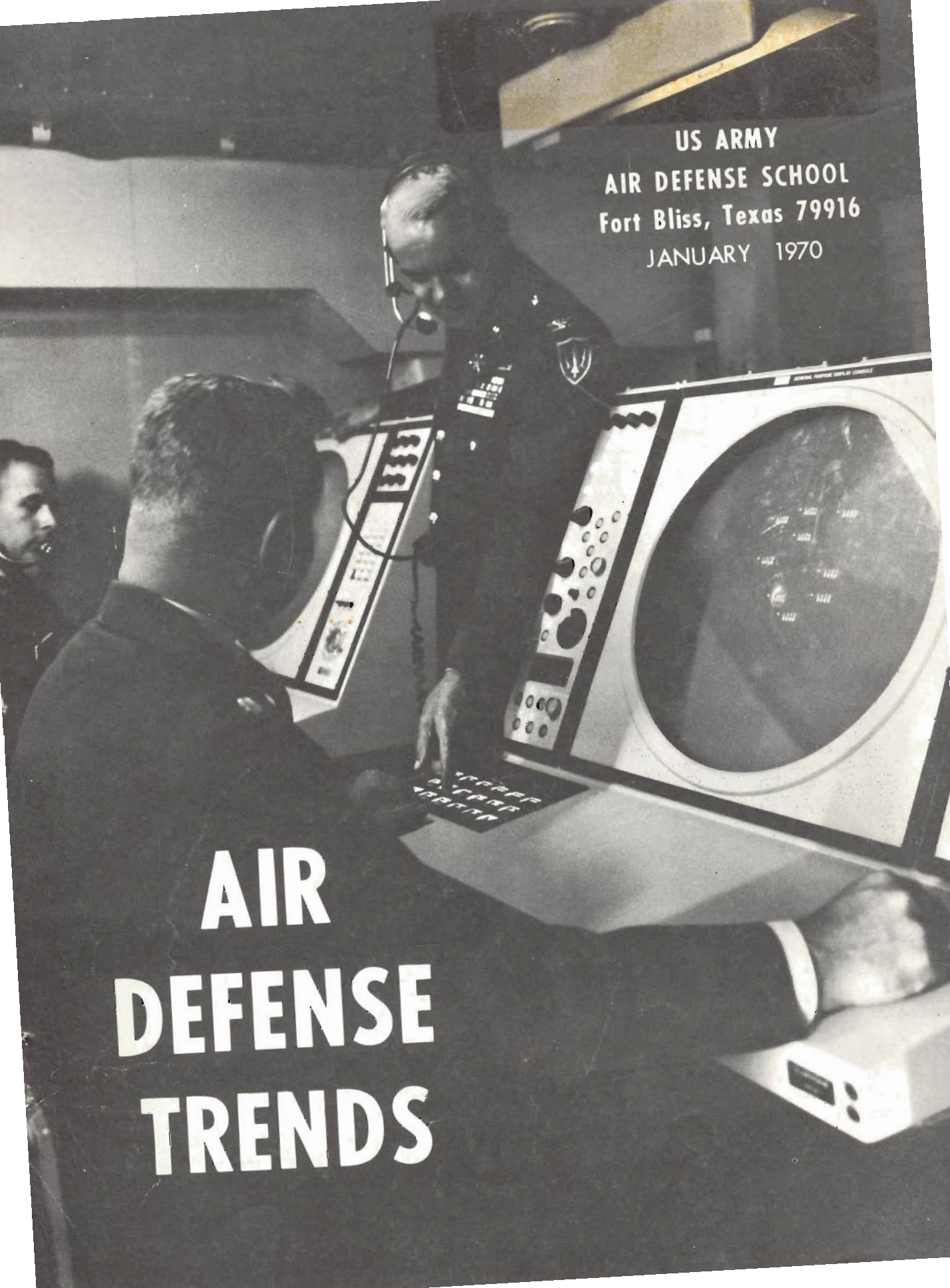

US ARMY
AIR DEFENSE SCHOOL
Fort Bliss, Texas 79916
JANUARY 1970

# AIR DEFENSE TRENDS

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

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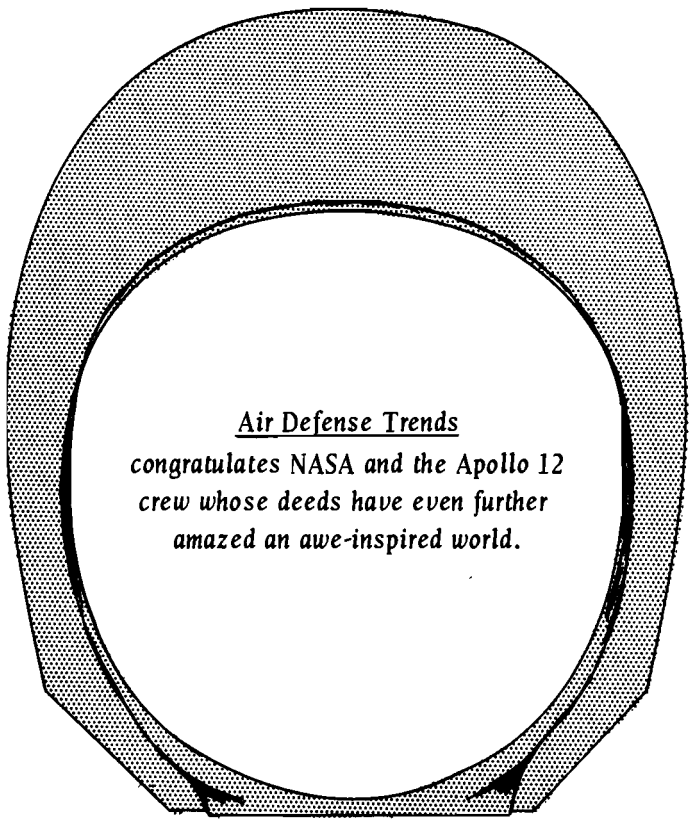
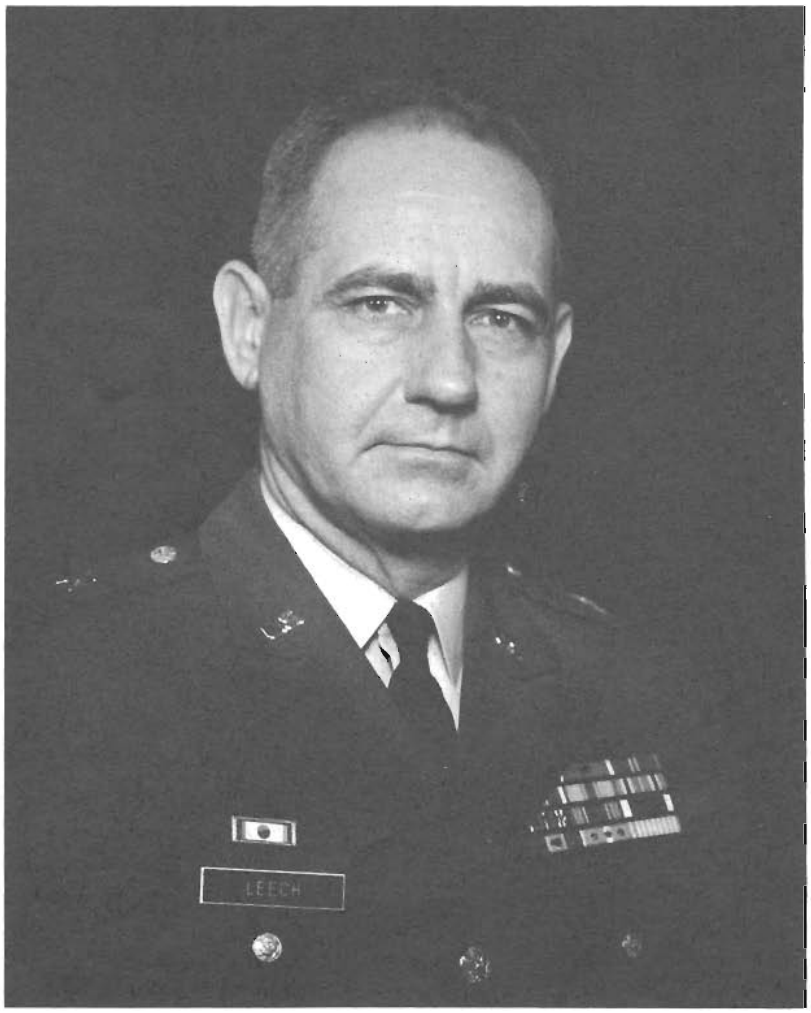
*Air Defense Trends is an instructional aid of the United States Army Air Defense School; it is published when sufficient material of an instructional nature can be gathered.*

*If we embrace this escape from reality, the Myth of the Atomic Bomb, we will drift into the belief that we Americans are safe in the world, safe and secure, because we have this devastating weapon—this and nothing more. We will then tend to relax when we need to be eternally vigilant.*

—*David Lilienthal*
*Commencement address, Michigan State College*
*5 June 1949*

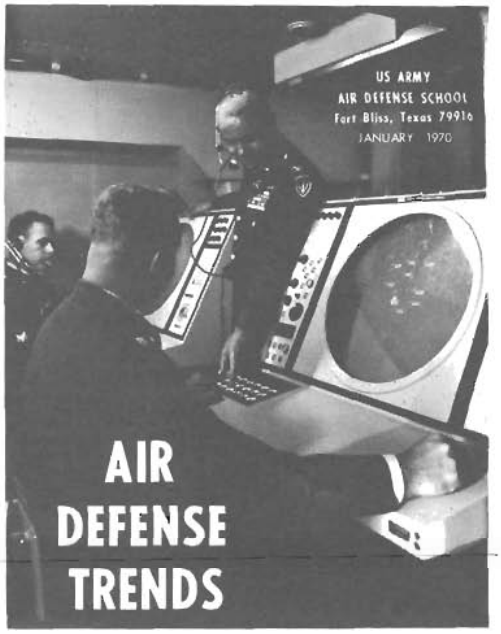

Air Defense Trends
congratulates NASA and the Apollo 12
crew whose deeds have even further
amazed an awe-inspired world.

# General Leech Is New Assistant Commandant




Brigadier General Lloyd L. Leech, Jr., assumed the position of Assistant Commandant of the US Army Air Defense School on 1 December 1969. Recently arrived from command of the 38th Artillery Brigade (AD), he brings years of experience in the missile field to the Air Defense School. General Leech is a native of Virginia. He is a graduate of Virginia Military Institute and holds a master's degree in Electrical Engineering from the University of Illinois. He has also attended the Signal Corps School, the Artillery School, the Command and General Staff College, and the National War College.

He was promoted to Brigadier General in October 1967. He served in Europe during World War II and in Korea in 1952 and 1953. Peacetime foreign service included tours in Germany and Korea. General Leech has been awarded the Legion of Merit with Oak Leaf Cluster, the Bronze Star Medal, the Army Commendation Medal, and the Air Force Commendation Medal.




COVER Only a few years ago the gigantic, complex Missile Master system was our primary continental United States guided missile fire distribution system. Those who have seen it will recall the towering defense acquisition and height-finder radomes, the expanse of the air defense command post, and the fabulous blue room with its array of consoles glowing with multi-colored signs and symbology.

The old AN/FGS-1 fell victim to the advance of technology and "went by the board" in 1967. It was replaced by the AN/TSQ-51 (Missile Mentor). Our cover is an action shot in the Missile Mentor Army air defense command post showing two of the eight general-purpose display consoles. See page 57 for a full report on the AN/TSQ-51.

## AIR DEFENSE TRENDS

An instructional aid of the United States Army Air Defense School, Air Defense Trends is published 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.

When appropriate, names and organizations of authors are furnished to enable readers to contact authors directly when they have questions concerning an article.

Unless otherwise indicated, material may be reprinted provided credit is given to Air Defense Trends and to the author.

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

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### COMMENTS DESIRED

Air Defense Trends seeks your comments on any material published. A different viewpoint or a new line of reasoning may be published to stimulate the exchange of ideas. If you are an authority on a subject, we invite you to write an article and inform our other readers. If circumstances prevent you from writing an article, then send in your idea and perhaps our editorial staff can assist in developing an acceptable article.

## US ARMY AIR DEFENSE SCHOOL

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Assistant Commandant . . . . . Brigadier General L. L. Leech, Jr

Deputy Assistant Commandant . . . . . Colonel P. A. Loiselle

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Deputy Commander. . . . . Colonel L. A. Witt

Chief of Staff . . . . . Colonel W. Y. McCachern

## US ARMY TRAINING CENTER (AIR DEFENSE)

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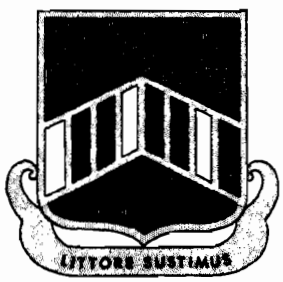
## 6TH ARTILLERY GROUP (AIR DEFENSE)

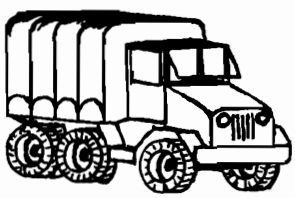
Commanding Officer . . . . . Lieutenant Colonel K. E. George

## 15TH ARTILLERY GROUP (AIR DEFENSE)




Commanding Officer . . . . . .Colonel J. D. Lewis

## SPECIAL TROOPS



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HUMAN RESOURCES RESEARCH ORGANIZATION

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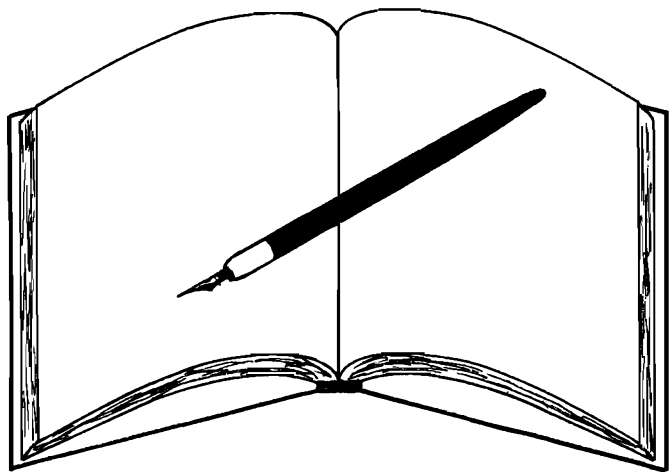


# LETTERS

# to the Editor

•I enjoyed the June issue of Air Defense Trends. The letter on employment by automatic weapons elements with Armored Cavalry units was interesting.

This "Two Here, Two There" concept mentioned in the article shows clearly the problems of command and control for automatic weapons commanders in Vietnam. As a platoon leader in an automatic weapons unit in Vietnam, with sections spread throughout a province, the problems of command and control were almost insurmountable. The daily delivery of even a single item, such as mail, was difficult and on many occasions impossible.

Attachment of automatic weapons elements to Armored Cavalry units in Vietnam is a sound idea; however, I must express that the "Two Here, Two There" concept that the AW commander faces in Vietnam today is exactly what he can expect when an enemy air threat is present. This is a good thing for us in ADA to keep in mind for the future.

BOBBY G. KIRBY
CPT, ADA

## WANTS REDEYE CHANGE

•Having graduated from Redeye school at Fort Bliss, I was assigned to my present unit and immediately assumed the responsibilities of Redeye section leader. During the past months it has become increasingly evident that reevaluation and reorganization of Redeye are needed and, in fact, overdue. After working with Redeye in the field, I and my cohorts agree that the basic Redeye tactical doctrine is sound. But the administration of Redeye sections in garrison is not at all practical nor efficiently outlined in current Army directives.

I have encountered two main problem areas. First, Redeye personnel are being misused or forgotten. Current policy hinders local commanders in assigning additional duties to Redeye personnel organic to their units. Training and the performance of maintenance

necessary to keep Redeye equipment in topnotch condition are not time consuming or rewarding enough to keep a section busy and morale high. Theoretically, such duties may be sufficient to motivate and keep a section busy, but this is not the case.

Secondly, Redeye training and testing are almost totally segregated from the training and testing of the unit to which the section is assigned. Commanders are primarily interested in the performance of their basic tactical elements, and understandably since the marks achieved on unit ATT's, ORT's, and similar exercises reflect a commander's leadership and ability. Because Redeye training and testing are conducted separately from the unit's basic tactical elements and are given little command emphasis from higher headquarters, commanders are naturally inclined to slight these activities.

To these two basic problems I offer the following solutions, realizing that other alternatives are numerous. In analyzing the latter problem, the most recognizable answer is to incorporate Redeye training and testing with the training and testing of the rest of the unit. Do away with individual Redeye ATT's and test the section as it functions with the unit in the unit's ATT. And just as important, give weight to the score achieved by the section. Commanders will then give more attention to their Redeye sections, and the overall performance and morale of such sections will improve. Current organization and training of Redeye sections separates them too much from their unit and impairs esprit.

The problem of misused and forgotten Redeye personnel could be eliminated by allowing commanders to assign them semipermanent additional duties. These additional duties should not conflict with regular Redeye training or maintenance, but if personnel were given well-defined and -limited jobs, I believe they would be more available for section training than they are now. The present system allows Redeye personnel to be assigned short order jobs which flash up at the spur of the moment and continually interrupt training and maintenance. If Redeye people were given additional duties, they would be earmarked for fewer details and would build a feeling of identity and unity with their organization—a feeling too many Redeye sections lack in a garrison situation.

The reevaluation and reorganization of Redeye sections must begin at high command levels where Army doctrine is traditionally spelled out. Small unit commanders cannot make the changes necessary to strengthen the readiness and morale of Redeye.

FRANK E. ROBERTS
1LT, Armor
*Redeye Officer*

•Recently a DA message came out directing the elimination of DA Form 2408-3 from TAERS. Please publish the gist of the directive for those of us who are off the beaten path of command correspondence.

— TAERS Clerk

*See "Notes," page 16 of this issue.*

*Ed.*

## MORE ON AIRSPACE CONTROL

•The article by Major Fontaine in the June 1969 issue of Air Defense Trends regarding Army airspace control and coordination was an interesting approach to a difficult problem. I feel, however, that there is a valuable lesson to be learned in Vietnam concerning the use of airspace by the field artillery. Existing in Vietnam today are a number of artillery warning control centers (AWCC) which transmit warnings of friendly artillery fires. The AWCC is the air clearance agency for all fires in their area of responsibility up to 5,000 feet. Airspace above 5,000 feet is controlled by an agency at higher headquarters. Having been the responsible officer for an AWCC that controlled a large area of terrain, including US, Royal Australian, Royal Thai, ARVN, and naval artillery fires, I can say conclusively that the problems associated with the artillery use of the Army airspace is more complex than Major Fontaine may have imagined or been lead to believe. While the planned fires do not pose a great problem in that time is not critical for posting, "contact" fire missions by artillery coupled with air strikes and medical evacuation helicopters require a great amount of coordination.

For the above reasons, I feel that the field artillery status board (shown in his type ACE layout) will require a person on duty at all times who is in direct communication with the AWCC. If the status board is not current in real time, it cannot be of value in assisting the aviation officer in planning his missions and directing his portion of the airspace for its users. It might also be helpful to have the field artillery board divided into "current" missions and "planned or on-call" missions.

Another problem that has not been resolved is who will "check-fire" the artillery when aircraft are needed for medical evacuation or landing reserve troops. Will check-firing of artillery be the ground commander's decision or the decision of the Chief of the ACE?

Interesting problems—and for that reason I feel that the air defense must be in close coordination with not only the aviators but with our cousins, the field artillery, in the planning and execution phase of the ACE.

KENNETH A. GRUNER
CPT, ADA, USA
*Asst S3, 2d Bn, 35th Arty*

# USAADS Instructional Notes

*Hinman Hall*

## OFFICE OF DOCTRINE DEVELOPMENT, LITERATURE, AND PLANS

### SURFACE-TO-SURFACE CAPABILITY FOR AIR DEFENSE WEAPON SYSTEMS

The School endorses the Combat Developments Command's Army 85 Concept Study, dated December 1966, which advocates that all division and field army air defense systems have a secondary surface-to-surface capability. This is in consonance with the present DA policy established in the Combat Development Objectives Guide which states that a desirable characteristic for air defense weapons is the capability to deliver surface-to-surface fires and consideration should be given to this capability in development of new air defense weapon systems, although not at the expense of the surface-to-air capability of the system.

Experience has shown that as air defense systems become more sophisticated and consequently more expensive, resistance to purchasing and fielding single capability air defense weapons increases. When practicable, future air defense systems for the field army should be developed with a dual capability from both the cost effectiveness and personnel utilization standpoints. When air supremacy has been gained, systems without a dual capability are subject to inactivation. The existence of an expensive single capability air defense system is sometimes difficult to justify as long as air supremacy is maintained.

In recent low to mid intensity conflicts, the enemy air threat to the field army has been practically nonexistent (e.g., Korean Conflict and South Vietnam). The air threat, just as the CBR threat, thereby receives little attention. Since World War II, US air supremacy during limited conflicts has caused a complacent attitude toward air defense by most field commanders although a very real air threat to future Army forces exists. ADA is essential to the division's effectiveness and survivability.

A dual capability would be more attractive to the field commanders because it provides additional firepower for the division since the surface-to-surface capability could be utilized in the absence of an air threat. A dual capability definitely weighs greatly against current arguments for taking air defense out of the division and corps structures.

An effective air defense requires that the fire units be deployed in close coordination and habitual association with the combat and support elements of the division and corps. Consequently, division and corps commanders and staffs would become more familiar with air defense weapons and air defense personnel would gain additional knowledge of the overall division and corps operations. This close association would cause field commanders to consider their organic air defense in planning operations. A dual capability air defense system, providing the field army with additional firepower in the surface-to-surface role, would necessarily be considered in planning and utilized in operations.

This position is not intended to apply to air defense missile systems without surface-to-surface capability presently in the field, nor is it intended to have any relationship to the static installations of the CONUS air defense systems.

---

## NONRESIDENT INSTRUCTION DEPARTMENT

### THE ADA ADVANCED COURSE GRADUATE

### MUST YOUR PROFESSIONAL DEVELOPMENT STOP HERE?

*Lieutenant Colonel Wilmer O. Gray, Jr*
*Nonresident Instruction Department*
*US Army Air Defense School*

*CPT Daniel F. Vooys, Distinguished Graduate of the Air Defense Artillery Officer Advanced Course, Class 4-69, receives his diploma from LTG Harry H. Critz, Fourth US Army Commander, during graduation ceremonies at the US Army Air Defense School, Fort Bliss, Texas.*

Six times each year ADA Advanced Course students stand at the graduation steps of the course, receive their diplomas, and are ready for the next step along their career development paths. For some graduates this represents the last formal resident career schooling. It need not, however, represent an end to career development and progress. Graduates have spent 37 weeks absorbing what they probably thought was all the training necessary for advancement and to perform well any job to which they may be assigned.

Realistically, no course, regardless of the diversification, could have fulfilled that most desirable objective in the time allocated. So now, after having arrived at their new duty stations and assumed new duties as battery commanders, staff officers, military advisers, service school instructors, or ROTC instructors, they recognize a need for further professional development and a need for assistance to help them in their new job.

In this issue of Air Defense Trends, we offer a method of personal career development. In subsequent issues, information will be provided by the Nonresident Instruction Department, US Army Air Defense School, Fort Bliss, Texas, that can assist the ADA Advanced Course graduate in performing his assigned duties. Let us now discuss personal career development.

PERSONAL CAREER DEVELOPMENT:

1. US Army Command and General Staff College (C&GSC). Some advanced course graduates will not be selected for further military career schooling, but they will continue to serve on active duty. Many may be assigned to positions where knowledge at the C&GSC level of schooling will be desirable if not necessary for effective performance. The C&GSC may be completed by:

a. Correspondence course study.

b. Correspondence course study plus active duty study on a TDY basis.

c. Attendance at five USAR School Reserve Duty Training phases and five Active Duty for Training phases at a USAR School during the summer. Active duty officers may be authorized TDY for attendance at the USAR School active duty phases.

d. A combination of a, b, and c above.

Completion of this graduate level course through any of the methods above is comparable to completion by resident study, for the content of the correspondence course parallels the content of the resident course. It will not adversely affect chances for selection for C&GSC resident schooling. On the contrary, the chance for selection is improved. For further details, write the Commandant, US Army Command and General Staff College, ATTN: CNRI, Fort Leavenworth, Kansas 66027. Advanced course graduates should use this medium of study to improve their professional qualifications and to make themselves more competitive as they move along in their career.

2. Industrial College of the Armed Forces. Another graduate level course offered by correspondence is "National Security Management." This course, the basic course of instruction at the graduate level, and its extraction, "Management in the Department of Defense," are open for enrollment of personnel in the grade of major and above with a college degree or the equivalent in professional experience. Those interested in national security management or management in the Department of Defense should write the Commandant, Industrial College of the Armed Forces, ATTN: Correspondence School, Fort Lesley J. McNair, Washington, D.C. 20315.

3. The Army War College. The third graduate level correspondence course is offered by the US Army War College. This course, "The Development of a National Strategy and a

Supporting Military Program," is open to 100 active duty and 100 Reserve component officers annually. Selection is made by DA of those resident or nonresident C&GSC graduate applicants in the grade of lieutenant colonel or higher. To obtain a nonresident curriculum pamphlet outlining this course, write the Commandant, US Army War College, ATTN: AWCIE, Carlisle Barracks, Pennsylvania 17013.

Remember! Professional preparation and development need not be stymied simply because of nonselection for resident graduate schooling. Each advanced course graduate is encouraged to take advantage of the nonresident military educational opportunities available through correspondence study. It may make the difference between "up" or "out."

*Editor's Note:*

*Check this space in the next issue of Air Defense Trends for information on how the Nonresident Instruction Department can help the Air Defense Artillery unit commander.*

---

## AIR DEFENSE ARTILLERY TECHNICIANS CAREER DEVELOPMENT CORRESPONDENCE COURSE

Effective January 1970, the Nonresident Instruction Department will offer an Air Defense Artillery Correspondence Course for Air Defense Artillery Enlisted Technicians in MOS career groups 24 and 25. The purposes of this course are:

1. To provide instruction in nontechnical military subjects:

a. For transition from the technical to the leadership and supervisory field in MOS Career Group 16.

b. To improve military knowledge and job proficiency.

c. To provide a correspondence course which enlisted technicians may complete and earn 30 points toward promotion.

2. To assist ADA enlisted technicians in preparing for their annual MOS evalution.

The scope of this subcourse includes:

| | |
|---|---|
| Battery Correspondence | Map Reading |
| Military Correspondence | ADA Employment |
| Supply Procedures | Safeguarding Defense Information |
| Drill and Ceremonies | First Aid and Sanitation |
| Leadership | Field Radio, Wire, and Cable Techniques |
| Military Instruction | The Army Equipment Record System |
| Military Justice | |

ADA enlisted technicians desiring to improve their general military knowledge, or to prepare for transition to one of the military occupational specialties in MOS Career Group 16,

are encouraged to submit one copy of DA Form 145, Army Correspondence Course Enrollment Application, through their unit commander to:

Commandant
US Army Air Defense School
ATTN: NRI Department
P.O. Box 5330
Fort Bliss, Texas 79916

Include in block 11 of DA Form 145: ADA 801, General Subjects for ADA Technicians. Enrollment applications are being accepted now so that the subcourse can be promptly shipped.

# Notes From
# US Army Air Defense Center and Fort Bliss

## DA FORM 2408-3 ELIMINATED

Authority to discontinue use of DA Form 2408-3 was issued in DCSLOG-LOG/MP-PB message dated 12 September 1969.

We quote:

"1. Subject form is eliminated from TAERS effective 1 October 1969.

"2. Pending receipt of procedural instructions, the following interim procedures are prescribed:

"a. Close out and process all DA Forms 2408-3, as prescribed by references a and b (TM 38-750 and TM 38-750-1) for September 1969.

"b. Effective 1 October 1969, use DA Form 2407 (Maintenance Request) to record organizational maintenance actions pertinent to aircraft, except that DA Forms 2407 and 2407-1 (Continuation Sheet) will be closed out at the end of each calendar month and processed in accordance with references a and b (TM 38-750 and TM 38-750-1).

"3. Reporting of organizational maintenance actions on DA Form 2407 for all equipment except aircraft is limited to the application of all modification work orders and replacement of tactical and combat vehicle engines/power packs, combat vehicle track, gun and howitzer tubes (40-mm and over), hourmeters, odometers, and tachometers. All organizational maintenance actions for aircraft will be reported.

"4. More detailed procedures pertinent to the above reduction of administrative workload is targeted for distribution to the field in mid-October 1969."

---

## PROTECTION OF SENSITIVE ELECTRONIC CHASSIS, INSTRUMENTS, AND DEVICES

Sensitive electronic chassis, instruments, and devices should be handled very carefully and should be protected while intransit from one place to another by being placed on cushion material.

Available through normal supply and especially designed for this purpose is:

FSN 8135-664-0057, Cushion Material, packing bound fibers, rated water resistant, low absorbing, 72 inches long, 24 inches wide, 2 inches thick. Color: Red, orange. 12 sheets per box. Price: $2.16 per sheet.

---

## ELECTRONIC WARFARE FREQUENCY BAND DESIGNATIONS

Department of the Army has announced these changes in electronic warfare frequency band designations effective 31 December 1969.

- World War II frequency band designation system (i.e., P, L, S, C, X, and K) shall no longer be used in official correspondence.

- The frequency band designation system established by reference is the only system authorized for use by the US Army in all areas of EW on those occasions when the need for specific frequencies is not critical.

- The use of specific frequencies, in lieu of band designation, is authorized when it will assist in achieving clarity or ease of understanding.

Authorized electronic warfare operational bands are listed below:

| Band | Frequency MHz |
|---|---|
| A | 0-250 |
| B | 250-500 |
| C | 500-1000 |
| D | 1000-2000 |
| E | 2000-3000 |
| F | 3000-4000 |
| G | 4000-6000 |
| H | 6000-8000 |
| I | 8000-10,000 |
| J | 10,000-20,000 |
| K | 20,000-40,000 |
| L | 40,000-60,000 |
| M | 60,000-100,000 |

## ANALYSIS OF PROMOTION LIST

Here is an analysis of the colonel promotion list released 27 October 1969 by The Adjutant General.

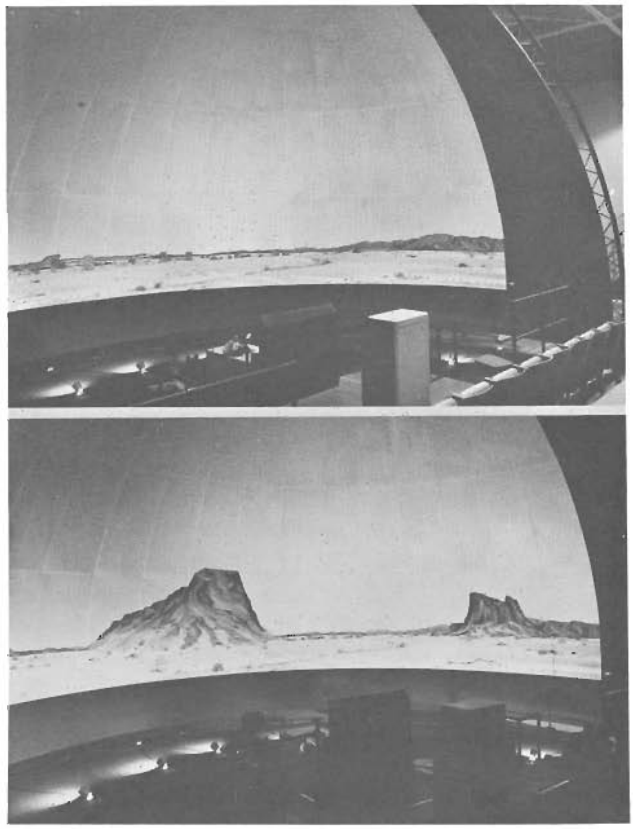
| | Considered | Selected | Percent selected |
|---|---|---|---|
| Overall Army List | | | |
| Primary Zone | 3,132 | 770 | 24.6 |
| First Time | 1,443 | 731 | 50.7 |
| Previously Considered | 1,689 | 39 | 2.3 |
| Secondary Zone | UNK | 66 | |
| Fort Bliss Army List | | | |
| Primary Zone | 41 | 13 | 31.7 |
| First Time | 17 | 12 | 70.5 |
| Previously Considered | 24 | 1 | 0.4 |
| Secondary Zone | 12 | 0 | |
| Army-Wide ADA* | | | |
| Primary Zone | 190 | 56 | 29.5 |
| First Time | 90 | 52 | 57.8 |
| Previously Considered | 100 | 4 | 4.0 |
| Secondary Zone** | UNK | 1 | |
| Fort Bliss - ADA Only | | | |
| Primary Zone | 24 | 11 | 45.8 |
| First Time | 12 | 10 | 83.3 |
| Previously Considered | 12 | 1 | 0.8 |
| Secondary Zone | 7 | 0 | |

*Army-wide ADA percentages supplied by OPO-ADA.
**Compared with 16 secondary selections for FA and 19 for Infantry.

# Notes From the US Army Air Defense Board

REDEYE MOVING TARGET SIMULATOR

The US Army Air Defense Board recently completed a service test of the moving target simulator (MTS). The MTS was developed by the Naval Training Device Center, Orlando, Florida, in conjunction with the Redeye Project Manager's Office, US Army Missile Command, Redstone Arsenal, Alabama, to provide economical training of Redeye gunners and to eliminate the cost involved in using live aircraft for training.



*The top photograph shows the moving target simulator with a level terrain presentation. By adding mountains, bottom picture, different presentations can be given the trainee.*

The MTS projects a target image upon a spherical screen assembly using a 16-mm projector. The target image and an infrared spot are then translated in azimuth and elevation by a servomechanism.

The firing platform of the MTS has room for two instructors and two trainees with Redeye trainers. An observation platform for seating 20 observers is directly behind the firing platform.

The concept of the MTS is to develop a higher degree of gunner proficiency than that provided by real targets. This concept is based on four factors. The instructor, who has complete control of all aspects of gunner training, can repeat desired trajectories and need not be concerned with pilot reactions, drone operations, or other time-consuming activities associated with live aircraft support. Presentation of all aircraft types and trajectories with accurate repeatability of target runs to permit objective evaluation of the trainees by the instructor can be provided by simulated targets. Loss of training time as a result of unfavorable weather conditions can be eliminated. Simulated targets provide the best possible means for expansion of training during times of mobilization when target ranges and aircraft are in great demand.

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## IMPROVED HAWK

The US Army Air Defense Board recently received production prototype components of the Improved Hawk missile system for service testing. Testing began in late September in the Nations East Wells Maneuver Area east of El Paso. After service testing is completed at Fort Bliss, other tests will be conducted until the Improved Hawk has proven itself reliable and suitable for use by the Army.

The Improved Hawk missile system, which incorporates state-of-the-art improvements, is designed to replace the existing Hawk missile system. The configuration of the Hawk battery has been changed very litttle in the Improved Hawk program. The only visible changes are the addition of a van to house the information coordination central (ICC) and the relocation of the omnidirectional antenna which is now mounted on top of the pulse acquisition radar (PAR).

The ICC van houses the general-purpose computer, which is the brains of the Improved Hawk system. Utilizing data from the Hawk radars, the computer will detect and evaluate the target, assign the target to a firing section, and order a missile to be fired against a hostile target; thus, the Improved Hawk's system reaction time will be greatly minimized. The battery control officer (BCO) will be able to select one of two modes of engagement, manual or fully automatic. In the automatic mode the BCO can always override the computer. The ICC will also serve as the communications center for the battery as well as house the identification, friend or foe (IFF), equipment and battery terminal equipment (BTE).

The battery control central has been modified to permit display of additional information at the tactical control console.

Several modifications have been made to the radar system. The only change to the PAR was the relocation of the omnidirectional antenna as mentioned above. The continuous-wave acquisition radar has been extensively redesigned. Extensive use is being made of solid-state devices. The high powered illuminator radar has been given greater target tracking capability as well as improved circuitry.

The greatest changes have occurred in the Hawk missile. The Improved Hawk round is designed along the certified round concept. The round will require no electrical checkout or repair in the field.

# Notes From the Human Resources Research Organization

## HUMRRO RESEARCH AIDS PROJECT 100,000

In October 1966 the Department of Defense (DOD) launched Project 100,000 by revising the entrance standards for military service so that men who would previously have been rejected because of low mental-test scores or minor physical defects became eligible to enter the Armed Forces.

While reducing entrance requirements, DOD insisted that the Services not lower performance standards. The new-standards men were not to be coddled or run through watered-down training programs but were to be helped in every reasonable way to acquire the skills and knowledge necessary for successful military service.

As soon as Project 100,000 began, the Army turned to the Human Resources Research Organization (HUMRRO) for assistance which has been of three types: technical advisory service, short-range assistance, and long-range assistance.

## TECHNICAL ADVISORY SERVICE

A HUMRRO scientist spent 5 months as a member of an Army Technical Advisory Service team that prepared a report on the Marginal Man and Military Service covering the experience, policies, and studies of marginal personnel by all Services from World War I to 1966. HUMRRO had formerly completed a study (entitled "A Study of Category IV Personnel in Basic Training") of how various aptitude groups perform in basic combat training (BCT).

HUMRRO Division No. 4 has initiated a comprehensive review of psychological and sociological research literature on organization leadership. This new project, LEAD-REVIEW, is being supported by the Office of Naval Research and will identify gaps in the understanding of the leadership process and will point the way toward experimentation to fill these gaps. Also, it will provide a basis for the development of training for leaders. LEAD-REVIEW will concentrate on leadership at lower and intermediate levels. HUMRRO research has shown that, while low-aptitude (category IV) personnel were succeeding in BCT, they fell furthest behind their higher aptitude fellow soldiers in cognitive (as contrasted with motor) tasks. This indicated that efforts to improve Army training of low-aptitude personnel would be most profitably devoted to training subsequent to BCT, where the cognitive demands are higher than in basic training.

## SHORT-RANGE ASSISTANCE

HUMRRO scientists provided two types of assistance to the Army in its course revision efforts. One scientist helped develop USCONARC Regulation 350-100-1, Systems Engineering of Training, which is resulting in improved training for low-aptitude soldiers and men of all aptitude levels. Other scientists have helped revise and evaluate specific Army courses. The revisions incorporated two well-known training technology principles: the careful development and specification of performance objectives and the sequencing of

subject-matter content so that the significance of each topic is firmly established for the learner prior to its introduction. A research team developed and administered an end-of-course performance test for the switchboard operator's course and helped the Signal School analyze and interpret the results. Another major contribution was the development of a detailed task and skill analysis of the job and of a computer-based system that enables the School to keep its instruction constantly up to date despite frequent changes in Army policies, regulations, and procedures. HUMRRO personnel also worked with Army personnel to develop an instructional program and end-of-course proficiency tests to evaluate the effectiveness of the revised program.

## LONG-RANGE ASSISTANCE

HUMRRO Division No. 3 has planned and undertaken four work units: SPECTRUM, APSTRAT, REALISTIC, and UTILITY.

### SPECTRUM

Scientists assigned to SPECTRUM are developing procedures the Army can use in selecting training methods and subject matter that will achieve more effective training for all personnel, but particularly for low-aptitude trainees. The SPECTRUM staff conducted a laboratory study to examine the relationship between mental ability—as judged from scores on the AFQT—and the learning of military skills and knowledges. In general, they found it took low-aptitude men up to five times as long and up to six times as much instructor assistance as was required for higher aptitude trainees. SPECTRUM scientists are developing training strategies to determine the best instructional methods for teaching particular kinds of subject matter to men at particular aptitude levels.

### APSTRAT

HUMRRO scientists in work unit APSTRAT are developing instructional systems appropriate for a wide range of trainee aptitudes and testing them in the field. The APSTRAT-developed instruction will be taught by regular Army instructors to standard-input trainees in a completely conventional Army training setting. The APSTRAT team selected the field wireman course as its research vehicle because the course incorporates a wide variety of tasks and the trainee input to this course typically has a wide range of aptitude levels. Members of the team have system-engineered the wireman course and are developing a variety of materials to give instructors and trainees several options as to how course material is to be taught and learned.

### REALISTIC

In work unit REALISTIC, a team of scientists is trying to identify the levels of reading, listening, and arithmetic skills that Army enlisted men need to perform their job duties satisfactorily. They are also trying to develop guidelines for reducing any discrepancies they may discover between the levels the men have attained and those required by the Army jobs. For example, they are trying to determine whether it makes more sense to try to raise trainee reading levels or to reduce the difficulty levels of the material these trainees must use. Listening is being emphasized because many low-aptitude personnel who have

difficulty reading can learn much of what they need to know through listening. Considerable evidence indicates that the difficulty level of many materials soldiers must use in training and on-the-job duties—regulations, directives, field manuals, and technical manuals—does not match the ability of the men who are expected to use them. The feasibility of substituting learning by listening for learning by reading for trainees whose reading skills are particularly poor is being studied. The effectiveness of rate-controlled tape recordings as Army instructional material is being explored.

UTILITY

Work unit UTILITY has three principal objectives: to determine how men in mental category IV compare with men in other mental categories in job performance and overall suitability for military service, to identify characteristics of men in category IV who are associated with successful on-the-job performance, and to determine what background and other nonintellectual measures might prove useful in screening, classifying, and assigning such men. This study essentially compares the job performance of category IV and non-category IV personnel in five different MOS's. In UTILITY, HUMRRO scientists have collected data on approximately 1,800 soldiers. Each man was individually tested with especially developed paper-and-pencil knowledge tests. Scores on these tests will be compared with scores on performance tests and with supervisor ratings to see what relationships exist. Ultimately, this research effort will provide essential information on the relationship between aptitudes and on-the-job performance.

## PROGRESS REPORT

The Director of Research at Division No. 3 recently delivered an interim progress report to key staff officers at Headquarters, US Continental Army Command. His presentation cited these general conclusions:

1. The training system should be modified to conform better with individual differences.

2. The first priority modifications should be the development of procedures to train the low-ability man better.

3. A significant disparity exists between readability of Army publications and the capability of many job incumbents to use them. Research data show that publications can be modified to make them more understandable.

# Notes From US Army Air Defense Command

A HISTORICAL SKETCH

The balloon swayed lazily atop its steel tether. Professor T. S. C. Lowe rode the basket. His job? To observe the grey-clad Confederate forces. Union troops had just introduced a startling innovation to warfare—for the first time observation balloons were being used effectively as a means of reconnaissance. The date was 30 August 1861.

Such a tempting target proved too much for members of the Washington Artillery of Louisiana to resist. Deployed on Munson's Hill, less than 2 miles from the balloon's launching site at Ball's Cross Road (now the intersection of Glebe Road and Wilson Boulevard in Arlington, Va.), the Confederate artillery opened fire. Their weapon was a 3-inch rifle firing a 6-pound projectile.

Both sides claimed victory—the Union forces because the Rebs missed; the Confederates because the projectile apparently passed so close that Professor Lowe requested immediate return to earth. This skirmish is reported by military historians to be the first recorded instance of an "antiaircraft incident."

In less than a century, the "art of antiaircraft" has progressed from this single round to the machineguns of World War I, the 90-mm and 120-mm cannons of World War II, the radar-directed Skysweeper of the early fifties, and, finally, to the deadly surface-to-air missiles (SAM).

The antiaircraft defense of the United States is today the responsibility of the United States Army Air Defense Command (ARADCOM). Nike Hercules missiles of ARADCOM guard 18 major populated and industrial areas. In addition, Hawk missiles capable of intercepting extremely low-flying aircraft are deployed in Florida for defense against a possible attack from Cuba. ARADCOM can trace its history to 29 June 1950 when Army General Orders No. 20 established the Army Antiaircraft Command (ARAACOM). Creation of an overall command to integrate Army air defense forces was felt necessary in face of the increasing threat of war during the days preceding start of the Korean Conflict. A few days after the establishment of ARAACOM, the Republic of Korea was invaded. At first, the command was responsible only for "the planning and deployment of Army air defense forces and maintaining cognizance of the state of training and readiness." Full command of all Army air defense units assigned to the air defense of the United States was assumed 10 April 1951.

Early Army air defense forces were armed with weapons only slightly improved over the World War II arsenal of 90-mm and 120-mm guns, multiple machineguns, and 40-mm automatic weapons. One of the first major improvements in the defense came with adoption of the 75-mm Skysweeper. The Skysweeper was fully automatic and self-contained, with a target tracking radar mounted directly on its carriage.

The Army, however, was "missile-minded" long before establishment of ARAACOM. While Government-sponsored German scientists were devoting their efforts to ballistic missiles (an outgrowth of the V-2 program), the Army also launched several independent missile development programs. As early as February 1945 the Army contracted with Bell Telephone Laboratories and Western Electric Company to initiate an air defense missile program. This was the beginning of the now familiar "family" of Nike missile systems.

In June 1947 the Antiaircraft and Guided Missile School was established at Fort Bliss, Texas, and a joint Army-Navy guided missile department formed.

With the impetus of the Korean war, Secretary of Defense George C. Marshall established a director of guided missiles in his office. Through this office decisions came in rapid succession to "weaponize" selected missiles that showed promise. The Nike Ajax was one of these. By 1951 the Nike Ajax had successfully accomplished the free world's first interception of an aircraft by a missile.

The first two of ARAACOM's subordinate commands (regions) were established 1 September 1950, and by July 1951, 38 battalions were assigned to the command, including 19 National Guard units. ARAACOM Headquarters, first located in the Pentagon, was shifted to Mitchell Air Force Base, New York, in November 1950 and finally in January 1951 moved to Colorado Springs where it set up shop first in the Antlers Hotel and later at its present site on Ent Air Force Base.

A revolutionary turn in American air defense came 28 October 1953 when troops being trained to man Army air defense sites fired the Nike Ajax missile for the first time. This event marked the beginning of the transition from guns to missiles.

The first operational missile unit in ARAACOM, the 36th AAA Missile Battalion, moved on site at Fort George G. Meade, Maryland, 17 December 1953.

On 1 September 1954, the Department of Defense combined elements of all military services into a single Continental Air Defense Command (CONAD) directly under the Joint Chiefs of Staff.

Phasing out of gun units from the Active Army air defenses began in 1954 as large numbers of the Nike Ajax missile became operational.

In 1955 missile units opened a program of annual service practice firings at the Red Canyon Range in New Mexico. Also in 1955 the total of missile units passed the number of Active Army conventional gun units.

Exclusive responsibility for employment of surface-to-air missiles used in "point" or local defense was delegated to the Army in 1956 by a directive of the Secretary of Defense.

On 11 January 1956, responsibility for supervision of training National Guard nondivisional antiaircraft artillery units from the Continental Army Command was reassigned to ARADCOM.

In March 1957, as the command prepared to inactivate the bulk of the remaining gun batteries, the designation of the Army Antiaircraft Command was changed to the present United States Army Air Defense Command, or ARADCOM.

Firing of the Nike Hercules missile by ARADCOM troops in late 1958 heralded the beginning of the atomic era in air defense. Nike Ajax units quickly began converting to the more advanced Nike Hercules, and on 30 June 1958, Battery A, 2d Missile Battalion, 57th Artillery, stationed in Chicago, became the first ARADCOM unit to become operational with the Nike Hercules. Almost simultaneously units also became operational in the New York and Washington-Baltimore defense areas.

By the end of 1958, Department of the Army had announced conversion of Army National Guard air defense units to missiles.

The era of the gun ended in 1960 when ARADCOM inactivated its last two gun battalions, the 4th Battalion of the 7th Artillery, Savannah, Georgia, on 25 January and 2d Battalion of the 68th Artillery, Sault Sainte Marie, Michigan, in June.

The Hawk, second of the ARADCOM weapons, came into the arsenal in June 1959. Hawk stood for "Homing All the Way Killer" and the missile, effective from treetop level to medium altitude, complements the high-altitude Nike Hercules. The first Hawk units deployed within the continental United States as a part of the active, on-site air defense system were emplaced in southern Florida during the Cuban crisis of October 1962. They are now part of the permanent defenses of ARADCOM.

In a little over 18 years ARADCOM has seen dramatic changes in the concepts and weaponry of air defense. The future promises to be equally challenging.

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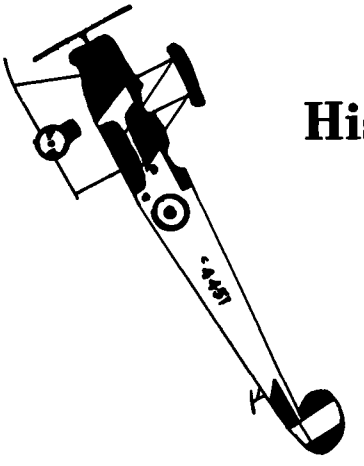
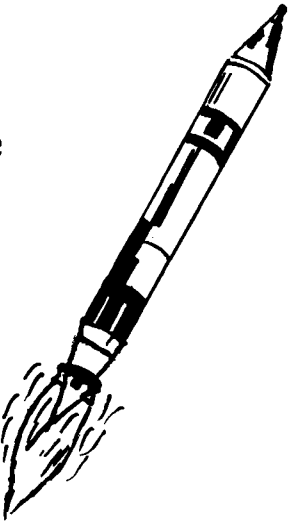
## 2D REGION HEADQUARTERS RELOCATED

Headquarters, 2d Region, ARADCOM, has been moved from Richards-Gebaur Air Force Base, Missouri, to Selfridge Air Force Base, Michigan. The purpose of the move is to place the headquarters more centrally within its area of responsibility where more effective command and technical supervision of units in the 2d Region can be accomplished.



# History of Air Defense



*Editor' Note:*

*In this article, the third installment of "History of Air Defense," we see the advancements made in aircraft design by the United States, England, Germany, and Japan between World Wars I and II.*

The 1914-1918 war had changed the possibility of air attack into a reality. The Armistice in 1918 and the Treaty of Versailles were intended to reestablish peace throughout the world. The German air force was to be disbanded permanently, but within a few years ways were found to circumvent these restrictions. Following the seizure of power by Hitler and his Nazi party in 1933, the Luftwaffe was reborn and German rearmament was initiated.

The United Kingdom ended the war, with a full understanding of the threat posed by air attack and the need for establishment of an adequate air defense system. However, with peace in the air, all three Services were quickly shorn of their wartime strength.

In the United States, waves of pacifism, disarmament, and isolationism swept the country. The American Expeditionary Forces was returned home and demobilized, and all Services reverted to peacetime status. The Army Air Service, which had been separated from the Signal Corps in May 1918, did not receive official status as a separate branch of the Army until June 1920.

All United States antiaircraft artillery units were demobilized by 1919, although the need for such units was recognized. The aversion to war, plus the concept of depending upon mobilization of the citizen-soldier in case of war, plagued the antiaircraft artillery along with the entire Army establishment. By 1934, the antiaircraft artillery components of the Coast Artillery Corps consisted of eight active (plus 20 inactive) regiments. It was not until war threatened in Europe in the late thirties that plans were made to expand the antiaircraft artillery, and the actual expansion did not begin until 1939.

The Japanese became more militaristic in the next two decades and built up military forces to assist in their aim of becoming the dominant power in the Far East. Little attention was given to air defense, in view of the limited air threat. Army air forces were

developed as a separate branch. In 1937, Japan commenced its war operations by attacking China, after having seized Manchuria and six northern Chinese provinces during the 6 preceding years.

In 1925, the British Government decided to form an air force command to be called the Air Defence of Great Britain (A.D.G.B.). The army and navy had urged that all squadrons be equipped with defensive fighters. The RAF held the view that a bomber force strong enough to take the offensive and threaten an enemy's vital centers was the essential part of an air defense organization. Fighters should be used primarily for the defense of bomber airfields. The Air Ministry approved a force of 52 squadrons for the A.D.G.B., 17 to be equipped with fighters and 35 with bombers. By 1930, only 12 bomber squadrons had been formed. In 1934, the Air Ministry issued requirements for a high-performance, long-range bomber.

When war broke out in September 1939, the RAF Bomber Command consisted of 55 squadrons. The British believed that the long-range, twin-engine bombers, equipped with power-operated gun turrets, could defend themselves against enemy fighter attacks as long as they maintained a close formation. This theory was supported by an action on 3 December 1939 when 24 Wellingtons attacked two German cruisers at anchor off Heligoland. The bombers returned without loss even though they had a running fight with a force of German Me-109's and -110's.

The Bristol Blenheim light bomber (fig 1) was the fastest of the British twin-engine bombers. Its speed enabled it to be used for low-level daylight attacks, and it held a speed advantage over contemporary fighters until 1938. The Blenheim had a maximum speed of 295 mph at 15,000 feet, a service ceiling of 27,000 feet, and a range of 1,900 miles. Armament consisted of one caliber .30 machinegun in the left wing, two caliber .30 machineguns in a retractable top turret, and one rear-firing caliber .30 machinegun under the nose.

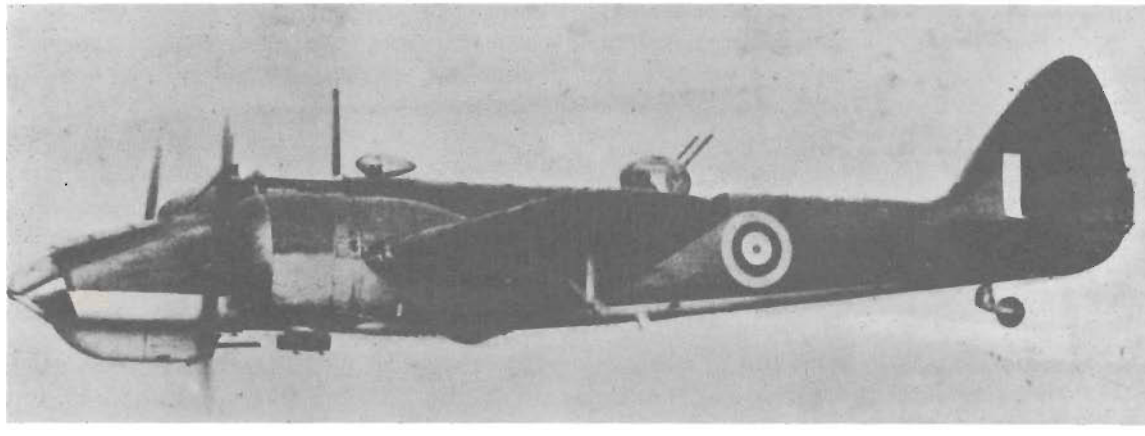


Figure 1. Bristol Blenheim.

The Armstrong-Whitworth Whitley twin-engine heavy bomber (fig 2) was one of two heavy bombers available in September 1939. It had a maximum speed of 245 mph at 16,250 feet, a service ceiling of 25,000 feet, and a normal range of 1,250 miles. Armament consisted of a two-gun power turret in the nose, a four-gun power turret in the tail, and a belly gun in a retractable "dust bin" under the fuselage. The military load of ammunition and bombs was 5,827 pounds.

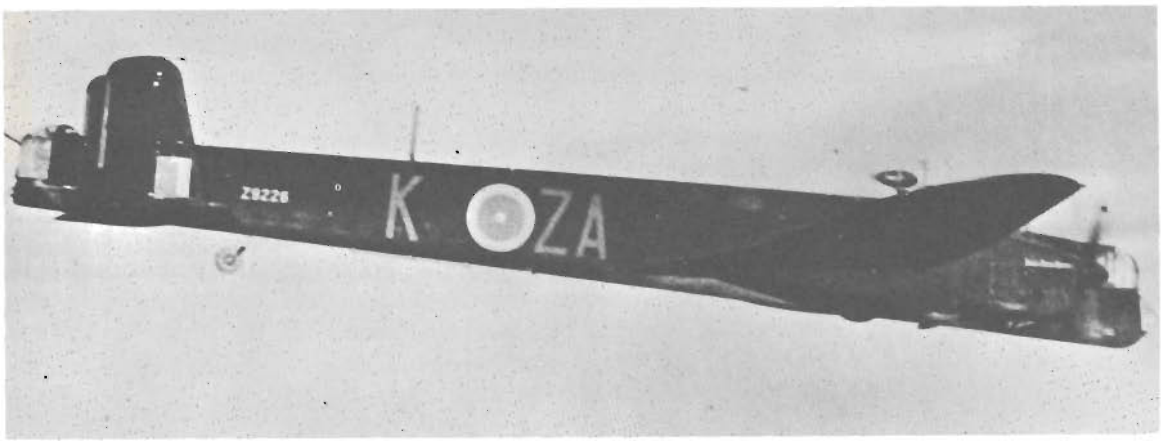



Figure 2. Armstrong-Whitworth Whitley.

The Vickers Wellington, the other twin-engine heavy bomber, bore the brunt of the night bombing effort until the advent of the four-engine heavy bombers. The Wellington 1C had a maximum speed of 250 mph at 15,500 feet, a service ceiling of 24,000 feet, and a range of 3,200 miles at 180 mph. Armament consisted of a two-gun power turret in the nose and one in the tail, and one flexible gun in the belly behind the wings.

The development of the American bomber was handicapped by national policy and lack of funds. The ocean barriers made America relatively immune to attack from the air except by a carrier-borne force. The control of the oceans, and therefore the defense of the United States, was the responsibility of the Navy. The mission of Army bombers was the support of the ground forces, and this could be accomplished by relatively short-range, high-speed aircraft. The development of a long-range bomber did not gain favor until the early thirties. The MacArthur-Pratt agreement of January 1931 assigned the mission of coastal defense to the Army Air Corps, thus justifying development of a long-range bomber. In 1933, the War Department approved a plan for a bomber with a range of 5,000 miles carrying a 2,000-pound bomb load at 200 mph. The B-17 was the first successful bomber developed under the plan.

The Martin MB-2, a two-seater biplane (fig 3) became operational in 1920. It had a maximum speed of 99 mph, a service ceiling of 8,500 feet, and a range of 588 miles. Armament consisted of five caliber .30 machineguns, and the bomb load varied from 1,800 to 3,000 pounds. The MB-2 remained in service until 1928, when it was replaced by the Keystone LB-5 and -6.

The Martin XB-907 (B-10) (fig 4) was delivered to the Army on 20 March 1932. It was an all-metal monoplane with internal bomb storage and the first United States bomber with a gun turret. A later model attained a maximum speed of 207 mph at 6,000 feet. This was faster than any American fighter in service at that time.

The primary service version was the B-10B. It had a maximum speed of 213 mph, a service ceiling of 24,200 feet, and a range of 1,240 miles. Armament consisted of three caliber .30 machineguns—one in the nose, one in the rear turret, and one in the ventral tunnel. It carried 2,260 pounds of bombs.

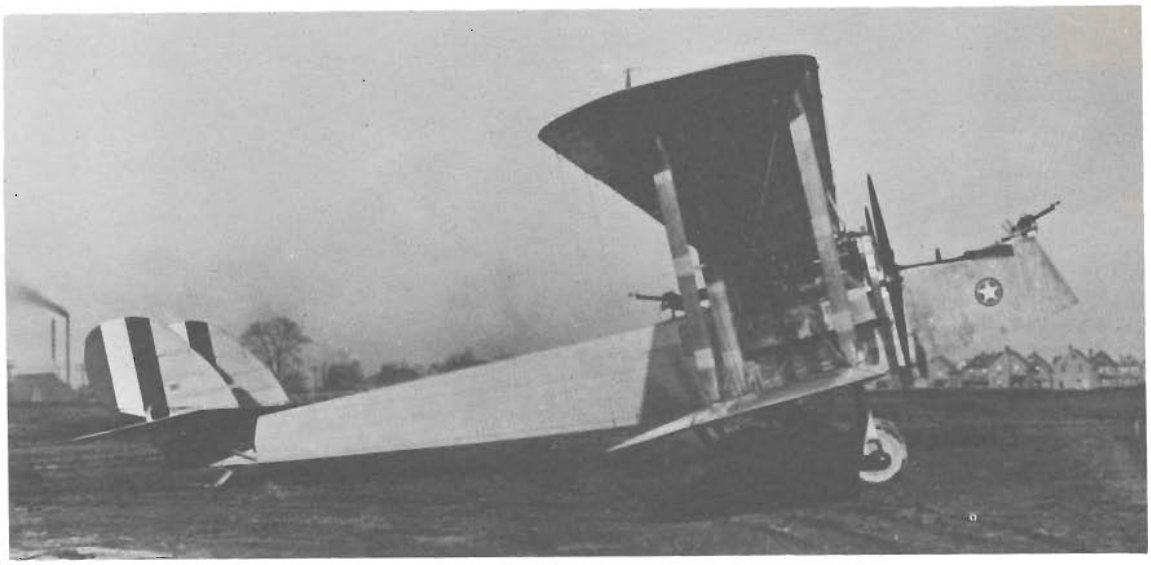


Figure 3. Martin B-2.

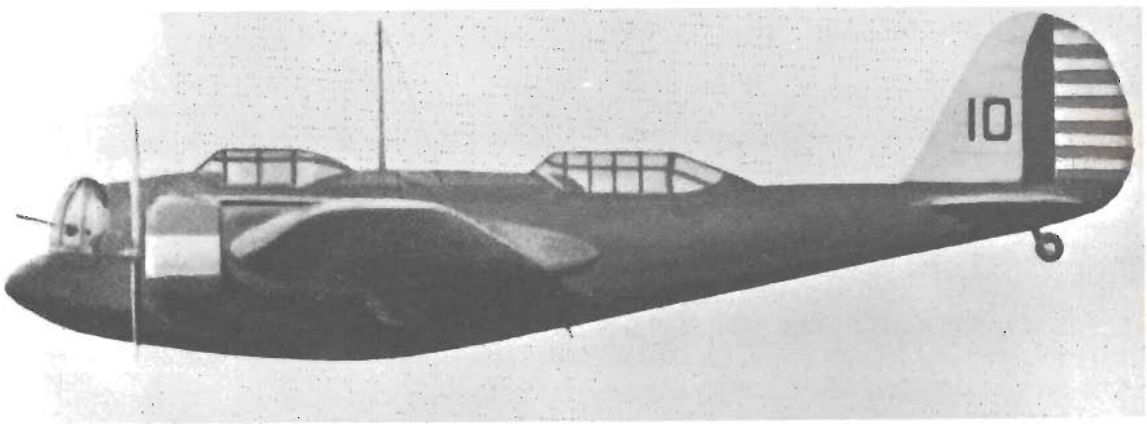



Figure 4. Martin B-10.

The Boeing XB-17 (fig 5) flew for the first time in July 1935. Armament consisted of five caliber .30 or .50 machineguns—one in the nose and one in each of four blisters in the fuselage. On 20 August 1935, the XB-17 (Flying Fortress) flew 2,100 miles nonstop with an average speed of 232 mph. An improved version, the YB-17, had a maximum speed of 256 mph at 14,000 feet, a service ceiling of 30,600, and a range of 1,377 miles carrying 10,496 pounds of bombs.

Figure 5. Early model of the Boeing B-17A.

There was a setback in 1938 when the Secretary of War directed the Air Corps to procure only light, medium, and attack bombers. The Munich crisis caused the development of the Fortress to be accelerated, but large-scale production did not start until just before the United States entered the war. There were only 23 Fortresses in service in September 1939, when the war in Europe began.

In January 1939, design was started on the B-24 Liberator. The specifications called for a speed exceeding 300 mph, a service ceiling of 35,000 feet, and a range of 3,000 miles. The XB-24 was flown for the first time on 29 December 1939.

German bomber development was based on the concept that dive bombing was superior to bombing from horizontal flight. This theory was supported by tests conducted using both types of bombing; tests of two American Curtiss Hawk dive bombers purchased by Germany in 1933 were the immediate cause of conversion to dive bombers.

Until about 1936, plans called for a long-range program which would produce a strategic air force in 8 to 10 years. Bombers were to be considered as first line and fighters as second—France was assumed to be the potential enemy. Two good four-engine bombers were test-flown in 1936, the Dornier 19 and the Junkers 89, both of which subsequently had ranges of over 1,500 miles. Both were canceled in early 1937, and only a few were built. The Focke-Wulf 200K Kurier was the military reconnaissance-bomber version of the Focke-Wulf 200B Condor transport; one of the latter flew nonstop from Berlin to New York in 1938, a precursor of things to come. The Kurier saw extensive use in the Nazi campaign against Allied shipping. It was Goering, implementing Hitler's blitz concepts, who effectively killed the German chances of having a strategic air arm by 1940. Emphasis was to be on fighters, fighter-bombers, and dive bombers.

The principal dive bomber was the Ju-87 (fig 6), known as the Stuka. The B model in 1938 had a maximum speed of 242 mph, a service ceiling of 27,900 feet, and a range of 498 miles. Normal armament was two wing-mounted 7.9-mm machineguns and a flexible 7.9-mm machinegun in the rear cockpit. One 1,100-pound bomb could be carried under the fuselage, or one 550-pound bomber under the fuselage and four 110-pound bombs under the wings.

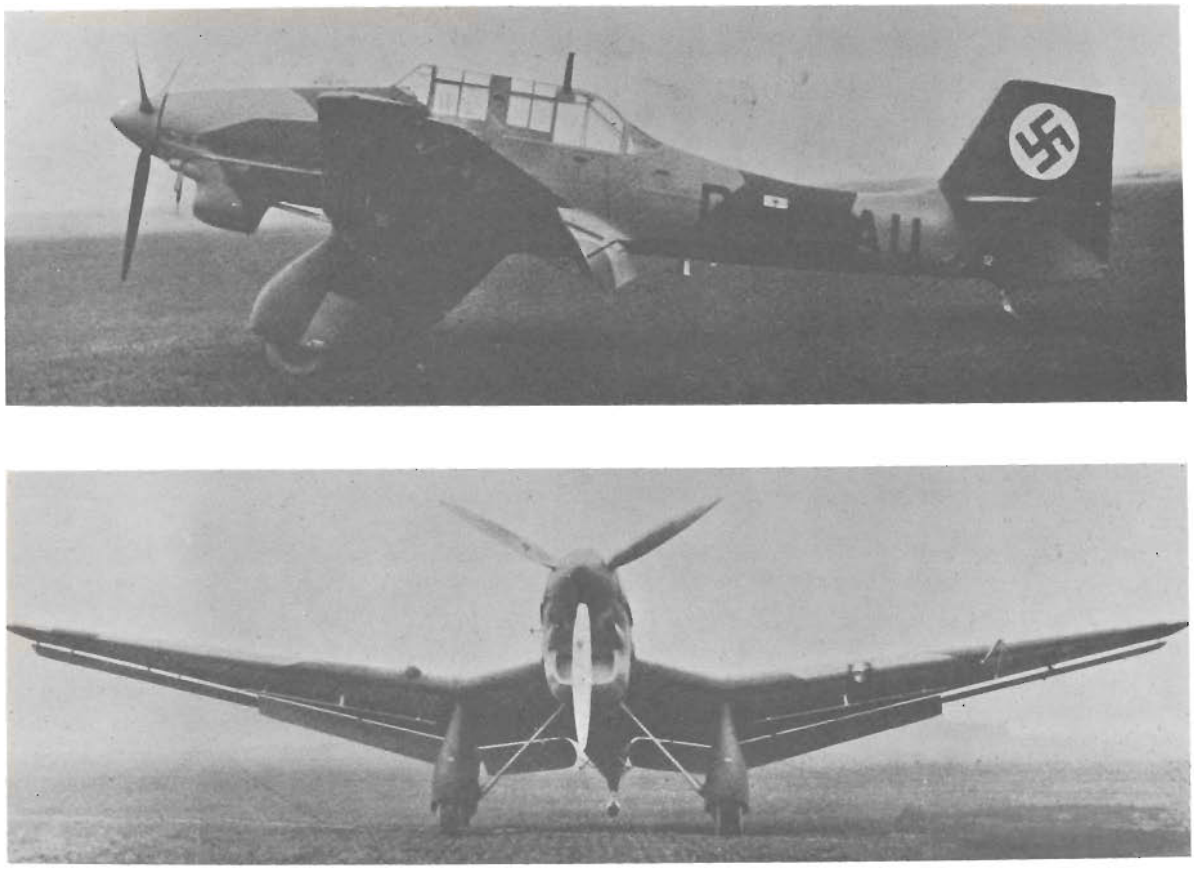


Figure 6. Junkers Ju-87 Stuka.

The principal medium bombers were the Heinkel He-111 (fig 7) series and the Dornier Do-17 series.

The Heinkel 111 was the first modern medium bomber acquired by the Luftwaffe. It was flown for the first time in 1935, and by 1937 the E model was in service, with a maximum speed of 267 mph and a service ceiling of 22,950 feet. Armament consisted of three 7.9-mm machineguns, and the plane carried 2,200 pounds of bombs.

The Dornier Do-17 initially went into production in 1936 as the Do-17E-1. The Do-17E had a speed of 220 mph, a service ceiling of 18,050 feet, and a range of 990 miles with a 1,760-pound bomb load. Normal armament consisted of two 7.9-mm machineguns.

As a result of the success of the Ju-87 as a dive bomber, the decision was made in 1938 to modify the twin-engine Ju-88 medium bomber, then under development, to include a diving capability. The Ju-88 first saw service as the Ju-88A over the Firth of Forth in September 1939. It had a maximum speed of 286 mph, a service ceiling of 22,300 feet, and a range of 1,553 miles. Normal armament was three 7.9-mm machineguns. Its bomb-carrying capacity was 3,968 pounds.

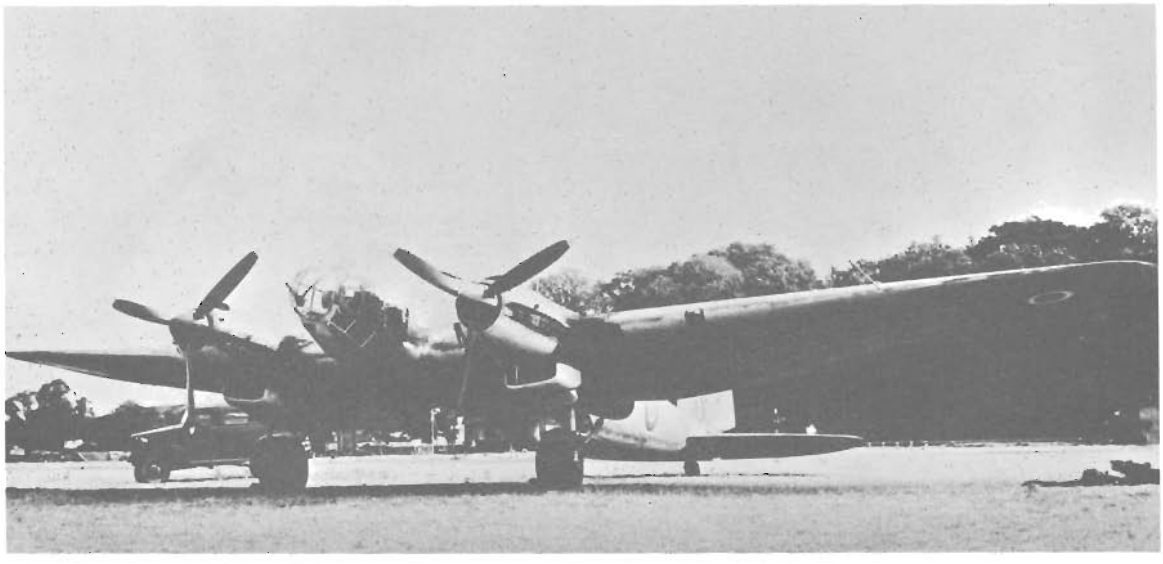


Figure 7. Heinkel He-111.

The Japanese development of bomber aircraft during the interwar years lagged behind that of the United States, United Kingdom, and Germany. Most of the bombers were patterned after planes in service with foreign air forces; copying was done principally to save time required in ordinary development. Maneuverability was given a high priority even at the expense of structural strength, and there also was an almost complete lack of armor and leak-proof fuel tanks.

The Mitsubishi 93-B twin-engine bomber was developed from the German Junkers K-46. It had a maximum speed of approximately 160 mph and a service ceiling of 22,960 feet.

The Mitsubishi Navy Type 96 twin-engine bomber was developed from the German Junkers Ju-86K. It had a maximum speed of 230 mph at 10,000 feet, a service ceiling of 24,000 feet, and a cruising range of 950 miles with 2,200 pounds of bombs. Armament consisted of seven 7.7-mm machineguns.

The Kawasaki Army Type 97 was a twin-engine bomber. It had a maximum speed of 245 mph at 15,000 feet and a service ceiling of 24,500 feet. Cruising range with 4,400 pounds of bombs was 240 miles. Armament consisted of two 25-mm cannon and four 7.7-mm machineguns.

The Mitsubishi Army Type 97 twin-engine bomber (fig 8) was developed from the American B-10. It had a maximum speed of 220 mph at 10,000 feet and a service ceiling of 22,000 feet. Cruising range was 1,180 miles with 4,400 pounds of bombs. Armament consisted of seven 7.7-mm machineguns.

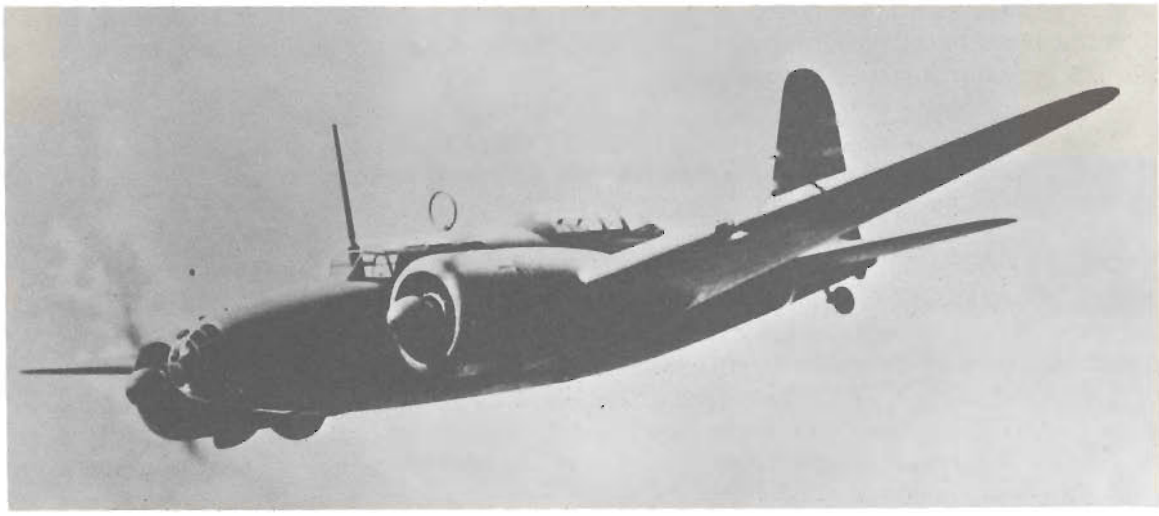


Figure 8. Mitsubishi Army Type 97 (Sally).

The Mitsubishi Army Type 97 (Mitsubishi 104) single-engine bomber had a maximum speed of 260 mph at 13,120 feet and a service ceiling of 27,000 feet. Cruising range was 500 miles with 1,100 pounds of bombs. Armament consisted of three 7.7-mm machineguns.

The Mitsubishi Army Type 98 single-engine light bomber had a maximum speed of 250 mph at 11,000 feet and a service ceiling of 25,000 feet. Cruising range was 280 miles with 1,230 pounds of bombs. Armament consisted of four 7.7-mm machineguns.

The Mitsubishi Army Type 98-1 (fig 9), a different single-engine light bomber, was developed from the American Northrop A-17. It had a maximum speed of 260 mph. Armament consisted of three 7.7-mm machineguns, and the plane carried a maximum bomb load of 1,000 pounds.

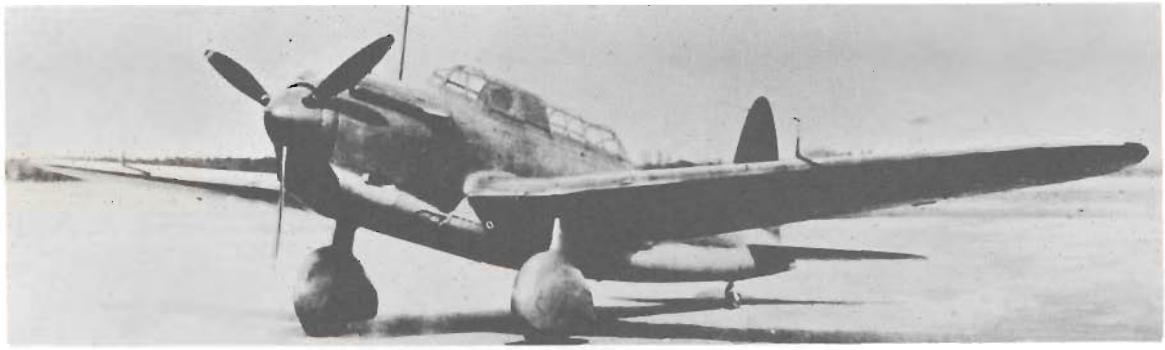


Figure 9. Mitsubishi Army Type 98-1 (Mary).

The Mitsubishi Army Type 98 twin-engine bomber was developed from the Mitsubishi 93. It had a maximum speed of 220 mph at 15,000 feet and a service ceiling of 23,000 feet.

Cruising range with 2,200 pounds of bombs was 1,180 miles. Armament consisted of one 20-mm cannon in the nose turret, two 7.7-mm machineguns in the wings, and two 7.7-mm machineguns in the rear gun position.

The Kawasaki Army 99 twin-engine medium bomber had a maximum speed of 285 mph at 14,000 feet. Operational radius was 500-600 miles. Armament consisted of four 7.7-mm machineguns. The plane's bomb capacity was 1,500 pounds.

Planning for an attack on Pearl Harbor was started during the late 1930's. Intensive training was started in November 1941, covering all aspects of the planned attack. Bomb and torpedo runs were made against targets of the size expected at Pearl Harbor. The approaches were of the same length and altitude as dictated by the land formation in the vicinity of the harbor. All pilots were drilled until they could execute a successful attack under the exact conditions that were anticipated. As a result of this comprehensive training, the air force that attacked Pearl Harbor had the best trained pilots for the execution of a specific mission of any air force in the world.

***Editor's Note:***

***The installment to follow will describe the air defense artillery and related equipment that was available or being developed between the wars.***

# Employment Guidelines for Self-Propelled Hawk

*Major Harold D. Carpenter*
*Command and Staff Department*
*US Army Air Defense School*

*In this article, Major Carpenter describes the self-propelled Hawk and its functions. The weapon will give the field army commander increased mobility and firepower and will enhance air defense survivability on the battlefield. Renée Rockette emphasizes some major features of the system.*

*—Editor*

The objective of air defense forces in the field army is "to limit the effectiveness of enemy offensive air efforts to a level permitting freedom of action to friendly forces of all types." Maneuver element commanders must be free of excessive harassment from enemy airpower if they are to accomplish their missions. US military forces have enjoyed air superiority during all hostilities since 1943; because of this, perhaps all concerned tend to take this "freedom of action" for granted. "Move, shoot, and communicate" has long been a catch-phrase for field artillerymen, and this old cliche still tersely brings home the inherent requirements for accomplishment of the field artillery mission. On the field army battlefield of today and tomorrow, it is every bit as important for air defense forces to possess the capabilities of rapid displacement and maneuver, coupled with effective communications and a high degree of operational readiness.

Originally, our air defense missile units were employed in static positions around highly populated defense areas where mobility was not a prime factor. However, this concept of static defense is totally unacceptable for a field army environment. Mobility is mandatory. Nobody argues against the basic truth that both the Hawk and Nike Hercules systems are extremely effective; however, towed Hawk, even though it is effective against the low-altitude threat, simply does not have the desired capabilities of mobility and survivability to support divisions on line in the field army area. Even though towed Hawk can be employed within 20-30 kilometers from the forward edge of the battle area (FEBA) (placing it closer makes it highly vulnerable to the enemy's air reconnaissance, heavy artillery, and offensive air effort), terrain masking can and frequently will render it largely ineffective against the very low-altitude threat. Also, towed Hawk, though fully mobile, still does not have the capability of keeping up with a fast-moving offensive operation such as an armored penetration and exploitation. Because of this gap in low-altitude coverage, it was decided to modify the towed Hawk system to make it more mobile (fig 1) and to give it more firepower, low-altitude coverage, and a greater degree of survivability. As a result, the first self-propelled Hawk battalion has already been deployed in Germany, and other units are now being outfitted for deployment.

The stated mission of self-propelled (SP) Hawk is "to provide all-weather air defense of the division area against low- and medium-altitude aircraft." A comparison of organization and capabilities between towed and SP Hawk might show how this mission accomplishment is enhanced by SP Hawk. Towed Hawk battalions are organized in the conventional air defense four-firing-battery organization (fig 2), while self-propelled Hawk battalions have only three firing batteries (fig 3). At first glance it would appear that this decrease of one firing battery represents a decrease in capability; an examination of firing battery organization and equipment shows why this is not true. The towed Hawk battery (fig 4) has a firing platoon

containing two firing sections; each section has three towed launchers, for a battery total of six. It follows that the towed Hawk battalion's total firepower capability is represented by 24 launchers within the four batteries. The SP Hawk battery (fig 5) has three firing platoons, one towed and two self-propelled. Each platoon has three launchers (see photo, top of page 40) for a battery total of nine. Thus, the SP Hawk battalion, with its three batteries, has 27 launchers, or three more than does the towed battalion. Looking at it another way, a towed Hawk battalion has eight fire units and an SP battalion has nine.

Figure 1. Self-propelled Hawk platoon in march order.

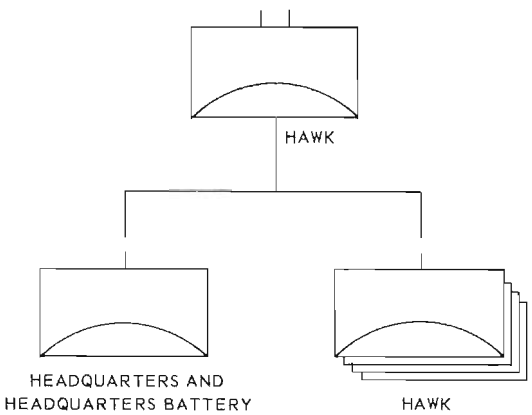



Figure 2. Hawk battalion (towed) organization.

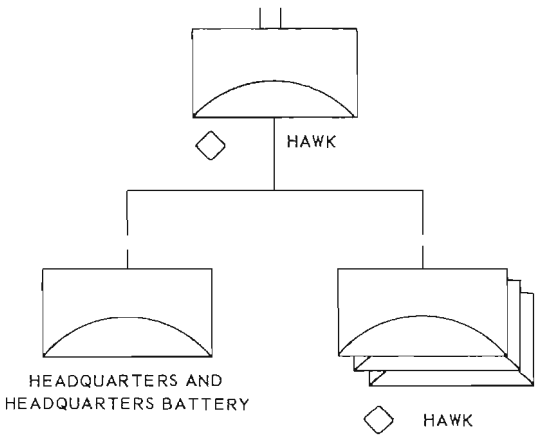



Figure 3. Self-propelled Hawk battalion organization.

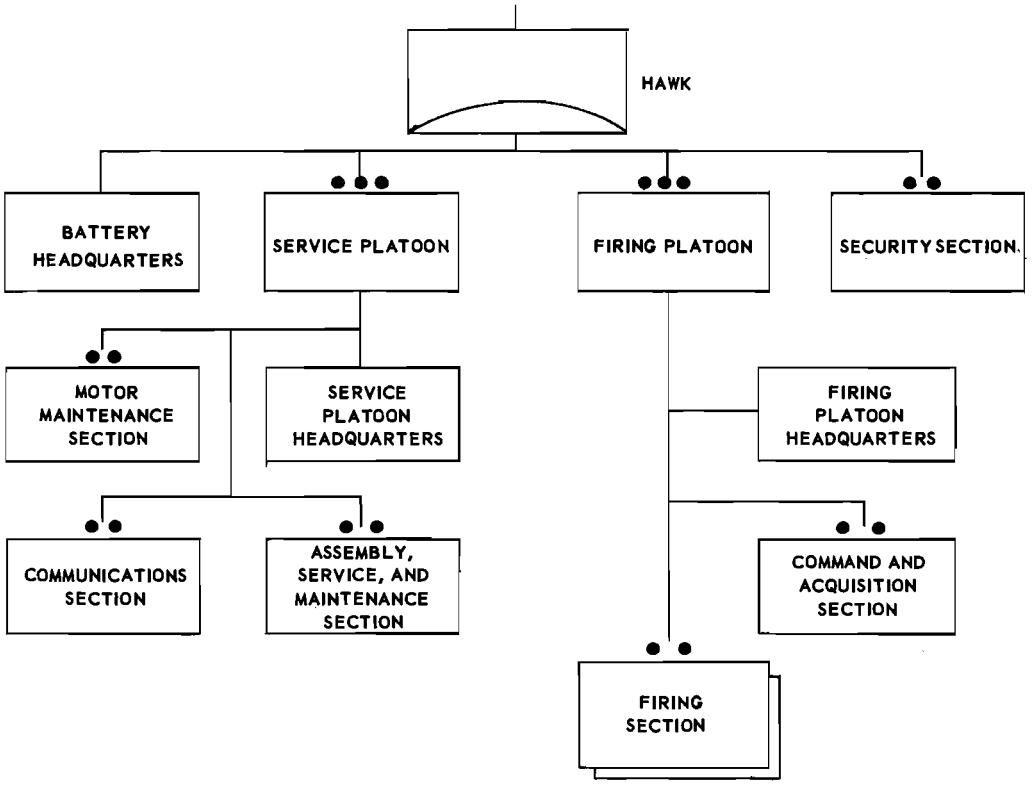



Figure 4. Towed Hawk battery organization.

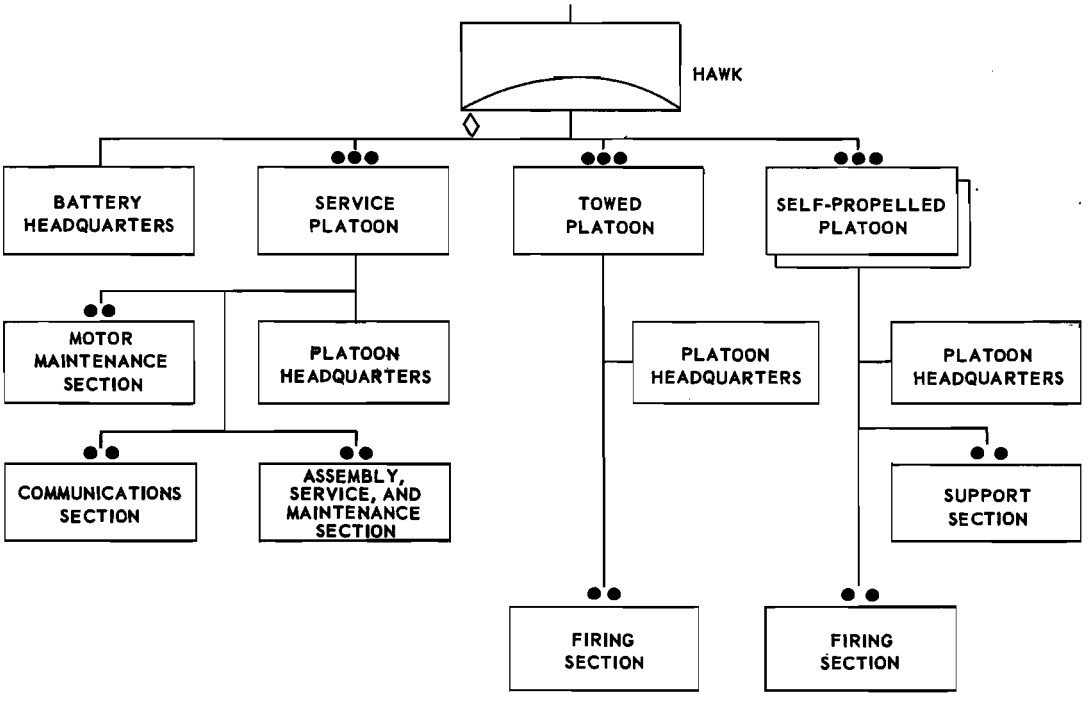
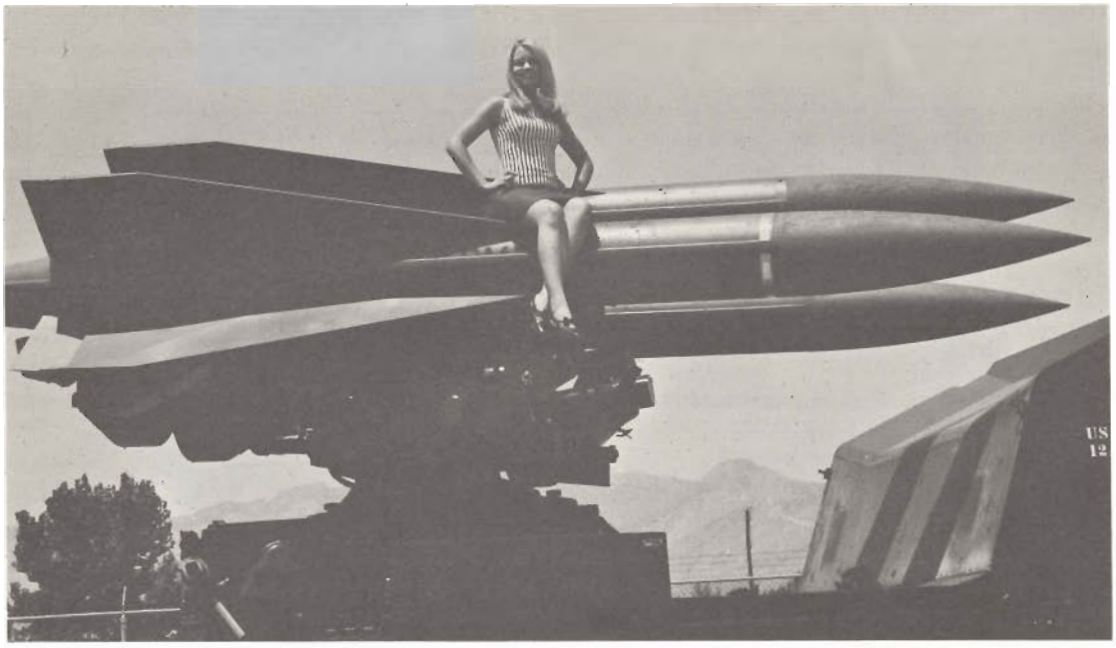


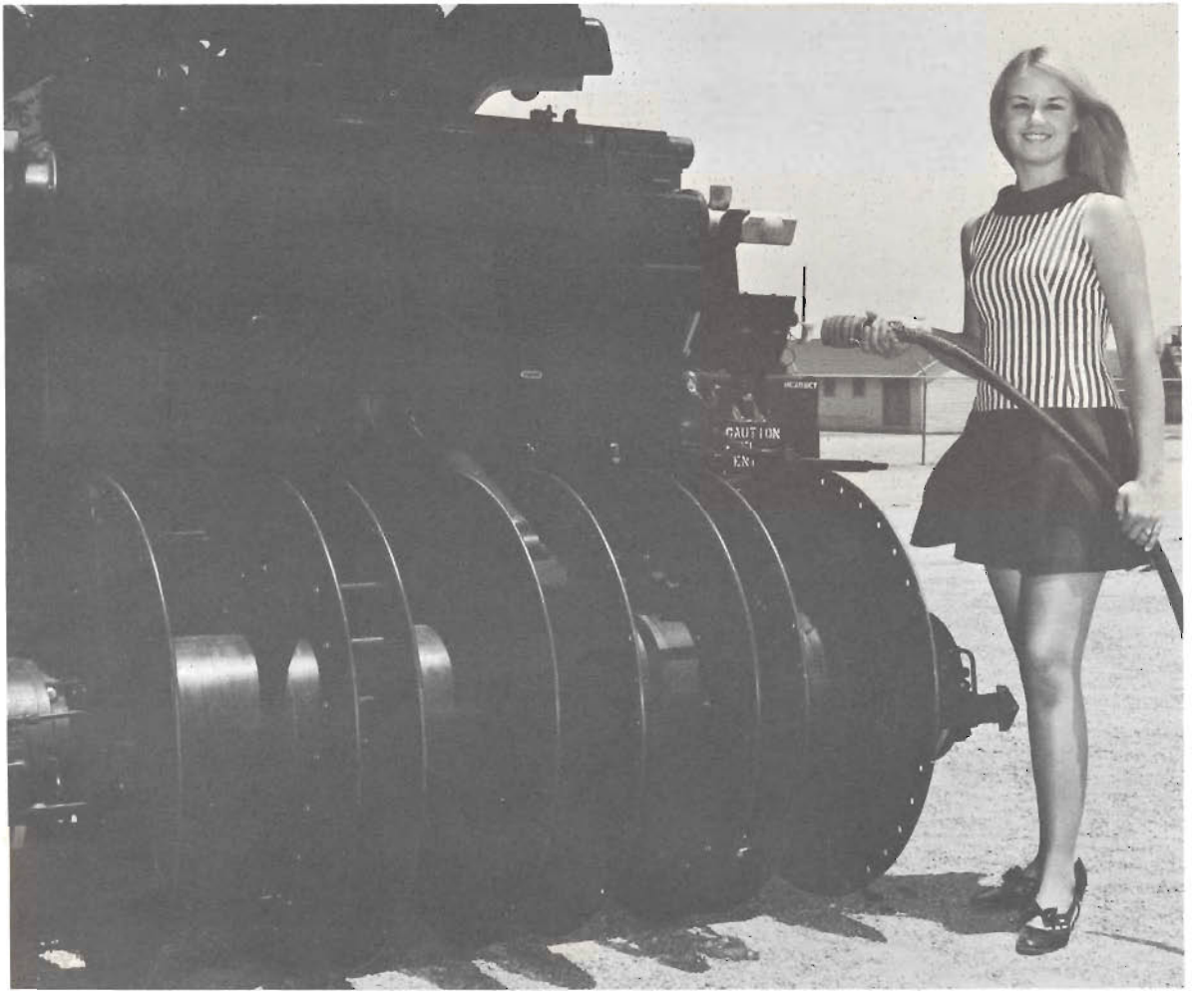

Figure 5. Self-propelled Hawk battery organization.



*"This is the launcher assembly. It is almost identical to those you are used to seeing."*

*"How's this for an improvement? This is one of the innovations of SP Hawk. It is called the interconnecting box. Here the crew chief can control the local operation of his equipment."*

The towed platoon of an SP battery is the same as a battery (minus) of towed Hawk; i.e., it contains a battery control central (BCC), pulse acquisition radar (PAR), continuous-wave acquisition radar (CWAR), high-powered illuminator radar (HIPIR), range-only radar (ROR), three towed launchers, generators, and associated equipment. Each SP platoon includes a trailer-mounted BCC which serves as the platoon command post (PCP), CWAR, HIPIR, and three SP launchers with missiles, and such related equipment as the interconnecting box (see photo, bottom of page 40). The SP launcher is a modification of the M548 cargo carrier. Each launcher has its own onboard generator, and Hawk crewmen will be happy to learn that each launcher has a powered cable reel, rather than using GI power (see photo below). Figure 6 shows the SP Hawk firing battery major items of tactical equipment.




*"Here are the cable reels. They will enable you to speed up laying and retrieving cables, and you won't fall behind on your march order and IP schedules."*

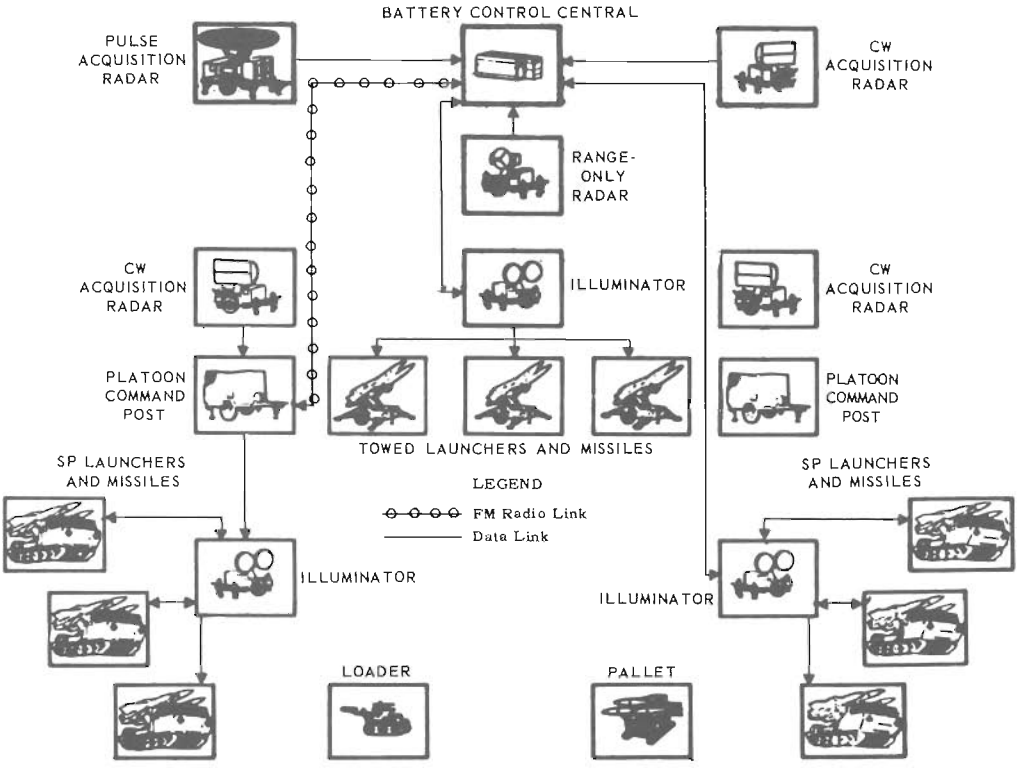


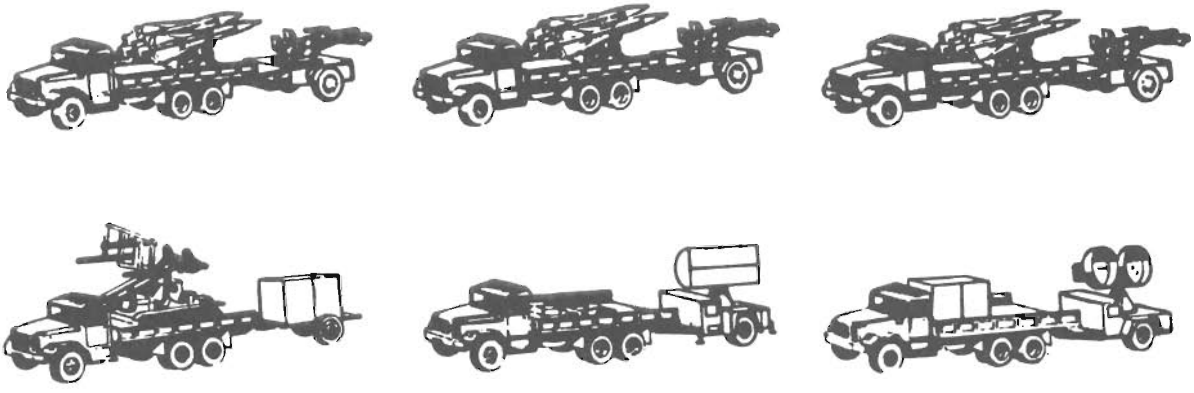

Figure 6. Self-propelled Hawk firing battery major items of tactical equipment.

*"The organic IFF antenna you see here will help solve the identification problem. Remember, it can be operated as shown here or from a remote position."*

When a towed Hawk battery displaces by echelon, or breaks down into two separate fire units, the augmented assault fire unit (AAFU) requires six towed loads of equipment. An SP Hawk firing platoon with the same amount of firepower requires only three towed loads (fig 7).

Another facet not yet discussed is identification. With the present towed Hawk battery, the identification, friend or foe (IFF), is transmitted through the antenna of the PAR; consequently, when an AAFU is in operation, there is no identification capability except that transmitted by voice over the unit's organic radios. With SP Hawk, each platoon will have its own IFF; the towed platoon will use the PAR/BCC IFF as it presently exists, while each SP platoon has its own IFF antenna, which may be mounted on the PCP or remoted several meters away (see photo above).

(1) Self-propelled Hawk platoon firing section.



(2) Towed Hawk augmented assault fire unit.

Figure 7. Comparison of SP Hawk firing sections and towed Hawk augmented assault fire unit.

The normal status for an SP Hawk battalion will probably be assignment or attachment to the ADA group at corps level within the field army. Ideally, SP Hawk battalions should be allocated one per division on line. It may prove feasible, especially during offensive operations, to further attach SP battalions to divisions. This brings to light an interesting command and control relationship because the Chaparral/Vulcan battalion commander is the division air defense officer and will remain so even though Hawk is also attached to the division.

The same deployment guidelines as presently used with towed Hawk are still applicable for the SP battalion. Any time Hawk is deployed with Nike Hercules, it should be positioned to complement Nike Hercules with low-altitude coverage; therefore, the primary deployment guideline is early destruction along low-altitude routes of approach. Because of Hawk's relatively short range, defense in depth is important with Hawk units being deployed approximately one behind the other to insure engagement until target destruction. Also, because of Hawk's small dead zone and because fire units will periodically be nonoperational for maintenance, mutual support is desired within the defense with fire units providing mutual protection and coverage of adjacent units' dead zones. Mutual support can be achieved if fire units are positioned no farther apart than 0.8 of Hawk's maximum effective range. With towed Hawk this is sometimes impossible or impractical because of the size of the defended area. The fact that SP Hawk has three fire units per battery will make mutual support much easier to achieve, with each battery capable of fighting the air battle from three separate locations simultaneously.

The SP Hawk is even more flexible in deployment options than towed Hawk. With three fire units per battery in the division area, the two SP platoons could be sent forward, up to

10 to 15 kilometers behind the FEBA, while the towed platoon, with its lesser degree of mobility and survivability, could remain in place 20-30 kilometers from the FEBA.

With Chaparral/Vulcan and Redeye present in the forward area, it may sometimes not be necessary to have both SP platoons well forward. Another scheme of deployment would be to leave one SP platoon to the rear with the towed platoon, cabled directly into the towed platoon's BCC.

Whether moving to support the defended unit's maneuver plan or to enhance its own survivability, SP Hawk is certainly capable of much faster displacement, with less vulnerability to detection, than is towed Hawk. This makes it much easier to apply one of the age-old principles of war, the principle of surprise simply by "being where you weren't a short time ago." This rapid displacement is even more important because Chaparral, Vulcan, and Redeye are all visually direct weapons and are seriously degraded in periods of poor visibility or adverse weather conditions. It is during these periods when the SP platoons simply must be as close to the FEBA as required for mission accomplishment.

Self-propelled Hawk is now a reality, another step forward for the air defense artillery to increase support of the maneuver elements in the field army. Hawk is a member of the air defense family in good standing and now has more mobility and increased firepower; it is capable of 50 percent more low-altitude coverage per battery.

# Why Division ADA?

*Joseph B. Fries*
*US Army Combat Developments Command Air Defense Agency*
*(Illustrated by Bill Hainline)*

## The Question

Our combat divisions already have Redeye. Why load them down with that big and expensive Chaparral/Vulcan air defense artillery (ADA) battalion? Why not just form a few battalions and lend them to the divisions when needed?

That's a good question—and it's asked often enough. The question reflects the fact that no American army has been under serious air attack since the WW II North Africa battles. The question also reflects the natural desire for economy.

## The Answer

The answer to the question is that every current-day US division has an ever-present need for organic air defense artillery—more than just Redeye. The arguments in favor of this answer outweigh the arguments against it because they recognize the needs for air defense artillery: readiness, adequacy, and combined arms membership. Further, they reflect the changing times.

### READINESS

More than any other combat arm, air defense artillery must be ready and available for instant action (fig 1).

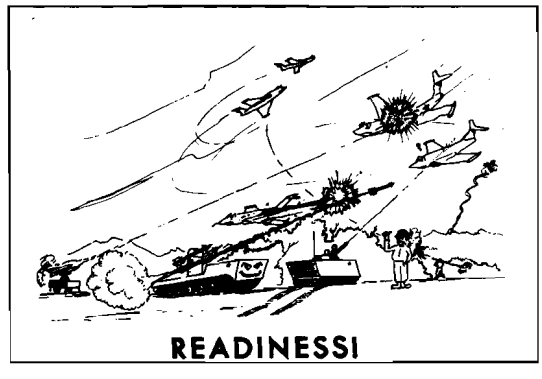



Figure 1. Readiness.

Without a ready air defense, our forces could suffer a battlefield disaster that could be inflicted by the North Korean Air Force, as just one example. Any sensible enemy commander will try to destroy our undefended forces with surprise air attacks. Consider the lessons of Pearl Harbor (1941) and the Israeli demolishment of the Arab airfields (1967).

Enemy aircraft are fast and getting faster. The when and where of their attacks are completely unpredictable and will be made at a time and place suitable to the enemy. The best defense against such attacks is the existence of a combat-ready and fully deployed air defense during all phases of ground combat.

The survival of US combat divisions during the first days of intense enemy air activities—and afterward—depends on a ready and available ADA capability. The rapid transition of a division from peace to war—or the transition from no air threat to high air threat—dictates that ADA be an organic element of each division. Otherwise, the divisions may have little left to transition with!

You can't meet the readiness requirement by buying just a little air defense and trying to parcel it out "when and as needed"—that's a case of too little—too late.

## ADEQUACY

To be impressed by the adequacy (fig 2) argument, you must accept these statements:

- The enemy air arm is strong and capable of use anywhere.
- The enemy air arm poses a severe low-altitude threat.
- The US divisions must be protected from the air threat.
- The best way to defend the divisions against the air threat operating at very low altitudes is through deployment of large numbers of simple short-range ADA weapons in the forward area.

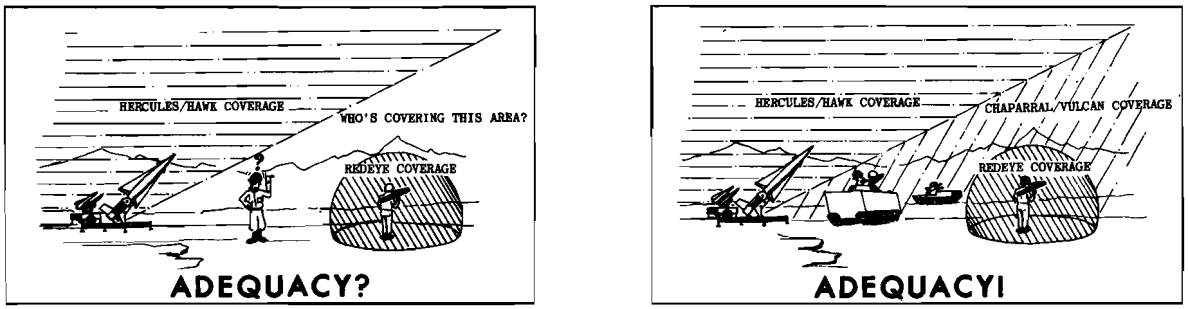



Figure 2. Adequacy.

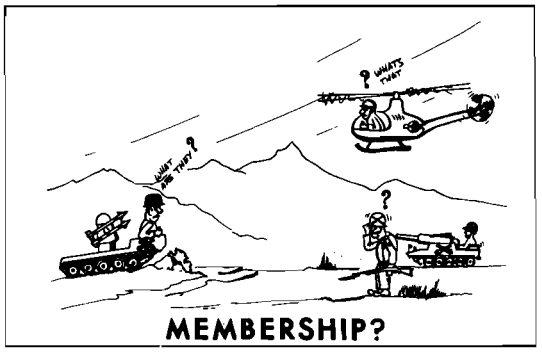
A division commander is given the resources to accomplish his mission. It follows that he should also be given the means to adequately protect those resources. In fact, each commander has the responsibility to do whatever is necessary to protect his forces from air attack (the inalienable right of self-defense).

Redeye alone can't do the job for the combat divisions. Redeye is deployed up front for close-in defense of the infantry, armor, and field artillery battalions. Even if more Redeye weapons were put into the division, other factors would keep Redeye from defending against

many enemy aircraft flying below the coverage of the rearward-deployed Nike Hercules and Hawk. Further, to operate most effectively, the Redeye teams must receive timely alerting information from forward-deployed ADA. So, if you don't provide Chaparral/Vulcan ADA to the divisions, you not only fail to provide an adequate defense, but you also degrade Redeye while at the same time requiring more Redeye.

## COMBINED ARMS MEMBERSHIP

The ground force commander in future warfare will be concerned with his air flank as well as his ground flanks. This demands that ADA be considered—and really be—a vital member of the combined arms team (infantry, armor, field artillery, air defense artillery) (fig 3). To be a first-class member of any team requires the day-to-day association, operational rapport, and intimacy with procedures that can only be obtained from a permanent relationship. This is an old lesson learned by others besides ADA.



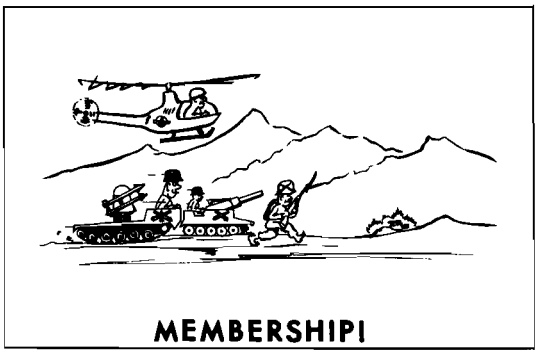




Figure 3. Combined arms membership.

The need for a close relationship between ADA and the other combat arms is magnified by the very real enemy air threat; the requirement for continuous, ready, and effective air defense; the large numbers of aircraft in the division area; the complications of air traffic control; the need for detection, identification, and engagement of hostile aircraft; and ADA employment in the ground fire support role. Logistic support considerations are also a factor.

Division airspace has a lot of demanding users. The problems associated with division airspace coordination further strengthen the requirement for permanent association of the major division airspace users. The Chaparral/Vulcan airspace control element (ACE) personnel, if they are to be a responsive element of the division airspace control team, need that intimate knowledge of division organization and methods of operation attainable only through habitual association.

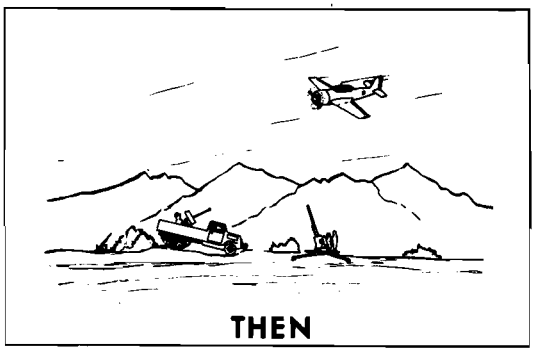
## CHANGING TIMES

Is all this just more motherhood-and-flag discussion? Maybe so, if you believe nothing much has changed in the last 30 years. But things have changed (fig 4).

•There has been a continuing evolutionary improvement in Air Force tactical aircraft performance, avionics, and nuclear and nonnuclear ordnance. These improvements pertain to both friend and foe.

•There has been a revolutionary change in the quality and quantity of Army aviation. New employment concepts have been born and proven. The enemy is also active in this area.

•The introduction of first generation surface-to-air missiles in the 1950's produced a revolutionary change in the effectiveness of medium and heavy ADA. Chaparral and Redeye-type weapons—and Vulcan, too—result in a similar revolution in light ADA effectiveness. It would be suicidal not to use this effectiveness.



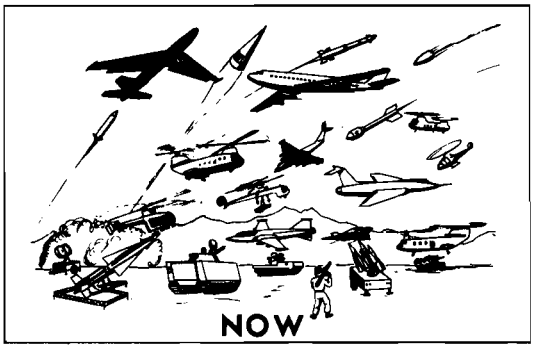




Figure 4. Changing times.

A quick look at the organization, equipment, and the hard-hitting, fast-moving, and "three-dimensional battlefield" doctrine of our divisions of the 1970's shows that things have changed greatly since Normandy and Chorwon. The same goes for our potential enemies.

These changes clearly lead to a need for ADA that is ready, adequate, and a combat arm in the fullest sense. At the division level, this means an organic ADA battalion—Chaparral/Vulcan, at present.

## SUMMARY

This article may best be summarized by quoting a position statement jointly issued by the Air Defense Center Team on 28 March 1969 (see page 24, Air Defense Trends, June 1969): "The severe low-altitude air threat to the US field armies is best countered by relatively large numbers of simple short-range air defense artillery weapons employed in the division areas. Training and operational considerations dictate that the bulk of this air defense artillery, currently the Chaparral/Vulcan units, be organic to the divisions." The Center Team statement is consistent with a recent policy statement by the Army Chief of Staff recognizing the need for an effective division air defense capability.

# To Win Popular Support

# New Direction Is Needed

*Captain Gerald R. Sullivan*
*High Altitude Missile Department*
*US Army Air Defense School*

We have been promised by our most dedicated enemies that we can expect future insurgencies. In 1949 China warned of future revolutions in Asia. The topic was renewed in 1960 when Soviets from 81 Communist and Worker's Parties promised to increase the tempo of "wars of liberation." They elaborated by declaring that a definite anti-American theme could prevail in these struggles.

Although numerous factors contribute to the defeat of an insurgency, the key factor lies in depriving the guerrilla of popular support. Unless our internal defense and development (IDAD) forces accomplish this task, they can expect little hope for ultimate defeat of their adversary. The role of the American soldier as an oversea ambassador is not new. However, he needs to be trained and motivated to be a better ambassador. In this manner our IDAD efforts to win popular support can become more effective.

Our definition of popular support is any support that the insurgent gains from the local community in the way of food, clothing, shelter, intelligence, funds, or cover. For our purposes, insurgency and guerrilla warfare are treated synonomously. Both rely extensively upon popular support for success.

Next, we must consider where our troops are deployed. They can be in a passive environment where the situation involves peacetime oversea duty. In contrast they may be actively involved in counterguerrilla operations. For our purposes it does not matter. The principles we will develop are applicable regardless of the situation.

Our goal is simple. First we want to prevent a situation that allows an insurgency with anti-American precepts to develop. Failing this, our strategy is to defeat the insurgency in the earliest phase possible. Guerrilla warfare progresses through three basic stages. Those set forth by Mao Tse Tung have universal application to insurgencies. Briefly stated they are:

Phase I - Organization, consolidation, and preservation.
Phase II - Guerrilla warfare or progressive expansion.
Phase III - Destruction of the enemy.

As one of his century's foremost authorities on guerrilla warfare, Mao Tse Tung elaborated extensively on the need of popular support for success. He compared the guerrilla to a fish. Just as the fish depends on water for life, the guerrilla depends on people for survival. Mao was so adamant regarding the importance of popular support that he developed his famous three rules and eight remarks. He used these successfully during the anti-Japanese war and later to overthrow the government of Chiang Kai Chek. Here we see the real importance Mao attached to the relationships his soldiers must have with the local populace.

Rules.

1. All actions are subject to command.
2. Do not steal from the people.
3. Be neither selfish nor unjust.

Remarks.

1. Replace the door when you leave the house.
2. Roll up the bedding on which you have slept.
3. Be courteous.
4. Be honest in your transactions.
5. Return what you borrow.
6. Replace what you break.
7. Do not bathe in the presence of women.
8. Do not without proper authority search the pocketbooks of those you arrest.

Mao's rules and remarks teach us a great lesson. We must know and respect the local populace because our every action has a profound influence on their attitudes toward us.

Let us establish one vital fact at this point. The Communist nations realize the significance of popular support in their "wars of liberation." Furthermore, they will employ any measure to secure this support. To be effective in countering this threat, we must surpass their efforts. One cannot simply know his enemy. One must use this knowledge to defeat him. Every possible measure must be employed to insure that the insurgent does not enjoy the benefit of popular support.

Modern armies have contended with the problem of winning popular support in various ways. Malaya and the Philippines offer two of the more successful studies in IDAD actions. In Malaya the British adopted the tactic of the strategic hamlet program, called the Brigg's Plan. Hamlets were relocated in areas which isolated the guerrilla from access to the populace. In this manner they were also able to protect the populace from the terror tactics of the insurgents. By measures such as police checkpoints, identification systems, and curfews, their isolation program was more effective. Because the government had deprived the insurgent of popular support, the insurgent effort was starved out of existence after a 9-year period.

Raymon Magsaysay was quick to perceive methods for defeating the guerrilla. During his campaign against the Huks in the Philippines, he instituted a two-part program that dealt directly with the problem of popular support. By establishing a civil agency to explain the new army to the populace he gained support through a program of mutual understanding. Rewards were offered for Huks dead or alive. The second part of the program was unique in that it dealt directly with the nucleus of the whole insurgency. The Huk movement focused on the vital need for sweeping land reforms in the Philippines. Magsaysay offered approximately 25 acres and a home to any insurgent who surrendered. He fulfilled his promises. The Huks were deprived of a cause, the government won the loyal support of the populace, and the insurgency was defeated.

Internal defense and development forces face a herculean task in the business of winning popular support. They must gain the confidence and respect of the local populace. These same people must be protected from terroristic or retaliatory tactics of the guerrilla. Potentially unpopular measures often have to be initiated to separate the guerrilla from the populace. Included are strategic hamlet programs, police checkpoints, curfews, identification systems, and martial law (fig 1). In addition, the people must be educated through a well-organized propaganda program.

The important question for each of us is: Exactly what is our personal relationship in the whole concept of winning popular support? The individual soldier has one of the most important functions in IDAD. The role of oversea ambassador has universal application to soldiers stationed in a foreign area. True, the soldier does not formulate foreign policy; however, he does represent our government and, therefore, has an affect on the success or failure of our foreign relations because of his contacts with the people.

When we deal with people, certain factors must be emphasized. We must be able to communicate with them. We must understand their motivations and aspirations. Above all, we must fully understand their cultural system, realize how it differs from our own, and apply this knowledge in attaining our goal.

*Figure 1. Vietnamese security officer and US Army counterparts at a night meeting with local officials. These visits are conducted to discuss curfew, checkpoint, and pass procedures to insure that everyone understands the purpose of the restrictions and that they are effective.*

The US soldier is subject to the scrutiny of the people. Evaluations made of his actions and words are remembered. Decisions of the people are based on the opinions they have formed regarding Americans. With thousands of servicemen stationed in foreign lands, how well they represent America is a matter of major concern for the military.

Recognizing the importance of our relationships in foreign countries, the military has taken steps to foster good relations. Special Forces, since its inception, has prescribed extensive language and foreign area training as requirements. The Foreign Area Specialist Training (FAST) program is requiring better preparation of personnel assigned to foreign countries. Civic action (fig 2) and charitable programs provide another means of involving our interests with those of the local populace. Literature concerning numerous countries is available to servicemen free of charge. Informal language training is available through service libraries and formally through service schools. In-country orientations are given US personnel upon their arrival in every country. The Army must insure that every individual assigned to an oversea area is prepared to meet the inherent obligations regarding his relationships with the people of that area. Too often, in spite of the best of intentions, we foster resentment in a host country. In Vietnam a soldier can exhibit poor taste by giving

preferential treatment to a youngster before showing the proper respect toward the elders. Similarly, the well-meaning American gesture of placing a friendly hand on the head of a Vietnamese is taboo in their culture.

*Figure 2. US Army advisor in Vietnam, Vietnamese counterpart, peoples self-defense force, and local personnel prepare to engage in a group civic action project to build a community building. The completed building now provides a place for local government officials to administer to the needs of the populace and as the administrative headquarters for the self-defense group.*

We need to remember the experiences we have while assigned overseas and those qualities we most admired in foreign visitors to our country. We will then have a keener perception of why we need to fully prepare our soldiers for oversea assignments. Those additional measures which would improve our image among foreign neighbors include downgrading the importance of charity, encouraging linguistic development, developing an effective oversea orientation program, actively involving service personnel in civic action programs (fig 3), and assigning area specialists at unit level.

Popular support is not won through charity. Giving an individual money or other tangible items tends to degrade his self-respect and foster resentment toward the giver. This is a flaw in our efforts to win popular support. What we should do is cause the individual to feel that he has done something to earn what we give him, thus preserving his sense of dignity. This does not preclude worthy charitable programs. But we are inclined to feel that when we give to charity, we have performed a successful civic action program. Nothing could be farther from the truth.

*Figure 3. US Army nurses caring for children at an orphanage near Saigon.*

Language training offers some positive measures we can employ to improve our position in gaining popular support. We Americans tend to expect natives of every foreign country to communicate with us in English. We rarely attempt to address them in their native language with so much as a "good morning" or "I'm pleased to meet you." Before we can expect popular support, a local populace must respect us. One way to gain people's respect is to show an interest in their language. Host countries have multitudes of bilingual and even trilingual individuals. They have been able to do what some of us regard as impossible. Why? Simply because the language ability was necessary for them to sustain their livelihood or to survive. This is the attitude we must adopt. Language training is something that every soldier must regard as a necessity if we are to accomplish our mission.

We cannot send everyone to language school; however, we could send more personnel for shorter orientation courses. The following are listed as possible methods for emphasizing and offering inducement to develop needed linguistic skills:

1. Require every officer to study foreign languages and indicate results in his efficiency reports.

2. Authorize additional pay to multilingual enlisted personnel. This could be based on the number of languages and the degree of proficiency attained.

3. Require a period each week or month of mandatory language orientation at unit level. In oversea areas this offers an opportunity to involve members of the local populace who desire to learn the English language.

Everyone cannot become fluent in foreign languages. However, this emphasis on learning would cause a greater percentage of our personnel to learn the language of the country in which they are stationed. Most importantly, the populace of that country would recognize our personal interest in their country, language, culture, and customs.

Following is a good illustration of the value of being completely familiar with the culture of a country and able to communicate with the populace. Colonel John F. Freund and Captain Vernon Gillespie, both Special Forces officers assigned in Vietnam, faced disaster in 1965. Montagnard tribesmen were revolting against the Army of South Vietnam. The situation was about to erupt in a bloodbath that would be a catastrophic setback to our efforts in South Vietnam. Colonel Freund turned the tide when he mounted a ladder and addressed the rebels in fluent French. Earlier, Captain Gillespie had regained the confidence of his Montagnard tribesmen by demonstrating an understanding of the culture of these people. In spite of a pending attack early the next morning, he participated in a 3-hour religious ceremony that served to reunite the tribesmen with other South Vietnamese. These two men were able to destroy the long efforts of hard-core Viet Cong to turn the Montagnards against the South Vietnamese simply because they understood the culture of the local populace and could communicate with them through a common language.

Our civic action projects should do more to actively involve the interest and talents of the individual soldier. Our soldiers have skills in farming, machine repair, carpentry, masonry, and electronics that can be of great value in our civic action projects. Imagine the beneficial impact if these men taught our foreign neighbors new skills and trades or spent a day working with them on their farms. Our soldiers would be sharing their talents with local citizens and helping them to do something for themselves. By working together men share a common experience which forms a strong bond of friendship. Other projects might include new wells, churches, schools, and roads.

Measures that will insure that our men are better prepared to represent us in foreign countries:

1. Require issuance of literature concerning a country to all personnel upon receipt of oversea orders, and then check that the individual has learned about the country.

2. Require these same personnel to attend a detailed orientation at the port facility prior to departing CONUS.

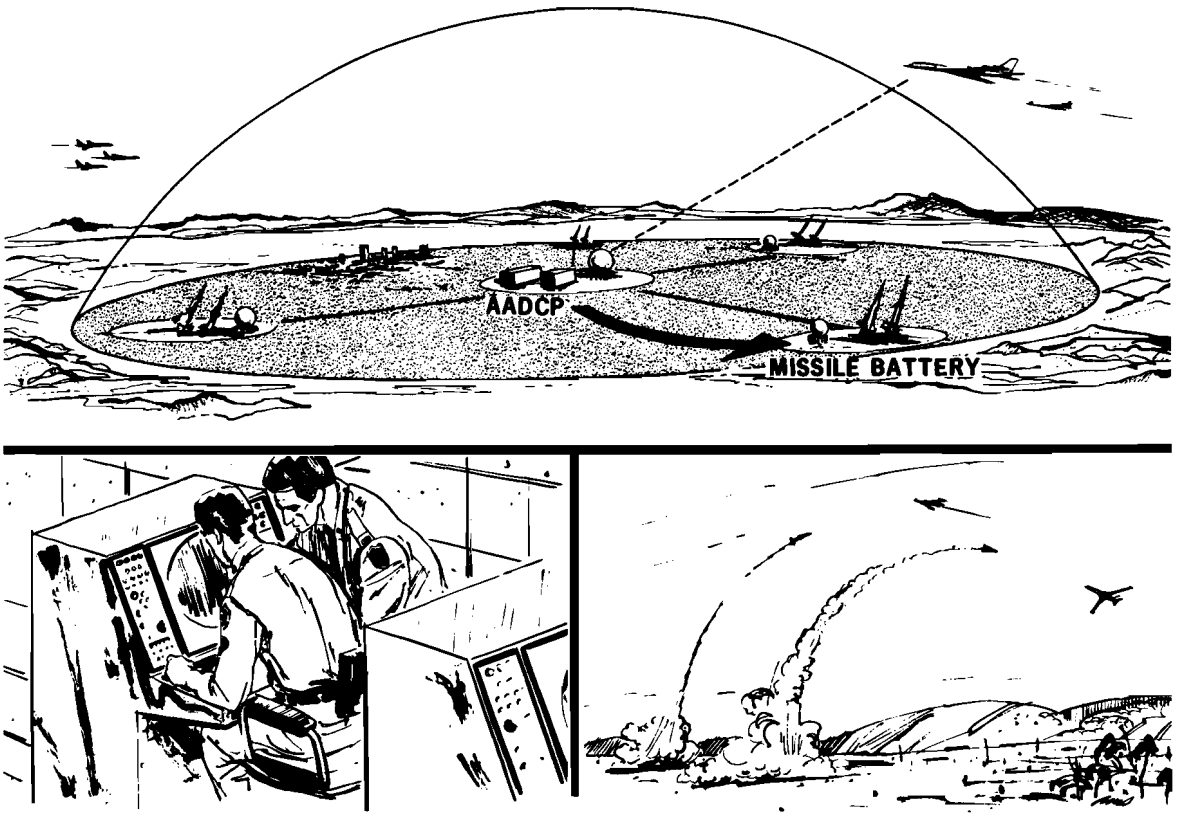
There must be a nucleus at unit level in our efforts to win popular support. This nucleus should contain the basic ingredients of knowledge in language, culture, and civic action. Here, a golden opportunity for the foreign area specialist exists. Every unit should have one enlisted man assigned in a TOE position who is a specialist in that geographical area and

conversant in the language. He is the individual whom the unit commander can have available for advice, interpretation, or civic action direction. As an enlisted man, he can have a direct influence on the behavior and training of other enlisted personnel.

In summary, popular support cannot be neglected if we are to be successful in our IDAD efforts against promised wars of liberation. Our success lies in surpassing Communist efforts. One positive measure we can adopt is to involve the individual soldier more closely with popular support by using broader programs of language training, foreign area orientation, civic action considerations, and unit area specialists.

# Ring of Defense

A REPORT ON MISSILE MENTOR—THE ARMY'S AN/TSQ-51
FIRE DISTRIBUTION SYSTEM




*Missile Mentor AN/TSQ-51.*

The Missile Mentor AN/TSQ-51 is a versatile data processing and display system designed to replace existing fire distribution systems in the continental United States (CONUS) with a more capable, flexible, economical, and easily supported system.

Missile Mentor was designed and built for the Army by Hughes Aircraft Company, Fullerton, California, under contract with the US Army Missile Command, Redstone Arsenal, Alabama. The system is operational at a number of sites throughout the United States.

The US Army Air Defense Command (ARADCOM), the Army component of the multination, multiservice North American Air Defense Command (NORAD), helps provide around-the-clock protection from air attack for our population centers. While radar can spot targets far at sea, and defensive missiles, such as Nike Hercules and Hawk, are accurate and deadly, there's more to air defense than simply locating a single target and then shooting

it down. Today's air defense must be capable of detecting, identifying, sorting out hostile aircraft, and keeping track of and engaging hundreds of potential threats approaching at supersonic speeds from many directions and altitudes.

Missile Mentor (fig 1) represents a giant step forward in improved air defense for our population centers. A decade of major advances in technology, such as the development of transitors, thin-film devices, and integrated electronics, has permitted design and production of the most advanced data processing and display system ever built for air defense application. For example, Missile Mentor's modern solid-state design allows it to fit conveniently in just two standard military trailer-vans.

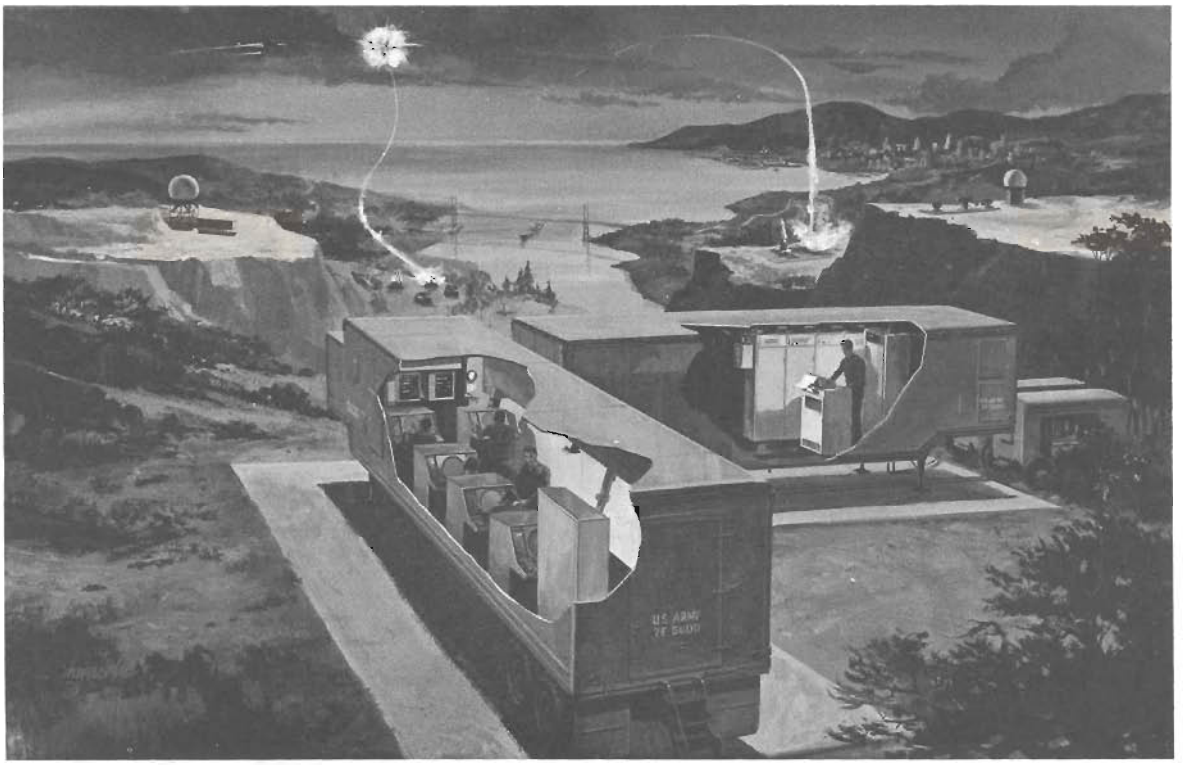


Figure 1. The Army's Missile Mentor (artist's concept).

The system consists of two principal elements: the Army air defense command post (AADCP) and the remote radar integration station (RRIS). The AADCP provides complete air situation displays; performs automatic tracking, status monitoring and target/battery assignment; and exchanges digital and voice data (fig 2) with its surface-to-air missile (SAM) batteries, RRIS's, adjacent AADCP's, and other systems such as SAGE/BUIC (semiautomatic ground environment/backup interceptor control facility). The RRIS performs rate-aided tracking at remote sites.

Weapons status is received at the AADCP from all fire units via existing communications links. The AADCP monitors the activities of all fire units and, when necessary, provides corrective action. When the AADCP is collocated at a battery site, radar input is provided

to the AADCP by the local battery acquisition radar. This input is processed to develop target tracks on which threat evaluation is performed. The threat level is determined by the computer based on criteria established by the defense commander. Command and track status data are then transmitted to the fire units from the AADCP. The RRIS is required in some CONUS defense areas to extend the radar coverage of the AADCP; the RRIS and AADCP exchange processed track data.

Figure 2. AADCP exchanges data with firing units.

The CONUS system configuration is based on present siting requirements which call for an AADCP for selected defense areas and several RRIS's where required. Both the AADCP's and RRIS's are built from the same modular building blocks.

A full complement AADCP in the CONUS system configuration has one general-purpose computer, eight consoles, and five equipment cabinets installed in two vans. The consoles, display processor equipment cabinet, and status boards are installed in the operations van; the computer, radar integration and video processor cabinet, data link cabinets, and power cabinet are in the equipment van. Consoles, cabinets, and computer need no special air conditioning.

The RRIS equipment consists of a computer, one general-purpose console, and two equipment cabinets.

The system utilizes 50-60 hertz, 120/208-volt, 3-phase, 4-wire power. A 45-kilowatt generator provides all necessary power for the RRIS, a 68-kilowatt generator supplies power for the operations van, and a 35-kilowatt generator supplies power for the equipment van. Emplacement is accomplished by locating the vans on a level spot and interconnecting the system elements with the cables provided. The operations van and equipment van of the AADCP may be located anywhere within 200 feet of each other. Without modifications, the local surveillance radar may be located up to 200 feet from the RRIS or equipment van of the AADCP. ARADCOM has recently remoted the operations van consoles and associated items into existing site facilities.

The AN/TSQ-51 AADCP equipment consists of three basic elements: the Hughes CP-784/U general-purpose computer, general-purpose display consoles, and electronic equipment cabinets.

The militarized computer has been developed specifically to solve the real-time processing problems encountered in air defense systems. Its features include a very fast modular memory with independent, simultaneous access to as many as four memory units; an instruction repertoire particularly designed for air defense application; real-time and elapsed-time clocks; a fast, versatile input/output scheme; and unique interrupt features. The design enables simultaneous computation and input/output.

The general-purpose display console gives air defense commanders more information than they have had before upon which to base air battle decisions. Information on the display console capabilities is classified.

The equipment cabinets are designed for ease of maintenance and maximum use of circuit board packaging. Circuits not adaptable to this technique are mounted in pluggable modules. Doors on the back as well as on the front of all cabinets provide easy access.

The AN/TSQ-51 represents one of the most striking products of DOD cost effectiveness analysis methods. Not only has the system capability been increased by an order of magnitude, but the initial cost is only one-sixth the cost of the AN/FSG-1 system. In addition, the annual operating and maintenance costs have been markedly reduced.

These dramatic improvements have resulted from a decade of major advances in component technology coupled with improved manufacturing techniques, a functional design that capitalizes on the state-of-the art, and advances in system organization.

The overlapping development of several new technologies during the 1950's introduced components such as transistors, core memory devices, integrated electronics, subsystems such as solid-state general-purpose computers, alphanumeric displays, and digital data terminals. New manufacturing techniques allow these components to be available in quantity at low cost. Such techniques include automatic machine wiring and mass production of circuit boards. In addition to providing the foundation for increased functional capbility and improved system design, these new components permit packaging of the AN/TSQ-51 in a fraction of the space formerly required.

Increased functional capability has paralleled component improvement. Functional improvements include a unique new method of automatic tracking; the use of alphanumeric displays and computer-driven status boards; incorporation of a general-purpose, programable computer and general-purpose display consoles; and expanded data exchange capability.

Better system organization is the result of a truly modular design (fig 3) which permits the ready adaptation to requirements of any defense by selection of appropriate equipment modules and computer programs. It also provides a potential for growth that, until now, was an unfulfilled goal of the military electronics system designer.

Figure 3. Various modules are manned by Army personnel as they run through a defense exercise at AADCP.

# Air Defense Automatic Weapons in Vietnam

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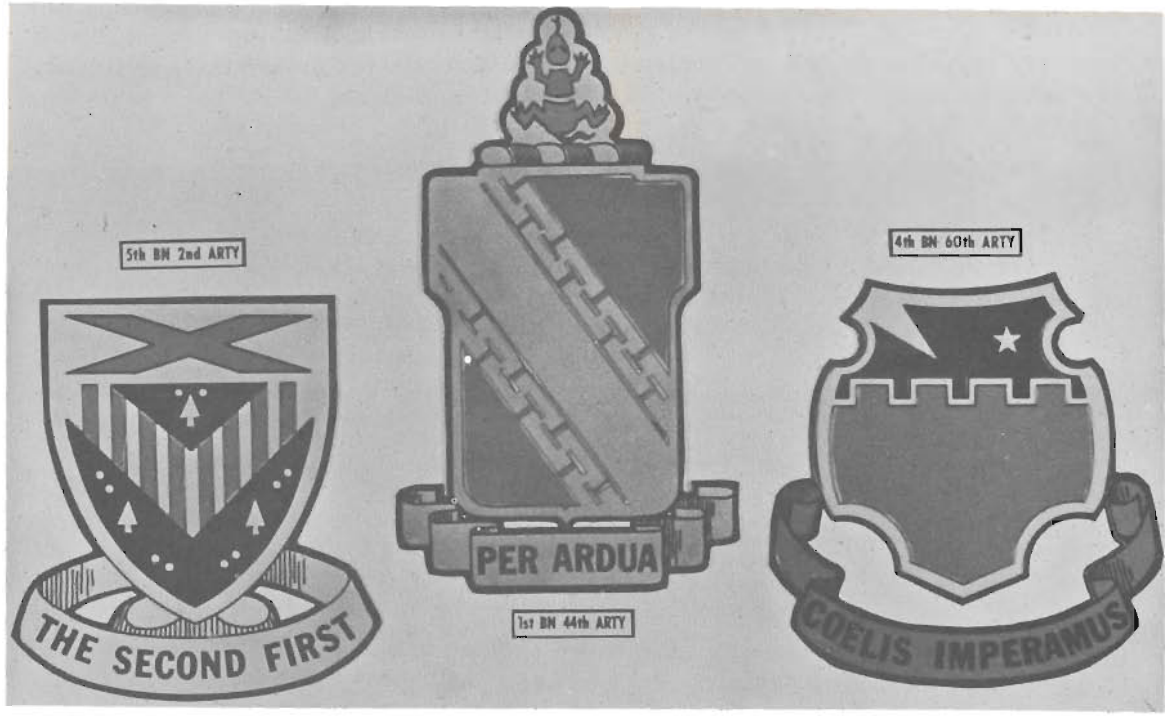



"Super—Devastating—Number One—Fantastic" are just a few of the laudatory comments uttered daily about the combat air defensemen and their automatic weapons (AW) battalions serving in Vietnam today. As long as rapid-firing gun systems are a part of the Army's arsenal, this prevailing attitude will continue. Unlike a missile unit, self-propelled (AW) units possess an unequaled effectiveness in the ground support role while performing a variety of offensive, defensive, and support missions. The lack of an air threat in Vietnam has virtually eliminated air defense as the primary mission of the AW units deployed there. As a result, the intended secondary mission—ground defense—has become the primary mission and is being executed vigorously every day.

## ORGANIZATION

Three automatic weapons battalions are located in Vietnam. Each AW battalion is organized identically, with a battlion headquarters, four Duster (M42) batteries, an attached machinegun (M55) battery, and an attached searchlight battery. The personnel strength for the battalion, with attachments, is approximately 1,000 men—one of the largest battalions you will find in Vietnam. The battalion headquarters is organized similarly to any air defense battalion headquarters. Being a separate battalion, it has its own surgeon and chaplain. The Duster batteries are organized with a battery headquarters and two firing platoons. The machinegun battery has a battery headquarters and six machinegun sections,

and the searchlight battery consists of a battery headquarters and three searchlight platoons. The vast and diverse amount of weapons mix enables the battalion to support large areas with many divergent missions.

## METHODS OF OPERATION

One battalion is attached to and in general support of the 24th Corps. Duster batteries support the 3d Marine Division; 1st Brigade, 5th Mechanized Infantry Division; 101st Airborne Division; and 24th Corps Artillery. The machinegun and searchlight batteries have some squads attached to the Duster batteries and support the 101st Division and Americal Division. The majority of the battalion's assets go to supporting maneuver operations and for convoy security along highways and supply routes. A separate machinegun battery is attached to the Americal Division and functions similarly.

Another battalion is attached to I Field Forces Vietnam (IFFV) Artillery. Assets of this battalion are placed in a general support reinforcing role to the three artillery groups of IFFV Artillery. These assets, based upon requests from major supported commanders, and in coordination with the AW battalion commander, are further placed in a direct support role to artillery units, maneuver units, and critical installations. This battalion has the largest dispersion of the three battalions, operating over 25,000 square miles with a provisional platoon attached to the 1st Cavalry Division Airmobile (AM). Generally, the battalion supports artillery batteries, maneuver units, and critical installations of the 4th Infantry Division, 173d Airborne Brigade, and Task Force South. Some AW elements and searchlights also support Republic of Korea forces and Military Assistance Command Vietnam teams throughout the corps zone. Every effort is made to get "double duty" from the AW assets by employing them on highway strongpoints during the day where possible and having them return to their fire base at night to resume their perimeter defense mission. Helicopters are used extensively to airlift Quad 50's into newly established remote fire bases for initial protection.

A third battalion is attached to II Field Forces Vietnam (IIFFV) Artillery. This battalion supports the 1st Infantry Division, 25th Infantry Division, 9th Infantry Division, and other elements of IIFFV Artillery. Some elements are under the operational control of the Royal Thai Volunteer Forces and 199th Light Infantry Brigade. Generally, the battalion's biggest effort is supporting maneuver forces and convoy protection. This battalion has, in addition, devoted considerable effort to improving the accuracy of indirect fire procedures with the Dusters and Quad 50's. It has the second largest dispersion in Vietnam and has supported elements of the 9th Infantry Division during that unit's operations in the Delta.

## THE VULCAN COMBAT TEAM IN VIETNAM

The 1st Vulcan Combat Team (Prov) was deployed to Vietnam for combat evaluation in November 1968 and was scheduled to leave in March 1969. However, due to the tactical situation at the time, the Vulcans were retained in RVN for an additional 45 days. The evaluation was oriented primarily toward a ground support role, and then to the air defense role, should air targets of opportunity appear. The Vulcan is a 20-mm Gatling type of automatic weapon mounted on a modified M113A1 armored personnel carrier (fig 1). It is one of the two principal fire units of the composite Chaparral/Vulcan battalions now being trained and

deployed worldwide. The team consisted of five Vulcans, one officer, and 21 enlisted men. The Vulcans were employed in pairs, with the fifth Vulcan being used as a float. The team was assigned to one particular battalion for the entire period and was further attached to AW batteries in support of ground elements. The Vulcans were tactically employed during the 5-month period on missions similar to those assigned to the Duster and Quad 50 units. These missions included convoy security, reconnaissance in force, security for mine sweep operations and engineer quarry operations, security for medical civic action programs, show-of-force runs, perimeter defense, and ambush patrols, using both direct and indirect fire techniques. The evaluation was highly successful. Supported commanders constantly commented on the Vulcan's mobility, maneuverability, lethality, and firepower. During their short stay, the team traveled over 13,000 miles and fired more than 170,000 rounds.

Figure 1. Vulcan leaving base camp at 2d Battalion, 47th Infantry, for patrol.

## LESSONS LEARNED

Hundreds of lessons have been learned by AW elements in RVN. A partial listing follows, indicating some of those which carry great importance to personnel who have served there. They learned these lessons well, and a high price was paid for many.

B40 ROCKET STANDOFF

Observation: During attacks against friendly fire support bases (SB) defended by AW elements, the initial assault has been prefaced by attempts to neutralize the AW's with B40 rockets.

Evaluation: It has been found that chain link fence causes the B40 rocket warhead to detonate upon striking the fence prior to reaching the vehicle, thereby minimizing or negating damage to the vehicle or critical injury to personnel. The chain link fence can be easily carried on each Duster (fig 2), Quad 50 (fig 3), or searchlight and immediately erected upon moving into position. Additionally, some protection is provided the crew while a parapet is being constructed. All three battalions used this field expedient.

COUNTERFIRE BY AUTOMATIC WEAPONS

Observation: AW performing perimeter defense should have the capability of immediate counterfire in the event of mortar/rocket attacks.

Evaluation: Friendly units in RVN habitually employ night ambush patrols around landing zones and fire support bases. To capitalize on the quick reaction and rapid rate of fire of AW, prior clearance must be established daily by the supported commander. The AW commander must keep precomputed data and free fire zones current to immediately take observed or suspected mortar/rocket positions under fire. The use of accurate, up-to-date range cards is a must!

ALTERNATE POSITIONS FOR AW

Observation: The VC/NVA have increased their firing at AW elements during the initial stages of ground or standoff attacks in an attempt to neutralize their great firepower.

Evaluation: To prevent the enemy from pinpointing AW units, several alternate positions per weapon are needed. The weapons should be shifted after dark at irregular intervals.

PERIMETER DEFENSE TEST

Observation: Tests were conducted to determine the best means of employing Dusters and Quad 50's against a ground assault from a perimeter defense position. Targets were placed at varying ranges and firing conducted at piled rocks and metal scrap, cans of fougasse, the ground immediately in front of the targets, and into the center of the target area.

Evaluation: Results showed that firing at the ground in front of the targets produced the best results and was the most effective way of stopping an attack.

VULCAN MUZZLE CLAMP

Observation: The ground support muzzle clamp created too congested a shot pattern in the target area.

Figure 2. Duster moving in.

Figure 3. Quad 50 in perimeter defense.

Evaluation: The high rate of fire and tight shot pattern actually oversaturates the target area. The air defense muzzle clamp provides more dispersion and better effect in the target area.

EFFECTIVE USE OF SEARCHLIGHTS

Observation: The AN/MSS-3 (23-inch) and the newer AN/TVS-3 (30-inch) searchlights have found a very important place in RVN.

Evaluation: The searchlights have proven very successful in the following areas. Harrassing and interdiction: Using both the visible and infrared modes, they have preempted many night assaults by illuminating unsuspecting "sappers." Counterfire: The enemy habitually places himself near friendly elements or villages. It has been found that illumination by the searchlights will normally cause the enemy to cease fire immediately. Pacification: Illumination of outpost, village, and hamlet defensive areas where field artillery illumination rounds cannot be used keeps from alienating friendly Vietnamese.

USE OF LONG-RANGE AMMUNITION

Observation: VC/NVA units set up mortar, recoilless rifle, and rocket positions just outside the maximum range of the regular 40-mm, self-destruct ammunition.

Evaluation: During the seige of Ben Het in June 1969 the enemy used this tactic. The Duster crews began loading one gun with regular and one gun with long-range ammunition. Upon observing the mortar, recoilless rifle, or rocket flashes, the crew would begin its direct fire adjustment with the regular ammunition then switch to the long-range ammunition and deliver fire on the enemy. Doing this gave the enemy a false sense of security during the adjusting period and resulted in numerous secondary explosions at enemy positions.

CULVERT PERSONNEL SHELTERS

Observation: AW units in fast-moving situations don't have sufficient time or personnel to build adequate personnel bunkers each night.

Evaluation: Dusters, Quad 50's, and searchlights carried five 6-foot sections of culvert and sandbags as part of their basic load. Upon arrival at any new location, the crew emplaced the culvert on the ground near its position, filled enough sandbags for a two-deep layer, and added blast walls, thus providing an instant bunker with overhead protection. As time permitted, additional layers of sandbags were added toward an optimum four-layer level.

DECREASING MINING INCIDENTS

Observation: The increased number of mining incidents encountered by AW elements indicates a necessity for more frequent and thorough minesweeping operations.

Evaluation: Not all incidents are occurring on established roads; several have occurred while supporting infantry sweeps and in open terrain. Some occurred where terrain features

required the AW's to return from a mission using the same route used earlier in the day. The recommendations are shown below:

Prior to traveling on hard surface roads, the AW commander must insure that, as a minimum, a visual check for the presence of mines has been made.

Prior to traveling on dirt roads, the AW commander must confirm that an electronic sweep has been conducted by the supported unit.

When traveling cross-country or on trails, AW's must not be driven in ruts or in the tracks of other vehicles unless the driver sees the tracks being made by a preceding vehicle. AW commanders must avoid channeling their vehicles into terrain which provides little maneuverability and is therefore a high-risk mine area. If, however, this is not possible (due to obstacles, terrain features, or enemy activity), the route of march should be swept by attached engineer personnel traveling immediately in front of the lead vehicle. Whenever possible, a different route of return to the base camp should be selected to preclude mines being emplaced between the time of original passage and return. Again, if this is not possible, the AW commander must request that the route again be swept by engineer personnel prior to use.

Mining incidents normally precede an ambush. Crews of damaged vehicles must remain alert during recovery from a mining incident. Personnel on other vehicles must be instantly responsive to protect the crews of disabled vehicles.

## EPILOG

As all Vietnam veterans are well aware, the AW battalions in Vietnam have compiled an outstanding combat record and have consistently received high acclaim and praise from all supported units and their commanders. Each battalion has been decorated with the Presidential or the Meritorious Unit Citation, and individual awards are abundant. Two of the battalions arrived in Vietnam in November 1966 and the third in March 1967. During this time more than 4 million Duster rounds and more than 10 million Quad 50 rounds have been fired. The exact number of enemy kills is impossible to determine because of the body count rule and the manner in which the VC/NVA remove their dead from the battlefield; however, the friendly killed in action losses for the three battalions is less than 100. The individual awards include more than 450 medals for valor and more than 1,000 Purple Hearts. Each battalion has been involved in every major offensive action that has been conducted in its particular zone and is currently supporting every major tactical unit involved in offensive or defensive action in RVN. Wherever AW elements are located, it has been proven that they are habitually the first to return counterfire during an attack. Commander after commander has commented on the AW personnel's outstanding morale, esprit de corps, willingness to fight, and professionalism.

# Trends in Military Vehicle Batteries

*By Joseph Reinman*

*Editor's Note:*

*This article first appeared in the January 1969 issue of Army Research and Development. It is republished here because of its interest to transportation elements of air defense artillery units. The author is an electrical engineer in the Vehicular Components and Materials Laboratory, US Army Tank-Automotive Command.*

Average users are inclined to regard a storage battery as a "dirty black box," to be recognized and condemned only when it fails to crank an engine. In reality, it is a complicated electrical component which absorbs punishment inflicted by other component malfunctions—often from the vehicle operator's lack of understanding of electrical system principles.

Advanced tremendously in recent years by scientific progress, today's battery is a carefully designed component. Research and development have provided a large variety of innovations, many of which have been incorporated into military vehicle electrical systems.

For example, batteries have been designed to withstand vehicle, engine and gunshot vibration. Research has also revealed the importance of battery location in vehicles to permit easy maintenance, a suitable "living temperature" range (80° F. plus or minus 20), and engine cranking with a minimum line voltage drop.

Other innovations include hermetically sealed batteries to ensure freshness upon activation; also, improved overcharge capabilities designed into the battery to protect it from effects of malfunction voltage regulators.

In addition to these advances, the battery of the future promises to bring other significant improvements, some aimed at extending its life. One important factor that will determine its life is whether or not it is being provided with the correct charging voltage. Different charging voltages are required for arctic regions than for the tropics—or for other conditions of hot or cold.

An automatic means of providing voltage adjustments over these temperature extremes will soon be employed in military vehicles.

One technique involves a device which constantly measures battery internal temperature. Based on the temperature of the electrolyte, the unit provides an electrical signal to the voltage regulator, causing a related change in charging voltage. This method is currently being evaluated at the Yuma (Ariz.) Proving Ground. Final winter testing is scheduled at Fort Greely, Alaska.

A second method of automatic charge control, currently under study, uses a device to measure rate of battery gassing. This technique appears to be more suitable for sophisticated vehicle electrical systems.

With the advent of the high-impact, thin-wall, plastic containers for standard-sized batteries (external size), more power can be obtained from the same cubic volume. New

designs are expected to increase capacity by 15 to 20 percent. See-through walls will permit visual electrolyte level inspection.

The plastic, one-piece battery top and noncorrosive, braided plastic handles are already standard on most military batteries. New SLI (starting, lighting and ignition) batteries have been made part of the standardized military battery group.

For specialized applications and low-temperature operation, U.S. Army Tank-Automotive Command (USATACOM) engineers have developed a standard-sized nickel-cadmium battery. The main interests here are long life under extreme temperature variation, elimination of current leakage of the metal case, maintenance of waterproofness, and provision of an economical means of rebuilding the battery.

The need for a battery state-of-charge indicator for driver information has become increasingly apparent. To be effective, this device must show a vehicle operator the amount of battery capacity remaining under any operational condition.

Obtaining reliable information depends upon numerous variables such as battery temperature, age, history, quality and type of charging system, and storage condition. One promising method involves measuring the dielectric constant of the electrolyte.

One of the basic tools for engineering long, dependable service into a battery is the use of "Application and Installation Standards." These include information concerning proper battery size and number, temperature control, ventilation, cables, connections, hold-down facilities, battery-supporting components, manuals and specifications to promote good field practice. Standards are updated periodically, along with the technical manuals to reflect innovations.

A recent development in the battery field is the dry-charged, water-activated, immobilized electrolyte, lead-acid battery. USATACOM engineers are studying methods of producing immobilized, dry electrolyte that can be carried inside the battery while it is being shipped. Presently, the elctrolyte is transported in a separate container along with the battery.

A recent feasibility study and a subsequent contract led to the development of methods of preparing the electrolyte in a dry form. Unlike the conventional sulfuric acid-water type, dry electrolyte will remain in an immobilized state inside the battery. The battery is activated by adding water.

A standard, military 6TN battery requires about two gallons of sulfuric acid electrolyte which is shipped externally. Approximately 30 percent of the package volume is water.

Using the empty spaces within the battery to contain immobilized, dry electrolyte would eliminate the need to ship water and sulfuric acid in a separate container. Benefits would be reduced volume, weight and transportation costs.

A few problems still must be worked out before dry electrolyte can be used successfully in the field. For example, the cells of a 6TN are activated conventionally by adding roughly 1,000 cubic centimeters of sulfuric acid electrolyte, having a specific gravity of 1.280.

More than this amount of the currently available dry electrolyte is needed, however, to meet the military requirement of 100 ampere-hours for this battery. Furthermore, government-imposed regulations preclude making the battery larger to accommodate additional electrolyte.

USATACOM and industry engineers are working on several possible solutions to this problem—by improving organic and inorganic gelling agents, improving electrolyte methods, and developing thin-wall containers to obtain increased internal volume.

Three methods of obtaining water-activated immobilized electrolyte batteries are undergoing evaluation at USATACOM. Each shows considerable promise, and completion of the water-activated battery development program is expected by 1970.

# Lessons Learned in Vietnam

## TACTICAL EXPERIENCES OF DEPLOYED UNITS

*(Introductory comments by the Editor)*

•The experience of Battery C, 6th Battalion, 71st Artillery, in setting up a base for combat operations on Hon Tre Island, is an account of what any unit with a similar responsibility might encounter and how resourcefulness can solve problems•

### HON TRE

*Captain Charles E. Stephens*
*Headquarters US Army Air Defense Command*
*Ent Air Force Base, Colorado*

Battery C, 6th Battalion, 71st Artillery, was fully deployed on Hon Tre Island and was ready to assume its assigned mission—the air defense of the Cam Ranh Bay and Nha Trang airbases and logistical facilities, together with the collocated Air Force control and reporting post (CRP). Throughout the summer months the island community continued to grow. The island base was originally supposed to consist of only three units: Battery C, 6th Battalion, 71st Artillery; Detachment 11, 619th Tactical Control Squadron, USAF; and the 228th Signal Company. The 228th Signal Company decided to develop its own cantonment area and to locate it with tactical operations atop Hill 324. The battalion operations central of the 6th Battalion, 71st Artillery; direct support platoon minus; a dental detachment; and the 97th Artillery Group alternate Army air defense command post (AADCP) also came to Hon Tre Island. The island population now numbered approximately 800, all to be under the supervision of the Battery C commander who would assume the title of Deputy Sub-Installation Coordinator when the development was complete. Also, at this time the island became sector VIII of the Nha Trang Installation Defense.

The problems that faced the founders of the island complex soon became acute. Tactical operations were being conducted which required maximum support with a minimum of interference. It therefore was imperative that the base for combat operations be constructed as rapidly as possible. Remaining to be built were 30 buildings, a 50,000-gallon water tank, 2 miles of perimeter defenses, and an improved road to the tactical site on Hill 424. The improved road was needed because the original road constructed by the 864th Engineer Battalion had become unusable. The precipitous old road had claimed two vehicles, damaged many others, and ruined numerous tires.

The 864th Engineer Battalion on Hon Tre labored only to clear the areas for the tactical site and cantonment area, to construct the road joining the two areas, and to drill water wells. It therefore became necessary that the island community provide a workforce to construct all remaining buildings. The Engineers gave technical advice and assistance.

Had any delay been allowed, the work would have fallen behind schedule and the monsoon would have caught the island forces living in tents. Regardless of some lack of agreement between organizations on the island, the project continued at a rapid pace except for the road construction which continued to lag behind schedule.

A matter of great concern was the transportation between Hon Tre Island and Hha Trang. The only source of transportation was one landing craft, utility (LCU), provided by the 90th Heavy Boat Company at Cam Ranh Bay. The boat was assigned as a ferry between the island and the mainland—the trip each way took 1 hour. On the odd hour the boat would leave the mainland, and on even hours it would depart Hon Tre. Transportation to and from the island was necessarily regulated by priorities—Engineer equipment and construction supplies first and rations, water, unit supplies, and mail second. All other items were on a first-come-first-on basis. At times this schedule was interrupted when the LCU was diverted to other duties in Nha Trang harbor. No replacement LCU's were available. The 90th Heavy Boat Company had problems trying to keep this World War II craft operating, and they did a commendable job; but at times lack of adequate transportation resulted in delays and hardships on the island.

To reduce the loss in man-hours when personnel left the island for the mainland, the Nha Trang Regional Exchange was persuaded to establish an exchange facility on the island. The facility originally consisted of one trailer dispensing only necessities but was expanded into a regular PX with laundry, tailor, and barbershop concessions. A great amount of time was saved by having these facilities on the island because to go to the mainland PX required half a day.

The most glaring problem facing the Battery C commander was the critical shortage of TOE property. Property authorized by the TOE was adequate for the battery but was not sufficient to support the battery and all the miscellaneous units that were hanging onto its coattails. Take water containers, for example; there was no source of potable water on Hon Tre Island. The wells that the 864th Engineer Battalion had drilled yielded not a drop. This meant that all water on Hon Tre had to be brought to the island by ship. To transport the water, one 400-gallon water trailer was authorized by TOE. This was obviously inadequate; with the ship making two trips a day, there still would be only 1 gallon of water per man per day for cooking, washing, and drinking. Even by making repeated crossings of the bay during the day, not enough water could be brought to the island. Requests for assistance from 97th Artillery Group and United States Army Vietnam (USARV) met with no success. However, someone in the battery discovered a 10,000-gallon water tanker rusting in the Cam Ranh Property Disposal Office (PDO) yard. The tanker was retrieved from the junkyard, cleaned up, and pressed into service, thereby solving the problem of getting sufficient water to the island. Now the problem was one of too much water. The storage tank that was part of the base development plan was to hold 50,000 gallons. The water was to be made potable by a self-contained water purifier. Unfortunately, the purifier did not arrive until late in 1968 and the storage tank stood unused for several months. The problem of storage was solved by using a number of Air Force 400-gallon water trailers along with six 600-gallon Navy cubes. The island never again experienced the water shortage that it had known in its earlier development; although, the times that the 10,000-gallon tanker broke down were in themselves small crises.

The next pressing issue was POL. Similar problems existed with POL as with the water. The battery TOE allowances simply could not support the requirements. The single tank and

pump unit authorized could not keep up with the needs. POL estimates were from 2,000 to 3,000 gallons of MOGAS and 10,000 gallons of diesel fuel monthly. These figures at first seemed excessive, but there were over 100 vehicles and 20 generators (four of them 100-kilowatt sets) on the island. Fortunately for all units, a POL yard was established using 5,000-gallon bladders from the Nha Trang fuel depot. The POL yard ended up with the capability of storing 5,000 gallons of MOGAS and 10,000 gallons of diesel fuel.

By the end of September the base development project was complete except for the improved road and water tank. All units scheduled for deployment to Hon Tre had arrived and were operational. The position of "Island Coordinator" (the individual having overall supervision for the development) had been abolished, and the Battery C commander now assumed overall responsibility for the island base for combat support operations.

The most demanding issue facing the Battery C commander at this time was security. Just how could Hon Tre be protected, and how could its defense become an integral part of the Nha Trang installation defense (NTID)? By becoming sector VIII of the NTID, the island was called upon to defend itself and to provide backup forces for defense of the mainland (Nha Trang) installation.

It was decided to divide the island into "defense islands." This was ideally suited to arrangements previously worked out with members of the island community. Detachment 11, 619th TCS, was to organize and defend the Artillery-Air Force cantonment area. The 228th Signal Company was charged with defense of its cantonment area and tactical site atop Hill 324. Battery C was to defend the installation on Hill 424—the tactical site for the battery and the CRP. This concept was tested twice when the Signal Company and the Army-Air Force cantonment area came under attack by sapper squads.

The attacks were coordinated and occurred at the same time but were repulsed with very light casualties and negligible damage. Hill 424—the tactical site for the battery and the CRP—was never the victim of an overt attack, although several incidents around the perimeter were evidence that the area was under surveillance. A report on the attack credited the lack of action against Hill 424 to the fact that no Vietnamese personnel had ever worked on or visited the site. In his defense plan for the area, the Battery C commander had directed that the site be declared a restricted area and thus off limits to all Vietnamese personnel. Had this policy been applicable to the other two areas, it would have been adopted, but it could not be done because large numbers of Vietnamese were employed to provide services for the units.

The development of Hon Tre Island as a base for combat operations is a good example of what mistakes in base development might occur and how they can be overcome. From the first, the idea was to redeploy Battery C as quickly as possible. However, the unit was deployed too quickly. Facilities that should have existed before the unit's arrival were long in coming. Barbed wire—so necessary for any perimeter defense—did not arrive until the battery was already in place on Hill 424.

The plans for the development were inadequate. Some materials did not arrive for months after they were needed. Other requirements (e.g., POL storage, water, and transportation) seemed to have been treated with a minimum of concern.

The preponderance of building construction was done by non-Engineer troops. The Engineers constructed only those things for which they assumed responsibility.

The island base was divided into three organizational areas when two would have been better. The Artillery-Air Force cantonment area should have been collocated with Hill 424. This would have made the area more secure and eliminated the problem of having to motor between the two areas. There was sufficient area on Hill 424 to allow for this collocation.

Although these factors tended to slow down the Hon Tre base development, they did not stop it; they merely made progress more difficult. The success attained can be credited to the men of all units who labored to construct Hon Tre Island as the effective base for combat operations that it is today.

# Know the Score

One of the chief means to improve training effectiveness and efficiency in air defense is to provide a method of reliably scoring each round that is fired at a target. This scoring capability is particularly important with the added emphasis on evaluating and training of operators using modern weapon systems in a ground-to-air role. Due to the high-technology content of today's weapon systems, operator confidence in his weapon may be the most significant aspect of this problem. In some instances economies have created conditions in training where all trainees are not permitted the luxury of target practice.

From the viewpoint of improving training effectivity, simulation, and cost effectiveness, a scoring system that is capable of determining the exact distance by which the projectile misses its target (as depicted in fig 1) is a necessary feature of modern-day, air defense training. The model 800B electronic miss distance indicator (MDI) was designed by Babcock Electronics Corporation to meet the need for a highly reliable, low-cost, weapon-scoring system for use in personnel weapon training and evaluation of surface-to-air firings of missiles and automatic weapons. The system fulfills the need for a device to augment existing target systems and provide a means whereby the most effective training of personnel and the combat readiness of crews can be insured.

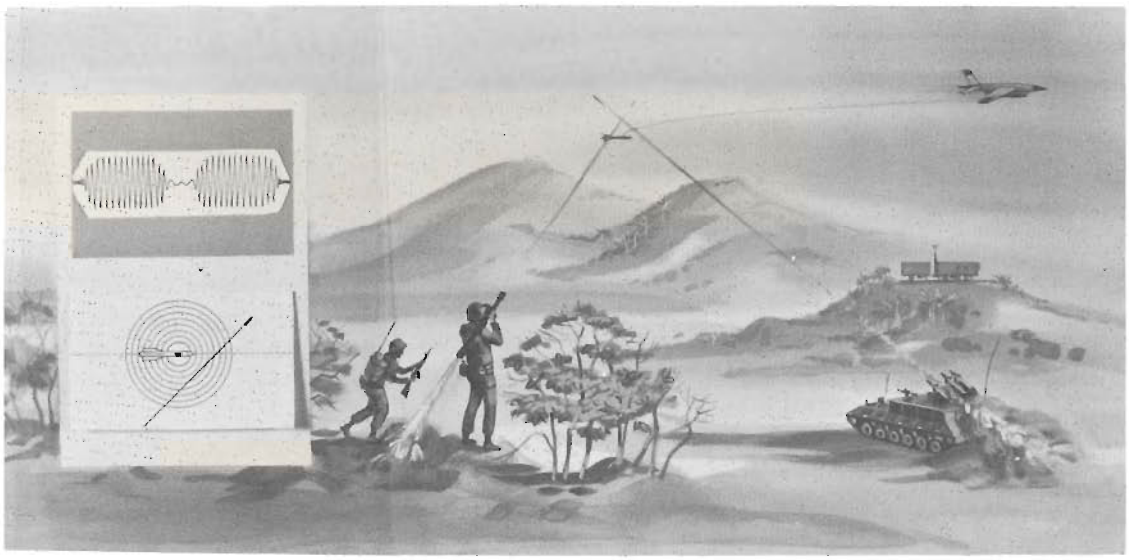


Figure 1. Tractor-two target system with scorer in tow target (artist's concept).

The 800B is an accurate, reliable method of measuring miss distance between airborne targets and intercepting projectiles. To improve system flexibility and reduce cost, the 800B MDI system is noncooperative; it requires no modification of the projectile to be scored. Therefore, the simulation is improved since no preprograming of the target is required for a presentation. The scoring system is completely integrated (fig 2); it includes the airborne sensor with a fixed, portable unit and an airborne recording station. These stations receive,

record, and reproduce the scoring information. The system operates instantaneously, permitting fast evaluation of firing performance to improve training effectiveness. Data are automatically recorded on a variety of media to facilitate evaluation and interpretation. To insure that data are recorded, a built-in tape recorder in the recording station begins to make a permanent data record when the signal decision circuits sense that a projectile has entered the sensor's field of influence. In addition, a built-in oscillograph furnishes a continuous visible monitoring oscillograph record for evaluation and interpretation.

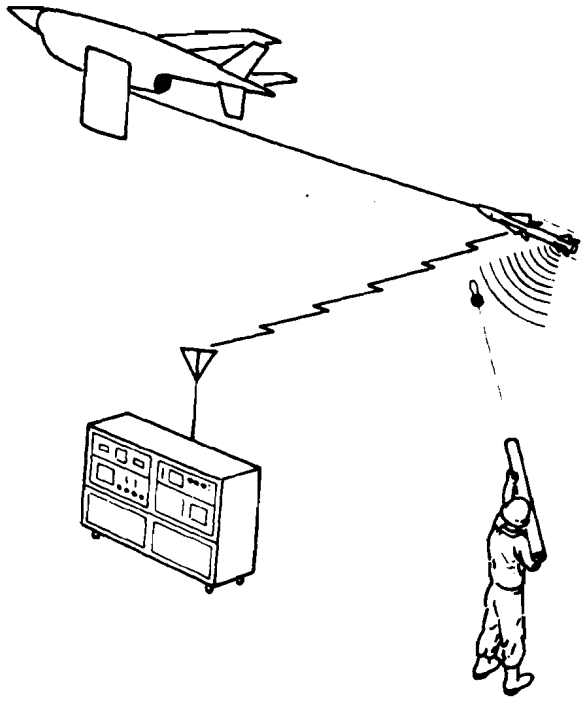


Figure 2. Tractor-tow target system with scorer in tow target.

The 800B system measures the miss distance of all types of projectiles. It has performed successfully with projectiles varying in size from the very largest missile down to a .50-caliber bullet. It consistently and reliably scores projectiles with velocities varying from 500 to 5,000 feet per second. To improve system reliability and reduce system weight, the airborne component of the 800B is a solid-state electronic sensor. The sensor, mounted in the airborne target (fig 3), uses step-keyed RF radiation to create an electromagnetic sphere of influence around the sensor antenna. The size of the sphere of influence is predetermined by the sensor used and is governed by the size of the projectile to be scored. Depending on the model used, the sensor operates at 1740 or 1775 megahertz (MHz). To transmit scoring data to the recording station, the sensor uses an integral FM telemetry transmitter operating between 216 and 260 MHz. When a projectile enters this sphere, the sensor produces a signal that is transmitted to the ground station (fig 4). The miss distance is determined by comparing the reflected doppler cycles to a predetermined range wavelength reference.

The 800B is presently installed in the vertical fin assembly of the standard Army model TA8-IRE infrared target which is towed by the model BQM34 drone (figs 5 and 6). Cost per presentation is reduced by including only a minimum of components in the expendable portion of the target. The system can be installed in any target vehicle or tractor-tow combination. In most cases the installation requires only minor modification.

The performance of Babcock's 800B scorer has been officially tested by the US Army, Air Force, and Navy. The system is currently in use at White Sands Missile Range scoring performance of the Redeye and Chaparral missiles, Vulcan gun, and Army quad .50-caliber guns. It has been used to score the Navy's 3-inch AA gun. The system's ability to perform in a wide variety of environments has been demonstrated by installations in the high-altitude, rocket-powered AQM-37A missile target and in the low-altitude, propeller-driven missile target MQM-61A.

The scoring system is durable and reliable. Its design and construction features and integrated modular circuits meet or exceed all the requirements of military specifications.

Figure 3. Tow target TA8-IRE with 800B4 scoring system inserted in target wing.

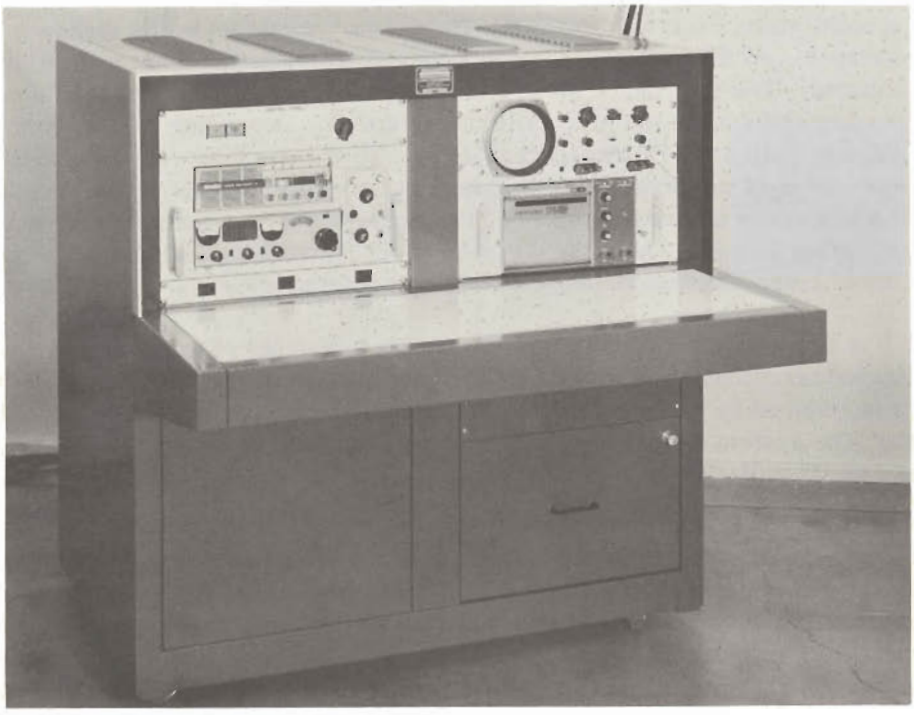


Figure 4. Scoring ground receiving and recording station.

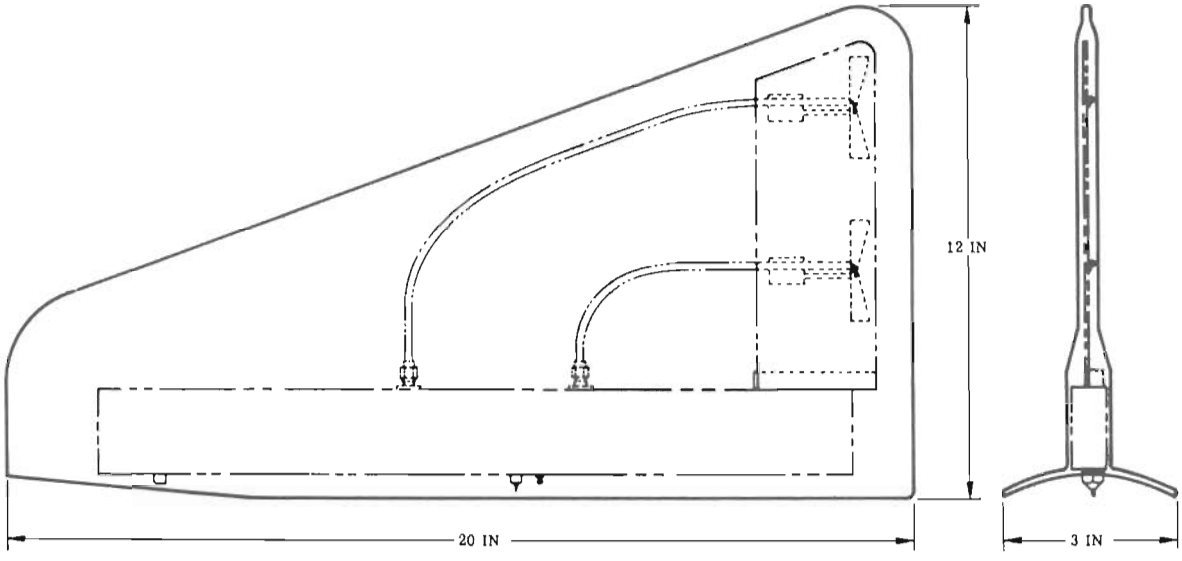



Figure 5. Installation drawing of target wing with 800B4 scoring system installed.

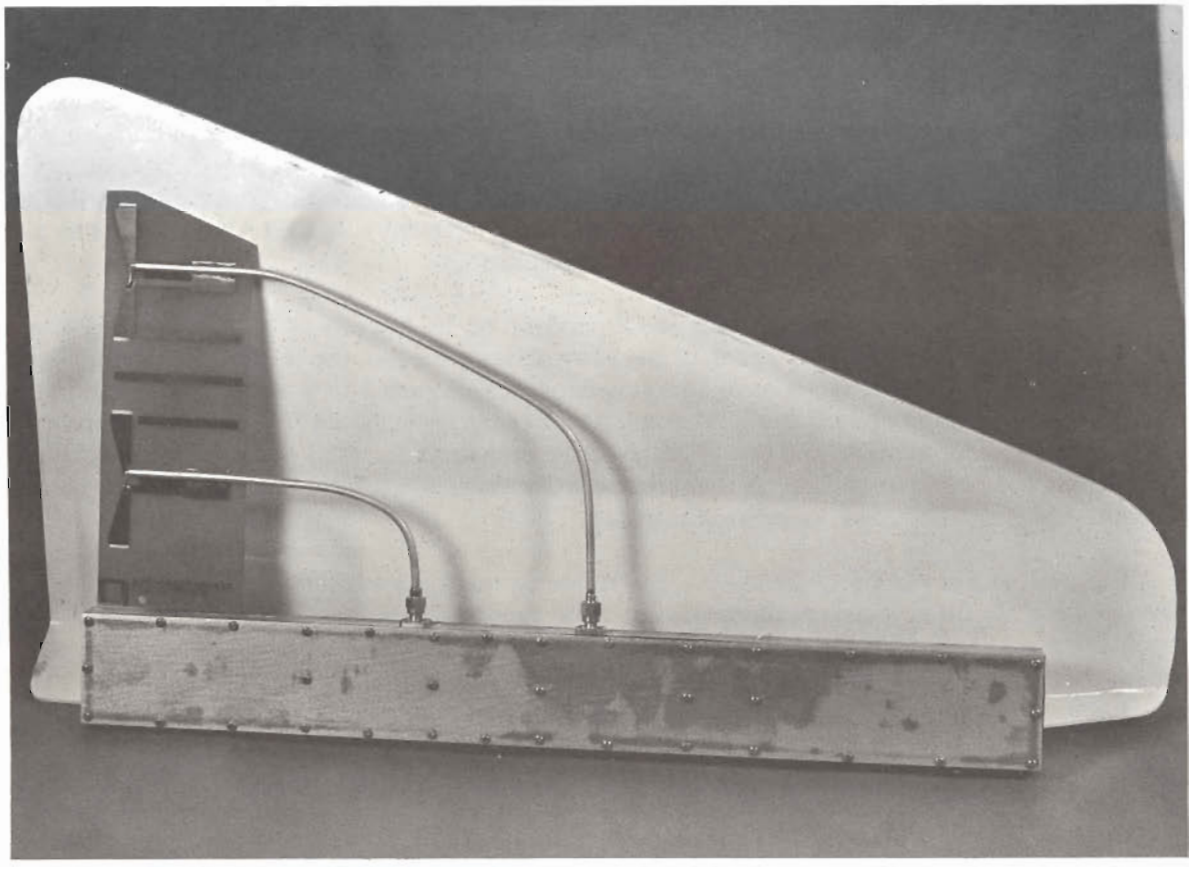


Figure 6. 800B4 scoring system shown prior to installation in tow target wing.

# Military Pulsed Doppler Radar (MPDR 30/1)

The military pulsed doppler radar (MPDR 30/1) is an operational search radar developed by the Siemens Corporation of Munich, Germany, for the German Ministry of Defense. It is of mobile, solid-state (except for transmitter power tubes), modular design and is packaged in individual cases capable of being hand-carried by two men.

The MPDR 30/1 is designed for use by forward area combat troops for air defense. It can be installed and operated in a truckborne shelter, or transported by truck, helicopter, or other means for installation in a hut or similar enclosure.

Its prime mission in the forward area is to search for and detect aircraft from near-ground level (below 100 feet) to conventional high altitudes. It has a proven elevation envelope of 40°. The single operator can interrogate any or all targets detected by use of IFF equipment, such as the Mk 10 or Mk 12, and observe on the radar scope the symbology indicating target identification. He can then acquire hostile targets (or friendly targets if the radar is being used for forward air control) by "hooking" the targets with range and azimuth markers. Such acquired targets can be designated by the operator, in terms of range and azimuth, to defensive weapon systems nearby or via radiofrequency link to more remote weapon systems. Rapid updating of designation is provided by a high system data rate. All radar control and functions are fulfilled at the radar display which can be remoted several hundred feet from the remainder of the equipment. The display utilizes a 12-inch cathode-ray tube with long persistence. This display, combined with a high system data rate, permits the establishment of angle and range tracks on detected targets, thus allowing a better assessment of a particular threat to the immediate area. Accordingly, forward area air defense is insured by a radar which fulfills this mission and provides the associated identification, acquisition, and designation capabilities. The MPDR 30/1 has demonstrated these capabilities against targets of varying altitudes from the ground up, both day and night, in all climates and in all weather and under severe countermeasure conditions.

Figure 1 shows the overall physical configuration of the equipment in the operating condition. The individual carrying cases of the assemblies, such as the three which comprise the transmitter and exciter, all have carrying handles. Figure 2 is a more detailed illustration of the transmitter and exciter. The individual cases comprising this unit are shown along with a typical module, the power stage of the transmitter. The power tubes shown are the exciter and power amplifier, both tetrodes. The transmitter contains integral air cooling (flexible hose) and requires no external cooling.

Figure 3 shows the receiver case. The lights on the top panel are for fault diagnosis and isolation, built-in maintenance features. The receiver contains the synchronization modules, and IF and video amplifiers, each packaged in its individual module.

Figure 4 shows the signal processor, each of the modules shown being a doppler range gate. These are high-quality crystal filters, all of which are identical.

Figure 5, the radar display case, shows the radar controls and system status lamps. The case is 11 inches deep by 24 inches wide. Cases vary in height up to 24 inches. The equipment is completely cabled from the front and is self-cooled.

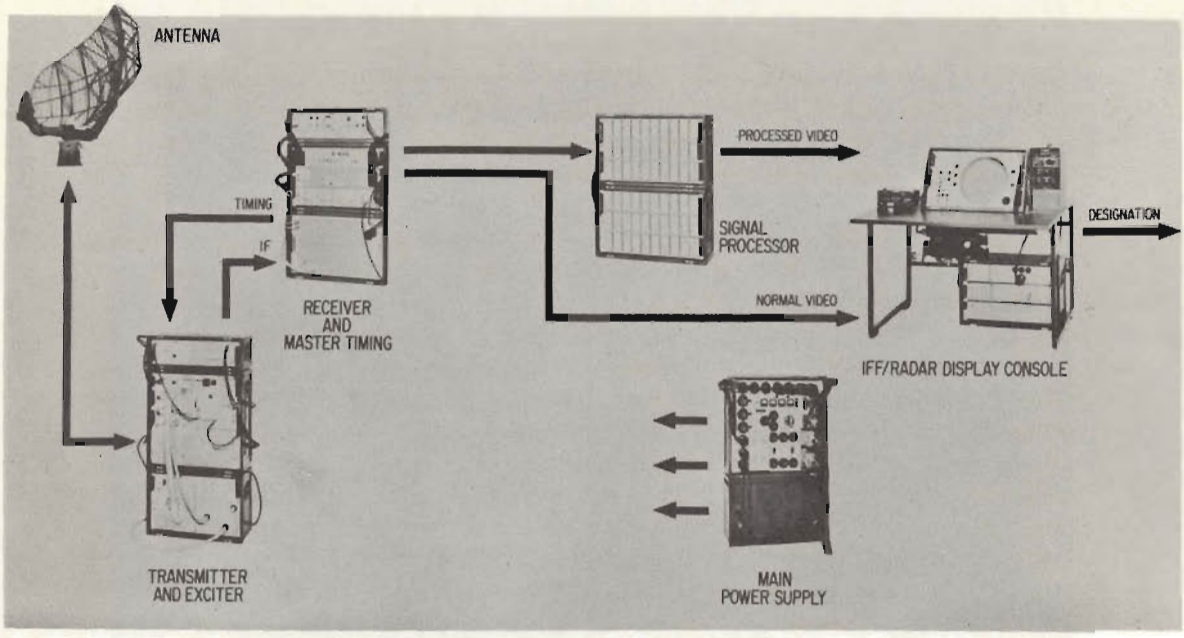



Figure 1. MPDR 30/1 physical configuration.

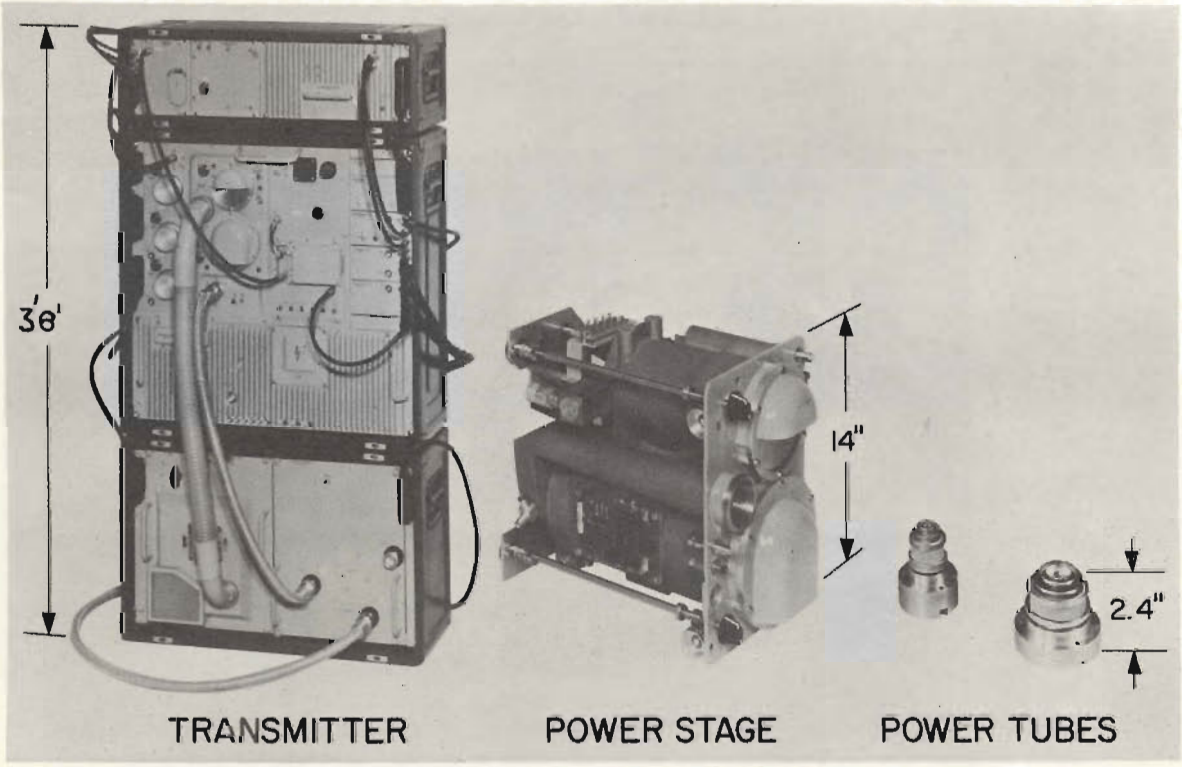



Figure 2. Detection system transmitter.

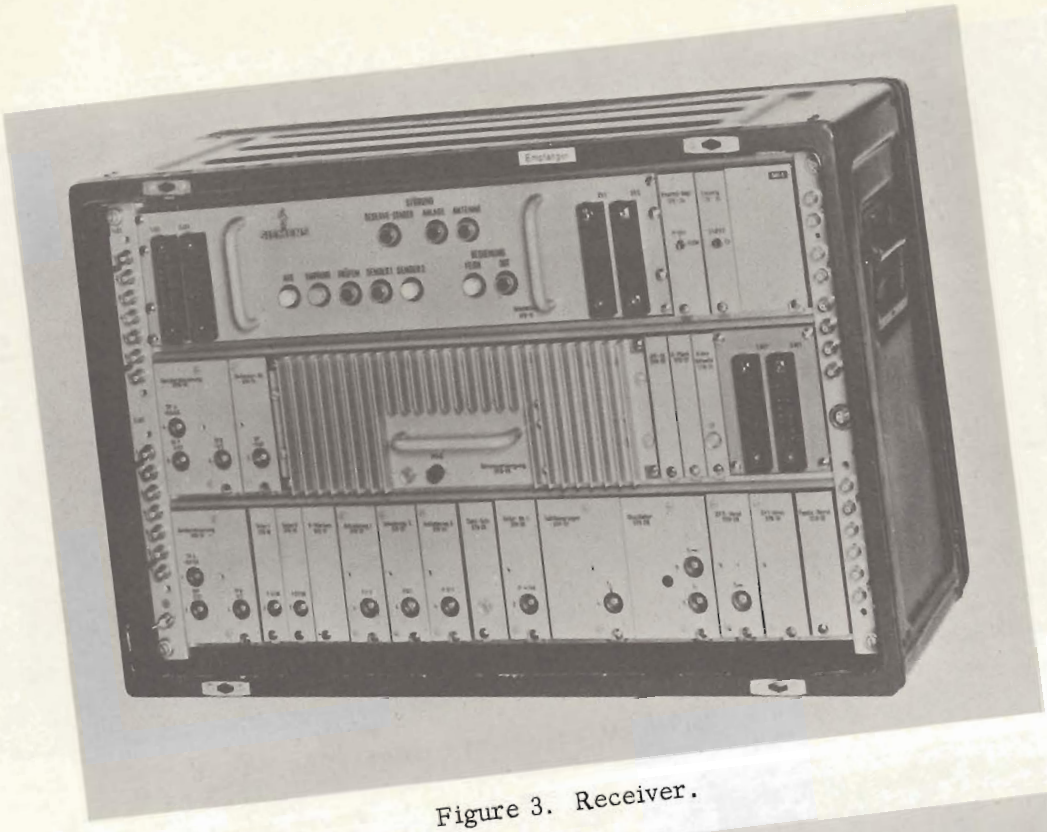


Figure 3. Receiver.

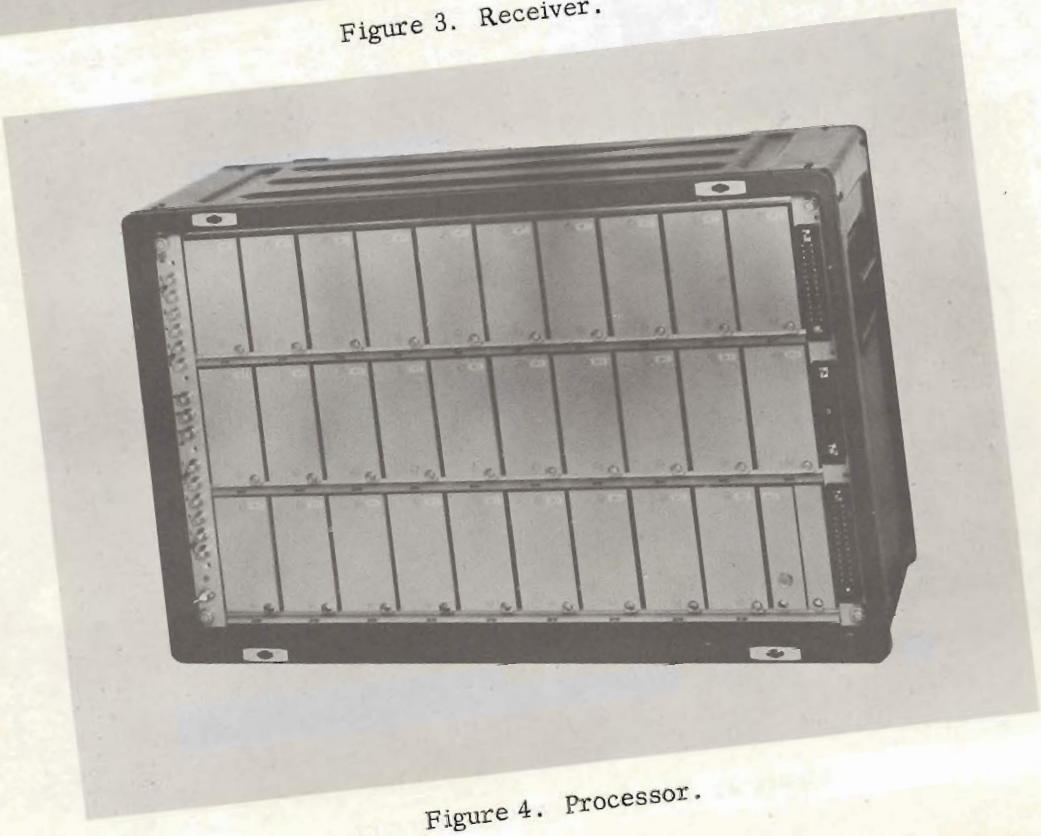


Figure 4. Processor.

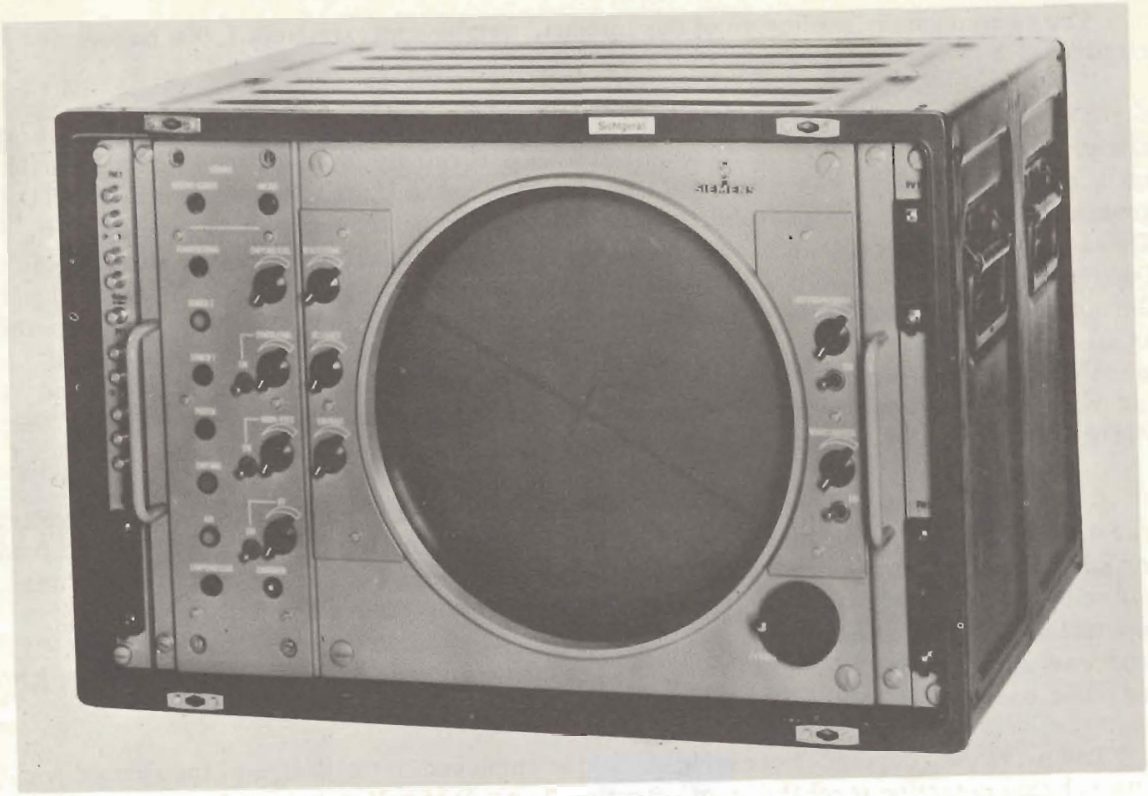
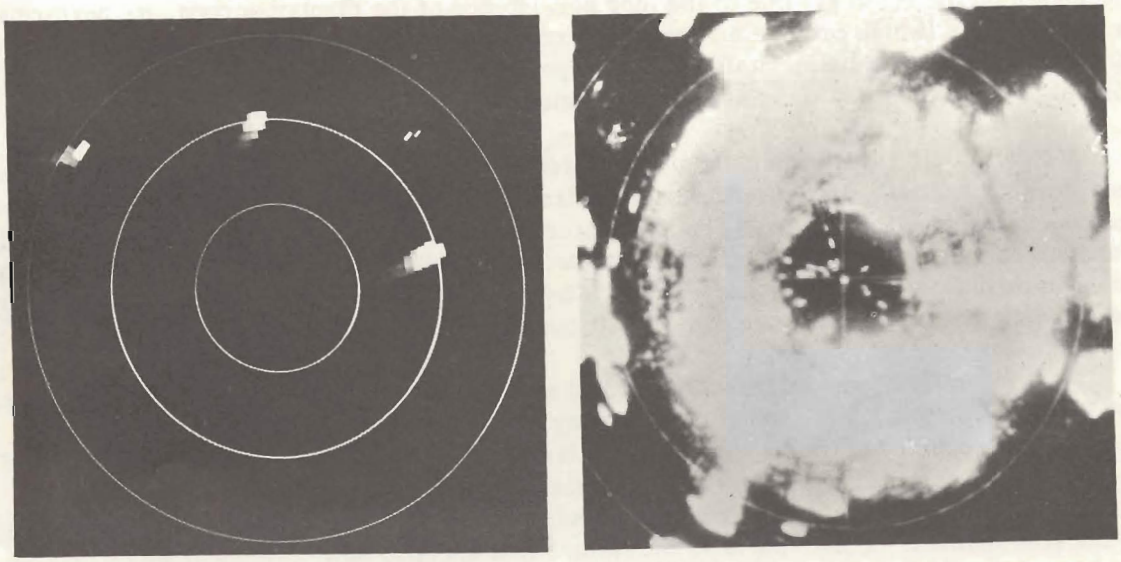


Figure 5. Display.



FULL PULSE DOPPLER OPERATION UNPROCESSED VIDEO DISPLAY

Figure 6. MPDR 30/1 radar display.

The radar system, exclusive of the antenna, weighs approximately 1,000 pounds and requires 3.5 kva, 60-hertz power.

The MPDR 30/1 has a primary functional capability of aircraft detection in dense radar clutter environments such as is encountered when aircraft fly low over land or water or in rain, snow, or chaff. The system has demonstrated to the United States and other NATO governments an outstanding capability of fulfilling this requirement as shown in figure 6. These unretouched photographs were made under the auspices of the German Ministry of Defense from the MPDR 30/1 display with the antenna mounted on top of a building in Munich, Germany. The picture on the right shows the radar view of that area with the radar operating as a conventional pulse radar; i.e., with no doppler processing. The picture on the left, taken with full pulse doppler processing, shows three aircraft extracted from that dense radar clutter which would completely escape detection by a conventional pulse radar. The MPDR 30/1 is capable of detecting very small targets in maximum radar clutter.

The MPDR 30/1 is a fully coherent pulsed doppler radar employing a crystal-controlled transmitter in the L-band frequency spectrum. Transmitter frequency can be changed from one end of the band to the other in less than 1 minute. Being crystal controlled, the transmitter output frequency is extremely stable, thus allowing accurate and stable frequency separations between radars to eliminate interference. Radiofrequency interference (RFI) suppression techniques are used throughout the design to keep the emission of spurious RF and pulse energies to an absolute minimum.

The particular doppler processing technique employed in the design of the system permits reliable detection (probability of detection $P_d \sim .9$) of helicopters and propeller aircraft down to zero radial velocities; i.e., hovering helicopters and propeller aircraft in circular flight about the radar. Consistent detection of these aircraft has been demonstrated down to touchdown on the runway. Due to the long persistence of the display screen, its performance in tracking jets (which provide a return of narrower spectrum than propeller aircraft) is such that target tracks can be maintained over a spectrum of velocity ranges from well below normal jet velocity up into the supersonic region.

The MPDR 30/1 has been extensively tested environmentally under extremes of temperature, humidity, shock, and vibration in accordance with standards used by NATO countries. Because the radar is mobile, it was built and later environmentally tested to insure that it could be transported by truck over rough terrain, to be set up quickly upon arrival, and to be operational immediately upon being energized. A 6-month exhaustive test program conducted by the German Ministry of Defense proved that the design meets these requirements.

The system is highly reliable, being designed with a mean time between failure of about 300 hours. Its modular construction and many human engineering features permit rapid repair when required. The extensive use of lamps, meters, self-test features, and a built-in test oscilloscope, as shown in the illustrations, provides for rapid fault diagnosis and isolation. Components of the radar which could possibly fail are monitored by specific lights on the front panels. These diagnose the failure to a specific plug-in module which can be readily replaced. For more complex failures, the light patterns on the panels (i.e., combinations of lamps out, illuminated, or blinking) permit immediate fault isolation to a specific

module or modules. In addition, diagnostic matrices are provided for the isolation of failures when specific light patterns show on the front panels. This simplified system permits the operator to correct troubles. For failures of more subtle nature, the instruction manual provides pyramidal step-by-step procedures for use of the built-in test oscilloscope and meters, with the many testpoints provided, for rapid isolation.

In summary, the existing design of the MPDR 30/1, now in operational use, has demonstrated outstanding performance in the reliable detection of low-flying aircraft and therefore affords protection against this classic enemy tactic. The MPDR 30/1 is a mobile radar designed basically for operation in a shelter transported by truck. The display can be remoted and the remaining equipment operated unattended. The solid-state design, modular construction, and extensive built-in fault diagnosis and isolation indicators make for a radar of high reliability and high availability. Accordingly, the MPDR 30/1 is ideally suited for forward area air defense weapon systems or for any combat situation where a high-performance, reliable, mobile, air-search radar is desired.

# Series DC Circuit

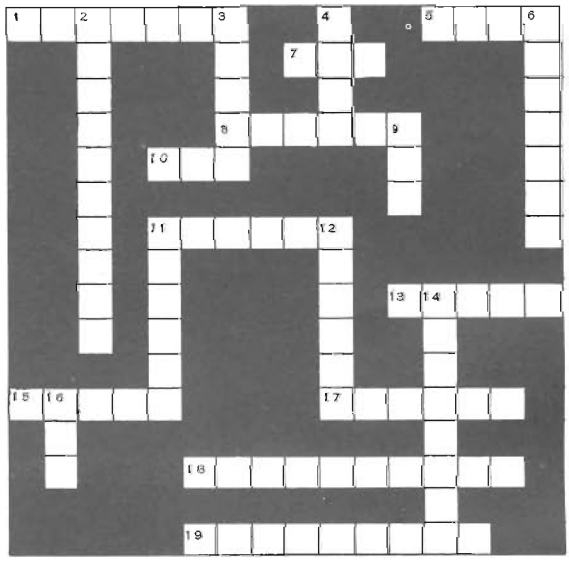
## Across

1. There is only one _____ in a series circuit.
5. The largest series resistance has the largest voltage _____.
7. If a circuit has 10 volts across a 10-ohm resistance, then _____ ohms must be added to reduce the current by one-half.
8. Resistances are connected _____ the voltage source.
10. An open results in no current in _____ parts of the circuit.
11. With a 10K resistance in series with a 2K resistance, $R_t$ equals _____ K.
13. If three 50K resistors are connected across 180 volts, the IR voltage drop across each resistor is _____ volts.
15. With two equal resistances across an 80-volt battery, each resistance equals _____ volts.
17. The applied voltage equals the sum of the _____ IR voltage drops.
18. IR voltage drops are in _____ with the resistance.
19. If current remains the same when resistance is increased, it means the voltage drop has _____.

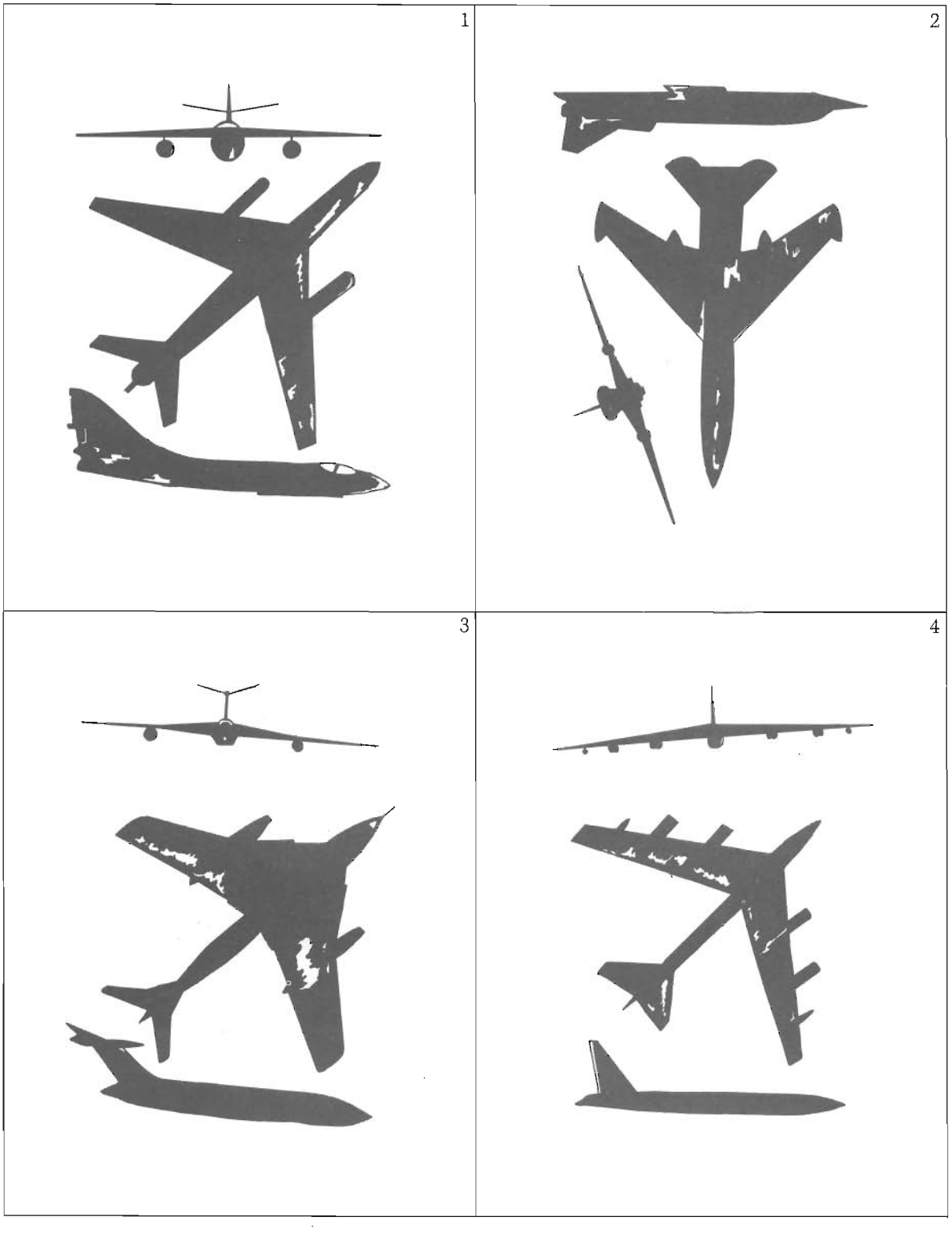
Answers on page 89.

## Down

2. The current is the same in each _____.
3. The sum of the individual values of power used in the resistances equals the _____ power supplied.
4. When one resistance in a series string is open, the current is _____ in all the resistances.
6. The voltage drops equal the _____ of IR.
9. The total resistance of a series string is the _____ of the individual resistances.
11. If the voltage across each of three 10-ohm resistors is 10 volts, the applied voltage is _____ volts.
12. The sum of IR voltage drops _____ the applied voltage.
14. The resistance of an open series string is _____.
16. With a 4-ohm and 2-ohm resistance across a 6-volt battery, the current in both is _____ amp(s).



# Recognize These Aircraft?



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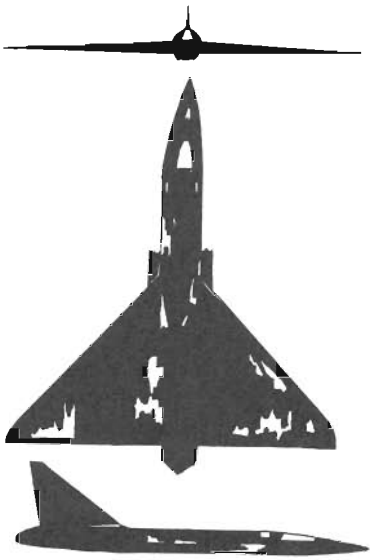

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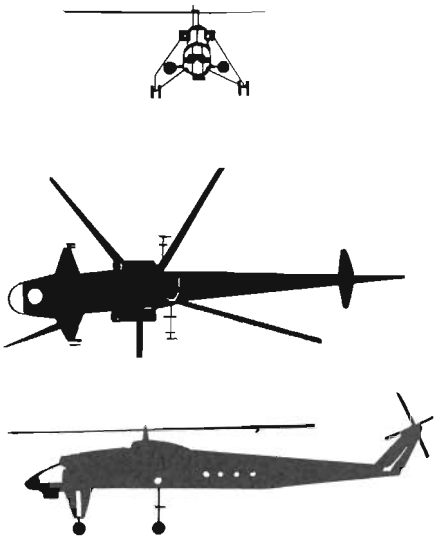

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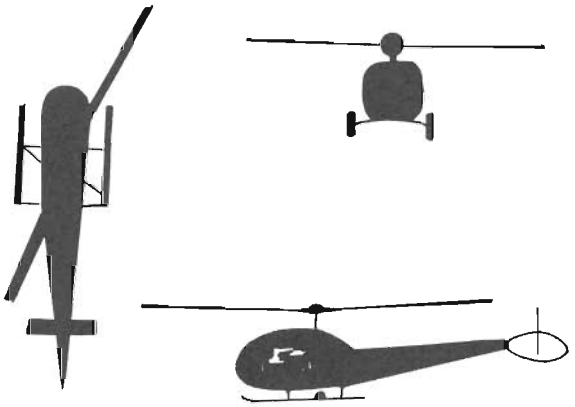

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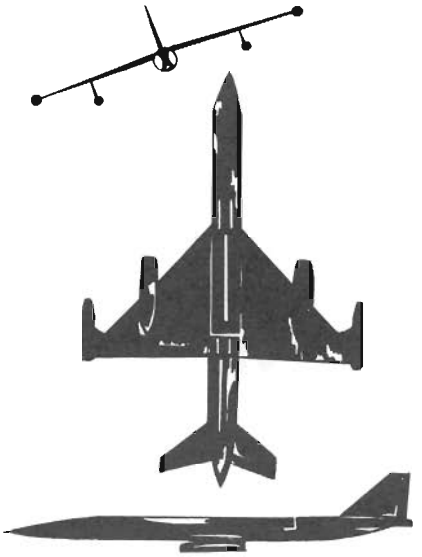



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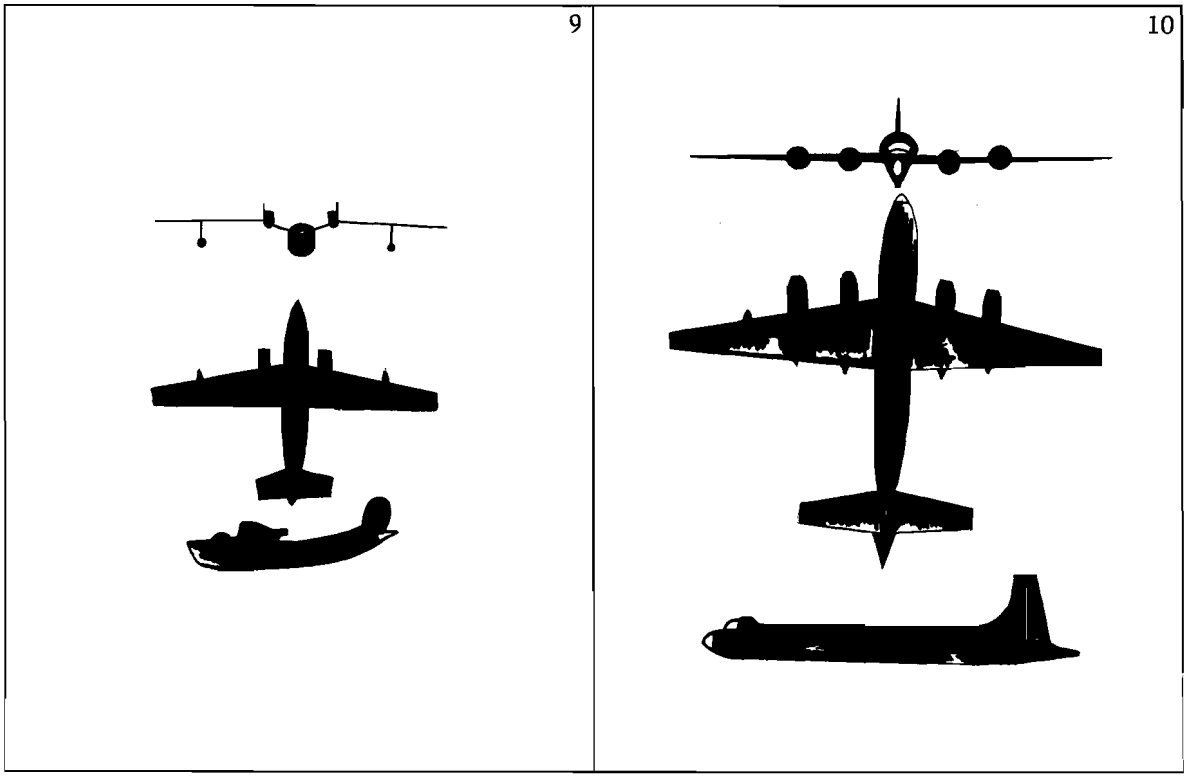


Correct identifications of aircraft:

1. A3D (US).
2. Blinder (Russia).
3. B-2 Victor (RAF).
4. B-52 (US).
5. Mirage IV (France).
6. Mi-10 (Russia).
7. OH-13 (US).
8. Bounder (Russia).
9. Be-6 (Communist China).
10. CL-28 Argus (Canada).

Answers to crossword puzzle:

| Across | | Down | |
|---|---|---|---|
| 1. | current | 2. | resistance |
| 5. | drop | 3. | total |
| 7. | ten | 4. | zero |
| 8. | across | 6. | product |
| 10. | all | 9. | sum |
| 11. | twelve | 11. | thirty |
| 13. | sixty | 12. | equals |
| 15. | forty | 14. | infinite |
| 17. | series | 16. | one |
| 18. | proportion | | |
| 19. | increased | | |

# 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

TRANSISTORS
Basic Transistors by A. Schure. John F. Rider, New York.
"This simplified, heavily pinpointed approach makes Basic Transistors readily understandable without an instructor, making it suitable for individual as well as classroom study."

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The Day Kennedy Was Shot by James A. Bishop. Funk and Wagnalls, New York.
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Basic Microwaves by Bernard Berkowitz. Hayden Book Co., New York.
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## ARTICLES

BOOBY TRAPS
"More on Mines & Booby Traps," Williard Pearson, Infantry (May-June 1969), pp 26-27.
General Williard Pearson writes this article with the purpose of enhancing the proficiency of our soldiers in detecting mines and booby traps.

GUIDED MISSILES - HAWK
"An Improved Hawk Concept," Wm. C. Schlondrop, Marine Corps Gazette (June 1969), pp 51-52.
This article describes the enormous variety of testing and evaluation that is accomplished before such a complex system as Hawk can be fielded.

LASERS
"Corps of Engineers Studies Use of Laser to Control Weeds," Army Research & Development (April 1969), pp 1 and 6.
"Laser beam control of aquatic weed infestations in navigable waterways is being investigated by the U.S. Army Corps of Engineers in a series of experiments to develop eradication methods minimizing side effects harmful to other plant life, fish, wildlife, and water quality."

MILITARY EDUCATION
"In Defense of Academic Ignorance," Hamilton H. Howze, Army (June 1969), pp 18-19.
"More and more Army officers are seeking to earn higher degrees through postgraduate schooling at civilian institutions. While no one disparages the value of scientific education, our real concern is whether we are overlooking the Army's need to equip its officers with a thorough military education."

PLANETS
"To the Outer Planets," James E. Long, Astronautics & Aeronautics (June 1969), pp 32-47.
"A rare solar-system alignment, a turning point in the existing planetary program, and a readiness of the technology all argue a high-priority program to explore the outer planets - Jupiter, Saturn, Uranus, Neptune, and Pluto."

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"Czechoslovakia; a Scenario of the Future?" Phillip A. Karber, Army Journal (April 1969), pp 18-29.
The author describes the preparation, planning, and military invasion into Czechoslovakia by Soviet forces, and studies the possibility of a similar aggression in other countries of Central Europe.

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"GI Bill of Rights; Benefits for Veterans," Wm. J. Driver, Army Digest (June 1969), pp 4-5.
This article describes some of the many benefits which are available to veterans and also explains how he may get up-to-date information on any particular question on benefits.

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"The US Involvement in Vietnam - How and Why," Mark E. Swenson, Air Force/Space Digest (June 1969), pp 32-38.
"Mark E. Swenson draws a broad philosophical and historical diagram of the forces that brought about the US's major presence in Vietnam. The decision to escalate our military commitment and what has happened since."

NUCLEAR NONPROLIFERATION TREATY
"Weakness of the Nonproliferation Treaty," Morton A. Kaplan, Orbis (Winter 1969), pp 1042-1057.
This author discusses the difficulties of actually enforcing the principles of the nonproliferation treaty.

GUIDED MISSILES - U.S.
"How Important is Missile Defense?" R.B. Pitkin and Gerald L. Steibel, The American Legion Magazine (August 1969), pp 10-15.
Here is a look at this year's big national debate on an antiballistic missile system that has seen two presidents clash with Congress over its need.

INTERNAL REVENUE LAW - U.S.

"The Time for Lower, Fairer Taxes Is Now!" Mortimer M. Caplin, Reader's Digest (September 1969), pp 39-44.

"A former Commissioner of Internal Revenue proposes a plan which would clamp down on loopholes and special preferences and, for the mass of American taxpayers, substantially reduce the individual bite."

MILITARY LAW

"The Military Justice Act, of 1968," Myron G. Sugarman, Armor (July-August 1969), pp 54-55. This article describes the changes that have been made in the 1968 act, which the author believes places the military system of criminal justice once again ahead of most civilian systems.

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Direct communication to the editor is authorized:

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