given a specific position and thoroughly instructed in his duties and responsibilities. Harmonious operations should develop as experience and job knowledge increase, thus reducing loading time.

d. Additional training facilities to supplement live loading exercises are required to achieve proficiency in all facets of air movement. Familiarization with basic techniques of cargo lashing and tiedown devices can be attained in classroom demonstrations and discussions. Of great importance is the development and use of mockups of the various aircraft cargo compartments which are invaluable in driver training. Replicas of C-124, C-130, and C-141 cargo compartments may be constructed, or salvaged fuselages of actual aircraft may be used. The mockup ramp angles allow realistic training conditions in a simulated environment. However, a simple outline of the compartment, depicted on the ground by using chalk or engineer tape, may suffice. Regardless of the methods used, personnel become confident in their ability to meet requirements.

The foregoing information was invaluable during June-July 1968 when the 8th Battalion (Hawk), 7th Artillery, 6th Artillery Group (AD), participated in the Strike Command Joint Task Force Exercise BRIM FIRE 1-68. This air defense exercise called for an assault fire unit (AFU) and an augmented assault fire unit (AAFU) to be transported by C-141 Starlifters from Biggs Field, Texas, to MacDill Air Force Base, Florida. At MacDill, personnel and equipment were transloaded to the C-130 Hercules for final delivery to the objective area. Training and liaison were intensified during the preparation phase. The participating personnel spent 2 weeks reviewing each facet of air movement with particular stress on the loading and tying down of equipment. The battalion air movement officer, in conjunction with MAC and TAC loadmasters, prepared loading plans. Each item of equipment was weighed, marked with necessary labels, and assigned to respective aircraft. After all plans had been formulated, actual loading exercises were conducted to verify the computations. Alterations were made, as required. The plans were thus finalized well in advance of the actual movement. The airlift required 8 MAC C-141's and 19 TAC C-130's. A successful movement was achieved.

Some important lessons learned in loading the AFU and AAFU equipment were:

a. Once load plans have been finalized through approval by Air Force loadmasters and by actual testing of loads they should not be changed. Minor alterations are permissible;

however, it must be understood that changes, regardless of their minuteness, may create confusion and loss of time.

b. The air movement principle of full utilization of aircraft space is not an invariable. This principle cannot always be adhered to because unit and tactical integrity, by necessity, must be paramount.

c. The smokestack on a scoop loader must be removed before loading it into a C-130 or C-141 aircraft.

d. Pallet trailers with missiles on the A and C arms can be loaded if driven on in the forward position.

e. The 5-ton wrecker must be driven on in the forward position; it cannot be backed on. Prior to loading the wrecker on a C-130, its height must be decreased 1/2 to 1 inch by reducing the tire pressure.

The ever-increasing emphasis upon speed of mission accomplishment dictates that detailed planning precedes air movement. It is becoming the mode of transportation, relegating land and sea movements to secondary roles. The advent of the C-5A increases the urgency that the Army become airmobile conscious. Air defense, with new and more compact systems, must increase its air mobility to insure full performance of its role with the overall Army team.

Friend or Foe

Joseph B. Fries,
United States Army Combat Developments Command Air Defense Agency

(A discussion of visual aircraft recognition problems and solutions.)

THE QUESTION

You're a Vulcan platoon leader in B Battery, 5th Battalion (Chaparral/Vulcan), 471st Artillery. Your 6-gun platoon is in direct support of a fast-moving tank column heading toward a key objective. Up the valley streaks a jet heading your way. Nobody told you he was coming, you can't see his markings, and he's not firing (yet). The jet (fig 1) is a swept-wing job, but is it an Air Force F-100, or is it the similar appearing Mig-19? That is the question!

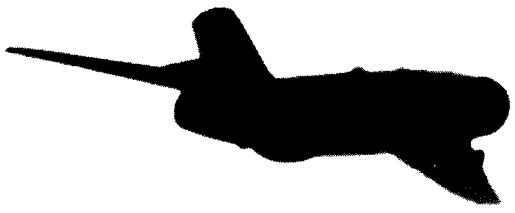

Figure 1. Friend or foe?

Your Vulcan squad leader's answers to the question are of more than passing interest to the tank unit, F-100 pilots, and Mig-19 pilots. The price of error is high. The squad leaders have only seconds to make this life or death decision.

Let's leave the decision hanging and look into what's behind the aircraft recognition problem.

WORLD WAR II EXPERIENCES

Many gunners have had to make the decision your squad leaders must now make. To see how World War II AAA gunners did in making similar decisions, we can look at the official battle record of First Army AAA from June 1944 to May 1945 (fig 2).

- Hostile aircraft destroyed - 766
- Friendly aircraft destroyed - 12
- Hostile aircraft damaged - 429
- Friendly aircraft damaged - no listing
- "Shot at, but missed" - no listing

Figure 2. First Army AAA.

Not shown here, but of interest, is the fact that about 35 percent of the hostile aircraft seen by the forward area AAA went unengaged, primarily because of identification problems. First Army AAA did well, but each mistake or period of indecisiveness must have been costly.

THE PROBLEM NOW

The price of error is even higher now than before. The enemy air threat is more deadly, so we can't afford to let him pass because of our mistakes or indecisiveness. Our air defense weapons are so many and so lethal we can ill afford mistakes as far as our own aircraft are concerned. Yet, the modern gunner's aircraft recognition tools—his eyeballs—are no better than those of his World War II predecessors. So there is an aircraft recognition problem now. As with so many problems in the Army, the solution lies in improved training.

TRAINING

The training of Chaparral and Vulcan gunners is ultimately the responsibility of air defense artillery unit commanders in the field. The magnitude of the Army's aircraft recognition training requirement can be appreciated if you will remember that there will be many hundreds of Vulcan and Chaparral squads in the Army. Add to these the thousand-plus Redeye teams organic to the battalion-size infantry, tank, cavalry, and field artillery units. Then consider that the Army is stressing that all troops must respond aggressively to air attack. Finally, keep in mind that our Army, Navy, Marine, and Air Force pilots have a very personal interest in the quality of the training of all these people.

Current methods of visual aircraft recognition training can produce reasonably satisfactory results, given enough effort. But the methods of training have demonstrated significant weakness, both in general approach and in the visual training aids used. All in all, they need modernizing to fit the needs of today's Army in solving today's problems.

IMPROVEMENTS UNDERWAY

Commanders, gunners, and pilots should know that modernizing of aircraft recognition training methods is underway. Improved training aids and training instructions are now undergoing final development by the US Army Air Defense School. These aids and instructional methods are based on research conducted by George Washington University's Human Resources Research Office (HUMRRO). Research personnel of HUMRRO Division No. 5 (Air Defense), which is located at Fort Bliss, developed and evaluated several types of training aids and instructional methods for aircraft recognition as part of the research project. The new visual aids and instructions will replace equivalent material included in the 5-QQ-8 (SLARK No. 1) 35-mm Aircraft Recognition Slide Kit now available to each Vulcan and Chaparral platoon leader. Note: The SLARK kit is not a TOE issue item—it must be obtained through training aid channels, or maybe you can share the kits already obtained for your division's Redeye sections. The new material is currently identified as the "Ground Observer Aircraft Recognition Slide Kit (GOAR)." The new GOAR slides are designed to teach aircraft recognition at tactically realistic ranges and flight aspects.

Figures 3 and 4 and 5 and 6 show two of the new slides compared to two equivalents used in less modern training.

Figure 3. F4, new GOAR kit.

Figure 4. F4, old SLARK kit.

Figure 5. Mig-21, new GOAR kit.

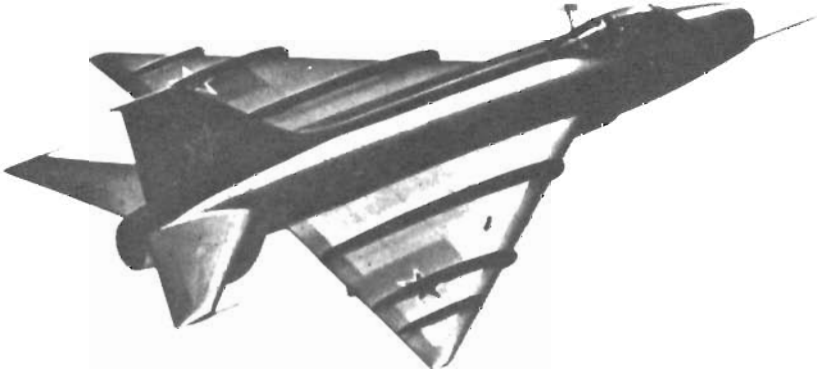

Figure 6. Mig-21, old SLARK kit.

The new GOAR slides are certainly more difficult to identify than the SLARK slides, but they produce results in the field. The strengths of the new slides versus the weaknesses of the old slides are shown here.

New strengths	Old weaknesses
• Ground-to-air views • Clear sky backgrounds • No nationality insignia • Consistency in view numbers and aspects • Tactically realistic image size (small)	• Air-to-air views • Distinctive backgrounds • Prominent nationality insignia • Inconsistency in view numbers and aspects • Unrealistic image size (too large)

Figure 7. New versus old.

The new slides are shown during training in 5- to 8-second exposures—there being no tactical requirement for the "instant recognition" approach of years ago. Nationality insignia are taught as a subject separate from aircraft recognition since insignia vary (for example, the F-100 is used by 12 countries) and often may not be visible in the field.

Slides alone, no matter how modern, are of no value unless presented as part of a properly designed training program. A modern training program that can be administed by a junior officer or noncommissioned officer is shown in figure 8.

What	When	Why	How
• Supplemental training	Throughout	Review and supplement	Self-study. Use card decks or substitutes. (Card decks under development at Fort Bliss.)
• Goal setting	1st stage	Inform and motivate	Set 95 percent class accuracy goal per aircraft per hour. (Achievable. ATT sets 90 percent minium.)
• Nomenclature familiarization	2d stage	Develop standard language	Standard pattern of recognition features. Simple terms. Use slides.
• Aircraft familiarization	3d stage	Define the problem	Introduce theater tactical aircraft and their recognition features. Keep number of aircraft low. Use slides.
• Recognition practice and comparisons	4th stage and as needed	Discriminate between aircraft	Stress "look-alikes." Stress individual performance. Use slides. 5- to 8-second exposures. Informal tests and reviews. 90 percent class average, before proceeding.
• Achievement testing	5th stage and as needed	Expose problem areas	Formal test. Vary tests. Use test slides.
• Remedial training	6th stage and as needed	Solve problems exposed	Variable, depending upon whether problem is with an individual or the class, or with a single aircraft or a pair/group.

Figure 8. The new program.

Figure 9. F-4C, friend.

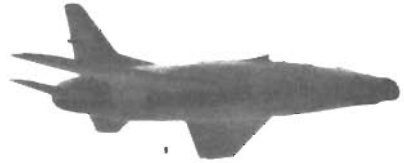

Figure 10. F-100, foe.

Figure 11. F-105, friend.

Figure 12. F-101, foe.

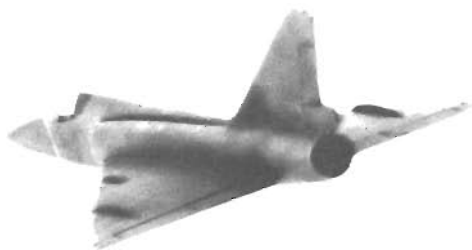

Figure 13. F-106, friend.

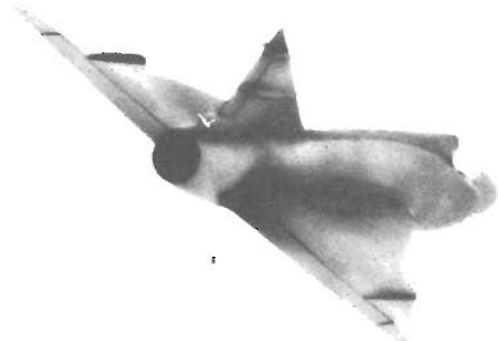

Figure 14. F-102, foe.

Figure 15. UH-1D, friend.

Figure 16. UH-1C, foe.

The specific technqiues used during stages 4, 5, and 6 offer the most improvement over the older methods. It is here that individual problems are clearly brought out and methodically solved. It is not enough that the class average is good—each man must be good.

Such a program is not a one-time effort, but rather is repeated and updated as necessary to maintain peak proficiency. The method is described in the new FM 44-30, Visual Aircraft Recognition, which should be available down to the Vulcan and Chaparral platoon level. Note: Order Aircraft Recognition Manual on your DA Form 12-11, Requirements for Army Doctrinal Publications (FM), and you will get your FM 44-30.

REDEYE TROOP TEST RESULTS

Do the new methods work? Yes, they do! They were tested by the 101st Airborne Division in the Redeye Troop Test at Fort Campbell, Kentucky, in March 1967. In that test, 40 "just-graduated" Redeye personnel were administed up to 14 hours (average 9 hours) training on the 12 test aircraft used (an SP4 conducted the classes). The aircraft shown in figures 9 through 16 were some of the test aircraft.

There were also four other liaison aircraft and helicopters. To further complicate the problem, both the "friend" and "foe" jets had US markings. As you can see, there was a real challenge.

This class of newly graduated gunners started with a measured aircraft recognition proficiency of 53 percent on the 12 test aircraft. This was quite good, considering that some of the test aircraft had not been covered in previous US Army Air Defense School familiarization-type instruction. Using the improved methods, the class average was then raised to 94 percent, with some gunners attaining 100 percent. This was about as expected for the new technique.

In the Troop Test itself, there were over 1,800 aircraft-to-team exposures. The teams used GI binoculars or eyeballs only, as they saw fit. About 15 percent of the aircraft slipped by unidentified due to fleeting exposures, long range, etc. The remaining aircraft were identified correctly 96 percent of the time. These encouraging results are in part directly attributable to the use of the improved visual recognition training aids and techniques.

HELP NEEDED

Is 96 percent good enough? Almost, but not quite. Even a 96 percent correct identification capability is not good enough when you consider the requirement to clear the sky of hostile aircraft while avoiding shooting down friendly aircraft. If a friendly aircraft passes in range of a large number of Vulcan or Chaparral squads, each with a 96 percent identification accuracy record, the aircraft's chance of making it through without getting mistakenly shot at by at least one squad is not as good as it should be. Of course, even one percentage point in identification makes a great difference. But until the goal of perfect identification capability is reached, efforts to reduce the possibility of friendly aircraft being exposed to gunner error must be continued. This is where pilot cooperation, the command and control system, and the battalion forward area alerting radars (FAAR) come into the picture. Pilots cooperate by adhering to air traffic control procedures designed to minimize unnecessary exposure to friendly Army air defenses. The Army's command and control system, through

warning of forthcoming friendly air activity and/or through imposition of temporary "hold fire" orders, complements the gunner's identification capabilities. FAAR provides timely warning and tentative identification of many aircraft; thus, the combination of well-trained gunners, air traffic control procedures, the Army's command and control system, and the FAAR insure that Vulcan and Chaparral provide maximum danger for enemy aircraft while not unduly endangering friendly aircraft.

THE ANSWER

Back to the question posed at the beginning of this article. That incoming aircraft is a Mig-19 and not an F-100 as your well-trained Vulcan squal leaders know. They positively recognize overall form differences and differences in nose, canopy, and tail in this "paired comparison"; shoot down the Mig; and give this article a happy ending—happy for the tank unit and F-100 pilots, anyway.

To insure more happy endings and fewer "sorry about that" endings, air defense artillery unit commanders must insure proficiency of squads (fire units) by making all necessary training aids available to them. At present, each Vulcan and Chaparral platoon should have access to at least one copy of FM 44-30 and one SLARK No. 1 kit, and when available, the SLARK No. 1 replacement—the GOAR kit. Self-study aids should also be improvised. But, most important of all, commanders must be interested and they must provide command emphasis. Without these, the program will fail—modern training methods or not.

Sentinel: History and Development

Captain William P. Merritt
Sentinel Central Training Facility
US Army Air Defense School

The development of any new and revolutionary weapon that might greatly affect the conduct of future warfare invariably gives immediate impetus to a parallel development of a defense weapon to counter its effects. Historical and contemporary examples of such measures and countermeasures are well known and, up to the present, no weapon against which defense is impossible has been proved to exist. Despite the fact that each new weapon system initially appears to be virtually invulnerable to defensive action, technological progress moves sufficiently rapid so that the successful defense mechanism never lags far behind.

At the outset of the Nike Ajax project in 1945, a look into the next decade suggested the subsonic, high-altitude, piloted bomber as the central element of the 1955 offensive threat. The project resulted in an effective antiaircraft guided missile system which was deployed for protection of cities and industrial centers throughout the United States. In adapting to this threat, it soon became apparent that a definite requirement existed for an antiaircraft system capable of dealing with the extremely high-altitude, supersonic, nuclear-carrying, air-supported targets. In 1953, at the Bell Telephone Laboratories, work was initiated on the Nike Hercules program. As a result of this program, the United States antiaircraft capability was greatly extended. A study was begun in 1954 at the Bell Telephone Laboratories of a single-stage, solid-propellant missile to be used with the Nike Hercules type of ground equipment as a possibility of defending against nuclear warhead carriers of the future to include ballistic missiles with ranges up to 5, 500 nautical miles. While the study indicated that considerable improvement in the missile was possible, the gain in overall system effectiveness was too modest to justify an increased effort. It became clear that the future threat could be countered only by a completely new system.

Based on the information thus gained, another study was initiated by Bell Telephone Laboratories and Douglas Aircraft Company for a complete defense system, to include defense against a possible intercontinental ballistic missile. This study was completed in October 1956. Active development work began the next month on the Nike Zeus system under a clause contained within the basic Nike Hercules contract. In February 1957, Project Nike Zeus, an antimissile guided missile defense system, was formally established.

The Nike Zeus system was composed of two major divisions.

a. The defense center, where the acquisition radar, data processing equipment, and communications equipment were located.

b. The battery, where the discrimination, target tracking radar, and missile tracking radar, as well as the guidance computers and the Nike Zeus missiles, were located.

For nearly 8 years, the Army and its contractor team pioneered in the development of this antimissile system. By late 1962 the Nike Zeus development program had reached a point where almost all of the technical returns were in; almost all of the questions had been answered.

Nike Zeus was good, but was it good enough? The advances in technology now made possible the development of a more sophisticated system that would be considerably more effective than Nike Zeus.

In January 1963, Secretary of Defense McNamara made public the following decisions regarding the future of the Nike Zeus system: It would not be deployed, its test program would be continued with the hardware already in existence, and it would be used as a building block in the accelerated development of a more advanced system to be known as Nike X (fig 1).

Secretary McNamara said further: "We propose to proceed with the greatest urgency in the development of the Nike X system, retaining the option to move ahead with actual production and development of such a system if the capabilities of the system and the circumstances warrant such a decision at some later time."

Figure 1. Sprint and Spartan missiles of the Nike X system.

The primary role for which Nike X had been designed was that of urban or city defense. Like the original Nike Zeus concept, it was designed to operate from detection to kill in a completely automatic engagement.

In Nike X, a multifunction array radar and a data processing system replaced the Nike Zeus defense center. Missile sites were planned to be spotted about the defense area to provide optimum coverage. This modular concept would enable planners to tailor the defense installation for the particular needs of the area to be defended. A smaller radar, known as missile site radar, would be sited at each missile farm to serve as the command guidance link with the Sprint missile (fig 2). Control of the multifunction array radar and associated missile site radars in a defended area was to be provided by the data processing system.

For 4 years the Army contractor team worked on the development of Nike X. Concurrent work was conducted at industrial locations, in research centers, and at test sites spread from Ascension Island to Kwajalein Island. The knowledge and components from Nike Zeus were plowed back into Nike X development.

In September 1967, Secretary of Defense McNamara made public the decision to deploy a light antiballistic missile (ABM) defense for the United States against a possible nuclear attack by China in the mid-1970's. He stated in part: "Such an ABM deployment designed against a possible Chinese attack would have a number of other advantages. It would provide an additional indication to Asians that we intend to deter China from nuclear blackmail, and thus would contribute toward our goal of discouraging nuclear weapon prolification among the present nonnuclear countries.

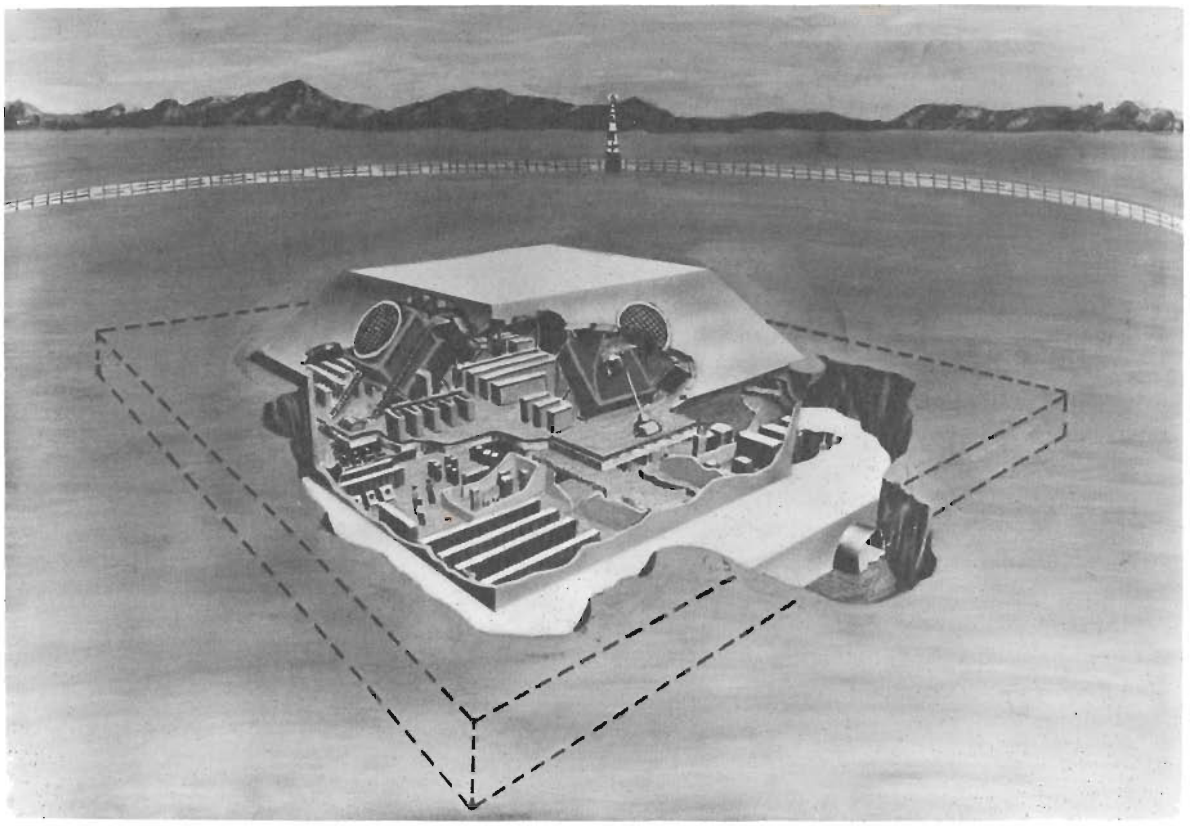

Figure 2. Missile site radar cutaway (artist's concept).

"Further, the Chinese-oriented ABM deployment would enable us to add, as a concurrent benefit, a further defense of our Minuteman sites against Soviet attack, which means that at modest cost we would in fact be adding even greater effectiveness to our offensive missile force and be avoiding a much more costly expansion of that force.

"Finally, such a reasonably reliable ABM system would add protection of our population against the improbable but possible accidental launch of an intercontinental missile by any one of the nuclear powers.

"After a detailed review of all these considerations, we have decided to go forward with this Chinese-oriented ABM deployment, and we will begin actual production of such a system at the end of this year."

Thus, the decision was made to begin production of a light antiballistic missile defense for the United States. The system was to be named Sentinel, and production was to begin by the end of 1967.

Department of the Army recognized that the development and deployment of the complex Sentinel system could not be supported by the existing management organizations and techniques in the time available. Basically, a single individual at Department of the Army general staff level was required to have the overall Army responsibility for coordination and direction

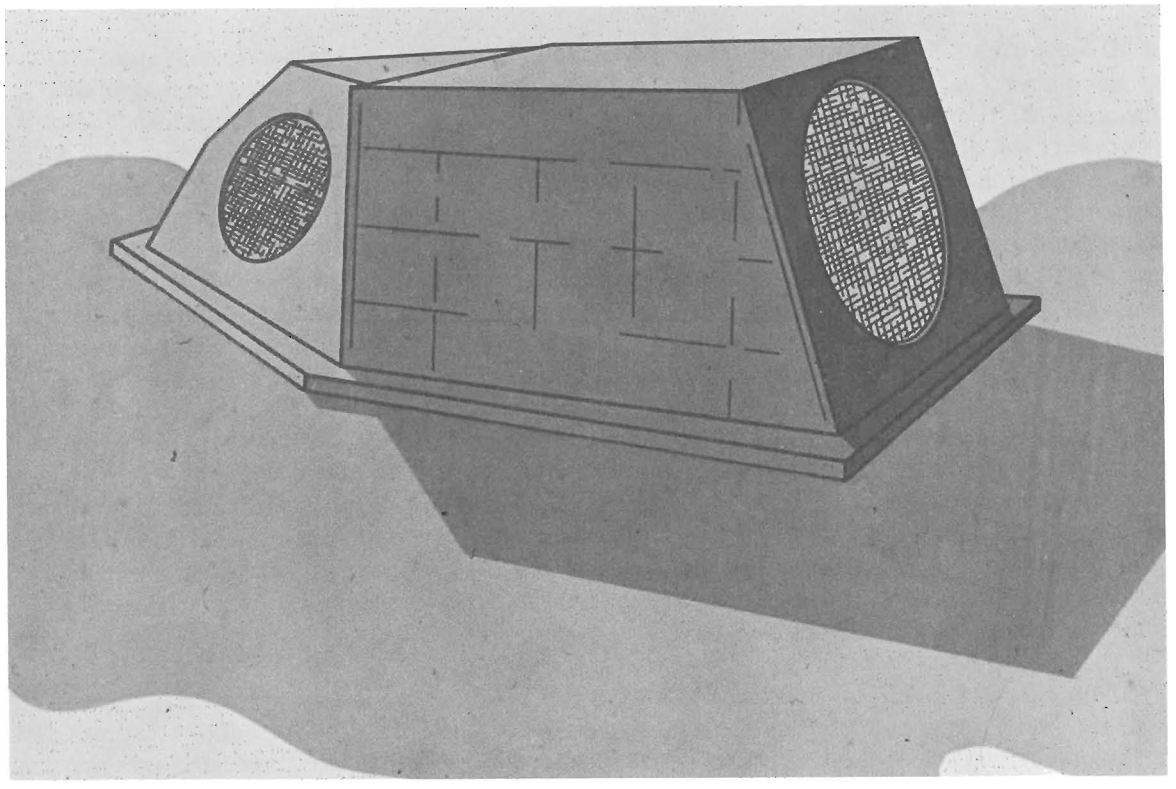

Figure 4. Perimeter acquisition radar (artist's concept).

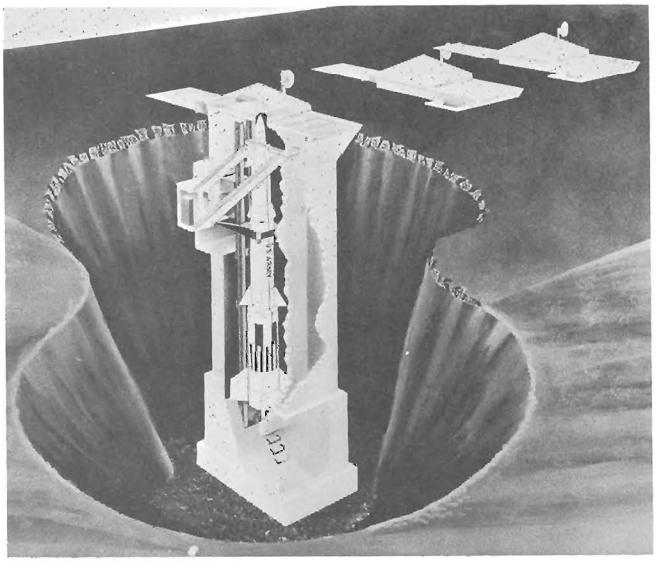

Figure 5. Spartan missile ready for launch (artist's concept).

The missile site radar (MSR) is a shorter range radar housed in a semiunderground, two-story building, approximately 225 feet square. It uses the same antenna array for both transmitting and receiving. The primary purpose of the MSR is to perform missile and target tracking functions; however, it will have other built-in modes of operation which will be controlled automatically.

The data processor system executes and controls the ballistic missile defense battle. This computer is programed to receive the data outputs of the PAR and MSR and convert them to missile direction data; fire the missile at the appropriate time and guide it to target intercept.

The Spartan missile (fig 5) is a three-stage, solid-propellant missile used for long-range intercepts both in and out of the atmosphere. It delivers a nuclear warhead and is used as an area defense weapon. It is emplaced vertically in an underground launch cell.

The Sprint missile delivers a nuclear warhead at great speed within the earth's atmosphere to target intercept (fig 6). It is used as a local defense weapon and, like the Spartan, is emplaced vertically in an underground launch cell. The complement of missiles for an MSR site is called the Spartan and/or Sprint missile farm.

The tactical support equipment includes the on-site powerplant and environmental control equipment. Power requirements for a PAR or MSR site vary from about 10 to 20 megawatts. Much of the radar and data processing equipment and the missiles require environmental control.

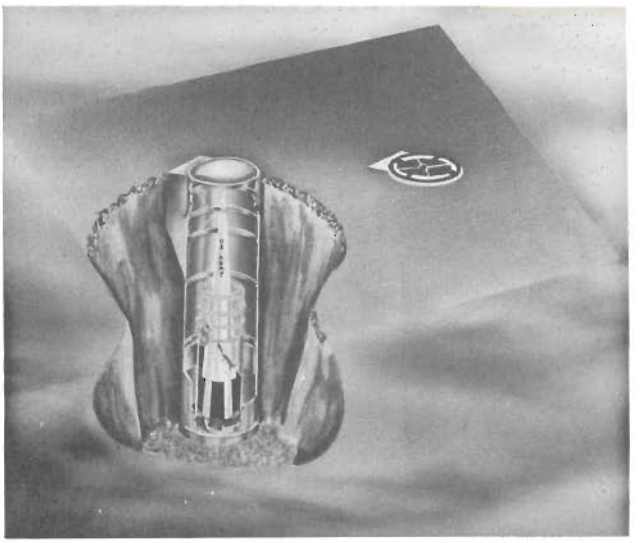

Figure 6. Sprint missile ready for launch (artist's concept).

The nature of the sophisticated missile attack which the Sentinel system must defend against requires that the reaction time of the system—from a standby mode to a full engagement mode—approach zero. This criteria places stringent demands on the design of the Sentinel system. The radars must be capable of continuous operation in the surveillance mode. The Spartan and Sprint ballistic missiles must be maintained in a ready-to-fire condition at all times. A single failure within the system must not cause the entire system to fail. Individual failures must be correctable while the system is operating in other than the engagement mode. Critical time to repair must be reduced by automatic fault detection which will quickly localize the fault to a replaceable unit. Finally, a capability must be provided for self-sufficient operation in a nuclear environment.

On 13 September 1968, the Office of the Assistant Secretary of Defense announced that, as a result of congressional authorization, the Army is acquiring land in the Boston area for the nation's first Sentinel ballistic missile defense site which will be constructed by the Army Corps of Engineers.

The site will consist of a PAR facility to be located near Sharpness Pond in North Andover township 22 miles north of Boston. Associated with the PAR will be an MSR and missile launching facility to be located at Camp Curtis Guild, a Massachusetts National Guard camp near Reading, 14 miles north of Boston. Each facility will require approximately 300 acres of land.

Deployment of the Sentinel system will involve the most extensive and complex management effort undertaken to date by the US Army. The Secretary of the Army, the Chief of Staff, the Department of the Army Staff, most of the major commands of the Army, and a large portion of our nation's scientific and production organizations will be involved in accomplishing this program.

Power Generation Equipment

Major J. E. Wilson
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US Army Air Defense School

In the age of electronic gadgetry and magic lights, the need for continuous, precise power is a real need and can be construed as the cornerstone of mission accomplishment. Before any electronic maintenance can be performed, power has to be adjusted to the proper input for the equipment. Missile equipment needs continuous, precise power for its power operation. Much downtime that is chargeable to a missile system should more appropriately be charged to generators. It is hard to pinpoint just what chassis failed when the generator kicks off. Probably none, but when you've had a few power failures during a short period of time, there are definitely going to be missile equipment problems. On a random basis, power failures are allowable at the rate of two or three per year.

The purpose of this article is to portray some lessons learned and measures that can be taken to facilitate continuous, precise power. The appropriate technical manual is to be followed for the prescribed maintenance, and these lessons learned should help in maintaining high operational efficiency. This article is based on actual hardships experienced and measures taken to remedy shortcomings.

Hard work and detailed planning are required to make your generator perform well over a long period of time. A generator is precision equipment and needs good, clean fuel. Such fuel is easy to obtain in the continental United States but is difficult to obtain in oversea areas. Units in the field need a means of handling fuel that will allow the fuel intended for tomorrow's consumption to remain stable long enough for foreign matter to settle and be eliminated.

One practical field expedient in Vietnam utilized two 600-gallon pods arranged in series. The first pod was filled daily and the settlings drained the next morning by the crew coming on duty. Then the good fuel pod was tapped to supply the generators for the next 24-hour period. The pods were alternated in this fashion from day to day. The auxiliary fuel system was used and the onboard tank on the generator was kept full in case the fuel system broke down. Another filter in the primary fuel system was a 55-gallon drum. This filter, which was drained twice a day, provided an additional measure to insure clean fuel.

Under field conditions the generators are in the open and at the mercy of the elements. Therefore, some hasty expedient must be devised to protect the equipment from water. One means available to field units is the standard maintenance tent. The canvas on one side can be rolled up about 10 feet to allow exhaust gases to escape and yet provide protection from the elements. You may group many generators in this shelter. For those generators that cannot be placed in the central shelter, due to cable lengths or the tactical situation, other expedients can be devised. One measure successfully used in Europe was to cover individual generators with deuce-and-a-half bows and canvas by placing the bows on the ground and covering, primarily, the instrument end of the generator. This cover protects the cable entry and prime armature from water.

Organizational maintenance, in numerous cases, must be done at the actual site of operation; however, if better than field facilities can be provided, they should be used. Again, the maintenance tent that is furnished field units is satisfactory, but some improvised flooring such as PSP is needed. Concrete, of course, is better. If it is available, use it.

When a generator is due for quarterly service, the operators (or mechanics) need to go over the equipment with a "fine-tooth comb," tightening those bolts that have vibrated loose. This must be done in addition to the required quarterly service prescribed by the technical manual.

To assist in generator operations, most tables of organization and equipment prescribe a spare generator. This allows the generator maintenance personnel to plan their schedule and to perform preventive maintenance on one generator at a time. What is needed is to increase this maintenance standby to two generators. Naturally, if all sections of the battery do not require power 24 hours a day, there is no problem.

One field expedient devised by direct support people in Europe was to employ a junction box to allow for parallel operation. This expedient is feasible if your unit does not require all generators to run under maximum load. The tactical situation may dictate dispersion of generators in which case this solution could not be considered. However, even if you must disperse your generators, it is well to have parallel devices because they allow the user to switch from one source to another without having to shut down the equipment. The obvious gain is the reduced time that each generator runs, which results in more time for maintenance.

Lessons Learned in Vietnam

TACTICAL EXPERIENCES OF DEPLOYED UNITS

(Introductory comments by the Editor)

• The nature of operations in Vietnam has given rise to numerous innovations by individual units. Their accumulated experiences, and lessons learned therefrom, provide valuable information that merits dissemination. Here is a pictorial account of some innovations of certain Hawk units •

Hawk units deployed in Vietnam are required to devise protection against small arms and mortar fire.

The sandbags at the bottom of the pulse acquisition radar (PAR) (fig 1) are used to prevent the mound that the unit has built from wearing away. The roofed area to the left of figure 1 provides protection from the elements for mechanics performing organizational and direct support maintenance on the radar. Nearby is a covered, movable frame to provide protection from the elements when mechanics are working on the receive-transmit unit.

At this continuous-wave acquisition radar (CWAR) position, sandbags and 55-gallon drums are used for protection against small arms fire (fig 2). The organic maintenance tent provides protection from the elements. The flag in the foreground warns personnel that the radars are radiating and to be alert to the radiation hazard. Notice that the sandbags are stacked low so that the radar is not masked in any direction of search. Sandbags are also serving to stabilize terrain.

Command control is the heart of any system and must be adequately protected. Figure 3 illustrates a good method of defense for the communications center. All-round fortification against small arms and mortar fire is employed.

Provision must be made for the security of classified repair parts. Some units, when they were first deployed in Vietnam, found that CONEX containers (fig 4) filled the bill. Later, permanent facilities (fig 5) were constructed.

Care in handling, storing, and maintaining repair parts is one of the maintenance warrant officer's prime concerns. The repaired parts must be given a system check and then placed in PLL storage. Shown in figure 6 is an example of how one unit did it. Note the DX tags still hanging on the chassis. In Vietnam they served the additional function of recording dates when the system check was performed on the chassis. Also note that each bin is marked to facilitate location of parts by the mechanic and the parts clerk. Parts are wrapped in plastic to protect them from harmful effects of humidity.

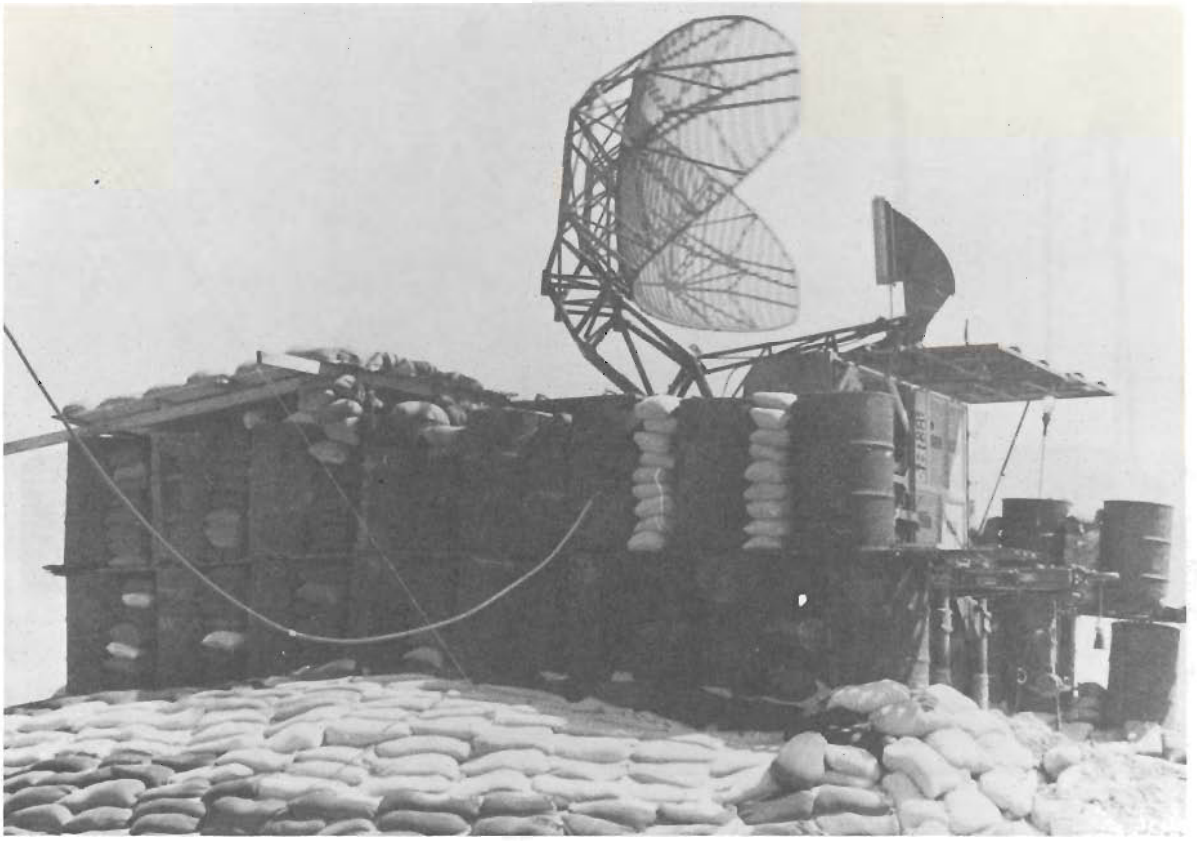


Figure 1. Pulse acquisition radar.

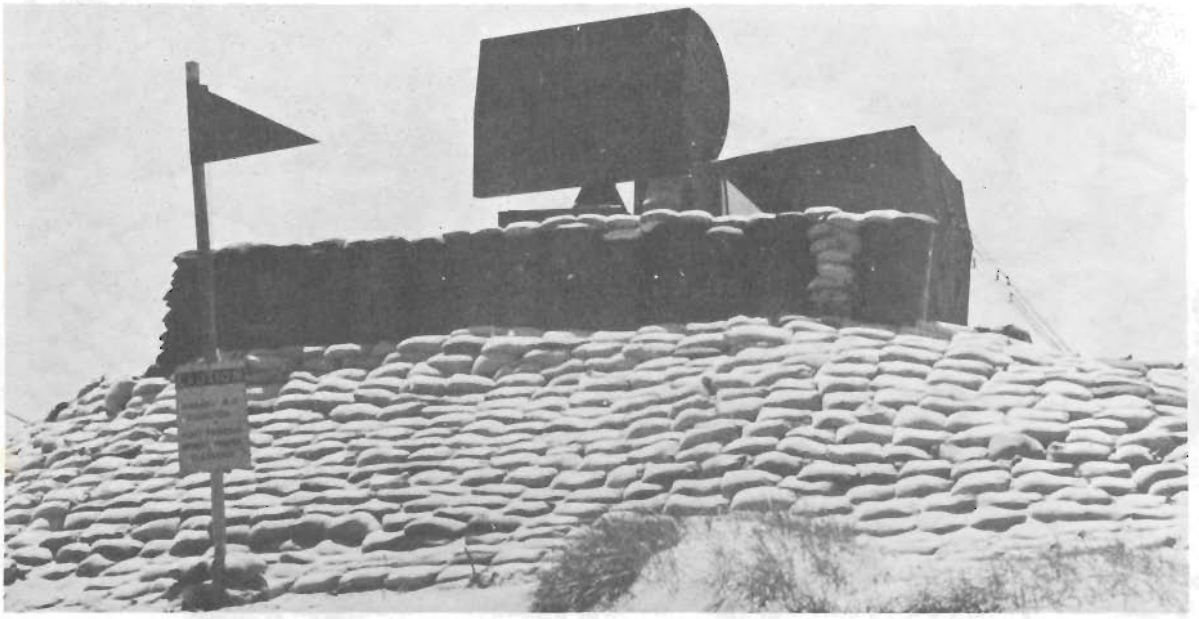


Figure 2. Continuous-wave acquisition radar.

Figure 3. Communications center.

Figure 4. Hawk repair parts storage facility (CONEX containers).

Figure 5. Hawk repair parts storage facilities (permanent).

Figure 6. PLL storage.

EMPLOYMENT OF AUTOMATIC WEAPONS AND SEARCHLIGHTS

• The military situation in Vietnam has virtually limited air defense action in that country to automatic weapons in support of field force units. Experience of this type has been accumulated during the last 3 years, and lessons thus learned are a firm basis for today's policies and procedures. Here is a report on the findings of one automatic weapons organization •

Specific employment of automatic weapons and searchlights will vary depending on terrain and mission; however, a few lessons learned have provided firm guidelines in certain situations.

Automatic weapons must always be employed in pairs. Two weapons are considered to be the smallest fire unit capable of working as an effective tactical force to maintain basic mutual support, section command integrity, and provision for vehicle recovery.

Searchlights employed in conjunction with automatic weapons in fire support patrol bases and night defensive positions considerably enhance the defense posture. Searchlights can provide accurate direction for automatic weapons by laying their azimuth indicators parallel with the automatic weapons. Other night vision/detection devices used jointly with the automatic weapons defense also enhance the effectiveness of target engagements.

Twin 40-mm, self-propelled gun M42's, when used with infantry elements, should always be protected by infantry security elements and employed at the flanks or on high ground.

Multiple caliber .50 machineguns M55 may be used to support infantry elements but only in special situations where secure commanding terrain is available for firing positions. In this way the M55 can fire effectively on pinpoint targets.

Searchlights are used primarily in the infrared mode to provide enemy detection without disclosure of position. When personnel have detected and identified definite targets, the searchlight may be switched instantly to visible light mode for target illumination and engagement. Infrared reflections are encountered from even small obstacles in the searchlight's line of illumination; therefore, clear fields of illumination are essential to effective searchlight employment. Illumination can be improved by emplacing the searchlight above surrounding obstacles. Light may be reflected from clouds to improve the vision of friendly patrols and friendly nearby positions using starlight scopes.

When properly employed, automatic weapons have been extremely effective against enemy ground forces. The mobility, quick reaction, and devastating volumes of direct fire of automatic weapons have deterred enemy attacks and destroyed his fixed forces. However, when improperly employed, automatic weapons have lost effectiveness, providing reduced fire support and incurring excessive maintenance requirements. For example, extended search and destroy operations in heavy jungle terrain cause excessive wear on M42 engines, transmissions, and suspension parts.

Movement of the M55, mounted on its $2\frac{1}{2}$-ton truck prime mover, is sometimes cumbersome. Where mobility and cross-country movement is a consideration, the M42 is preferable. Where fields of fire and observation are limited, the M55 can provide a heavy volume of close-in, penetrating fire.

Although both weapons are capable of indirect area fire, the M42 is preferred because of its speed, accuracy, and increased range. Additional accuracy of M42 indirect fire may be obtained by use of fire data from collocated US field artillery units' fire direction centers.

The M55 should be employed in static situations where heavy firepower is required and mobility is secondary. Where access to a tactical location by land is limited, the M55 can be readily employed by airlifting it into position. Consideration must be given to immediate evacuation if retrograde movement becomes necessary.

The caliber .50 projectile has more penetrating ability than the point-detonating 40-mm round and is generally preferred where fields of fire contain heavy vegetation. Ammunition for both weapons may ricochet up to maximum ranges. Point-detonating, self-destruct 40-mm ammunition, though designed to self-destruct at 3,500 meters, occasionally ricochets up to a range of 9,000 meters. This fact must be considered if either weapon is to be employed in an area of heavy friendly or civilian personnel concentration.

Like Crossword Puzzles?

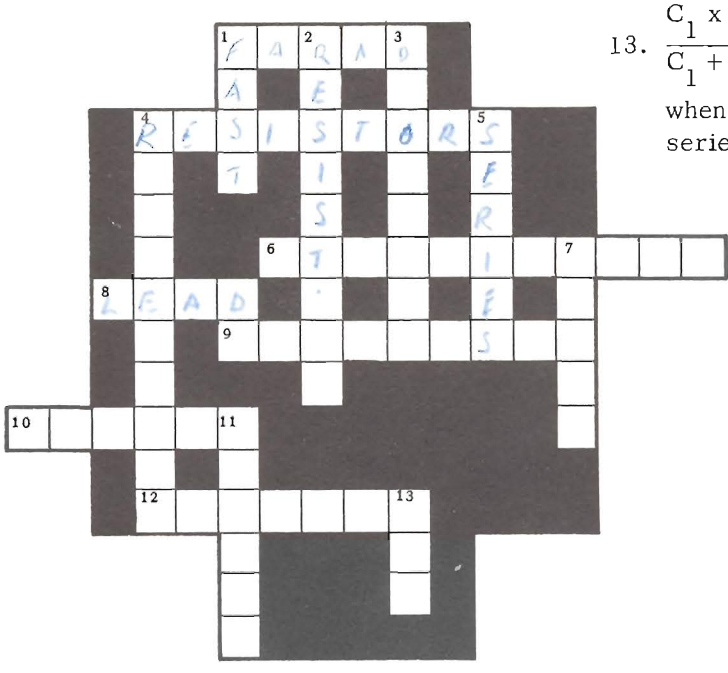
Here's one to test your knowledge of capacitance and capacitive reactance.

Horizontal

1. The unit of capacity.
4. Increasing the _____(plural) between the plates of a capacitor will decrease the capacity.
6. _____ tends to oppose a voltage change.
8. In a capacitive circuit, current will _____ voltage.
9. Capacity increases if the dielectric constant of the insulation is _____.
10. A capacitor _____ electrical energy.
12. The voltage across a capacitor lags the related _____.

Vertical

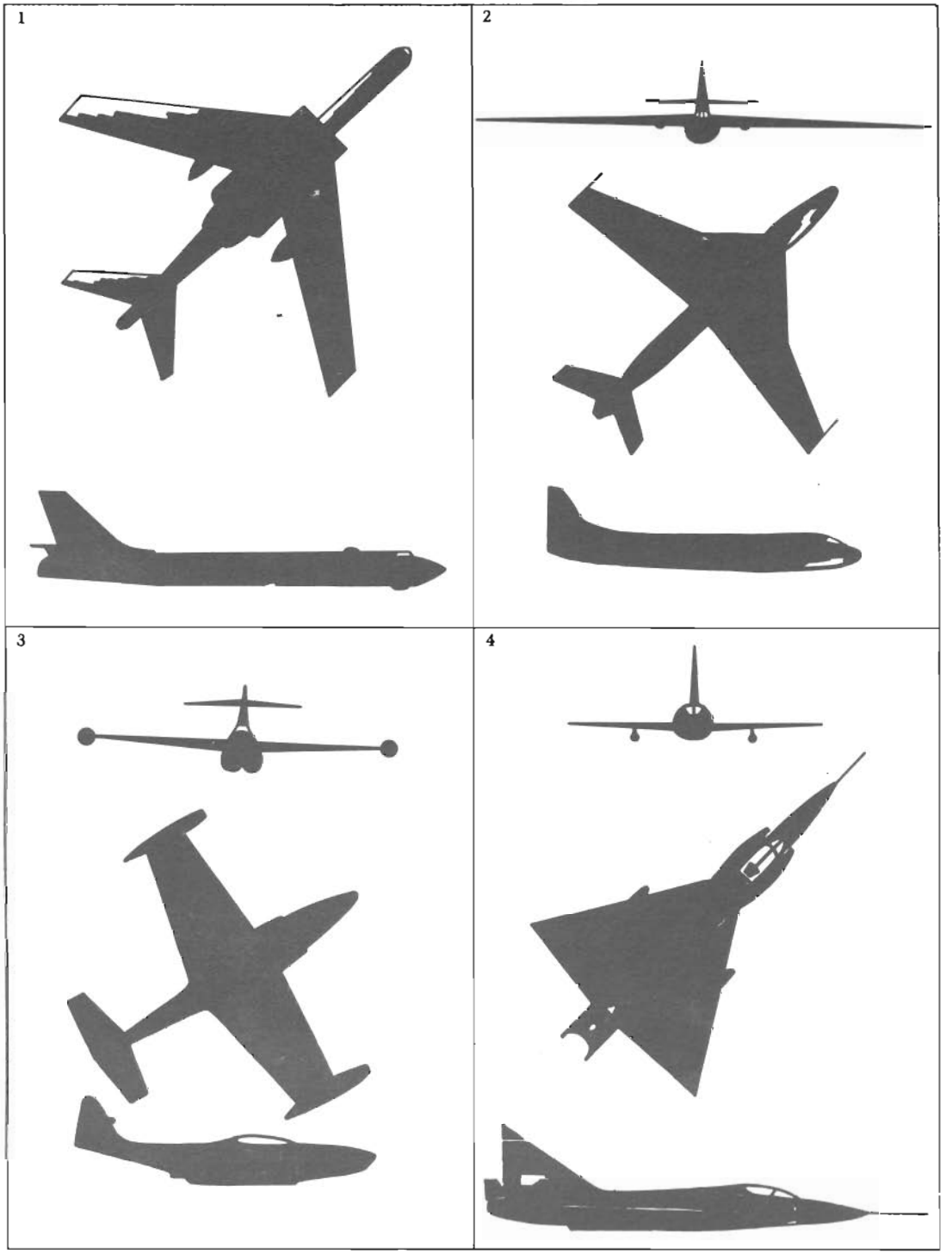
1. If a high dc voltage is applied, a capacitor will charge very _____.
2. The opposition of a capacitor to the flow of ac.
3. If the frequency of the ac voltage applied to a capacitor is increased, the reactance will _____.
4. Insulation between plates of a capacitor.
5. When the same current flows through two capacitors, they are connected in _____.
7. To find the total capacity of capacitors connected in parallel, their values are _____.
11. The total capacitance decreases when capacitors are connected in _____.
13. $\frac{C_1 \times C_2}{C_1 + C_2}$ is used to find total capacitance when _____ capacitors are connected in series.



Answers on page 73.

A Challenge!

Do you recognize these aircraft?



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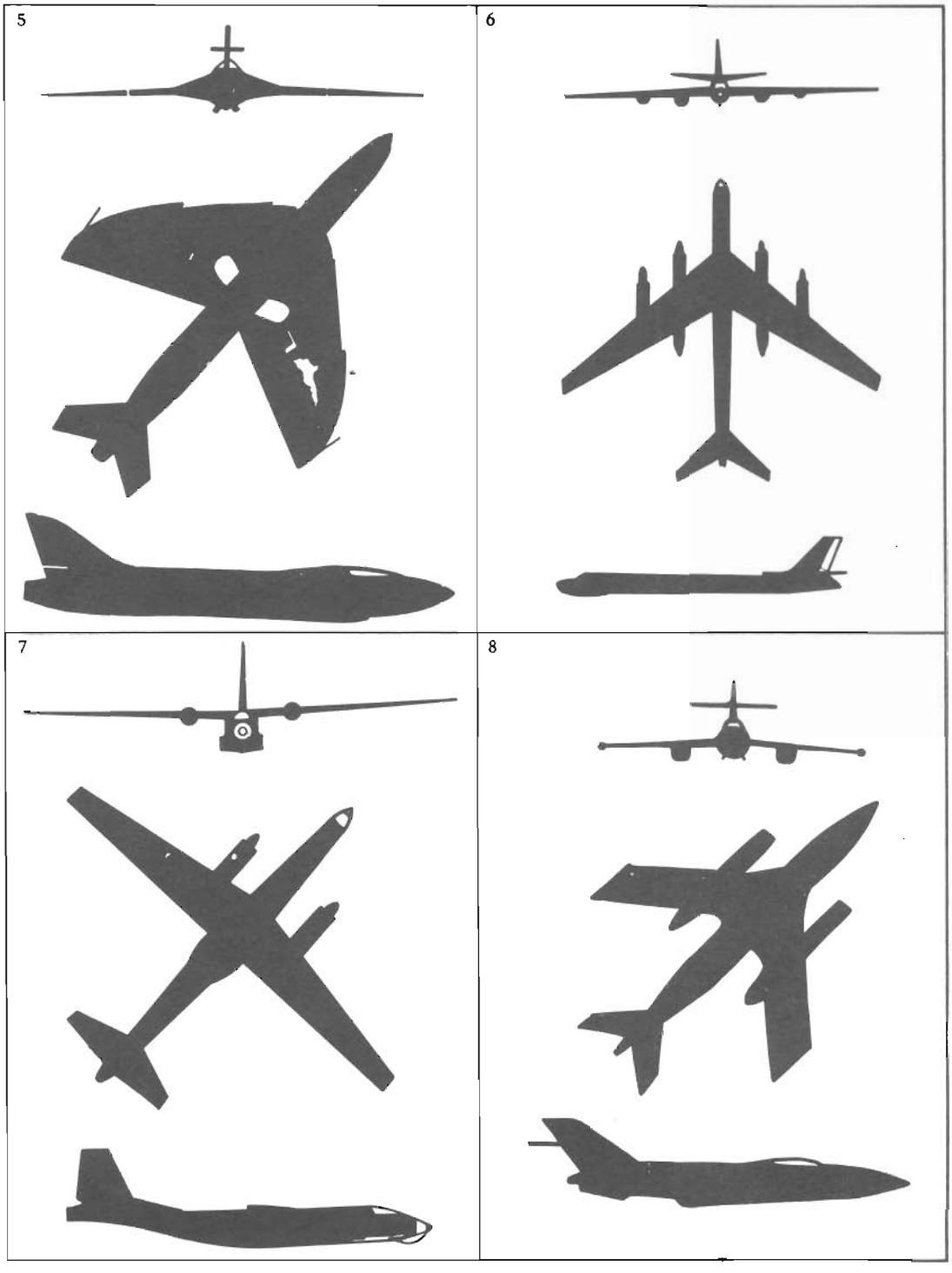

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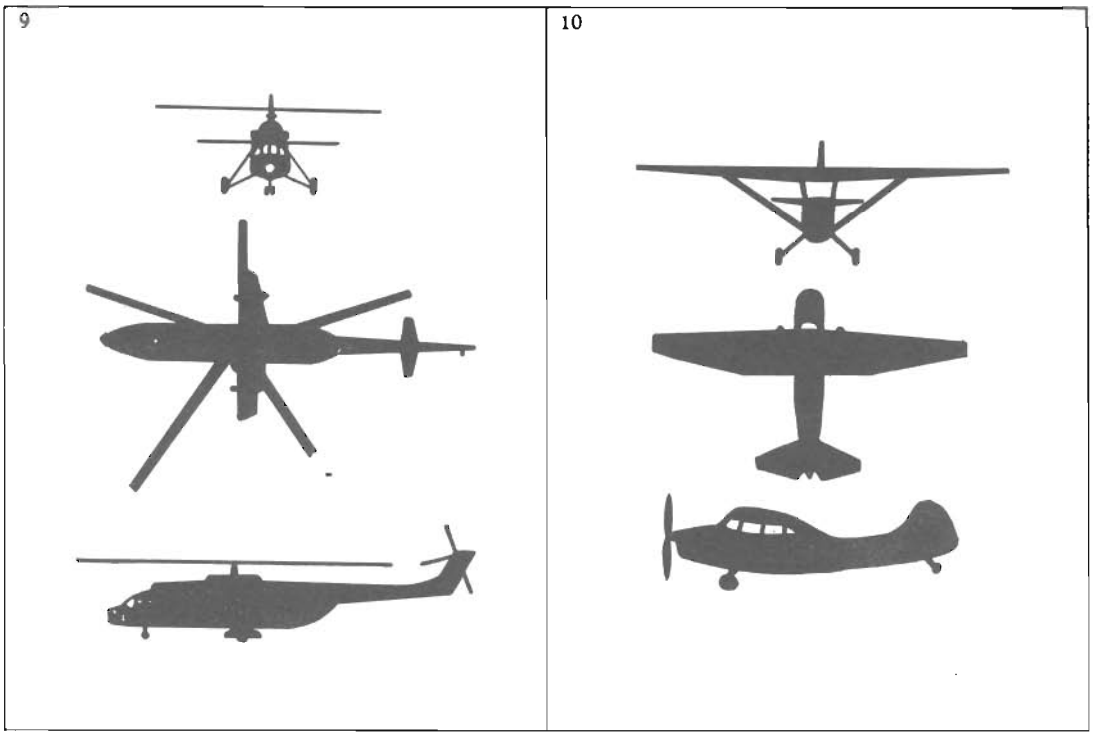


Correct identifications for aircraft:

1. Tu-16 (Russia).
2. Valiant (RAF).
3. F-89 (US).
4. F-102 (US).
5. Hunter (RAF).
6. Tu-95 (Russia).
7. An-8 (Russia).
8. YAK-25 (Russia).
9. Mi-6 (Russia).
10. O-1C (US).

Answers to crossword puzzle:

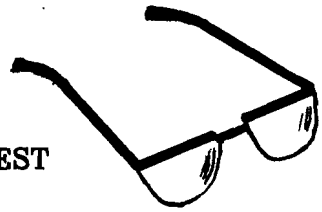
Horizontal

1. Farad
4. Distances
6. Capacitance
8. Lead
9. Increased
10. Stores
12. Current

Vertical

1. Fast
2. Reactance
3. Decrease
4. Dielectric
5. Series
7. Added
11. Series
13. Two

Reader's Corner



CURRENT BOOKS AND ARTICLES OF MILITARY INTEREST

This list is published to draw attention to worthwhile and informative books and articles in other publications. We realize that not all items will be available to all readers. Our motive is to be helpful to as many readers as possible.

The content of these publications does not necessarily represent the opinion of the US Army Air Defense School.

—Editor

BOOKS

ARMS AND ARMOR
The Weapons of World War III, the Long Road Back from the Bomb by John S. Tompkins. Doubleday, Garden City, N.Y.
"In this important book, the author shows why and how the road back from the bomb is a long and hard one."

CIVIC ACTION
Peaceful Conflict, the Non-Military Use of the Military by Edward B. Glick. Stackpole Books, Harrisburg, Pa.
"Dr. Glick shows how the discipline, training, and technical skills of armed forces can be employed not only in preventive counterinsurgency of a civic action nature, but also for national development."

COMMUNISM - U.S.
I Testify; My years as an F.B.I. Undercover Agent by Julia Brown. Western Islands Co., Boston.
"Julia Brown, a Negro lady of Cleveland, Ohio, is hoodwinked into joining the Communist Party to work for 'civil rights' . . . becomes disillusioned . . . . Later FBI asks her to rejoin the Party as undercover agent . . . she succeeds, and for nine long years, avoiding detection, works for the Party while reporting to the FBI."

ELECTRONIC CALCULATING MACHINES
Computers Self-Taught Through Experiments by Jack Brayton. Howard W. Sams & Co., Indianapolis.
"By studying this book and performing the various experiments anyone who would like to know how computers function can easily and enjoyably gain this knowledge."

NUCLEAR WARFARE
Nuclear Weapons by Otto Berzins. Hart Publishing Co., N.Y.
This pertinent and lucidly written book deals with the bomb's devastating explosion and also the complex and lingering effects of radiation, as well as steps an individual citizen can take before and during an emergency to minimize effects.

ELECTRIC CIRCUITS

Analysis and Design of Transistor Circuits by Laurence G. Cowles. Van Nostrand Co., Princeton, N.J.

"A refreshingly new and direct treatment of transistor circuit principles is presented in this book, which is primarily concerned with practical circuit design."

GUIDED MISSILES

Some Birds Don't Fly by Gary Paulsen. Rand McNally, Chicago.

"Today, when almost all 'birds' do fly, we forget that it was not always thus. But the author has not forgotten, as he makes clear in this hilarious recounting of what really happened in the days when hardly any birds got off the ground, that when they did fly, nothing within range was safe."

ISRAEL-ARAB WAR, 1948-1949

Lightning Out of Israel, the Six-Day War in the Middle East by the Associated Press.

"Viewed through the eyes of nameless Arabs and Jews who fought, as well as famous statesmen who debated before the eyes of the entire world, the Arab-Israeli war is vividly presented here in words and pictures."

LEADERSHIP

Taking Command; the Art and Science of Military Leadership by Samuel H. Hays. Stackpole Books, Harrisburg, Pa.

"From twenty years' research and teaching of future officers, West Point's specialists share here - for enlisted men, officers, and those preparing for leader roles in all of the services - the unique problems, skills, and knowledge required in military leadership today."

NUCLEAR WARFARE - CHINA

China and the Bomb by Morton H. Halperin. F.A. Praeger Co., N.Y.

"Seldom has a book been more timely than this one . . . . It brings together in highly readable fashion all the ingredients of the Chinese nuclear program."

OCCUPATIONS

Careers and Opportunities in Computer Science by John M. Carroll. Dutton Co., N.Y.

"Here is a precise and yet comprehensive picture of a fascinating field in a book for anyone interested in one of the most important developments of modern life."

SECURITY, INTERNATIONAL

Issues of National Security in the 1970's. F. A. Praeger Co., N.Y.

"Here are the problems that face the policy-maker and the military strategist: nuclear proliferations or disarmament, confrontation or detente, national forces or alliance arrangements." This is a Contemporary Military Reading List selection.

UNITED NATIONS

United Nations Forces, a Legal Study by D. W. Bowett. F. A. Praeger Co., N.Y.

"This book is the first comprehensive and detailed analysis of international forces and, in particular, of United Nations Forces."

U.S. - FOREIGN RELATIONS - RUSSIA
The Politics of Surrender by M. Stanton Evans. Devin-Adair Co., N.Y.
"It is his contention, backed up by a frightening mass of documents and 'case histories,' that in many crucial instances World Communism is being helped rather than hindered by the architects of our defense, our aid program, and foreign relations as a whole."

VIETNAM - HISTORY
Letters from Vietnam by Bill Adler, ed. Dutton Co., N.Y.
"This remarkable book is the first collection of letters written by Americans in the war in Vietnam."

ARTICLES

ARMY COMBAT DEVELOPMENTS COMMAND
"The Future Begins Today," Harry W. O. Kinnard, Ordnance (September-October 1968), pp 162-164.
"The Army Combat Developments Command is concerned not only with how our ground forces will fight, be equipped, and be organized in 1990, but also with the current effectiveness of our troops in Vietnam."

LIGHT
"Light," Scientific American (September 1968), entire issue.
"Presenting an issue about light: how modern developments such as lasers and the elucidation of the wave-particle nature of light flow from the great tradition of optics that began with Newton."

RADAR
"A Performance Study of the Lunar Module's Landing Radar System," J. Eichler, Journal of Spacecraft and Rockets (September 1968), pp 1016-1022.
"The navigation-guidance system of the Lunar Module (LM) spacecraft includes a Doppler radar system used in the lunar-landing phase."

RADIATION
"Overcoming Radioactive Contamination," Michael K. Stein, Military Review (September 1968), pp 49-55.
This discussion is concerned with the problem of pressing the attack through zones which have been contaminated by use of nuclear weapons.

TUNNELS
"Tunnel Destruction in Vietnam," Francis E. Trainor, The Military Engineer (September-October 1968), pp 341-342.
"Destruction of Viet Cong Tunnel complexes is one of the most challenging and dangerous jobs of the combined arms teams. Combat engineers in Vietnam face critical and unique problems in locating and destroying or neutralizing the tunnels."

U.S. ARMY - TRAINING
"Army Training Reexamined," John H. McIntosh, Educational Technology (August 30, 1968), pp 18-19.
"The Army's systems engineering program offers a valuable keystone upon which to base precise and measured revisions of military courses and training techniques."

AIR DEFENSES - EUROPE
"New Look At Europe's Air Defense," Hugh Wilson, NATO's Fifteen Nations (August-September 1968), pp 43-47.
Building and maintaining Western Europe's air defense shield is a never-ending and very serious game, but it is there and ready for whatever may happen.

DESIGN
"Computers Take the Tedium Out of Relay Design," W. P. Simon, Bell Laboratories Record (September 1968), pp 255-260.
"Computers are well on the way to taking over a large part of the routine work involved in the design and selection of relays. As a first step, a program has been prepared for some simple applications; but it can be expanded for more complicated situations."

DIODES
"Getting to Know the Zener Diode; Unique Component Disregards Ohm's Law," Norman Crawford, Popular Electronics (November 1968), pp 51-54.
This article bridges the gap between little or no useful information such as found in most books on Zener diodes for laymen, and information that is unnecessarily topheavy with technical details.

FEDERAL BUREAU OF INVESTIGATION
"Battlefield," John Edgar Hoover, Army Digest (October 1968), pp 4-7.
"In a presentation concerning the cooperation of the Federal Bureau of Investigation with the Armed Forces, ARMY DIGEST welcomes to its pages the distinguished Director of the FBI, J. Edgar Hoover, who discusses the various aspects of law enforcement."

FOREIGN RELATIONS - RUSSIA
"Missile Treaty With Russia - End to 'Mad Momentum,'" George Wilson, Astronautics & Aeronautics (October 1968), p 6.
"A missile agreement may never be closer than it is right now. The question is whether the new President in the U.S. and his counterpart in the USSR will have the wit, fortitude, and luck to negotiate it."

GUIDED MISSILES
"Blowpipe - a Man-Portable Supersonic Missile System," International Defense Review (No. 3, 1968), pp 189-190.
"The 'Blowpipe' one-man portable supersonic missile system . . . is designed to defend positions against low level attacks from the air. It is a command optical line of sight system, initial gathering of the missile being automatic, followed by manual guidance via a radio link."

GUIDED MISSILES - SENTINEL
"Sentinel and Beyond: A Staff Report," Space/Aeronautics (September 1968), pp 42-51.
"Sentinel interceptors will add a new kind of muscle to our strategic forces. But follow on ABM deployment will feature better radar eyes to discriminate more sophisticated targets, and a central nervous system to coordinate offense with defense and keep tabs on force expenditure in a nuclear exchange."