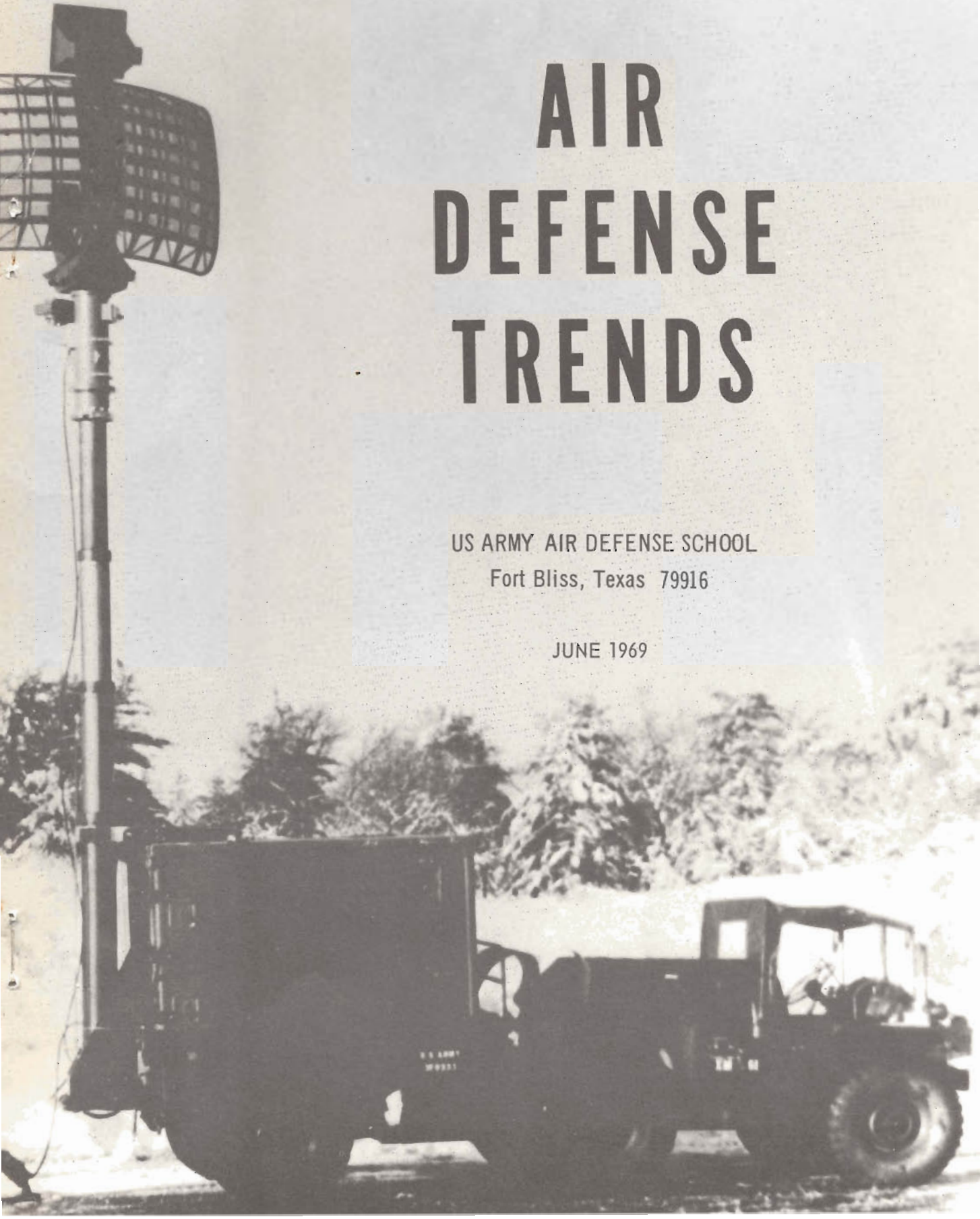
AIR DEFENSE TRENDS

US ARMY AIR DEFENSE SCHOOL
Fort Bliss, Texas 79916

JUNE 1969



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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.

THE US ARMY AIR DEFENSE SCHOOL
CELEBRATED ITS 145TH ANNIVERSARY
5 APRIL 1969

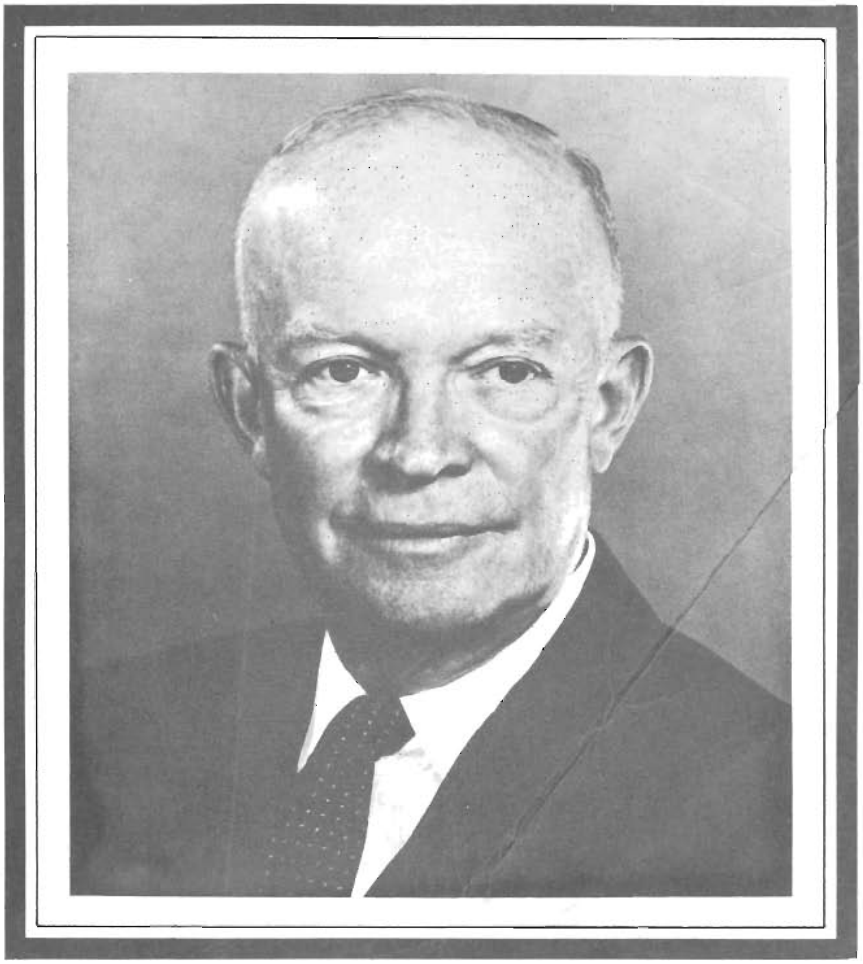
The Romans conquered all peoples by their discipline. In the measure that it became corrupted their successes decreased. When the Emperor Gratian permitted the legions to give up their cuirasses and helmets because the soldiers complained that they were too heavy, all was lost. The barbarians whom they had defeated for so many centuries vanquished them in their turn.

—Maurice de Saxe: Mes Reveries,
x, 1732

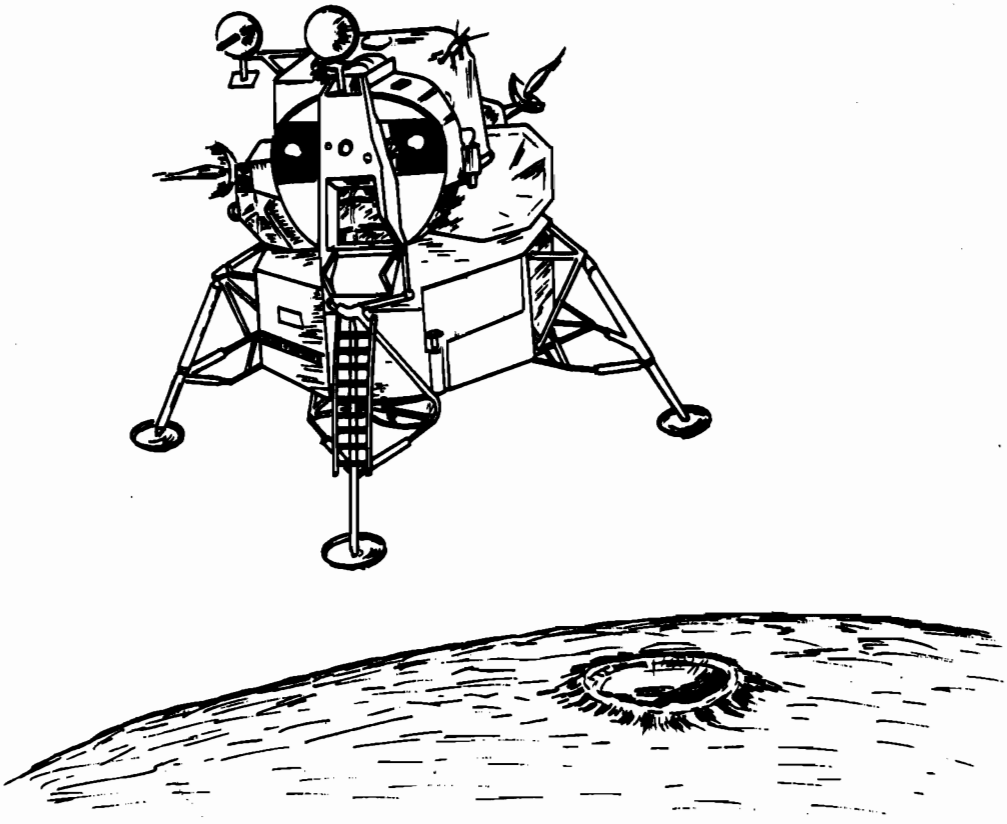
"Human dignity, economic freedom, individual responsibility; these are the characteristics that distinguish democracy from all other forms devised by man."

— Dwight D. Eisenhower

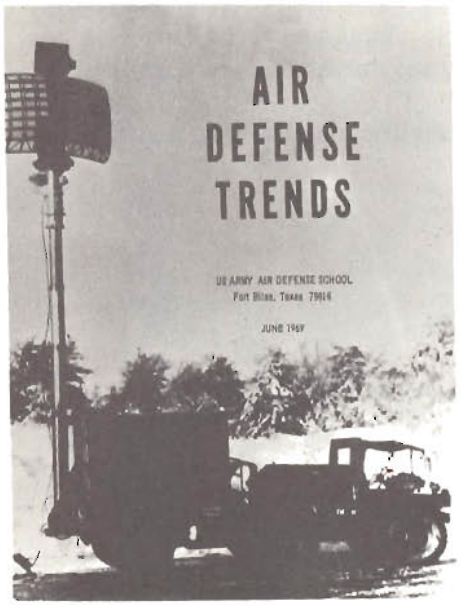
General of the Army and
former President of the United States
Dwight D. Eisenhower—1890-1969



IN MEMORIUM



Air Defense Trends congratulates NASA and the valiant Apollo 10 astronauts.



COVER As attack aircraft of potential enemies become more combat efficient, so must our systems of defense become more effective. Speed and accuracy of detection and identification are vital factors in successful air defense, and the system pictured here provides that speed and accuracy. This is the new forward area alerting radar (FAAR), which has recently been released for service testing. It was developed by the US Army Missile Command, Redstone Arsenal, Alabama. As the name implies, it will be deployed throughout the forward edge of a battle area where it will locate and identify aircraft flying at very low altitudes. It will then transmit this information by radio frequency data link to Chaparral, Vulcan, and Redeye fire units.

The FAAR system is air transportable and consists of a lightweight, pulse-doppler radar mounted in a standard S250 shelter and transported by an M561 (Gama Goat) 1-1/4-ton truck. Power is supplied by a 5-kilowatt generator in a 1/2-ton trailer towed by the "Goat" (not shown in this picture). The identification, friend or foe (IFF) equipment is the new AN/TPX-50 which has the capability of challenging and identifying all targets detected. A radio data link sends target data to small rapid alerting and identification display (RAID) units located with the fire units.

FARR provides continuous coverage of the air defense space assigned the forward area defense weapons, even in a heavy-clutter environment. Target location and identity are displayed on a plan position indicator and in turn are transmitted to the RAID units.

The RAID (fig 1) displays data received from the FAAR on a matrix of 49 squares, each of which contains two colored disks that are green on one side and red on the other. A green disk exposed within a square indicates a friendly airborne object within the airspace represented by that particular square. A red disk indicates a hostile or unidentified object within the airspace represented by the square. In this way, RAID can display up to 49 friendly and 49 hostile or unidentified targets at once.

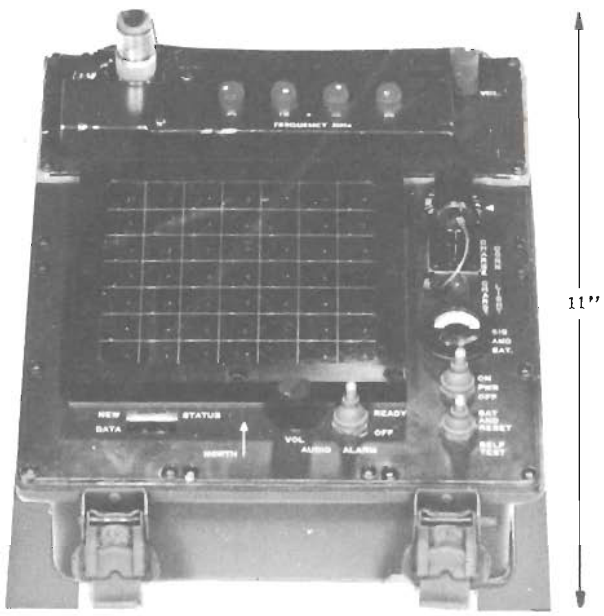


Figure 1. Rapid alerting and identification display radar.

FAAR is deployed as a platoon consisting of 12 radar sections organic to headquarters and headquarters battery of the Chaparral/Vulcan battalion. Each section has one radar manned by a crew of three: section chief, radar operator, and driver/radar operator.

Forward area unit commanders will welcome this extremely valuable addition to their air defense arsenal.

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.

Articles appearing in this publication do not necessarily represent the view of the US Army Air Defense School.

It is the earnest desire of the US Army Air Defense School that Air Defense Trends fulfill its intended purpose to the maximum extent. Comments from the field in the form of "letters to the editor" are solicited to enhance the effectiveness of the publication.

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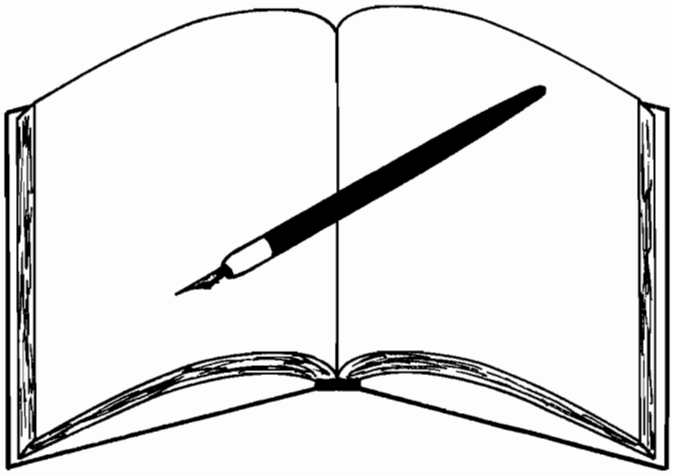


When appropriate, names and organizations of authors are furnished to enable readers to contact authors directly when they have questions concerning an article.

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.

Air Defense Trends acknowledges with pleasure the many encouraging letters and other communications from its readers.

LETTERS to the editor

LIKES "STANDARD TACTICAL MISSIONS"

• I have just finished reading the first copy of Air Defense Trends and enjoyed it very much. The doctrine expressed in the article on standard tactical missions for air defense artillery is excellent, and the sooner it is adopted for Army-wide use the better. There is no reason for ADA to be out of step with the rest of the Army. Widespread use of ADA tactical missions will provide commanders with the knowledge of what air defense artillery can do for them.

Yours in general support,

W. H. Steward, Jr
LTC, ADA, USAR
4160th El Paso USAR School
PO Box 9391
El Paso, Texas 79986

BOOS "STANDARD TACTICAL MISSIONS"

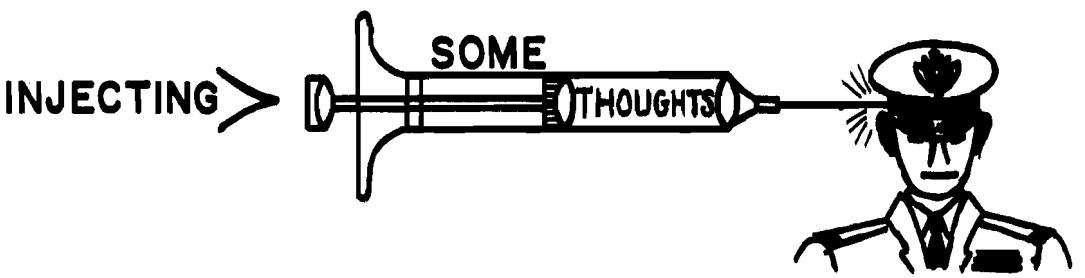
• The members of our unit liked the first issue of AD Trends. However, I would like to take exception to the article on "Standard Tactical Missions for Air Defense Artillery."

I noticed that the Air Defense School stated that this was strictly a developmental item and is not doctrinal yet. Even though the combat support branches use standard tactical missions, I seriously doubt their validity when applied to air defense. Regardless of what you name it, air defense is based upon command guidance, whereby the force commander tells the air defense commander what he wants defended and their priority for defense. After the air defense commander weighs the priorities or requirements against his available assets, he can come up with his recommended organization for combat.

Therefore, I do not see the need for standard tactical missions.

—AD Veteran

This letter seems to have been written with the idea of . . .



• Although automatic weapon (AW) units are members of the air defense artillery branch and are part of the Army's overall air defense capability, their current utilization in a ground support role in Vietnam stimulates thought to different employment with another branch of the combat arms. In Vietnam, with a practically nonexistent enemy air threat, it seems surprising that AW elements are not employed exclusively with armored cavalry units. A look at the capabilities of AW elements, together with the disadvantages and problems of current employment, may indicate why the current mode of employment is so surprising.

The present employment of AW in Vietnam involves support of nearly every type of free world military assistance forces, very often field artillery oriented or associated. Deployed throughout Vietnam in security and defensive missions, AW elements are habitually divided into sections (two-to-four weapons) so that a single battalion is dispersed throughout a corps zone. Resultant problems of command and control, logistics, communications, and weapon effectiveness arising from wide geographical dispersion and division into small fire units are numerous. Throughout the chain of command from battalion commander to platoon leader, tremendous difficulty is experienced in merely visiting AW troops, let alone having effective command or control. In many cases, sheer inaccessibility to AW positions precludes effective logistics resupply, maintenance performance, and communications. Weapon effectiveness with guns spread over large geographical areas is hardly in keeping with any tradition of massed firepower. In fact, a "two here, two there" concept seriously multiplies one detrimental factor affecting AW—that of ammunition resupply in view of their rapid firing rate. A method of employment as a unit exists where these problems would be decreased or eliminated.

Even at a glance, the compatibility of AW elements with armored cavalry units indicates glittering possibilities. Automatic weapon battalions are heavily weighted with tracked vehicles organized into four firing batteries of self-propelled twin 40-mm guns (M42) and often have an attached battery of multiple .50 caliber machineguns (quads) trailer-mounted and carried in 2-1/2-ton trucks. The fully automatic twin 40-mm gun is mounted on a basic M41 light tank chassis which points glaringly to the compatibility with armored cavalry. In actuality, the M42 was originally designed to be employed with armored divisions (for air defense coverage) which further substantiates similarities between the type units. Both 40-mm and armored cavalry units contain, in effect, armor-protected, highly mobile, track-laying vehicles mounting effective weapons which indicates a maximization of mobility and firepower should the two be employed as a unit. The devastating firepower of the twin 40-mm gun, capable of 240 rounds per minute at a muzzle velocity of 2,870 feet per second, is entirely consistent with armored cavalry's principle of shock. In addition, each M42 mounts an M60 machinegun (although an observer in Vietnam may often notice two M60's per vehicle plus occasional .50 caliber machineguns), and crewmembers carry a complete array of individual weapons to round out the guns' total capability. Mobility of the M42, which attains speeds of 45 mph, crosses 6-foot ditches, fords 40 inches of water, and climbs 60-percent grades, is commensurate with that of an armored cavalry unit either on or off existing roads. Communications (with AN/VRC-12-series FM radios and AN/GRC-106 AM radios) are compatible with armored cavalry units.

Inevitably, maintenance procedures would be enhanced if AW elements could draw upon the expertise of armored cavalry units. The application of maintenance programs should

prove more effective consistent with the parallel that system-common items of equipment require identical maintenance services. Although there are specific differences between types of vehicles, the fact remains that both units have basic tank-type, track-laying vehicles which ultimately need similar maintenance services. Moreover, certain repair parts are interchangeable between the different tracked vehicles which increases economy of effort and simplifies repair parts supply. Particularly in an emergency situation the capability to exchange a crippling repair part and continue the operation may be the critical factor contributing to mission accomplishment. Because the AW battalion would be operating in a small area of operations as a cohesive unit, timely delivery of repair parts to deadlined vehicles could be effected. By consolidating existing maintenance resources of personnel and equipment, the AW battalion can exercise more direct supervision of the maintenance effort and increase efficiency of its entire program. Armored cavalry units have a better capability for recoverability with their tank retriever vehicles and could aid in powerpack replacement/service with additional wrecker support. Actually, the compatibility between the two units' maintenance systems would indicate that AW units should be provided an identical maintenance TOE to raise AW maintenance performance capability; however, this conjecture cannot be exploited within the constraints of this letter. Other combat service support procedures and problems encountered by AW units are similar to those of armored cavalry units.

For further understanding of the proposal, a look at an ideal employment of an AW battalion with an armored cavalry regiment may depict better the many facets of the idea. At the outset, it is apparent that total capability, effectiveness, and versatility of the regiment would be tremendously improved with the addition of an entire AW battalion. With the AW battalion employed separately or integrated into existing squadron arrangements, the regimental commander has increased flexibility to employ traditional armored concepts of aggressive maneuver and violent execution. If the AW battalion retained attached quads, the regiment could enjoy economy of force by using the quads to secure command, logistic, and artillery bases, thus freeing maneuver forces for operational requirements. Firepower and mobility, already fearsome in an armored cavalry regiment, could well be described as awesome if a battalion of 64 twin 40-mm guns were added to the configuration. Since the M42 was originally designed to be employed with armored units, design characteristics and basic conceptual capabilities would be fully realized as intended. An armored cavalry unit may be utilized in defensive or security roles, but is more often considered as the aggressive offense and maneuver arm. AW units have the capability to complement the armored cavalry's offensive role either in support or as a separate entity. It would seem reasonable to capture this capability and maximize total effectiveness rather than relegating AW units to the part-time defensive role currently in effect. In retrospect, an M42 is in reality a light tank and, if attached full time, would indubitably complement a tank-type unit.

From the AW viewpoint, many continual problems arising from current employment techniques could be lessened or circumvented. AW commanders could at last realize vested responsibility in command and control. Instead of the current position as AW advisers to supported units and administrative command, commanders at each echelon would be in full contact with their men and able to participate in active supervision and control. The ordinarily smaller area of operations maintained by armored cavalry regiments as compared to a corps area, in which AW elements are presently scattered, would reduce geographical

dispersion and extended lines of communication and logistics to a manageable level. Correspondingly, administrative and maintenance problems would be simplified by any appreciable reduction in area size.

As an adjunct to assignment of an AW battalion to an armored cavalry regiment, morale and esprit de corps of AW personnel would undoubtedly be lifted. The current situation places AW personnel throughout a large area, widely separated from commanders and each other, often working for numerous supervisors, and dependent upon another unit for all support. Habitually, units care for assigned personnel first and only secondarily care for attached or support personnel. Sustained work in an environment of "always second" places an emotional burden on the minds of personnel and creates poor attitudes toward integral mission accomplishment—a dangerous disposition in combat. If AW elements were consolidated as a unit, personnel could work as a team and pursue common goals under coordinated supervision similar to any other unit in the Army.

Probably at this stage of the Vietnam conflict a real location of AW resources to armored cavalry units (ideally regimental) would raise controversy and encounter physical difficulties forbidding the action. Nevertheless, utilization of AW elements with armored cavalry is possible and could conceivably contribute much to the overall mission accomplishment. Perhaps the absence of an enemy air threat could never really erase all traditional air defense doctrine and culminate in a "surprising" concept. However, when an enemy air threat exists, Redeye alone provides air defense for the armored cavalry unit. If Vulcan is the answer, why is this system not also with the armored cavalry?

—A Vietnam Veteran

USAADS Instructional Notes

Hinman Hall

OFFICE OF DOCTRINE DEVELOPMENT, LITERATURE, AND PLANS

TRAINING LITERATURE REPORT

Here is a list and the status of Department of the Army training literature produced by the US Army Air Defense School for the second and third quarters, fiscal year 1969.

a. FM 23-17A, Redeye Guided Missile System (revision), classified supplement to FM 23-17, was submitted to The Adjutant General's Office (TAGO) in January 1969.

b. FM 44-4, Procedures and Drills for Chaparral Self-Propelled Weapon System (new), was distributed in January 1969.

c. FM 44-4A, classified supplement to FM 44-4 (new), was submitted to TAGO in January 1969.

d. FM 44-19, Qualification Program, Air Defense Artillery Weapon Systems, was distributed in December 1968.

e. FM 44-21, Service Practice for ADA Automatic Weapons Units (revision), was submitted to TAGO in January 1969.

f. FM 44-30, Visual Aircraft Recognition, was distributed in April 1969.

g. FM 44-82, Procedures and Drills for Nike Hercules Missile Battery, was distributed in November 1968.

h. FM 44-99, Procedures and Drills for Hawk Missile Battery (Towed and Self-Propelled) (revision), was submitted to TAGO in April 1969.

i. ATP 44-85, Air Defense Artillery Automatic Weapon Units (M42, M55) (revision), was submitted to US Continental Army Command (USCONARC), in March 1969.

j. ATP 44-255, Air Defense Artillery Battalion, Hawk Self-Propelled (new), was submitted to TAGO in January 1969.

k. ATP 44-500, US Army Air Defense Artillery Missile Warhead Support Organization, was distributed in January 1969.

l. ATP 44-535, ADA Battalion, Nike Hercules (change), was distributed in October 1968.

m. ASubjScd 23-17, Redeye Gunner and Air Defense Section Training (revision), was submitted to USCONARC in March 1969.

n. ASubjScd 44-14, Automatic Weapons Section (M42) (change), was submitted to USCONARC in March 1969.

o. ASubjScd 44-16F10, Advanced Individual Training and Refresher Training of Automatic Weapons Crewman MOS 16F10 (revision), was submitted to USCONARC in March 1969.

p. ASubjScd 44-17, Machinegun Squad (M55) (change), was submitted to USCONARC in March 1969.

q. ATT 44-85, Air Defense Artillery Automatic Weapons Units (revision), was submitted to USCONARC in March 1969.

r. ATT 44-235, ADA Missile Units (Hawk), Change 1, was distributed in November 1968.

* * * * *

SL-ARK KITS

Order your SL-ARK No. 1 through your local audiovisual center or training aids center. They are not stocked by the US Army Air Defense School. Army Subject Schedule 44-2 provides guidance on training in aircraft recognition.

SAM-D MOTOR IS TEST FIRED

The solid-propellant motor designed for use with the Army's new SAM-D (Surface-to-Air Missile—Development) system has successfully passed its first firing test.

The dual-purpose firing was designed to test both the propellant system, modified slotted-tube grain configuration, and the motor case.

NOW IN advanced development, the SAM-D air defense missile system is intended for battlefield and continental defense against high-performance aircraft and short-range missiles. It will use a sophisticated phased-array radar to simultaneously detect and track multiple targets and track and issue guidance commands to the missiles in flight.

The highly mobile system will be mounted on tracked or wheeled vehicles.

Missiles—capable of delivering either conventional or nuclear warheads—will be carried in multiples on launcher vehicles and launched directly from their individual closed canisters.

THE MOTOR WAS developed and tested by Thiokol Chemical Corporation, contractor to Martin Marietta Corporation, for the high-energy propulsion system. Raytheon Company is the prime contractor for the SAM-D system.

—ARADCOM Argus
March 1969

NONRESIDENT INSTRUCTION DEPARTMENT - NEW MOS CORRESPONDENCE COURSES

A new Enlisted Career Development Program is being prepared which will offer enlisted career development correspondence courses for all military occupational specialties (MOS) in Career Group 16, Air Defense Artillery. These correspondence courses are designed to:

a. Aid in improving job knowledge and job performance.

b. Assist in qualification for promotion (up to 30 promotion points may be awarded for completion of 30 credit hours of correspondence subcourses).

c. Assist in preparing for annual MOS evaluation tests.

Each course will cover, in one or two subcourses of 30 to 40 hours each, the material applicable at the specified skill level above the entry MOS. Appropriate manuals and regulations will be furnished as texts. The first series of these courses will be available by 1 June 1969 for the following MOS skill levels:

a. 16B20 and 16B40 - Nike Hercules Missile Crewman.

b. 16D20 and 16D40 - Hawk Missile Crewman.

c. 16E20 and 16E40 - Hawk Missile Fire Control Crewman.

Additional courses to cover the remaining Career Group 16 MOS skill levels (except MOS 16J) will be available during 1969 in time to prepare for the related MOS evaluation tests. These courses will be listed in the 1969-70 Correspondence Course Catalog to be distributed 1 July 1969.

These MOS correspondence courses are particularly well adapted for group study with two or more individuals studying together and participating in joint discussions and critiques.

Individuals desiring to enroll in one of these courses must complete DA Form 145, Army Extension Course Enrollment Application, and submit it through normal channels to the Nonresident Instruction Department, United States Army Air Defense School.

A copy of the 1969-70 Correspondence Course Catalog, which describes, in detail, all of the Career Group 16 correspondence courses, may be obtained by completing and forwarding the request (see post card at end of this publication). This card may be torn out and mailed. No postage is required.

COMMAND AND STAFF DEPARTMENT

CAREER

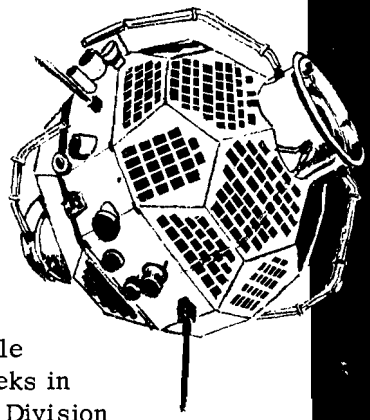
MINDED

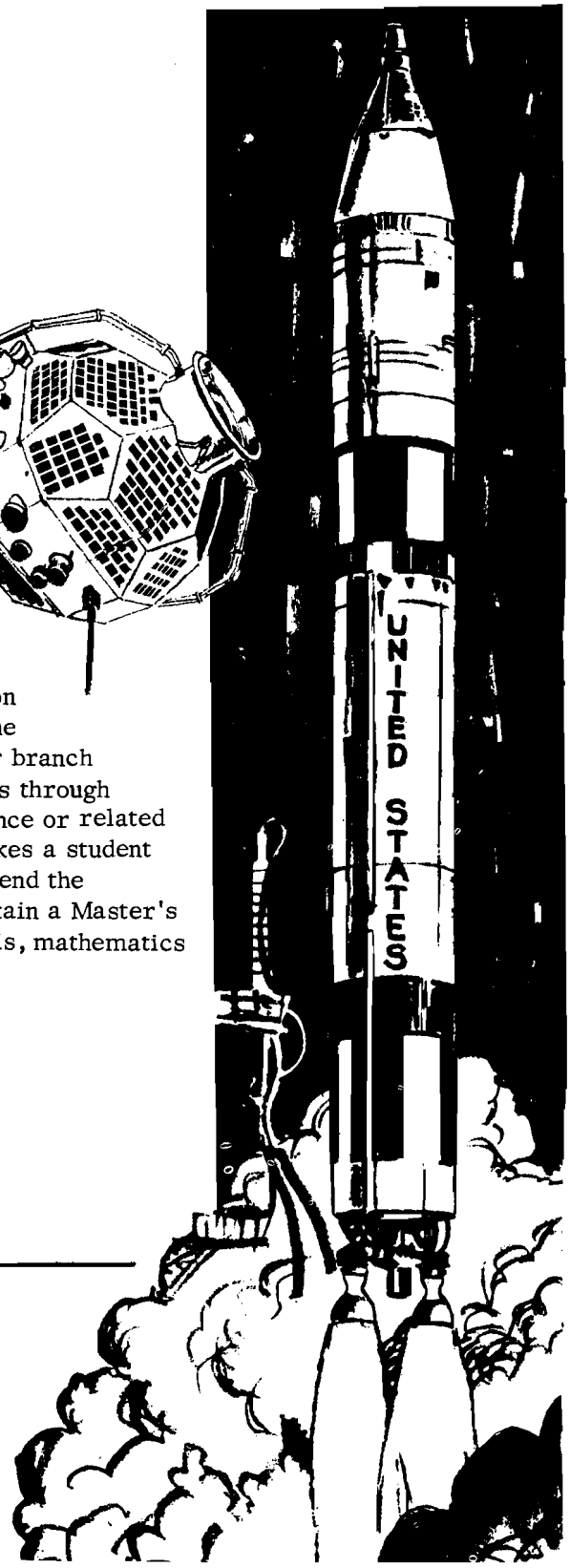
OFFICERS

GIVE YOURSELF A BOOST BY ATTENDING

THE

GUIDED MISSILE SYSTEMS OFFICERS COURSE
(4F-1181)





Today's missile development programs have created new demands for officers with the 1181 MOS—officers trained in the technical aspects of missile systems. The 4F-1181 course is 30 weeks in length and taught by the Missile Science Division in the Air Defense School. Prerequisites for the course are commissioned officer of any arm or branch of any service who has had college mathematics through integral calculus and at least one physical science or related course. Completion of the 4F-1181 course makes a student who has an undergraduate degree eligible to attend the University of Texas at El Paso for 1 year to obtain a Master's Degree in operations research/systems analysis, mathematics physics, or engineering.

For additional information, write:

Commandant
US Army Air Defense School
ATTN: Command and Staff Department
Missile Science Division
Fort Bliss, Texas 79916

MISSILE ELECTRONICS AND FIRE DISTRIBUTION SYSTEMS DEPARTMENT

METRIC PREFIXES
Mega, Giga, and All That Jazz

Ask the average American how tall he is and he'll probably answer in terms of feet and inches. Drop into a British supermarket and you'll find foods priced on the basis of how much they weigh in pounds and ounces. Then why does a Dutchman measure his height in meters and weigh himself in grams? For the same reason that 100 (rather than 12 or 16) pennies make a dollar. It's easier that way.

Matter of fact, measuring anything in terms of 10's and 100's is a snap. That's why electronics employs the metric system for just about every measurement you can think of.

One of the nicest things about the metric system is the fact that you can refer to any unit in terms of multiples and submultiples as a power of 10; it's simple to move from one to another with elementary mathematics.

Let's say we have a resistor which has a value of 680,000 ohms. Since it's as cumbersome to write this figure as it is to write 100 cents for $1, we can drop those last 3 zeros by using a symbol for 1,000 or 10^3. That symbol, as you can see in the table, is k, and 680,000 ohms becomes 680 x 10^3 ohms, or simply 680k.

Similarly, instead of specifying that a small capacitor has a value of 0.00005 farad, we can use another symbol, μ, to indicate that the capacitor has a value of 50/1,000,000 farads, or 50μf. Again, the table shows there's a power of 10 involved, but this time it has a minus sign in front of it. That minus sign indicates that the symbol stands for 1 over 10^6, or 1/1,000,000.

Study the table until you know what the metric system is all about, remembering that 10^1 is 10, 10^2 is 100, 10^3 is 1,000, and so on, while 10^{-1} is 1/10, 10^{-2} is 1/100, 10^{-3} is 1/1,000, etc. In almost no time, you'll wonder what you ever found so confusing about mega, giga, and all that jazz!

Power of 10	Prefix	Symbol
10^{12}	tera	T
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^2	hecto	h
10^1	deka	da
—	Units	—
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

Because it's based entirely on multiples and submultiples of 10, the metric system of measurement has found its way into scientific circles the world over. In the table, the metric prefixes appear in the center column, while the corresponding powers of 10 and the symbol for each prefix are in the columns at the left and right, respectively. A negative prefix indicates 1 divided by that particular power of 10, so 10^{-3} becomes $1/10^3$ or 1/1,000 or 0.001. Since any power of 10 is simply 1 plus the number of zeros indicated by the power concerned, 10^3 is 1 followed by 3 zeros or 1,000; 10^6 is followed by 6 zeros or 1,000,000, and so on.

Notes From the US Army Air Defense Board

FORWARD AREA ALERTING RADAR

One of the current activities of the US Army Air Defense Board is the service test of the forward area alerting radar (FAAR) (fig 1) which is described in the cover story of this issue of Air Defense Trends. Under the direction of the US Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland, engineer and service testing will begin soon. The engineer test will be conducted at White Sands Missile Range, New Mexico, and at Aberdeen Proving Ground, Maryland. Military personnel from the US Army Air Defense Board, Fort Bliss, Texas, will conduct the service test in five phases: testing in a temperate climate at Fort Bliss, Texas; air transportability testing at Fort Bragg, North Carolina; ground transportability testing at Fort Lee, Virginia; and testing in Alaska and Panama to evaluate the performance of the radar in extreme environments.

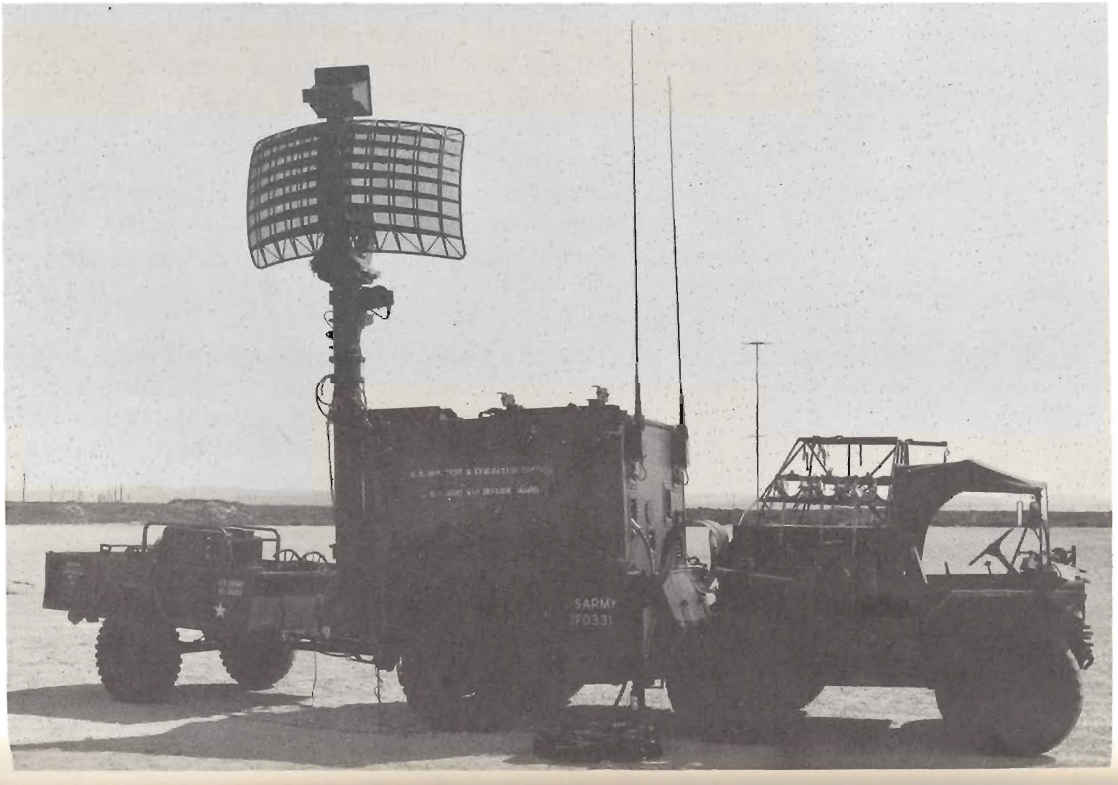


Figure 1. Forward area alerting radar (FAAR) (US Army Air Defense Board *photograph, Fort Bliss, Texas*).

MODERNIZATION THROUGH MICROMINIATURIZATION

Three years of research and development on the new microminiaturized air defense battery fire distribution equipment, commonly referred to as the battery terminal equipment (BTE) (AN/GSA-77), will culminate this spring with the conduct of final service tests by the US Army Air Defense Board.

The BTE (fig 2), which will replace existing equipment, will integrate the Nike Hercules or Hawk weapon systems into any of the three different types of Army air defense command posts. The installation time and costs are a very small fraction of that for present equipment.

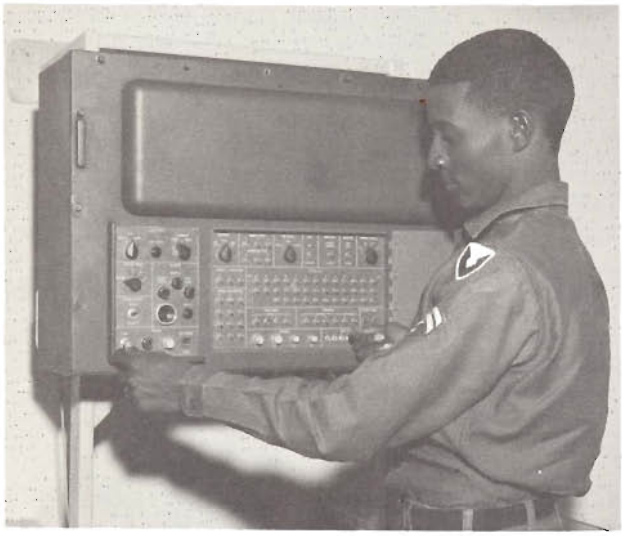


Figure 2. Battery terminal equipment (BTE) (AN/GSA-77) (US Army Air Defense Board photograph, Fort Bliss, Texas).

The BTE has countless advantages over present equipment. One BTE will be located at each defense battery. This 128-pound unit is designed to replace 4,000 to 6,000 pounds of corresponding equipment and to negate the need for present support equipment, such as one transport truck and an air-conditioning unit. Also, the generator and trailer required with present equipment will not be used because the BTE requires only 170 watts of power compared to 7,000 watts required for present equipment. Maintenance of the BTE requires a minimum of training and personnel because it has self-contained fault detection and isolation facilities that automatically test the BTE every 3 minutes and sound an alarm when a fault is detected. This feature gives a defense battery 24-hour-a-day, 7-day-a-week data communications without downtime for maintenance. If communications are lost between the batteries and the air defense command post, the batteries will still receive data from adjacent batteries via a new device called the round-robin. This device ties the batteries together laterally, in addition to the present direct line to the air defense command post, and provides the battery with alternate lines of communciation to aid in accomplishing its mission.

The tremendous savings in cost and manpower and the advantages of the BTE over current systems will greatly enhance the Army air defense posture.

CHAPARRAL AND VULCAN

Chaparral and Vulcan, the Army's newest air defense systems providing low-altitude air defense in the forward battle areas, are presently undergoing extensive service testing at the US Army Air Defense Board, Fort Bliss, Texas.

New air defense battalions will be equipped with the two weapons: the M61 20-millimeter Vulcan and the Chaparral guided missile (a modified Navy-developed Sidewinder). These

systems will complement each other by combining the quick reaction and extremely low-altitude capabilities of the Vulcan with the longer range capability of the Chaparral.

The Forward Area Weapons Branch of the US Army Air Defense Board is testing the Chaparral and Vulcan to determine whether they are suitable for Army use in arctic, tropic, and temperate environments and to determine to what degree the systems meet the qualitative materiel requirements (QMR).

These materiel requirements are specifications developed by the Combat Developments Command to test maintainability, reliability, operability, transportability, and other capabilities. The Air Defense Board, as part of US Army Test and Evaluation Command, acts as an independent testing agency and determines to what degree the equipment meets the materiel requirements. If changes are required, the Air Defense Board suggests these changes to the project manager. The project manager considers the proposed changes and determines how to improve the equipment.

The Chaparral air defense system (fig 3) undergoing service testing, consists of a launch and control station (LCS), modified Sidewinder-1C missiles, and a modified full-tracked vehicle. The LCS is capable of carrying a basic load of 12 missiles (4 on launcher rails and 8 in the storage compartment) and contains all the equipment needed for missile firings.

The system provides space for a crew of five, vehicle fuel and fuel for the main power unit for a minimum of 18 hours' operation, on-equipment materiel, and crew personnel equipment needed for combat operations. The overall weight of the system, when combat loaded, is approximately 27,400 pounds.

At this time, much of Chaparral's service testing has been completed. The Air Defense Board conducted a limited nonfiring test of the Chaparral system during June through August 1967. In September and October 1967, the US General Equipment Test Activity, Fort Lee, Virginia, supported by the Air Defense Board, conducted the Rail, Marine, and Highway Transportability tests. During November 1967, the US Airborne, Electronic and Special Warfare Board, Fort Bragg, North Carolina, supported by the Air Defense Board, conducted air transportability tests at Fort Bliss, Texas.

The Chaparral has been undergoing aircraft tracking tests conducted by the Air Defense Board at Fort Bliss, Texas. A system is also undergoing a 12-month tropic storage test, and another will be placed in storage in the arctic in the near future. Service testing will be conducted in the tropic and arctic environments at the completion of the two storage tests.

The Vulcan (fig 4), which complements the Chaparral in maintaining forward area air defense, is also undergoing extensive and similar testing. The Vulcan 20-millimeter gun is a six-barrel automatic gun adapted from an aircraft mounted air-to-air system. The weapon can be fired at either 3,000 or 1,000 rounds per minute. The Vulcan air defense system is being developed in two configurations, self-propelled and towed.

The self-propelled version is designated the XM163 and consists of a modified M61A1 six-barrel automatic gun, a 1,000-round linkless ammunition storage and feed system, a one-man servo-operated turret assembly, and a range-only-radar unit, all assembled and installed in a modified M113A1 armored personnel carrier.

Figure 3. Chaparral (US Army Air Defense Board photograph, Fort Bliss, Texas).

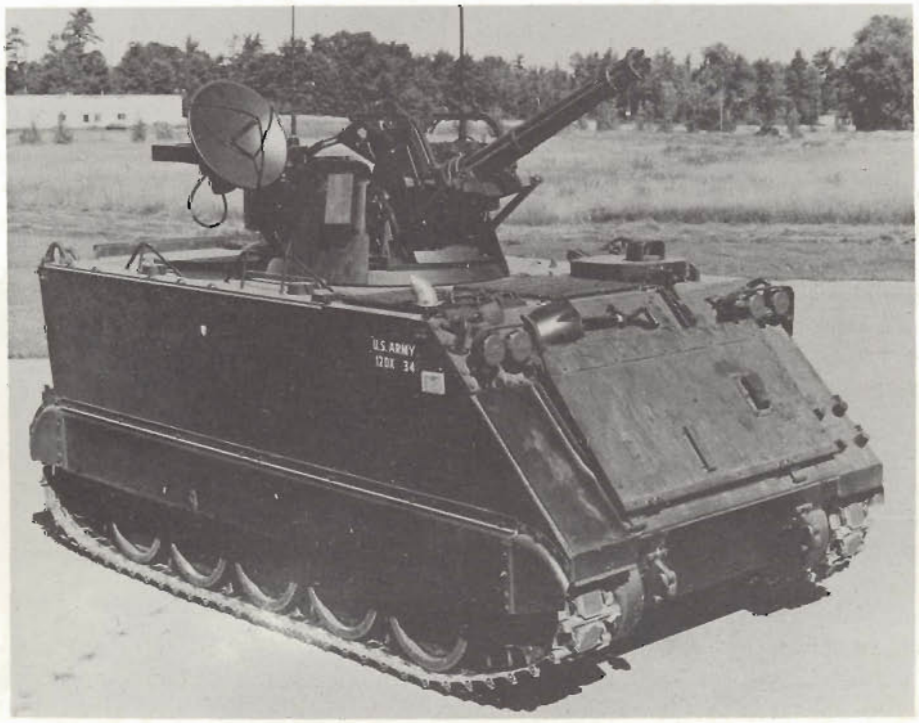


Figure 4. Vulcan.

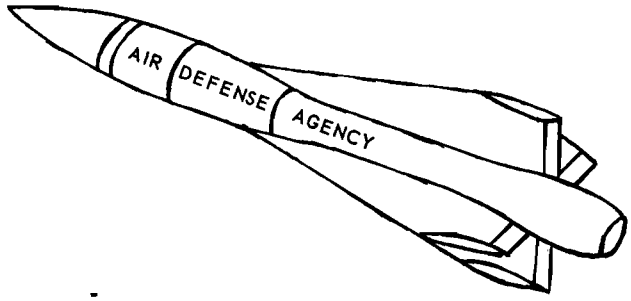
The towed version is designated the XM167 and consists of a modified M61A1 six-barrel automatic gun, a linked ammunition feed mechanism, a one-man servo-operated assembly, and a range-only-radar unit, all assembled and mounted on a two-wheel carriage to be towed by a $1\frac{1}{4}$-ton truck.

An initial production model of the self-propelled Vulcan was delivered to the Air Defense Board in December 1967. Testing of the Vulcan by the Air Defense Board was conducted in July through December 1967 with engineering and service tests of the Vulcan self-propelled system. Tests were conducted in two phases. The first phase was conducted in July through August 1967 and included aerial firing, mobility, and intravehicular communications tests. This phase of testing provided the Vulcan Project Manager early information concerning the relative effectiveness of the self-propelled system. The second phase of testing was conducted in September through December 1967 and consisted of aerial firing, maintainability, air portability, and mobility tests.

Engineering and service tests by the Air Defense Board have continued since December 1967. Additionally, in December 1967, the Air Defense Board began initial production tests of the XM163 Vulcan system. As a result, in December 1967 through June 1968, the Air Defense Board concurrently conducted a service test, an engineering test, and an initial production test of the self-propelled Vulcan system.

A model of the towed XM167 Vulcan system was received by the Air Defense Board for testing in July 1968, and testing has begun.

Notes From the US Army Combat Developments Command



BACKGROUND

The job of the United States Army Combat Developments Command Air Defense Agency (USACDCADA) is to determine how US Army air defense artillery units of the future will fight, how they will be organized, and how they will be equipped. Some actions are reported as matters of general interest.

CHAPARRAL DEFENSE EVALUATION

On 26 March 1969, the US Army Combat Developments Command Air Defense Agency issued a newsletter entitled "Manual Effectiveness Evaluation of Chaparral Deployments." The classified newsletter provides field commanders with interim tools, procedures, and techniques for manually evaluating defense effectiveness against air attacks on a Chaparral area or vital area (point) defense.

The approach used for the manual evaluation of Chaparral defenses was that of the "urgency diagram" (see app B, FM 44-1, USA AD Arty Empl, for a sample). The urgency diagrams developed show the limits at which detection, firing, and intercept must occur, and permit a rapid assessment of the effects of terrain. The 32-page newsletter includes urgency diagrams for jet aircraft, turboprop aircraft, and helicopters. It also includes examples of typical Chaparral fire unit deployments. Detailed defense evaluation procedures are included.

JOINT AIR DEFENSE DOCTRINE

At the suggestion of the Agency, the Air Defense Center Team recommended to Department of the Army that certain changes be made in Joint Chiefs of Staff (JCS) policies regarding joint air defense operations. The policies requiring change are recorded in JCS Pub 8 and JCS Pub 12. The main thrust of the Center Team recommendations is to insure field army control of its ADA weapons, rather than leaving this army control optional, and to insure that the forward area ADA data receipt and reporting requirement is minimized.

DIVISION AIR DEFENSE ARTILLERY

A recent Center Team action established the position that air defense artillery must be organic to the divisions. Specifically, the Center Team view is that divisions have air defense requirements that can be met only through use of organic Chaparral/Vulcan battalions (and Redeye, of course) and, further, that the concept of "pooling" a small number of Chaparral/Vulcan battalions at some high command echelon for division use, as needed, is an invalid concept.

ORGANIZATION

All Chaparral/Vulcan tables of organization and equipment have been rewritten to reflect the new weapon mix decision announced by the Department of the Army (DA) in December 1968. This decision changed the Chaparral/Vulcan battalion mix from 32-32 systems per battalion to 24-24. TOE 44-325G, ADA Battalion, Chaparral/Vulcan, Self-Propelled, and its component tables were redone in December 1968. They have been approved by DA and are now awaiting publication and distribution. This is the Chaparral/Vulcan organization organic to infantry, mechanized, and armored divisions. TOE 44-725G, ADA Battalion, Chaparral, Self-Propelled, Vulcan, Towed, and its component tables were redone in January and are now at DA for approval. This is a nondivisional Chaparral/Vulcan organization.

FIELD MANUALS

The 44-series doctrinal field manuals older than those listed below are obsolete.

a. FM 44-1, US Army Air Defense Artillery Employment—July 1967.

b. FM 44-1A(S), US Army Air Defense Employment (U)—September 1965 (with one change).

c. FM 44-2, Air Defense Artillery Employment (Automatic Weapons), M42/M55—November 1968.

d. FM 44-3, Air Defense Artillery Employment, Chaparral/Vulcan—April 1968.

e. FM 44-95, Air Defense Artillery Employment, Nike Hercules—April 1968.

f. FM 44-96, Air Defense Artillery Employment, Hawk—April 1968.

If you have any suggestions or complaints regarding these manuals, see paragraph 2 or 1-2 of the manuals. These paragraphs tell you how to get in your two cents' worth with the proponent for these manuals—the United States Army Combat Developments Command Air Defense Agency at Fort Bliss.

TERMINOLOGY

The term "Hold Fire" has at least two meanings. To people oriented toward the Redeye/Vulcan/Chaparral type of operation, "Hold Fire" simply means "do not fire" and is applied

as a weapons control status on an area/time/class of aircraft basis. To Nike Hercules/ Hawk people, "Hold Fire" is a special control instruction sent to a particular Nike Hercules or Hawk fire unit and means "do not fire—destroy any missiles in flight." "Hold Fire" is not really used identically in both of these applications. This wording problem has caused confusion. So the Agency, with the concurrence of the US Army Air Defense School, is recommending to DA that the weapon control status terms be changed to "Weapons Free," "Weapons Tight," and "Weapons Hold," (no change in the special control instructions "Hold Fire," "Cease Fire," and "Cease Engagement").

Notes From the Human Resources Research Office

An accurate list of Human Resources Research Office (HUMRRO) accomplishments on behalf of the Army would be difficult to compile, but here is a report on some of the most recent ones of interest to air defense personnel.

- A new method of instruction for guided missile operators has been adopted.

- A self-instructional, automated course in an abbreviated version of the Vietnamese language, tailored for military advisers in that country, has been made available.

- Programed textbooks for teaching low-altitude aerial observation skills and knowledges are in use.

- Findings from HUMRRO research in electronics maintenance training have been implemented at the Missile and Munitions Center and School and the Air Defense School.

- A new method for teaching a soldier to aim and fire his rifle at night with increased effectiveness has been perfected.

- Scientists are progressing with a computer-administered instruction (CAI) project which HUMRRO has dubbed IMPACT. During its first 18 months, CAI made considerable progress. This advanced-development effort is aimed at providing the Army with an effective, efficient, and economical CAI system.

Twelve experimental, individual-student stations have been constructed at HUMRRO/Alexandria and are being connected, in a remote mode, to the HUMRRO computer (IBM 360/40H). The remote mode is being used so that the prototype CAI system will operate in the same way it would for student stations located any distance from the computer.

The instructional decision model, which is the heart of the IMPACT CAI system, is being developed and a "breadboard" version should be ready for testing soon. The model is a set of rules for matching the presentation of specific subject matter and questions (selecting and sequencing) with student capabilities (student characteristics and responses to earlier material).

Detailed behavioral objectives have been developed for the first program of instruction—a course to teach the COBOL computer language to Army miltary and civilian programers. The IMPACT staff has completed that portion of the instructional content which will be used in the first student testing of the prototype IMPACT system.

Software development, which consists of a specially modified version of IBM Coursewriter language, is progressing rapidly. This language has already been modified for use with the student-station cathode-ray tube display device.

Project IMPACT is being undertaken in four successive, and partially overlapping, cycles—a procedure which HUMRRO believes will produce a maximum payoff most rapidly and which will provide the Army with a CAI system it can put into operation with minimum delay.

Project IMPACT is focused on critical military subject matter. However, its results will be important to civilian education because CAI is a sophisticated technological development for all instruction —both education and training.

The 12 student stations are being equipped with the Sanders Associates 720 data-display system consisting of a cathode-ray tube, typewriter-type keyboard, and light-writing pen. In addition, each station will be equipped with an auxiliary visual-display device that can project still or motion-picture frames and sequences.

This auxiliary display device is a screen onto which images are projected from a Perceptoscope (a 16-mm random-access film projector which is controlled by the computer).

Two of the 12 student stations will also have some special experimental features which will be evaluated for effectiveness. One will be equipped with a Sylvania Tablet. The Tablet is an electronically sensitized sheet of glass that enables the computer to read what a student writes upon it (making it possible for the student's responses to be as much like those required on the job as possible). The IMPACT staff will also investigate the feasibility of voice input and output techniques.

The computer, with its enormous information storage and retrieval capability, is a tool that permits many complex instructional decisions to be computed and carried out almost instantaneously—decisions such as what material should be presented next to each student in light of his individual situation. For the computer to be effective in CAI, it must be programed to operate under appropriate decision rules; i.e., it must have built-in rules for the best ways to teach particular kinds of subject matter to particular kinds of students. Taken together, these rules comprise the decision model for the instructional process.

The IMPACT staff has surveyed various aptitude, achievement, and other diagnostic tests and has selected a suitable set. They have selected concepts, methods, and techniques from the psychological literature for adaptation to IMPACT requirements. They have analyzed the subject matter structure of the COBOL language according to formal mathematical and logical techniques in order to devise efficient teaching-learning approaches.

This work, together with other source material, has allowed the IMPACT staff to begin preliminary formulation of decision rules to use in individualizing instruction.

IMPACT staff members have conducted an analysis of military and civilian programer jobs in the Army. This analysis provided the basis for development of behavioral objectives for the COBOL course.

Next, they have prepared the instructional content to be used in the first student testing of the prototype CAI system. This content was based on the course's behavioral objectives.

A progress report on the first $1\frac{1}{2}$ years of IMPACT research and development is in preparation.

From the Field

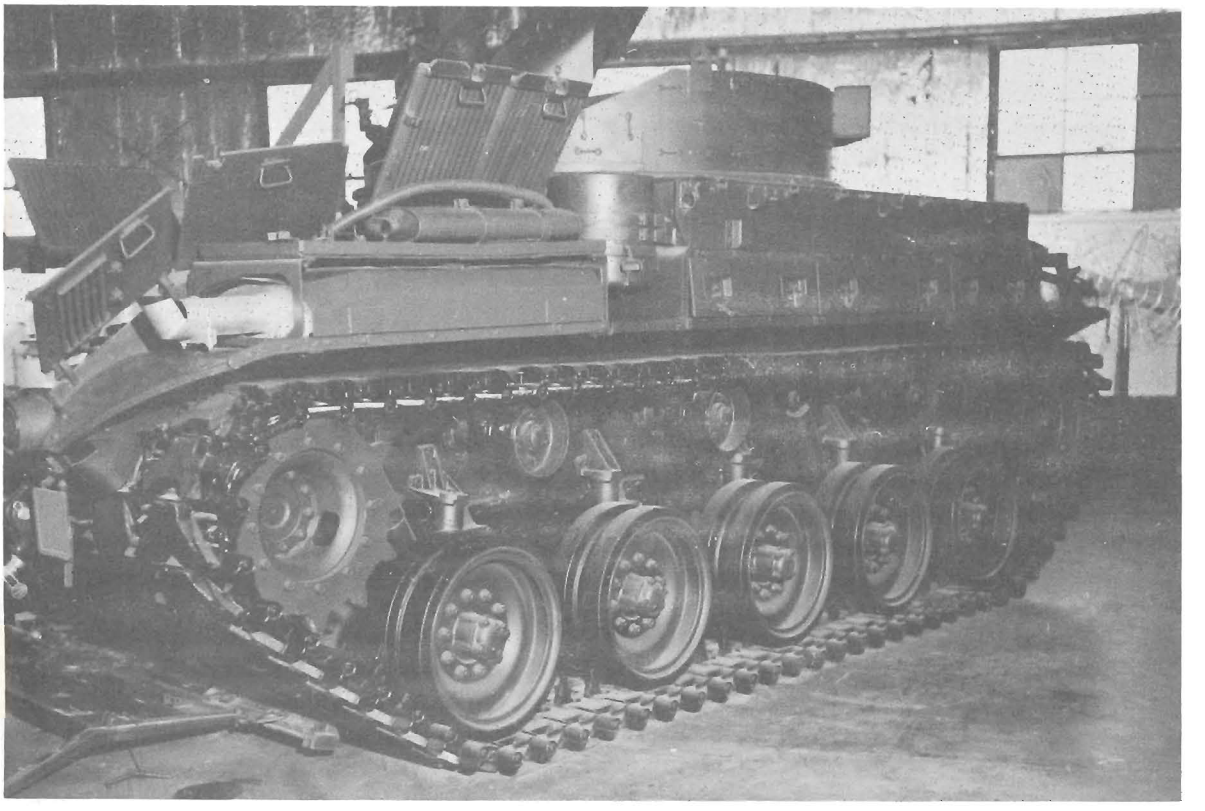
HELPFUL HINTS

Editor's Note:

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

US ARMY TRAINING CENTER (AIR DEFENSE)

Instructors of the Noncommissioned Officer Candidate School, 1st Advanced Individual Training Brigade (Air Defense), US Army Training Center (Air Defense), at Fort Bliss, have developed a training aid which visibly demonstrates to each candidate the functional parts of the M42 "Duster." Each part of the system that the candidate must study during his maintenance classes is disassembled and painted different colors, so that he can quickly see and differentiate between the functional parts of each system (figs 1 through 6).



The right side of the M42 is shown to the candidate first, which gives him a knowledge of how the equipment looks in the field.

Figure 1. M42 gun (right side).

Portions of the left side of the vehicle have been removed so that the candidate can see how to repair or replace a broken part.

Figure 2. M42 gun (left side, disassembled).

The various systems in the engine compartment are painted different colors so that the candidate can quickly see and differentiate between the systems.

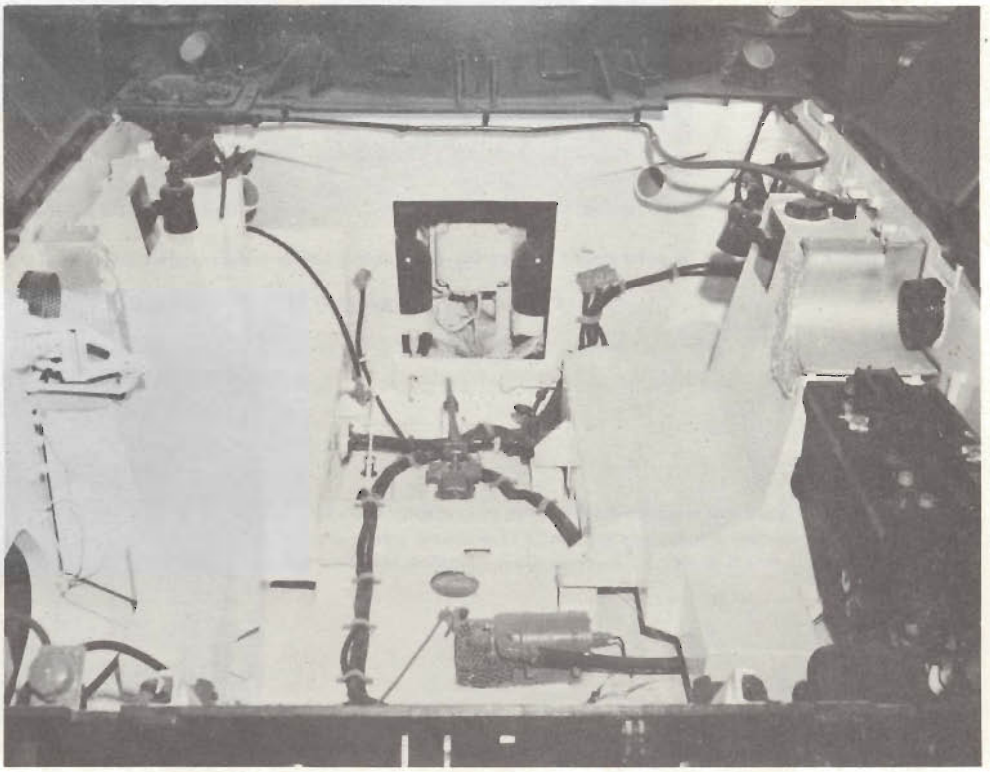
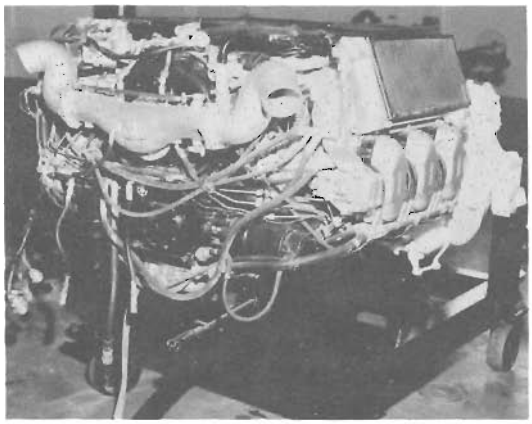
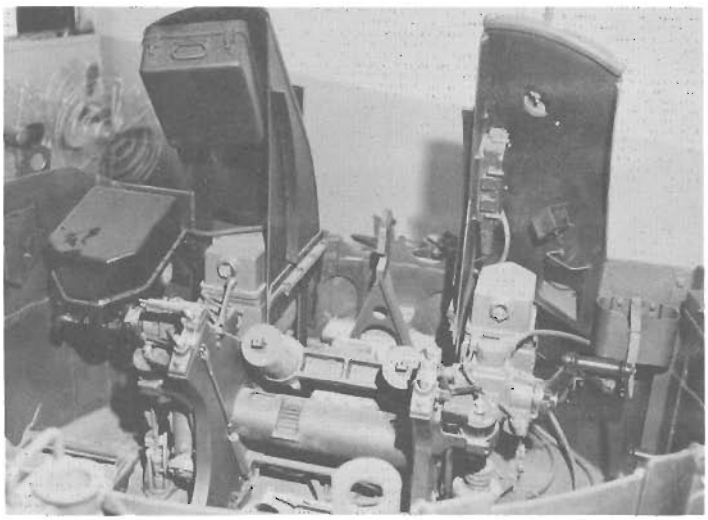


Figure 3. Engine compartment of M42 gun.



The engine is removed and mounted on a movable stand so that the instructor can point out the exterior parts of the engine as he explains how they are repaired or replaced.

Figure 4. M42 gun engine.



The inside of the turret is color-coded to give the candidate a better understanding of the major parts and their functions.

Figure 5. M42 gun turret (inside).

The two 40-mm guns are removed from the turret assembly and displayed so the candidate has easy access to them. One gun is disassembled to show all parts that must be cleaned during maintenance operations.

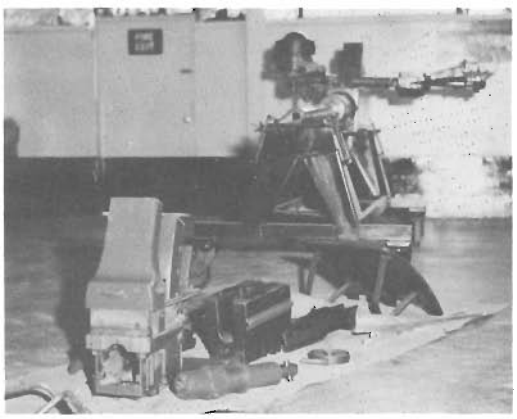
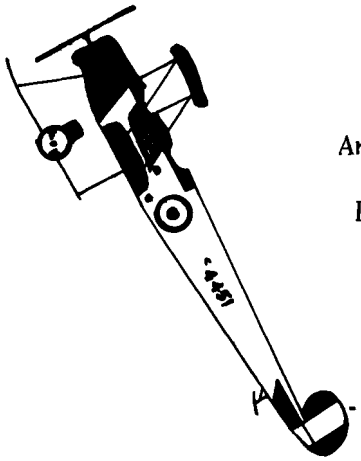
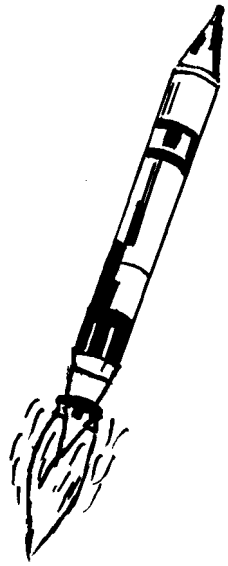


Figure 6. Two 40-mm guns, with one gun disassembled.



The winged thing has come,
And feeding upon the fruits of man' brain,
It grows bigger, stronger, swifter,
It is at once magnificent and fearsome.



History of Air Defense

THIS IS THE FIRST IN A SERIES OF ARTICLES ON AIR DEFENSE HISTORY.

With the first awakening that an airborne object could harm him, man began searching feverishly to find an effective defense. Each successful measure was, in turn, negated by advancements in aerial vehicles. These vectors of destruction have become so awesome as to hang a dark cloud of foreboding over the feeling of security that is one of man's fundamental psychological needs. Their ominous threat of mass destruction has reached into the very lives of civilized man the world over. For these reasons, air defense has become of paramount consideration in our national defense. And the new Air Defense Artillery Branch is inevitably caught up in the sweep of action to devise means of protection that we can trust. With this magnitude of emphasis on air defense, one must wonder how it all happened; so let's take time to look back and see.

Our source of material for this series is Air Defense-An Historical Analysis produced in four volumes by the US Army Air Defense School in 1965 under the supervision of Colonel David B. Byrne, now Inspector General, Third US Army.

—Editor

THE GREAT WAR, 1914-1918

THE WINGED THING IS CONCEIVED

World War I gave birth to a new dimension in warfare—attack through the air. This, in turn, required those on the receiving end of such attack to combat the new threat by the use of airplanes and antiaircraft. The cycle continued, and attackers had to change tactics

and techniques to offset the defense. By today's standards, World War I materiel and operations used for air defense and offense were primitive, but they set patterns and isolated problems that remain with us today. Thus, the first Great War is more noteworthy for establishing trends in weapons and tactics than for producing statistics as to bombs dropped and planes killed.

At the start of the war, neither the United Kingdom, France, nor Germany had a capability of defense against air attack. On the other hand, none of the countries could launch an effective air attack.

Very soon, however, single-seat airplanes, initially utilized for reconnaissance purposes, were developed to perform, by air-to-air combat, a secondary mission of denying enemy snooping over friendly territory. With time, the single-seater became primarily a fighter, an airmobile machinegun platform, with the intelligence task largely taken over by two-seater craft. The two-seater craft were forced to carry forward-firing armament as well as weapons for use by the rear seat occupant.

Typical of the early single-seater was the French Caudron G-111 (fig 1). The armament of this type plane first appeared in February 1915 when a French pilot named Garro mounted a forward-firing automatic rifle on his Morane monoplane close behind the propeller. The propeller blades were protected by steel plates that deflected those bullets that hit the blades instead of going between them. Garro scored 5 victories in 16 days. This one plane put the Germans in a state of panic; for the first time they were on the defensive.

Figure 1. French Caudron G-111 (1915). The first plane to be flown by Americans in France. Powered by a 35-horsepower radial engine, it was one of the safest planes of its day.

The Allies retained the advantage in the air gained by Garro's plane until April 1915, when it was forced down behind German lines. Based on the forward-firing concept used by Garro, Fokker within 48 hours had mounted a machinegun on a Fokker E-1 that was synchronized with the engine so that it shot between the revolving propeller blades. Everything

else in the air then became obsolete. The Fokker E-1, structurally weak and underpowered, with a top speed of 80 miles per hour (mph) and a range of 120 miles, had established the pattern for aerial combat. For several months, the Germans were dominant in the air and Allied aircraft losses became enormous.

The Allies, in an effort to counter the threat of the Fokker E-1, developed the Nieuport 11 (French), a forerunner to the Nieuport 18 (fig 2). The Nieuport 11 carried a caliber .30 Lewis machinegun (fig 3) mounted above the top wing so it would fire above the propeller. It had a top speed of 100 mph and could climb to an altitude of 10,000 feet at the rate of 600 feet per minute. Because of its speed and maneuverability, the Nieuport 11 was able to make a good showing against the Fokker E-1.

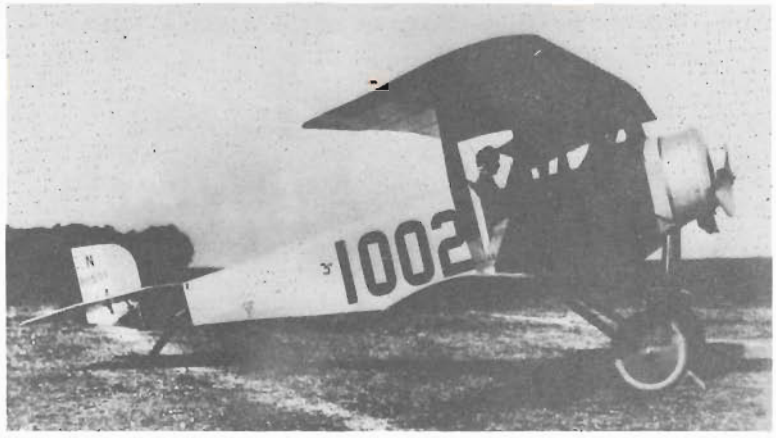


Figure 2. Nieuport 18. Nose heavy, and the wings of early models tended to break under stress.

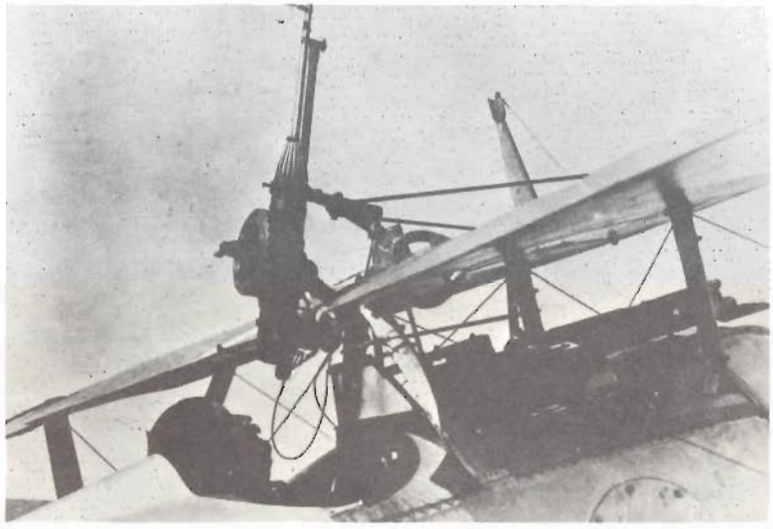


Figure 3. Nieuport 27. The model 11 had only a fixed Lewis gun above the top wing. The model 27 had a semiflexible upper gun and a synchronized Vickers machinegun.

For several months, the Germans were successful in keeping the secret of Fokker's gun. Pilots using the weapon were forbidden to fly over enemy territory for fear that it might be captured, but a German pilot lost in a fog landed by mistake at a French airfield. His plane was captured before he could destroy it, and within a few weeks, the Allies had airplanes equipped with similar armament. With both sides fairly evenly matched, the fight for air supremacy began on a serious scale.

Great air battles were fought, but neither side could maintain a decisive advantage. Allied and German designers worked to produce airplanes with better performance capabilities and more effective armament. Some of the most outstanding fighters that were produced are described briefly.

The German Albatros II became operational in August 1916. It had a speed of 109 mph and a ceiling of 17,000 feet and was armed with twin Spandau guns synchronized to fire through the propeller. The Albatros proved to be much superior to contemporary Allied planes in both rate of climb and firepower.

The Sopwith Camel (English) became operational in July 1917. It had a speed of 122 mph and a ceiling of 24,000 feet and was armed with twin Vickers machineguns. The Camel could outmaneuver any contemporary plane, with the possible exception of the German Fokker Dr. 1 (fig 4).

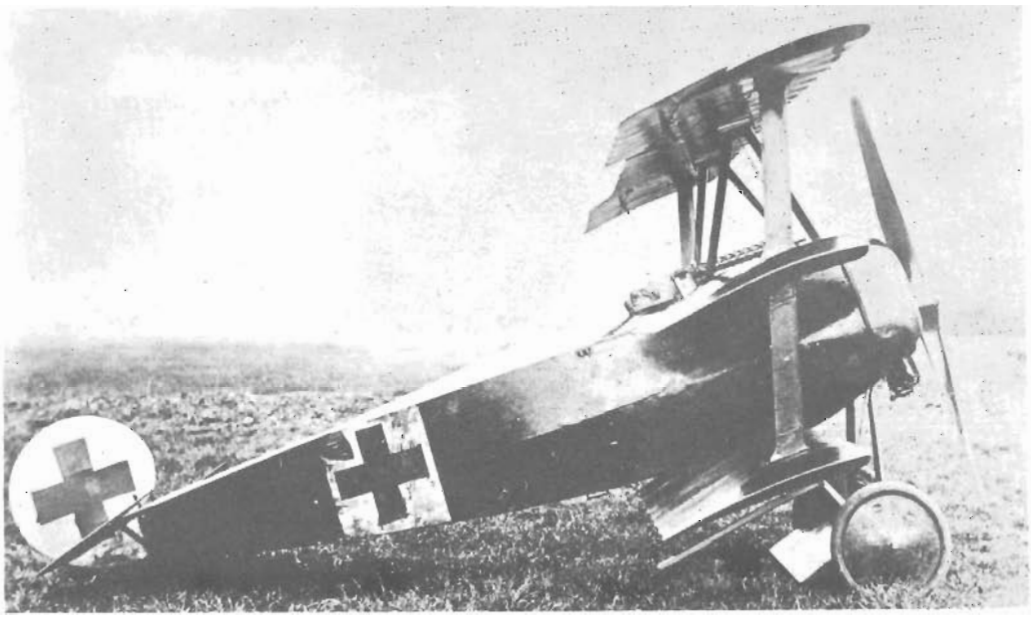


Figure 4. Fokker Dr. 1.

The Fokker Dr. 1 became operational in August 1917. It had a speed of 115 mph and a ceiling of 19,600 feet and was armed with twin Spandau guns synchronized to fire through the propeller. The guns could be fired independently or simultaneously. The Dr. 1 had an excellent rate of climb, and its maneuverability matched that of the Camel.

The French Spad S. 13 (fig 5) became operational in the summer of 1917. It had a speed of 130 mph at 6,500 feet altitude and a ceiling of 22,300 feet and was armed with twin Vickers machineguns. One model carried a 37-mm gun mounted to fire through the hollow propeller shaft and a single Vickers machinegun mounted on top of the cowling. This model met with some success but was soon abandoned because of the slow rate of fire and tremendous recoil of the 37-mm gun.

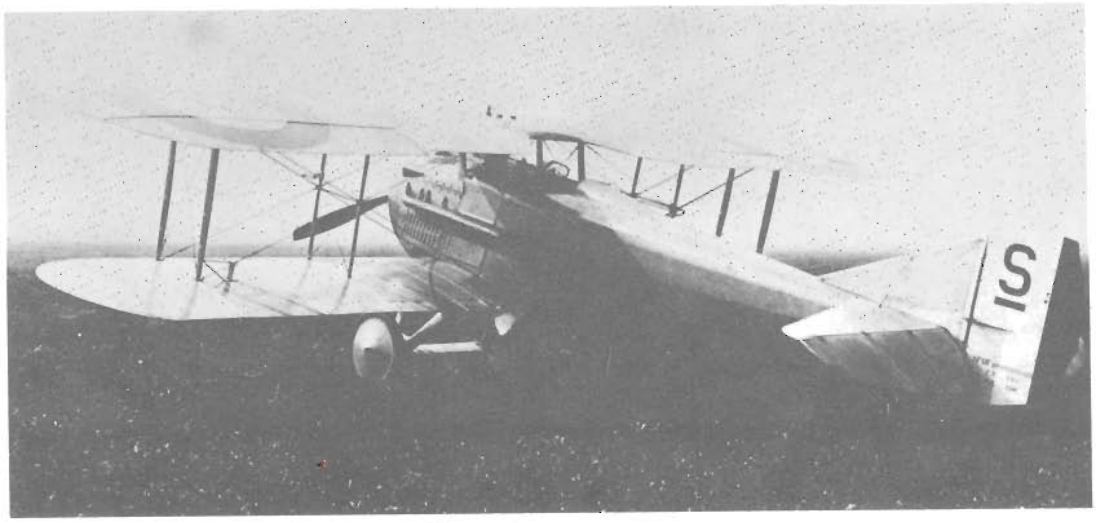


Figure 5. Spad 13.

Work continued throughout the war to improve aircraft performance and armament. By the end of the war, planes were in operation with engines of the 350-horsepower class and could attain combat altitudes up to 20,000 feet and ranges of almost 1,000 miles. Armor was used for crew protection from ground fire, planes were developed to operate from carriers, and armament of up to four machineguns was in use. Rockets, puncture-proof fuel cells, drop tanks, and engine superchargers were some of the many devices created to improve fighter performance that had reached the testing stage.

Most important of all was the fact that the fighter had become an indispensable weapon of war. Fighter tactics to this day are based on the general pattern for aerial combat established during World War I.

A logical parallel development in airplanes was the bomber. As with fighters, bombers also struggled for speed and altitude. Higher speed meant shorter time over hostile territory. Higher altitude permitted overflying the increasingly annoying antiaircraft, inaccurate and inefficient though it might be. But there were penalties also. Increased range meant smaller bomb loads. The increased speed and altitude had disastrous effects upon the accuracy of gravity delivery of bombs.

The first attempts at bombing, during World War I, were crude and ineffective. Two-seater fighters and reconnaissance airplanes were used as bombers which had maximum speeds of 75 to 90 mph and service ceilings under 1,000 feet altitude. Small bombs improvised from shells, and hand grenades were dropped over the side of the plane by hand and aimed by eye; steel darts, 6 inches long and about the diameter of a pencil, were used in the same fashion to bomb troops in the open. Bombing was done with the plane in level flight at as low an altitude as possible, thus exposing the aircraft to machinegun and rifle fire from the ground and resulting in many casualties.

The first long-range strategic bombing mission in history was conducted in November 1914 when three British Avro 504's bombed the Zeppelin sheds at Friedrichshafen in Southern Germany. The bombing did little damage and one plane was lost.

Figure 6. A DH-4 in France, June 1918.

Bombs specifically designed for air delivery were developed shortly, however, ranging in size from 16 to 1,650 pounds, to be released from carriers beneath the aircraft. Also, toward the end of the war, a high-altitude drift sight was developed that allowed bombing from heights up to 18,000 feet and established the requirement for a special bombing plane. The principal Allied bombers were the English De Havilland DH-4 (fig 6) and Handley Page HP 0/400 (fig 7).

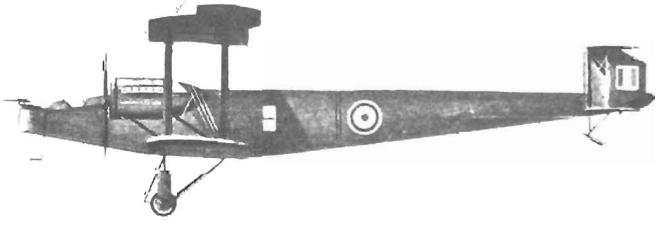
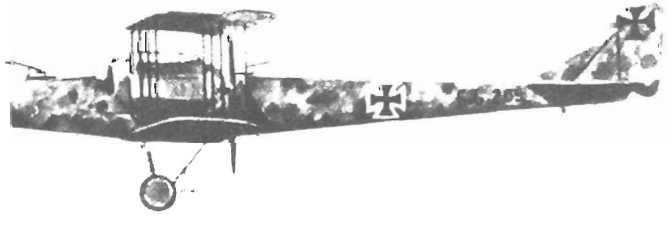


Figure 7. Handley Page 0/400.

Figure 8. Gotha.



The DH-4 light single-engine bomber had a maximum speed of 124 mph, a service ceiling of 15,800 feet, and an endurance of 3 hours 16 minutes. Armament consisted of four caliber .30 machineguns and 322 pounds of bombs. An improved version, the DH-9, carried 450 pounds of bombs.

The HP 0/400 heavy twin-engine bomber, with a maximum speed of 96 mph, carried 1,800 pounds of bombs. Further development of the Handley Page resulted in the HP-V/1500, a giant four-engine plane capable of carrying 7,500 pounds of bombs. It was designed to bomb Berlin, but the war ended before the mission could be carried out.

The DH-4 and the HP 0/400 were selected for American production; however, only the DH-4 was produced in quantity. Both types of planes were powered by the United States 400-hp Liberty engine, America's most significant technical contribution to the air war.

The primary German bomber was the twin-engine Gotha (fig 8), with performance capabilities similar to the HP 0/400. The Germans did little tactical bombing, but the Gotha was used for both day and night raids on London and Paris.

The first American bombing raid was conducted in June 1918, and from this date until the end of the war, United States bombers carried out 150 raids. Many of the missions were against targets as much as 150 miles behind enemy lines.

Great technical advances in aviation were made during the war, but bombardment did not prove particularly effective. Bad weather limited bomber range, and poor bombing accuracy prevented the concentrated sustained attacks required to prove the offensive power of the bomber.

An account of defense measures which evolved as a result of this threat from the air will appear in the next issue of Air Defense Trends.

Dogma, Lucubration, and Contrivance

Colonel Mark W. Niemann
Office of Doctrine Development, Literature, and Plans
US Army Air Defense School

This seemingly unlikely title translates roughly into doctrine, literature, and plans. This trio names the general responsibilities of the Office of Doctrine Development, Literature, and Plans which is the United States Army Air Defense School (USAADS) watchdog in the sense that it exercises scrutiny over these areas of activity. Actually, the functions of the office involve much more than simply playing watchdog. Let's talk history for a minute.

In 1964, the order came out to combine the School Plans and Operations Division with the Training Literature Division of the Nonresident Instruction Department. This new office was named the Doctrine Review and Training Literature Directorate. In 1968, the name was changed to Office of Doctrine Development, Literature, and Plans (DDL&P). The organization remained the same. Today DDL&P has over 60 military and civilian members and is organized as shown in figure 1. Figure 2 shows where it fits into the School structure.

It would be difficult to select any one of our functions as being more important than the others, but certainly one of the most stimulating is working with new equipment. We develop, coordinate, and constantly update the School input to training plans for new hardware. Right now, improved and self-propelled Hawk, Chaparral/Vulcan, and the highly versatile SAM-D are kicking up some excitement among our planners and writers.

To keep things rolling, we maintain a history of development on every new system and modification. To feed the files, our staff hobnobs with contractor personnel and interested military agencies. United States Army Materiel Command (USAMC), United States Continental Army Command (USCONARC), United States Army Combat Developments Command (USACDC), and United States Army Test and Evaluations Command (USATECOM) are prominent contacts. Out of this maze of activity comes solutions to special problems on the fielding of new equipment. The role played by DDL&P is that of USAADS representative to the project manager of each system or subsystem involved.

The end product is the USCONARC training plan for a specific system. The plan is current, comprehensive, and logical. It comprises all training aspects relating to the equipment. System maintenance will have been worked out with USAMC. Provisions will have been made for instructors and key personnel to receive new equipment training. There will be provisions for training literature, equipment, personnel, and facilities. Finally, the development and publication of Army subject schedules, the Army training program, annual service practice procedures, and the Army training test serves to wrap up the plan and introduce the new equipment to the field army.

We have the function of preparing and updating Army-wide air defense artillery training literature of the applicatory variety so we are up to our ears in technical writing. The scope of the material we put out ranges from instructions for the enlisted technician to guidance for the senior commander. The variety of weapon systems in use and coming up keeps our writers hopping. Not only must they engage in research in depth, but they must become experts in many subjects if we're going to get the job done. Probably the most challenging

requirement of this function is developing doctrine for employment of the various weapon systems. This involves all aspects of structuring air defense most effectively in the field army. Consequently, it is necessary to coordinate with the various agencies with whom we collaborate in developing training plans and with whom we are the School point of contact.

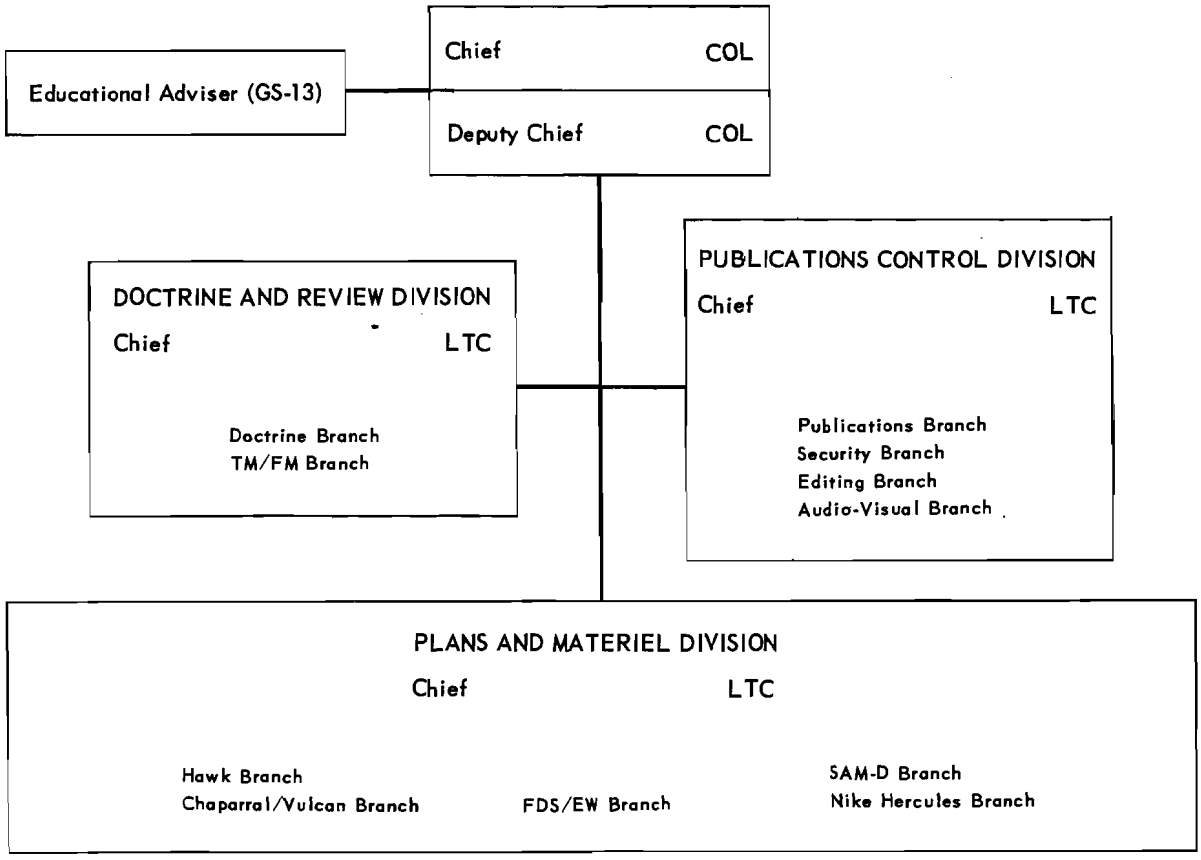


Figure 1. Office of Doctrine Development, Literature, and Plans organization.

Analogous to our function of developing Army-wide training literature is the function of providing staff supervision over preparation of School instructional publications. In this endeavor, practicable doctrine, technical accuracy, and compliance with pertinent directives are paramount. A lot of mental exercise goes into doctrinal determinations because DDL&P is responsible for collection, coordination, preparation, and dissemination of doctrinal information. This staff supervision is highly beneficial to the students and instructors because it results in standardization of nomenclature, style, illustration, and format within the School. The practice of maintaining writers and editors of Department of the Army level training literature at a central office is a marked improvement over the former practice of scattering them among the various instructional departments. The present method facilitates the interaction among writers that is essential to high-quality publications.

Looking in another direction, studies and recommendations by DDL&P result in the specifications that appear in air defense military occupational specialties (MOS). In the case of new weapon systems, the task statements and job descriptions are accumulated by this shop under systems engineering of training requirements. We also develop and update

air defense artillery and fire distribution system maintenance MOS evaluation test materials. In other words, we write and update the "pro-pay" tests. And material for those test aid pamphlets the maintenance technician pours over just before his annual test is also developed by DDL&P.

A new addition to the responsibilities of DDL&P is systems engineering of training of air defense Army subject schedules. This activity, once it is in full swing, will account for significant growth in the office. The job is very complex; the regulation that directs the action has more than 100 pages. In a nutshell, all the aspects of developing a training course are individually and then collectively cranked through the scientific processes of systems analysis and the resulting product is a course in the School curriculum or an Army subject schedule.

Most of the efforts of our staff that result in the printed word, whether a simple letter or a complicated manual, are finally monitored and edited by the Publications Control Division to keep us in line with USAADS policy and the rules of grammar. Another highly important facet of this division is the Audio-Visual Branch which develops long-range air defense training film programs and furnishes a film liaison officer to assist the US Army Pictorial Center in film production. We are involved in more than 20 film projects annually. This division provides administrative and logistical support for the office and maintains our reference library. We have (and use) a whopping 85 meters of field manuals. technical manuals, Army regulations, and other publications.

DDL&P also has the function of administering the Air Defense Center Team program. The structure of the team and its functions are prescribed in USCONARC Regulation 1-5.

Figuring strongly in most of the DDL&P activities is the Educational Adviser. He provides guidance on training plans and requirements, training devices, training literature, task and skill analysis, and system engineering of training. He determines and prepares qualitative and quantitative requirements for the School and Center and for Army-wide training devices to support air defense weapon systems training. Review of qualitative materiel requirements and small development requirements prepared by other agencies is another of his duties. He represents the School, hence USCONARC, in the planning, conduct, and reporting of service tests of training devices with US Army Test and Evaluation Command.

We hope that the information in this simplified account will acquaint you with how DDL&P fits into the School pattern and what we are doing to serve air defense operations and advancement. Dogma, lucubration, and contrivance, together with their many ramifications, are our contribution to you, the air defense artilleryman.

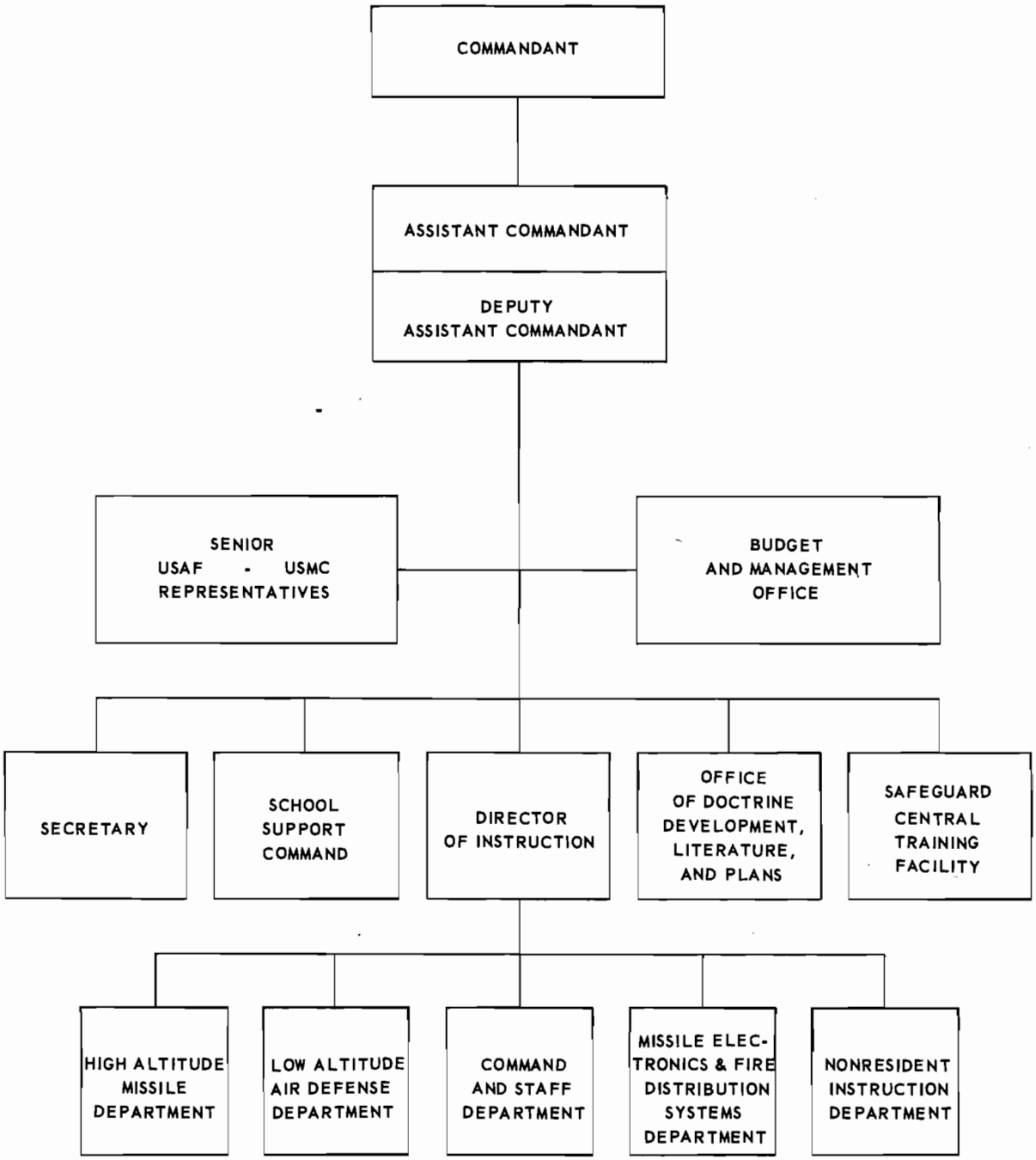


Figure 2. Air Defense School organization.

Army Airspace Control and Coordination

A NEW CONCEPT

Major Raymond W. Fontaine, Jr
Command and Staff Department
US Army Air Defense School

Editor's Note:

Portions of the material in this article are in the nature of a proposal and should be regarded as such.

2010 9 June 1944: 107th Tactical Reconnaissance Squadron reports two P-51C (Mustang) aircraft lost to intense and accurate AA fire from American ground forces.

2035 9 June 1944: 109th Tactical Reconnaissance Squadron reports one P-51C fired upon by Allied Navy at Utah Beach and by ground forces off the beachhead; aircraft completely destroyed and pilot rescued. Another P-51C hit by fire from Allied fleet of Utah Beach and shot down in sea; pilot and aircraft missing.

2040 9 June 1944: 109th Tactical Reconnaissance Squadron reports two P-51C aircraft fired upon by Allied naval vessels off Omaha Beach.

---- 9 June 1944: Two Mustang aircraft shot down by AA from US ground forces and two other friendly aircraft destroyed by Allied warships.

---- - September 1965: 0-1 pilot caught in B-52 strike due to improper flight procedures.

The true events depicted above represent only a fraction of the many and costly mistakes made through the lack of proper coordination. Many improvements have been made in coordination capabilities during the last 25 years, and each improvement has helped some. One of the latest improvements in the coordination of air defense fires and Army aviation has been introduced into the field army's command and control structure. This new medium has been named the airspace control element (ACE).

Before we commence with a lengthy discussion of functions, internal operations, organization, and equipment of the ACE, a brief look into the past is required. Within the type field army structure and at every major level of command, army, corps, and division, we find an agency referred to as the tactical operations center (TOC) (fig 1). This facility is defined as "a command installation wherein the necessary communications facilities and personnel are centralized to control and coordinate current tactical and tactical support operations." This center previously consisted of the following elements:

a. Communications-electronics element (CEE).

b. Fire support coordination element (FSCE).

c. Tactical air support element (TASE).

d. Chemical, biological, and radiological element (CBRE).

e. Engineer element (ENGRE).

f. G2/G3 element.

g. Army aviation element (AAE).

h. Air defense element (ADE).

Today, several changes have occurred among these elements. For example, the ENGRE and the CBRE have been deleted. The FSCE has been renamed the fire support element (FSE), and the CEE is now the electronic warfare element (EWE). There also has been some realinement of functions. The most significant change from our viewpoint, however, is the grouping of the Army aviation element and air defense element into a single coordinating body—airspace control element (ACE) (fig 2).

This grouping was accomplished because, with improved weapon technology, automatic processing capabilities, improved mobility, and sophisticated communications, combat operations (to include air defense operations) have accelerated multifold. Through collocation, the airspace control element has expedited the coordination so essential between Army air defense and Army aviation in hope of preventing or reducing future incidents of the type cited at the outset of this article.

Considering the above, let us now examine this new agency. Specifically, we shall discuss five functional areas of interest in the ACE:

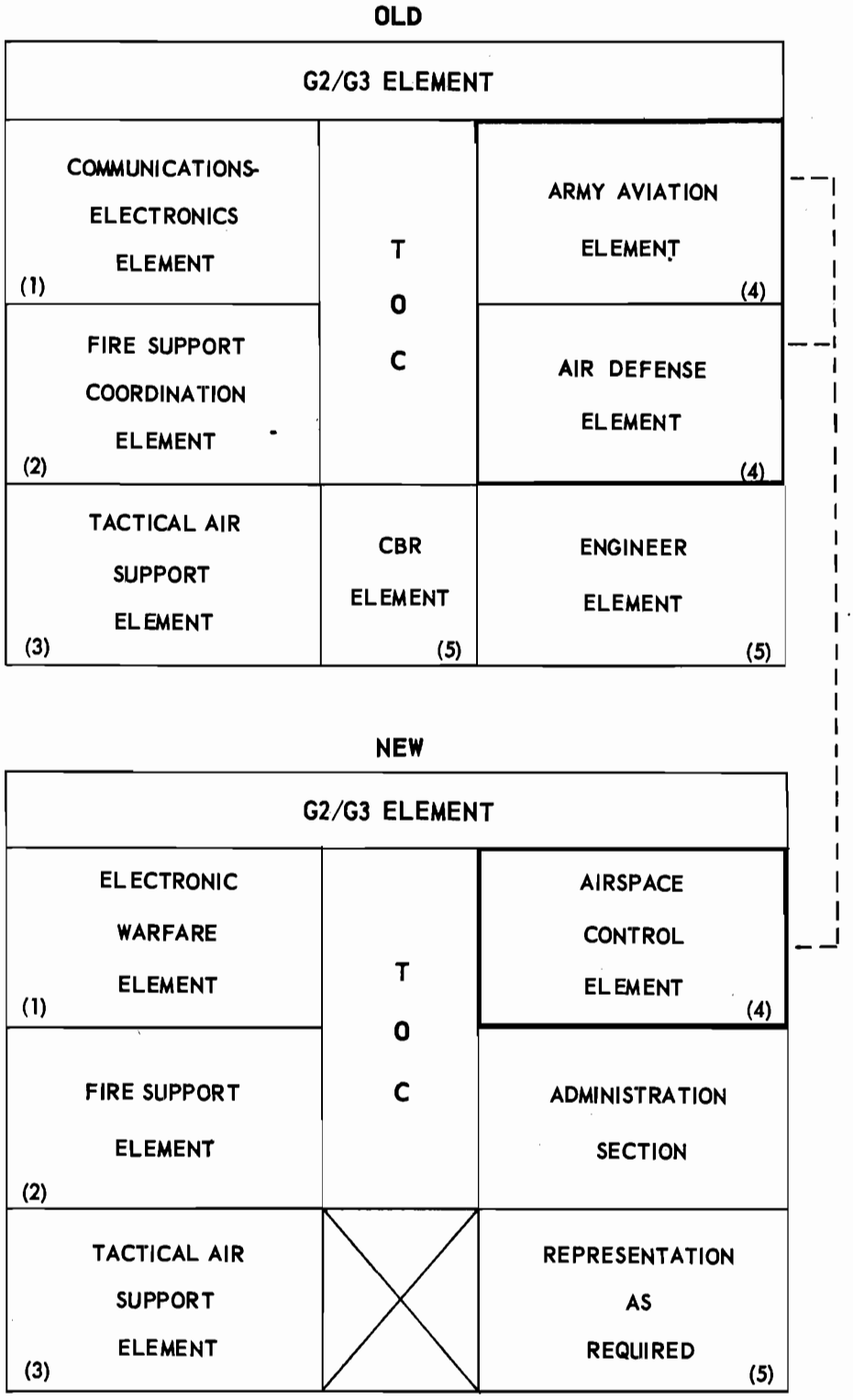
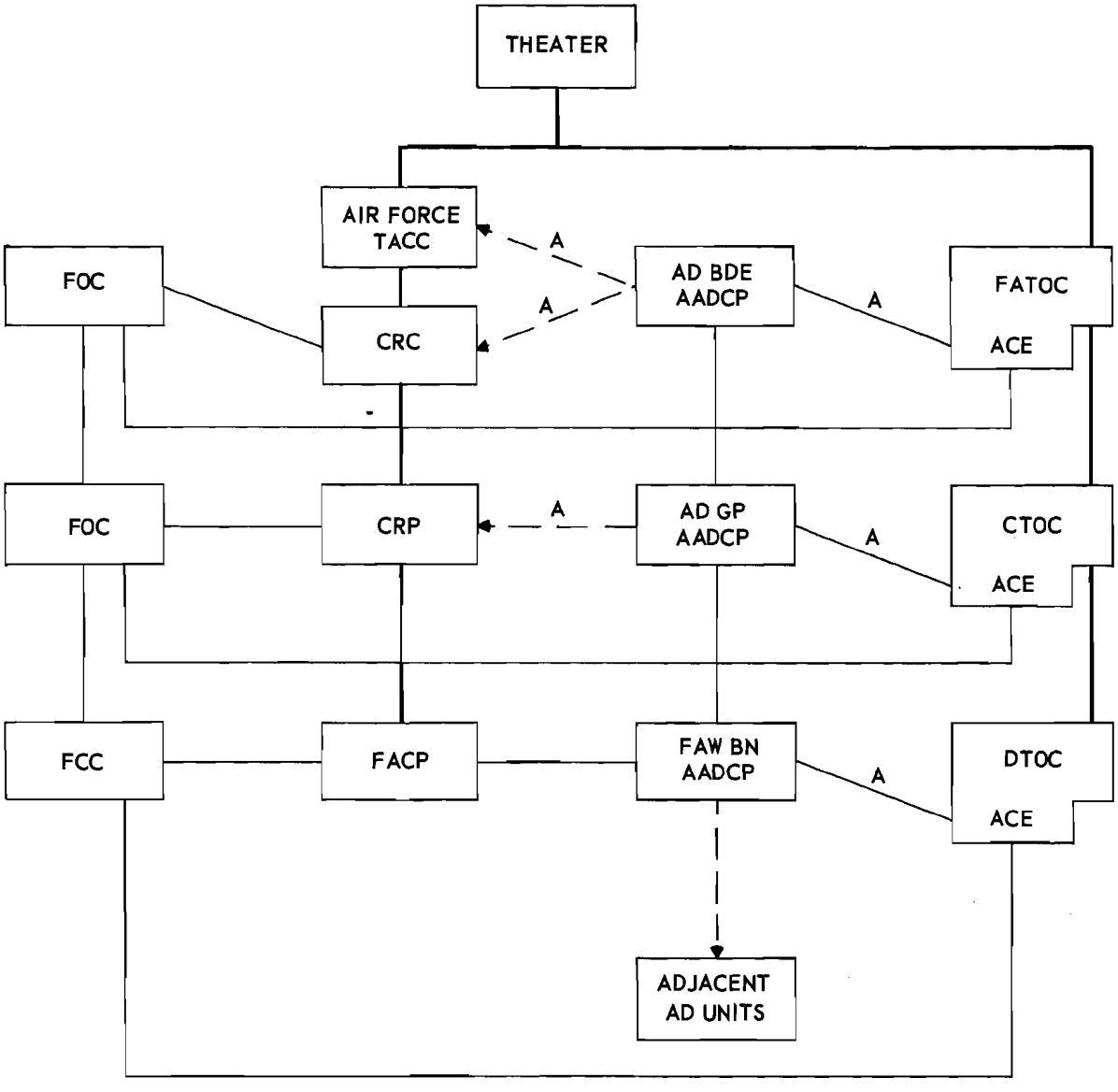


Figure 1. Tactical operations center.



LEGEND:

COMMAND

COORDINATION

A AUGMENTED LIAISON

Figure 2. Command, control, coordination, and liaison in theater.

a. Coordinating the use of airspace.

b. Coordinating Army air defense operations.

c. Coordinating Army air traffic.

d. Providing continuous information on aviation status, to include the allocation and reallocation of Army aviation resources.

e. Providing intelligence obtained through AD channels.

To elaborate on these specific areas — first of all, the coordination of the use of airspace over the combat zone involves several agencies; i.e., Army aviation, Army air defense, Air Force, and combat elements of the command. Personnel within the ACE must coordinate with the other elements of the tactical operations center and, based upon directives of higher headquarters, determine how airspace requirements can best be met. The ACE must then submit its recommendations to the G3 element of the TOC. There may also be occasions when the ACE will have to prepare the airspace utilization annex (ref: FM 101-5, annex H) when an agency outside the tactical operations center has not prepared it.

Example: Coordinating the use of airspace by the ACE in FATOC. Incident: Impending severe weather conditions over the next 7 days will seriously interfere with Army aviation during upcoming operations if the coordinating altitude is not changed. Army G3 informs the Chief, ACE, to arrange for change in coordinating altitude. ACE Actions: Chief, ACE; Aviation Officer; and ADA Officer evaluate the problem and determine that the coordinating altitude should be raised from the existing 6 "angels" to 12 "angels" (6A to 12A). The Aviation Officer in the ACE contacts both Army aviation and the Air Force and recommends the new coordinating altitude. The Army and Air Force component commanders discuss the new recommended coordinating altitude and submit their joint recommendation to the unified commander. Once the unified commander approves the coordinating altitude, this information will be passed to appropriate subordinate commands. The new coordinating altitude will be posted to the aviation status board in the ACE. The ACE will then inform the FOC (controlling Army aviation), the AADCP, and the CRC (controlling Air Force aircraft) of the new coordinating altitude. ACE then informs other elements of the TOC.

The second major function concerns the coordination of Army air defense operations. Basically, this requires ADA personnel in the ACE to make continuous estimates of the air defense situation and recommend the allocation and employment of available air defense means. The ACE also has the responsibility of disseminating pertinent AD information; e.g., information relating to the employment of nuclear weapons and to other elements of the TOC. Conversely, the ACE relates information to subordinate ADA units concerning activities of the various combat and combat support agencies within the command. Summarizing this function, we could say the ACE provides the G3 and the commander with a continuous readout of the tactical and administrative[1] activities of subordinate AD means.

Example: Coordination of Army air defense operations in ACE at CTOC. Incident: The air defense artillery group AADCP informs ADA personnel in the ACE that two Hawk batteries

[1]The term "administrative" in this context refers to combat service support activities; e.g., missile and equipment status.

of the 6th Battalion, 10th Artillery, will move to new locations in support of a pending offensive operation. ACE Actions: Upon receipt of information from ADA group AADCP or ADA group staff, ADA personnel in the ACE will insure that aviation personnel in the ACE are made aware of the move so that they can notify Army/Aviation (i.e., FOC/FCC) of the new ADA site locations. ACE will also notify the Air Force (i.e., CRP) to insure no accidental engagement of these sites by friendly Air Force aircraft. ACE will inform all other TOC elements of this movement to insure proper coordination of combat support and combat service support activities.

The third major function of this facility is the coordination of Army air traffic. This, like air defense operations, involves several subordinate functions. Army aviation and air defense artillery personnel within the ACE will determine prohibited and/or restricted AD area and coordinate other restrictions imposed on Army air traffic. Based on these restrictions, the ACE will determine and coordinate air recovery corridors and Army aviation flight altitudes and provide information for the preparation of the air traffic regulation plan to be included in the airspace utilization annex. Once this plan receives approval by the G3, the ACE will disseminate the plan to the other elements of the TOC, the direct air support center (DASC), Army aviation (i.e., FOC/FCC), and appropriate air defense units. The ACE also has the responsibility of coordinating with other elements of the TOC that will influence air operations and of disseminating appropriate changes to the air traffic control plan.

Example: Coordination of Army air traffic by ACE in CTOC. Incident: Army aviation flight A03 will depart Airfield Foxtrot at 0300 and proceed to Airfield Papa. Expected time of arrival is 0420; direction of flight is 90°, and altitude of aircraft is 5 "angels" (5A). ACE Actions: Upon receipt of data on flight A03 from the FOC, ACE will post the aviation status board and airspace utilization map, also known as aviation situation map. The ACE will immediately determine whether any friendly field artillery is firing in the vicinity of the flight route. If friendly artillery is firing near or through the flightpath of A03, the ACE will notify the FOC to either change the altitude of this flight or reroute the aircraft. ACE will inform AADCP of the friendly flight and will notify the AF CRP if flight A03 is expected to leave the Army block of airspace or raise above the coordinating altitude.

The fourth area of interest concerns Army aviation of the command. The ACE must inform all TOC elements about aviation resources available. Based on the mission of the command and other related factors, the Chief, ACE, will recommend allocation of aviation resources to subordinate commands. Due to the ever-changing tactical situation, the ACE will also be responsible for reallocation of these means to satisfy the most critical needs of the command. In addition to allocating aircraft for tactical missions, the Chief, ACE, after coordinating with key staff personnel, will advise the G3 as to aviation resources available to support combat service and combat service support operations.

Example: The ACE in DTOC monitors aviation status of the command. Incident: Division G4 requests ACE to obtain an Army aircraft to transport a critical part to a Chaparral battery in the forward combat zone. ACE Actions: Aviation personnel in ACE check with the aviation battalion (FOC) to obtain an aircraft and learn that the last available aircraft has just been committed. Chief, ACE, will then determine the criticality of the mission and, based on the priorities established by the G3, reallocate an Army aircraft to deliver the critical part. ACE will then inform G4 that an aircraft (e.g., flight A16) has been provided. Aviation personnel in the ACE will then notify the AADCP and post the aviation status board and aviation situation map.

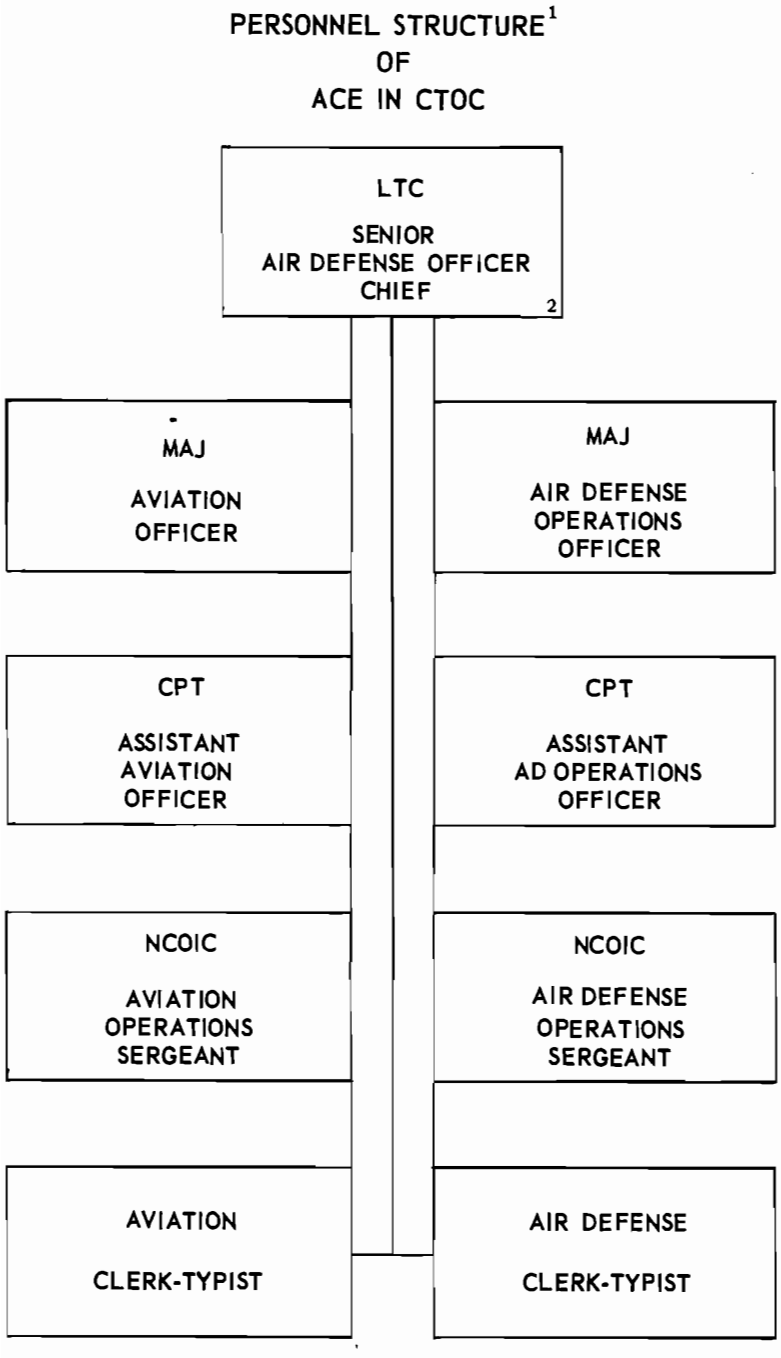
The fifth and last major function of the ACE concerns the gathering and dissemination of information. Like all agencies and elements of the command, the ACE also has the responsibility of collecting intelligence information. Primary sources of intelligence are received from Army air defense, Army aviation, and Air Force command and control facilities. This information, like a two-way street, will be continuously fed into the G2 element of the TOC and related to subordinate, adjacent, and higher headquarters through appropriate channels by the ACE.

Example: The ACE in CTOC is concerned with intelligence information. Incident: The group AADCP informs ACE that an attempted act of sabotage occurred at Site 21. ACE Actions: Chief, ACE, obtains all pertinent information about incident and immediately relates information to the G2 element in the TOC. ADA personnel in ACE record information in ADA journal.

Let's now take a look at the manning structure of the ACE. Personnel configuration is basically the same at each major command level with the scope of the operation being the predominant factor in the number of personnel allocated. Recommended personnel at each level consists of a senior air defense officer, assistant aviation and air defense operations officers, aviation and air defense operations sergeants, and aviation and air defense records clerks (fig 3). It should be noted that personnel mentioned here are not necessarily provided by TOE and that the commander will most likely modify the manning structure to meet the operational needs of the command.

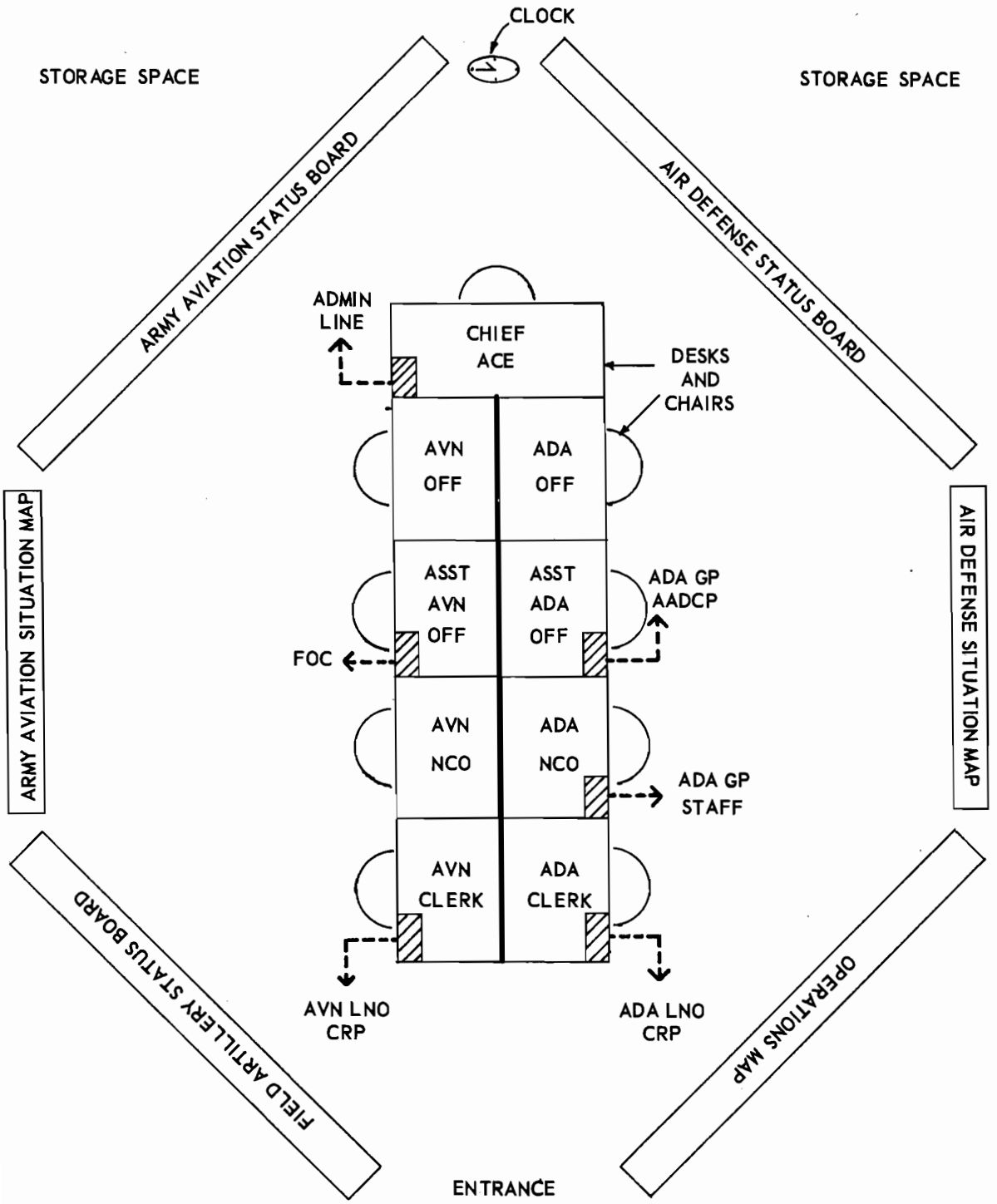
Equipment requirements for the ACE is another item of discussion. One concept is illustrated in figure 4. (Note figures 5 through 9.) Here we have reduced working space, with the working areas for air defense and Army aviation partially separated, yet maintaining integrity of effort. Again, it is emphasized that actual implementation and organization of the ACE will depend on the desires of the commander and overall supervision of the G3.

Our next area of discussion involves command and control within the ACE. This might well be considered the most controversial topic of this facility. Current doctrine does not stipulate who will be in charge of the ACE. Thus, we have a situation in which either a representative from air defense artillery or Army aviation could assume the job as Chief, ACE. What does this mean to us as members of the Air Defense Artillery Branch? The present concept is that the officer assuming the title of Chief will exercise overall command jurisdiction of the ACE. He will have a compatible ranking officer to advise him on either air defense or Army aviation, depending on who is selected to this command position. Current opinion is divided on this issue. Certain factions feel that the senior officer assigned to the ACE, regardless of experience or background, will be the Chief. Other opinion is that the final selection of the Chief will rest with the commander, and his selection will depend on the current tactical situation. To assist the Chief, he will have assistant aviation and air defense officers. They will be primarily responsible for conducting the internal operations of the ACE and advising the Chief. The respective operations sergeants will assist the aviation and air defense officers in both tactical and administrative matters and will be primarily responsible for correct input data to the aviation and air defense journals maintained by the records clerks. (Note. It is suggested that DA Form 1594 be used in the journals.) The clerks will maintain chronological records of events and provide internal maintenance support of the ACE.



[1]Recommended personnel (day operations)
[2]Assuming ADA officer is appointed Chief, ACE

Figure 3. Personnel structure of ACE in CTOC.



Telephone or radio

Note. See figures 5-10 for specifics on status boards and situation maps.

Figure 4. Type ACE layout (CTOC).

ACE CALL SIGN - BADGER

FOC CALL SIGN - GOLF

FCC CALL SIGN -

AVIATION STATUS BOARD

COOR ALT	10A	8A	360°	9A
ATCL	X	6A	179°	7A / 5A

FLIGHT NO.	TYPE MISSION	DEPARTURE TIME/GEOREF	ARRIVAL TIME/GEOREF	SPEED (KNOTS/ALT)	DIRECTION	AIRFIELD/ TYPE A/C	REMARKS
A01	RECON	0700 / KF0110	0730 / KG2015	90 / 5A	37°	A / U1B	AADCP NOT LOG POSTED
A16	SUPPLY	0710 / HE2010	0745 / HJ3040	60 / 7A	45°	C / CH47	
A40	SUPPLY	0715 / HJ2050	0910 / QE1010	100 / 9A	90°	D / CH47	CRC NOT AADCP LOG POSTED

ARMY AIR-FIELDS	U-1B	U-1D	CH-47	L-19	MOK			
(A) BROOKS KF 0110	16	14	5	4	3			
(B) DAVIS KG 2015	10	8	12	4	4			
(C) MORON HE 2010	14	22	10	6	2			
(D) BLISS HJ 2050	16	18	12	4	3			
(E) PLAINS ME 4005	20	30	6	6	3			
AIR FORCE AIRFIELDS	**F-104**	**PHAN**	**F-102**	**F-111**				
(1) SMITH MD 1020	10	20	18	16				

TYPE AIRCRAFT AVAILABLE

Figure 5. Aviation status board.

FSE CALL SIGN - BLUE				FIELD ARTILLERY STATUS BOARD					
UNIT	TYPE WEAPON	FIRING DATA		TARGET	TIME OF FIRE	MAX ORD	ROUNDS TO BE FIRED	TIME RECEIVED FROM FSE	REMARKS
		FROM GEOREF	TO GEOREF						
BTTY C C/6/52	175-mm	KF 2010	KF 5030	SUSP EN SABOTAGE PLAT	0800-0815	8A	BTTY 6	0755	FIRE MISSION TO BE REPEATED AT 1000
BN 6/52	175-mm	KF 2010	KF 5010	EN BASE CAMP	0830-0900	10A	BN 10	0815	

Figure 6. Field artillery status board.

DEFCON: 1 | ADW: (R) Y W | AIR DEFENSE STATUS BOARD | AADCP CALL SIGN - DOLPHIN

NIKE HERCULES UNITS	CALL SIGN	SITE NO	LOC	STATE OF ALERT BS	5	15	1HR	RSLD	Q/A	MISSILE STATUS HE	XS	XL	REMARKS
A6/450	DANO A	21	KF 1020	✓						10	6	6	
B6/450	DANO B	22	KF 1530		✓					12	5	7	
C6/450	DANO C	23		✓						10	6	8	
D6/450	DANO D	24		✓						12	7	6	
HAWK UNITS	CALL SIGN												
A6/451	AJAX A	31		✓						30			
B6/451	AJAX B	32		✓						28			
C6/451	AJAX C	33		✓						30			
D6/451	AJAX D	34		✓						26			
A6/452	TOM A	41		✓						24			
B6/452	TOM B	42		✓						32			
C6/452	TOM C	43		✓						30			
D6/452	TOM D	44							✓	28			GEN O/A ETR 1900

DIV UNITS	C/V FU	STATE OF ALERT BS	STD	SEC	C MSL	V AMMO	REMARKS
19 DIV	24/24	20/16	4/8	0/0	96	300	
25 DIV	32/32	16/16	16/16		126	400	
5th DIV	24/24	24/24			96	300	
1st DIV	32/32	18/16	12/14	2/2	120	390	

POP-UP CRITERIA: -10A / +200L

CASE:

AADCP ADAOO: LT JONES

GEN INFORMATION:

Figure 7. Air defense status board.

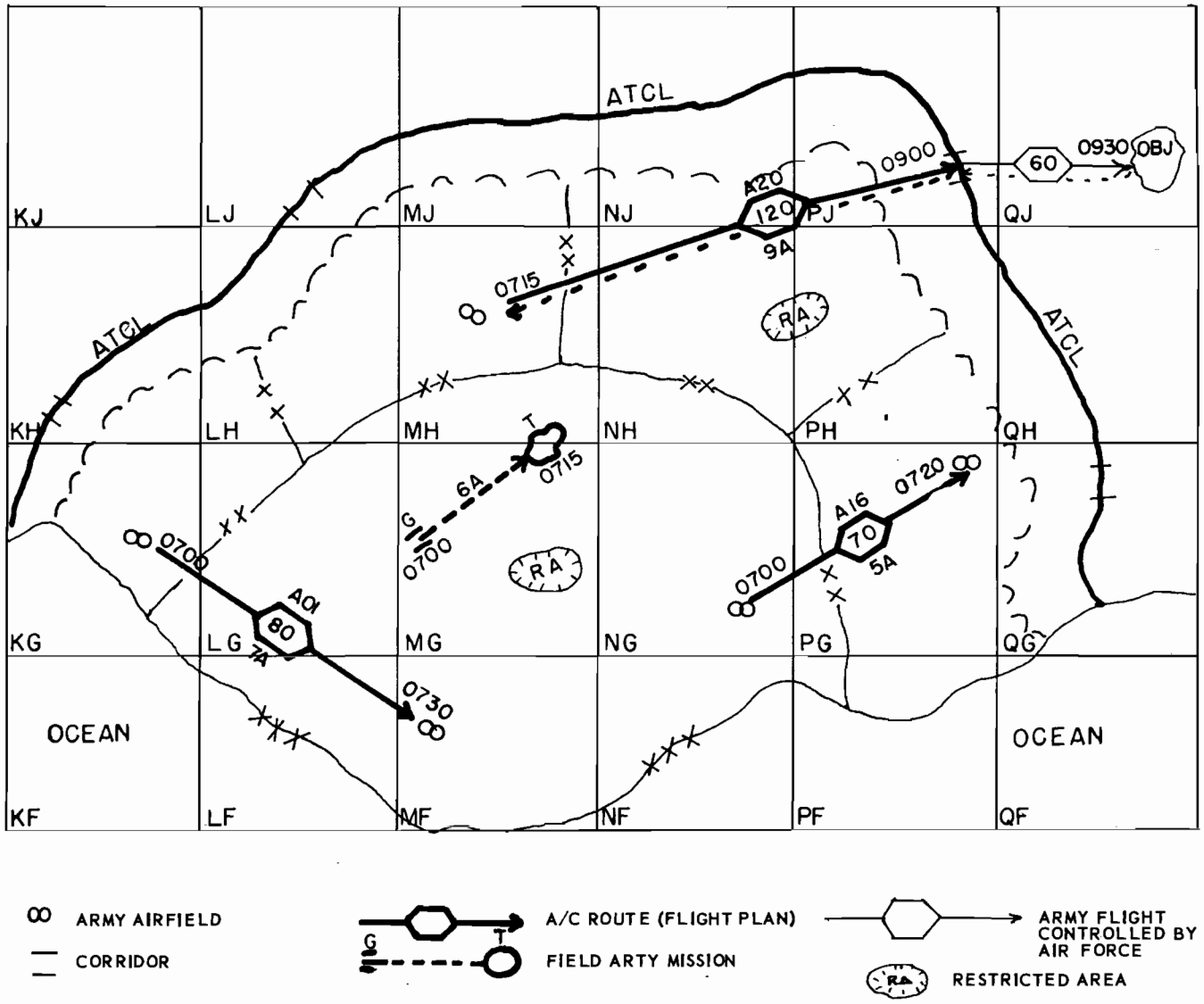
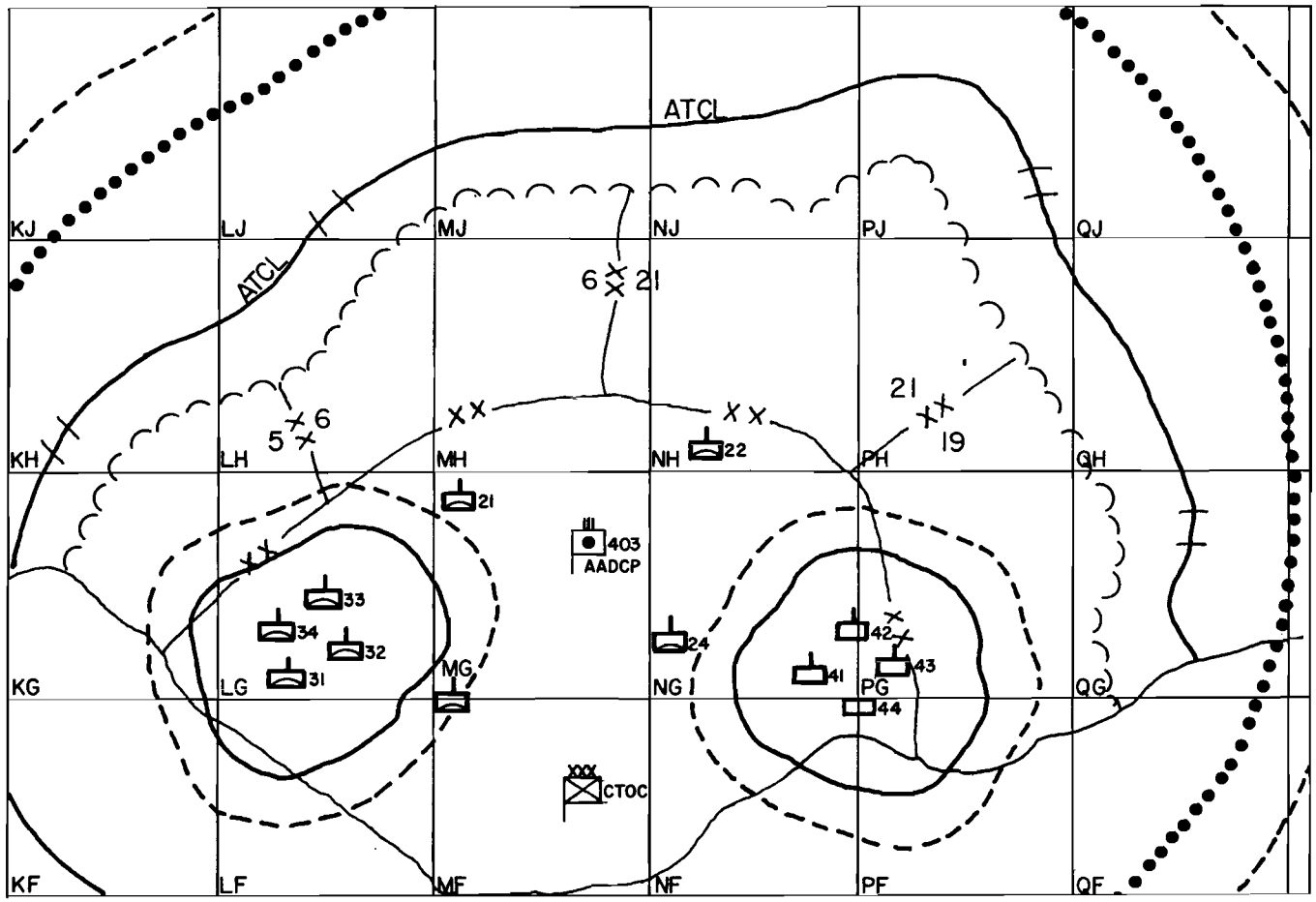


Figure 8. Army aviation situation map.



●●●● ENGAGEMENT RANGE (U)

- - - - ACQUISITION RANGE (U)

FIRE UNIT

Figure 9. ADA situation map.

Considering the previous discussion, what then are the distinct advantages of the ACE over the old air defense element and Army aviation element? Advantages readily apparent are:

a. Integrity of effort.

b. Common mission.

c. Reduction in liaison requirements.

d. Increased effectiveness of coordination.

e. Cross-training through association.

f. Reduction in facilities.

g. Reduced communications linkup.

h. Rapid exchange of information and data.

i. Integration under one head.

j. Reduction of effort and smoother coordination in supporting combat, combat support, and combat service support activities of the command.

k. Improved coordination with other TOC elements.

l. Increased manpower.

Disadvantages have also arisen with the creation of the ACE. Some of the more prominent are:

a. Determining whether an air defense artillery or Army aviation officer will be the Chief, ACE.

b. Complexity of efforts in one element.

c. Possible personality conflicts between aviation and air defense personnel.

d. Maximization of ACE's workload.

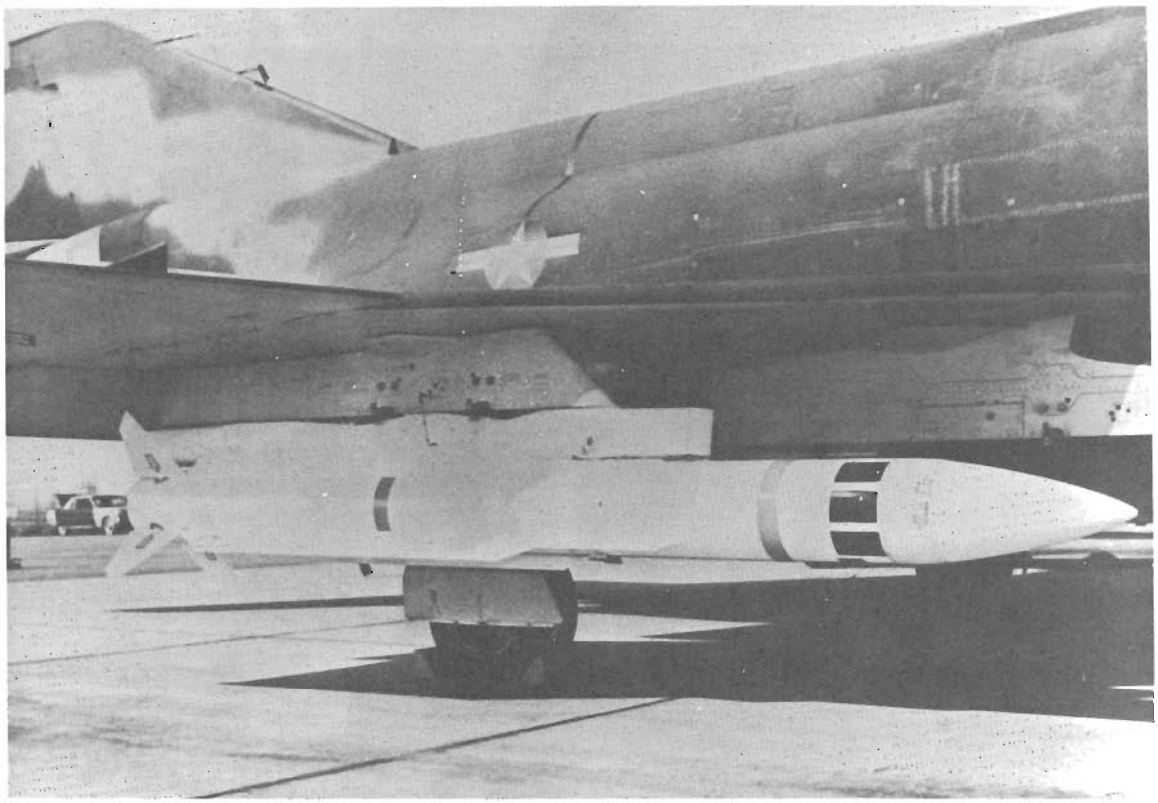
e. Increased responsibility for Chief, ACE.

It is evident from the above that there are numerous pros and cons as to the effectiveness of the airspace control element in comparison to the old air defense element and Army aviation element. Unfortunately, at this time, no experience factors are available from which to form a conclusive study. However, we enthusiastically support the ACE and believe it will significantly contribute to the overall increase of coordination, which is so essential and demanding on air defense and Army aviation forces in the field army today. The advantages

of this new element far outweigh the disadvantages. Again, the old axiom arises that the effectiveness of any weapon system, agency, organization, or element will be directly proportional to the effectiveness of the personnel who operate it. It is now up to you in the field to implement, evaluate, and report the effectiveness of the airspace control element.

Is This a Myth?

Chief Warrant Officer Alfred Nunes
High Altitude Missile Department
US Army Air Defense School



Do effective antiradiation missile (ARM) systems really exist? Generally, you can expect either of two answers to this question. The first is an unequivocal denial; the second an affirmative reply with an explanation that it is a doomsday weapon as far as radars are concerned. The fact is that in this era of new developments, the ARM is an old idea. Research on this weapon began as long ago as the 1940's and has, in one way or another, continued since. In recent years, changes in emphasis from nuclear to conventional warfare have provided the impetus for development of more than one of these attack systems.

For a better understanding of an ARM system, let's look at the following questions:

What is an ARM?

How effective can it be?

What range can the system achieve?

Is an ARM system worth the cost?

The answers to these questions are surprisingly simple. The ARM is an airborne, or possibly ground-based, missile system that is designed to acquire and home on a selected radiofrequency (RF) radiation source. Missiles using this homing technique have been used effectively in surface-to-air and air-to-air roles for more than 10 years. Their operating characteristics are generally the same; a ground-based or airborne radar illuminates the target and the missile, using a seeker antenna, homes on the reflected RF radiation. In the ARM, the victim radar is the radiation source. Surface-to-air and air-to-air missiles are effective against maneuvering aircraft even though aircraft reflect a relatively weak RF signal. Considering that a radar site cannot maneuver and that it provides a greater source of RF energy than that reflected from an aircraft, it is reasonable to assume that the ARM will be at least as effective as other homing missiles.

What about detection and engagement range of an ARM system? If a radar transmitter is capable of transmitting RF energy out to the aircraft carrying the ARM and detect the reflected RF energy with its receiver, then the ARM antenna and receiver should detect the transmitted signal at that range and probably beyond. It is suggested that a reasonably sophisticated ARM system would detect the radar signal well beyond the ARM's capability to engage the radar. Missile flight or engagement ranges will be greater than would normally be expected from missiles in the 500- to 1,000-pound category. Because these missiles will not need to expend propulsion energy in maneuvering and can be launched from great altitudes, ranges from 30 kilometers for a low-altitude launch to around 100 kilometers for a high-altitude launch can be expected. Altitude of launch will normally determine the engagement range.

Is an ARM system an economical investment? For use in a nuclear conflict, where aircraft carrying nuclear weapons capable of destroying complete cities can be expected, the development of an ARM system does not appear to be economically justified. However, ARM has a valuable role in conventional warfare where there are many high-cost aircraft continually flying sorties against relatively small targets within areas defended by air defense systems. Although these targets have tactical or strategic value, they may cost less than the attacking aircraft. Compare a small bridge or a tank to one of today's fighter-bombers. It can be seen that air defense systems which could cause attrition of these aircraft will be given a high priority for attack by enemy air elements. Attack with rockets, cannon, and bombs can be expected; however, camouflaged positions on the ground are hard to see from an aircraft moving at more than 300 miles per hour. Under these circumstances, an ARM system which is not affected by camouflage and can be launched in some instances from outside the air defense system engagement range is both an economical and realistic investment.

Is an ARM system unbeatable? Not any more so than electronic jamming or other countermeasure devices which have confronted air defense in the past. Investigation is currently in progress, and ways and means are being developed to counter this threat. Commands or agencies interested in the state of development of the countermeasures may submit requests for information to US Army Air Defense School, ATTN: AKBAA-S-DL-D, Fort Bliss, Texas.

Imagine, if you can, a complex military system that requires no calibration or adjustments! We discuss it in this article on

MAINTAINABILITY: A Look Into the Future

Thomas W. Wiggins
High Altitude Missile Department
US Army Air Defense School

The speed with which an attack can be launched against the United States or its allies has placed added emphasis on operational readiness of the national defense structure. This, of course, requires that air defense systems be designed and maintained for a high degree of availability. Traditionally, optimum system readiness has relied heavily on more emphasis being placed on design reliability and maintenance support. This, however, has not produced results commensurate with the attendant high cost. As systems become more complex, they are accompanied by proportional increases in maintenance support cost.

The magnitude of this problem can be seen only when it is realized that the maintenance support for a typical item of military equipment, over its life cycle, is from 10 to 100 times the procurement cost. For many years, more than 10 percent of the national defense budget has been allocated for maintenance support of operational systems. Evidence now indicates that the maintenance support cost can be substantially reduced by the incorporation of maintainability features in the design of future weapon systems.

The overall objective of maintainability is the reduction of maintenance support and is defined in AR 705-50 as "a characteristic of design and installation which is expressed as the probability that an item will be retained in or restored to a specific condition within a given period of time when maintenance is performed in accordance with prescribed procedures and resources." This definition suggests that maintainability is a major characteristic contributing to equipment availability and, therefore, readiness. The other major contributing characteristic is, of course, reliability.

Maintainability can further be distinguished as design specifications that fully minimize upkeep and repair. In this connection it is helpful to know that, where maintenance is the action required to keep equipment in or restore it to a serviceable condition, maintainability is a design characteristic that makes possible the accomplishment of operational objectives with a minimal expenditure of maintenance support effort and resources.

In recent years industry and the military have recognized the importance that maintainability engineering can have on the research, development, production, and availability of equipment. Consider, for example, some steps taken by the automobile industry to reduce maintenance cost to the automobile user. Chassis lubrication and oil change requirements have been greatly reduced. Undercoating has virtually eliminated the chassis and body rust problem that plagued car owners for so many years. Alternators have extended the useful life of batteries and electrical system components. In this regard imagine, if you can, a complex military system that requires no calibration or adjustments because operating tolerances were considered when the system was in the design stage. To be effective, maintainability studies must be begun at the conceptual stage of a new system and continued through until the system is fielded.

A low level of operational availability of military equipment not only degrades the national defense capabilities, but it makes successful combat planning with low-density, high-cost systems impossible. The responsibility of design engineers to provide reliable military equipment is well established. Only in recent years, however, has maintainability engineering been recognized as having a vital role in equipment reliability and availability.

Military systems cost can be placed into three readily recognizable categories. These categories are procurement, logistic support, and operational availability cost.

Procurement cost is the price in dollars paid to the manufacturer for the equipment and includes all research, development, and material costs inherent in production of the item. As military systems become more complex, it is expected that procurement cost will rise proportionally. It can be anticipated that the Government will balk at future procurement of great amounts of high-cost equipment. Consideration, therefore, must be given to maintaining defense preparedness with a reduced number of systems. The conclusion might be drawn that to reduce the number of defense systems will degrade the national defense posture. This, however, is not the case if the reduction is accompanied by an appropriate increase in system availability. For an increase of only 25 percent in the availability of an air defense system, only four will be required to provide the amount of operational availability normally requiring five systems. This is in effect getting five for the price of four. With a timely initiated and vigorously pursued program of maintainability engineering in equipment design it is expected that an availability increase greater than 25 percent can be realized.

Support cost, measured in dollars, takes into consideration such factors as (1) the amount and complexity of test equipment required to support a system; (2) repair facilities needed; (3) volume and variety of repair parts called for; (4) number and skill level of support personnel required; and (5) number, size, and complexity of maintenance manuals needed. The support area offers the greatest possible opportunity for increased availability and cost reduction. One can readily see the effect that reducing factor 1 would have on all the other factors. Equipment designed with self-check capabilities or simple go-no go check requirements would reduce factor 1, thereby reducing to a minimum factor 2. Because some air defense systems in operation today require large amounts of complex test equipment, reducing factor 1 would also reduce spare parts requirements. The skill level of support personnel could be materially lowered, and because many of the technical manuals are in support of the test equipment, a large amount of these could be eliminated. Maintainability features can be said to have a contagious effect—if we can lower requirements in one area, the other areas generally follow the lowering trend.

Operational availability cost, which cannot be measured in exact dollar amounts, can be expressed as a percentage of lost operational time required for maintenance. Basic considerations are complexity of equipment, complexity of the operation and maintenance, personnel limitations, and operation environment. The interrelationship between these factors is such that if the requirement or level of one is changed, the contagious effect will again be apparent. The foregoing is a generalization of the maintainability concept and the part that maintainability engineering will play in future equipment design.

Articles to follow will treat specific maintainability features in more detail. These features will include integrated circuits, throw-away components, wooden-round concept, self and go-no go checks, and personnel limitations. At present, these areas offer a wide range of possibilities for reducing support cost and increasing operational availability time.

Hawk Unit Back From 'War'

First Lieutenant Steven L. Raymer
Public Information Officer
US Army Air Defense Center and Fort Bliss
(Photographs by Lt Raymer)

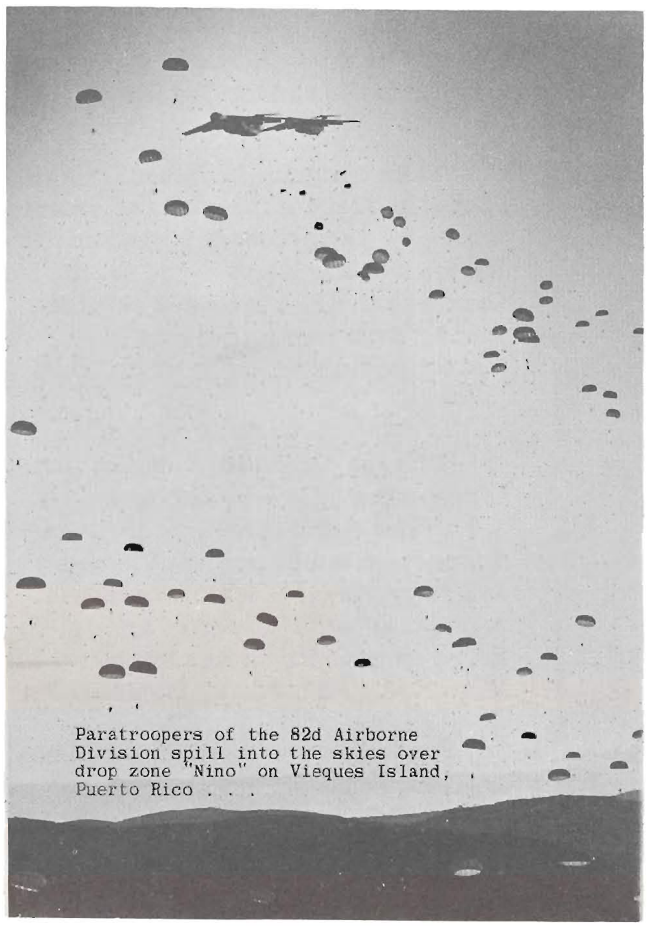
Heavily laden C-141 Starlifter jet transports filed down the taxiramps at El Paso International Airport recently, returning a Hawk air defense artillery missile battery to Fort Bliss from war games in the Caribbean.

The war on the Puerto Rican island at Vieques was over, the insurgent popular forces crushed in a rapid-reaction test of the United States Strike Command. The task at hand for Battery B, 4th Battalion, 56th Artillery, was now that of unpacking and evaluating its war readiness performance in the 9-day Caribbean maneuver.

Called Exercise Boldshot-Brimfire, the multiservice Strike Command operation pitted an Army-Air Force contingent of more than 2,500 combat troops against guerrilla forces seeking to overthrow the imaginary nation of Isabella. In an almost classical 20th-century warfare scenario, United States military assistance had been requested.

Positioning for action

Against this setting, American Green Beret Special Forces spearheaded an assault on the eastern portion of the 20-mile-long island, followed by a paratroop jump by more than 800 soldiers of the Army's 82d Airborne Division. The Fort Bliss unit provided low-altitude air defense protection for the US strike force.



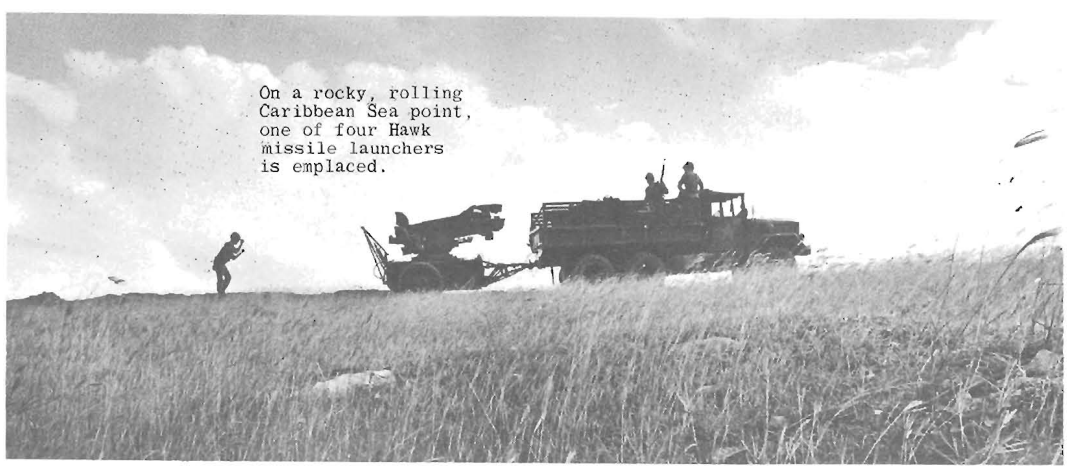
Paratroopers of the 82d Airborne Division spill into the skies over drop zone "Nino" on Vieques Island, Puerto Rico . . .

The 96-man Hawk missile battery was sited on a rocky point which sliced into the deep-blue Caribbean. The unit's combat readiness was tested in exercises with the Puerto Rican Air National Guard.

Flying F-104 Starfighter jets, the air guardsmen repeatedly tried to penetrate the Hawk defense and were successfully turned back. After being airlifted nearly 2,500 miles to the balmy, jungle island on C-130 Nike Hercules transports, the battery took up battle positions 11 January.

The Fort Bliss unit was emplaced shortly after a precise airborne assault by the paratroopers based at Fort Bragg, North Carolina. At D637 the first planeload of nearly 40 troopers spilled from a C-141 Starlifter over the rocky, rolling drop zone "Nino."

One of the first paratroopers to jump into the rugged jungle area was Major General John R. Deane, Jr, 82d Airborne Division commander. The airborne assault into a 10-knot surface wind was made by the unit's division ready force—the 3d Battalion (Airborne) of the 506th Infantry.



On a rocky, rolling Caribbean Sea point, one of four Hawk missile launchers is emplaced.

Witnessing the paratroop jump, which included the dropping of 48 platforms loaded with light vehicles and supplies, were Army General Theodore J. Conway, Commander in Chief of the US Strike Command, and Air Force Lieutenant General Benjamin O. Davis, Strike

Command Deputy Commander in Chief. The airborne assault was silhouetted against a fiery early morning sun as the troop-laden transports winged their way across the neighboring islands of St. Croix and St. Thomas to the rectangular drop zone on the 3-mile-wide Vieques Island.

The going gets rough . .

While suffering 22 minor injuries—about 5 percent of the airborne assault force—the paratroopers pushed on during the morning hours to the Camp Garcia Airfield, a principal objective held by the enemy. The role of Aggressor troops was played by other US forces.

With the Aggressors holding the commanding hills overlooking the 5,000-foot asphalt airstrip, the paratroopers—about 80 percent Vietnam war veterans—assaulted the position. An ensuing battle supported by Air Force tactical air strikes brought the airfield into US hands by midafternoon.

The Aggressor forces having been routed, a coordinated and combined infantry and armored assault on other enemy positions was made later in the week. Some portions of the exercises included the use of live ammunition with infantry weapons and live ordnance by F-4C Phantom jets of the Air Force Tactical Air Command.

Crete

A report from 32d Army Air Defense Command

On the rock-bound Acrotiri Peninsula, 14 miles from Chania, the ancient capital of Crete, lies the $50 million NATO Missile Firing Installation (NAMFI).

A firing simulator is being placed on a Nike Hercules at the launching area at the NAMFI range by six Battery A, 4th Missile Battalion, 6th Artillery, soldiers.

Opened in February 1968 by the host nation, Greece, the installation was built primarily to take the pressure off McGregor Range in New Mexico and cut travel time and costs for Europe-based units undergoing annual service practice. At present, seven members of the North Atlantic Treaty Organization—the United States, Germany, Netherlands, Belgium, France, Norway, and Denmark—use the NAMFI range.

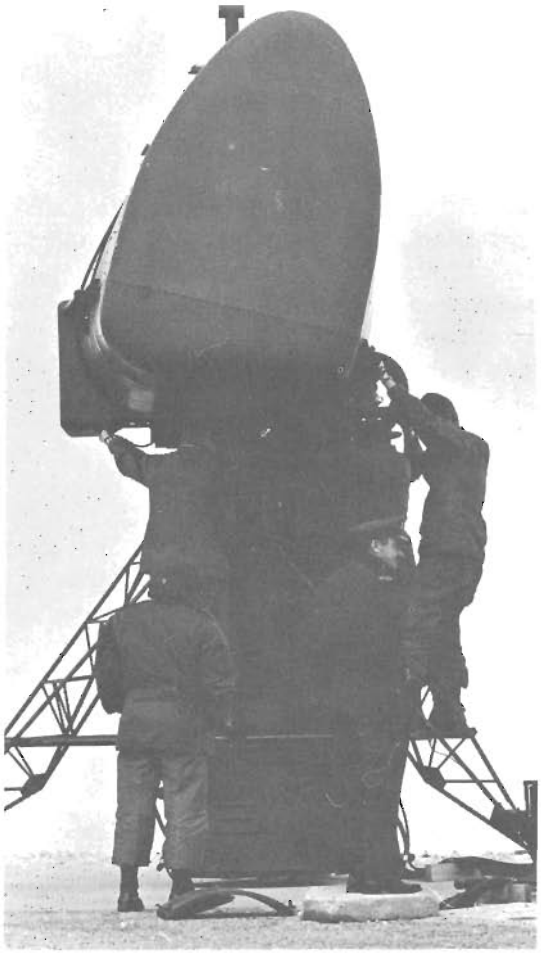
An installation with an annual operating budget of $21 million, NAMFI is under the operational control of SHAPE (Supreme Headquarters, Allied Powers, Europe), with administrative control held by the Hellenic National Defense General Staff.

The NAMFI target area extends 150 miles into the blue Mediterranean and varies in width from 3 miles at the firing point to 40 miles at the target area extremity. Eight air and sea surveillance radar units make up part of an extensive safety system for the entire area.

The most vital aspect of the operation is Range Control, built on a precipitous bluff overlooking the launching pads. Here the control room personnel feed firing data into computers and keep a series of information charts and boards posted. The missiles are fired from a 1,000-foot-high launching area which includes three Nike sites and four Hawk pads. Nike Hercules, Nike Ajax, and Sergeant missiles are fired on the range.

Five Battery D, 3d Missile Battalion, 71st Artillery, soldiers work on a Nike Hercules missile in the launching area during a SNAP session.

Firing at NAMFI is of extreme importance because the score a unit receives during annual service practice is the measure of its ability to perform its air defense mission during combat. This score is not only a rating of a unit's performance during the few days required for annual service



Four Battery A, 4th Missile Battalion, 6th Artillery, soldiers run an orientation check on an acquisition radar set. Standing by is an evaluator whose job is to appraise the crew.

Nike Hercules firing.

practice firing, but it is also an indication of the quality of training it has had and of the ability of its men to perform tactical missions at any time and in any place.

Even though units ordinarily spend only 1 week at NAMFI, the comfort and entertainment of crewmen during off-duty time has not been overlooked.

The installation provides free movies, swimming and basking on the warm sandy beaches, modern officer's and enlisted men's clubs, a library, and restaurants. Facilities such as a post exchange, laundry, post office, and barbershops are also available.

The nearby town of Chania, one of the oldest towns on the island of Crete, provides the missilemen with a look into the ancient past of Greece with its relics of Minoan civilization—well-preserved medieval churches, houses, and monuments.

Without a doubt, the NATO Missile Firing Installation plays a key role in advancing the cause of freedom throughout the free world by keeping NATO missilemen well prepared in the mission of air defense.

Lessons Learned in Vietnam

TACTICAL EXPERIENCES OF DEPLOYED UNITS

(Introductory comments by the Editor)

NOISY AS HELL - BUT!!!

•This Quad-50 is one of our best bets for stopping the Vietcong (VC). Here's what one combat unit has to say about it•

The flash from the VC mortar alerts the crew of an awesome weapon. Soon a thunderous roar is heard and a fiery stream of tracers seals the fate of the insurgents.

The weapon is the multiple caliber .50 machinegun M55, alias the "Quad," "Quad-50," or "Whispering Death." Originally designed as an antiaircraft weapon in World War II, the Quad mounts four caliber .50 machineguns and delivers 2,000 rounds per minute on target. The Quad proved itself as a formidable weapon against mass troop ground attacks in Korea and has again proved itself in Vietnam.

The Quad's current employment is characterized by a strictly ground support role. Its mission includes convoy and strong point security, and perimeter defense. A versatile weapon, it can be ground or truck mounted and airlifted for mobility.

The Quad can spew its devastating firepower through 360° traverse and up to 85° elevation.

•The foregoing comment made mention of airlifting the Quad 50. This report gives some valuable, detailed information on the operation•

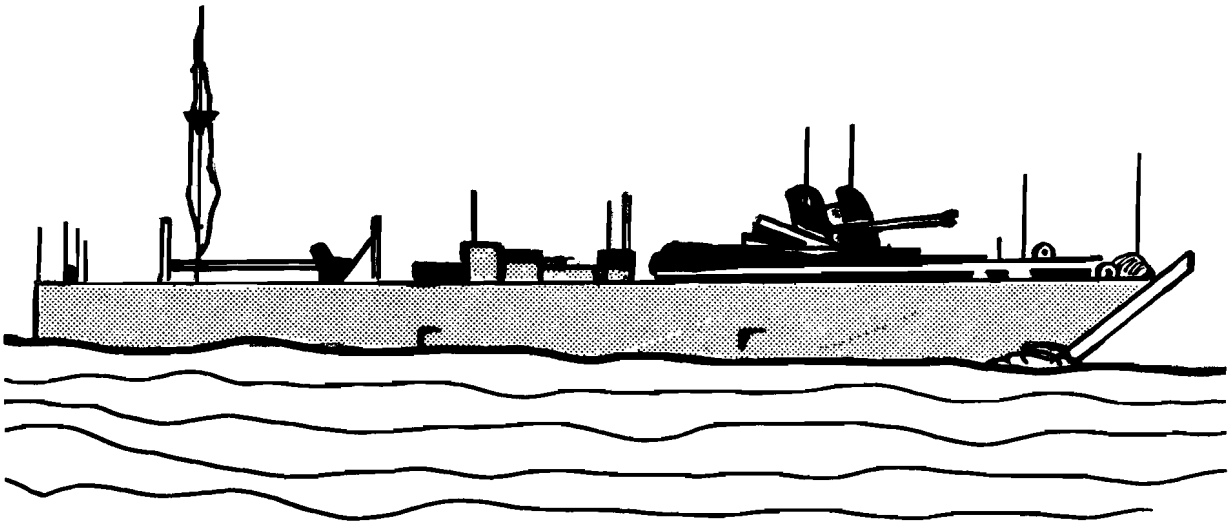
The M55 can be airlifted by CH-47 helicopter. This method of movement can be accomplished with the M55 loaded internally or externally. The preferred method is to externally sling-load the weapon.

Internal airlift: The M55 loaded internally with ammunition and tools carried externally requires extended helicopter utilization time. This method should be used only when helicopter utilization is not critical. Consideration must also be given to an adequate road network for moving the M55 and to helicopter landing zone utilization due to the time required to load and unload. The equipment required includes a 20-foot cargo sling, donut, 4- by 12-foot cargo bag with liner, and a large clevis. The ammunition, tools, repair parts, and dufflebags are placed in the cargo bag which is secured to one end of a 20-foot sling. When the clevis with donut attached is secured to the other end, the load is ready for pickup.

External airlift: The CH-47 lands to load the crew and upon takeoff picks up the previously prepared external load. In the new position area, the CH-47 places the M55 and ammunition into firing position and lands to off-load the crew. This method is the most efficient because it conserves helicopter and landing zone utilization time and permits the M55 to be lifted from the old firing position directly into the new position. The equipment required for this phase of the operation includes four 11-foot cargo slings, two 20-foot slings, four small clevises, two large clevises, one donut, a 4- by 22-foot cargo bag with liner, and one thin string 20 inches long.

Preparations: The ammunition, tools, repair parts, and dufflebags are placed in the cargo bag. The cargo bag is secured to one of the 20-foot slings. The second 20-foot sling is wrapped around the lower cylindrical base of the M55 and secured by one large clevis to the cargo bag sling. The 11-foot slings are connected to the M55 lifting shackles by using the four small clevises. The 9-, 10-, or 11-foot slings are satisfactory; longer slings cannot be controlled during hookup and have a tendency to hang on the M55 mount, causing damage at pickup. The free ends of the 11-foot slings are connected to the large clevis and the donut is secured. The four slings are bound together over the center of the weapon with the thin string, preventing slings from becoming entangled in the mount and eliminating the possibility of damage during pickup. It is advisable to have one M55 crewman with radio at the new location to guide the CH-47 into position.

• Here is another example of how the M42 (Duster) has grown in importance in the Vietnam conflict •



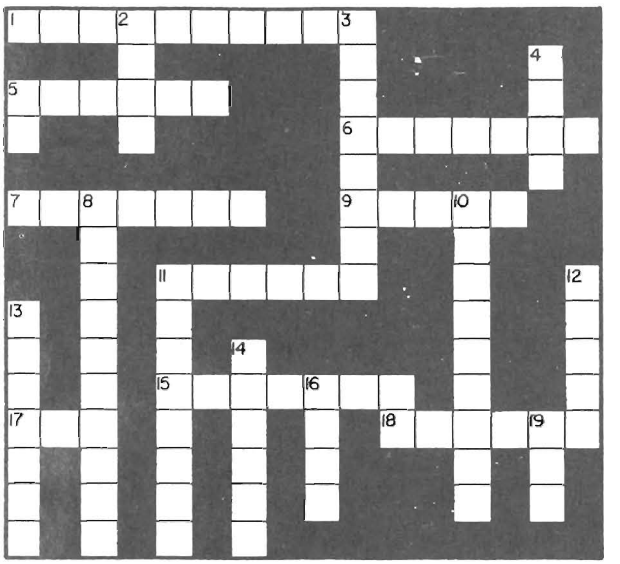
Designed as an antiaircraft weapon but now used in the ground support role, the twin 40-mm self-propelled gun M42 (Duster) is credited with a new method of employment—waterborne operations.

To attack "safe-havens" that the enemy established along coastal areas in central Vietnam, the Duster was loaded on a landing craft, mechanized (LCM), and transported in bay areas, inland waterways, and on rivers. Maneuvering offshore, the Duster/LCM effectively interdicted enemy locations which were inaccessible by land. The LCM provided an adequate firing platform for the Duster. In a drifting condition, the craft's stability enabled the Duster crew to engage point targets (caves, bunkers, and buildings) with a high degree of accuracy. Moving under power, the LCM firing platform provided sufficient stability for engaging area targets.

Observation and adjustment procedures are generally the same as those used on land. An observer can easily direct fire from the LCM; however, the field of observation is restricted to the shoreline. Greater observation is achieved with an aerial observer who also can mark targets with smoke and adjust fire on targets not visible to the crew.

How's Your Memory of Electricity?

Here's a chance to test yourself.



Across

1. A _____ in potential causes current flow.
5. A connection _____ the circuit is required to produce current.
6. The charge of 6.25×10^{18}.
7. A closed path for electron flow.
9. Like charges _____ each other.
11. The positive particle of an atom.
15. Charges of opposite polarity _____.
17. Rate of alternation.
18. A completed circuit is _____.

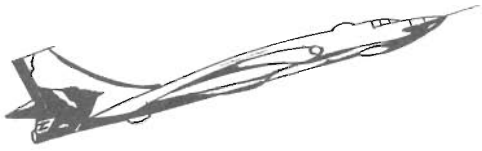
Down

2. Electrons _____ from − to +.
3. Opposite of a proton.
4. Practical units of resistance.
5. One type of voltage.
8. Oppugnation to current.
10. The zinc container of a dry cell.
11. All ac voltage sources reverse in _____.
12. Describes dc voltage.
13. Electron flow.
14. Suspended electricity.
16. Smallest particle of an element.
19. The no-load voltage of a generator (abbr).

Answers on page 73.

Do You Recognize These Aircraft?

1



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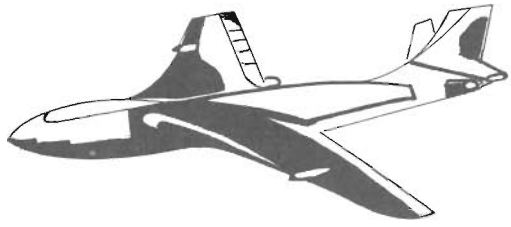

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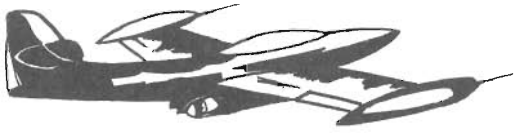

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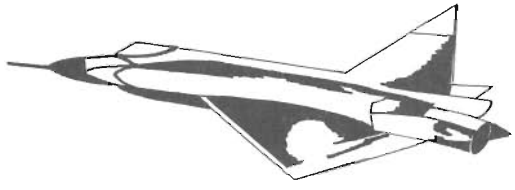

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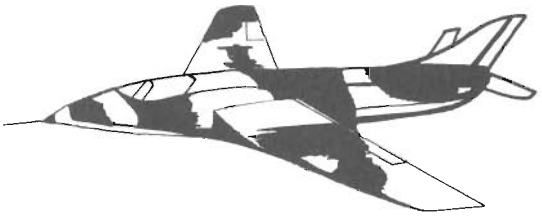

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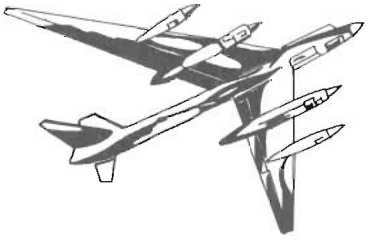

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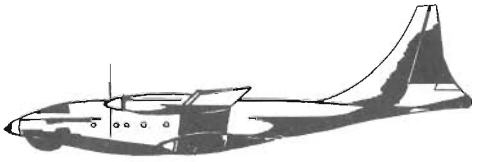

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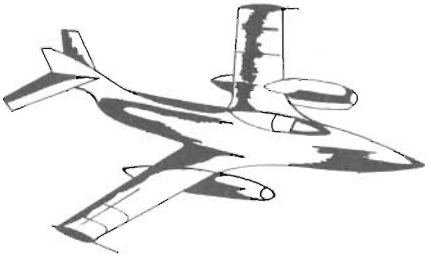

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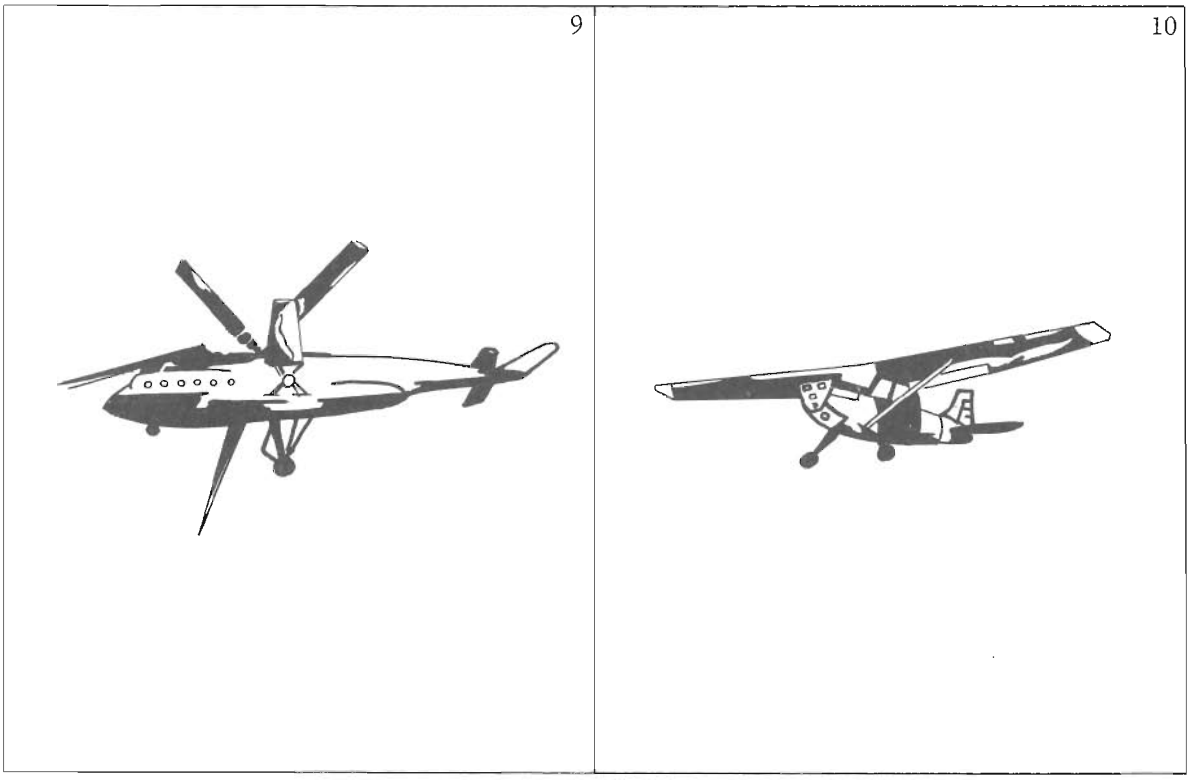


Correct identifications of aircraft.

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

These are isometric projections of the same aircraft that appeared as silhouettes in the January 1969 issue of Air Defense Trends.

Answers to crossword puzzle:

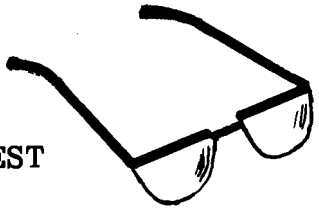
Across

1. difference
5. across
6. coulomb
7. circuit
9. repel
11. proton
15. attract
17. ROA
18. closed

Down

2. flow
3. electron
4. ohms
5. ac
8. resistance
10. electrode
11. polarity
12. fixed
13. current
14. static
16. atom
19. emf

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

ATOMIC BOMB
China and the Bomb by Morton H. Halperin. Praeger, New York, 1965.
"Why does China want a nuclear force? How will she use it? What can other nations expect, and what should U.S. policy be? These imperative questions are asked and answered in Mr. Halperin's major new book on Communist China."

VIETNAMESE CONFLICT, 1961-
Behind the Lines: Hanoi, December 23, 1966-January 7, 1967 by Harrison E. Salisbury. Harper and Row, New York, 1967.
"Now, in this book distinguished by its vivid prose and on-the-spot photographs, Mr. Salisbury enlarges on what he saw and heard behind the lines in North Vietnam."

VIETNAM - POLITICS AND GOVERNMENT
The United States in Vietnam by George M. Kahin. The Dial Press, New York, 1967.
"Here for the first time is an objective and historically oriented account of the Vietnamese debacle, thoroughly documented and supported by facts compiled by two of America's foremost scholars in Asian affairs."

SCIENCE AND CIVILIZATION
Scientists and War; the Impact of Science on Military and Civil Affairs by Sir Solly Zuckerman. Harper and Row, New York, 1967.
"In this timely and thoughtful book, the chief scientific adviser to the British Government discusses the grave responsibilities of science and scientists in relation to the military and political decisions of our time."

VIETNAMESE CONFLICT, 1961-
No Place To Die; The Agony of Vietnam by Hugh A. Milligan. Morrow, New York, 1967.
"Written by the AP writer whom the battle correspondents themselves call the Ernie Pyle of Viet Nam, this book evokes what it is really like to live, fight and die in this, the most confusing war that America has ever fought."

ELECTRICITY
Elements of Electricity by William H. Timbie. J. Wiley and Sons, New York, Rewritten 1967.
This text gives adequate information, applies this information to real things, provides sufficient drill in concrete practical problems, and presents only those facts and principles that a technical student needs to know.

PROGRAMMING (ELECTRONIC COMPUTERS)
How to Pass Computer Programmer Aptitude Tests by John J. Jensen. Cowles Education Corp., New York, 1967.
"To help you prepare for these tests, our editors have compiled a list of commonly asked questions about computer programmer aptitude tests and have answered them as concisely as possible."

US - POLITICS AND GOVERNMENT
Safe - Not Sorry by Phyllis Schlafly. Pere Marquette Press, Alton, Ill., 1967.
"This book tells what most politicians are afraid to discuss - why we have riots and mounting crime, who has been embezzling defense dollars to buy votes, why we don't win in Vietnam, and who caused our big missile and anti-missile gaps."

CHINESE ARMY
The Role of the Chinese Army by John Gittings. Oxford U.P., New York, 1967.
The author examines the transformation in the Chinese Army from the civil war to the present day, and pays particular attention to its effect on the Army's political and social roles.

NATIONAL SECURITY
Issues of National Security in the 1970's by COL Amos A. Jordan, Jr. Essays. Praeger, New York, 1967.
A series of 14 essays by nationally recognized authorities presents a picture of the history and probable future trends of security. This book is on the Contemporary Military Reading Program list.

COMMUNIST DEVELOPMENT - VIETNAM
Rural Pacification In Vietnam by William A. Nighswonger. Praeger, New York, 1966.
"The focus of this study is on the administration of pacification in South Vietnam."

LASERS
Lasers and Masers by Charles A. Pike. H. W. Sams, Indianapolis, 1967.
"This book presents the fundamentals of both gas and solid-state laser and maser devices."

ARTICLES

CZECHOSLOVAKIA - POLITICS AND GOVERNMENT
"Czechoslovakia and Western Security," Henry M. Jackson, Air Force Magazine (November 1968), pp 43-46.
"The Soviet Union is a dangerous and unpredictable adversary. We cannot be confident that a Soviet Union that spearheads a five-nation intervention in Czechoslovakia will not use military force in pursuing its objectives in other situations, when it believes this can be done without incurring unacceptable risks."

LIBERALISM
"Are 'Liberals' in U.S. Out of Date?", U.S. News & World Report (December 23, 1968), pp 32 and 33.
"Now it is the 'intellectual gap' - the lack of understanding between older 'liberals' and the young. It was demonstrated at a conference of intellectuals and scholars. Far more than a 'generation gap' is involved. The young and their elders barely speak the same political language - and they disagree on almost everything."

ARTILLERY
"New Trends in Artillery," Gilbert J. Melow, Jr., Ordnance (November-December 1968), pp 282-285.
"The Army Weapons Command is developing lighter weight weapons with no decrease in reliability plus such innovations as a rapid-firing howitzer and an unconventional fire-out-of-battery recoil cycle."

US ARMY
"A Status Report on the U.S. Army," Army (November 1968), entire issue.
This annual directory and report presents a status report on the Army, a picture of the situation in Vietnam, a photo directory of the principal leaders, and a 1968 weapons guide.

RANGEFINDERS
"Ruby Laser Rangefinder," James F. Hadwin and Phil Miller, Signal (December 1968), pp 28-30.
"One of the more promising aspects of electro-optic technology has been the use of the laser as a range finding device."

RETIREMENT
"Careers for Retired Military," Gordon A. Moon II, Army (January 1969). "Retired servicemen who seek a second career can be helped tremendously by an organization like San Francisco's Careers for Retired Military, which is successfully placing retired military people in meaningful civilian positions."

COMMUNICATION, MILITARY
"The Mallard Project," Signal (November 1968), special issue. The Mallard project has for its objective the provision of modern communications equipment for tactical warfare purposes in the 1975-77 time frame.

US - MILITARY POLICY
"The Alarming Decline of Our Military Power," Hanson W. Baldwin, Reader's Digest (December 1968), pp 86-90. "A long accumulation of misguided policies and short-sighted decisions has seriously depleted the fighting strength of our military establishment. In the first of a series of articles, the retired military editor of the New York Times assesses their disastrous effects on our ground forces."

VOLT-OHMMETERS
"Build the Popular Electronics Digital Volt-Ohmmeter," Don Lancaster, Popular Electronics (December 1968), pp 29-40. For less than the price of many transistor multimeters you can now build your own real digital volt-ohmmeter. Here are complete instructions and schematics.

ETHICS
"The Collective Guilt Myth," William H. Chamberlain, The Freeman (January 1969), pp 3-9. This author reminds us that guilt is always individual, never collective, and that it is ridiculous and wrong to blame society as a whole for the assassination of individuals or for disorders on campuses or among racial groups.

SPACE STATIONS
"Why Space Stations?" Robert R. Gilruth, Astronautics & Aeronautics (November 1968), pp 54-60. "As base for developments and operations, equivalent in function to terrestrial bases for exploration, the orbital station should form the gateway to our future in space."

TARGET ACQUISITION
"Target Acquisition: Vietnam Style," David H. Hackworth, Army Journal (October 1968), pp 10-16. "Commanders in Vietnam have uniformly agreed that a bigger problem than killing the enemy is finding and fixing him."

GUIDED MISSILES
"The Controversy Over a U.S. Anti-Ballistic Missile System," Congressional Digest (November 1968), entire issue. This issue describes the US strategic ballistic missiles, compares US and Soviet weaponry, describes the development of the Sentinel system, and gives pro and con arguments on whether the US should deploy an antiballistic missile system now.

KOREA - POLITICS AND GOVERNMENT
"Korea - Our Next Vietnam?" James M. Wroth, Military Review (November 1968), pp 34-40. "North Korea has launched a campaign of increased violence and infiltration. With continued political and economic progress in South Korea, Communist efforts are likely to result in little more than harassment. However, the United States, as well as South Korea, must keep watch to preclude the serious implications inherent in North Korean actions."

Purchase and Importation of Goods made in Communist China, North Korea, and North Vietnam prohibited by US Customs regulations. Officials advise servicemen overseas to save PX sales slips and "certificates of origin" from local merchants as proof of source.

Army Digest
January 1969

Readers are invited to submit for possible publication articles and informative notes that are of professional interest to the air defense artilleryman. Articles should be current and forthrightly stated and should relate to some aspect of what air defense units in the field are doing to accomplish their mission, particularly in the technical and tactical areas. Miscellaneous articles expressing either technical or non-technical ideas that may be of value to air defense will also be considered for publication.

Direct communication to the editor is authorized:

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Just a Reminder –

A "Letters to the Editor" section has been initiated in this issue of Air Defense Trends. The Trends staff is giving top priority to units that are experiencing difficulties in their operations. Realizing that you may have had a problem, and had to devise a method to overcome it, we would like to share the fruits of your experience with other air defense artillerymen. The "Letters to the Editor" section establishes a free exchange of information between air defense artillerymen of all ranks in the deployed commands around the world.