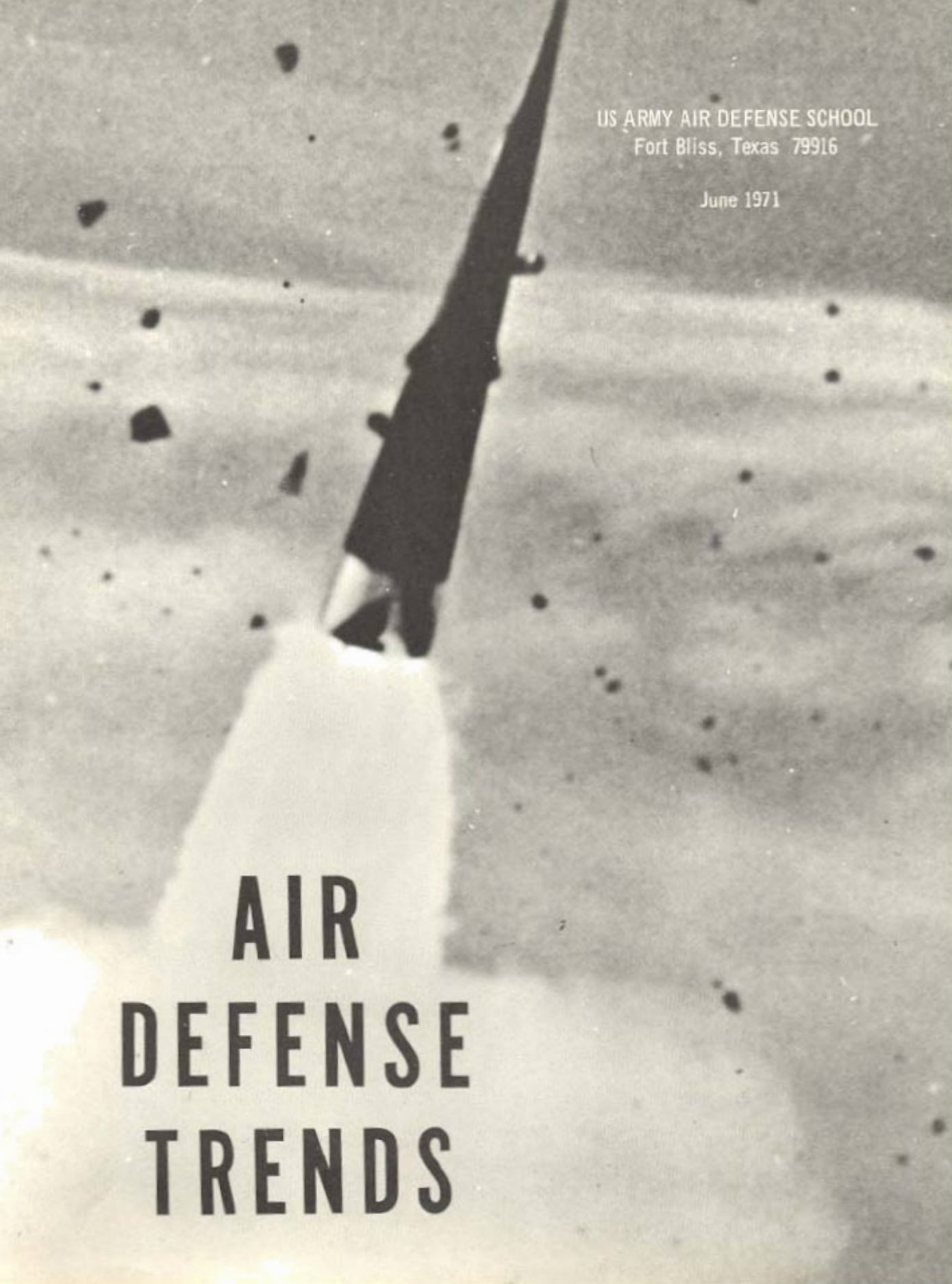


US ARMY AIR DEFENSE SCHOOL
Fort Bliss, Texas 79916

June 1971

AIR DEFENSE TRENDS

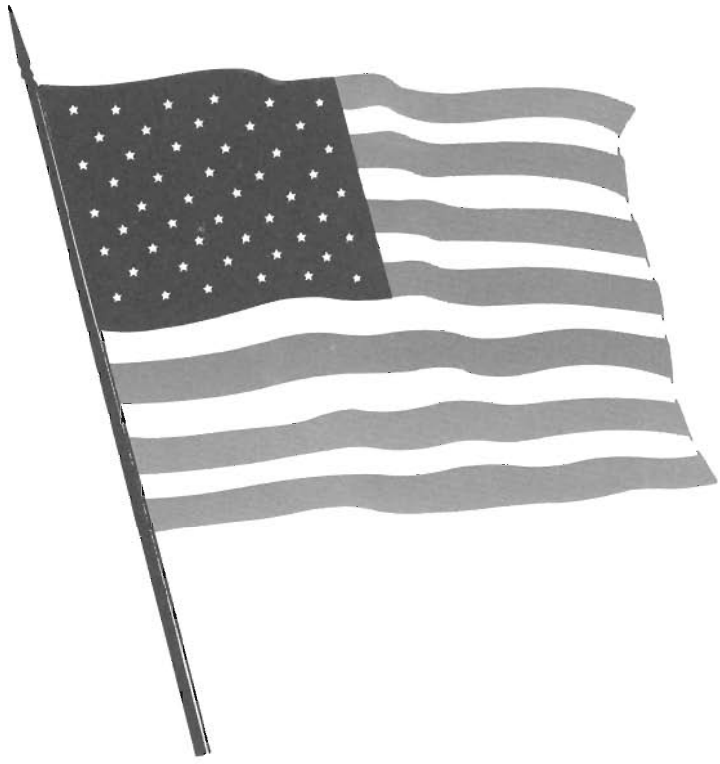
AIR DEFENSE TRENDS
US ARMY AIR DEFENSE SCHOOL
Fort Bliss, Texas 79916

IN THIS ISSUE

120461

Page

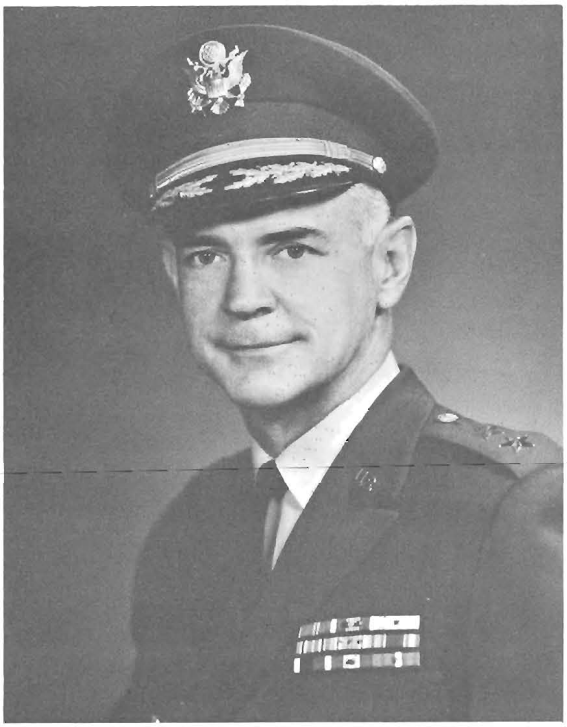
Air Defense Trends is an instructional aid of the United States Army Air Defense School; it is published when sufficient material of an instructional nature can be gathered.



This Flag, which we honor and under which we serve, is the emblem of our unity, our power, our thought, and purpose as a nation. It has no other character than that which we give it from generation to generation. The choices are ours. It floats in majestic silence above the hosts that execute those choices, whether in peace or in war. And yet, though silent, it speaks to us—speaks to us of the past, of the men and women who went before us, and of the records they wrote upon it.

—Woodrow Wilson
1917 Flag Day Message

General Cassidy Leaves Fort Bliss



Major General Richard T. Cassidy, after having served as Commanding General, US Army Air Defense Center and Fort Bliss, including the post of Commandant of the US Army Air Defense School, since June 1968 has been reassigned as Commanding General, US Army Air Defense Command. Concurrently, on 10 April 1971 he was nominated by President Nixon for advancement to the rank of lieutenant general. A native of California, General Cassidy graduated from West Point in 1940 with a Bachelor of Science degree and a commission in the Coast Artillery. He subsequently completed courses at the Antiaircraft Artillery School, Army Air Force School of Applied Tactics, Command and General Staff College, US Army War College, US Army Strategic Intelligence School, US Army Language School, US Army Air Defense School, and Dugway Proving Ground. He was promoted to brigadier general in April 1963 and to major general in September 1966. He served in the Southwest Pacific during World War II, participating in three campaigns. He has also served in Japan, England, Iraq, and Germany. General Cassidy has been awarded the Bronze Star Medal and the Army Commendation Medal with two Oak Leaf Clusters and has been recommended for the Distinguished Service Medal. He has been replaced by Major General Raymond L. Shoemaker, formerly the commanding general of the 32d Air Defense Command in Germany.

General Underwood Is New Fourth US Army Commander

Lieutenant General George V. Underwood, Jr., assumed command of the Fourth US Army, 12 April 1971. He has served as Commanding General, US Army Air Defense Command, since 1 July 1968, following the previous assignment of Commanding General, US Army Air Defense Center, and Commandant of the US Army Air Defense School at Fort Bliss, Texas.

General Underwood entered the service from Indiana when he bacame a cadet at the US Military Academy at West Point. He graduated in the class of 1937 with a commission in the Coast Artillery Corps. He holds a Master of Arts degree in Journalism from the University of Wisconsin. He has also attended the Command and General Staff School, the War Department General Staff Task Force Staff Officer course, the Armed Forces Staff College, and the US Army War College.

General Underwood has had eight assignments in Washington, D.C. Besides numerous important assignments in the continental United States, he has served in Hawaii, China, Alaska, and Germany. He has been awarded the Distinguished Service Medal, the Legion of Merit with three Oak Leaf Clusters, the Army Commendation Medal with Oak Leaf Cluster, and the Special Breast Order of Yun Hui (Chinese).

Deputy Assistant Commandant Retires

Colonel Postford A. Loiselle relinquished the position of Deputy Assistant Commandant of the US Army Air Defense School 31 March 1971 due to his retirement—a post he has held since July 1968. Colonel Loiselle entered service from North Carolina. He graduated from the Citadel where he majored in business administration; he also attended the Adjutant General School, the Artillery School, the Command and General Staff College, the Command Management School, and the US Army Air Defense School. He served in the Southwest Pacific during World War II and at GHQ under General MacArthur during the Korean Campaign. Peacetime oversea service included tours in Alaska and England. Colonel Loiselle has been awarded the Legion of Merit with Oak Leaf Cluster, the Army Commendation Medal with two Oak Leaf Clusters, four campaign medals, and six service medals.

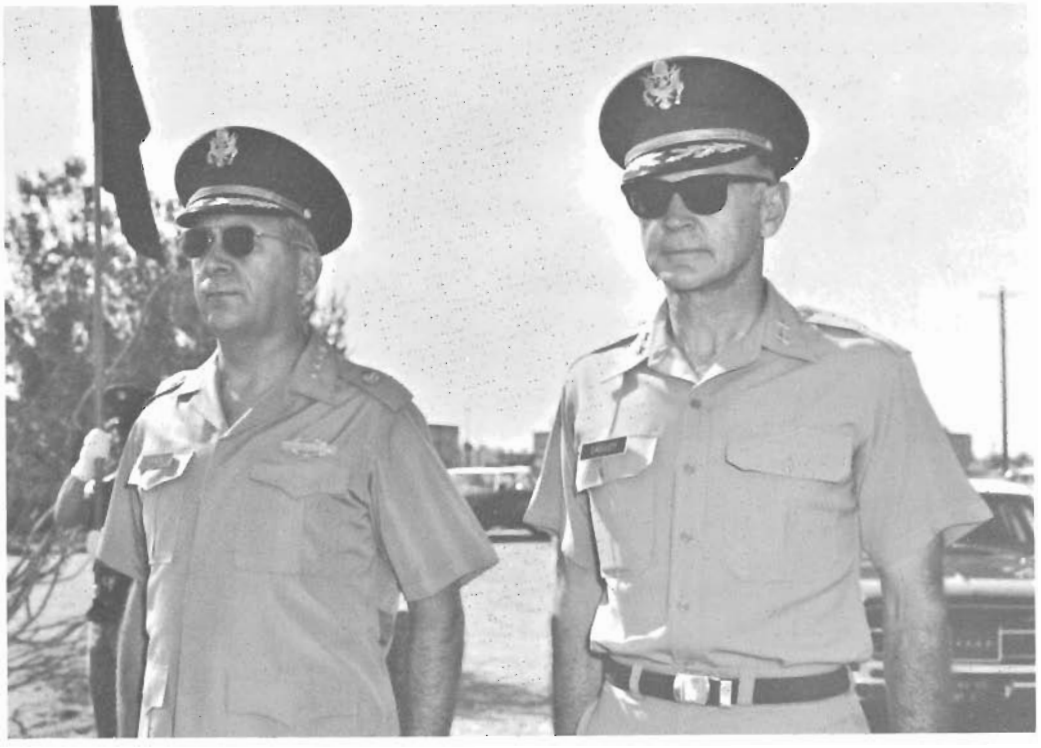
Colonel Connor Is New Deputy Assistant Commandant

Colonel John E. Connor, Jr, formerly the Director of Instruction, was recently appointed Deputy Assistant Commandant of the US Army Air Defense School. Colonel Connor is a former faculty member of the National War College. He also held several high-level staff positions with Department of the Army, Washington, D.C. A native of Dover, Delaware, Colonel Connor is a graduate of the University of Delaware and holds a master's degree in International Affairs from George Washington University. He has attended the Command and General Staff College, Armed Forces Staff College, Army War College, and National War College.

His wartime service includes the Panama Canal Zone, Europe, and Korea. Colonel Connor has been awarded the Legion of Merit with two Oak Leaf Clusters, Bronze Star Medal, Air Medal with two Oak Leaf Clusters, and the Army Commendation Medal.

General Haines Visits Fort Bliss

(April 1971)



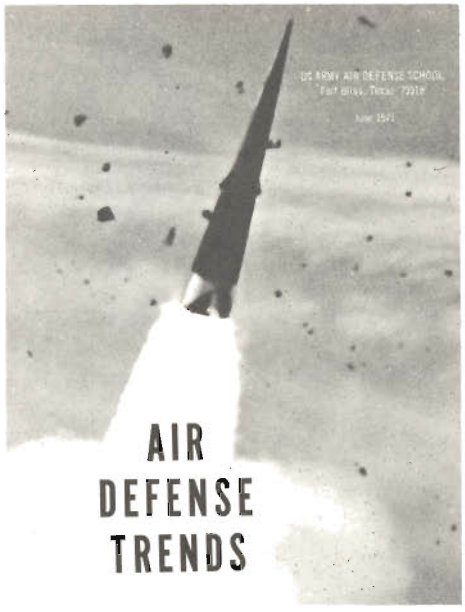
General Ralph E. Haines, Jr (left), Commanding General of the Continental Army Command and Major General Richard T. Cassidy, Commanding General, US Army Air Defense Center and Fort Bliss, during the 17 gun honors ceremony for the visiting CONARC commander at the Fort Bliss Replica Museum. General Haines received briefings on the missions of the Air Defense Center and the US Army Air Defense School during his visit. As this issue of Air Defense Trends goes to press, Major General Cassidy has been nominated for promotion to lieutenant general.

Weapons for Replica Museum

Recently, Miss Marjorie Graham, principal of Radford School for Girls, El Paso, Texas, presented a World War II heavy artillery collection to the Fort Bliss Replica Museum. The collection, consisting of 12 field pieces, was loaned to the museum indefinitely.

Miss Marjorie Graham, principal of Radford School for Girls, and Major General Richard T. Cassidy, Commanding General, US Army Air Defense Center and Fort Bliss, inspect a Japanese 20-mm, twin-barrel air defense weapon, one of 12 in the collection presented to the Fort Bliss Replica Museum.

Alphonse Solis, Fort Bliss Replica Museum aide, trims his tree sculpture of a horse which he has cultivated and shaped as another of the museum's many attractions.



COVER Much as a gigantic bullet would speed from the muzzle of a gargantuan gun, the Sprint missile blasts free of its tube and screams aloft to kill an enemy's incoming ballistic missile. The "debris" cluttering the scene is the fiberglas tube cover that was shattered when Sprint cleared the "muzzle." Based on recent tests, the odds that Sprint will make a kill are 7 to 1. In other words, seven of eight shots could result in kills. This fact greatly increases the effectiveness of the Safeguard system because Sprint is backing up the long-range Spartan missile which will reach into outer space to demolish hostile missiles. Sprint will zero in on any that "leak" through and pick them off at a closer range.

The sequence of actions from blastoff to kill occur in a matter of seconds. Safeguard computers have told the missile what azimuth heading to take. A computer signal fires a gas generator at the launch tube base that blasts the Sprint clear of the tube. A first-stage motor ignites instantly as the Sprint pitches toward the target and zooms off. A single radar tracks both missile and target and guides the missile toward the computed kill point. A second-stage motor ignites, and the Sprint accelerates to more than 100g, growing white hot in the process. An ablative heat shield inside the protective shell keeps the missile circuitry and mechanism cool enough so that it can respond instantly to guidance commands and save a city or vital defense installation from what could be certain and complete destruction.

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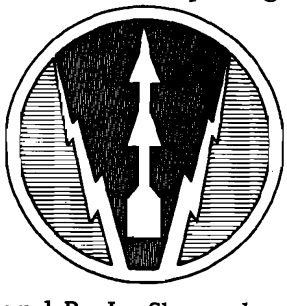
US ARMY AIR DEFENSE CENTER AND FORT BLISS



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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, CONUS 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 at 50 cents a copy from the Book Store, US Army Air Defense School, Fort Bliss, Texas 79916. The form below is printed for convenience in ordering.

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

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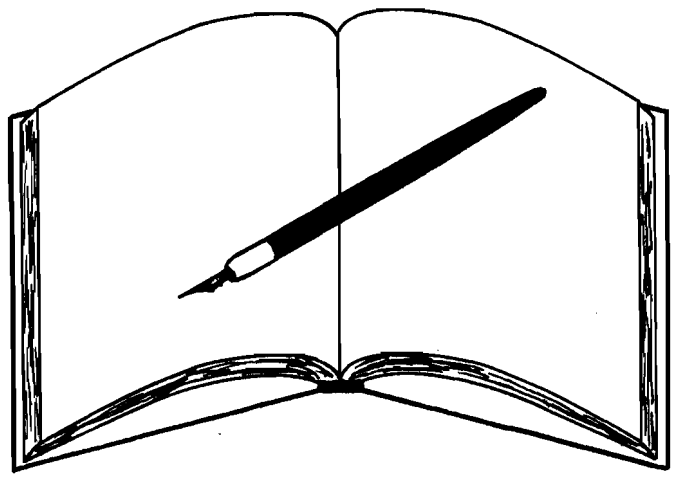
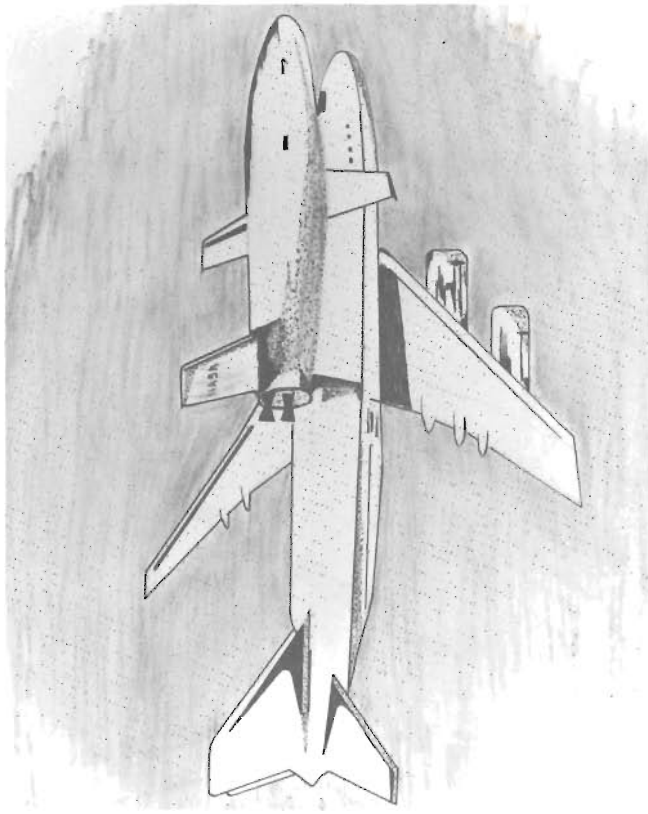


EDITORIAL

Project Space Shuttle



In July 1969 man took his first step on the surface of the moon, fulfilling a dream perhaps as old as civilization. Awe-inspired nations gazed in wonder, and American hearts swelled with pride. We had reached a milestone in conquering outer space, our most challenging frontier. Having achieved this once illusive goal, the question now arises, what shall our next step be? Some advocate further moon exploration and construction of a space way station. Others would bypass the moon and seek landings on other planets. Several different ideas have been advanced, but the one which seems to be gaining the most popularity is Project Space Shuttle.

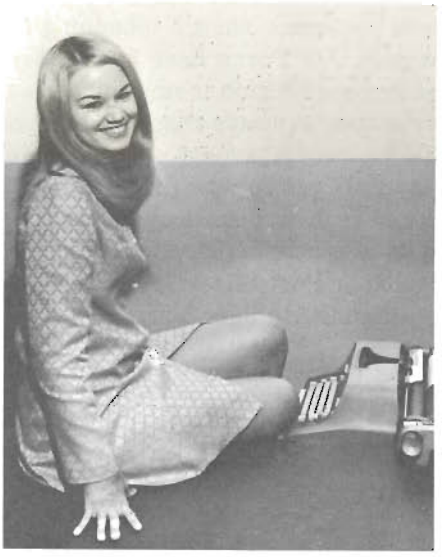
Preliminary design is now under study at the National Aeronautics and Space Administration, and thinking seems to be in terms of a piggyback configuration similar to the sketch above. The booster vehicle would carry a second vehicle on its back which would be released at the proper instant to enable it to go into orbit for later docking at a space station.

Convair Division of General Dynamics is designing the booster. The Space Division of North American Rockwell Corporation is designing the shuttle orbiter. Both vehicles would be recoverable for future flights, thus greatly reducing the cost involved.

A big question now is where the space shuttle launching facility should be located. Cape Kennedy in Florida and Vandenberg Air Force Base in California are under consideration, but White Sands Missile Range in New Mexico looms large as a possible site for several reasons. Abundant room for the long runways that will be needed, the noncorrosive nature of the desert air, the extensive visibility, superb weather conditions for takeoffs and landings, tremendous amounts of natural gas for the production of liquid hydrogen, nearby universities to provide scientific and technical manpower—these things make White Sands Missile Range uniquely suited as a launch facility. Thus, it is altogether possible that in the next few years air defensemen at Fort Bliss may be able to breeze up the highway for a short distance and watch the space shuttle in action.

—W.E.S.

LETTERS



to the Editor

● *Many individuals have written asking to be placed on the regular distribution list of Air Defense Trends. Regrettably we cannot provide individuals with personal copies of the publication on a regular basis. We are bound by Army regulations to organizational distribution. Exceptions can be made when the nature of the individual's duties justifies the use of the publication as a reference, such as service school instructors, liaison personnel, or military advisory personnel. Any military member, however, active or retired, may subscribe to the publication. Simply write to the Book Store, US Army Air Defense School, Fort Bliss, Texas 79916. See page 4 for further information.*

—Ed.

● I have read with interest the September 1970 edition of Air Defense Trends. The book was well received by the men of my unit, but I shudder to think of some people's attitude at the Combat Developments Command Air Defense Agency. I refer to the article, "FDS—Who Needs It?"

The fire direction system must be equated to a man's nervous system. If a man were to stick his hand in a fire without a nervous system to transmit the danger to his brain, he would certainly end up with a burned hand. The same would apply to air defense units trying to engage an enemy, but it would be only a local war because the rest of the defense would not be forewarned.

TAC SOP's are a wonderful thing, but they rely on good communications to make them really effective and the fire direction system is part of good communications.

J. W.

● I have inclosed a copy of the speech made by LTC D. J. Fuller of the Royal Artillery at a recent consolidated advanced individual training graduation ceremony at Fort Bliss. As I am sure you are aware, Lieutenant Colonel Fuller has been the British Liaison Officer at

Fort Bliss for the past 2 years and has recently returned to England. I think the message in his speech is outstanding and should be made available to as many soldiers as possible. I hope you will agree and print it in Air Defense Trends.

H. M. HILL
Fort Bliss, Texas

We agree with your evaluation of LTC Fuller's speech. The full text of the speech follows.

—Ed.

GRADUATION ADDRESS

Members of the graduating class, ladies and gentlemen:

I consider it a pleasure and honour as the British Liaison Officer to have been invited to be the guest speaker here today. I would like to welcome the visitors to this morning's ceremony, and to each member of the graduating class I offer my congratulations on your splendid achievement in qualifying in your respective military occupational specialities.

You have completed 8 weeks of intensive MOS training covering both the technical and tactical aspects of the various air defence weapon systems. Modern air defence weapons are highly sophisticated and complex and require intelligent, dedicated students to work diligently in order to operate them effectively. You graduating students have demonstrated these admirable characteristics.

Remember that these courses have given you the nuts and the bolts of your trade—you are not yet experts. You will be going out to join your field force units and will become a member of a weapon crew. It is essential that you learn to become part of the team—the others will be depending upon you. The drills, training, discipline, and motivation that you have so ably acquired here in the 1st Advanced Individual Training Brigade could literally be a matter of life or death. It is up to you to remember them and use this background to become a professional expert. We must remember that the modern air defence systems, whether Redeye, Vulcan, Chaparral, Hawk, or Nike Hercules, are so effective and lethal that we, as air defence gunners, are charged with a high responsibility to ensure we use them effectively. Don't forget that, within the guidance of your standard operational procedures, the decision and responsibility of shooting down a $2 million aircraft may be yours alone. No one but a well-trained, competent professional can be entrusted with this responsibility.

I see from the records of the graduating class that 49 are National Guard personnel and that, of 255 Army personnel, approximately 50 percent will be serving in the continental United States and 50 percent will go to oversea duty stations.

Your qualifications cover the full spectrum of the air defence family of weapons that have been designed for the defence of both your own great country and also most of the other countries of the free world.

Those of you who will be serving as Nike Hercules or Hawk missilemen here in ARADCOM must realize the importance of your task. You have the vital responsibility of protecting the air flank of your own nation. I think the motto "Alert Above All" on the ARADCOM insignia is aptly chosen. Remember this and always keep your missile sites in a high degree of readiness to defend your homeland from possible enemy air attack.

Those of you assigned to the new divisional Chaparral/Vulcan battalions will be very much in the limelight. You will be under the close scrutiny of the other combat arms and, at the same time, will be able to observe them and make your own comparisons. By your professional competence and high standards, make the other arms confident and appreciative of the excellent air cover that can be provided by the divisional air defence battalions.

You Duster and Quad .50 crewmen may be defending an allied force's base camp or fire support base in Southeast Asia. You will be joining forward area battalions that have rightly gained for themselves the highest praise and respect of the other combat troops. Your assignment to a tactical unit presents you with a new challenge more demanding than any with which you have been confronted so far. You now have a firm base on which to build. You will gain invaluable experience and will find it rewarding to become an effective member of a duty crew. The amount of effort that you put forth in your new duties will determine the degree of success you achieve as members of the crew and of the Army. As your experience increases, you will be given added and challenging responsibilities along with increased privileges. The knowledge that you are able to tackle these responsibilities will serve you well in the future, regardless of whether you make the Army a career or choose to return to civilian life.

I would like to digress slightly to talk about some of the opportunities available to you young soldiers while in the Army. Often the function of the military is exclusively thought of in terms of combat—yes, we are trained to defend and protect our country from both external and internal threat. But remember, war is simply an extension of diplomacy. It is the last resort when the leaders and diplomats cannot avert a threat to our country, or maintain a status quo necessary to ensure our own national security and way of life. Then, as soldiers, by our training, loyalty, and dedication, we must be prepared if necessary to fight for what we believe in.

It must also be remembered that the military in your country is also one of the nation's leading educational institutions, spending $2.6 billion annually to teach academic and vocational subjects that equip men with knowledge and skills needed in the civilian job market. For many hundreds of young men, who have been slighted by the institutions of civilian society, military service has often provided a second chance for self-development, for making the most of their talents and starting them up the ladder of success and advancement. Take every opportunity offered in the Army to improve your education and learn new skills. Your Army provides a most comprehensive list of correspondence courses in both military and civilian subjects, and there is no reason why you should not make this a stepping stone to a new and successful career.

Many of you graduating today will, like myself, have the privilege of serving in foreign countries as representatives of your country. I only hope you are as warmly received as I have been here and have as enjoyable a time. Take the opportunity to travel, meet new

people, and learn to respect and understand their customs. Normally, soldiers have proved themselves to be some of the best ambassadors that a nation can provide. I hope a high proportion will take the opportunity to visit my own country—the British Isles. It has the great advantage that we speak a language similar to yours.

I wish each of you the best of success in your future endeavours, whether as a member of the Armed Forces in service to your country, or as a civilian in private life.

Again, congratulations on the successful completion of this portion of your Army career.

● I have read your publication Air Defense Trends, January 1971, with great interest—as usually.

As you seek readers comments on the material published I take the opportunity to inform you by referring to page 28 that the number of European NATO countries using the Hawk air defense system should correctly include also my country, Denmark, where Hawk has been in operation since 1965.

I should also draw your attention to the fact that another European nation; namely, Spain, is also using Hawk.

C. BONDE
COL, Royal Danish Air Force
Chief of Staff, RDAF SAM Group

● Your editor's note on page 28 of the January 1971 edition should read as follows:

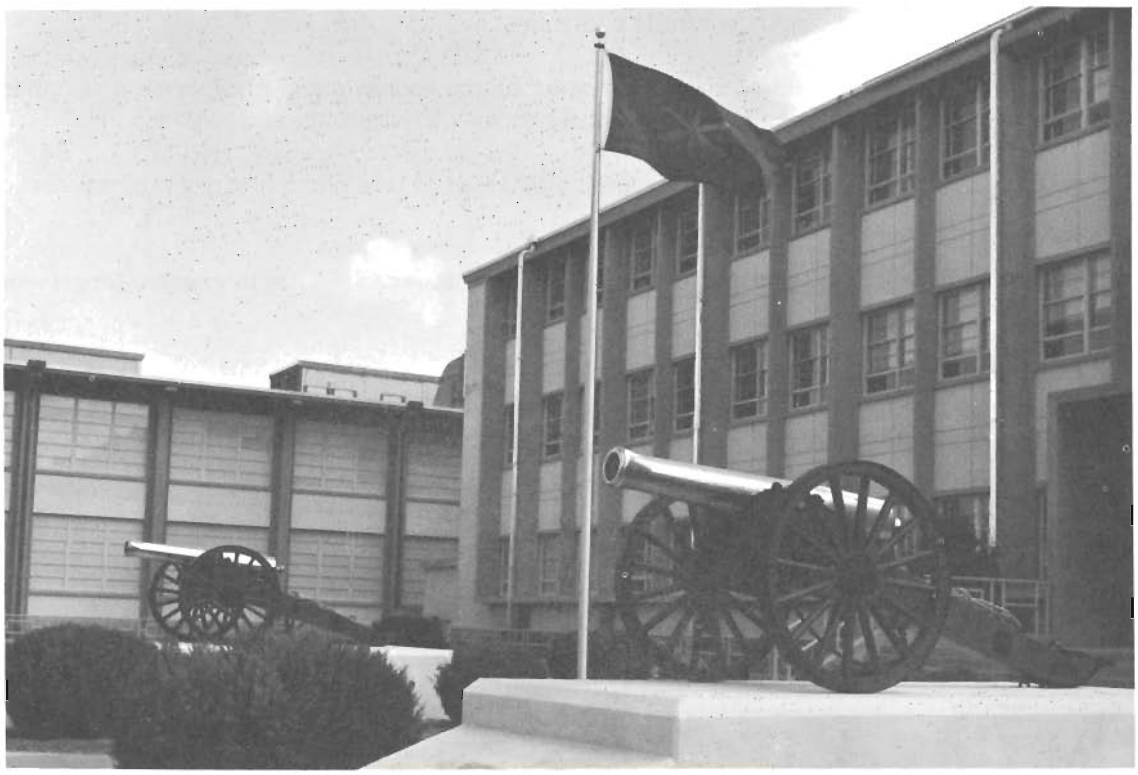
Hawk battalions have recently been withdrawn from the Panama Canal Zone and Vietnam. US Hawk battalions are also located in Korea. Seven NATO nations have Hawk units: Belgium, Denmark, France, Greece, Italy, The Netherlands, and West Germany. Spain also has the Hawk system. Marine Corps Hawk has been withdrawn from Vietnam.

PAUL E. JONES
Colonel, USA
OACSFOR-AD

We thank Colonel Bonde and Colonel Jones for their interest and comments.

—Ed.

USAADS Instructional Notes



Hinman Hall

OFFICE OF DOCTRINE DEVELOPMENT, LITERATURE, AND PLANS

ALTERNATE ACQUISITION RADAR

Radars selected for installation at Improved Nike Hercules sites not designated to receive the high-power acquisition radar (HIPAR), all of which are in the AN/FPS family of radars, are now known as alternate acquisition radars (AAR). This name change results from the placarding on control-indicators used with these radars. Former terms, such as alternate battery acquisition radar, auxiliary acquisition radar, and advanced acquisition radar, will no longer be used in School publications or DA training literature prepared by this School.

TRAINING LITERATURE REPORT

Here is a list of Department of the Army training literature which have been or will be produced in final manuscript form by the US Army Air Defense School during fiscal year 1971 and should be printed and distributed during the first half of fiscal year 1972:

FM 23-17, Redeye Guided Missile System, Apr 68 (revision).

(S-RD) FM 44-1A, U.S. Army Air Defense Artillery Employment (U), Oct 69 (revision).

FM 44-1-1, U.S. Army Air Defense Artillery Operations, Oct 69 (change).

FM 44-4, Procedures and Drills for Chaparral Self-Propelled Weapon System, Jan 69 (revision).

FM 44-5, Procedures and Drills for Vulcan Self-Propelled Weapon System, Aug 68 (revision).

(C) FM 44-9, Air Defense Artillery Fire Distribution System AN/TSQ-51 (U), Aug 67 (change).

FM 44-19, Qualification Program, Air Defense Artillery Weapon Systems, Apr 70 (change).

FM 44-20, Service Practice for Air Defense Artillery Missile Units, Jun 66 (revision).

FM 44-21, Service Practice for Air Defense Artillery Automatic Weapon Units, Mar 69 (revision).

FM 44-30, Visual Aircraft Recognition, Mar 69 (revision).

(C) FM 44-82A, Procedures and Drills for Nike Hercules Missile Battery (U), Jun 70 (change).

FM 44-97, Air Defense Artillery Engagement Simulator; Guided Missile System Radar-Signal Simulator Station AN/MPQ-T1 (Nike Hercules), May 68 (revision).

FM 44-99, Procedures and Drills for Hawk Missile Battery (Towed and Self-Propelled), May 69 (revision).

FM 44-100, Procedures and Drills for Vulcan Towed Weapon System, Feb 70 (change).

ATP 44-235, Air Defense Artillery Battalion, Hawk, Jul 70 (revision).

ATP 44-255, Air Defense Artillery Battalion, Hawk, Self-Propelled, Apr 69 (revision).

ATP 44-500, US Army ADA Missile Warhead Support Organization, Jan 69 (revision).

ATP 44-535, Air Defense Artillery Battalion, Nike Hercules, Oct 68 (revision).

ASubjScd 44-2, Visual Aircraft Recognition, Jul 67 (revision).

ASubjScd 44-7, Air Defense Artillery Chaparral/Vulcan Squad, Jun 70 (change).

ASubjScd 44-10, Air Defense Section, Airspace Control Element, Tactical Operations Center, Nov 69 (revision).

ASubjScd 44-33, Assembly and Monitoring Team (Missile Warhead Support Detachment), Jun 69 (revision).

ASubjScd 44-34, Hawk Self-Propelled Platoon, Oct 69 (revision).

ASubjScd 44-37, Command and Acquisition Section (Hawk), Jun 67 (revision).

ASubjScd 44-38, Fire Control Platoon (Nike Hercules), Jun 67 (revision).

ASubjScd 44-39, Launching Platoon Headquarters and Launching Section (Nike Hercules), Jun 67 (revision).

ASubjScd 44-40, Assembly and Service Section (Nike Hercules), Jun 67 (revision).

ASubjScd 44-41, Communications Section, Jun 69 (revision).

ASubjScd 44-42, Air Defense Artillery Communications, Jul 69 (revision).

ASubjScd 44-16P10, Advanced Individual Training and Refresher Training of Chaparral Crewman, MOS 16P10 (new).

ASubjScd 44-16R10, Advanced Individual Training and Refresher Training of Vulcan Crewman, MOS 16R10, Apr 70 (revision).

ATT 44-325, Air Defense Artillery Battalion, Chaparral/Vulcan, Self-Propelled, Feb 69 (revision).

ATT 44-535, Air Defense Artillery Missile Units (Nike Hercules), May 66 (change).

The following items of air defense artillery training literature have been affected as indicated:

FM 44-4A, Procedures and Drills for Chaparral Self-Propelled Weapon System, Aug 69, has been superseded by revised FM 44-4.

FM 44-97A, Air Defense Artillery Engagement Simulator; Guided Missile System Radar-Signal Simulator Station AN/MPQ-T1 (Nike Hercules), May 68, will be superseded by FM 44-97.

TC 44-8, Air Defense Element, Tactical Operations Center, Nov 63, will be superseded by Change 1, FM 44-1-1.

ASubjScd 44-17H20, Advanced Individual Training and Refresher Training of Fire Distribution Crewman, MOS 17H20, Aug 65, is to be rescinded.

CORRECTION

That portion of the last paragraph on page 84 of the January 1971 issue of Air Defense Trends which reads "Allied Command Europe" is intended to read "Airspace Control Element."

COMMAND AND STAFF DEPARTMENT

GUIDED MISSILE SYSTEMS OFFICER COURSE

If the center of gravity (cg) of a missile moves forward to a position ahead of the aerodynamic center of pressure, what effect will this have on the missile's longitudinal stability? This question was recently asked of a student in one of the Army's most demanding courses. The instructor who asked it is an Army officer, probably a recent graduate from a civilian college or university and most likely has a graduate degree in engineering. The student could be an officer from any branch or arm of the military service. He is enrolled in the US Army Air Defense School's Guided Missile Systems Officer Course 4F-1181.

The history of the course is as exciting as the curriculum and challenges it provides for the students. The course traces its history back to the early days of United States rocketry in 1946 when Department of the Army sent a directive to the Department of Gunnery at the then Antiaircraft Artillery School, Fort Bliss, Texas, requesting that a course of instruction be established to train officers for positions related to rocketry. It was a big challenge for Lieutenant Colonel Lawrence W. Byers, who was designated to accomplish this mission. But Colonel Byers, with the aid of Mr. Edward L. Safford, a civilian educator (now education supervisor in the course), established a 3-month curriculum covering the areas of aerodynamics, propulsion, guidance, and control theory. Their first students were four US Army officers and one Canadian officer.

The course shifted quickly into higher gear with the arrival of German rocket experts at nearby White Sands Proving Ground. Top scientists, such as Dr. Wernher von Braun and his team of rocket engineers, were made available to assist in the teaching of new instructors for the course. Ten new instructors joined the staff, and the course also added actual V1 and V2 components for use in demonstrations. Class enrollment was expanded to 40 students in each of three classes per year. The students included members of the Army, Navy, and Air Force as well as British and Canadian officers.

In the early 1950's, students were receiving 7 months of instruction at Fort Bliss and 3 months at institutions such as Johns Hopkins University, University of Michigan, and branches of the University of California. Missile systems, such as Nike Ajax, Talos, and Shrike, were being developed concurrently, and since graduates of the Guided Missile Systems Officer Course were familiar with the missile programs, they were in great demand. In the second half of the 1950's, reorganization of military missile development took place. The result was the separation of Army and Air Force missile systems on the basis of missions. The Air Force assumed total responsibility for strategic-type missiles, and the Army became responsible for tactical-type missiles. Within the Army, reorganization took place with the requirement that all surface-to-surface missile training be conducted at Fort Sill, Oklahoma, and all surface-to-air missile training be conducted at Fort Bliss, Texas. The course, however, continued to be open to all branches and arms of the service.

With the rapid expansion of missile-related technology, all hardware-oriented instruction was eliminated from the course by 1959. Today the course is conducted at the US Army Air Defense School by the Missile Science Division, Command and Staff Department. Its mission is still essentially that found in the directive of 1946. Its primary purpose is to provide

commanders with staff officers capable of analyzing developments and trends in the scientific field as they relate to concepts in the field of missilery.

Presently, the Guided Missile Systems Officer Course is 30 weeks in length and includes a wide range of engineering subjects, all taught at junior, senior, or postgraduate college level. These subjects fall into the general areas of engineering mathematics, physics, aerospace/mechanical engineering, electrical engineering, computers, and OR/SA (operations research/systems analysis).

A typical student would be most apt to say that the most difficult portion of the course is the first 6 weeks. He would say this, not because the material is extremely difficult, but because it has been at least 5 years since he has studied in a college-type environment. During the initial weeks a student must renew old study habits or form new ones, and the large amount of time spent doing homework often requires a sacrifice on the part of his family. After 7 to 9 periods of instruction each day, he must return home and tackle several hours of problems and reading assignments for the next day's lessons.

The student receives a large block of instruction in mathematics, including a calculus review, vector analysis, differential equations, and engineering analysis. The purpose is to improve the student's capability to handle difficult problems in the engineering courses that follow. In the physics portion of instruction, a working knowledge of mechanics, thermodynamics, and modern (nuclear) physics is stressed to provide further foundations for the technology related to missiles which the student will receive.

With the foundation received in mathematics and physics the student next receives instruction in electrical and aerospace/mechanical engineering. In these blocks of instruction he learns the rudiments of modern missile design to include electronics, aerodynamics, propulsion, and guidance and control. In addition to these areas of instruction he also receives comprehensive courses on analog and digital computers and in systems analysis where modern management techniques are taught.

As a conclusion to his 30 weeks of intensive study, the student is placed in a group of five or six students to complete a final design project. In this practical research and design problem, the students tie together all of the various engineering subjects to which they have been exposed. Complete computer facilities are provided to test and evaluate their design's flight characteristics and performance.

Officers who wish to enroll in the course should apply to Department of the Army, Navy, or Air Force. Each application will be given careful consideration based on the prerequisites for acceptance. Army personnel will often receive questionnaires inquiring as to whether they desire to attend.

Graduates of the course receive utilization tours in positions such as senior staff adviser, systems analyst, technical intelligence officer, liaison officer to civilian or military agencies, or evaluator of missile systems. Selected officers may now take the opportunity to attend a follow-on graduate program at the University of Texas at El Paso or other branches of the University of Texas system. This program leads to a master's degree in engineering, physics, or operations research and systems analysis. The course of study in the follow-on

program consists of 1 year of intensive study with Department of the Army specifying the degree field in accordance with the needs of the Army and the desires of the individual student.

The need for officers who possess such advanced education has been well established. Effective development and employment of the technically complex systems which characterize the modern Army requires ready availability of individuals who possess both military experience in the field and a theoretical knowledge of the engineering disciplines involved.

The key to a successful future may lie in your attending the Guided Missile Systems Officer Course.

Further information about the course may be obtained by writing to the Commandant, US Army Air Defense School, ATTN: Missile Science Division, Command and Staff Department, Fort Bliss, Texas 79916.

PREREQUISITES

- Must be a commissioned officer in grade of first lieutenant or higher.
- Must have credit for college courses in integral and differential calculus.
- Must have one semester of a college physical science; e.g., thermodynamics, fluid mechanics, engineering statics or dynamics, physics, strength of materials, heat transfer, or electrical engineering.
- Must have SECRET (final) security clearance.
- Must have at least 2 years of Active Army service as an officer.

NONRESIDENT INSTRUCTION DEPARTMENT

NEW AIR DEFENSE ARTILLERY CORRESPONDENCE COURSES FOR ENLISTED PERSONNEL

The Nonresident Instruction Department, US Army Air Defense School, recently completed a revision of its MOS career group 16 correspondence courses. The new courses now offer not only technical material relating to air defense artillery enlisted military occupational specialties, but include general air defense and other common military subjects.

The new courses are divided into the 20 and 40 skill levels for each MOS. Each new course consists of three phases with credit-hour totals ranging from 88 hours for the 16J20 course to 138 hours for the 16F40 course. Phase I contains strictly MOS technical subcourses designed to improve job knowledge and efficiency. Phase II consists of air defense subcourses closely related to the MOS. Phase III is designed to expand the NCO's general military knowledge by introducing several common subject subcourses. The overall plan of the new courses is to provide a career progression from the 20 skill level to the leadership-oriented 40 skill level.

To illustrate this concept, the 16B20 course includes such subjects as ADA Communications in phase II, which relates directly to the Nike Hercules missile crewman MOS. In phase III, the student's knowledge is broadened in common subject subcourses, such as Drill and Command, Weapons, CBR Operations, and Unit Readiness. In contrast, phase II of the 16B40 course contains NCO leadership and career development subcourses, and subcourses in phase III are directed to broadening knowledge in group, brigade, and division-level operations.

The revised courses were first offered in January 1971. Enrollment applications are now being accepted. Completion of correspondence courses is a convenient method of accumulating promotion points as well as improving job efficiency and broadening overall military knowledge. The courses also provide an excellent way of preparing for MOS evaluation tests. Soldiers interested in this program should write to the Commandant, US Army Air Defense School, ATTN: Nonresident Instruction Department, P.O. Box 5330, Fort Bliss, Texas 79916.

The programs of instruction for MOS's 16B20 and 16B40, Nike Hercules Missile Crewman, appear below. Similar programs are available for each air defense artillery enlisted military occupational specialty.

CAREER DEVELOPMENT CORRESPONDENCE COURSE 16B20
(Nike Hercules Missile Crewman)

SC No.	Title	Credit hours
	Phase I	
ADA 800	Nike Hercules Missile Crewman, Part I	37
	Phase II	
ADA 625	ADA Communications, Part I	18
ADA 626	ADA Communications, Part II	8
ADA 805	ADA Employment and Operations	4
	Phase III	
ADA 957	Drill and Command	8
AG 55	Safeguarding Defense Information	2
CSS 220	CBR Operations	4
CSS 247	Weapons	2
CSS 263	Emergency Medical Care	4
CSS 267	Unit Readiness	2
CSS 270	Organizational Maintenance and Maintenance Management	6
ARTY 465	Basic Map Reading	8
ADA 603	GEOREF	2

CAREER DEVELOPMENT CORRESPONDENCE COURSE 16B40
(Nike Hercules Missile Crewman)

SC No.	Title	Credit hours
	Phase I	
ADA 802	Nike Hercules Missile Crewman, Part II	36
ADA 801	General Subjects for 16- and 24-Series MOS, 40 Level	20
	Phase II	
ADA 900	NCO Leadership and Career Development	20
ADA 528	Maintenance and Supply Procedures	12
	Phase III	
AG 55	Safeguarding Defense Information	2
CSS 297	Company Administration (Publications, Records, and Personnel Management)	5
CSS 276	Company Administration—Feeding Operations I	4
CSS 277	Company Administration—Supply	4
CSS 261	Medical Support System	2
CSS 203	Division Administrative Operations	1
CSS 269	Division Maintenance Operations	1
CSS 273	Division Support Command	2
CSS 282	Division Signal Communications	4
CSS 253	Intelligence	2
CSS 258	Military Justice	2
CSS 210	Methods of Instruction	6
ARTY 465	Basic Map Reading	8

MISSILE ELECTRONICS AND CONTROL SYSTEMS DEPARTMENT

Because of the difference in terminology used to describe existing fire distribution systems (i.e., AN/MSG-4, AN/GSG-5, and AN/TSQ-51) and that used for the forthcoming command, control, and coordination system AN/TSQ-73, this School henceforth will use the terminology, command, control, and coordination system, to describe all of these systems.

Notes From
US Army Air Defense Center and Fort Bliss

IMPROVED HAWK CONTRACTS AWARDED

The US Army Missile Command, Redstone Arsenal, Alabama, has announced that the Army has awarded Raytheon Company contracts in excess of $50 million which call for FY 71 production of missiles and equipment for the Improved Hawk system. Largest of the awards, which was $26.3 million, called for an undisclosed quantity of missiles, while $20.9 million will be spent for ground support equipment. A smaller contract for $2.8 million calls for additional engineering services on the Hawk system. Most of the work will be performed at Raytheon's Andover, Massachusetts, facility.

Hawk is the Army's air defense system that can destroy high-performance aircraft and air-breathing guided missiles operating at low altitudes. It is deployed with US Army and Marine Corps units in the United States and overseas.

Under the Improved Hawk Program the outward configuration of the 16-foot missile is unchanged, but the missile contains a new guidance package, a larger warhead, and an improved motor propellant.

The Hawk program is managed by US Army Missile Command, Redstone Arsenal, Alabama, and Raytheon Company is the prime contractor.

NEW COMPUTER SYSTEM INSTALLED

Fort Bliss recently became the first installation to employ the new IBM 2314 computer in data processing. The 2314 is a multicommand, direct access storage device, and it completes and makes operational the entire complex of IBM system 360 units now in use at Fort Bliss. This milestone in progress means a great increase in efficiency and a great saving in space. Information once stored in drawers full of cards can now be stored on a single disk.

Activities serviced by the new system include military personnel accounting, supply accounting, finance accounting, and academic records. By 1973 the system will be in uniform use throughout the Department of the Army. The Army will then be able to meet the requirements of Congress, Department of Defense, and commanders throughout the United States because information can be transmitted between commands in seconds.

EXPLOSIVE ORDNANCE DISPOSAL

The US Army Combat Developments Command (USACDC) has announced preliminary results of a conference it sponsored recently at Redstone Arsenal, Alabama, on the Army's explosive ordnance disposal (EOD) mission.

Doctrine, materiel, and organization working groups with memberships representing nearly every major Army command and Department of the Army presented recommendations to establish objectives and materiel priorities for the EOD program in the 1970's.

Emphasis was placed on speeding development of EOD protective clothing now in engineering development under USACDC specifications. The garb, somewhat resembling a space suit in appearance, is designed for EOD personnel operating in contaminated areas.

The requirement for a low-cost, maintenance-free, and easily operated 35-millimeter camera for use by EOD personnel was particularly stressed. The conference also proposed an on-the-job training program to recruit junior enlisted personnel, with training phased in such a way as to maximize personnel utilization and incentive.

Streamlining EOD supply and maintenance by removing from active-unit inventories certain items of equipment not normally used in EOD operations was proposed. Such items would be supplied on request rather than automatically.

The conference additionally recommended that the EOD service field manual (FM 9-14) be reworked to insure that it fully addresses all aspects of the EOD mission. This includes Presidential and VIP protection, support to local and state authorities in EOD incidents, and destruction of unserviceable ammunition.

Among materiel development efforts included in the conference's priority list were:

- Radiation analyzers to detect and identify fissionable materials.

- "Sniffers" to detect low concentrations of effluents passed into the air from explosive and incendiary materials within munitions containers.

- Chemical, ultrasonic, abrasive, and mechanical means to gain entrance to improvised explosive devices and to neutralize hazards.

- Improved disposal containers.

- Body armor to protect against blast and fragmentation that would also allow improved dexterity over current body armor.

- Remote television to view and record "render-safe" procedures and to help in selecting proper courses of action in EOD incidents.

- An armored dud retriever vehicle to magnetically collect hazardous munitions, protecting operators from blasts and fragments in the event of explosions.

- Detection devices, such as lightweight X-ray fluoroscopes or baltographs, which produce either polaroid or fluoroscopic screen images through munitions containers of varying thicknesses.

- Applications of cryogenic freezing techniques to neutralize hazards. An example would be injecting nitrogen to halt fuze action.

USACDC will weigh the recommendations of the conference to produce an integrated and complete EOD Program Development Plan, outlining measures that should be taken to insure Army readiness to meet current and future ordnance disposal tasks.

Explosive Ordnance Disposal team in action.

New Periodical

The US Army War College announces the publication of a new triannual periodical recently approved by the Department of the Army. Issue dates for the magazine are scheduled for spring, fall, and winter.

Entitled Parameters—The Journal of the Army War College—edited by Colonel Keith L. Monroe, Military Police Corps, the new publication will carry articles expressing mature, professional thought on matters of broad military strategy, national defense policy, top military management, and other subjects of significant military interest. A section of the periodical will carry news of recent developments at the War College. Parameters will also review current books of interest to its readership.

In the main, authors of articles appearing in Parameters are expected to be drawn from the faculty, students, and alumni of the College; guest lecturers and panelists who have appeared before the student body; and authorities in fields relating to strategy, defense policy, and management.

Notes From the US Army Combat Developments Command

DOCTRINE

A major revision of FM 44-96, Air Defense Artillery Employment, Hawk, has been prepared and submitted for command approval and printing. The new FM 44-96 differs from the 1968 issue in that it:

•Updates and improves doctrine on organization, command and control, communications, employment concepts, RSOP, active and passive defense, and United States Strike Command (USSTRICOM) air defense artillery (ADA) battalion (provisional) organization and employment. Guidance peculiar to the towed or self-propelled Hawk systems is clearly delineated.

•Applies the standard tactical missions—general support, direct support, etc.—to Hawk operations.

•Provides in a single appendix a summary of the key points of each chapter. This innovation is intended to provide a ready reference for the reader desiring main points only.

A representative of US Army Combat Developments Command Air Defense Agency attended an air defense symposium in Heidelberg, Germany, 25 September 1970. The host was Commander in Chief, US Army Europe (CINCUSAREUR), and attendees included the USAREUR corps and division commanders and senior staff officers. Key points stressed by CINCUSAREUR included the extreme importance of ADA to field army operations, with emphasis on division air defense; the immediate need for an improved warning system to serve division air defense units; the requirement for habitual liaison between the ADA groups/Hawk battalions and the corps/divisions; the importance of all troops using all available weapons against attacking aircraft; and the need for frequent air defense field exercises. The symposium effectively furthered understanding and appreciation of ADA in Europe.

ORGANIZATION

The Air Defense Agency recently developed three new/revised tables of organization and equipment (TOE) which are presently being staffed. One TOE integrates the Improved Hawk system into the ADA structure, and the other two provide all-Vulcan battalions for the airborne and airmobile divisions.

- TOE 44-245H, Improved Hawk Air Defense Artillery Battalion (Towed), has a strength of 737 men and is organized much like the current towed Hawk battalion. The battalion features new and improved equipment and missiles that will increase intercept capability, new maintenance procedures for the Improved Hawk missile, and a new MOS structure for organizational and direct support maintenance personnel.

- TOE 44-435H, Vulcan Air Defense Artillery Battalion (Towed), organic to the airmobile division, provides a headquarters and headquarters battery and four Vulcan firing batteries of three platoons (12 guns) each. Strength is 443 men. The battalion is completely transportable by Army helicopter; however, its ground mobility is severely limited due to the relatively small number of organic vehicles.

- TOE 44-425H, Chaparral/Vulcan Air Defense Artillery Battalion (Towed), is being revised to delete all references to Chaparral. The revised unit has a strength of 555 and provides four Vulcan firing batteries. Each firing battery has three platoons of four guns each. Although the weight of the battalion was reduced to permit air-dropping and 100-percent air transportability, the battalion retains full ground mobility.

MATERIEL

Litton Industries has been awarded a contract for research and development of the AN/TSQ-73 Army air defense command, control, and coordination system. The system will be developed against the qualitative materiel requirement (QMR) originated by this Agency and will replace the Missile Monitor (AN/MSG-4) fire distribution system now in use by Hawk and Nike Hercules units overseas. Improvements include a greatly expanded track-handling capacity and the capability to automatically exchange real-time tactical digital data with the fire units and other Army and other Service control center facilities. Microminiaturized and modular in construction, the system will feature high reliability, ease of maintenance, and built-in automatic fault detection and isolation equipment. Mean time between failure should be at least 600 hours, and operational availability should be better than 99.9 percent.

The QMR for a 3-D (dimensional) acquisition radar, originated by the Air Defense Agency, has been released by Headquarters, US Army Combat Developments Command for worldwide review. When fielded, the 3-D (range, azimuth, height) radar will replace existing AN/GSS-1 radars in ADA battalions. The radar will significantly enhance the battalions' overview capability in both an electronic countermeasure (ECM) and non-ECM environment. The radar's ability to provide height information on airborne targets, as well as range and azimuth, will assist in the identification and threat analysis process.

NEWSLETTER SERVICE

Field manual changes have often proved to be too slow to provide field units with timely information based on equipment and unit test results, materiel and organizational changes, and lessons learned by other units. In an attempt to speed up the process, especially as it pertains to Chaparral and Vulcan, the Air Defense Agency recently initiated a newsletter service. Newsletters are published on an as-required basis.

- The first two newsletters were classified and provided data and procedures for manual effectiveness evaluation of Chaparral (26 March 1969) and Vulcan (31 July 1969) air defenses. The latest newsletter (18 June 1970) provided unclassified up-to-date data regarding Vulcan air density and muzzle velocity controls. Copies were distributed in quantity sufficient to permit issue to squad level.

- Field units can exploit the newsletter service to share their lessons learned by sending accounts of these lessons to the Commanding Officer, US Army Combat Developments Command Air Defense Agency, ATTN: CSGAD-MF, Fort Bliss, Texas 79916.

REVISION OF FM 44-1

FM 44-1, US Army Air Defense Artillery Employment, February 1970, is being considered for revision. Comments from the field are welcomed. Address comments to the Commanding Officer, US Army Combat Developments Command Air Defense Agency, Fort Bliss, Texas 79916.

Notes From the US Army Air Defense Board

AIR DEFENSE COMMAND, CONTROL, AND COORDINATION SYSTEM (ADCCCS) AN/TSQ-73

SFC Bernard J. Butcher
SP4 Francis T. Elliot III

The Army's new air defense command, control, and coordination system is the AN/TSQ-73. Scheduled to be tested in the near future, it is intended ultimately to replace inadequate and obsolete fire distribution systems now deployed overseas. The decision to replace presently deployed systems was made as a result of several factors.

First, the deployed systems are special-purpose equipment and have been extensively modified to fit the characteristics of individual air defense areas. Second, these systems can be maintained operationally only by continuous and costly refurbishments. These conditions contribute to a lack of flexibility and commonalty and an increase in training and logistic costs. Finally, the latest oversea systems have been operational for nearly a decade; however, technological advances continue to bring faster, harder hitting, and more elusive attack aircraft. The burden, therefore, falls upon air defense to keep pace. Thus, the decision has been made to build and test a new command, control, and coordination system.

The contract for the AN/TSQ-73 system was awarded to Litton Data Systems, Van Nuys, California, on 23 July 1970. Some of the desired features requested of the contractor are high reliability, transportability, and automation. Included in the system will be both battalion and group level packages which will incorporate a general-purpose computer already employed in other areas of the Army's automatic data systems.

A command, control, and coordination system is only as good as its computer, and the AN/TSQ-73 computer will employ the latest advances in microelectronic integrated circuit technology. All major subsystems required to build this system have been modularized. The principal remaining effort involved will be one of repackaging existing circuitry to obtain ultimate benefits of modern fabrication techniques. These improvements should result in desired upgrading of system reliability and maintainability, along with reduced size, weight, and power consumption.

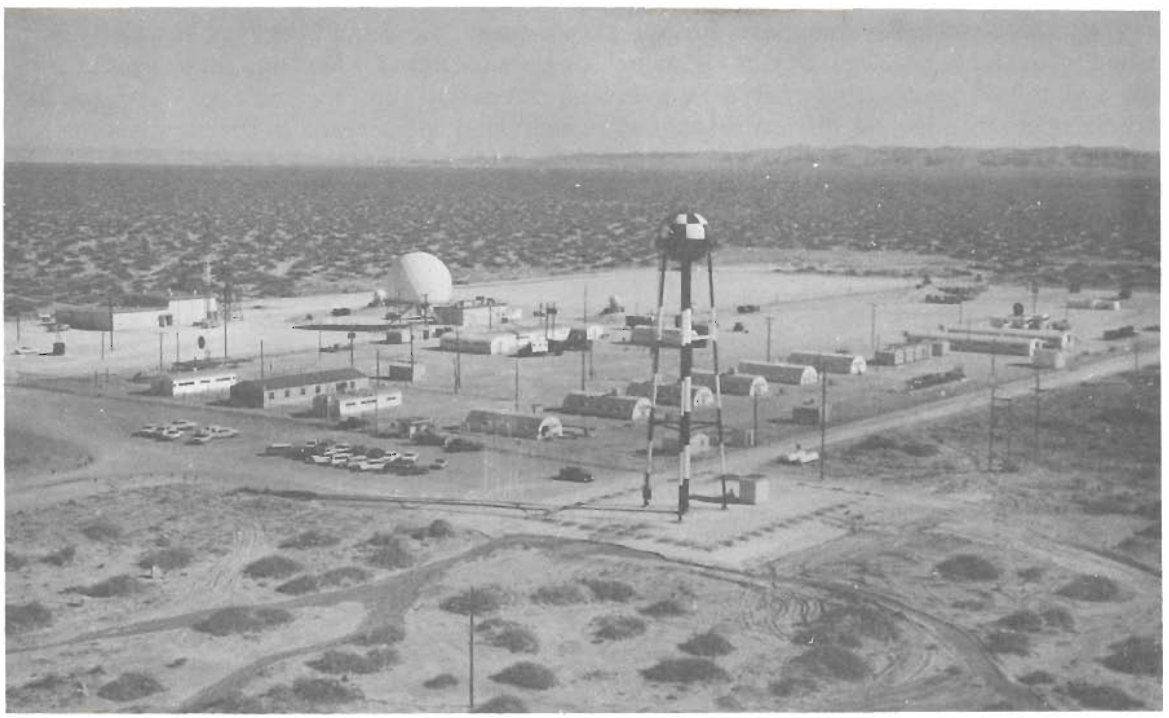
As now envisioned the AN/TSQ-73 system will be tested to meet a variety of requirements, many of which are unique among air defense systems of its type. The AN/TSQ-73 will be housed in a single shelter. The system must be sufficiently flexible to permit employment in a wide variety of environmental conditions, such as arctic, tropic, jungle, desert, or

mountains, while maintaining operational capability for extended periods. These features must be combined with a reduction in logistic costs. The system must demonstrate its required capabilities, aid in reducing the number of operator and maintenance personnel required, and reduce the number and variety of items currently necessary in the logistics system while keeping the mean time to repair at a minimum.

In keeping with the desired reduction of maintenance and operator personnel, established power plant operator/mechanics (MOS 52B) and engineer missile equipment specialists (MOS 62C) will be utilized if at all possible. Maintenance and operator personnel should receive training similar to that of the present AN/TSQ-51 repairman (MOS 25K) and fire distribution operator (MOS 16K), respectively.

The AN/TSQ-73 will be the most advanced system of its kind in the Army. It will provide battalion and group/brigade commanders with a rapid means for commanding, controlling, and coordinating the air defense activities of their commands; supervising and controlling the engagement operations of fire units; and exchanging necessary information among the systems of an area defense.

SITE MONITOR



The Site Monitor Test Facility is an isolated installation located approximately 10 miles east of Fort Bliss. The 14-acre site primarily comprises an air defense system, an electronic countermeasures/electronic counter-countermeasures (ECM/ECCM) system, and a fire distribution system (FDS) testing facility of the US Army Air Defense Board (USARADBD).

The site facility with its installed equipment, surrounding terrain features, and proximity to the US Army Air Defense School at Fort Bliss provides excellent facilities for testing newly developed radars, modifications to existing radars, and identification, friend or foe (IFF), systems. The facility operates under the control of the Medium Altitude Air Defense Branch, Test Division, US Army, and US Air Force.

A complete Improved Nike Hercules fire control system, consisting of the low-power and high-power acquisition, missile tracking, target tracking, and target ranging radars, is available. An Improved Hawk system, less four launchers and one launching section control box, will also be available. Also present are alternate acquisition radars (AN/FPS-69 and AN/FPS-71) with associated AN/FPA-15 and AN/FPA-16 ECCM consoles which are integrated into the Nike Hercules system. Pertinent data are recorded on magnetic tape and are then refined and analyzed at the Board's computer facilities. A telephone and microwave system provides constant voice and data communications with Air Defense Board headquarters, White Sands Missile Range, and other test ranges.

The Site Monitor complex is a key element in the accomplishment of the Air Defense Board's mission. Current testing is being conducted on modifications to the Improved Nike Hercules system called SAMCAP (surface-to-air missile capability) designed to improve system performance against maneuvering targets in an ECM environment. Later, during CY 71, the side lobe fast blanking (SILOFAB) ECCM modification to the high-power acquisition radar is scheduled for testing at the Site Monitor facility. Both modifications, after successful achievement of test criteria, will be applied to currently deployed equipment in the field, thereby increasing many of the capabilities of the Nike Hercules system for protection against the aircraft threat of the 1970's.

Notes From the Human Resources Research Organization

Here is a list of technical reports (TR) recently produced and published by HumRRO Division No. 5, Fort Bliss, Texas.

1. TR 70-2, Methods of Training for the Engagement of Aircraft With Small Arms.

a. This report should be of interest to those concerned with doctrine and training for air defense and infantry, as well as those interested in simulation and miniaturization in training.

b. Two approaches were used in developing training for engaging aircraft with small arms. The first approach involved practice in leading and tracking with a special training device in a full-scale environment. The second approach employed a miniaturized training facility in which men practiced leading, tracking, and firing air rifles against 1/10-scale silhouette targets mounted above a 1/4-ton vehicle.

c. In January 1967 a miniaturized training program which had been developed jointly by HumRRO and the Technique of Fire team of the US Army Infantry School was demonstrated at Fort Benning, Georgia.

d. The Department of the Army published Training Circular (TC) 23-15, Engagement of Aerial Targets With Small Arms, which describes the miniaturized training program demonstrated in 1967 as modified.

2. TR 70-4, Auditory and Visual Tracking of a Moving Target.

a. This report describes research conducted to compare auditory and visual tracking localization of a moving sound source. The research is part of a continuing effort to improve individual training and performance in aerial target detection and other aspects of use of forward area air defense weapons.

b. This report would be of value to personnel responsible for training in air defense and especially to those interested in the potential for using auditory perception in tracking and aiming performance.

3. TR 70-12, Aircraft Recognition Performance of Crew Chiefs With and Without Forward Observers.

a. A field test using miniaturized simulation of aircraft flyovers was conducted to compare the aircraft recognition performance of observers working alone or with forward observer teams. Comparison of the results with those of an earlier full-scale test showed this simulation to be valid.

b. This report would be of interest to those concerned with air defense training, with aerial detection methods, and with crew performance in general.

4. TR 70-7, Equipment-Device Task Commonality Analysis and Transfer of Training. Research described in this report was undertaken to develop procedures that would enable training personnel to assess the utility of an existing training device for new training purposes.

5. TR 70-8, Development and Evaluation of an Improved Radio Operator Course (MOS 05B20). This report describes a HumRRO-developed program of instruction for radio operators which proved more efficient than the standard program of instruction, thus lowering recycle and attrition rates.

6. TR 70-9, An Experimental Program of Instruction on the Management of Training. The research was designed to synthesize training technology and systems engineering of training to provide and test an instructional prototype for Army officers in their roles as training managers.

Did You Know?

A NEW FEATURE

(With input from the Office of Personnel Operations, Department of the Army)

FORMAL EDUCATION PROGRAMS FOR CAREER OFFICERS

Due to accelerated technological changes and the greatly increased complexity of the Army's mission, there has been increased emphasis on encouraging all officers to develop educationally to their maximum potential. To provide these officers, Congress has authorized up to 8 percent of the active officer corps to participate in resident civil schooling. Regulations permit officers to study up to 2 full years to attain degrees ranging from the associate level to doctorate level.

In response to many inquiries received at Department of the Army asking, "How can I increase my formal civilian education level through resident instruction?," the following information is provided concerning five educational programs that are the most applicable. Additional information can be obtained by contacting the civil schools officer of your career branch.

GRADUATE DEGREE PROGRAM

The purpose of this program is to provide essential training in areas not adequately covered by training facilities within the Department of the Army. The primary objective of this program is to train and maintain an adequate number of officers to fill the Army's continuing requirements in graduate fields. Officers are trained under this program only to the extent necessary to satisfy validated Department of the Army requirements. These requirements vary from year to year and are determined annually by the Army Educational Requirements Board (AERB) in accordance with AR 621-108. The following information concerning this program is provided for your convenience:

- Governing regulations - AR 350-200 and DA Cir 351-9.

- Maximum length of training - Up to 2 years on a full-time uninterrupted basis (including summer sessions).

- Funding - Tuition costs are borne by DA, and the officer receives full pay and allowances.

- Service obligation - Two years for each year of schooling or fraction thereof; in any case, not less than 3 years.

- Utilization - Mandatory. Assignment will be made to validated positions immediately following completion of the training. Initial utilization assignments are for 3 years. Assignments may be deferred or interrupted for attendance at service schools or maintaining short tour equity. Upon completion of initial utilization tour, the officer will revert to the normal career pattern of his branch. Subsequent reutilization tours can be expected.

- Eligibility requirements - Chapter 4, AR 350-200.

•Primary zones of consideration - Master level, 3-12 years of Army promotion list service for RA officers or active federal service for Reserve component officers at the time of entry into school. Doctorate level, 3-19 years of Army promotion list service for RA officers or 3-15 years of active federal service for Reserve component officers at the time of entry into school.

•Desirable prerequisites - Completion of combat duty and the military school and command level commensurate with the rank of the applicant at the time of entry into school.

•Fields and subjects of study - DA Cir 351-9 lists the validated positions by field and subject of study which have been allocated to the career branches.

•Application procedures - Full details are provided in chapter 4, AR 350-200. Applicants should submit their requests as early in their careers as possible to receive consideration the maximum time they are eligible for the program.

•Selection considerations - Selections are made by the career branch in conjunction with DA Civil Schools Branch. Officers are selected on a best-qualified basis from all applicants for each field of study. A high academic aptitude and an outstanding military record are essential. Nonselection at the earliest opportunity following filing of an application does not preclude subsequent consideration. All active applications are reviewed each time selections are made. Application remains active until withdrawn by the applicant, applicant declines selection, is returned by the career branch when the applicant's military or academic record precludes approval, or the applicant becomes ineligible by virtue of exceeding the time in service limitations.

UNDERGRADUATE DEGREE PROGRAM

The purpose of this program is to provide career-oriented officers and warrant officers who have displayed Regular Army potential or are in Regular Army status with the opportunity of attaining a baccalaureate degree of functional value to the career branch. Pertinent information concerning this program is provided for your convenience as follows:

•Governing regulations - AR 350-200, AR 145-1, and DA Cir 351-5.

•Maximum length of training - Up to 2 years on a full-time uninterrupted basis (including summer sessions).

•Authorized schools - Any accredited college or university listed in Part 3, Education Directory, Higher Education.

•Funding - Tuition costs are borne by DA, and the officer receives full pay and allowances. (If educational funds are not available at the time of entry into school, the selectee may elect to participate by paying his own tuition.)

•Service obligation - Two years for each year of schooling or fraction thereof; in any event, not less than 3 years.

•Utilization - None required.

•Eligibility requirements - (See DA Cir 351-5.)

•Primary zone of consideration - RA or Voluntary Indefinite category officer with 2-7 years of active commissioned or warrant service at the time of entry into school. Applicants requiring 1 year or less will be considered for the Degree Completion Program conducted under the provisions of AR 621-5.

•Desirable prerequisites - Meet the general eligibility requirements (less education) for appointment in the Regular Army (AR 601-100). Completion of combat duty and the military school and command level commensurate with the rank of the applicant at the time of entry into school.

•Acceptable areas of study - Appendix C, AR 145-1, lists areas of study appropriate to the career branch.

•Application procedures - (See DA Cir 351-5.) Applicants should submit their requests as early in their career as possible to receive consideration within the maximum time they are eligible for the program.

•Selection considerations - Selections are made by the career branch on a best-qualified basis. Military performance and service potential are the primary criteria of selection. Priority is given to applicants who require the least amount of resident study to complete degree requirements. Nonselection at the earliest opportunity following filing of an application does not preclude subsequent consideration. Application remains active until withdrawn by the applicant, applicant declines selection, is returned by the career branch when the applicant's military record precludes approval, or the applicant becomes ineligible by virtue of exceeding the time in service limitations.

DEGREE COMPLETION PROGRAM

The Degree Completion Program is a part of the General Educational Development Program of the Army. The purpose of this program is to provide commissioned and warrant officers with the opportunity to develop educationally and professionally to their maximum career potential. Study should be in areas of functional importance to the career branch. The pertinent information concerning this program is provided for your convenience.

•Governing regulations - AR 621-5 and AR 145-1.

•Maximum length of training - Up to 1 year on a full-time uninterrupted basis (including summer sessions).

•Authorized schools - Any accredited college or university listed in Part 3, Education Directory, Higher Education.

•Funding - Officers receive full pay and allowances while attending and are responsible to bear all educational costs incident to this schooling. Permament change of station (PCS) is authorized if schooling is in excess of 20 weeks. Assistance in meeting expenses is available under the Veterans Readjustment Benefit Act (GI Bill).

•Service obligation - Two years for each year in school or portion thereof.

•Utilization - Not required.

•Eligibility - (See para 11, AR 621-5.)

•Primary zones of consideration - Reserve officers, not less than 3 years at the time of entry nor more than 18 years of active federal service at the time of completion; Regular Army officers, not less than 3 years at the time of entry nor more than 23 years for Army promotion list service at time of completion.

•Appropriate areas of study - (See app C, AR 145-1.)

•Application procedures - (See para 11, AR 621-5.)

•Selection considerations - Selections are made by the career branch on a best-qualified basis. Military performance and service potential are the primary criteria of selection. Priority is given to applicants who require the least amount of resident study to complete degree requirements. Nonselection at the earliest opportunity following filing of an application does not preclude subsequent selection. Application remains active until withdrawn by the applicant, applicant declines selection, is returned by the career branch when the applicant's military record precludes approval, or the applicant becomes ineligible by virtue of exceeding the time in service limitation.

USACGSC COOPERATIVE DEGREE PROGRAM

The purpose of this program is to provide selected students attending the regular course at the US Army Command and General Staff College (USACGSC) the opportunity of attaining a master's degree. The College has negotiated agreements with University of Kansas, Kansas State University, and University of Missouri (Kansas City) (UMKC) to offer programs leading to master's degrees in five disciplines: political science, history, public administration, business, and speech communications and human relations. Graduate courses are conducted by the universities at USACGSC on a residence-credit basis, except for the UMKC's political science, MPA, and MBA programs, which will be available on the UMKC campus. Cooperative degree courses are taught as elective courses within the framework of the USACGSC curriculum. Students possessing baccalaureate degrees who meet prerequisites for admission to a graduate school at one of the participating universities may seek admission to the program. Participants earn credit toward a master's degree while in residence at USACGSC and become eligible to apply for full-time study to complete their degree subsequent to graduation from USACGSC. The provisions of AR 621-5 govern; attendance up to one summer session and the fall semester following graduation from CGSC is authorized to complete the master's degree requirements, subject to approval by the career branch.

ADVANCED DEGREE PROGRAM FOR ROTC INSTRUCTOR DUTY

The purpose of this program is to increase the overall academic qualifications of commissioned officers assigned as ROTC instructors. It provides an opportunity for officers with a baccalaureate degree to attain a master's degree prior to being assigned to ROTC instructor duty. The program is open to commissioned officers in the grades of lieutenant colonel, major, or captain with at least 5 years' commissioned service. Applicants who

are selected are authorized to attend graduate civil schooling for up to 2 years under provisions of AR 621-5 to attain a master's degree.

•Governing regulations - DA Cir 621-7 and AR 621-5.

•Maximum length of training - Up to 2 years on a full-time uninterrupted basis (including summer sessions).

•Authorized schools - Any accredited college or university listed in Part 3, Education Directory, Higher Education. Normally, participants will be assigned to the ROTC unit at the same institution following completion of degree requirements.

•Funding - Officers receive full pay and allowances while attending school and are responsible to bear all educational costs incident to this schooling. Permanent change of station (PCS) is authorized if schooling is in excess of 20 weeks. Assistance in meeting educational expenses is available under the Veterans Readjustment Benefit Act (GI Bill).

•Utilization - 2-3 year ROTC assignment.

•Eligibility - (See para 11, AR 621-5, and DA Cir 621-7.)

•Primary zones of consideration - Officers with not less than 5 years' commissioned service at the time of entry into civil school.

•Desirable prerequisites - Completion of combat duty and the military school and command level commensurate with the rank of the applicant at the time of entry into school.

•Appropriate area of study - (See app C, AR 145-1.)

•Application procedures - DA Cir 621-7.

•Selection considerations - Selections are made by the career branch on a best-qualified basis. Military performance and service potential are the primary criteria for selection. Final approval for participation is contingent upon applicant's acceptance for graduate study and acceptability as an ROTC instructor by the institution to which nominated.

ENLISTED PERSONNEL MANAGEMENT

Enlisted personnel management in the Army is changing, advancing, becoming more centralized, more standardized, and more concerned with plotting a career course for each soldier.

Beginning with this article, the Enlisted Personnel Directorate, Office of Personnel Operations, Department of the Army, sketches some of the current trends and developments in enlisted personnel management. Today's topic: Evaluation, the Key to Professionalism and Equity. (Future topics will include Progressive Skill Development Through Military Schooling; Centralized Promotion; and Centralized Assignment.)

ENLISTED EFFICIENCY REPORTING

As promotion of enlisted personnel becomes centralized at Department of the Army, the need for accurate and complete information about each soldier increases. Thus, on 1 July 1970, a new Enlisted Efficiency Report (EER) came into use. The new DA Form 2166-4 is shorter and simpler in format and contains several new or improved features including:

- Provision for a rater's recommendation about the soldier's career development.
- A new rating scale on promotion potential.
- Emphasis on the ratings being completed by first-line supervisors.
- A minimum of 30 days as a valid rating period.
- A requirement that controls be established so that each individual knows his rater and reviewer and, when applicable, whom he must rate.
- Provision for the rated individual to appeal his completed EER.
- No indorser is required, but the reviewer must concur or nonconcur with the rating. If he nonconcurs, he must give cause.

The new EER should bring in much information needed for accurate career planning, but there are more developments in evaluation.

REVISED EVALUATION DATA REPORT

The enlisted Efficiency Data Report (EDR) is the feedback to the field of information gained from enlisted efficiency reports. Going to the individual and his commander, the EDR gives such information as the individual's evaluation score (based on EER and MOS evaluation tests) and his MOS evaluation test profile. The revised form will also inform the soldier how he rates compared to the Army-wide average in his MOS. Also included are a soldier's eligibility for superior performance or specialty pay and his promotion status. One more feature of the new Evaluation Data Report is the requirement that each individual be counseled by his unit commander or immediate supervisor on the results of his MOS test and EER. The new EDR should be of great benefit to the individual in helping to make sure of his exact standing among his contemporaries and pointing out those areas where he should strive to improve.

NEW TRAINING FILM, "EES—THE KEY TO YOUR FUTURE"

A new 16-mm color training film, MF 12-5543, "EES—The Key to Your Future," has been prepared under the guidance of Office of Personnel Operations, Department of the Army. The film has a running time of 33 minutes. This film gives a comprehensive picture of the Enlisted Evaluation System (EES) as a valuable personnel management tool. It stresses the importance of evaluation scores to the careers of enlisted personnel, and it provides answers to questions frequently asked by officer and enlisted personnel about the Enlisted Evaluation System. Prints of the film have been distributed to audio-visual support centers and are available for requisition by CONUS and oversea commanders.

Certified Round Cost Effectiveness

(From a report by Alan Compton, US Army Missile Command, and R. L. Drake, Raytheon Company)

Recently the Department of Defense has been pursuing a "no maintenance" concept in designing weapon systems and equipment. The goal is to reduce cost and at the same time improve efficiency. One of the most promising ventures is the certified round, formerly known as the "wooden round" concept. This concept involves development of an air defense guided missile that can be launched without prior servicing or power application. This would relieve deployed units of organizational maintenance; thus, manpower and repair parts requirements would be sharply reduced.

Some highly encouraging results were obtained in an Army cost effectiveness study of the certified round for the SAM-D air defense system. SAM-D is now in the advanced stage of development. The cost and effectiveness of the conventional missile design and logistical support policy were compared with the cost and effectiveness of the certified round design having only CONUS depot support. The advantages of a missile not requiring field tests or maintenance during a 20-year service life were evaluated. The possibility and cost of producing an effective missile with 20-year reliability that would elicit stockpile confidence without the assurance derived from periodic testing were considered. Also, consideration was given to the additional cost of insuring high missile reliability in the field, including research, development, testing, and evaluation, along with manufacturing costs. The certified round could be considered cost effective only if these expenses were less than the support cost savings during missile service life.

The study first defined basic missile design characteristics in terms of reliability and unique or special maintenance requirements. This was done, using the design information prepared during the contract definition phase of the program updated by breadboard and experimental model hardware identification. Reliability predictions were then made, using storage and operating failure rates increased by the probable operational environments expected during service. Operational environments examined were transport by rail, air, and sea; road march on wheeled and tracked vehicles; and emplacement on launcher. Launch and flight environments were also examined. The missile was sequenced through scenarios of these environments in a variety of life-cycle mission profiles, allowing an assessment of reliability at any point in the missile service life.

The estimated reliability values were combined with system detection, evaluation and transfer probabilities, and warhead lethalities in effectiveness equations to predict the time at which stockpile reliability caused the system effectiveness to drop below a required value. This, in turn, established test and maintenance frequencies necessary for maintaining a required level of effectiveness over the life cycle.

A number of reasonable support concepts were formulated for maintaining the required level of effectiveness, both conventional round (i.e., test and maintenance would be performed in the field) and certified round. Costs were calculated against a baseline production rate and deployment of SAM-D, including one-time and recurring costs at all support echelons.

Results of the study show the certified round concept to be both feasible and cost effective for the SAM-D system. Furthermore, an estimated life-cycle cost savings of approximately $300 million could be realized over conventional logistic support concepts.

The Chaparral/Vulcan Activation and Training Program

First Lieutenant F. D. Robertson, Jr
C/V S3, 15th Artillery Group (AD)

Chaparral/Vulcan (C/V) battalions will be organic to the divisions and corps throughout the US Army. To implement this program, the Commanding General, US Army Air Defense Center and Fort Bliss, has charged the 15th Artillery Group (Air Defense), under the command of Colonel William C. Grammer, with the responsibility of activating, training, and deploying all C/V battalions.

Prior to activation of a Chaparral/Vulcan battalion, a complex marriage of personnel and logistics activity takes place lasting approximately 6 months. Officer and NCO qualification courses are completed, specialty and common MOS slots are filled, and a vast amount of equipment from Chaparral and Vulcan weapon systems to thumbtacks is assembled for the start of unit training.

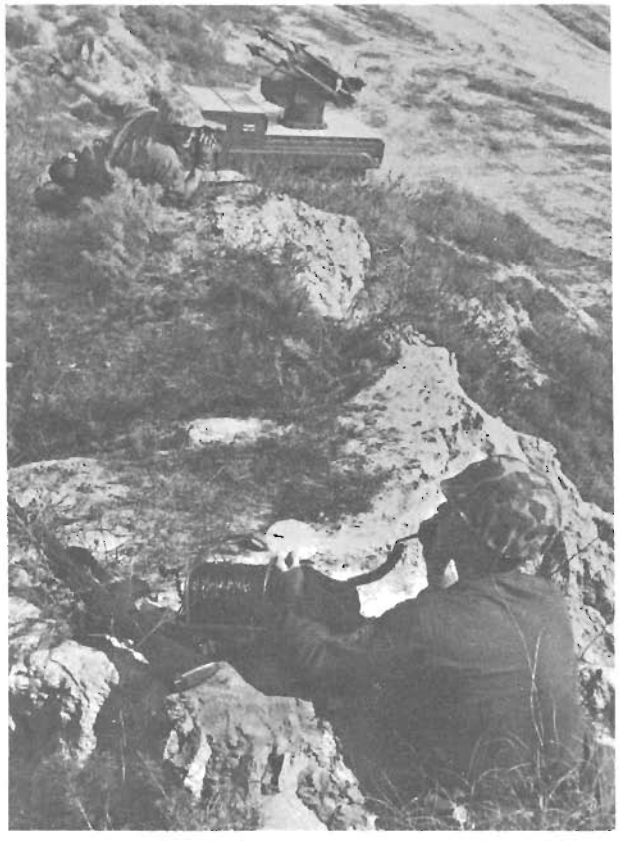


Figure 1. Advanced Chaparral unit training emphasizes combat operations.

Upon activation, the unit begins a training program which encompasses all phases of the Army training program (ATP) from initial organization to basic and advanced unit training, culminating with the conduct of an army training test. During basic unit training (BUT) the activated battalion conducts training on basic Army subjects. These subjects include such general information as CBR warfare, qualification with small arms, mapreading, and others. Emphasis is placed on small unit (squad, platoon, and battery) operations during this phase.

After completing the 7 weeks of BUT, the unit begins the next phase of the training cycle, advanced unit training (AUT). During this phase, the small-unit operations are combined into battalion-size operations. Emphasis during AUT is on combat operations (fig 1), with intensive training on such items as reconnaissance, selection, and occupation of position; convoy procedures; night occupation; field fortifications; and battery and battalion field training exercises. The Chaparral and Vulcan practice firings are one of the most essential aspects of the unit's training. Each Chaparral fire

unit fires one tactical XMIM-72B Chaparral missile (fig 2), and all Vulcan fire units engage both aerial and ground targets.

Figure 2. Chaparral firing exercise.

During the latter part of AUT, 15th Artillery Group (AD) administers an Army training test (ATT) to evaluate the effectiveness of the unit's training and combat proficiency. The ATT is a graded field exercise divided into two phases, tactical and firing. The tactical phase is the execution of a simulated combat operation and includes all types of hostile enemy action from guerrilla operations to nuclear warfare. Aggressors, pyrotechnics, and actual aircraft are used during the ATT to add realism to the exercise. Simulated bombing and strafing runs by B-57's and F-100's from the 4758th Squadron at Holloman Air Force Base are flown to evaluate the unit's air defense capability. Operation orders and fragmentation orders are transmitted to the unit from a division tactical operations center (DTOC) manned by personnel from 15th Artillery Group (AD). The unit's reaction, organization for combat, and control of the situation are evaluated from the battalion level down to the individual crew members of the fire units. Test problems are inserted which simulate the destruction of equipment, produce casualties, and create maintenance and logistics problems in order to thoroughly evaluate the unit's reaction to all combat probabilities.

The 15th Artillery Group (AD) evaluates all aspects of the ATT problem play. Umpires evaluate everything from motor maintenance to communications and from tactical operations to medical evaluation procedures. The battalion, battery, and most staff section umpires are obtained from other activating C/V battalions, giving these future C/V personnel valuable experience for their upcoming training.

The next phase of the ATT, holding equal importance with the tactical phase, is the firing phase. The evaluation of this phase includes the crew's ability to engage modified Firebee aerial targets with tactical Chaparral missiles and 20-mm Vulcan rounds. The firing phase also includes aircraft recognition, crew drills, timed loading exercises, and missile check-out for Chaparral (fig 3); and aircraft recognition, prefire checks, and ground target engagement for the Vulcan.

Figure 3. 15th Artillery Group (AD) personnel evaluate 2d Battalion, 59th Artillery, during Chaparral missile checkout.

The scores from the unit's tactical phase are compiled and combined with the firing phase scores, and the battalion is awarded a rating of either excellent, satisfactory, or unsatisfactory. Each unit must complete the ATT with at least a satisfactory rating before it can be deployed to its parent unit. Final ATT scores are forwarded to all concerned commands and to agencies involved in the activation and training process.

With the satisfactory completion of the ATT, the training cycle is finished, but the unit's work is far from complete. Its training has assured its ability to function efficiently, but its status of material readiness has not been evaluated. To insure that the unit has maintained a satisfactory readiness posture, a Fourth US Army command maintenance management inspection (CMMI) is accomplished. Following the CMMI, the unit begins packing and shipment to its parent division or corps.

Presently deployed Chaparral/Vulcan battalions are 1st Battalion, 59th Artillery; 7th Battalion, 67th Artillery; 7th Battalion, 61st Artillery; 2d Battalion, 60th Artillery; 3d Battalion, 61st Artillery; and 2d Battalion, 59th Artillery, all located in Europe. The 8th Battalion, 61st Artillery, is located in Korea. Deployed in the continental United States are the 5th Battalion, 67th Artillery; 6th Battalion, 67th Artillery; 4th Battalion, 61st Artillery; 7th Battalion, 60th Artillery; and 8th Battalion, 60th Artillery. Presently in their training program are 5th Battalion, 59th Artillery; 1st Battalion, 62d Artillery; and 6th Battalion, 68th Artillery.

With the extensive and strenuous training that the C/V battalions undergo during their training cycle, each deploys well prepared to provide excellent low-altitude air defense for its parent unit. The Army training program, the ATT, the CMMI, and all aspects of the activation, training, and evaluation process for the C/V battalions combine to produce well-disciplined and technically proficient members of the combined arms team, which can destroy, nullify, or reduce the effectiveness of the low-altitude, high-performance threat to forward combat units on the battlefield.

Crotale—France's Answer to Low-Level Aerial Attack

One of the newest air defense systems to enter production is Crotale. The system has been designed specifically to meet the challenge of low-altitude attack by the most modern fighter class aircraft. The effectiveness of high- and medium-altitude air defense systems in driving the threat down to the very low-level avenues of approach has added new significance to low-altitude systems. To fill this requirement, the Crotale system has been developed in France, initially for the Republic of South Africa where it is known as Cactus.

Crotale, an all-weather system, consists of two main units, the acquisition unit and the firing unit, both vehicle-mounted. (Crotale, translated to English, means rattlesnake.)

The acquisition unit (fig 1) contains a doppler-type surveillance and target designation radar that can track a target through ground clutter. The antenna rotates at high speed to provide a high data renewal rate. Other elements of the acquisition unit include an IFF (identification, friend or foe) interrogator and decoder, a real time digital computer, an exploitation console, and digital data link equipment. The computer processes several track-while-scan loops for target designation and threat evaluation. The data link employs either cable or radio and transmits target designation and operational orders to the firing unit. Operational status data are received from firing units.

Figure 1. Crotale acquisition unit.

The firing unit (fig 2) contains an ecartometric monopulse radar able to track one target and guide two missiles to the target simultaneously. Other elements of the firing unit include a telecommand transmitter that sends digital guidance orders to the missiles, an infrared gathering system used during the preguidance phase, television to supplement the radar in tracking very low-flying targets, and a four-missile launcher turret slaved to the radar. Also included are a real-time digital computer, an exploitation console, and digital data link equipment identical to that of the acquisition unit. The computer performs eight vital functions. It computes the influence of parallax on target designation data; acquires the target; tracks the target; computes the possibility of interception, thus avoiding the firing of missiles at targets that are out of range; generates guidance orders during both the gathering and actual guidance phases; generates the fuze arming order; generates the missile destruct order if necessary; and generates the end of engagement information.

Figure 2. Crotale firing unit tracks targets and guides missiles simultaneously.

Figure 3. Air transportability is another of Crotale's assets.

The missile is encased in a sealed container which serves as a launching tube. It has excellent maneuverability attributable to its canard configuration. Other elements include a fuze that is insensitive to jamming and atmospheric effects; a high-explosive warhead; a telecommand receiver for reception of missile guidance orders, arming orders, and automatic destruction orders from the firing unit; a transponder; a solid-propellant, single-stage rocket motor; an autopilot; servomotors for the control surfaces; a primable battery; and a static converter.

The acquisition and firing units are installed on semicross-country vehicles which have some unique features. An internal combustion engine drives an alternator to provide the electrical energy consumed on board. One electric motor is geared to each of the four wheels to provide propulsion and additional braking while reducing vibration and providing the possibility for an airtight vehicle for use in a nuclear, bacteriological, or chemical warfare environment. A hydraulic circuit, powered by the engine, is available to energize three jacks for automatic leveling. An air conditioning unit insures constant temperature inside the vehicle.

Extensive use of microelectronics makes Crotale a compact, durable, highly reliable system. It is equipped for all-weather operation and is air-transportable (fig 3).

The crew of each unit consists of three men: a chief operator and crew commander, an assistant operator, and a driver. Equipment at the acquisition unit operator's fingertips includes a plan position indicator which displays the air situation together with indications of level of threat, initiated targets, IFF response, a north indicator, and the bearings of fire units. Signal lamps indicate the degree of threat. When the radar sees the target as urgent, the computer automatically initiates a track-while-scan loop, the corresponding pushbutton

lights up, the computer triggers the IFF interrogator, and the final result of threat evaluation is displayed by corresponding signal lamps. A track-while-scan loop can be initiated manually by a joystick to deal with targets not classed as urgent by the radar. Information on the status of firing units is displayed by signal lamps on an operation panel. The panel also includes three pushbuttons (one for each firing unit). Pressing one of these buttons assigns a selected track-while-scan loop to the designated firing unit. There are also three pushbuttons for sending missile-destruct orders in case of late IFF recognition.

The firing unit operator is provided with a console designed so that he, too, has all necessary controls at his fingertips. He can perform the operations of battery alinement. He can supervise the firing sequence under normal conditions, and he can come into the engagement sequence should such action become necessary. The console is equipped with pushbuttons to select the firing mode (single shots or salvo), pushbuttons to enable fire interdiction in a given altitude bracket, signal lamps showing the status of firing sequence, a pushbutton to fire the missile as soon as the acquired signal lamp lights, and a pushbutton for destruction of the missile in flight. Also available are an A-scope to monitor target and missile tracking, controls so the operator can perform manual lock-on for training purposes or in case of trouble during actual operation, and numerical display and pushbuttons for tests and alinement. The television receiver is equipped with aided tracking controls.

A Crotale battery normally consists of three troups. Deployment of the troup, which normally consists of one acquisition unit and up to three firing units, can be accomplished in less than 5 minutes. Operations common to both units include choosing a location where the slope is acceptable; leveling of the vehicles; switching the power supply from wheel motors to internal supply for exploitation equipment; preparing equipment for action, using built-in test and control instruments; alining the battery; and recording parallax data. Operations peculiar to the acquisition unit involve setting in the IFF code and recording firing interdiction sectors. Those peculiar to the firing units involve recording the firing interdictions, selecting the mode of firing, and fire authorization acknowledgement.

Reaction time is defined as the time elapsed between first detection of the target and departure of the missile from the launcher. With Crotale, normal reaction time (involving acquisition, preparation for firing, and operations on the missiles) is extremely quick. When a target is detected that demands immediate engagement, the computer of the acquisition unit runs into an urgent procedure, enabling target designation and allowing the missile to be fired without computation of intercept probability. In this case reaction time is reduced by several seconds. Immediately after the first missile is fired a second missile may be fired at the same target.

When the last missile is fired, the launcher can be completely reloaded in less than 6 minutes. Reloading is accomplished with a light vehicle carrying four tested missiles in their containers. A crane is used for the transfer and may replace from one to four missiles. An automatic reloader is being tested to reload the four missiles in less than 2 minutes.

Maintenance is simplified by having equipment in standard racks containing "interchangeability units," much as the card switching method used in comparable US Army missile systems. Standard tests are made, and exchanges are made only when test results indicate faulty functioning. The missile, being considered a round of ammunition, is limited to go/no-go tests without removing it from its sealed container.

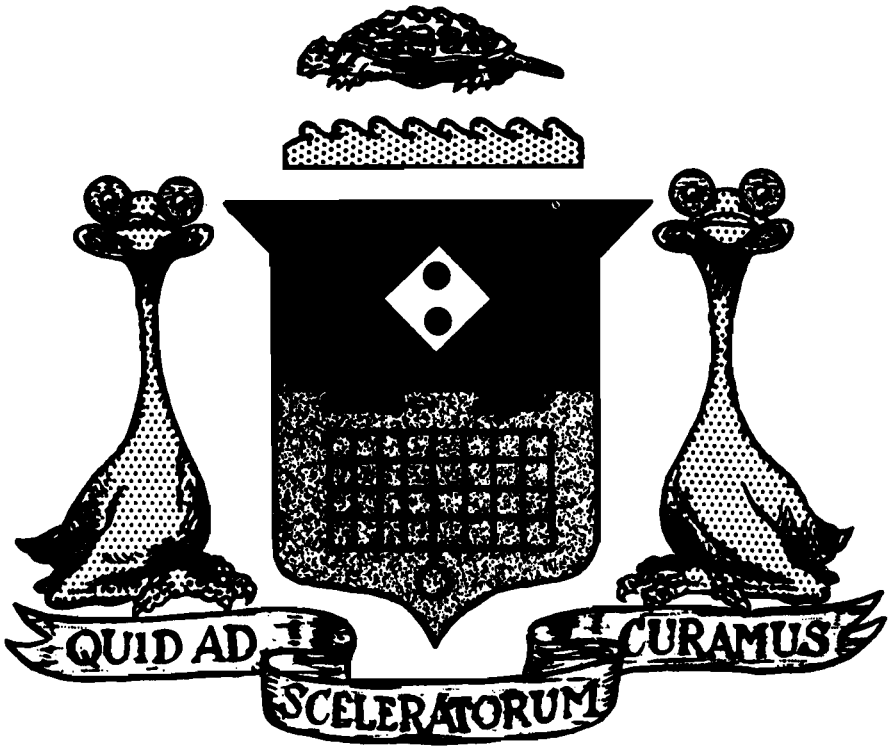
Crotale is designed so that, with minor modifications of the software of its universal digital computers, it can meet any change in operational needs whether for Army, Navy, or Air Force. Versions under consideration include ground missions where the system would be mounted on light or medium tanks, and a semimobile or fixed configuration in a shelter for defense of airfields and other stationary critical points. A shipborne model integrated within the overall defense environment of a ship is already under study.

The US Army Materiel Command will test and evaluate the Crotale system during this fiscal year. The project direction is at the US Army Missile Command, Redstone Arsenal, Alabama. The tests will be conducted at Redstone Arsenal, Alabama, and the US Army Air Defense Board facilities at Fort Bliss, Texas, and will include firings against aerial targets.

Russia Tests Multiple Reentry Vehicle

The Soviet intercontinental ballistic missile SS-11, equipped with a multiple reentry vehicle warhead, has recently been test fired. This is the first time such a vehicle has been tested. This missile and warhead pose a direct threat to United States Minuteman ICBM sites should Russia's first-strike philosophy be pursued. Russia's gains in the ICBM race seem to justify the current administration's policy of employing the Army safeguard ballistic missile defense system to protect our ICBM sites and thereby preserve our retaliatory capability.

U.S. ARMY AIR DEFENSE



GUIDED MISSILE LORE

With this issue of Air Defense Trends we are introducing "US Army Air Defense Guided Missile Lore" as a new feature. To identify folklore and stimulate interest in this feature, intended as a morale booster, we present an article on the subject by Edmund A. Davis. Mr. Davis is employed by US Army Missile Command's Technical Assistance Division at Fort Bliss. Mr. Davis served in air defense artillery units during World War II and the Korean Conflict, has been in direct contact with missilemen since 1957, and has engaged in extensive research. He is one of the few experts on air defense lore.

—Editor

If folklore can be defined as the orally transmitted, unrecorded tradition of an identifiable group, then the air defense guided missileman has a brand of his own.

The missileman refers to his missile as a "bird," his missile site as "the hill," his control station oscilloscopes as "scopes," and his control console operators as "scope dopes," and he has a wealth of additional argot which is not technical jargon. Rather it consists of slang adaptations and abbreviations that spring up in the ever-active, fertile mind of the American GI missileman. His argot appears in the jokes, riddles, rhymes, anecdotes, and stories constantly heard "on the hill" or "in the shack" or in any of the other places missilemen gather to work or relax.

Much of the lore that is now a part of air defense guided missilery is not original with missilemen. It has come to them from other types of organizations, military and civilian, including those from which the current concepts of air defense evolved. More specifically, air defense guided missilery evolved from the antiaircraft artillery (AAA) which developed from the Coast Artillery (CA) of which World War I railway artillery was a part. As a matter of fact, a tale has developed and kept pace with the evolution. It bears all the characteristics of the folktale currently accepted by folklorists as qualifying for the honor. It is a traditional prose narrative, a short story of apparently oral origins, strictly fictional and told primarily for entertainment. Consider, if you will, the—

HISTORY OF THE OOZLEFINCH

On 6 July 1956, the Oozlefinch, legendary featherless bird of the Coast Artillery Corps, awakened from his sleep of several years, tucked a Nike in the crook of his nude left leg, and, traveling by ways known only to himself, arrived at Fort Bliss, Texas, the home of the Antiaircraft and Guided Missile Center—there to become the guardian of all missilemen.

Since, as it is well known, the Oozlefinch always flies backwards to keep dust, trivia, and other inconsequentia out of his eyes, the Nike is always positioned at the correct attitude.

The birth and beginnings of this fabulous bird were humble, almost inconsequential, and extremely vague. But, in true Horatio Alger fashion, this ancient, ageless bit of improbability has risen to a position of high honor. The Oozlefinch has focused his benevolent gaze over the men of the guided missiles. He is at once the confidant of generals, the protector of Very Important Persons, and above all, the guardian, patron, and monstrous mentor of modern missilemen.

The first recorded history of the Oozlefinch came through the somewhat rambling mumblings of a Captain H. M. Merriam of Fort Monroe, Virginia. Presumably a raconteur of no mean talents, the captain must be given the credit for discovering the bird about 1905. He apparently was the only man who had seen the creature, and he was loathe to describe appearance, habits, or habitat. One physical characteristic he did emphasize, however, the great bird's eyes. These eyes, as vividly described by the captain, remain today as the outstanding physical mark of the Oozlefinch.

These eyes are large, all-seeing, unshaded by eyelids or eyebrows, and rather seriously bloodshot. Just why the eyes are so prominent and red, no one seems sure. But being all-seeing, the bird can gather more information in a shorter period of time than mere mortals who have conventional sight. Because his eyes were unshaded by eyelids or eyebrows, the bird is forced to move tail foremost to protect his powers of observation, but also, he can turn them 180° to gaze inwardly when he desires the maximum value from self-contemplation.

In the chronological history of the Oozlefinch, the wife of Colonel E. R. Tilton, also of Fort Monroe, follows Captain Merriam. Sometime before Christmas of 1905 or '06, while shopping in Hampton, Virginia, Mrs. Tilton came across a model of a bird which appeared to duplicate Captain Merriam's description of the Oozlefinch. A purchase was made for an amount unrecorded. Colonel Tilton transported the bird to the Fort Monroe Officers Club, and there it was accorded a perch behind the bar, where it remained for many, many years

while gradually assuming its powers of guardianship. It appears that several unprincipled individuals attempted to remove the bird from his perch, and it was necessary, finally, to provide him with a glass cage for safekeeping.

Early in 1908, new construction was initiated at Fort Monroe for the Coast Artillery School. The constant shake, rattle, and roll of the dice and dice box on the bar disturbed the bar itself, and a separate room was provided for those individuals addicted to such gambling. The Oozlefinch insisted on joining these festivities and moved—glass cage and all—to the mantle shelf of an adjacent room in the Casemate Club. This room became famous as the "Oozlefinch Room," and the sessions of the Artillery Board were held there every afternoon until long after retreat, winter and summer. The Oozlefinch never missed a meeting, and with his all-seeing eyes, took in all of the work of the Board, becoming so deeply interested in its proceedings that he practically became a member. This room became known eventually as the "Gridiron Room" and the Oozlefinch became a member of the "Gridiron Club" (an organization no doubt addicted to drinking and gambling but mostly to "roasting" nonmembers).

Time passed; individuals came and went; the Oozlefinch spent much time in deep professional thought, particularly as World War I approached. Most of this time he was under the constant care of Keeney Chapman, Club Steward, who spent over 40 years in this position.

During World War I, three regiments of Coast Artillery (the 42d, 43d, and 52d) formed the 30th Artillery Railway Brigade in France. Just as the eagles of Napoleon crossed the length and breadth of Europe, so the spirit of the Oozlefinch proceeded to France with the Railway Artillery. He, himself, remained at Fort Monroe, but he kept both eyes focused on the proceedings "over there."

It was sometime during this period that those who remained at Fort Monroe thought it desirable to initiate a crest or coat-of-arms for the Gridiron Club. The design created quite a sensation among the noninitiated and the secrets of his composition were never divulged to outsiders. However, it is believed that the heraldic story ran something like this: The body of the shield "parti per fess, dovetailed" indicates the general woodenness, not of the Artillery Board and the other members of the "Gridiron Club" but of the passing throng who paid not their toll cheerfully in passing through the Sanctum to the bar. "Gules and Sable:" The color of the shield is red and black—red for the Artillery, and black in mourning for those who lost at dice by throwing the lowest spots. "In honor, a deuce spot of dice, lozenged proper." The honor point of the shield was given to the lowest marked dice, as it was the one which most frequently appeared to some members, the law of probabilities to the contrary notwithstanding. "In nombril a gridiron sable:" the lower half of the shield given over to the memory of those who did not belong to the "Gridiron Club" but who were constantly roasted by it. The supporters, "two Oozlefinches, regardant, proper," were a natural selection, "regardant" meaning looking, or better, all-seeing, with the great eyes that this bird has to protect while in flight in the manner described. The crest "a terrapin, passant dexter proper," was selected owing to the great number of these animals, cooked to perfection by Keeney Chapman and served with great pomp to the members of the Artillery Board on occasions of state. This was always accompanied by libations of "red top," red top being a now obsolete drink made in the Champagne Country of France and once imported to the United States, in times gone by that now seem almost prehistoric. The wavy bar, over which the terrapin is passing, represents the adjacent waters of the Chesapeake, the natural habitat of this animal.

Considerable thought was given to the selection of a motto, and finally after considerable search among Latin scholars, the decision was reached to utilize "Quid ad sceleratorum curamus." It appears there was some difficulty in finding a Latin word for "hell" and the one selected translates literally as "place of the damned," which was apparently as near as the ancient Romans ever came to the word desired. Freely translated, therefore, the motto reads, "What in hell do we care!"

During World War II, antiaircraft artillerymen fighting overseas remembered the existence of the Oozlefinch and many of them took his likeness along as their sacred guardian. His spirit led those men who fought in both the European and Pacific Theaters to greater successes.

In 1946 the Oozlefinch finally became restless at Fort Monroe, and as all his friends began to depart to be replaced by individuals of various branches, he decided to move to Fort Scott, California, where the Seacoast Artillery Branch of the Artillery School and the School of Mines were activated. When these schools were closed, about 1948, the Oozlefinch retired to some unknown cloister where he turned his eyes inward and engaged in deep meditation over the events of the times and need for modernization of the Artillery.

After 8 years in this secluded retirement, the Oozlefinch was contacted by his old friend Major General Robert J. Wood, commanding general of the US Army Antiaircraft Artillery and Guided Missile Center, who persuaded the bird that the time had come for him to return to active duty. Cognizant of the amazing activities of the descendants of those whom he had known so well, and conscious of the need for taking under his care the problems of modern-day gunnery, the new guardian of the missilemen flapped his featherless way to the Fabulous Southwest where the high, dry, and somewhat dusty climate admirably suited his penchant for flying backward.

Here at the Antiaircraft and Guided Missile Center, he appointed General Wood as "Chief Oozlefinchling I," authorizing the general to speak for him during his many absences to the missile ranges. The glorious bird also insisted on becoming a member of every class and every activity; on taking part in every festivity; and on assuming protection of students, instructors, trainees, combat units, and in fact, all personnel of the garrison. He charged himself, in addition, with particular care for Very Important Visitors to the Guided Missile Center and specifically, not only to protect such visitors from the long-winded, technical briefings and orientations to which they were subjected, but to accord them suitable recognition as "Oozlefinchlings" for their punishment.

To reward both these visitors and others, the amazing bird created the Ancient and Honorable Order of the Oozlefinch, directed its incorporation under the laws ot the State of Texas, and from time to time approved the awarding of "degrees" to those deemed worthy of this honor. Among the degrees were: Master, First Class, Gunner, Apprentice, 24-Hour Expert Oozlefinchling, and Charitable Oozlefinchling.

These degrees, which carried various qualifications as prerequisites for award, all required that the recipient be physically present at the Guided Missile Center for induction. The Oozlefinch also authorized still another degree, the coveted "Oozlefinchling, Old Timer." This degree was bestowed upon persons who qualify by virtue of their association with the

bird long before he took over his present job of protecting the men who man the missiles, as well as their dedication and faithfulness to the spirit of the Oozlefinch. This degree was awarded to persons who were prohibited by age, space, or other ills from journeying in person to the shrine of the Oozle at the present US Army Air Defense Center.

One of the first "Old Timer" degrees was awarded to Captain Ellis C. Baker, who retired shortly after World War I after service with the 42d Railway Artillery Regiment. It was a letter from Captain Baker to General Wood, promptly relayed to the Oozlefinch, of course, recalling the captain's association with the awkward angel of the artillerymen during World War I, which prompted the establishment of the "Old Timer" degree.

Captain Baker's old unit, the 42d Railway Artillery Regiment, was the parent unit of the 42d Field Artillery Group, now in Europe, which was one of two field artillery organizations which trace lineage to the Oozlefinch. The other unit laying claim to the bird was the 64th Field Artillery Battalion (Lancers) in Hawaii, which traced its history to the 3d Battalion of 43d Coast Artillery Regiment (RR). When first informed of these units' claims, the Oozlefinch issued only an outraged "Quid ad sceleratorum curamus," and flapped—tail foremost—to a remote missile firing range to sulk and brood. Later, however, he disclosed that the birds claimed by these two units are progeny of his still in oversea service. The sage old bird, in a burst of magnanimity, bestowed on each of the units the degree of "Oozlefinchling, Old Timer," and returned to his many duties at the AAA&GM Center.

On 1 July 1957, the US Army AAA&GM Center was redesignated the US Army Air Defense Center. Simultaneously, Major General Sam C. Russell assumed command of the Center and became Chief Oozlefinchling II. He was followed by Brigadier General Stephen M. Mellnik, Lieutenant General (then Major General) Marshall S. Carter, and Major General Tom V. Stayton. Since the command of Major General Russell, the numbering of the Oozlefinchlings has been discontinued.

In July 1959, after extensive talks between the Oozlefinch and Chief Oozlefinchling, still Major General Russell, it was decided to drop all "degrees" except the 24-Hour Expert. Prompting this decision was the fact that the Ancient and Honorable Order of the Oozlefinchling had grown to over 48,000 strong. To be qualified for this award, one must now be a civilian guest of the Center and attend all briefings and missile firings during the prescribed period.

It was not until 2 years later, February 1961, that the Oozlefinch recognized the female human earthling as a guest to the Center and came up with a second "degree," the Powder Puff Oozlefinchling. The requirements, however, remained the same as for the 24-Hour Expert.

During the next few years and through thousands of missile firings, the legendary bird seemed to turn up everywhere, and sometimes the skinny-necked fellow was even thought to be in two places at once. His farthest known migration over the years occurred in 1962 when he went to the outer Hebrides in Scotland where he observed with much gusto the Corporal missile firings by the 1st US Army Missile Command stationed in Italy.

It was shortly thereafter, in January 1963 to be exact, that our intellectual friend barely escaped disaster. The featherless bird, overseer of missilemen, had become lost in a San Francisco fog. The exact circumstances of this all but fatal mishap are shrouded in official secrecy. Because, after all, the Oozlefinch up to that time had a reputation for infallibility.

But this much was made known. En route from McChord Air Force Base, Washington, on what should have been a routine flight, the fabulous bird, 24 hours overdue, was reported to have overshot the 40th Artillery Brigade helicopter strip and nearly crashed during a heavy fog that blanketed Fort Scott. The venerable warm-blooded vertebrate then became disoriented and, after barely missing a tail-on (remember he flys backward) collision with the Marin County countryside tower of the Golden Gate Bridge, became totally confused. Needless to say, he was immediately rescued, although how is again shrouded with red tape and mystery.

Questioning of the Oozlefinch himself brought an unmitigated "no comment," and eventual public disclosure of the incident by the Information Officer of the 40th Brigade almost brought the creature's incredible career to a heartbreaking finish.

He is presently brooding at Fort Bliss, again in deep meditation, waiting for the unusual occurrence to be forgotten. Don't be fooled, however, for though he is quiet, "the guardian of all missilemen" is ever present in spirit.

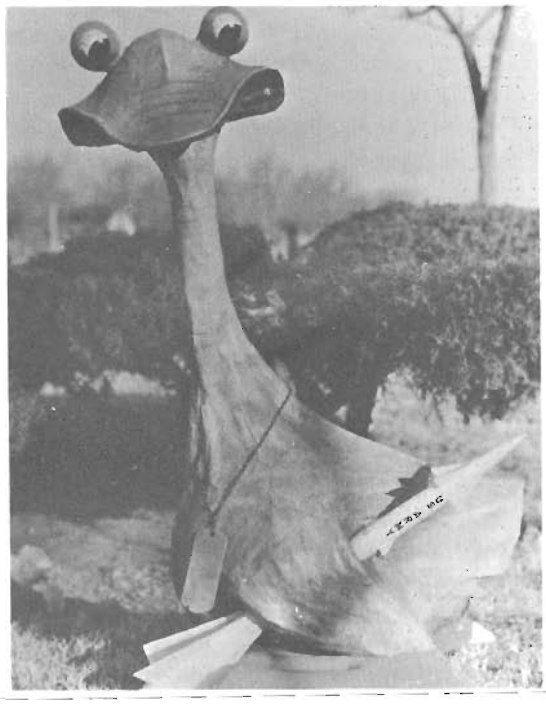


Figure 1. The Oozlefinch as he appears today.

Figure 2. Image of the Spirit of the Oozlefinch sometimes known as the transplanted Oozlefinch.

My efforts at determining the bird's itinerary were thwarted when an informant, who for obvious reasons, wishes to remain anonymous, revealed that while serving on the "G-staff" in 1956, he overheard General Wood ask the Oozlefinch what its itinerary had been. My informant claims that the Oozlefinch advised the general that the itinerary was a matter that concerned no one but himself and the finance officer who disbursed the travel pay for his trip.

A first lieutenant, who also claims anonymity, says that the praise accorded to the Oozlefinch is obviously the work of some second lieutenant seeking favor and acceptance as an air defense officer. They know that with a word the bird can relegate them to a dreaded assignment in the field artillery.

The photograph depicting the coat of arms and the likeness of today's more mature bird, as shown in figure 1, is astonishing. Of course, unlike the plight of the artist of the Railway Artillery Reserve in 1919, to whom the task of drawing a likeness from verbal descriptions fell, and who, from the meager and confusing data, produced the caricature in figure 2, the artist for the facsimile shown in figure 1 had the coat of arms as a guide.

ANECDOTES AND JOKES

Here's more air defense lore.

- Anecdote - A second lieutenant practicing to become proficient as a tactical control officer for the Nike Hercules system was reading the step-by-step procedures for the "Missile Firing Sequence" from his "crib cards." He would read the step in the procedure from the card and perform it on the equipment, check his action against the card, and go on to the next step. He performed the sequence perfectly until he reached the last step—the "countdown." Here the typist had forgotten to put periods between the numbers 5.4.3.2.1, and the Lieutenant read the sequence "fifty-four thousand, three hundred twenty-one—fire!" At this point another operator tripped a CO^2 fire extinguisher whose "whoosh" sounded like a Nike Hercules missile launching and another operator caused the recorded needle on the "plotter" to appear to follow a missile course. Someone then told the lieutenant, "You really did it, sir! Look at it go!" And the lieutenant collapsed, thinking he had accidently fired the missile.

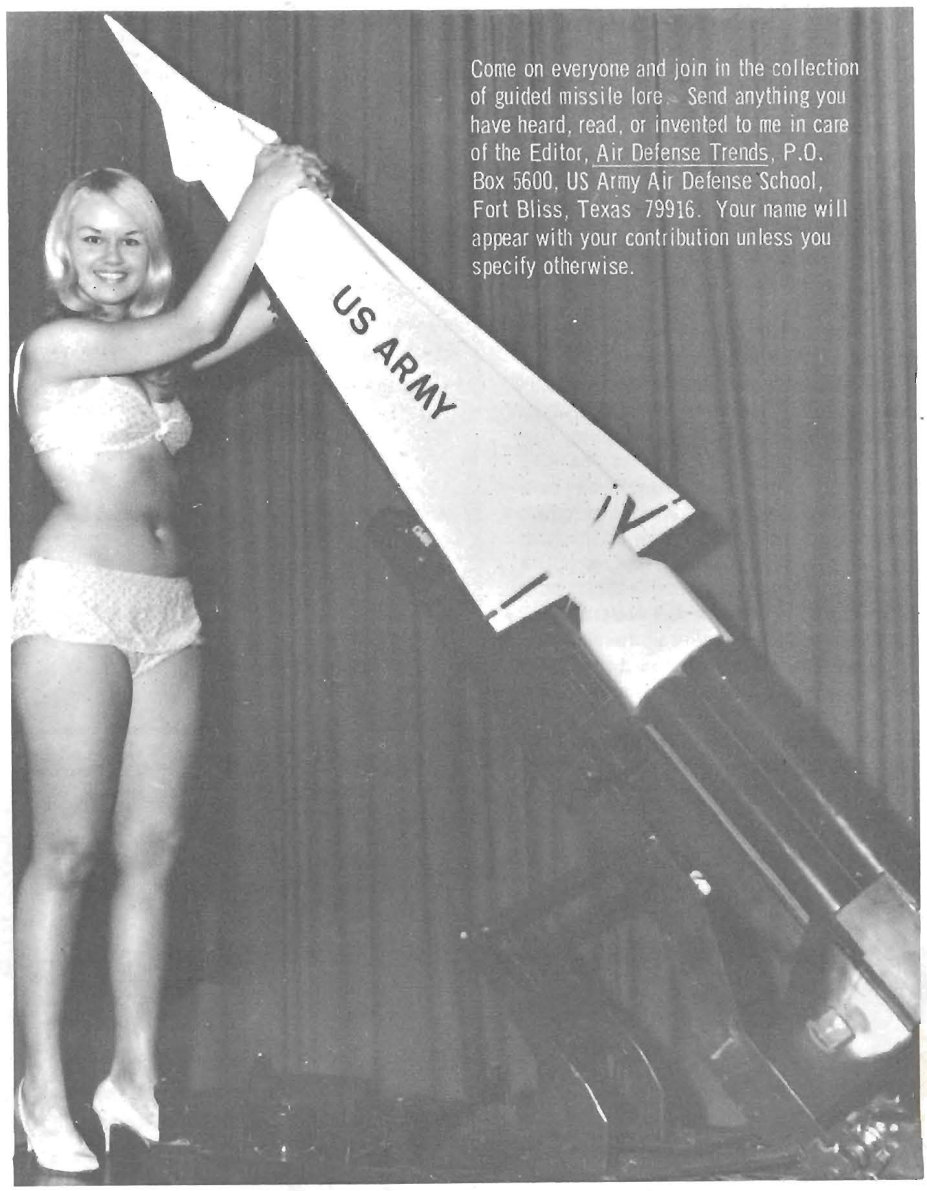
- Joke - Most US Army guided missile system tactical equipment is painted olive drab (OD) on the outside and seafoam green on the inside. A maintenance technician had been working steadily for some time trying to repair a radar set. His commander made regular and too frequent visits to the radar asking the technician what the situation was. The CO came up behind the sergeant one more time and asked, "Well, Sarge, how does it look?" The exasperated sergeant backed out of the radar, stood stiffly at attention, and replied softly and in measured monotone, "OD on the outside - light green on the inside," and dove back into the radar.

- Joke - A Hawk firing platoon leader was heard to complain, "My platoon sergeant is just like a dummy round. It won't work and you can't fire it."

- Anecdote - Army tactical equipment requiring electric energy gets its power from trailer-mounted, gasoline or diesel engine driven electrical generators which depend upon a towing vehicle for locomotion. A second lieutenant asked a passing sergeant how to get a generator started. The sergeant advised him to hook it onto a truck and tow it.

●Practical joke (the fool's errand) - Military personnel specialists, during their Army careers, move about from one organization to another regardless of branch; i.e., Infantry, Artillery, Air Defense Artillery, Signal Corps, etc. Often they are not familiar with the jargon peculiar to each such outfit and consequently are made the object of good-natured hazing during the first weeks in their new homes. A not unfamiliar request made of a newcomer by missilemen is, "Get us a table of organization and equipment modification for an in-flight missile maintenance mechanic. Similarly, truck drivers and supply specialists coming from nonmissile units are frequently sent after in-flight missile maintenance men, in-flight maintenance saddles, and in-flight maintenance dismounting devices (parachutes).

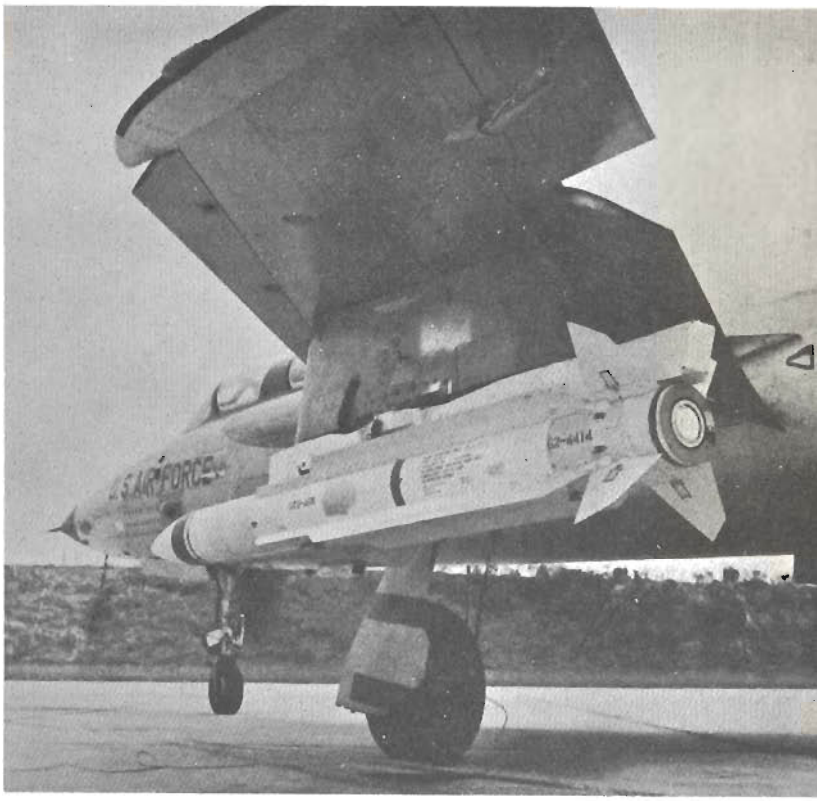
●Joke - Crew chief to operator leaning against an open computer door: "Get away from there before you get amps in your pants."

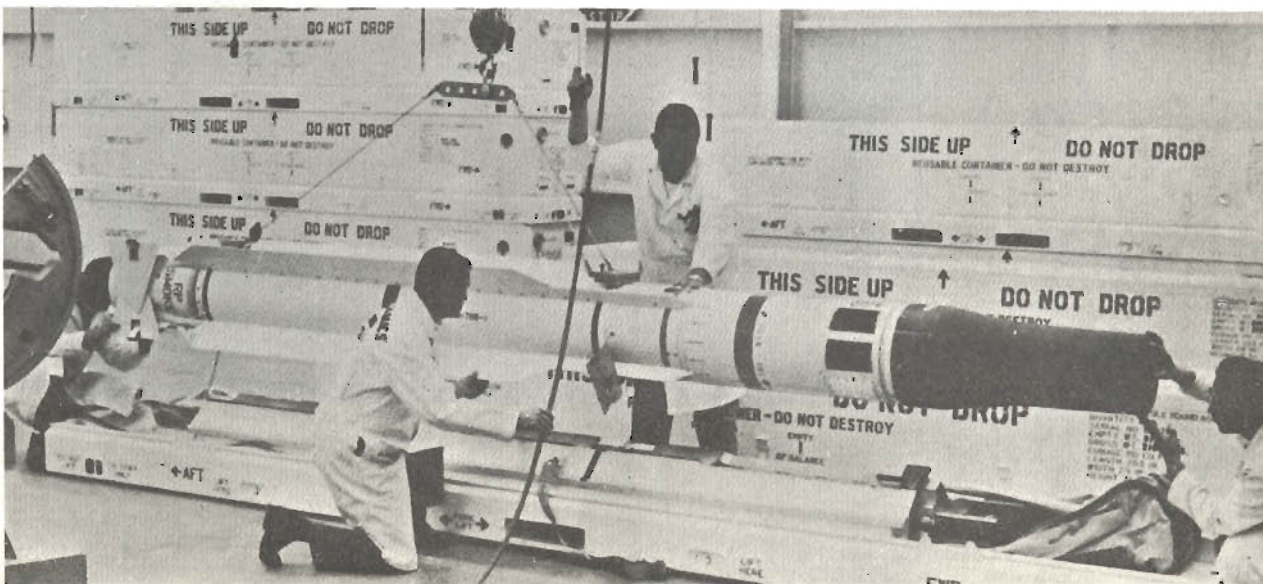


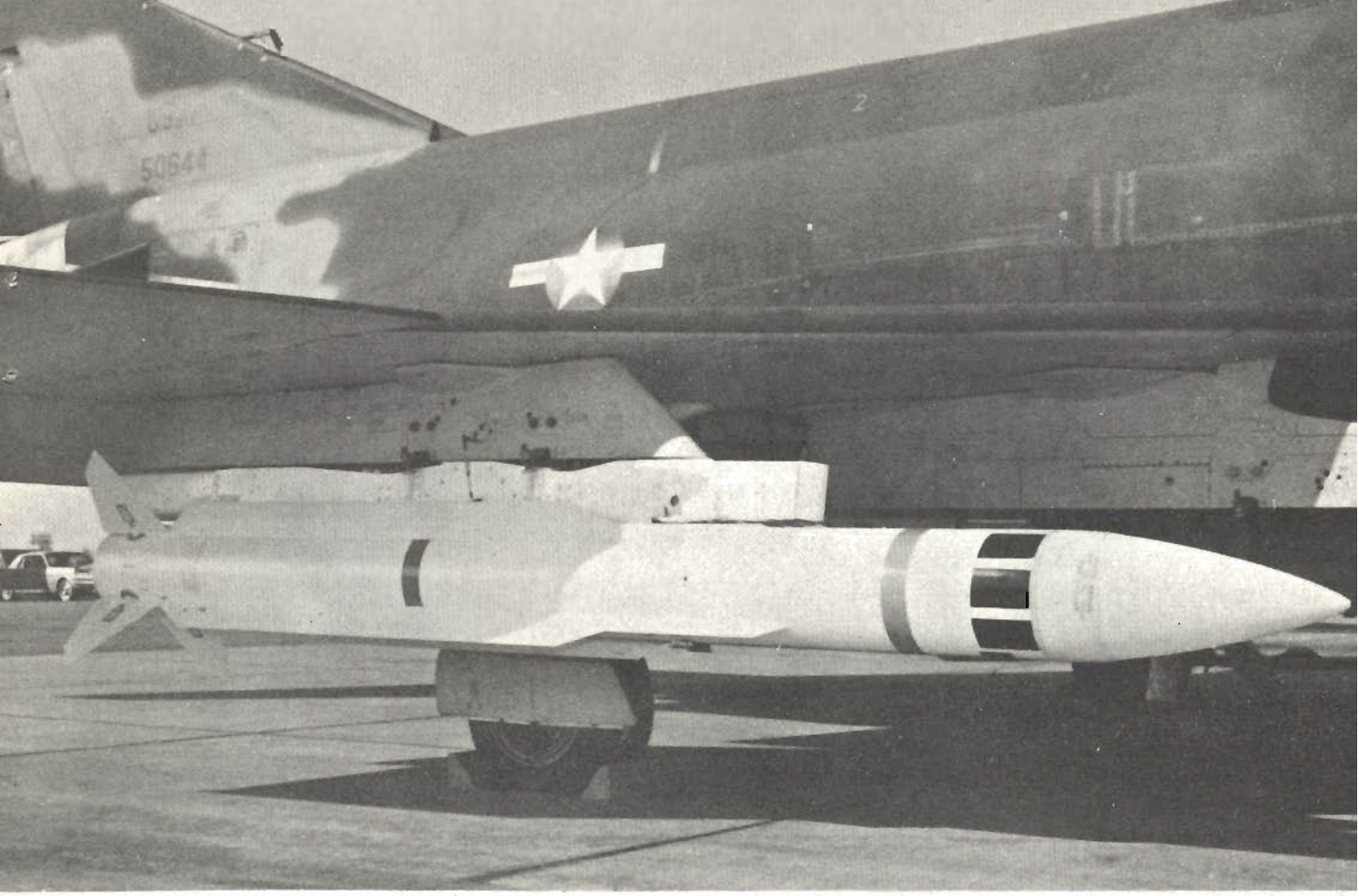
Come on everyone and join in the collection of guided missile lore. Send anything you have heard, read, or invented to me in care of the Editor, Air Defense Trends, P.O. Box 5600, US Army Air Defense School, Fort Bliss, Texas 79916. Your name will appear with your contribution unless you specify otherwise.

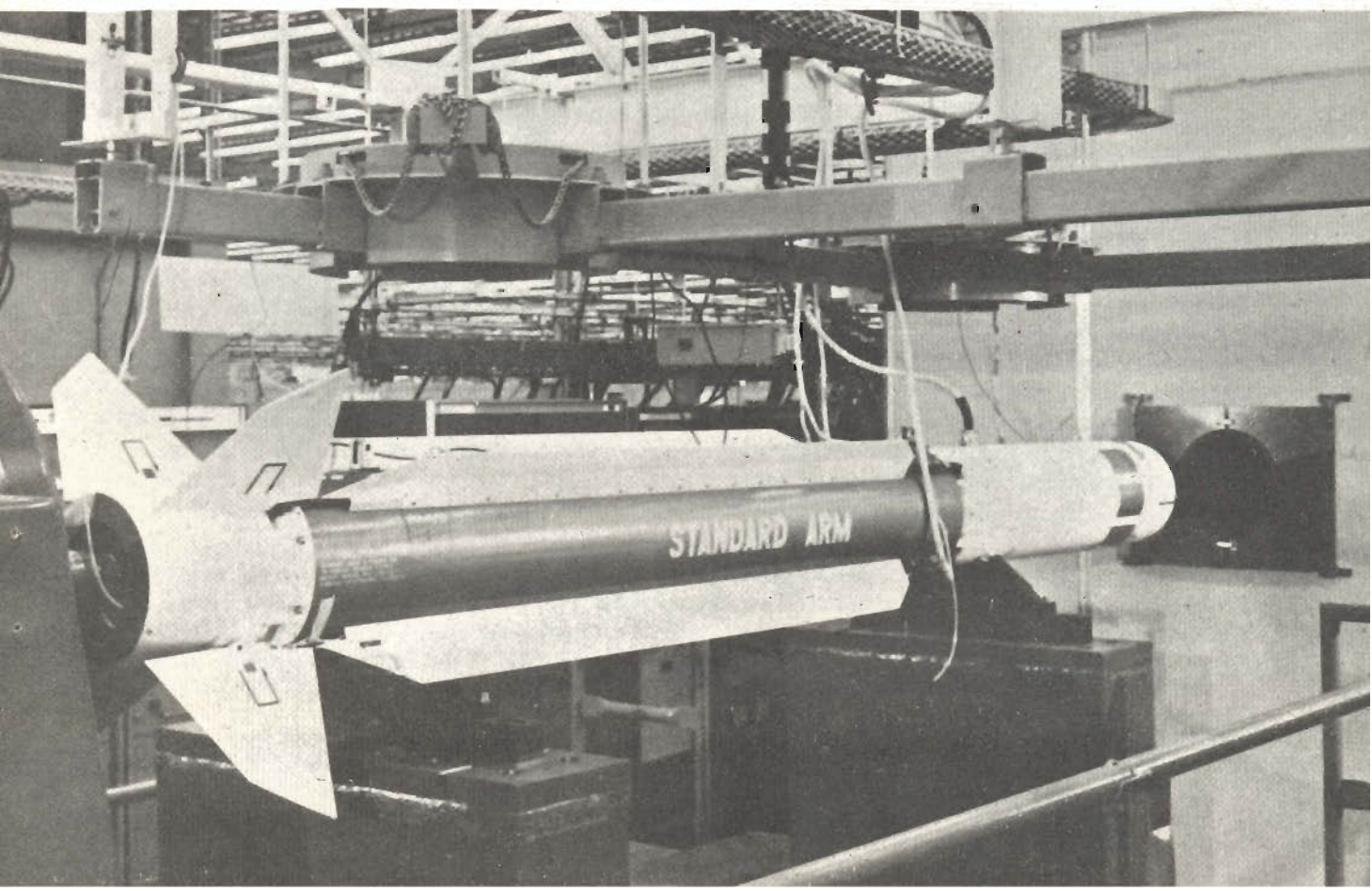
Standard ARM Is Tested on F-4D, F-105

Standard ARM anti-radiation missile In production at General Dynamics Pomona Div., is operational on Air Force Fairchild Hiller F-105s (above), and has been test fired on a USAF McDonnell Douglas F-4D (left). Production line quality assurance test of a missile with an inert motor is ballasted so that shaker at rear will produce realistic vibration (left, below). Radio frequency chamber for seeker test has temperature chamber on the other side, and the missile can be readily moved around to it for this phase of environmental testing. Missile on F-105 Is trainer version, indicated by absence of rectangular black dielectric plates behind the radome for ordnance fusing. Standard ARM has a phosphorous marker in spacer section, lettered RP SMOKE in missile being loaded for shipping (below). This provides an impact marking device for subsequent attack on concealed sites. The Navy-managed program is producing the third version of the missile, using a Bendix radar receiver and a General Dynamics-designed seeker built at Pomona. The first version used a Texas Instruments Shrike seeker combined with the Navy Standard shipboard missile's more powerful Aerojet-General solid motor to form the Interim ARM. The second version used a Maxson seeker.








STANDARD ARM

The Negro Soldier, Yesterday and Today

Major James W. Revels
High Altitude Missile Department
US Army Air Defense School

"We ain't what we oughta be; we ain't what we wanta be; we ain't what we gonna be; but thank God we ain't what we was" echo the immortal words of Dr. Martin Luther King.

The black man has been a part of the military establishment of this country from the American Revolution to the present conflict in Vietnam. Black soldiers were instrumental in the downfall of slavery in the Civil War. They fought beside the French in World War I, helped defeat the Germans in World War II, and have proved that, given a chance, they can perform all the tasks of the modern-day soldier from piloting sophisticated aircraft to command of combat units.

Despite the Negro's long history of slavery and second-class citizenship, he has served his country loyally in many wars. In a leading Negro magazine this statement appeared, "The waging of war is one of the most inhuman practices engaged in by man and yet war has been, almost without exception, a part of man's culture in the most primitive of tribes and the most highly developed of modern nations. Crude weapons were hammered out by naked cavemen along with primitive tools and, today, nuclear scientists use the most advanced of scientific knowledge to create weapons so awful that they can literally destroy the civilized world."[1]

During early wars, many Negroes were cited for bravery, but none received the coveted Medal of Honor. However, the barrier was finally conquered during the Korean war. Two members of the famed 24th Infantry, PFC William Thompson and SGT Cornelius H. Charlton, were awarded the nation's highest honor for their bravery "above and beyond the call of duty."

[1]Publisher's statement, Ebony, August 1968, p 29.

Following the Civil War, the Army of the United States had four Regular Army Negro regiments, the 9th Cavalry and 10th Cavalry and the 24th Infantry and 25th Infantry. The men of these regiments were the legatees of the Civil War troops out of which the units had been organized and of the Indian fighters and plains soldiers who filled their ranks until the turn of the century.

When it was apparent that Negroes would become involved in World War I, the following editorial appeared in the Crisis: "The Crisis says first your country, then your rights. Certain honest thinkers among us hesitate at that last sentence. They say it is all well to be idealistic, but is it not true that while we have fought our country's battles for one hundred and fifty years, we have not gained our rights? No, we have gained them rapidly and effectively by our loyalty in the time of trial. Five thousand Negroes fought in the Revolution, and the result was the emancipation of slaves in the North and abolition of the African slave trade. At least three thousand Negro soldiers and sailors fought in the War of 1812, and the result was the enfranchisement of the Negro in many Northern states and the beginning of a strong movement for general emancipation. Two hundred thousand Negroes enlisted in the Civil War, and the result was the emancipation of four million slaves and the enfranchisement of the black man. Some ten thousand Negroes fought in the Spanish-American War, and in the twenty years ensuing since that war, despite many setbacks, we have doubled or quadrupled our accumulated wealth."[2]

The Negro took up arms again in World War I. Most of the 404,348 Negro troops were in the Services of Supply, in quartermaster, stevedore, and pioneer infantry units. Two infantry divisions, the 92d and 93d, were formed and sent to France. The 93d was not a true division, but four separate infantry regiments without trains or artillery. These regiments, three of them National Guard, were assigned to the French, reorganized according to French tables, and used as integral parts of French divisions on the Western Front.

If a Gallup poll had been taken during World War I and the man on the street asked what he thought of the Negro soldier, the result might have paralleled the current split over the issues of our time. During World War I, few weeks passed without a detailed reporting of the bravery of American Negro soldiers in the nation's press. The United Press reported: "American Negro troops proved their value as fighters in the line east of Verdun on June 12 . . . . The Germans attempted a raid in that sector but were completely repulsed by the Negroes. The Boches began a terrific bombardment at one minute after midnight (throwing over between 3,000 and 4,000 shells from guns ranging in size from 67 to 340 millimeters). The bombardment was concentrated on small areas. Many of the shells made holes from ten to fifteen feet across. In the midst of this inferno the Negroes coolly stuck to their posts, operating machine guns and automatic rifles and keeping up such a steady barrage that the German infantry failed to penetrate the American lines. The Americans miraculously sustained only two wounded."[3]

Despite such favorable press coverage, rumors of Negro cowardice and mistreatment were spreading throughout America. The Outlook reported: "The 369th Infantry, characterized by some as possessing black skins, white souls and red blood, ought to silence for all time the slanderous charge that Negroes are cowards and will not fight; and the service which these representatives of their race have rendered in the war to make the world safe for democracy ought to make forever secure for that race in this their native land their right for

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[2] "The Reward," The Crisis, Vol XVI, September 1918, p 217.

[3] The Crisis, September 1918, p 238.

life, liberty, and the pursuit of happiness." Such reports as Negro troops were being abused by their white officers, systematic attempts were being made to break and demote Negro officers, American white officers were attempting to import the worst features of color prejudice into France, and Negro troops were being employed as "shock troops" in the most dangerous battle zones and as labor troops where the work was hardest spread through the larger cities, but were all denied by General John J. Pershing. However, the Houston riot of 1917, involving troops of the 24th Infantry, was no rumor.

Following World War I it was clear that most commanders of Negro combat troops had little to recommend for the employment of Negro troops in a future war except labor duties under white supervision. Therefore, it would appear that some of the rumors previously reported were true. The 92d and 93d Infantry Divisions were poorly staffed and poorly trained. In a letter to the Assistant Commandant, General Staff College, 14 March 1920, General Charles C. Ballou, commander of the 92d Division, wrote: "The Secretary of War gave personal attention to the selection of white officers of the higher grades, and evidently intended to give the division the advantage of good white officers. This policy was not continued by the War Department . . . the 92d . . . was made the dumping ground for discards, both white and black. Some of the latter were officers who had been eliminated as inefficient, from the so-called 93d Division . . . . To officer a division in which the best possible leadership was required, only one-half as many students were summoned to the training camp as were summoned from which to select the officers of the white divisions. College degrees were required for admission to the white camp, but only high school education was required for . . . the colored . . . and in many cases these high school educations would have been a disgrace to any grammar school. For the parts of a machine requiring the finest steel, pot metal was provided."[4]

It should have been apparent to the military planners following World War I that the employment of Negro troops presented some problems. The Negro combat troops had failed to come up to Army standards. If such a failure were to be averted in the future, plans had to be made to determine the best and most efficient means of employing Negro troops. And so it was. The peacetime years following World War I were planning years.

In general, the position of the War Department on the subject of the employment of Negro troops in the summer of 1940, on the eve of the greatest expansion which the United States Army had known, may be summarized briefly as follows:

"1. Negroes would be mobilized in proportions equal to their representation in the nation's manpower of military age. Preferably, they should be mobilized early, both to allow numbers to be built up to and maintained at a percentage level approximating nine plus percent, and to provide earlier training, since adequate training might take a longer period than normal.

"2. Negroes would be utilized in both arms and services and in all types of units for which they could qualify. Combat arms assignments for Negroes should be in the same ratio as for whites. Full agreement on their use in all arms and services had not been reached among staff agencies or by the chiefs of all arms and services, but a strong stand on their proportionate use in all branches had been taken by the Personnel Division.

[4] Ulysses Lee, US Army in World War II, Special Studies, "The Employment of Negro Troops," Office of the Chief, Military History (Washington 1966), p 18.

"3. Negroes would be utilized in units with all-Negro enlisted personnel, but these units did not need to be employed separately. A strong group believed that Negro units should be kept small and used in attachment or assignment to larger white units. A less widely held view was that only as parts of otherwise white divisions could Negro combat units operate successfully and in a manner which would guarantee their sharing proportionately in battle losses and battle credits.

"4. Officers for Negro units might be Negro or white. They were to be assigned in 50 percent greater numbers than to similar types of white units. Negro officers were to be chosen and trained according to the same standards as white officers and, preferably, trained in the same schools. Negro officers were to serve only with Negro units and should command Negro troops only. Specific units for which Negro officers were authorized would be designated. Initially these would include only the Reserve and National Guard units and such service units as might be so designated.

"5. In their utilization, Negro troops were to be trained, officered, quartered, clothed, and provided with all facilities in the same manner as white troops."[5]

Although these plans were well laid, much intervened between planning and execution. Thus, the Negro soldier entered World War II.

During 1942 the Army was scheduled to expand to 3,600,000 men. Of these, 337,750 were to be Negroes. The Air Force, which was to expand to 997,687, was allotted 53,299 Negroes in 1942, or 10.6 percent of its total increase of 502,822 men. Since the Air Force received the largest increase, it experienced the most problems with the question "what to do with the Negro troops?" Special units, such as quartermaster truck companies and air-base security battalions, were organized to absorb the influx of Negroes. However, the Army continued its employment of the Negro troops by dividing them among infantry, engineer, and quartermaster units.

A number of miscellaneous units were provided for Negro troops in 1940-1942. Chief among these were bands, replacement companies, postal units, service command units at posts and at civilian educational institutions, and a special service company. Various provisional units, training units, and school detachments were also utilized for the placement of Negro troops. Many of these units, such as bands and replacement companies, were needed to service Negro trainees.

"Negro military police units were not employed until after local experience with Negro military police detachments showed that their use in areas with large Negro troop populations paid dividends in better relations with civilians in these communities which had learned to look upon Negro military policemen as something less that a threat to local customs," reports Mr. Ulysses Lee in his special study of the Negro in World War II.

In World War II Negroes were accepted for military service at a continuously lower rate than whites. As of 30 September 1941, when the number of Negroes classified in the immediately available class (1-A) by Selective Service was 13.1 percent of the total in that class and therefore higher than the approximately 10.7-percent proportion of Negroes among those registered, the number of Negroes in Class IV-F (rejected by Selective Service) showed an

[5] Ulysses Lee, US Army in World War II, Special Studies, "The Employment of Negro Troops," Office of the Chief, Military History (Washington 1966), pp 49-50.

even greater disproportion. Of men rejected as a result of physical examination, 12 percent were Negroes; of men rejected for obvious physical or mental disabilities without physical examination, 15.8 percent were Negroes. Of the registrants classified between 15 May and 15 September 1941, 1.1 percent of the whites, or 60,001, were deferred for educational deficiency, while 12.3 percent of the Negroes, or 83,466, were so deferred.[6] Of the Negroes rejected, the largest numbers fell into two classes, venereal disease cases and the educationally deficient. For whites, the largest number were rejected for mental disease.[7]

Nevertheless, the Negro soldier served his country well during World War II. He endured the hardships of segregation and maltreatment by white officers and hostile civilians. Many of them agreed fully with the statement attributed to Joe Louis: "There may be a whole lot wrong with America, but there's nothing that Hitler can fix."[8]

Although placing Negro units within the continental limits of the United States created some problems after Pearl Harbor, assigning them overseas became one of the most interesting facets of the war. Combat units were more seriously affected by this development than service units, but all Negro units were affected. Negro troops were not welcome in Alaska, Australia, Belgian Congo, British Isles, British West Indies, Chile, Greenland, Iceland, Labrador, Liberia, and Venezuela. Additionally, theater commanders were known to cancel or reduce requests for certain types of units when informed that only Negro units were available. However, by 31 December 1943, 53,709 (5.61 percent) Negro troops were stationed overseas, mostly in North Africa, Australia, New Guinea, and the British Isles.[9]

Despite the presence of Negro troops in oversea theaters, none of the larger combat units had been actively employed in combat. After much public outcry, General Benjamin O. Davis formally recommended in April 1943 that a Negro combat unit be sent to an active theater without delay. So the 99th Fighter Squadron, under the command of his son, LTC Benjamin O. Davis, Jr, was hastily trained and shipped to North Africa. Upon the performance of the 99th depended the future of Negroes in military aviation. The 99th was attached to the 33d Group, 64th Wing, XII Air Support Command. In June it participated in its first combat mission and was credited with the downing of its first enemy plane.

Subsequent evaluation of the 99th indicated that its ground discipline and ability to accomplish designated tasks promptly were excellent, but its pilots were not of the fighting caliber needed for combat. The Group commander reported: "Based on the performance of the 99th Fighter Squadron to date, it is my opinion that they are not of the fighting caliber of any squadron in this Group. They have failed to display the aggressiveness and desire for combat that are necessary to a first-class fighting organization."[10] Thus ended the hope of major participation in combat by Negro units.

Because of the nature of the report and its consequences, Lieutenant Colonel Davis was summoned to Washington to discuss the matter. He met with a Special Advisory Committee

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[6] Selective Service in Peacetime, First Report of the Director of Selective Service, 1940-41 (Washington 1942), p 401.

[7] Selective Service as the Tide of War Turns: Third Report of the Director of Selective Service, 1943-44 (Washington 1945), pp 207, 629.

[8] Attributed to Joe Louis by a public speaker; quoted in Sterling A. Brown, "Out of Their Mouths," Survey Graphic (November 1942), p 483.

[9] Ulysses Lee, US Army in World War II, Special Studies, "The Employment of Negro Troops," Office of the Chief, Military History (Washington 1966), p 433.

[10] Ltr, HQ XII Air Support Command, to General Cannon, Deputy Commander, Northwest African Tactical AF, 16 September 1943.

on 16 October 1943 and stated that the report was entitled to respect. However, he added that his squadron carried out its mission, except on one occasion when it turned back because of weather. About the lack of aggressiveness, Lieutenant Colonel Davis stated that his pilots were a little shy at first, but later were as aggressive as the others. As to the stamina of the individual pilots, Lieutenant Colonel Davis had noted no differences between his pilots and others.[11]

Under the pressure of public dissent, the Inspector General (IG) conducted an investigation into the Army's policy for the activation, training, and employment of Negro units in the fall of 1943. The IG found that there was no identifiable policy; thus, an ineffective use of Negro units resulted. This investigation caused the G3 to recommend "that all available Negro combat units be shipped without delay to active theaters and ultimately employed on missions for which they were activated and trained; and that, when necessary, they be used initially on missions other than their combat missions provided that they retain their combat identity and not be otherwise disposed of until they have had an opportunity to prove themselves in combat, gain their share of battle honors, and accept their share of battle losses."[12]

The Deputy Chief of Staff approved the recommendation in principle, but the practice of deployment was far from simple. Commanders such as the Commander, Army Forces in the South Pacific Area, when queried concerning the use of Negro combat units, still preferred white units although the need for such units was great. However, he added, if no white divisions were available, he could use a Negro division for combat with none but white officers.

Thus, the Central Pacific Command was directed in December 1943 to make plans for the use of the 93d Infantry Division, a Negro division. This move included only three of the five regiments. The remaining regiments, the 366th Infantry and 372d Infantry, were assigned security duty in Massachusetts and New York.

By the end of February 1944, the Advisory Committee on Negro Troop Policies, armed with the Inspector General's survey previously conducted, prepared a recommendation to the War Department attempting to improve the employment of the Negro troops. The IG's survey concluded: "Units containing Negro personnel have a history of activation and training, followed by a transfer of personnel and acquisition of new troops, which has necessitated units starting all over again, and for many units, this has occurred more than once."[13]

After much discussion, the Committee finally advised the War Department: "It is the recommendation of this committee that, as soon as possible, colored infantry, field artillery, and other combat units be introduced into combat and that, if present organizations or training schedules do not permit such prompt commitment, steps be taken to reorganize any existing units or schedules so as to permit the introduction of qualified colored combat units, as promptly as possible, into battle."[14] In forwarding the recommendation, the chairman pointed out: "There has been a tendency to allow the situation to develop where selections

[11] Minutes of Meeting of Certain Members of the Advisory Committee on Negro Troop Policies, 16 October 1943.

[12] Memo, G-3 for DCofS, 6 January 1944.

[13] Memo, TIG for DCofS, 1 January 1944.

[14] Ulysses Lee, US Army in World War II, Special Studies, "The Employment of Negro Troops," Office of the Chief, Military History (Washington 1966), p 482.

are made on the basis of efficiency with the result that the colored units are discarded for combat service, but little is done by way of studying new means to put them in shape for combat service. With so large a portion of our population colored, with the example before us of the effective use of colored troops (of a much lower order of intelligence) by other nations, and with the many imponderables that are connected with the situation, we must, I think, be more affirmative about the use of our Negro troops. If present methods do not bring them to combat efficiency, we should change those methods. That is what this resolution purports to recommend."[15]

The recommendation was approved and eventually resulted in the 92d Infantry and 93d Infantry Divisions being alerted for oversea shipment. Two courses of action were decided upon by the War Department. One regimental combat team of the 93d Infantry Division would be used in combat as soon as possible. Second, one regimental combat team from the 92d Infantry Division would be selected and intensively trained for shipment to an undetermined combat zone at the earliest possible date.

So the 92d and 93d Infantry Divisions entered training for combat. Observations from higher headquarters indicated that both divisions progressed better than had been expected. Despite training difficulties and other problems, the divisions were deemed in "good shape."

Thus, Negro combat units were finally assigned combat missions. The Washington Post, 17 March 1944, carried a story with a dateline, "Allied Headquarters, South Pacific, March 15," indicating that "American Negroes of the 24th Infantry were in front-line action for the first time, with Sgt Alonzo Douglas of Chicago credited with being the first Negro infantryman to kill a Japanese in the Solomons."

When the North Korean Army marched into South Korea in 1950, our Army found itself in a position where the available units, Negro or otherwise, were required to be hurriedly prepared for duty in Korea. Thus, many Negro units, battalions and separate companies, were sent to Korea and became involved in combat. Unlike the situation that prevailed during World War II, no choice was available to commanders. The Department of the Army provided the force commanders with the most available units.

In July 1948 President Truman issued an order to all commanders directing the integration of the Armed Forces, but integration did not occur immediately. For the most part, Negro units were assigned intact to previously all-white units. Naturally, this was not the intent of the order and it was not long before more direct orders were issued and commanders required to comply fully with the spirit of the Presidential order. By 1955, all formal racial discrimination had been eliminated, although vestiges lingered into the early 1960's.

As a result of the order to integrate, Negroes for the first time found themselves assigned to previously restricted units. Combat units received a greater number of Negro troops; as a result, more Negroes were involved in combat operations rather than supporting them as was the case in World War II.

With the order to integrate the military service, the Army became the vanguard of integration in America. Korea proved that the Negro soldier was no different from the white

[15] Ulysses Lee, US Army in World War II, Special Studies, "The Employment of Negro Troops," Office of the Chief, Military History (Washington 1966), p 482-483.

soldier—that he could live and fight under adverse conditions, equal to any soldier produced by this country.

In an interview reported in The New York Times, 17 December 1950, Colonel S. L. A. Marshall, who was placed on temporary active duty in 1950 to study at first hand the effectiveness of US Army tactics in Korea, said that a special study was made of companies in the 2d Division in which whites and Negroes were integrated. "In my judgment those companies handled themselves as efficiently and courageously as any companies in the war. In fact, the mixed Company B of the 9th Infantry Regiment gave the bravest account of itself of any company." When the white commander of Company B was wounded, a Negro first lieutenant took over the company and served with great distinction, Marshall noted.

The New York Times, 9 February 1951, reported that "US Army Infantry outfits that are discarding Negro segregation practices in Korea are discovering that removal of the color line among fighting troops is paying good dividends both in morale and in battle."

Commanders found that integration had a beneficial rather than a detrimental effect on the effectiveness of their units. As the replacements intermingled more and more within the outfit, friendships were formed which were in no way hampered by the soldier's color. There had been instances of Negro officers outranking white officers without any special friction in either case.[16] H. H. Martin, reporting for The Saturday Evening Post, 16 June 1951, wrote: "No disciplinary or morale problems have arisen by reason of the integration of Negro soldiers into white units, and there has been no friction between the troops that could be traced to differences in color."

Although Negroes fought well during the Korean war, those serving in all-Negro units experienced low morale and felt rather insecure. Describing this insecurity, a Negro captain told reporter Martin: "You put him in a white regiment, and he looks around him and sees white men and black men both, and he feels in his heart, 'Now they are treating me like an American, not like a Negro.' But you put him in a Negro regiment, and he looks around him and sees nothing but Negroes, and he feels like somebody is using him as cannon fodder. He feels he is being treated not as an American soldier, but as a Negro soldier. And all the psychological inhibitions he has inherited through generations of living as a race apart . . . the lack of faith in himself, lack of confidence in his own race . . . take hold of him and he is hard to handle."[17]

Segregation in the modern army is not only inefficient in the use of manpower, and wasteful as to materiel and facilities, but probably impairs the cohesion of the primary group when its members are under stress. While there have been fine Negro units in the Army, the men of these units achieve efficiency despite the hindrances imposed by segregation. Segregation encourages a racial perspective so that the men tend to interpret everything unpleasant which happens to them in terms of racial discrimination. In segregated units, leadership tends to be less effective than in nonsegregated outfits, complaints tend to be more frequent and bitter, efficiency is frequently below the full potential, and morale . . . however morale may be measured . . . often ebbs low. This is true on the Army post whether in the United States or in Germany and on the field of battle whether in Italy or in Korea.[18]

[16] David G. Mandelbaum, Soldier Groups and Negro Soldiers, 1952, p 121.

[17] Ibid, p 123.

[18] J. B. Spore and R. F. Cocklin, Our Negro Soldiers, The Reporter, Vol 6, 1952, pp 6-9.

Since the Civil War, American Negroes in the Army had been formed into solid units. In short, they were segregated. In the fighting in Korea, certain battalions that had fought gloriously had become integrated by chance just before the action. Because of this, there arose in the Eighth Army an overpowering sentiment in favor of integration from flank to flank. It was due to this influence that a great national reform was at last brought about.[19]

Thus, the pages of history reflected the accomplishments of the Negro soldier from the Civil War through Korea. The Korean war served as a training ground and transition point for the development of the new policy which allowed the Negro soldier to be freely employed, for the first time, in Vietnam.

By virtue of the President's order in 1948, Negroes in Vietnam were assigned combat, support, staff, and administrative duties. Although no Negro units were employed in Vietnam, prestige units, such as the 101st Airborne Division, the 1st Air Cavalry Division, and Marines contained a large percentage of the total Negro population serving in Vietnam.

Commenting on the Negro in Vietnam, an unidentified general said, "This war in Vietnam, bad as it is, may turn out to be the best thing that ever happened as far as the Negro race is concerned. Over there, often for the first time, thousands of young Negroes are doing an important job and know they are doing it well. They are experiencing what it is like to be treated on an equal basis with whites. In the process, they are learning the two things that they need the most to get ahead . . . self-discipline and self-confidence." The general continued: "Negro veterans of this war, who will soon be returned to civilian life in large numbers, will produce more than their share of responsible leaders in civilian life. Anything that they might have learned in the Army is a bonus. The important thing gained by these young men is the experience of living under some degree of discipline, of getting along with whites on a man-to-man basis, and of earning some self-assurance."[20]

The Negro in Vietnam has performed all the tasks expected of the modern soldier. He is facing the Viet Cong and North Vietnam Army, from the DMZ to the Delta, with a skill and proficiency unequaled by soldiers of the past. He is advising the South Vietnamese Army and assisting in the rebuilding of war-torn Vietnam. He is a door gunner aboard a troop-carrying helicopter. He is a staff officer, Special Forces team leader, doctor, chaplain, and pilot. He is a combat commander.

Vietnam, a war of many firsts, produced the first Army Negro General since the Army/Air Force split. Brigadier General Frederic E. Davison commanded the popular 199th Infantry Brigade. The 199th was lauded for its performance during Tet 1968 and pioneered the joint (US/Vietnamese) operation concept. Brigadier General Davison is now the Director of Enlisted Personnel, Office of Personnel Operations, Department of the Army.

The Vietnam Conflict has been a pinnacle for the employment of the Negro soldier. From his position of obscurity during earlier military employment, the Negro soldier has taken his rightful place in our society. Commenting on the progress of the Negro in the Armed Forces, Secretary of Defense Clark Clifford, in a memorandum to President Johnson, reported: "Twenty years ago the Army had 1,306 Negro officers with only one a colonel. Now there

[19] S. L. A. Marshall, The Military History of the Korean War, 1963, p 48.
[20] US News and World Report (Washington 1968), pp 52-53.

are 5,637, of whom 27 are colonels, and one has been nominated to become a brigadier general. (Current promotion list contains the names of 17 Negroes. There are now 61 Negro colonels and promotables, according to the Army Times, 10 December 1969.) Negroes made up 10.7 percent of all Army enlisted men in 1948 but only 5.7 percent of the top enlisted grade. In 1968 the overall percentage is 12.1 percent, but now Negroes make up 13.9 percent of the grade which corresponds to 1948's top grade." The Secretary further added, "Equality of treatment and opportunity without regard to color is a fact in the Armed Forces of the United States. For most of our country's history, the opposite unfortunately was the case. The men and women of the Armed Forces have shown over the last twenty years that full equality of opportunity for white and black together is not just a dream, but that it can be made a reality. We shall be unrelenting in preserving and extending that reality."[21]

The Army Chief of Staff, General William C. Westmoreland, issued a policy statement recently on the subject of "equal opportunity" which stated substantially: "It must be clearly understood by all soldiers that the Army has made a firm commitment to continuing the task of removing every vestige of discrimination which affects the American soldier and his dependents. That same mutual trust and respect so manifest on the battlefield must pervade all Army installations and activities. We of the Army are proud of our heritage and our contributions to the furtherance of our national goals. I expect all soldiers to take pride in ensuring fairness and equal opportunity for all as we pursue our important mission of providing security for our great country."[22]

"We ain't what we oughta be; we ain't what we wanta be; we ain't what we gonna be, but thank God we ain't what we was."

[21] Armed Forces Journal, Vol 105, No. 50, August 1968 (Washington), p 2.
[22] Army Digest, October 1969, p 3.

SAM-D
Technology of a Modern Air Defense System

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Acknowledgment:

The author admits that he acted more as a compiler than as a creator in writing this article. Information used was drawn from presentations and papers originally conceived by engineers and managers from Raytheon Company and US Army Missile Command.

INTRODUCTION

Perhaps no single major missile system has entered into the development phase with as little fanfare as that of SAM-D. People ask me, "What is your work? I say, "SAM-D." Then I get that blank look which says I have not communicated, or another kind of look which says that they want to ask another question, "SAM-D who?" While this might not be indicative of the level of knowledge of the entire defense community, I do encounter the situation enough to show that SAM-D has crept, instead of jumped, into the development arena, and to indicate that a description of SAM-D might be of general interest. This article was written to describe SAM-D, where it came from, what it looks like, and what distinctive features and technological innovations make it unique.

SAM-D is the Army's all new air defense system being developed for defense of the field army against high-performance aircraft. This highly mobile system will simultaneously acquire, identify, track, and destroy multiple air-supported targets. With a continually increasing threat, Army air defenses are faced with targets that are faster, more difficult to detect, and harder to destroy than ever before. The SAM-D system is being developed to cope with this threat through use of phased-array radar technology, digital computers, and microelectronic packaging techniques.

The current program is a follow-on of two earlier study programs managed by the US Army Missile Command's Research and Engineering Directorate. These studies were oriented toward systems known then as Field Army Ballistic Missile Defense System (FABMDS) and Army Air Defense System for the 1970's (AADS-70's). After extensive studies by both Government and industry in the early 1960's, these two systems were discontinued because of complexity and cost. In October 1964, the present name, SAM-D, was assigned, and study effort was directed toward defense against high-performance aircraft and short-range missiles (SAM-D is an acronym for Surface-to-Air Missile—Development). This approach resulted in initiation of a contract definition program during which competitive proposals were evaluated, and Raytheon Company was selected as contractor to proceed into the advanced development program now in progress.

The need for SAM-D is based on recongition that the air defense threat is becoming more severe as it follows its own technological growth characteristic. While Nike Hercules and Hawk are being updated to meet more stringent performance requirements, they represent

the technology of the 1950's, and their basic configuration inherently prevents significant improvement in firepower, mobility, and availability. The desire to obtain quantum improvements in these three performance characteristics led to the requirement for a new system which would take advantage of all the best techniques in sensor systems, guidance, data processing, packaging, and availability.

SAM-D SYSTEM DESCRIPTION

The basic elements of the SAM-D battery are mounted on tracked vehicles in the field army application (fig 1). The fire control group in the foreground includes the multifunction, phased-array radar and weapon control unit. The launcher group, just behind the fire control group, consists of a trainable launcher and launch control electronics. The battery control group in the background executes the fire direction functions required when multiple fire control groups are combined into the battery. The fire control group and launcher group are the basic system elements. One fire control group with one or more launcher groups (and their basic load of missile rounds) is called a fire section. Fire sections can be combined in various ways to constitute a SAM-D firing battery. The number of fire control groups and launcher groups combined to form a battery depends on the tactical situation.

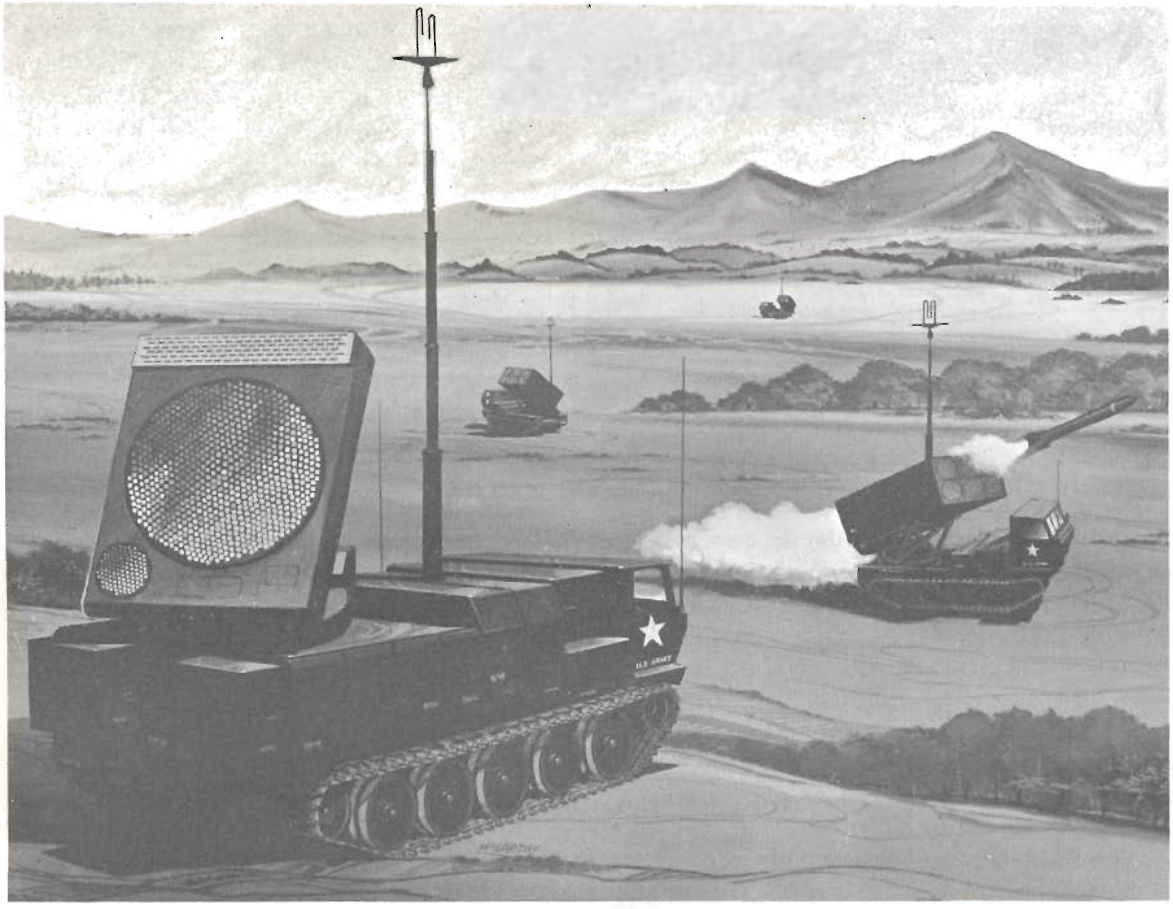

Figure 1. The SAM-D battery.

One field army version of the system uses all track vehicles. Prime power supplies are self-contained. Intrabattery and interbattery communications are accomplished with radios as is communication between fire control groups and launcher groups. Thus, cabling among system elements is eliminated. All of this promotes quick road march and fast deployment and eases constraints on the emplacement site selection.

The fire control group contains within itself the sensor, computer, and control equipment required to conduct its mission (fig 2). The SAM-D sensor, main element of the fire control group, is a computer-controlled, phased-array radar, capable of handling a multiplicity of functions. This single radar performs the functions of search, target track, and guidance normally performed by numerous radars in air defense missile systems now in the field. These several functions required of the radar impose differing requirements in terms of radiated power, data resolution, and data rates which are satisfied by means of a repertoire of waveforms optimized to the particular system function. The radar antenna is a space-fed, phase-steered array, using digital latching, ferrite phase-shifters. This type of radar has never before been utilized in a field army air defense system.

Figure 2. Fire control group.

Another major element of the fire control group is the weapon control unit which houses the weapon control computer, control panel, and displays. Through this unit, and operating under the rules of engagement established by the battery commander, the operators exercise control over the system. The operators are kept aware of the current situation through various displays which can depict several types of information at the operator's discretion. The operators can then select that mode of operation, from fully automatic to manual, which best counters the current threat situation. The computer, with its associated software, performs threat analysis and controls all system functions including the radar and guidance system.

In the battalion control group the data processor keeps track of the current situation information from all fire control groups in its battery and passes on fire control information, rules of engagement, and other procedures.

The SAM-D launcher (fig 3) is remotely controlled, trainable in azimuth and elevation, and capable of firing six missiles, either singly or in close sequence salvo. The missile

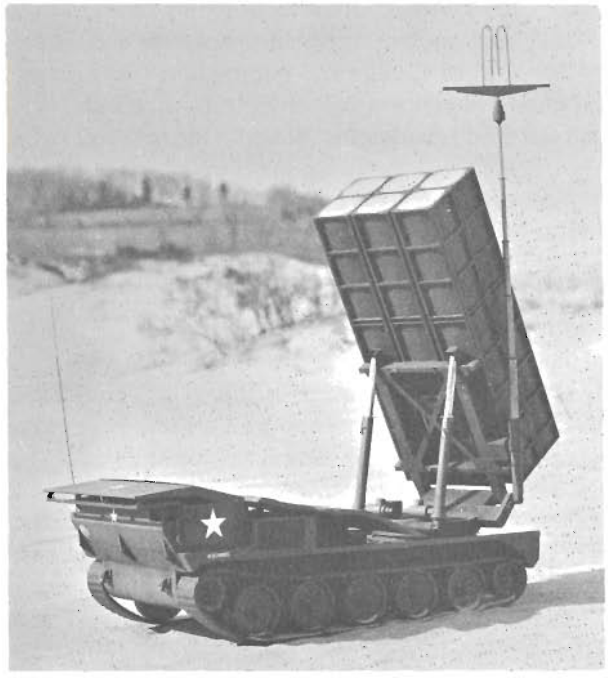

Figure 3. SAM-D launcher.

is launched from a canister which serves both as a protective shipping and storage container and an integral launch tube.

The SAM-D missile is designed to provide interceptor performance matched with the increased capabilities of the threat. To improve target track accuracy, missile guidance is accomplished in two phases: command midcourse followed by semi-active terminal homing.

The missile is of monocoque construction, using a slip-cast, fuzed-silica radome, and a cylindrical body section. Attitude control is accomplished by four aerodynamic tail surfaces powered by hydraulic control actuators. The propulsion system is an all-boost, solid-propellant rocket motor in a case constructed of maraging steel. The missile is segmented into nose, guidance, warhead, motor, and control sections. A development goal is to provide a missile which will require no preflight testing or maintenance at battery level.

The fire control group, launcher, and battalion control group are all carried by the same tracked vehicle. This vehicle is in the 80,000- to 90,000-pound gross weight class.

The vehicle payloads are designed in a modularized package which can be quickly dismounted and mounted. The prime power unit, weapon control unit, and radar unit can be loaded, permitting replacement of either defective SAM-D units or vehicles on a complete interchangeability basis.

Furthermore, the modular unit packages promote ease of application to other Army transporters, such as low-bed trailers.

TECHNOLOGICAL ADVANCES

The SAM-D system concept was evolved to provide significant improvements in firepower, mobility, and availability consistent with the advancing threat. The system configuration previously discussed indicates use of phased-array radar technology, digital computers, and microelectronics. Although rather new, phased-array radars have been successfully developed and some are presently in use in Navy applications. Powerful digital computers are rather commonplace. Integrated circuits and microelectronic techniques have been standardized for many applications. It might be concluded, then, that SAM-D does not advance the state-of-the art. From a hardware development point of view, this is correct. In fact, there was a deliberate emphasis on avoiding state-of-the-art development requirements. On the

other hand, improved performance is projected. This improvement is derived from the unique combination of sensor systems, computers, and packaging techniques into a coherent system, and therein lies the advance in technology. Even though the subsystem technology seems to be under control, system synthesis always presents a formidable task which becomes more difficult as the degree of automaticity and packaging density increases.

To understand the basis for the SAM-D system configuration, it would be helpful to explore the relationships between the key elements of the configuration and the performance improvement objectives.

Firepower

Firepower is the relative capacity to deliver destructive force on a target. Translated into terms relating to air defense missile systems, this capability can be related to engagement rate; that is, the number of target intercepts per unit time. Since the definition includes time relationships, it follows that on a system basis worthwhile objectives would be to increase the target information or data rates, decrease target threat analysis and firing decision time, and increase the ability to sustain a greater number of engagements per unit time. The combination of a multifunction array radar and a high-speed digital computer was chosen to meet these objectives for the SAM-D system.

In the past target search data rates have characteristically been constrained to the mechanical rotation speed of the radars employed. Use of a phased-array radar eliminates this mechanical limitation, allows use of pencil-beam antenna patterns, and permits data rate improvements of as much as 10,000 to 1, if such rates were desirable, because beam-steering in the array radar can be accomplished at millisecond instead of second intervals. Having such a high beam-steering speed opens all sorts of doors leading to multiuse capabilities, but this is not obtained without imposing a new, but more liberal, set of constraints. In any such application there must ultimately be a power-available constraint and a function time constraint imposed on the electronically steered array radar. There is, however, considerable leeway for adjustment of these two parameters depending on system performance boundary requirements and on the extent to which the multifunction capability is to be exploited. For SAM-D, it has been concluded that a single array radar, suitably programed, can fulfill search, track, and guidance functions. This is accomplished by constructing what is called a time-power budget which allocates waveforms and times on targets among the various functions. This time-power budget is implemented by using a digital computer and the operational software of the system which then, automatically and at high speeds, controls all timing, selects waveforms, and generates beam-steering commands.

Having high information rates and the ability to time-share functions pose the question of how all of these data will be assimilated. The digital computer, already employed to automatically control radar activities, offers a means of accomplishing this assimilation by permitting track data to be quickly processed on many targets and by immediate application of threat analysis logic to all of this target information. Such data processing techniques naturally carry on into automatic control of missile launch and guidance which rounds out the second objective generally defined as "reaction time."

The computer performance requirements have grown over original estimates as radar control and data processing burdens are more clearly defined. These performance

requirements are a word length of 24 bits, memory storage of around 100,000 words, and an instruction execution rate of 1,000,000 equivalent adds per second. The performance of this machine is comparable in a general way to any of the third-generation commercial computers now on the market.

The last firepower objective is to increase the capability to sustain more engagements per unit time. Guidance functions of current systems are accomplished by separate radars which are tied up or in use for the entire flight time of a missile. Thus, the number of engagements possible per unit time is fixed by the number of radars available and by the flight time to a particular intercept point. The use of a multifunction phased-array radar to accomplish guidance functions permits simultaneous guidance activities to be accomplished for more than one missile engagement at a time, thus lifting the one-radar/one-engagement constraint. As in target search and track, new, but again more liberal, constraints are imposed. The new bounds on multifunction operation of guidance activities are guidance data rate, radar power available, and the extent to which the other radar functions of search and track must be accomplished during periods of target engagement. The SAM-D system provides an equitable distribution of functions that results in ability to conduct missile guidance activities on multiple targets simultaneously while maintaining adequate search coverage and target track-while-scan performance.

Mobility

Mobility is used in the ordinary sense of the word; that is, movement from one place to another. Elements of mobility include ease of movement and speed of movement. Desirable improvement characteristics are to:

- Reduce march order and emplacement time.
- Expand terrain negotiation performance.
- Reduce the number of vehicles required.
- Reduce the volume and weight of the payload per vehicle.
- Reduce prime power requirements.
- Avoid high-risk packaging requirements.
- Enhance system survivability.

In SAM-D, the achievement of these desirable performance improvement features is associated primarily with materiel volume and prime power restraints. Reducing march order and emplacement time is solved rather easily through use of intervehicle radio communication and self-contained prime power, thus eliminating the need for cables and generator trailers. Improving terrain negotiation capability leads directly to use of tracked vehicles, thus materially simplifying the emplacement and site selection process.

The single unit occupying the major share of available volume and prime power is the radar transmitter. The functional capabilities of nine different radars are required to support Nike Hercules and Hawk system operations. The volume, number of vehicles, and prime power required by these radars severely limit improving the mobility potential.

SAM-D uses a single, multifunction phased-array radar to replace the functions of the nine Nike Hercules and Hawk radars. This represents a giant step in minimizing volume and weight of payloads, prime power requirements, and number of vehicles, as well as providing firepower advantages.

While the radar transmitter is the unit which requires the most volume, the remaining system units must also fit within available space. Concern could easily arise with respect to the need for risky packaging approaches and high-packaging densities which contribute to higher cost and reduced maintenance potential. SAM-D, therefore, is designed for maximum use of digital circuits for signal and data processing. About 80 percent of all tactical system functions will be accomplished using digital techniques. Even now, during advanced development, more than 3,000 replaceable modules are in use, and, of these, there are only 40 different types. Because of these factors, the volume aspects are not considered overly restrictive.

Use of digital circuits embodies the whole gamut of integrated circuit technology. The degree of integration (large-scale integration, medium-scale integration, or just plain integration) remains to be specifically defined. The general approach is to design a family of replaceable, throwaway digital modules which will satisfy reliability requirements, be compatible with the maintenance plan, involve low-risk development, and be inexpensive.

System survivability is enhanced because the fast displacement capability decreases the probability that the sites will be detected and equipment targeted.

The digital circuit packaging being used in the SAM-D advanced development system compares favorably with the one being planned for use in the tactical system. The two units are electrically equivalent. The number of active elements is equivalent. A volume reduction of 10 to 1 has been achieved primarily by replacing the interconnecting leads between the flat packs of the larger module with thick-film circuitry. Elimination of the interconnections also promises to improve reliability. This technique is typical of what is now available in commercial systems and thus represents a low-risk approach.

Availability

The definition of availability is best expressed in terms of an equation (fig 4). Here availability is equivalent to the mean time between failure divided by the sum of the mean time between failure (MTBF), the mean time to repair (MTTR), and the mean logistic downtime (MLDT). MTBF is the inverse of the system failure rate. MTBF is established by adding component failure rates and relates to reliability. MTTR is the repair time from fault isolation to final repair checkout. Included is time for removal and replacement of the defective units, alinement procedures if required, and operational checks. MLDT is the time required to order and obtain replacement parts. Included here are the administrative order procedures, delivery transit times, and stock availability. More simply described, availability is a quantitative measure of the time that a system is "in action" or "usable." As the defining equation indicates, availability can be discussed in terms of both reliability and maintenance/logistic aspects. Improvements in these characteristics are summarized in figure 5.

$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR} + \text{MLDT}}$$

$$\text{MTBF} = \frac{1}{\text{System failure rate}}$$

MTTR = Repair time which includes the time for fault isolation, removal and replacement, alinement, and checkout.

MLDT = Time to account for administrative details relating to ordering repair parts and stock shortage.

Figure 4. Definitions.

Ground system

- Digital circuit design.
- Reduce quantity of repair parts.
- Reduction of personnel and skill level.
- Repair at point of failure.
- Built-in test equipment.
- Repair while hot.
- Minimize field test equipment.

Missile

- Certified round.

Figure 5. Availability objectives.

We have already discussed the advantage of using digital circuit design with respect to mobility. This advantage was obtained by using integrated circuits with attendant benefits of packaging efficiency and standardization. Given that effective quality control procedures are in use, much better reliability can be confidently forecast with respect to any system using large numbers of integrated circuits (IC). A desirable side effect of using IC's is the ease of adapting circuits to multipurpose applications. The number of supply line items associated with SAM-D is expected to be an order of magnitude less than the combined Nike Hercules and Hawk line items. The supply job is simplified under these conditions, and the reliability program is enhanced because a fewer number of parts must be qualified. Then, too, training, publications, and test requirements are eased. Training needs, for example, are considerably reduced because maintenance personnel requirements at the battery level are half that of Hawk and about 65 percent that of Nike Hercules units. On the whole, the constructive feedback paths that originate with usage of digital circuit design permeates all aspects of the development, production, and field support processes.

By repairing the system at the site where the failure occurred, the logistic downtime can be minimized and the out-of-action time reduced. Achieving such a capability implies the existence of a fault detection and isolation system within the system and a design concept which emphasizes modularization and ease of removal and replacement of subsystems. SAM-D incorporates built-in test equipment (BITE), which has the capability of rapidly detecting failures and isolating these failures to a suitable subsystem level. The built-in test equipment consists of sensors which feed data to diagnostic logic which isolates the malfunction to the replacement unit level. A display on the control panel in the weapon control unit indicates the operational status of the system. BITE operation is normally automatic but is also subject to operator stimulation and control.

Another innovation which promotes minimum downtime is the "repair-while-hot" concept. Unit failures will not necessarily result in total system failure due to designed redundancy of key components and because all units need not be operational to conduct all

system functions. The malfunctioning parts might be replaced while the rest of the system remains operational, although possibly at some degraded level. Although somewhat constrained by personnel safety considerations, repair-while-hot procedures are possible and are being planned as part of the SAM-D maintenance concept.

The maintenance emphasis at the battery level is replacement rather than repair. This approach minimizes the quantity of test equipment required within the battery and also reduces manpower and skill levels required to accomplish battery maintenance.

The subject of availability has been discussed up to this point with respect to the ground-based elements of SAM-D, especially the fire control group. Missile reliability and maintenance are approached from a different and unique point of view. The missile is transported and stored in a protective canister which is also used as the launch rail or tube. This, in itself, provides a degree of environmental protection not previously available. Beyond this improvement, however, and subject to the desire to minimize battery level maintenance operations, a new concept known as the "certified round" has been introduced into SAM-D development planning. By definition, a certified round is one which, after leaving an industrial environment, requires no checkout, test, or maintenance by the user. Reliability is certified by the developer to be within statistical limits at a stated confidence level. Reliability certification is based on random samples of missiles subjected to periodic test sampling of the inventory. Design constraints imposed by such a concept are not materially different from those associated with more conventional maintenance concepts except for parts reliability considerations. Component reliability design, especially storage and transport reliability because of the long times of exposure, must receive emphasis, and higher parts costs are expected. On the other hand, analysis of the cost aspects indicates that the "certified round" approach is more cost effective than conventional concepts when life cycle or cost of ownership considerations are accounted for. In other words, the cost of mounting a significant field test capability with all required equipment, manpower, and skill levels exceeds the cost of developing and producing a "certified round."

CONCLUSION

The SAM-D technology advances with respect to system synthesis can be forecast to result in a system having greater firepower, more mobility, and higher availability than currently fielded systems. These attributes are not obtained without an increase in complexity. The system complexity, however, is conceptual in nature. It presents more formidable problems to the designer and the developer. To the user and the maintainer, though, the system is less complex than those now in the field. The burden on the logistics system is reduced. The burden on Army training requirements and the acquisition and retention of highly skilled operators and maintenance technicians are relieved. The man-machine interface is less demanding due primarily to the use of automation and automatic data processing techniques. In short, the complexity has been removed from the field and placed in the laboratory. All of this is obtained along with an operational flexibility which transcends anything available now. For instance, by software changes and very minimum hardware changes, the time-power budget of the radar can be altered to emphasize capability against particular threats or zones of radar coverage. Flexibility of employment, although difficult to totally describe as an objective and difficult to design into a system bounded by so many other constraints, nonetheless, has manifested itself as a very real part of the SAM-D configuration. In the final analysis, the operational flexibility afforded by the SAM-D system configuration is, perhaps, the single advantage which most properly allows SAM-D to qualify as the second-generation Army air defense missile system.

The Airmobile Air Defense Artillery Battalion

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The purpose of this article is to recommend an air defense system suitable for allocation as a TOE battalion to the US Army's airmobile divisions. In the interest of cost effectiveness and economical considerations, the article is restricted to the capabilities of the present family of US Army air defense artillery systems. The analysis and discussion have been limited primarily to considerations of an airmobile air defense artillery battalion that would be compatible with the airmobile division's concept of operations and fully capable of providing an independent and adequate air defense system. Considerations of logistics, communications, administration, civil-military operations, security, liaison, command, and control have been omitted. Detailed explanations and definitions have been avoided because it is assumed that the reader will have a comprehensive knowledge of air defense artillery and more than a limited knowledge of Army aviation and the airmobile concept.

The US Army division is an integral and key element of the US Army's fighting forces. The division is a fighting force with a fixed base and variable combat elements, organized and tailored to accomplish specific missions. To accomplish specific missions in varying environments, divisions are organized as airborne, airmobile, armored, infantry, and infantry (mechanized). The primary mission of the division is to destroy or capture enemy military forces and to secure or dominate key land areas and their populations and resources.

The air situation will, to a large degree, determine the extent to which the division can accomplish its mission. The possessor of air superiority in the combat zone can greatly affect land operations. The division commander desires friendly air superiority to insure freedom of action, mobility, and flexibility in accomplishing his mission. Friendly air superiority is a status that US forces may seldom experience in its entirety. Counterair activities of friendly tactical air forces and organic air defense forces must be employed to gain air superiority or maintain air parity to permit the fighting ground forces to engage the enemy without being hampered by hostile air operations. When deployed in defense of over-sea land areas, air defense forces must have the objective of limiting the effectiveness of enemy offensive air efforts to a level permitting freedom of action for friendly forces.

While operating in the field army combat zone, the division commander will enjoy the air defense protection afforded to him by the "protective umbrella" capabilities of two of the air defense artillery family of weapons, Nike Hercules and Hawk. Nike Hercules will provide long-range, high-to-medium altitude air defense (HIMAD), and the Hawk system will provide medium-range, low-to-medium altitude air defense (LOMAD). All of the five types of US Army divisions are programed to receive an organic air defense capability to fill any localized leaks in the "protective umbrella." This capability will be provided by the newest members to the air defense artillery family of weapons—Chaparral, Vulcan, and Redeye. The capability that these weapon systems will provide in the divisional area of combat operations is described as short-range air defense (SHORAD). The SHORAD capability can be further defined as providing two subordinate capabilities—low-altitude forward area air defense (LOFAAD), provided by Chaparral and Vulcan; and man-portable air defense (MANPAD), provided by Redeye.

Chaparral and Vulcan have been combined in a divisional table of organization and equipment (TOE) battalion of four firing batteries—two batteries of Chaparral and two batteries of Vulcan. This battalion will be an element of the division base with the primary mission of providing air defense to the division. The Redeye weapon will be deployed as an all-arms weapon with a two-man weapon team authorized for allocation to each company-sized unit. These teams will be commanded and controlled by an air defense section at each battalion headquarters.

Self-propelled (SP) Chaparral/Vulcan battalions have been authorized for deployment to the infantry, armor, and infantry (mechanized) divisions as provided in appropriate TOE's. The inherent mobility of the SP Chaparral/Vulcan battalions will provide these division commanders highly mobile and responsive air defense, reflecting characteristics of readiness and flexibility, and contributing greatly to kill effectiveness against the enemy's air threat. The airborne division is currently scheduled to receive an organization of two batteries of towed Vulcan. The airborne Chaparral capability has not yet been defined, presumably because Chaparral cannot be parachute-landed. The airmobile division is currently scheduled to receive 49 Redeye teams, giving it a MANPAD capability, but the LOFAAD capability is yet to be defined.

The mission of the airmobile division is basically the same as other types of divisions; it has the requirement to close with, engage, and destroy the enemy. The airmobile concept of operations provides immediate response and rapid maneuverability over large areas using organic aircraft. Obstacles and hostile troop concentrations can be overflown to position fighting forces deep in the enemy's rear, thereby achieving tactical surprise. Maximum use

is made of the (airmobile) division's ability to strike deep in the enemy rear. The advantages of the aerial envelopment form of maneuver are obvious. The enemy must divert and shift combat forces from the forward edge of the battle area (FEBA) to counter the threat to his rear, consequently rendering his frontline forces more vulnerable to other forms of maneuver and attack by friendly forces. Concepts of airmobile organization dictate that the helicopter is the prime mover of troops and equipment. Heavy equipment peculiar to the airmobile division's combat and combat support elements have been eliminated to maintain airmobility compatibility. The airmobile concept of operations is a welcome innovation to the art of war. It satisfies nearly all of the principles of war while providing the ground unit commanders the ability to visually supervise and direct the conduct of the battle. The capabilities of the airmobile division are enhanced in comparison to the capabilities of other US Army divisions.

Although the airmobile division is extremely capable, it is not without limitation. The airmobile division has less defense against air attack than other divisions. Limitations of aviation operations include vulnerability to enemy air defense measures and enemy aircraft. The enemy can be expected to have heavy air defense measures in depth; current operations in Southeast Asia have indicated this fact. The vulnerability of the airmobile division to enemy aircraft can be attributed to its lack of organic air defense and its type of operation. The airmobile division is a valuable asset to the field army or corps commander—too valuable to allow it to become useless in a combat environment where continuity of friendly air superiority cannot be maintained. The airmobile division has a definite need for an organic air defense capability. An aerial envelopment requires that the enemy's dispositions or capabilities not interfere materially with the flights of large numbers of aircraft.

To adequately provide continuity of air defense, and reflect those necessary characteristics of flexibility, readiness, and kill effectiveness, the airmobile air defense capability should be oriented toward the mission and the operational concepts of the airmobile division. ADA doctrine, organization, and materiel must support the ground force's scheme of maneuver. The US Army air defense artillery should be prepared to provide the capability of and assume the mission of airmobile air defense.

Airmobile air defense must provide the airmobile division commander with an organic air defense capability compatible with the airmobile concept of operations and capable of providing adequate air defense coverage over the airmobile division's area of operations. Because the airmobile division's area of operations can rapidly change from one area to another, its organic air defense should be capable of moving as rapidly as its supported elements to effectively support the airmobile division's scheme of maneuver. Airmobile air defense should be capable of rapid march order for aerial displacement by aircraft organic to the airmobile division. In addition to being air-transportable, airmobile air defense must be capable of rapid emplacement in its deployment as an airmobile element. The airmobile division's area of operations is most likely to vary from areas within a few kilometers short of the FEBA to areas several kilometers forward of the FEBA, where combat heliborne assaults would strike the enemy deep in his rear.

In the current field army air defense artillery scheme, the airmobile division's area of operations deep in the enemy's rear, well forward of the FEBA, would not be within the envelope of coverage offered by the "umbrella of steel" air defense protection of any of the air defense artillery weapon systems allocated to the field army, army corps, or divisional

air defense artillery deployed in proximity to the FEBA. The airmobile division's area of operations deep in the enemy's rear would either be out of range of nondivisional air defense artillery systems (SHORAD and LOMAD) or below acquisition radar coverage (LOMAD and HIMAD) due to earth curvature.

In a combat environment where the enemy possesses a strong tactical air capability and conducts aggressive aerial operations, the air defense system is subject to loss of its manned interceptors to higher priority counterair missions attempting to regain air superiority or maintain air parity. When operating outside of the protective coverage of ground-based air defense artillery weapons and experiencing the loss of manned interceptors to counter the hostile air threat, the airmobile division would have very little and perhaps no nondivisional air defense forward of the FEBA.

An effective airmobile air defense capability that would provide protection forward of the FEBA should be one that can effectively accomplish the functions of a fire unit during an air defense artillery engagement. Army air defense fire units must have the capability, with minimum external assistance, to accomplish all air defense engagement functions: detection of potential threat objects, identification of unknown objects, interception of enemy forces, and destruction of the threat.

The recently approved United States Strike Command (USSTRICOM) air defense artillery battalion will, with only slight modification, provide the airmobile division with an airmobile air defense. This battalion includes Chaparral, Vulcan, Hawk, and the forward area alerting radar (FAAR). The USSTRICOM air defense artillery battalion includes a headquarters and headquarters battery, two towed Hawk batteries, and one Chaparral/Vulcan battery. One additional Chaparral/Vulcan battery would give this battalion additional firepower and provide a more comprehensive air defense coverage for the airmobile division's eight highly mobile infantry battalions. This airmobile air defense artillery battalion would provide four towed Hawk firing sections, 12 towed Vulcan squads, and 12 self-propelled Chaparral squads.

The acquisition radars of the two Hawk batteries would provide the airmobile air defense artillery battalion with an effective and reliable detection and identification capability. Early detection and positive identification forward of the FEBA would be of prime importance in a combat environment where the enemy poses an aerial threat of appreciable magnitude. An air defense unit of any type could not adequately respond to intercept and destroy a hostile target forward of the FEBA without early detection and positive identification.. The pulse acquisition radars (PAR) of the Hawk batteries would provide a low-to-medium altitude detection capability with an electronic identification means. The Hawk continuous-wave acquisition radars (CWAR) would provide supplementary low-altitude detection. The FAAR's would be used as gap fillers for the Hawk radar coverage in addition to serving the Chaparral and Vulcan fire units with a detection and electronic tentative identification capability.

Proper deployment of the airmobile air defense artillery battalion forward of the FEBA would probably require a vital area defense configuration or a variation thereof, depending on the size of the defended combat assault area. The two towed Hawk batteries should be deployed to give comprehensive low-to-medium altitude coverage, with weighted coverage toward any likely low-altitude avenue of approach. The Chaparral squads should be positioned to complement the Hawk batteries in weighted and supplementary coverage along

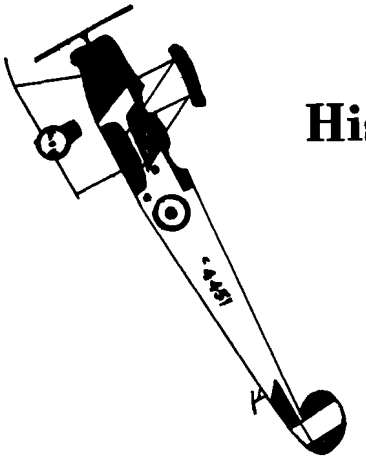
the likely low-altitude avenues of attack. The Vulcan squads should ring the defended area and provide mutual support or overlapping fire to adjacent squads.

The airmobile air defense artillery battalion would be comprised of present standard air defense system component equipment and therefore would not require designing a new air defense system to achieve airmobile compatibility. The standard towed Hawk batteries are considered air-transportable and airmobile in their standard configuration with the exception of the pulse acquisition radar, which must be disconnected from the trailer before airmobile movement. This shortcoming could be easily corrected with a modification. The towed Vulcan fire unit is airmobile in its present standard configuration; however, the Chaparral weapon system would require removal from its carrier, a modified M548 cargo vehicle. The weight of the Chaparral weapon system and the cargo vehicle exceeds the lifting capability of the cargo helicopters organic to the airmobile division. The Chaparral weapon system is independent of its carrier for air defense operations. A more suitable towed weapon platform for the Chaparral weapon system could be contrived in the interest of airborne and airmobile compatibility. All of the proposed airmobile air defense artillery weapon systems are 100-percent ground mobile in their present configuration.

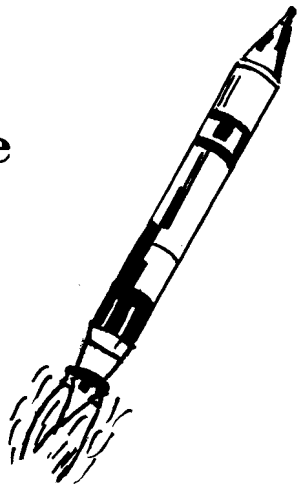
Although the proposed airmobile air defense artillery battalion would have a primary mission of providing air defense to committed ground forces, it could also assume a secondary mission of tactical airbase air defense.

The airmobile division is indeed an innovation to the art of warfare and provides the field army or corps commander with the capability to turn the tide of battle in his favor rapidly and effectively. This capability is realized through the effective utilization of the airmobile concept of operations by the timely deployment of troops by way of an airmobile heliborne combat assault—an assault launched against the enemy where tactically most advantageous regardless of the terrain or distance. Doctrine dictates that the airmobile division will be most effectively and advantageously used by executing the aerial envelopment form of maneuver to strike the enemy deep in his rear. As with the ground envelopment, the aerial envelopment should not be executed unless the enemy has an assailable flank—the aerial flank. To render the enemy's aerial flank assailable, the airmobile division must have adequate air defense. This air defense must be capable of supporting the ground commander's mode and concept of operations.

Airmobile air defense artillery must be air-transportable, be capable of defending in depth, and adequately perform the fire unit functions of early detection, positive identification, interception, and destruction. The proposed airmobile air defense artillery battalion will materially assist in fulfilling the objective of air defense for the airmobile division—the objective of limiting the effectiveness of enemy offensive air efforts to a level permitting freedom of action for friendly forces. The proposed airmobile air defense artillery battalion will be capable of delivering devastatingly accurate fires against the hostile air threat while operating under widely varying conditions of weather, terrain, and visibility.



History of Air Defense



Editor's Note:

The most effective air defense employed by Germany after 1943 was flak concentrations from antiaircraft guns. In this, the seventh installment, we see the effectiveness of this method of air defense and the tactics and techniques employed by the United States Army Air Corps to counter it.

Several factors had a general effect on the selection of targets, tactics, and techniques for Eighth Air Force attack. They included weather, flak, radar, and radio. The flak factor was so important as to deserve separate treatment.

By the fall of 1943, the German Air Force ability to defend the continent from air attack had decreased. Hitler previously had ordered more flak as the best defense, and so extensive was this flak program by March 1944 that Allied pilots no longer considered Calais as a "milk run." Thirty percent of the German gun production was for flak, and twenty percent of all ammunition produced above 7-mm was for flak.

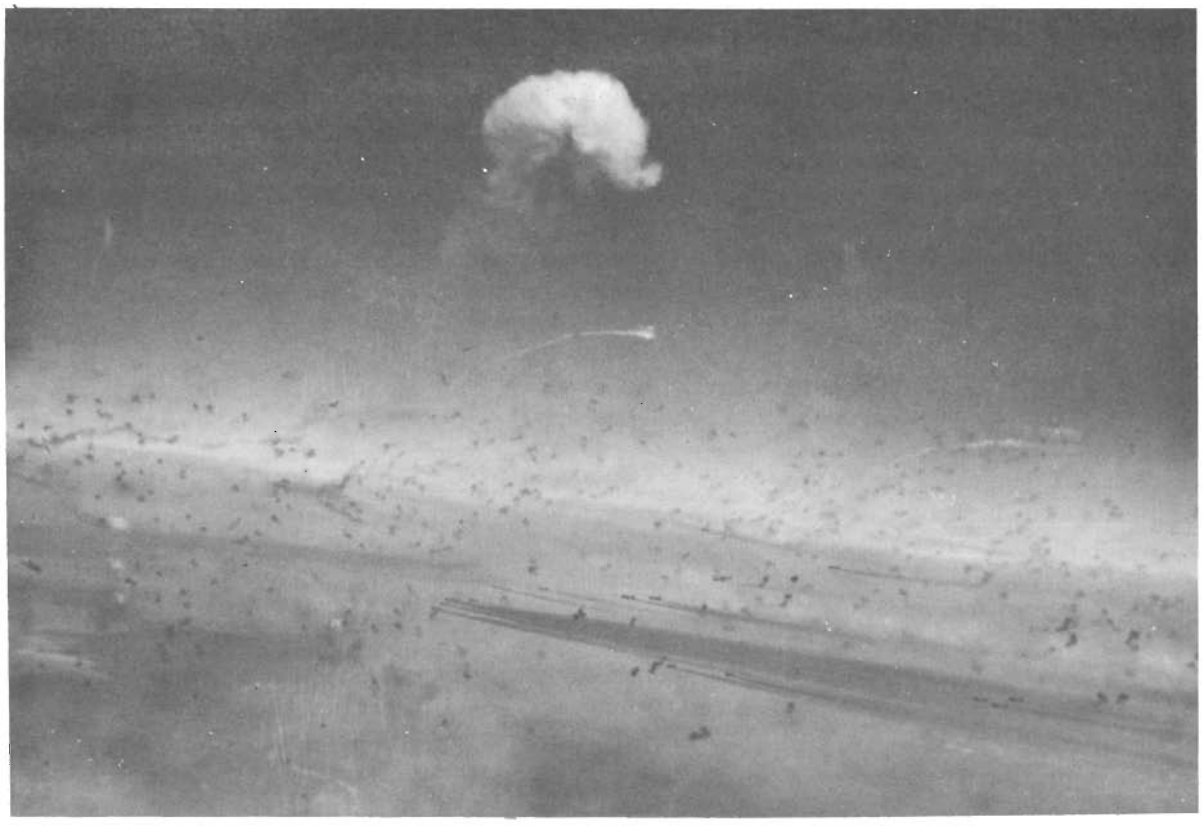
The magnitude of enemy flak defense increased according to the priority of the target being defended with oil refineries and the Ruhr area having the heaviest concentrations. For example, the refinery at Merseburg had a defense of 450 heavy guns, as did greater Berlin.

The number of our bombers damaged and lost to flak rose steadily from August 1942 to October 1944, due to the greater numerical exposure which occurred when increasing numbers of bombers were sent against heavily defended targets. In each month, beginning in April 1944 and ending in September 1944, from 3,500 to 4,500 bombers suffered flak damage. For every 100 bombers lost due to flak damage, more than half were forced to leave the formation and become stragglers.

Heavy losses to aircraft and aircrews and the large number of aircraft damaged by German antiaircraft defenses caused the Allied air forces to implement a program of detailed analysis of German flak as a means of reducing losses.

The importance of having flak analysis available to the various Air Force unit headquarters was officially recognized by an Army Air Forces Board which convened in February 1945 to make recommendations concerning passive measures required to minimize loss and

damage to large forces of high-level bombers from antiaircraft fire. In addition to recommendations concerning altitudes and use of chaff against enemy radar, the Board recommended that antiaircraft officers trained in flak analysis be assigned to Air Force headquarters down to group level. The Board also recommended that photo reconnaissance be made of flak defenses shortly before a planned mission and that the interpretation be forwarded to the attacking unit as soon as possible.



"Flak so thick you could walk on it." B-17's plow through a flak barrage on their way to Merseburg, chased by their contrails. The white cloud in the upper center is all that remains of one plane that was hit by flak.

Using antiaircraft officers as flak analysts with Air Force units developed initially as a field expedient by cooperation of antiaircraft and Air Force unit commanders, both in the European and Pacific theaters. During the last stages of the war, flak analysts were trained in the United States and sent overseas to the various Air Force units. The more formally trained flak analysis personnel operated as teams up to eight officers in strength.

A basic tool of the flak analyst was a recent aerial photo of the flak defenses at the intended target. By plotting flak gun locations and correlating capabilities at various altitudes with bombing speed and altitude effectiveness, the analyst could determine the best combination of altitude and direction of attack for a particular bomber force to expect a minimum of loss and damage. The flak analyst could advise the bomber force commander what loss and damage could be expected if a particular direction of attack, altitude, or

formation were dictated in the light of wind direction, sun position, smokescreens, target identification, or routing of other air units.

Intelligence and analysis of flak were important in planning low-altitude as well as high-altitude attacks. Many contemplated fighter-bomber missions were canceled when flak analysis revealed heavy concentrations and effective dispositions of flak against low- and minimum-altitude attacks. This indicated that coordinated and concentrated antiaircraft defense could prevent fighter attacks.

Analysis of flak also was useful in planning attacks against it in support of a bombing attack against the area defended by the flak. Those enemy positions which would most interfere with the planned mission could be identified and designated to the neutralization force. From time to time, flak suppression missions were flown by fighters. Antiflak white phosphorous bombs sometimes were used and achieved good results. It was determined by the Eighth, Ninth, and Fifteenth Air Forces, however, that neutralizing antiaircraft batteries was done at a high cost to the fighters. Since the neutralization of flak batteries would be only temporary, the aircraft loss was considered excessive.

The Eighth Air Force learned early that low-level bombing presented a far too dangerous flak risk to be continued. Attacks at 7,500 and 8,000 feet over St. Nazaire resulted in a 100-percent battle damage to the bomber force. A "rule of thumb" subsequently used was that the risk of flak decreased by half for every 5,000 feet of altitude above 15,000 feet. Bombers could fly at high altitude and take evasive action; however, these practices reduced bombing accuracy. Generally, the tactics were to fly as high as was consistent with bombing accuracy, changing altitude whenever possible, except on the actual bomb run which had to be a straight and level course.

The choice of the bombing altitude was strongly influenced by the number of antiaircraft guns at the target. When no antiaircraft was present, only 24 percent of all bombing missions were above 24,000 feet. When 1 to 50 AA guns were present, 58 percent of the bombing missions were above 24,000 feet; when 51 to 250 AA guns were present, 90 percent of the missions were above 24,000 feet.

Bombing accuracy in combat was considerably lower than that obtained under training conditions. Bombardiers were trained to bomb by individual aircraft, but in Europe both flak and fighters had forced bombers to fly in formations for defense. All aircraft in formation dropped their bombs with only the leader sighting on the target. Bomb pattern was a function of the size and compactness of the formation, and the actions of both fighters and flak tended to widen the formations or punch holes in them. Flak, by forcing the bombers to fly above 20,000 feet, contributed materially to bombing inaccuracies, forced target formations to help compensate for poorer bomb patterns, and resulted in increased discomfort of crews flying at high altitudes.

In analyzing the Eighth Air Force's B-17 12-plane formations from January 1944 to February 1945, it was found that radial bombing errors in the target area increased by 4.5 feet for each AA gun, 6.1 feet for each 100 feet of altitude, 621.6 feet for marshaling yards as against other targets under similar conditions, 281.9 feet for smoke or ground haze, and 24.8 feet for each degree of drift on the bomb run. As a result, antiaircraft accounted for

39.7 percent of the radial bombing error, while altitude was next with 21.7 percent against a target with only a 40-gun density.

To counter the threat of enemy fighters, the tactics preferred by the bombers was to fly in tight formations of 36 aircraft for mutual support; such tight formations, in which all elements were concentrated in trail within 1,500 feet, were very vulnerable to antiaircraft fire because one aircraft was liable to be hit by fire aimed at another. The requirements of fighter defense and flak defense were incompatible, and a compromise had to be accepted.

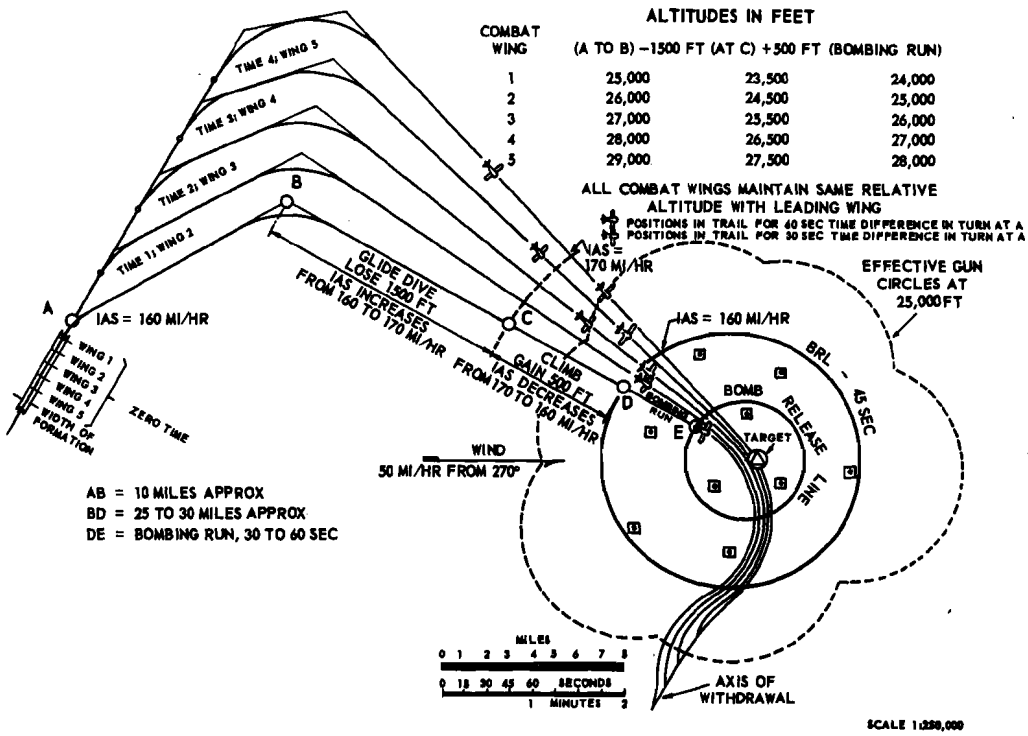
B-17 formation-bombing. Only the lead bombardier uses a bombsight; the others release their bombs on signal or by observing his release.

To counter the threat of aimed fire to the bombing unit, the tactic was to spread the formation to a limited extent. For example, if the 12-aircraft formation was spread out from 1,500 feet to 5,000 feet in trail, the risk from accurate flak was halved. A suitable formation for this purpose was the javelin type, in which the formation was split into 12 elements of three planes each, with elements separated 1,000 feet in trail. This tactic however, was prejudicial to fighter defense and fatal to the accuracy of follow-the-leader bombing.

If chaff forced the enemy to use barrage fire, this flak defensive tactic would not apply since, if the course of the bomber stream passed through the barrage, interval in the trail

was of no consequence. A wide spread of the bombing formation in altitude and breadth was the proper defense against barrage fire, but it was most difficult to estimate when the enemy would use this type of fire. (Widespread formations were prime fighter targets.) Precautions against barrage fire were not, therefore, considered a standard defensive tactic.

The only flak defensive tactic which gave no corresponding advantage to other elements of enemy countermeasures was the reduction in the interval between successive bomber units (e.g., bomber wings). It was calculated that two wings, flying 11 miles apart (in trail) instead of 4 miles, are exposed to twice as many aimed shells. Flak saturation would be achieved if the interval between formations was so short that ground defenses would not have time to break off engagements against the preceding formation and engage the succeeding formation. This tactic was also applied, if the target was suitable, by formations bombing abreast. Admittedly, certain disadvantages arose, such as propeller wash, danger of collision, and, if formations were staggered in height, air-to-air bombing. These disadvantages could mostly be overcome by training.



Bombardment division plan for evasive action against antiaircraft fire.

As the size of the bomber formations increased, the number of flak casualties increased. To counter this, the Allies devised new tactics. Saturation bombing was begun, which is the concentration of all of a bomber force on the same target. Both night and day bombing were used to gain the desired effect. To counter radar detection, electronic countermeasures (ECM), chaff, and bomber streams were used.

The objective of formation flying was to concentrate sufficient firepower to permit the formation to fly anywhere in spite of enemy fighter attacks and to deliver an effective pattern of bombs. With the advent of long-range fighters, the development of bomber formations proceeded toward quite different objectives. Now the need was to develop a formation which could be escorted readily, could develop a better bomb pattern, and would permit the passage of the formation so rapidly over an area of heavy flak that the guns could deliver aimed fire on only a few of the units within the formation.

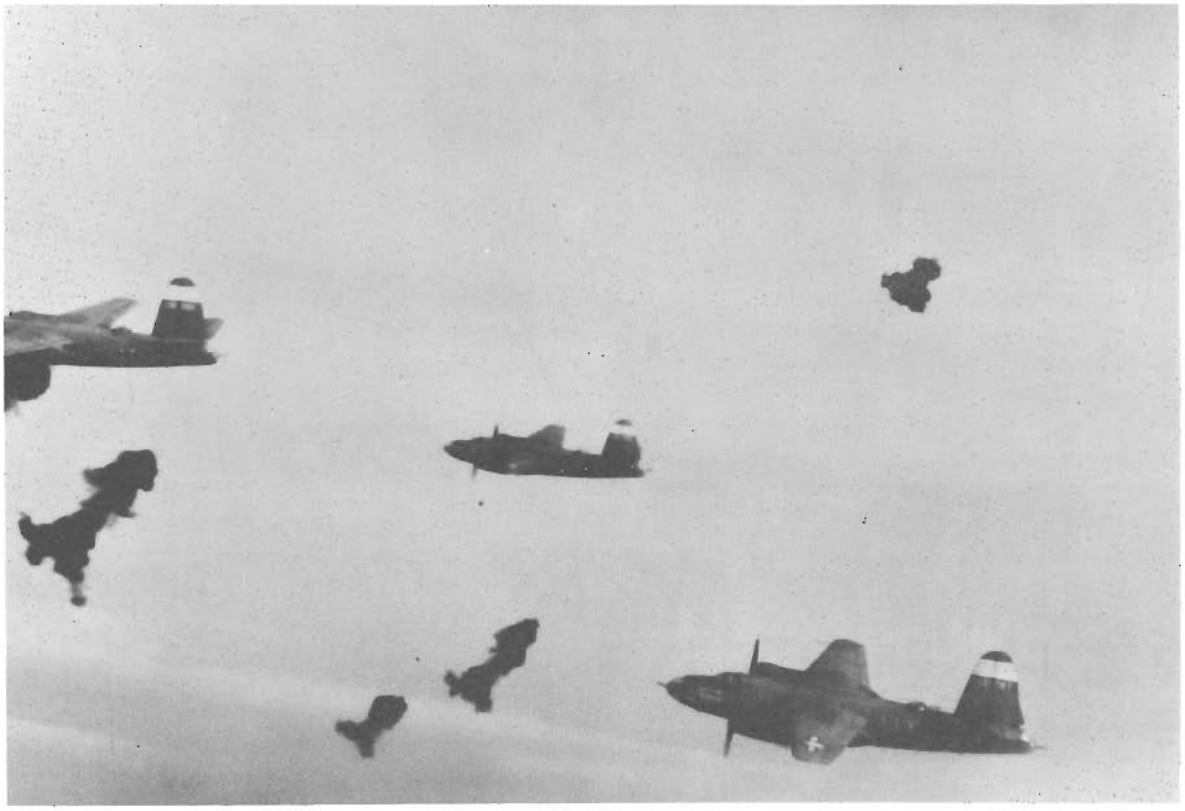
A B-24, crippled by flak, breaks formation and streaks for home.

This concept was applied to various formations, and it was finally resolved that the 36-plane B-17 formation and the 27-plane B-24 formation were the optimum sizes. Flak strength and deployment required heavy bombers to fly formations in column so that aircraft on the flanks would not be exposed to flak defenses en route. The turbulence behind a formation caused spacing between formations to be larger than desirable. The end result was a long column of planes which was difficult to escort.

The final defensive tactic was evasive action. Since this hindered achievement of briefed bombing altitudes and courses, the tactic generally applied after "bombs away."

During the period 6 June 1944 to 8 May 1945, the Ninth Air Force was engaged in flying air superiority, interdiction, and close support missions. Tactical sorties flown were 283,201.

In general, the Ninth Air Force did not send bombers where flak gun densities were above 60 to 70 except on a few occasions. On targets where flak density was high, bombers flew at the highest possible altitude. Ninth Air Force pilots who flew low-altitude flak suppression missions all stated that the attack of heavy flak batteries protected by light antiaircraft was extremely hazardous. During the period 16 October 1943 to December 1944, the Ninth Air Force lost a total of 2,300 aircraft. Of this number, 300 were lost to enemy fighters, 1,300 were lost to flak, and 700 were lost because of other reasons.



B-26's meeting aimed flak fire. In the plane at the left, the bombardier was killed and a gunner wounded.

In analyzing the overall losses of Ninth Air Force Aircraft (bombers, fighter-bombers, and fighters), the losses were attributed as follows:

	Total		Bomber		Fighter-bomber	
	Loss	Damage	Loss	Damage	Loss	Damage
Flak	45.8%	88.5%	53.4%	97.3%	45.8%	88.5%
Enemy aircraft	15.1%	3.4%	8.9%	0.8%	15.1%	3.4%
Other	39.1%	8.1%	37.7%	1.9%	39.1%	8.1%

The percentage of aircraft damaged by flak remained constant at about 25 percent of the aircraft exposed. The rate of loss to flak was greatest in dive bombers, armed reconnaissance and fighter sweeps had the second highest rate, and lowest rate of loss was suffered by escort planes. Seventy to ninety percent of all flak damage occurred in the target area (routes to and from targets were planned so as to avoid antiaircraft defenses).

Although the total losses suffered in Europe by the US Army Air Corps are a small percentage of the total number of planes used, the figures on the accompanying chart reveal in some measure the size of the US air forces (men and machines) engaged in the defeat of Germany.

	VERY HEAVY BOMBERS B-29					HEAVY BOMBERS B-17 B-24			MEDIUM AND LIGHT BOMBERS B-26 B-25 A-20			FIGHTERS P-47 P-38 P-51 P-40			ALL TYPES RECON PHOTO ETC.				
	EN A/C	AA	OTHER	AA + EN A/C	TOTAL	EN A/C	AA	OTHER	EN A/C	AA	OTHER	EN A/C	AA	OTHER	EN A/C	AA	AA + EN A/C	OTHER	TOTAL
ETO						2452	2439 5548	657	131	492 815	192	1691	2449 5324	1184	4274	5380		2033	11,687
MTO						847	1313 2766	606	352	306 808	150	1327	822 3157	1008	2526	2441		1764	6,731

USAF losses of aircraft on combat missions, January 1942-August 1945.

Because it took well over an hour to assemble a large force of bombers at altitude over England, German radar sites were well aware that an attack was coming. Warning sometimes would be as much as 2 to $2\frac{1}{4}$ hours, allowing ground controllers and flak units to gird themselves for battle. Interception of radio traffic, done by both sides, provided valuable information to the enemy. Even though radio silence was supposed to be observed, it was virtually impossible to insure that some of the 10,000 to 15,000 men in more than 1,000 planes would not inadvertently use a transmitter instead of an intercom.

Various countermeasures were used by the Allies against both radar and radio interception. Airborne devices were used to monitor enemy fighter frequencies; others were used to jam enemy radio interception stations while permitting friendly planes to continue the use of their radios. Chaff was used extensively, and by the end of 1943, all B-17's and B-24's had chaff dispensers. By the end of 1944, all B-17's and B-24's, except pathfinders, were equipped with two electronic jammers each, with 12 aircraft of each group equipped additionally with spot jammers. All chaff and electronic jamming was provided solely for the purpose of countering the German gun-laying radars. The Germans "cooperated" by having

most of their radars operate on the same frequency band. Frantic antijamming efforts by German scientists and tacticians gave only sporadic relief.

Spoofing tactics were employed also. Sometimes large formations of fighters would penetrate under cover of jammers, leading the enemy to believe that they were bombers; enemy fighters scrambling to attack the "unescorted bombers" would receive the surprise of their lives. At other times, small formations of bombers would break away from the large bomber stream to hit unsuspecting targets. These spoofing attempts were directed at minimizing losses to enemy fighters. The Eighth Air Force (and others) studiously avoided heavy flak defenses en route to and return from a target, particularly Happy Valley, or Flak Alley, as the Ruhr was known.

To Shoot or Not to Shoot

Major Charles A. Green
US Army Air Defense Board
Fort Bliss, Texas

The problem of visual aircraft recognition, more specifically enemy aircraft identification, dates to the initial use of aircraft in war. The magnitude of the aircraft recognition problem has continually increased as technology has advanced in aviation. Recognition is now most acute in the area of forward area air defense weapons due to the necessity of making final identification by visual means.

In recent hostilities we have enjoyed air superiority and, as a result, have given little attention to the development of an aggressive and continuing visual aircraft recognition program. Recently we have given greater emphasis to light, highly mobile, air defense artillery weapon systems for the protection of friendly forces along the forward edge of the battle area (FEBA). With the advent of these systems it was obvious that it would be necessary to identify aircraft by visual means in order to maintain mobility.

The complexity of the problem of aircraft identification by any means becomes more apparent when considering the Sino-Soviet aircraft listed in Air Force Manual 50-13. These aircraft are not all-inclusive of the Soviet air-breathing threat. The number and variety of United States and Allied aircraft which can be expected to be in the forward edge of the battle zone during an armed conflict increase the aircraft density, thus further compounding the problem. The gunner's evaluation process becomes even more difficult when we add the human variable to his quest for a solution of whether to shoot or not to shoot. The adverse effects of the human element will become more obvious as the problem expands. Before we discuss possible solutions to the problem, a chronological discussion of aircraft and air defense developments seems appropriate.

The first threat was posed by relatively slow-moving aircraft dropping unsophisticated high-explosive weapons, such as hand grenades, from the cockpit. To counter this aircraft threat a system of visual identification and early warning by means of wire communication from an observer in a forward position was used to alert friendly forces. This allowed the enemy aircraft to be engaged by various types of antiaircraft weapons developed to meet the

slow, low-flying aircraft. Since this initial confrontation of aircraft and air defense, numerous developments have taken place on each side. One of these was the development of supersonic aircraft, several versions having long-range nuclear weapon delivery capabilities. Numerous tactical evasion maneuvers have been developed to enhance the chance of engaging a target. The maneuver posing the greatest threat to forward area air defense is the high-speed, low-level approach.

Air defense forces have developed highly sophisticated early warning radars and high-speed, all-weather fighter-interceptors in an attempt to counter the current threat. These, however, only served to counter a portion of the overall expected threat and, at best, slow the remainder of the attacking force. To further deter the enemy as he approaches the defended area, a series of radar-controlled missile systems have been developed and deployed to meet the high- and medium-altitude threat. With each system a means of aircraft identification was provided to insure engagement of enemy aircraft and the safety of friendly aircraft.

Additionally, these air defense units are controlled by the area air defense commander and receive identification information from control radar centers. These identification measures include flight plan correlation, visual recognition by fighter-interceptors, and electronic identification. The identification of Army aircraft is provided by the flight operation centers and flight control centers located at army, corps, and division.

Having discussed measures taken to counter the threat prior to its arrival in the forward edge of the battle zone, it is now time to discuss air defense of this vital area. Weapon systems presently employed in defense of the forward edge of the battle area are the twin 40-mm self-propelled gun (Duster), multiple caliber .50 machineguns, Redeye, and Chaparral/Vulcan systems. A significant similarity among these weapon systems is their present dependence on visual aircraft recognition and their almost autonomous air defense operation. With these facts in mind we must be aware of the lack of progress in new methods and techniques of visual aircraft recognition. Of equal importance is the emphasis required to maintain an effective visual aircraft recognition program. Limited research on the latter indicates that aircraft recognition gets a great deal more lip service than action.

Extensive research of training techniques reveals that little has been done to improve training techniques—acquired from the British during World War II. In 1965 the Army contracted the services of the George Washington University Human Resources Research Office (HumRRO) to evaluate man's ability to detect and recognize low-altitude aircraft under optimum field conditions. The results of the study revealed several significant problems requiring more study, one of which was the requirement to improve methods of aircraft recognition training. Other significant problem areas include man's inability to adequately judge closing velocity and distance at various angles of approach. The angle of approach has a distinct bearing upon the range of final aircraft identification.

The statistics shown in table 1, extracted from HumRRO Report 66-19, are the results of this experiment and provide an indication of the actual range of the aircraft before the gunner makes his decision to engage or not engage. An important consideration at this point is the gunner's alertness, visual acuity, and training.

Table 1. Mean aircraft slant range under experimental conditions (meters)

Experimental conditions	Aircraft class	Detection	Tentative recognition	Positive recognition
Unaided vision 0-offset	Jet	13,159	4,587	2,180
	propeller	9,768	3,906	2,007
650-meter offset	Jet	11,172	6,199	2,700
	propeller	8,974	4,962	1,994
1,400-meter offset	Jet	8,442	5,347	2,834
	propeller	9,039	4,714	2,488
Unaided detection-aided recognition 0-offset	Jet	12,360	7,335	4,501
	propeller	9,864	6,696	3,892
650-meter offset	Jet	9,421	5,766	3,074
	propeller	8,592	6,370	3,835
1,400-meter offset	Jet	9,722	7,342	4,919
	propeller	9,553	7,952	5,245
Aided detection and recognition 0-offset	Jet	9,973	6,227	3,470
	propeller	9,661	5,370	2,926
650-meter offset	Jet	13,081	7,929	5,020
	propeller	9,695	7,086	4,393
1,400-meter offset	Jet	12,539	7,988	4,960
	propeller	10,255	6,757	4,198

Although little has been done about most of the problems discovered in the initial HumRRO study, a further study of the problems encountered in classroom aircraft recognition training was conducted in 1967. HumRRO Technical Report 68-1 was published at the termination of the study. This report covers several improvements in training techniques which should be incorporated in the next revision of FM 44-30, Visual Aircraft Recognition. Although the subject of visual aircraft recognition has generated much attention at high levels, it appears that little has been done to establish a joint service coordinated effort to seek a standard solution to the recognition problem.

The US Army Air Defense School is presently making an effort in the right direction by revising FM 44-30. HumRRO has published a draft manual for conducting aircraft recognition training in the classroom. If the necessary coordination with other interested agencies is accomplished prior to final publication of these documents, they will become positive steps toward improving the situation.

Training gunners in aircraft identification is of prime importance. Visual aircraft recognition training at present is boring. Live aircraft recognition under simulated combat conditions could increase interest in the training and provide a means of testing individuals and units, thereby establishing a competitive training program. It is recognized that training of this nature is expensive.

Considering the impracticality of such a venture on a worldwide scale, the possibility of application of the Redeye moving target simulator for this purpose was considered. It was ascertained that the film used to display aircraft on a background can be adapted for use as an aid in aircraft identification training.

The moving target simulator was developed to train Redeye gunners in the correct procedures to track and engage aircraft at various speeds and angles of approach or departure. Its application as a visual aircraft recognition training device would be a secondary role. Because one of the gunner's problems is to identify the target while tracking, the application of the simulator as an aircraft recognition trainer will add realism to the training.

The principle of operation of the moving target simulator which allows a film to display various types of aircraft on interchangeable backgrounds lends itself to target identification training in a variety of terrain configurations and under different climatic conditions. The human elements of visual acuity, eyestrain, and length of attentiveness can be effectively tested and procedures established to improve or circumvent the adverse effects of the human element. Additionally, the simulator produces a sound commensurate with the range, velocity, and approach/recede condition of the aircraft displayed. The sound effect can be used to train the gunner to estimate range and to determine types of aircraft. The current shortage of funds dictates that we use currently funded end items to the maximum extent possible. The simulator is funded and scheduled for worldwide deployment.

The ultimate solution to the problem is not yet at hand. The problems and proposals discussed thus far point to a need for a coordinated effort at a much higher level than the gunner before we can expect him to distinguish friend from foe with any degree of proficiency.

Having established that a great deal of confusion exists at all levels about the problem of identifying aircraft and that the success of the air defense effort in the FEBA will depend on the gunner's ability to distinguish friend from foe, several areas of coordination, control, and training require attention. We must seek resolution to this problem at all command levels. An appropriate beginning would be to establish a joint service agency to coordinate efforts required to improve and standardize visual aircraft recognition doctrine and literature. As a second step, we must establish a school to provide personnel trained to identify aircraft to units in the field. Once the individual receives his initial school training, proficiency must be maintained or increased; therefore, each unit requiring his talents must practice continual aircraft recognition training and have a means of periodically testing individual and unit proficiency. The establishment of a proficiency test provides a means of applying aircraft recognition to the annual MOS evaluation test and special pay incentives, thus creating a reward for exceptional proficiency. Diligent application of the stated proposals may not in themselves distinguish friend from foe, but they will provide the gunner with a coordinated effort, from the highest level of command to the lowest, aimed at insuring that he is as qualified as humanly possible to say friend or foe. Then, and only then, can we expect the gunner to make the proper decision to shoot or not to shoot.

Operational Lessons Learned

EXPERIENCES OF DEPLOYED UNITS

VIETNAM

Presence of Children Around Project Sites

Just prior to boobytrapping a pipeline being installed along a populated area, it was noticed that the many children who usually congregated around the project site had returned to their nearby homes.

It is believed that Vietnamese children who play in the area around a job site have knowledge of enemy activity in the immediate vicinity. When they suddenly disappear from the site, it is a good indication that there may be an enemy operation in the area.

Photo Confirmation of Visual Sightings

During the conduct of visual reconnaissance missions pilots were reporting many individual sightings of previously identified items with varying descriptions. Due to the size and number of missions required to be flown, a pilot cannot learn the tactical zone area well enough to avoid reporting previously sighted items. A policy requiring pilots to take confirming photographs of any significant sightings was initiated. Validity of sightings was improved, and the random photographic coverage revealed many significant items that had not been sighted by the pilots.

The importance of photography should be emphasized at the OV-1 Aviator's Qualification Course (F-14) at Fort Huachuca and in all unit-level training programs.

Operational Methods of Sapper Units

Sapper action is often a specified sabotage tactic employed in two levels: in separate attacks on installations and in support of infantry and artillery attacks.

In separate attacks conducted by small forces, sappers infiltrate deep into US- and FWMAF-controlled areas to sabotage airfields, docks, vital bridges, important buildings, and equipment, with the added mission of kidnapping, assassinating, and performing other terrorist acts. Their greatest aid is their relative freedom of movement, affording them access to, and surveillance of, their intended targets.

When sapper units are employed in support of infantry and artillery in a general, all-out attack, their mission is to create a breach in the defensive network of the attacked installation to permit an infantry-type frontal assault, while the infantry and heavy weapons units wait in concealment. They use sticks, prongs, and C-hooks to raise or spread the outer

perimeter barbed wire or wire cutters to snip the lower strands. They also mark passages through minefields with pegs or other means of identification.

The final task in preparing for the assault is the destruction of installation barricades, watchtowers, machineguns, and explosives along the perimeter defenses or in the minefields. After breaching an entrance for the infantry, the sapper units may remain in the battle or withdraw and prepare to cover the infantry withdrawal.

Other sapper-type actions are ambushes along principal roads and waterways and surprise raids on airfields, supply areas, and other facilities in rear areas not easily approached by large infantry units. These vary from complete sapper battalions (up to 300 men) in the larger cities to separate sapper platoons at the lower level (district and province). They collect detailed intelligence about potential sapper targets from bar girls, cycle drivers, civilian employees of free world forces, and numerous others under their employ. Their tactics range from concealing a grenade in a loaf of bread to driving an explosive-laden vehicle into a target area.

Sappers are well schooled and only the most outstanding and dedicated are selected for training. Thus, they enjoy a higher esprit than conventional units, and, as a result, their combat effectiveness is generally high.

Sapper units employ five basic tactical principles:

- Detailed reconnaissance, minute planning, and rehearsal until assurance of performance without error.

- Secrecy in planning and surprise in performance.

- Speed to enable assault troops to reach their objectives in as short a time as possible and thus exploit all aspects of the defender's disorganization.

- Initiative—taking advantage of any favorable circumstances that might arise during the mission, which is constantly encouraged through training and indoctrination.

- Flexibility and tailoring of needs for men, weapons, and equipment according to the mission.

KOREA

Operation of Data Converter AN/GSA-77

After completion of the installation of data converter AN/GSA-77 in units of the 38th Air Defense Brigade, numerous technical difficulties were encountered. The principal difficulty was the inability of organizational maintenance personnel and battalion-level missile maintenance technicians to repair the equipment, using the card substitution maintenance concept presented in TM 9-1430-580-14. A visit by a contractor representative revealed an inadequacy in the maintenance concept: troubleshooting procedures in the technical manual were developed with the assumption that component failures would be complete and not of the

marginal type. A partial breakdown of an electronic component which would affect the operation of the data coverter might not be revealed by the card test procedure in the technical manual. A more definitive procedure for isolating malfunctions and a more reliable system for testing circuit cards were evolved with the aid of the contractor engineer representative. Recommendation for inclusion of the improved methods was forwarded by that headquarters on DA Form 2028 (Recommended Changes to Publications) to United States Army Missile Command (USAMICOM) and was subsequently approved by that headquarters. The recommended changes will be included in a technical manual change.

An additional recommendation for more comprehensive wiring lists; i.e., correlative missile systems wiring identification in addition to the wiring diagrams for the data converter, also was forwarded to USAMICOM and subsequently approved.

Intensive Training Required

During the reporting period all line batteries of one Hawk battalion were deeply involved in training for annual service practice (ASP). Approximately 80 percent of the personnel involved in this training had not previously participated in an ASP. Command and control, administration, and primary tactical mission accomplishment were emphasized in the units. Increased efficiency and job knowledge of all personnel concerned resulted from this intensified training.

In preparation for ASP the S3 and electronic maintenance officer of another battalion conducted extensive training at each unit. Additionally, each unit conducted training on another Hawk system to obtain experience using an unfamiliar system. All units received ASP ratings of satisfactory.

Repair Parts Distribution Problem Solved

On three occasions each week, one battalion uses a UH-1D helicopter from I US Corps (GP) to distribute repair parts to the line batteries. This program reduced equipment downtime, vehicle repair, damage to sensitive electronic equipment, vehicle accident exposure, and the time that individuals are absent from their units.

Network Theorems

Across

1. _____ says the algebraic sum of voltages around any closed loop equals zero.

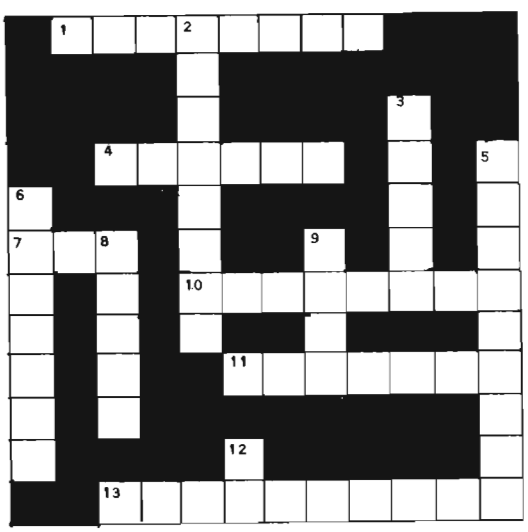
4. The magnitude of the current source in a _____ equivalent circuit is equal to the short circuit terminal current.

7. Networks may contain _____ numbers of branches.

10. The series resistance in a _____ equivalent circuit is equal to the resistance seen looking backward from the terminals with the load resistance disconnected.

11. In a Norton equivalent circuit, the single resistor R_N is in shunt with the _____ source.

13. The shunt _____ in a Norton equivalent circuit is equal to the resistance seen looking backward from the terminals with the load resistance disconnected.



Down

2. Kirchhoff says the sum of all _____ entering a point in a circuit equals the sum of all currents leaving that point.

3. According to Kirchhoff, if three amperes and four amperes enter a point in a circuit, _____ amperes must leave that point.

5. The _____ of the voltage source in a Thevenin equivalent circuit is equal to the open-circuit terminal voltage.

6. In a Thevenin equivalent circuit, the single resistor R_{Th} is in series with the _____ source.

8. A _____ network is the same as a pi.

9. Applying Kirchhoff's voltage law, if a series circuit has voltage drops of +21 volts and -24 volts, the drop across a remaining resistor is _____ or is under +3 volts.

12. _____ networks can be converted to T and vice-versa.

Answers on page 102.

Mailing of Drugs and War Souvenirs May Violate Laws and Regulations

The Bureau of Customs and Department of Defense recently joined in a concerted effort to discourage military personnel from using the mails to send home prohibited war souvenirs as well as marijuana and other drugs.

Commissioner of Customs Myles J. Ambrose said that Secretary of Defense Melvin R. Laird has committed his Department to assist Customs officials in scrutinizing mail for contraband.

Commissioner Ambrose said that intensified inspection of mail packages arriving at US ports of entry has resulted in marked increase in seizure of contraband. He called the flow of illicit war souvenirs "a veritable flood" and warned that "serious consequences" could ensue if the tide is not turned.

He said that military personnel are not involved in any major trafficking of drugs, but almost 25 percent of the flow of marijuana and hashish comes from military post offices overseas. He also said that most of the drug-smuggling out of Vietnam consists of marijuana and hashish.

According to Ambrose, the real problem, as far as the military is concerned, is the traffic in illicit war trophies and stolen weapons. Such traffic has increased during the Vietnam Conflict. A study made in 1968 showed that almost 20 percent of the packages received at San Francisco were in violation of custom regulations. Of these, 16.7 percent involved stolen Government property.

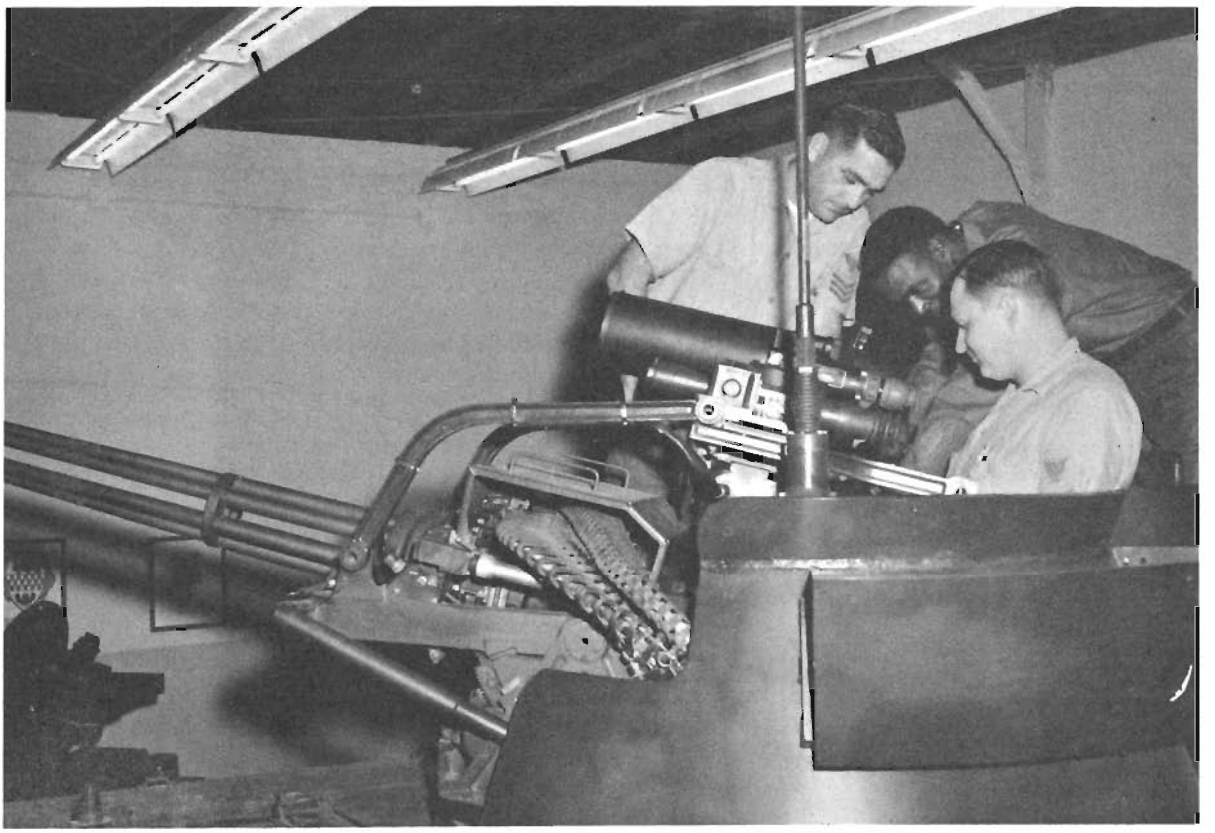
The commissioner explained that military personnel who mail contraband are violating Federal statutes as well as military regulations. People who mail contraband are violating, first of all, postal regulations. Because the packages come from across the border, the general smuggling laws are also violated. If the item crosses state lines, the Treasury Department tax regulations are violated.

Deputy Commissioner of Customs Edwin R. Rains said some war trophies can be brought back from Vietnam if permission is first received from the field commander. "But," he said, "many of the weapons seized by the Bureau are American-made and therefore stolen Government property."

Commissioner Ambrose said all detected violations will be reported to military authorities for investigation. He said part of the problem is ignorance on the part of those who mail war souvenirs. The Bureau of Customs has the complete cooperation of the Defense Department in this effort to deter the shipping of Government property and dangerous war trophies.

Sailors Take Vulcan Training

The West Texas desert is not the most likely place to find sailors, but two seamen were recently assigned to the US Army Air Defense School where they attended the 20-week Vulcan Mechanic Course. The two Navy men, selected for the weapon studies because of their experience in naval gun systems, will use the Air Defense School training to evaluate an upcoming experiment of the Vulcan gun system on board a Navy vessel.



Sailors receiving operating instructions on the Vulcan gun system.

They agreed that the Vulcan course is both interesting and challenging, sparking an enthusiasm that has increased their expectations of how the Army's Vulcan gun system will perform on board ship.

After completing the Vulcan Mechanic Course, the sailors joined Commander Service Squadron IV at Norfolk, Virginia, where they will serve 1 year on a Navy ship with the experimental Vulcan gun system.

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

Introduction to Logic and Sets by Robert R. Christian. Blaisdell Publishing Co., New York.
"This book is an introduction to some of the basic ideas, terminology, and notation of logic and sets."

Time Out of Hand by Robert Shaplen. Harper and Row, New York.
"What is the total situation in Southeast Asia? How has the war affected the region after more than six years of major American participation? What is the state of affairs within each country? Robert Shaplen answers these questions with the authority and perspective of a quarter-century of experience in the area."

Electricity by Harry Mileaf, ed. Hayden Book Co., New York.
"Electricity 1 through 7 is a complete, modern course in the fundamentals of electricity. The step-by-step presentation provides all necessary theory and pertinent practical background in seven concise volumes."

Electronic Computers by S. H. Hollingdale. Penguin Books, Baltimore.
"This explains how computers work, how problems are presented to them, and what sort of jobs they can tackle."

Introduction to Data Processing by Robert R. Arnold. Wiley, New York.
This book describes and explains the developments in the fields of business and industrial automation that have occurred during the past two decades.

The Careful Writer by Theodore M. Bernstein. Atheneum, New York.
"The Careful Writer is a concise yet thorough handbook covering in more than 2,000 alphabetized entries the problems that give (or should give) a writer pause before he sets words to paper: questions of use, meaning, grammar, punctuation, precision, logical structure, and color."

Microelectronics by Max Fogiel. Research and Education Assn., New York.
"The book is organized to provide detailed working knowledge to those interested in microelectronics. When taken in sequence, the thirteen chapters of this book render a logical development of virtually every aspect of this new field."

Structure and Application of Galvanomagnetic Devices by H. Weiss. Pergamon, New York.
"The book explains the physics of galvanomagnetic devices as well as their design, applications, and related circuit problems."

American Defense Policy by US Air Force Academy. Johns Hopkins Press, Baltimore.
"This book is an attempt to assemble in one volume a representative selection of the recent extensive American writings on defense matters."

The Bomb and the Computer by Andrew Wilson. Delacorte Press, New York.
"Andrew Wilson's book is the first to describe, for the general reader, the evolution of the war game as a serious and often unreliable military planning device."

Aliens in the Skies by U.S. Congress. Putnam, New York.
Even though the Condon Committee's report was supposed to settle the "flying saucer" question for good, UFO sightings continue to be reported and some members were convinced that this committee was told to bring in a negative report.

Eat the Weeds by Ben Charles Harris. Barre Publishers, Barre, Massachusetts.
"Here are colorful and practical directions for collecting and drying herbs, for using acorns as a substitute for bread, for making herb teas, barberry and elder wines, and candied angelica."

The Last Voyage of USS Pueblo by Ed Brandt. Norton, New York.
"The stories the crew told Ed Brandt emerge as a powerful composite document that gives a rounded picture of brave men caught up in a political situation most of them never understood."

The Way We Go to War by Merlo John Pusey. Houghton Mifflin, Boston.
"This spare, tightly reasoned book sheds light rather than heat on one of the most urgent problems facing America today."

ARTICLES

"What Does Air Defense Artillery Do in Vietnam?" Brank Blonska, ARADCOM Argus (August 1970), pp. 7-8.
"The mobility, quick reaction time, and devastating volume of accurate firepower of both Quad and Duster squads make them an awesome deterrent to enemy attacks."

"Roles for Air Cushion Vehicles," Trevor Holloway, Marine Corps Gazette (September 1970), pp. 40-43.
"The air cushion vehicle, a product of Great Britain, is assessed in its military and civilian spheres by a British author and journalist who contributes to leading publications at home and overseas."

"ARADCOM: America's Silent Safeguard," D. J. Heffernan, Army Digest (September 1970), pp. 4-11.
"Providing an effective defense today while planning and building to meet the threats of tomorrow offers a special challenge to the men and women of ARADCOM."

"International Law of War," Carl M. Guelzo, Military Review (October 1970), pp. 47-55.
"If the law of war is what nations wish it to be, then the future is bleak, for little agreement is now in evidence, and few states seem disposed to apply the power necessary to enforce what little can be agreed upon."

"Deterrence, the ABM, and Stability in Asia," Phillip Karber, Air Force and Space Digest (October 1970), pp. 60-61.
"The ABM is a stabilizing factor in the international power equation, not only in terms of our relations with the USSR but also in Asia as an arms-race preventive." (This article will appear in the next issue of Air Defense Trends.)

"The Building Trades Versus the People," Gilbert Burck, Fortune (October 1970), pp. 94-97.
"After years of submitting to union power, the construction industry and its customers are starting to fight back. They need help from those who in the end pay the bills - all consumers."

"Real-Time Military Communications for the 1970's," R. V. Reyes, Jr., Signal (October 1970), pp. 22-26.
"The acquisition of computer associated security equipment, employment of an automated quality assurance and control facility, and application of a properly sized, latest state-of-the-art communications processor, will give NORAD a completed Phase I real-time communications system needed as a uniquely important adjunct to national defense."

"Fedayeen: Palestinian Commandos," Selby F. Little, Jr., Military Review (November 1970), pp. 49-55.
"Since this article was written, the Palestinian guerrillas have precipitated a major crisis in the Middle East. The article is published, however, because of the historical background it provides on the development of the guerrilla movement."

"Jobs: An Updated Look Into the Future," Changing Times (October 1970), pp. 33-36.
"What fields offer the brightest prospects for the 70's? Here's a summary of predictions - and what's behind them - for nine major occupational groups."

"Managing the Civilian Work Force in the Seventies," Charles A. Roberts, Air University Review (September-October 1970), pp. 24-29.
"The thrust of this article will be to review our past . . . to examine our present . . . to consider the bad as well as the good - and hopefully to end up with reasonable predictions and recommendations."

"How We Choose the President," Albert L. Weeks, The American Legion Magazine (October 1970), pp. 7-11.
"The popular proposal to scrap the electoral system, now before the Senate, is giving some experts second thoughts."

"1970 Status Reports," Army (October 1970), entire issue.
The 1970 Green Book presents status reports from many of the major units of the Army as well as a summary of the past year in Vietnam and the very useful Command and Staff Directory.

"The South Vietnam Nobody Knows," Brooks McClure, Air Force Magazine (October 1970), pp. 45-51.
"Despite the innumerable reports of corruption and political repression in South Vietnam, the fact is that the war-torn land has slowly but surely progressed toward representative government with a considerable measure of freedom of political expression."

ANSWERS TO CROSSWORD PUZZLE:

Across

1. Kirchhoff
4. Norton
7. odd
10. Thevenin
11. current
13. resistance

Down

2. currents
3. seven
5. magnitude
6. voltage
8. delta
9. over
12. pi

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Direct communication to the editor is authorized:

Office of Doctrine Development, Literature, and Plans
US Army Air Defense School
P.O. Box 5600
Fort Bliss, Texas 79916

Aircraft Recognition

In this issue of Air Defense Trends we introduce a new method of training in aircraft recognition. The method was devised by Human Resources Research Organization, Division No. 5, at Fort Bliss, Texas. Students cooperating in the study attained an average score of 95 percent when this method was employed. The highest average attained, using other methods, was 87 percent, so we feel this program is worthy of your investigation.

INSTRUCTIONS

First, cut out the multi-image cards and flash cards.

Stage 1: Study each multi-image card carefully, one at a time. Read each recognition feature and look at it in the pictures of the aircraft. When you feel familiar with one aircraft, go to the next card. When you feel familiar with all of the aircraft, go to stage 2.

Stage 2: Spread the multi-image cards so that descriptions of recognition features are covered and you can compare all of the aircraft with one another from each viewpoint. See if you can name each image (cover the names where they show). Practice with one view at a time, working in a row across the cards, naming each aircraft. When you come to a view you do not know, uncover the name at the top of the card so that the next time through you will be able to correctly name the image. If you are having trouble naming the aircraft, go back to stage 1 and review each card again with the name uncovered, then return to stage 2.

Stage 3: Practice with flash cards. Hold the deck of flash cards so the aircraft names are away from you. Go through the deck one card at a time and identify each aircraft, checking your answers on the back. If you did not get the right name, put that card in the back so that it will come up again. But if you did get it right, drop that card out of the deck by placing it aside. Continue going through the deck until all cards have been dropped out, meaning you have correctly named them all. When you get all of the cards correct, shuffle the deck and work through it again, using the same procedure.

As space permits, additional cards will be printed in future issues of Air Defense Trends until currently employed military aircraft likely to be seen by the ground observer have been accounted for.