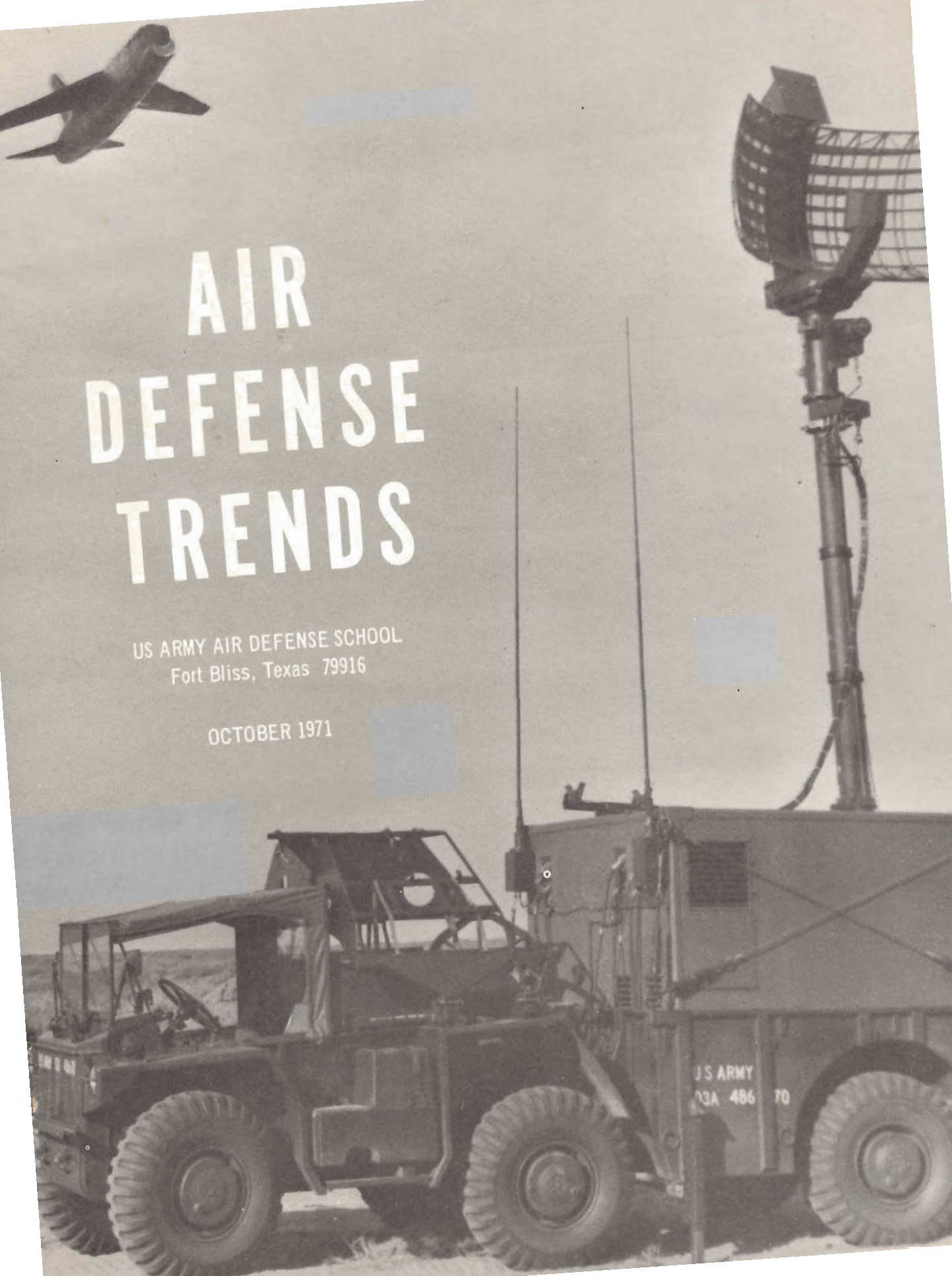


AIR DEFENSE TRENDS

US ARMY AIR DEFENSE SCHOOL
Fort Bliss, Texas 79916

OCTOBER 1971

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

IN THIS ISSUE

61279

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.

DESIDERATA

Go placidly amid the noise and haste, and remember what peace there may be in silence. As far as possible without surrender be on good terms with all persons. Speak your truth quietly and clearly; and listen to others, even the dull and ignorant; they too have their story. Avoid loud and aggressive persons, they are vexations to the spirit. If you compare yourself with others, you may become vain and bitter; for always there will be greater and lesser persons than yourself. Enjoy your achievements as well as your plans. Keep interested in your own career, however humble; it is a real possession in the changing fortunes of time. Exercise caution in your business affairs; for the world is full of trickery. But let this not blind you to what virtue there is; many persons strive for high ideals; and everywhere life is full of heroism. Be yourself. Especially, do not feign affection. Neither be cynical about love; for in the face of all aridity and disenchantment it is perennial as the grass. Take kindly the counsel of the years, gracefully surrendering the things of youth. Nurture strength of spirit to shield you in sudden misfortune. But do not distress yourself with imaginings. Many fears are born of fatigue and loneliness. Beyond a wholesome discipline, be gentle with yourself. You are a child of the universe, no less than the trees and the stars; you have a right to be here. And whether or not it is clear to you, no doubt the universe is unfolding as it should. Therefore be at peace with God, whatever you conceive Him to be, and whatever your labors and aspirations, in the noisy confusion of life keep peace with your soul. With all its sham, drudgery and broken dreams, it is still a beautiful world . . . Strive to be happy.

—*Found in old Saint Paul's church, Baltimore; Dated 1692*

The United States Army Air Defense School

FORT BLISS, TEXAS

OFFICIAL LINEAGE

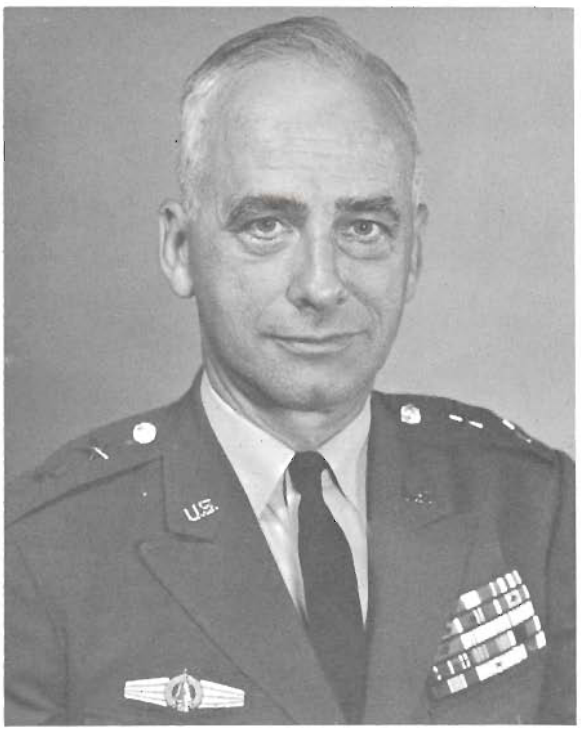
As Approved By
Hq Dept Of Army, June 1962

FORT MONROE
1824

FORT BLISS
1962

Date	Event	Original Source
5 April 1824	Establishment of "Artillery corps for instruction" at Fortress Monroe, Virginia	AGO Orders No. 18, dtd 5 April 1824
18 May 1858	The Artillery School is established at Fort Monroe, Virginia	WDGO 5, 1858
August 1907	Establishment of the Coast Artillery School at Fort Monroe, Virginia	WDGO 178, 1907; Coast Artillery School return, Aug 1907 (School term began 1 Sep 1907 under new designation)
31 March 1942	Establishment of Antiaircraft Artillery School at Camp Davis, North Carolina: absorbs the personnel and equipment utilized for antiaircraft artillery instruction at the Coast Artillery School, Fort Monroe, Virginia	AG 320.2/2GNOR (3-7-42) 9 Mar 42 (personnel and equipment of defunct Coast Artillery School, Fort Monroe, Va., transferred to Camp Davis, N. C.)
30 September 1944	Transfer of Antiaircraft Artillery School from Camp Davis, N. C. to Fort Bliss, Texas	Ltr, Hq Army Ground Forces 370.5/1132 (R) (3 August 1944) GNGT, dtd 3 Aug 44
1 November 1946	Redesignated Antiaircraft and Guided Missile School	AG 352 (26 Oct 46) ~~AD-S-GNGT-M~~, 1 November 1946
1 July 1957	Redesignation of U. S. Army Antiaircraft Artillery and Guided Missile School to U.S. Army Air Defense School	GO 57, Fourth U. S. Army, dtd 14 Jun 57; GO 78, U.S. Army Antiaircraft and Guided Missile Center, dtd 21 Jun 57; amended by GO 121, U.S. Army Air Defense Center, dtd 15 Dec 58

Major General Shoemaker Assumes Command of Fort Bliss



Major General Raymond L. Shoemaker, became Commanding General, US Army Air Defense Center and Fort Bliss, and Commandant of the US Army Air Defense School, 15 June 1971. He had been Commanding General of the 32d Army Air Defense Command since November 1969.

A native of Washington, D.C., General Shoemaker graduated from West Point in the class of 1940 with a commission in the field artillery. In addition to attending the Command and General Staff College, Armed Forces Staff College, and National War College, he engaged in graduate studies at Stanford University where he received a master of arts degree in journalism, and at George Washington University where he received a master of arts degree in international affairs.

He was promoted to brigadier general in June 1963 and to major general in August 1967. He served through five campaigns in Europe during World War II and with General Headquarters, Far East Command, during the Korean Campaign. He later served as Secretary to the United Nations Command delegation during the early phase of the armistice talks. Peacetime oversea assignments include Korea and Germany.

General Shoemaker has been awarded the Distinguished Service Medal, Silver Star, Legion of Merit with two Oak Leaf Clusters, Bronze Star Medal with Oak Leaf Cluster and "V" Device, Army Commendation Medal with Oak Leaf Cluster, and Purple Heart with Oak Leaf Cluster.

Change of Command

Brigadier General Hans H. Heise

Brigadier General Erich Hohagen

Brigadier General Hans H. Heise, who has commanded the German Air Force Training Command at Fort Bliss, Texas, for the past 3 years, is returning to Germany for retirement after 37 years of service in the German Air Force. His replacement is Brigadier General Erich Hohagen, who was previously assigned to the Ministry of Defense, Air Staff, at Bonn Germany. A change of command ceremony was conducted at Fort Bliss 9 September 1971.

Message From The Commandant

For years we in air defense stood apart, neither understood by nor really understanding the rest of the Army. With our reentry into the Division, any such split becomes intolerable. I urge each of you, then, to raise your horizon above the scope of this publication. Study it, yes; but do not limit yourselves to its contents. Become true, full-fledged players on the combined arms team by your grasp of what each member has to offer and by playing your role in assuring that our Branch does its part. Seek assignments in keeping with this broadened concept rather than retreating to the safety of the familiar. Only then will we earn our full share of promotions to senior grade and selection for senior service schools.

Share Your Ideas
We're All on the Same Team

What are you doing that's different to make your job easier or more effective? Have you devised some special technique in operations relative to maintenance, supply, administration, or training? If you have, and it works, and does not violate any regulation or general policy, we would like to publish the details for the benefit of other units and their personnel. Recognition will be given to the appropriate unit or individual(s) at the time the information is published.

Send whatever you have, including related illustrations, to:

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

Air Defense Trends congratulates General George V. Underwood, Jr, upon his elevation to four-star rank. General Underwood's achievement is unique in that he is the first air defense officer ever to have attained this distinction.

CAN ANY READER HELP US?

In the early days of antiaircraft artillery all field manuals used by these units were prepared by the Coast Artillery School at Fort Monroe; consequently, these manuals used the Coast Artillery prefix 4 (e.g., FM 4-105, Antiaircraft Artillery; Organization and Tactics, published in 1940). When FM 44-1, Antiaircraft Artillery Employment, was revised in 1952, it superseded FM 4-100 (1943). Research has failed to disclose the title of this manual. Another puzzler to the researcher of early AAA training literature is the title of FM 4-110, superseded by FM 44-4, Antiaircraft Artillery Guns (1950). Can any reader furnish information as to the titles in question?

EDITORIAL

> One of the interesting aspects of the drug abuse problem is that adults have had to go to young people for answers to their questions. Having no widespread personal experience or even observations of illegal drug use, the older generations have been the victims of an almost complete lack of knowledge with perhaps only misinformation as a point of departure. The result has been an attitude on the part of the young that their elders either do not know the answers or are exaggerating the truth. Young people have been learning from the hard school of personal experimentation similar to the way older generations may have learned about drinking or sex.

This statement by Major General Franklin M. Davis, Jr., Director of Military Personnel Policies, Office of the Deputy Chief of Staff for Personnel, Department of the Army, when he recently appeared before the House Appropriations Subcommittee on Defense, fortuitously sets a corollary to one problem inherent in establishing a Modern Volunteer Army. We refer to the difference in average age between policymakers and individuals who will comprise the bulk of such an Army.

Senior officers will be directly involved in formulating policy that will be the underpinning of any Modern Volunteer Army. This group is at the middle-age stage of life. The decisions and determinations of these leaders no doubt will be greatly influenced by Civil Service personnel in high-level assignments, and this group is also in the middle-age bracket. On the other hand, the men we want to attract and hold in service as professional soldiers average downward from 26 years of age.

In modern America the younger generation will not be greatly influenced in its actions by the older generation, and vice versa. But each generation wants to be the ruling element, and thereby hangs a dichotomy in the methods of goal-pursuit in our nation, the same dichotomy that haunts the architects of what is to be the US Army of the future. The situation reminds one of a quatrain from the Rubaiyat of Omar Khayyám:

> Strange is it not? that of the myriads who
> Before us pass'd the door of Darkness through,
> Not one returns to tell us of the Road,
> Which to discover we must travel too.

The road of a Modern Volunteer Army, from what is now evident to us, will be in many ways far different from the road the architects have traveled. Mutual exploration between generations into each others realm of experience would be most fruitful. However, this extent of cooperation appears to be highly improbable. The architects, then, must seek and search through the innermost caverns of the emotions of today's young people, an altogether complicated undertaking that requires deep study and concentration of purpose. They must then demonstrate a willingness to accept shocks and surprises and find a way to fit related demands into the program. Without exploring and treating this aspect of the fabric that makes up the personality of today's youth, there will be inevitable cracks in the final structure of the Modern Volunteer Army and our architects will have failed.

Because of these differences in ages and experience, the planning and building of the new Army must be meticulous and thorough, and this rules out any crash program if a product of quality is to result. When the team of builders has discovered the road of the young, then the wisdom they acquired traveling the older road may be amalgamated with their newly acquired knowledge and a volunteer Army of quality, pride, and purpose can become a lasting reality.

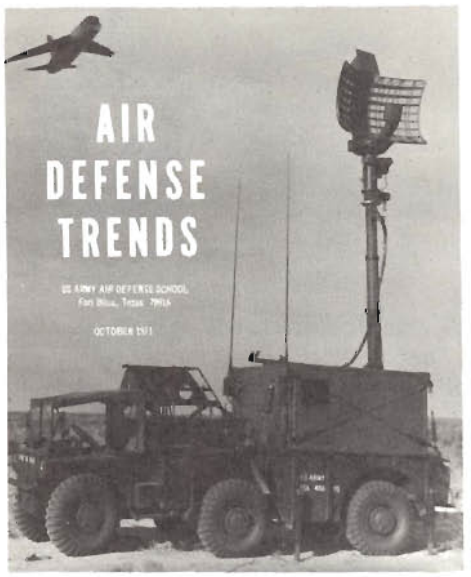
—W.E.S.

United States Is Leader of Western World, Like It or Not

(Quote General Lemnitzer, US Army (Retired))

General Lyman L. Lemnitzer at the time he was Supreme Allied Commander Europe (1963-1969)

Speaking recently before the El Paso, Texas, Chapter of the Association of the United States Army, General Lyman L. Lemnitzer, US Army (Retired), warned of the perils of abandonment of our international commitments and capabilities. He emphasized that we must be able to focus attention on more than one area of the world because our security cannot be preserved from within a "Fortress America." He spoke of Southeast Asia and China, but the thrust of his message involved NATO, the importance of which he feels has been blurred by recent events in Southeast Asia. Having served for 7 years as the senior military officer of NATO, General Lemnitzer is eminently qualified for the task he has set for himself: refocusing American attention on United States global interests, particularly with regard to Europe and the Atlantic community. He also expressed profound concern over the steady eroding of our military strength; actions of unruly mobs, including desecration of our flag; and the uncertainty that our nuclear deterrent will remain credible to a Soviet Union which apparently seeks a preemptive strike capability and is rapidly moving toward military dominance of the world. His experiences of high-level responsibility over many parts of the world, including US Army Chief of Staff, Chairman of the Joint Chiefs of Staff, and military head of NATO make him an expert on numerous military and political matters facing the United States today.



COVER To provide early warning for Chaparral, Vulcan, and Redeye fire units operating in the forward area, the US Army Missile Command engaged in the development of this forward area alerting radar (FAAR). It was first released for service testing in September 1968; however, testing was suspended in March 1969 due to deficiencies discovered during the service test. The Project Manager issued a stop work order in July 1969 which suspended production until these deficiencies could be corrected. During the period July 1969 to November 1970 the system underwent many improvements and, as a result of a preproduction test conducted during December 1970 and January 1971, service testing was resumed in February 1971. Here we see a simulated, low-level attack test of the improved FAAR in progress at the Air Defense Center's Dona Ana Range. Results of tests indicate that improvement efforts have been successful, and a decision to start limited production was made in March 1971. We are now at the point where selected personnel will soon begin new equipment training on the FAAR system, and delivery of the system to Fort Bliss units will ensue. An update on the FAAR system is contained in the article, "A New Look for Chaparral/Vulcan Battalions," appearing on page 47.

COMMENTS DESIRED

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

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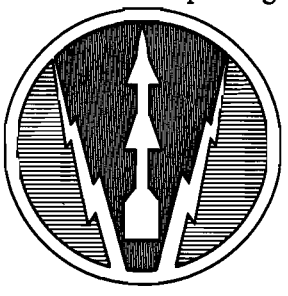

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AIR DEFENSE TRENDS

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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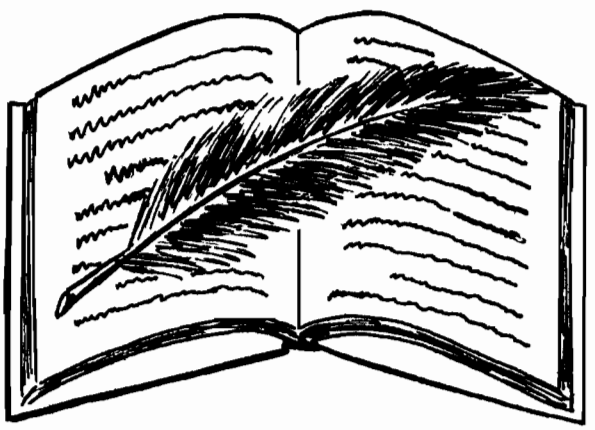
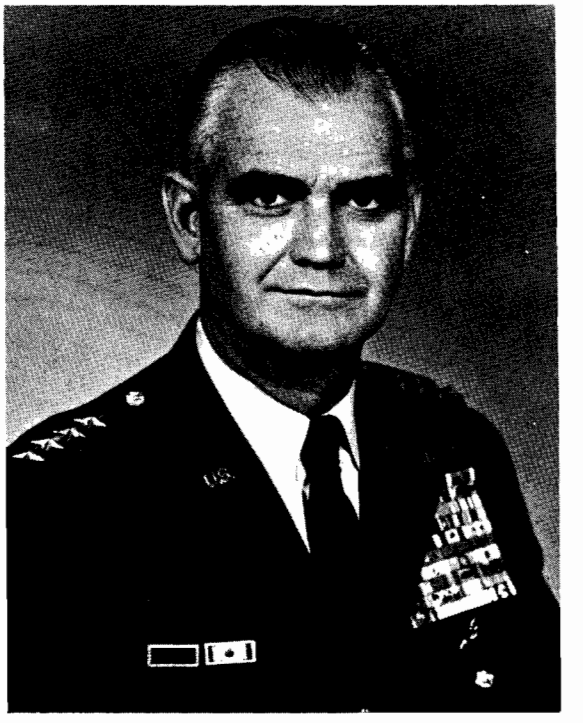


Blueprint for MVA

"FIRST, those of us in uniform in positions of high responsibility in the Army must attack this problem with all the vigor, imagination, and dedication we can muster, and we must apply ourselves intensively to the task.

"SECOND, we must eliminate unnecessary irritants and unattractive features of Army life where they exist. But we will hold to those immutable principles of dedicated professionalism, loyalty, integrity of character and sacrifice. They are the hallmarks of a disciplined, responsible Army. All else is secondary . . .



"THIRD, we will not achieve our goal without the application of resources, and I mean money. We will need to increase pay. And we probably find that we must put our money primarily in those jobs which are most arduous and have the least application to civilian pursuits . . . the infantry, artillery and armor.

"FOURTH, we will need the support of the American people and their leaders in business, industry, the church, education and the news media. We cannot attract the kind of soldier we need into an organization denigrated by some, directly attacked by others, and halfheartedly supported by many. This country cannot have it both ways. If the Army is portrayed and believed as a service to be avoided at all costs, a service in which only those with the least qualifications need be recruited, and if we do not have the active help of community and national leaders in every field, even money will not do the job." (ANF)

—General W. C. Westmoreland
Army Chief of Staff

LETTERS

to the Editor

●As one of the professional journals available to air defense artillerymen, and one that is considered branch representative, I would like to congratulate Air Defense Trends on the many fine scholarly and thought-provoking articles available in each and every publication. However, I have found that this journal is widely read by other branch members and critically compared with their own professional publications such as Infantryman, Artillery Trends, etc. In many cases this comparison has led to criticism of Air Defense Trends for both form and content. As an example I make reference to the January 1971 issue and particularly to the article by LTC Munroe entitled, "The Munroe Doctrine or How to Hit With Vulcan" and Major Stephens' article entitled, "Early Warning for Forward Area Weapons."

LTC Munroe attempts to elicit interest in his article by a humorless dialog on the explanation of the latest techniques of engaging an aircraft by a visually directed automatic weapon system. This technique that LTC Munroe vaguely refers to in his dialog was the subject of an in-depth study by US Army Combat Developments Command Air Defense Agency entitled, "Firing Techniques for Air Defense and Non-Air Defense Guns" and published in their newsletter of 22 January 1971. This recent study is an important milestone in the ever-changing doctrine of engaging aircraft by automatic weapons and provides valuable information for all US Army agencies as well as air defense artillerymen. It is imperative that a far-reaching study of this nature be treated with depth so that all branches can get the full "loaf of bread" and not just the stale crust.

Major Stephens, in his bid for a system of early warning for forward area weapons, has produced a thought-provoking and timely article to a very real problem that exists today for forward area air defense weapons. However, in his address to the problem, Major Stephens is victim to the same journalistic pitfalls as LTC Munroe in that he failed to make a professional, in-depth study of a significant forward area air defense problem. His remark in the first paragraph that there are currently two solutions to EW—wait for FAAR or forget it—is contradictory in that he further describes another alternative by using the same TOE personnel and equipment to support his position. Furthermore, his solution to the liaison officer's

problem of no radios by raiding divisional assets as a source of scrounging has no place whatsoever in a professional journal. I believe Major Stephens could vastly improve his concept by contacting Chaparral/Vulcan units in the field to ascertain the EW systems now in use and those which appear most functional. If this had been done, his scheme of radio nets would alter drastically based on the requirement for command and control of widely separated units.

GARY L. BRIDGEWATER
CPT, ADA
S3, 2d Bn, 59th Arty

We thank you for your interest, information, observations, and the compliment. It is flattering to hear our publication referred to as a professional journal, but we cannot claim the distinction. Air Defense Trends (ADT) is essentially an instructional aid and thus does not have the staff or funds to compete with professional journals.

Regarding LTC Munroe's article, the style of writing was intended to enhance easier and more interesting reading rather than to be humorous. A similar style of writing will be seen more and more as new field manuals and training manuals appear. This is the trend, along with color in illustrations, à la PS Magazine. The in-depth study you refer to was actually conducted by LTC Munroe. His article was published in ADT so as to reach numerous people who would never see the newsletter because of differing avenues of distribution.

Major Stephens' article is a condensed version of a lengthy report based on several months' study of the early warning problem. It would seem, however, that you have the advantage of on-the-scene experience with early warning systems now in use—experience which, if shared with our readers, would be of significant value. We therefore invite you to submit an article or report on the subject for publication in an early edition of Air Defense Trends.

—Ed.

● Reference your article on the ballistic aerial target system (BATS) in the January 1971 issue of Air Defense Trends. Having had some first-hand experience with BATS, I thought some of your readers might be interested in a "field report."

During February and March of this year I served as the US Camp Commander and Chief Evaluator for the first USAREUR Chaparral annual service practice conducted at the Salto di Quirra Missile Range in Sardinia, Italy. Four Chaparral/Vulcan battalions of the six in USAREUR participated. The other two had not been in Europe long enough to be required to undergo an ASP.

The target used was the BATS built by Brown Engineering Company of Huntsville, Alabama. More than 100 targets were used (a few being used for tracking) with what I considered outstanding results. There were only two cases in which one of the three boosters (folding fin aerial rocket) did not fire. This caused the target to achieve a lower altitude and a shorter time of flight (about 21 seconds). One of these two targets was destroyed by a Chaparral anyway because the gunner fired early enough in the engagement zone; the other target impacted into the Mediterranean before the Chaparral had time to intercept. There were two other cases in which the infrared (IR) flare did not ignite. One of these targets was intercepted anyway due to the Chaparral missile being able to "find" the sustainer motor

located just behind the nose cone assembly of the BATS. On the other, the gunner did not attempt to fire at the target because it did not ignite an IR flare.

The BATS proved to be a very stable target in the high winds which we usually encountered (sometimes about 50 knots). I attribute this largely to its roll-stabilized flight.

Four Chaparral missile systems were on line for live firing, and four BATS launchers were used. Due to topographic restrictions, all the BATS were fired from left to right in a 75° crossing pattern from a distance of approximately 1,500 meters. The BATS angle of elevation was 45°-50°, depending on the cloud ceiling, which gave a normal time of flight of near 40 seconds. Generally, the gunners had no trouble in detecting the target and had ample time to fire. Actually, on cloudy days it showed up even better than on clear days because of greater contrast with the background (provided, of course, the BATS stayed below the clouds).

The kill ratio for the firing was above 90 percent. A few gunner errors were committed (e.g., firing without missile tone) which precluded a successful engagement, but most of the failures were due to such missile malfunctions as guidance control group or target detection device failures.

I considered the ASP a highly successful endeavor largely because of the great people on the Evaluation Team and Support Group and also because it appears that Uncle Sam has a bargain in the less than $400 per copy for BATS.

ASA E. STEWART
Major, ADA
Op Off, AD Sec
3d Armd Div

●The Education and Development Committee of the Society for Technical Communication is surveying the training available in technical communications. Our beginning point is the rather difficult task of locating courses in the field. You can help us in our task. Would you run the enclosed request for information in a prominent place in your publication? Any information gathered should be sent to me. The committee will greatly appreciate any assistance you can lend. The final result should be an up-to-date list of courses of considerable value to the Society.

THOMAS E. PEARSALL
Professor

The request for information Professor Pearsall mentions in his letter is printed below and is self-explanatory. Courses administered in oversea areas should not be reported.

—Ed.

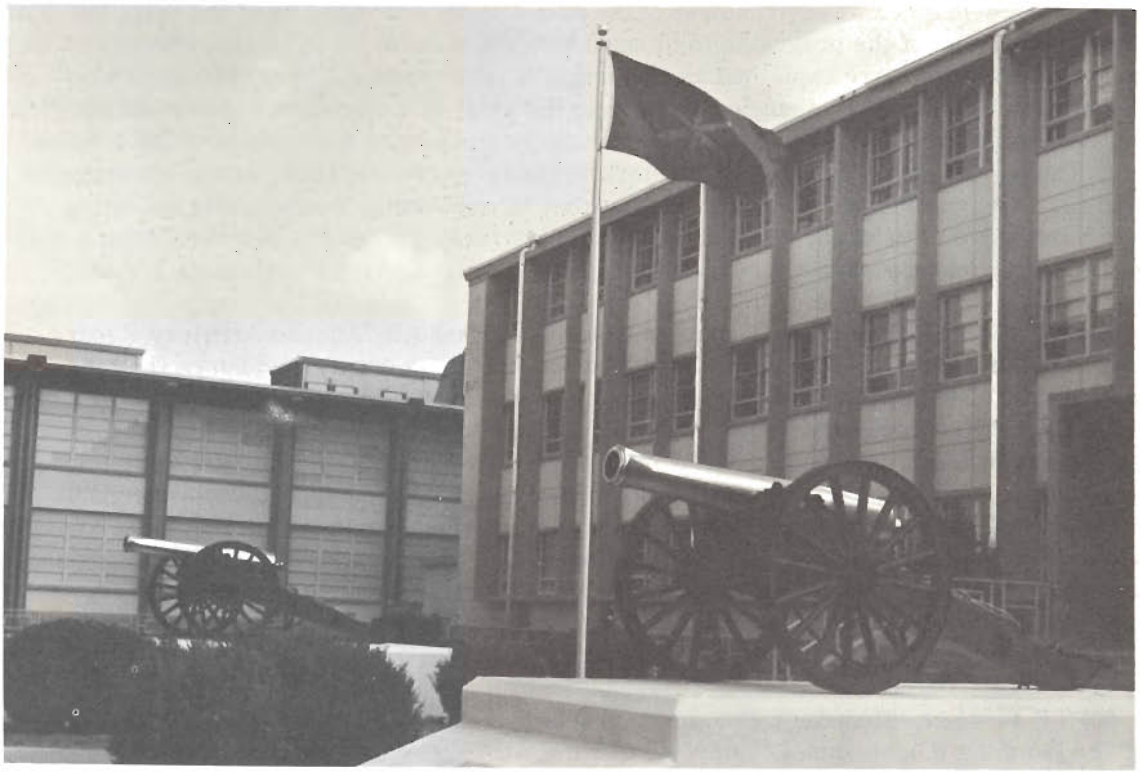
The Education and Development Committee of the Society for Technical Communication is surveying the training available in technical communications (writing, editing, or illustrating). Your help is requested. If you know of any courses in technical communications offered by schools in your area (at any level of education), please send a listing of the courses to:

Professor Thomas E. Pearsall
Department of Rhetoric
University of Minnesota
St. Paul, Minnesota 55101

Please include in your listing as much of the following information as possible:

Course titles
Hours or credits given
School where offered
Department where offered
Teacher's name

USAADS Instructional Notes



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OFFICE OF DOCTRINE DEVELOPMENT, LITERATURE, AND PLANS

AIR DEFENSE ARTILLERY TRAINING FILMS

Personnel at the United States Army Air Defense School continuously strive to develop training films that will enhance individual and unit training in air defense subjects. Eight of these films have been completed recently and are now available in audiovisual support centers.

(C) TF 44-4120, The Hawk Engagement Simulator AN/TPQ-21—Part III: ECM Programing (U), explains the capabilities of the Hawk engagement simulator and how these capabilities may be used to provide effective training for the Hawk operator. This 23-minute color film opens with a short sequence showing Hawk fire control personnel who have just completed an extensive training program in a non-ECM environment at their assigned stations. Suddenly the crew, confronted with extensive interference, is confused and unable to track and engage a simulated target, illustrating the need for training under conditions to be expected in an ECM environment. The narrator explains that crew training is not complete without extensive training under simulated ECM conditions. He points out that training program planners must use every available means to insure complete and effective training. The film then explains the capabilities and limitations of the Hawk engagement simulator in ECM training.

The battery commander visits the battalion S3 to request assistance in overcoming these training problems. Members of the S3 section develop a progressive program designed to train this crew in an ECM environment. The film follows one member of the battalion staff as he develops one of the programs to be used with the simulator. The procedures and techniques that he follows are explained as the program is developed. Next, the same crewmembers are seen at their assigned stations at the start of a test exercise to evaluate their effectiveness following extensive and comprehensive training in a simulated ECM environment. During the engagement the evaluators literally "throw the book" at the crewmembers. However, they function like the veterans that they have become, successfully operating through intensive interference. This sequence illustrates the results achieved when a well-planned and vigorously executed training program is employed during operator training.

(C) TF 44-4138, Electronic Countermeasures Against Air Defense Artillery Radars—Part I: Introduction (U), introduces the subject of electronic countermeasures (ECM) as it affects air defense artillery (ADA) radars, provides a brief history of its development, and divides the subject into jamming and deception. This 13-minute color film opens with a brief history of electronic warfare in World War II, the Korean Conflict, and Vietnam. It warns that we must consider any enemy capable of an aerial attack to be equally capable of using electronic countermeasures against our ADA radars. Various aspects and subdivisions of electronic warfare are pointed out and defined. One of these subdivisions is electronic countermeasures. The narrator points out that this film series, consisting of four parts, will be devoted to consideration of the radar countermeasures portion of electronic countermeasures.

(C) TF 44-4139, Electronic Countermeasures Against Air Defense Artillery Radars—Part II: Jamming (U), discusses jamming that the ADA radar operator must expect to encounter. This 13-minute film discusses and describes various types of transmitted jamming such as CW, AM, pulse-modulated, and noise, individually and in their various combinations. All of these many types of jamming are shown on an A-scope and plan position indicator (PPI). The next sequence discusses and describes several techniques of jamming to include spot, swept, and barrage, illustrating the effects of each on scope display. Jamming by reflection of electromagnetic energy is then shown and described in the final sequence. This type of jamming is described as that jamming of radarscope displays resulting from the reflection of a radar's signal to obscure real targets. Chaff, the most commonly used reflecting device, is discussed, and how it is dispensed to be most effective is explained.

(C) TF 44-4140, Electronic Countermeasures Against Air Defense Artillery Radars—Part III: Deception (U), is a 10-minute film that continues the series on radar countermeasures by discussing the deception and deception devices that the ADA radar operator must expect to encounter. Deception can be either manipulative or imitative. Using live action and animation, the film depects forms of manipulative deception such as spoofer, range-gate stealer, AGC capture, and speed-gate stealer. The next sequence describes several imitative deception devices such as chaff and decoys.

(C) TF 44-4141, Electronic Countermeasures Against Air Defense Artillery Radars—Part IV: ECM Tactics (U), discusses and describes tactical maneuvers that one must expect an attacking aircraft to employ against ADA radars. This 10-minute film discusses the following electronic countermeasure tactics: side-step, rocket-dispensed chaff, speed change,

multilevel or stacking, standoff, diversion, multicorridor chaff drop, and pop-up. The film points out that each of these maneuvers is designed to evade, confuse, or mislead the radar operator. The film ends by emphasizing that the operator should not be confused or upset by any of these tactics or the presence of radar countermeasures on his scope. Rather, he must expect such actions and interference and learn to overcome or read through such measures.

(C) TF 44-4166, Introduction to Radar ECCM (U), introduces electronic counter-countermeasure (ECCM) devices and circuits that are incorporated in most ADA radars to help counteract the effects of enemy jamming signals. This 12-minute film opens with an imaginary but plausible sequence where an approaching enemy jet bomber uses ECM to interfere the acquisition and tracking radars of an ADA installation. This interference permits the attacking aircraft to sneak through the defense and destroy it with an atomic bomb. The narrator then states that this sort of disaster indeed can happen, but it doesn't need to. He also states that radar receivers and antennas are highly susceptible to radar countermeasures, then points out that modern military radars are now equipped with various ECCM devices that usually will overcome jamming enough to allow a radar operator to work through it. Next the film shows how some of these fixes, such as azimuth strobe, interference suppressor, moving target indicator circuits, and a logarithmic receiver are used. Several other receivers and circuits are listed, not to teach what they are like or how to use them, but to indicate that such fixes exist and are incorporated in most ADA radars and should be used when needed. The film shows that ECCM equipment, even though it is sophisticated and ingenious, is never any better than the man who operates the radar. It shows further that considerable intelligence, initiative, study, training, and practical experience are required to become a first-rate radar operator who can use ECCM fixes effectively to read through interference. After assuring members of the audience that they, as radar operators, will be given every opportunity to excel in their field, the film discusses some of the factors which contribute toward effective training of radar operators to work in an ECM environment. Some of these factors are classroom study, published information, group discussions, familiarity with the radar to which the operator is assigned, effective operator and unit maintenance, and practical exercises using engagement simulators.

TF 44-4173, The Direct-View Storage Tube, is designed to orient the audience on the basic theory, principles, and characteristics of the direct-view storage tube (DVST). This 17-minute film shows the DVST in the Nike Hercules application; however, the same basic theory, operating principles, and characteristics prevail when this tube is used in other radars.

Using a variety of closeups of the scopes, the main capabilities and characteristics of the DVST are discussed. These capabilities include storage and integrating video information over a long period of time, generating a tail through controllable persistency, locating targets after a lapse of time, distinguishing moving targets from stationary targets, making rapid evaluation of scope video (direction and speed of moving targets), manual erasing, and operating under comfortable lighting conditions. Using animation, the interior of a DVST is shown with key elements explained. The addition of the flood gun and storage surface, the two main differences between the DVST and the conventional cathode-ray tube, is pointed out. The three main sections of the DVST—writing, flood gun, and viewing—are demonstrated and discussed in detail. Both the dynamic and manual (static) erase modes are explained.

TF 44-4209, Air Defense Artillery Weapon System, Chaparral, Self-Propelled—Part IV: Missile Loading and Unloading, discusses and demonstrates the techniques and procedures involved in loading, unloading, and testing Chaparral missiles. This 17-minute film covers the individual and collective duties of squad members in the Chaparral missile loading procedure. As the squad members gather near the launch station, the senior gunner prepares the mount for loading, then climbs down and positions switches and breakers on the master control panel for safe loading. The squad leader selects and designates the first missile to be loaded. Two crewmen prepare the launch rail for loading; then the squad removes the missile from the stowage bin, removes it from the case, and loads the missile on the rail. When all missiles are loaded with wings and fins installed, missile testing procedures are shown. Then the unloading procedure is demonstrated. The senior gunner again prepares the mount control panel and master control panel to insure that the launch station is in a safe condition. Safety streamers are inserted. The squad dismantles the missile to be unloaded, removes it from the rail, and places it to one side for placement in stowage after the new missile has been loaded. The selected missile is then loaded following procedures shown earlier.

DIVISION AIR DEFENSE OFFICER

Current Army doctrine places the Chaparral/Vulcan (C/V) battalion as part of the division base. The C/V battalion commander is also the division air defense officer and has equal status with other general and special staff officers in regard to planning aspects of the staff. It is essential that the C/V battalion commander have this equal status to facilitate proper and timely execution of any planning guidance which may be issued by the division commander or his designated representative. As a special staff officer, the C/V battalion commander also advises the division commander on all air defense matters within the division area of operation, including Redeye.

Should the C/V battalion be placed subordinate to division artillery (as an alternative), the following unsatisfactory conditions may prevail.

True responsibility for air defense artillery matters would be that of the division artillery commander.

Although the C/V battalion commander is the division air defense officer, recommendations on proper defense priorities and other air defense artillery matters would follow the "chain of command"; i.e., through the division artillery commander.

CHAPARRAL HYDRAULIC TEST

Users of the Chaparral depot support/general support toolkit (FSN 4935-167-8565) are cautioned that the flexible hose furnished with the hydraulic hand pump assembly (FSN 5130-134-7845) should be pressure tested prior to use. At USAMMCS one of these hoses ruptured at about 2,700 psi the first time it was used. The hose is rated at 2,850 psi. This pressure may be reached or exceeded during normal operation. Hose failure could be a personnel safety hazard.

—Missile and Munitions Materiel Digest

HAWK MAINTENANCE SHOP CATHODE-RAY TUBE

If you need a cathode-ray tube (CRT) for your 0-scope, in any of the Hawk maintenance shops, insure that you requisition cathode-ray tubes, FSN 5960-850-8896, and that the requisition includes the statement "Only CRT's manufactured by Dumont-Fairchild are acceptable for Hawk application." Tubes manufactured by General Atronic are too long to fit into the chassis on the console. The tube will not focus properly; therefore, it is not Hawk-acceptable. The Director, Arsenal Support Operations, Redstone Arsenal, Alabama, has initiated an equipment improvement report, and action is being taken to withdraw CRT's manufactured by General Atronic.

—Missile and Munitions Materiel Digest

VULCAN TEST

Reference TM 9-4933-210-14, page 5-35, step 27. After performing step 27, the test lead should be removed from TP 5 and then reinserted after establishing switch positions for step 28. Failure to do so will result in extensive damage to the control panel because +24 volts is shorted to ground when continuity check switch passes through position 6.

—Missile and Munitions Materiel Digest

MISSILE ELECTRONICS AND CONTROL SYSTEMS DEPARTMENT

ELECTRONICS INSTRUCTION

If there is a better way to teach electronics, find it! That's the attitude of our Missile Electronics Division. An example of this attitude can be seen in the realinement of the program of instruction. For many years electronic theory has been taught in long periods of up to 14 weeks at the beginning of the missile system courses. The student was often required to absorb facts at the beginning of the course that would not be used until many months later, after he advanced to radar or missile training.

The change in the program of instruction permits the placing of a group of subjects in a block of instruction using the functional context method of teaching. The material is taught when the information is necessary to the block of instruction being taught; e.g., the theory of transistors with transistorized equipment.

Another example of changes to improve electronics instruction is the combined classroom-laboratory teaching concept. Under conventional instruction, subjects that required eight periods to teach were presented to the student by teaching theory during the first four periods, followed by four periods of laboratory work. By using the classroom-laboratory technique, all material is taught in the laboratory. Student desks are in the center of the laboratory, and the benches for practical work are located along the walls. This arrangement permits the instructor to teach and demonstrate a key point, then have the student go immediately to his laboratory position to prove the newly learned theory.

In the near future the department will receive new training devices for basic electricity and electronic subjects. This equipment will be used in the combined classroom-laboratory environment. The instructor will use a large demonstrator to teach the students the fundamentals of electricity through advanced electronic circuits. The students will use smaller, identical training aids for their laboratory experiments.

In the area of computer science the Digital Technology Branch provides instruction on the fundamentals of automatic data processing. The material can be divided into the following major categories: number systems, digital logic, stored program concept and central processing unit, assembly and compiler language programing, flow charting, and automatic data processing system analysis. Digital technology instruction is offered to both enlisted and officer students. The enlisted courses are maintenance oriented and provide the student with a solid background for maintenance-related jobs. Officer courses, more diversified, give the officer a general background in computers, thus enabling him to perform proficiently in assignments where automatic data processing is involved.

In keeping with new and better teaching methods, the Digital Technology Branch also combines the conference-type class with practical exercises (PE's) and demonstrations. In support of the PE's the Branch is equipped with five Varian 620 training computers for student use.

In the future this Branch will have increased computer capabilities as it continues to stay abreast of the fast-moving computer field. Instruction will be given in the BASIC

computer language, one of the newest languages in the computer field that is gaining wide acceptance. The language is simple and easily learned. Consequently, less time is required for theory and more time can be allotted to writing different types of programs.

During fiscal year 1972 additional computers and peripheral equipment will be added to provide training for Safeguard and other future air defense systems.

NONRESIDENT INSTRUCTION DEPARTMENT

NEW ELECTRONICS COURSE

On 1 April 1971, the Nonresident Instruction Department, US Army Air Defense School, Fort Bliss, Texas, began offering a comprehensive course in Basic Electronics consisting of five subcourses. The subcourses, shown below, provide a detailed self-study program including mathematics and basic electricity, electronics, transistors, and computer fundamentals. Subcourses are administered in the order listed.

Subcourse title	Subcourse number	Credit hours
Basic Electricity	ADA 983	29
Electronics, Part I	ADA 984	19
Electronics, Part II	ADA 985	26
Computer Fundamentals	ADA 986	28
Transistors	ADA 987	23
	Total	125

Certificates of completion are awarded for each subcourse completed satisfactorily. A diploma is awarded for satisfactory completion of the entire course.

Enroll NOW by completing one copy of DA Form 145, Army Extension Course Enrollment Application, and submit it through channels to:

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

Notes From
US Army Air Defense Center and Fort Bliss

CHAPARRAL/VULCAN TRAINING CONVERSION REDUCES COST OF COURSE

In keeping with the Department of the Army's Resources Conservation (RECON) Program, the US Army Air Defense Center and Fort Bliss (USAADCENFB) saved American taxpayers $2.7 million in fiscal year 1971 by the conversion of advanced individual training in the Chaparral/Vulcan weapon systems into two separate courses of instruction.

Before November of last year, Chaparral/Vulcan trainees received instruction on both weapons and fired both during an 8-week course. Since November soldiers just out of basic combat training have been receiving instruction on either the Chaparral (a missile air defense system) or the Vulcan (an automatic firing air defense weapon), but not both.

With the segregated training, ammunition and targets used (and consequently the cost of the training) are reduced by nearly one-half.

This cost reduction, when prorated against a projected number of crewmen to train in future courses at USAADCENFB, will save the Government an estimated $15.5 million over the next 3 years. This savings has been audited and validated by the US Army Audit Agency at Fort Bliss.

The new training procedure was implemented here after a four-man panel conducted a study at the post in early 1969 to determine where a change in training operations would improve national air defense as well as reduce costs. The study revealed that the crewmen trained on both Chaparral and Vulcan during their advanced individual training did not have satisfactory proficiency levels. As a result, Department of the Army was asked to authorize separate training on the two weapon systems. The request was granted and the first separate Chaparral advanced individual training class began 9 November 1970. The first separate Vulcan class started 2 weeks later.

Today's air defense men graduating from the 1st Advanced Individual Training Brigade's 4th Battalion are given MOS 16P for Chaparral or MOS 16R for Vulcan. Previously, students graduating from the Chaparral/Vulcan combined course were awarded MOS 16R.

ADJUSTMENTS IN ARADCOM STRUCTURE

In March 1971, 27 of the US Army Air Defense Command's (ARADCOM) Nike Hercules fire units were designated for inactivation, to be completely closed out prior to 30 June. This action left a total of 52 Nike Hercules and 16 Hawk fire units still providing terminal defense for the continental United States against the manned bomber threat.

The term "fire unit" is used instead of "firing battery" to prevent confusion about the number of batteries being inactivated. Remember, each Nike Hercules battery is comprised of a single fire unit, whereas each Hawk firing battery, depending on whether it is towed or

self-propelled, is comprised of two or three fire units. In ARADCOM there were two exceptions in the Nike Hercules deployment: dual batteries in two cases or two completely separate fire control and launching facilities in a single battery. In the recent inactivations, one of the dual batteries was left intact while the other was cut in half. Therefore, while 27 Nike Hercules fire units were inactivated, only 26 firing batteries were lost.

The Army National Guard has been manning many of ARADCOM's sites for several years. Since the cutback, the National Guard is manning 27 fire units and the Regular Army is operating 25 fire units.

A total of 11 headquarters elements were also placed on the inactivation list. These include 2d Region Headquarters at Selfridge Air Force Base, Michigan, and the 17th Group Headquarters, Hampton Roads, Virginia.

Among the defenses that have been completely closed out are Minneapolis, the Milwaukee units of the Chicago-Milwaukee defense, and the Cleveland elements of the Detroit-Cleveland defense.

Here is a breakdown of the Nike Hercules fire units remaining in each defense:

Miami-Homestead	4
Washington-Baltimore-Norfolk	10
New York-Philadelphia	10
New England	4
Pittsburgh	4
Chicago	4
Detroit	3
Seattle	3
San Francisco	4
Los Angeles	6
Total	52

Hawk deployment remains the same.

Boundary adjustment shows two regions, 1st and 6th, and also the 31st Brigade at Miami-Homestead, with its area of responsibility. Each of these report directly to ARADCOM. The total number of defenses is 11, with Key West added to the 10 listed above. Further changes will be reported as they occur.

Notes From the US Army Combat Developments Command

DOCTRINE

The USACDC Air Defense Agency is working closely with the other Center Team members and the Field Artillery Center in developing a detailed concept for a brigade-level airspace coordination element (BACE) to extend forward the current division ACE capability. An additional service to be provided by the BACE is fire support warning to airborne aircraft to prevent conflict with field artillery fires. The BACE will be manned on a minimum basis, will be collocated with the brigade fire support coordination center (FSCC), and will, to the maximum extent, share FSCC displays and other facilities.

The Agency has developed a draft Army Airspace Management Handbook which contains step-by-step proposed procedures for all airspace users. Emphasis is on detailing the coordinating procedures required at the interface of all the various branch-oriented systems. Communications requirements are also tabulated. Procedures cover all levels from the maneuver battalion S3 air to the field army airspace coordination element (ACE) in a variety of airspace activities. The handbook is presently undergoing field review.

TROOP TEST

A division air defense troop test is currently scheduled for mid-1972. The division to conduct the test has not yet been selected. The Agency is developing the plan of test to include test objectives, essential elements of analysis, and test methodology. Problem-area input, based on field trips to selected divisions, will be considered during development of the detailed plan. Emphasis will be on collecting data on the adequacy of division air defense organization, command and control, and the airspace management system in a hostile air environment. The test will be a sequel to the Redeye Troop Test conducted at Fort Campbell in 1967.

STUDIES

The USACDC Air Defense Agency recently furnished major support to the DA-level Air Defense Evaluation Board (ADEB) study effort. The ADEB study reports on the comparison of effectiveness and cost of alternative air defense families. Five alternative families and a number of variations on the basic alternatives were compared. Each family consisted of one or more high-to-low altitude air defense components and three short-range air defense components. Systems used as high-to-low altitude components were Improved Hercules, Basic Hawk, Improved Hawk, and several versions of the SAM-D system. The short-range components consisted of both basic and improved configurations of Chaparral, Vulcan, and Redeye. Each family variation defended a large area in an air defense combat computer simulation. Based on this study, the most cost effective defense for the 1980-90 decade was determined.

Notes From the Human Resources Research Organization

DIVISION NO. 5

1. Technical Report 70-24, Shape Perception Judgments as a Function of Stimulus Orientation, Stimulus Background, and Perceptual Style, is based on research conducted by HumRRO Division No. 5 at Fort Bliss, Texas, as part of a basic research effort (BR-16) in determining important factors that influence pattern recognition. The results of this basic research will guide the design of more applied research in perception, especially in the area of recognition training.

2. The following research is planned for FY 72:

a. Work Unit INTERFACE has the objective of developing effective and economical training methods together with associated simulation devices and training aids for use in electronics maintenance training under conditions of limited availability of operational equipment. The procedures, methods, and materials developed in this research will permit Army schools, particularly the US Army Air Defense School, to develop effective training programs that require a minimal amount of operational equipment. As a result, student proficiency will be insured and the cost of training in time and equipment will be reduced. Research will be conducted primarily in support of the Low Altitude Air Defense Department and Safeguard Central Training Facility. The effort will also involve the Missile Electronics and Control Systems Department.

b. Work Unit SKYFIRE will continue its research objective to determine man's capabilities to perform the operator skills required for forward area weapons and identify effective training concepts for developing the required skills.

c. Work Unit SKYGUARD will deal with curriculum and instructional improvements for the Air Defense Artillery Officer Advanced Course.

d. Basic Research 16 will deal with improving ability to see military targets.

e. A new exploratory research effort will begin with the objective to develop procedures and materials for training and evaluating Army instructors to improve their classroom effectiveness.

3. Two research efforts will terminate at the close of FY 71:

a. Work Unit MANICON, which dealt with the determination of performance capabilities and training requirements for manual command and control functions of automated air defense systems.

b. Exploratory Research 83, which dealt with the General Educational Development Program for the Army with the objective of developing a functionally oriented GED program.

4. During the 3d quarter of FY 71, HumRRO Division No. 5 provided 35 man-days of technical advisory service to agencies at Fort Bliss which were, in many cases, work unit related but not included in the direct research effort.

How to Hit With Vulcan
A Response to The "Munroe Doctrine"

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Editor's Note:

"The Munroe Doctrine or How to Hit With the Vulcan" in the January 1971 issue of Air Defense Trends has been termed in some quarters as an oversimplification of the job of clearing the skies with Vulcan. We were reminded that this firing technique does not appear in the current family of Vulcan manuals, nor has it been accepted by the US Army Air Defense School or Department of the Army. Even though the technique has not been adopted, this fact did not prevent Sam (the gunner in the article) and his cohort from talking about it. General Electric Company, maker of the Vulcan system, has provided an interesting and informative followup article on the low-altitude air defense problem and the Vulcan solution. Some think that an uncritical acceptance of the ideas expressed in the original article might lead to wasteful use of Vulcan. This article is intended to present a simple explanation of the gun low-altitude air defense problem, the Vulcan solution, and the advantages and disadvantages of Lieutenant Colonel Munroe's doctrine.

Pointing and Firing Guns to Hit Aircraft Targets

To hit a moving aircraft target a projectile must be fired from a gun which is aimed at the correct gun pointing angle. The correct gun pointing angle is made up of the present position of the target plus the lead angle and the superelevation. The lead angle is the angular amount the gun must be pointed ahead of the target. Lead angle is basically determined by the target's angular rate, multiplied by the time of flight of the projectile.

At any instant, there is only one correct gun pointing angle in the one-gun, one-bullet, one-target situation. Air defense fire control attempts to calculate that gun pointing angle and to insure that the gun is pointed correctly and continuously. It is possible to find that position momentarily by sweeping through it—if the direction of the swept path is properly chosen. The gunner who is "sweeping through" must fire at exactly the right instant—or must maintain continuous fire before and after he sweeps through the correct position so as to be certain of firing at the right time. Only those few rounds fired at the right instant could hit the target.

Vulcan Fire Control Theory and Operation

The Vulcan fire control system uses a gyroscope in the sight to determine the correct gun pointing angle. Basically, the gyro spin axis is pointed at the target along the line of sight so that the rate of motion of the gyro axis is the target angular rate. A torque is applied to the gyro by an electromagnet to cause the sight to follow the target. The method of application of this torque is used to carry out the multiplication of target angular rate by time of flight and thus to determine the lead angle. The magnet axis is mechanically held parallel to the gun's firing barrel.

The Vulcan fire control depends, then, on correct alinement of the gyro spin axis (shown by the sight reticle) with the target; i.e., smooth tracking; and upon the correct value of electromagnet strength (determined by time of flight, hence by range to the target).

For the Vulcan system range may be determined in one of three ways:

- Radar range input from the range-only radar (radar mode).
- Manual input (knob setting) by the gunner (manual mode).
- Manual input (knob setting) by another man off-mount (external mode).

The radar mode range input is continuous, and if the gunner tracks smoothly, he will have a continuously correct solution. In the manual mode range input is intermittent at best and usually can be made only once during a target pass. Correct lead angle will be obtained only when the target is at or near the preset range. In the external mode the range input can be almost continuous, but its accuracy depends entirely on the range estimation capability of the off-mount observer.

The Vulcan gunner, in addition to tracking the target, must exercise judgment as to when to fire. In radar mode he bases his firing decision almost entirely on his tracking performance and his sight picture, and likewise in the external mode. In manual mode he must endeavor to fire when the target is at or near his preset range. (In external mode there can be an additional element; the observer can signal the gunner to fire by means of the ready-to-fire lamp which is under the observer's control.) The Vulcan gun system provides an element of controlled dispersion which is intended to overcome or mask the effect of system and gunner errors. This is done by a muzzle clamp which deliberately bends four of the six Vulcan gun barrels so as to enlarge the burst pattern.

The Munroe Doctrine

The Munroe Doctrine is a nontracking technique. As set forth by LTC R. H. Munroe in his memorandum on this subject, it contemplated a sight-overtaking-target procedure, or "sweep through," to be used either with the sight operative or the sight inoperative:

> "3. The nontracking technique is that of overtaking the target from the rear at a rate of traverse that will cause the sight to pass through the target along its longitudinal velocity vector and continue beyond the front of the target. The gunner will commence firing as the sight passes the nose of the target. (This may be refined so that he fires a target length or so beyond the target.) The gunner continues to increase the lead while firing.
>
> "a. Sight Operative. The technique is applicable when the computing sight is fully operational in that the gunner provides a smooth rate input albeit larger than is required at a given instant. Since a lead is generated, we may find that firing must commence as he reaches the tail of the aircraft.

"b. Sight Inoperative. The technique applies in the same manner as with the operative sight with the exception that the gunner fires later to account for the lack of a computer generated lead."

Comments on the Munroe Doctrine: Sight Operative

In the sight operative mode the Munroe Doctrine can be shown to be a valid firing technique which will produce hits in a nontracking situation. Provided only that the range input to the Vulcan gyro lead computing sight is reasonably correct, the gunner may sweep his reticle over the target, either overtaking the target or allowing the target to overtake the reticle. In either case, the gunner should fire early, before his reticle coincides with the target—approximately one time of flight before coincidence—about $1\frac{1}{2}$ seconds early at 1,000 meters range. That this is so can be seen from the following discussion. When the gyro lead-computing sight is used in its proper tracking mode, the sight reticle basically shows where bullets fired now will be, after the time of flight has passed, when they reach the range of the target. Since the gunner is tracking, the reticle stays on the target and the bullets fired at any time reach the target after one time of flight has elapsed. In the nontracking mode, however, if the reticle is overtaking the target, the sight is still computing lead angle for a target; i.e., for an imaginary target moving at the angular rate of the reticle and located at the range of the real target. When the overtaking reticle coincides with the real target, it indicates that bullets fired from the gun one time of flight before that coincidence will hit the target at coincidence. The same reasoning applies to the target-overtaking-reticle situation.

For the above situation to hold, range data must be continuous—either the radar must not break lock or range must be manually set; the overtaking rate of the reticle must be within the operating limitations of the sight. As a refinement, the firing burst should be started approximately one time of flight plus one-half the time duration of the burst before estimated coincidence will occur, so as to distribute the burst before and after the point of coincidence.

This method requires the gunner to estimate the time to coincidence—something which appears to be very difficult. However, in simulation trials and in Air Force air-to-air gunnery with similar gyro lead-computing sights, gunners appear to be able to obtain hits with this technique.

Comments on the Munroe Doctrine: Sight Inoperative

In the sight inoperative mode, the successful use of the Munroe Doctrine requires that the gunner sweep through the correct gun pointing position for some present position of the target, and that he be firing the gun as he does so. In the most general case, the correct gun pointing position will involve azimuth and elevation lead angle components, and super-elevation. The caged sight is locked to the gun line in azimuth and has $7\frac{1}{2}$ mils of super-elevation (SE for 1,000 meters ground range) built in. Even for level targets the elevation lead angle to be estimated will be much more than $7\frac{1}{2}$ mils—it may be 15-20 mils.

For targets on crossing courses with appreciable azimuth lead angles; i.e., 10° or more, it would appear to be very difficult to achieve hits by this method. The outer reticle of the Vulcan sight is 60 mils or roughly 4° in diameter. A 10° lead angle means that the caged sight must be leading the target by about $2\frac{1}{2}$ outer reticle diameters.

It is unlikely that a gunner could sweep more than 2 reticle diameters ahead of the target, firing all the time, and simultaneously maintain close enough elevation correspondence to obtain hits. Of course, gun and system dispersion assist to mask errors here also. However, Vulcan is expected to engage targets at up to 25° lead angle. Obviously, performance at such lead angles cannot be obtained consistently with the sweep-through, caged-sight technique.

Vulcan Operating Techniques Which May be Incorporated in SOP

For the general target problem with all fire controls operational (radar, sight, and sight current generator), and with target acquisition (lock-on) at a reasonable range—1,000 meters or more—the designed operating procedure, radar mode, will produce the best results and should always be followed.

For the same type of target, but with radar nonoperational, the designed manual mode or external mode procedure should be used.

For the pop-up target situation with operational fire control, when there is no time to track or accomplish radar lock-on, the Munroe Doctrine sight operative technique may be used, with the system in manual mode. Fire at or before the target reaches your preset estimated range, and fire early—fire one time of flight before target and inner reticle coincide.

For a system with completely nonoperational fire control (sight or sight current generator inoperative), the Munroe Doctrine caged-sight technique may be used. Remember that the entire lead angle is shown by the distance the reticle leads the target along the target's flightpath, and commence firing in accordance with some estimate of the appropriate lead angle for the situation.

Editor's Note:

Now you have the Munroe Doctrine and General Electric design concepts for consideration; however, only published DA doctrine providing for maximum use of the system as it was designed should normally be followed.

4F-1181 Course

The 33-week Guided Missile Systems Officer course (4F-1181) is the end result of a 3-month curriculum in missile aerodynamics, propulsion, guidance, and control theory originated in 1946 by E. L. Safford, Jr, of the US Army Air Defense School's Command and Staff Department. The course, taught by the Missile Science Division of the Command and Staff Department, provides commanders with staff officers capable of analyzing developments and trends in the scientific field as they relate to concepts in the field of missilery.

The curriculum development of this course, and the follow-on graduate program conducted at several universities, is the responsibility of Mr. Safford. He is a recognized professional in the fields of education, writing, and science; and an example of the highly qualified staff that teaches the 1181 course. An indication of his qualifications is his success as an author. He has had 10 books published, most of which provide valuable research material for studies related to air defense. His latest, A Guide to Radio & TV Broadcast Engineering Practices, has recently been published by TAB Books of Blue Ridge Summit, Pennsylvania.

E. L. Safford, Jr
Missile science specialist
and author of 10 science books.

Another book, to be published early next year, is concerned with radar and will show and discuss the role of the air defense missileman in the field. It will also contain information of value to the Navy, Air Force, and National Aeronautics and Space Administration concerning air traffic control systems.

Other instructors currently teaching the 1181 course include Major C. S. Thompson, Senior Instructor, and 14 officer and civilian training specialists.

Did You Know?

Watch this space in each issue of Air Defense Trends for information emanating from the Air Defense Artillery Branch, Office of Personnel Operations, Department of the Army. Questions may be directed to the appropriate action officer whose name and telephone number appear at the end of the related topic.

The information herein is the Air Defense Artillery Branch interpretation of current policies and programs. It is not an official Department of the Army publication.

—Ed.

OFFICER PERSONNEL

ASSIGNMENTS

Value of Diversified Assignments. Branch immaterial assignments, commensurate with an officer's grade, expose him to how the rest of the Army functions, broaden his knowledge of the military, and are vital building blocks to positions of higher responsibility in the Army. Certainly there is a time and place to begin diversification, and assignments of this type should not be undertaken at the expense of developing a sound base of experience as an air defense officer. Normally, an officer can expect these assignments to begin in the grade of major after he has had troop assignments, command, the advanced course, and staff experience at battalion level as a minimum. Air defense officers have performed well over a wide spectrum of branch immaterial jobs. So we encourage you to actively seek these assignments at the proper time and place in your career. It is good for your career, for ADA, and for the Army. (LTC Eye, OX3-1370)

Preference Statements. A preference statement should be updated before you have been on station for one-half of your current tour. Particular attention should be given to second and third areas of preference. We find that nine out of ten of our majors and lieutenant colonels want to be assigned to Fort Bliss or Colorado Springs, and requirements will not generally support that ratio. We have several desirable areas in CONUS and overseas that you should review and indicate on your request. Assignments are normally governed by the following priorities: (1) needs of the Army, (2) career development needs of the officer, and (3) preference of the officer. It is gratifying for us to satisfy all three priorities, and you can help by keeping a current preference statement with more than one option on file.
(LTC Beck, OX3-1052)

Changing Assignments. Many calls have been received recently from junior officers wanting to have their assignment instructions changed from one short tour area to another. It appears that many believe their first short tour will automatically be Vietnam. Others think that because we have very few air defense artillery (ADA) units in Vietnam they will go to Korea. The fact is that requirements vary greatly between these two areas and it is necessary to meet the requirements with those officers eligible at the time of the requirement. If an officer has a preference for one area over the other, he should so indicate in a current preference statement. Once an assignment is made, it remains firm. Exceptions are considered only for compassionate reasons or for overriding operational requirements. You do have a chance to influence the assignment. For example, if you have a strong personal

preference for Vietnam, your personnel officer can show you how to volunteer. Vietnam requirements are filled first with volunteers. The key point is to make your desires for a particular short tour area known before you receive orders. (MAJ Williams, OX3-1177)

Short Tour Turn-Around. Turn-around time for ADA majors reached a low of 20-24 months in fiscal year 1971. This is rapidly improving, and we project by first quarter FY 72 that the figure will be 30-36 months and hopefully will improve to about 40 months by the end of FY 72.

The lieutenant colonel picture is more favorable although we do have a few officers in this grade serving their second involuntary tour in Vietnam. We still have about 50 officers who have not been to Vietnam, however, and in the interest of equity all can expect orders to Vietnam during FY 72.

We feel that short-tour equity among air defense artillery officers is extremely important and that, if we are to maintain integrity among the air defense artillery officers, everyone must pull his share in all short-tour areas and especially in the combat zone.
(LTC Lambert, OX3-1052)

PCS Moves. Tour lengths in CONUS and long-tour areas are expected to stabilize as Army strength in short-tour areas returns to a more desirable balance. Turbulence will be reduced. We will attempt to avoid intra-CONUS moves other than for the most compelling compassionate or operational reasons. Most requirements in CONUS will be filled with officers returning from oversea assignments. Our goal in the branch will be to leave officers on station for at least the tour length specified in current regulations.
(LTC Beck, OX3-1052)

Aircraft Transition and Qualification Courses. The question of an additional aircraft transition or qualification course often arises when an officer receives permanent change of station orders. Indeed, this is an opportune time for a transition or qualification course, but limited quotas present a problem. Allocations for these courses are intended to provide a flow of qualified replacements for aviation units overseas. As a large portion of Army aviation is currently in Vietnam, and the personnel turnover is high, the vast majority of these school quotas are allocated directly against Vietnam requirements. Thus, we are only able to provide this training for officers in conjunction with a PCS, and in only rare instances to an assignment other than Vietnam. (LTC Honsinger, OX 3-1336)

PERSONNEL ACTIONS

Compound Service Obligation. Many questions are being received concerning compound service obligations incurred for attendance at schools. A typical situation is one in which an officer attends a service school and incurs a 2-year service obligation upon completion of that school, but before he completes the obligation for that school, he attends another school which also entails a 3-year service obligation.
QUESTION: What is his total service obligation?

ANSWER: His service obligation upon completion of the second school (or course) is the remaining obligation for the first course plus the 3 years incurred for attendance at the

second course. The time spent in the second course does not count toward fulfillment of the service obligation incurred by the first course.

EXAMPLE: Applies to officer who completes 1181 course and 1 year advanced civil schooling.

Date officer completes 1181 course	1 July 1972
Service obligated to (2 years)	1 July 1974
Starts master's degree (AR 350-200)	1 July 1973
Completes master's degree	1 July 1974
Obligated to (remain 1 year for 1181 course and 3 years for civil schooling)	1 July 1978

If, at the completion of the subsequent course, the obligation totaled more than 4 years, it would normally be reduced to 4 years.

EXAMPLE: Applies to officer who completes 1181 course and 18 months' advanced civil schooling.

Date officer completes 1181 course	1 July 1972
Service obligated to	1 July 1974
Starts master's degree	1 July 1973
Completes master's degree	1 January 1975
Obligated to (1 year remaining for 1181 course and 4 years for advanced civil schooling)	1 January 1980
In this case the obligation is reduced to 4 years after completion of the last course.	1 January 1979

In short, there are three points to be remembered about compound service obligations: (1) Service while attending a course of instruction is not credited toward obligated service resulting from an earlier course; (2) service obligations are computed forward from the date at which attendance at the course of instruction is completed or terminated; and (3) when more than one service obligation is incurred, the obligations run consecutively and not concurrently up to a maximum of 4 years. (MAJ Buff, OX3-1375)

WARRANT OFFICERS

Safeguard: How do I get into Safeguard? This appears to be the question of the day among warrant officers.

A good first step is to let your desires be known through a preference statement. (Yes, we do look at them!) We are looking for warrants who have shown that they can do a good job consistently. The ideal candidate for Safeguard duty would have the following qualifications:

a. High demonstrated manner of performance.

b. Well-seasoned from the standpoint of experience.

c. Technical expertise (hardware knowledge and some college background).

d. Retainability in the service.

e. Availability for reassignment.

A warrant officer who has had no oversea tour and who has been in CONUS for 3 or 4 years has little chance of being selected for the program until he completes an oversea assignment. Presently the program is still in the development stage, and only a limited number of warrant officers are needed. When deployment begins, the demand will increase and we will be looking for a much larger number of warrant officers to begin schooling in the systems. However, there is no firm time schedule on this yet. Your selection for this, and nearly every other program, is enhanced by maintaining a high degree of performance in your assigned duties. (MAJ Williams, OX3-1177)

Long-Range Active Duty Program (LRADP). The Department of the Army Active Duty Board, which was convened for the purpose of making selections for FY 72 Long-Range Active Duty Program, has adjourned. Those warrant officers selected will be notified by The Adjutant General in the immediate future. Those warrant officers who attain 20 or more years of active Federal service in FY 71 and FY 72 and who have not been considered for retention for the LRADP will be retained on active duty for consideration for the FY 73 retention program. (LTC Forte, OX3-1375)

Regular Army Appointment. The Department of the Army Regular Army Selection Board is in continuous session. Appointments as Regular Army warrant officers will be tendered to selected individuals to fill Regular Army vacancies within MOS's 221, 222, 223, and 224. All eligible warrant officers are encouraged to submit applications in accordance with the provisions of AR 601-101. (LTC Forte, OX3-1375)

ENLISTED PERSONNEL

Enlisted Preference Statement. Because of failure to submit a current enlisted preference statement (DA Form 2635), many senior NCO's are not considered for assignment to the job, station, or area of their choice. Preferences listed on the most recent preference statement in an individual's file are reviewed prior to determining a new assignment. The absence of this document or the presence of one that reflects outdated information may result in an unwanted assignment.

A commonly heard statement during interviews by the Senior Enlisted Control Division, Enlisted Personnel Directorate, OPO, is, "I gave my new preference statement to my unit personnel staff NCO—I can't understand what happened to it."

A missing or outdated preference statement can easily be avoided for NCO's in grades E-7 through E-9 by mailing a copy of this form to the Office of Personnel Operations, Enlisted Personnel Directorate, ATTN: EPCMS, Washington, D.C. 20310.

Here are some tips on filling out your preference sheet:

- Do not include in your preference an area where your MOS is not authorized. Example: An air defense artillery or harborcraft man should not request an assignment to Fort Rucker, Alabama.

•List several preferences and make them specific—an Army area is too vague. Do not cluster all your choices in the same area—if you list Miami, Palm Beach, and Hollywood Beach, you may have to settle for Alaska.

•Do not forget to fill in the "type of duty preferred" block.

•If you volunteer for an intertheater transfer (ITT), name the country to which you want to be assigned. And remember, a check in a "volunteer" block is the same as a volunteer statement.

In summary, a preference sheet can further your Army career and help accommodate your desires. While your assignment must fit the needs of the service, your preference is important in the assignment process. It receives great consideration, so keep it accurate and current.

Senior Graders With Physical Limitations. One of every six senior NCO's has a physical limitation which affects his assignment and utilization. If you are one of these individuals, Department of the Army is now stressing tighter reclassification monitoring which could affect you.

Commanders are being asked to consider the following points before initiating or forwarding reclassification actions:

•Has the individual had a fair chance to perform in his job and show what he can do?

•Has reclassification to a related MOS been considered before recommending a reclassification into an unrelated MOS? For example, was an E-8 with MOS 11B and a permanent hearing profile recommended for MOS 11F, a staff-oriented infantry MOS, or was the recommendation for an MOS in which his years of experience are of little use?

•What physical standards are used for judging a man's performance? Note that AR 611-201 standards are meant for entry into an MOS, not for retention purposes. Physical limitations are more significant to personnel in lower skill levels than to senior grade personnel in supervisory roles.

For the individual with a physical limitation, have you considered this?

•Reclassification to an unrelated field may have an adverse effect on your career.

•You are naturally not as competitive in a field in which you have limited experience.

•If you are now in an MOS incompatible with your physical capacity, have you prepared yourself for a new MOS by taking advantage of the Army's correspondence course programs? Do you have a secondary MOS?

It takes time. Department of the Army frequently receives calls from E-1— E-6 enlisted men in distress because they have submitted applications for oversea service and then waited a month or more with no word. It may be useful to know what happens to an application when it reaches DA.

To begin with, all applications must be submitted through the personnel office at unit level. They are then routed through the chain of command for a recommendation at each level. Applications for Vietnam must be forwarded to DA regardless of approval or disapproval. This, however, is not required when other areas of choice are involved; major headquarters may disapprove them. Disapproved applications are routed back to the volunteer.

Applications are normally received at Department of the Army about a month after submission. They must then go through several phases of data processing which require approximately another month. Thus, on the average, from the date an application is submitted to the date assignment orders are issued, at least 2 months pass. So a soldier considering applying for oversea assignment should plan accordingly. It takes time.

Credit to Vulcan

Medal of Honor holder Captain Harold Fritz credits the Vulcan weapon system pictured here with saving his life and the lives of 40 members of his unit in Vietnam on 11 January 1969.

"MEMENTOS" - Captain Harold Fritz, Medal of Honor holder for combat actions in Vietnam, is pictured with a photograph of the Vulcan air defense system which he manned during the action that earned him the nation's highest award. The framed photograph of the Vulcan air defense system was recently presented to him by Major General H. A. Rasmussen, Commanding General, US Army Weapons Command.

Captain Fritz was awarded the Nation's highest medal for heroism during the action on that day. He said, "The survival of my unit during the first few critical minutes of the ambush can be attributed to the Vulcan's ability to engage the enemy quickly and place a high volume of fire on the target. The tremendous shock and sound of the weapon firing 3,000 rounds per minute of 20-mm high-explosive ammunition was the critical factor in stopping the assault. Initially, the Vulcan gunner could not see the assaulting forces because of dust and smoke, so the Vulcan gunner started firing into the most likely area of enemy concentration. The shock and sound caused the assault to waver." Enough time was gained for

Captain Fritz, although critically wounded, to direct the fire of the Vulcan into the assaulting troops, organize his unit, and stop the assault.

The action took place close to fire base Thunder III on Highway 13 near Quan Loi, Vietnam. Captain Fritz's unit was clearing the road for a convoy from Saigon to Quan Loi when his force of six armored cavalry assault vehicles and one Vulcan was ambushed by approximately 200 well-equipped North Vietnamese troops. During the initial exchange of fire, severe damage was inflicted on the vehicles and many of the troops were wounded. Captain Fritz's vehicle was hit and he was seriously wounded. Two gunners were killed.

The crew of the Vulcan immediately took the enemy attackers under fire. In the first critical minutes of the ambush, its fire was the only effective firepower from friendly forces directed against the enemy.

Captain Fritz was able to move to the Vulcan and direct its fire into the enemy assault and delay the attack long enough for him to regroup his unit, remove machineguns from destroyed vehicles, and establish a defensive position.

A relief force consisting of a tank platoon and one Vulcan was summoned from Thunder III, the closest fire base. The relief force arrived in the ambush area approximately 35 minutes after the fight began. The battle continued for about 4 hours, but it was the first 35 minutes, and particularly, the first 2 or 3 minutes, that were the most critical according to the young captain.

Captain Fritz stated, "Without that single Vulcan, the unit would have been annihilated right then!"

The Commanding General, US Army Weapons Command, recently presented a picture of the Vulcan employed in the engagement to Captain Fritz who said, "I am Vulcan's most ardent supporter because I know that if it had not been for Vulcan I wouldn't be here today. Vulcan is an outstanding weapon for the type of ground missions that the 11th Armored Cavalry performed in Vietnam. There just isn't another weapon available that can place such a tremendous volume of fire on a target so fast. The turret reacts so quickly that the gun is immediately ready to fire. The tremendous shock and sound of the gun has a devastating effect on the enemy. I believe that the first few bursts fired in that ambush did not actually hit the enemy, but I do believe that they were stopped by the shock and sound of the weapon. Then the gun was able to shift from one group of assaulting enemy on one side of the road to the other side of the road and hold that assault long enough for me to organize the defense."

Captain Fritz thought that the Vulcan ground role capability should be further studied and developed. "It is an ideal weapon for convoy escort, reconnaissance, and other missions that require high mobility and tremendous firepower," he said. "I think that a platoon of four to six ground role Vulcans should be assigned to every combat battalion. In a tank battalion, for instance, the battalion commander could use the Vulcan to beef up his reconnaissance platoon when he has a particularly heavy job for them to perform. He could attach the platoon to his companies when their mission dictated, and he could use them to escort his gas and ammunition trucks when his lines of communications were not secure. Also, I believe

he would sleep a little better knowing a couple of them were in his CP area. I did not use the Vulcan in its primary air defense role, but it appears to me that a few of these in each battalion area would certainly add to the overall air defense capability."

"But on that one day in Vietnam, it was just a case of having the right gun at the right time in the right place. We just would not have made it without that Vulcan," he concluded.

Air Defense Communications–Where Does It All End?

Lieutenant Colonel Roscoe H. Munroe
US Army (Retired)

Army air defense communications, having grown in sophistication, complexity, and cost over the years, have reached the point at which a complete reevaluation of the requirement is needed to determine precisely which communications are actually required to perform the mission and which fall in the luxury category. The luxuries must then fall by the wayside so that resources can be more appropriately applied to the real necessities.

Currently communications are oriented toward the philosophy of centralized control despite innumerable studies that state decentralized control is more practical, desirable, effective, and economical. The current system has grown to consume a considerable amount of assets that could better be applied to the development of improved identification devices and/or weapons.

The unique nature of the air defense mission and the manner in which it has been pursued has caused air defense artillery to be almost separate from the rest of the Army. This, coupled with the fact that few active duty personnel have experienced the horror of being on the receiving end of an air attack, has caused the air defenders to have a tremendous selling job on their hands to "rejoin" the Army. Symptoms of the situation are the "let George do it" or "God will provide" attitude of many as regards air defense; the thought that Army air defense responds primarily to the Air Force as opposed to the Army; and the existence of what amounts to a separate chain of command in air defense that is parallel to, but separate from, the Army chains of command. This situation has resulted from a certain interpretation of "integrating" air defense resources and an approach to defending airspace as opposed to defending military assets. The integration of resources is an obvious requirement to provide the most protection to military assets at the least cost. However, integration concepts can be decidedly different yet accomplish the same results and not require the costly and cumbrous systems in being today. The difference lies in the approach.

The simplest approach is that of giving the field army, corps, division, brigade, battalion, and company commanders those air defense resources needed to defend their assets and letting them control them for their best defense. This is by no means to imply a lack of control or flexibility that would endanger friendly aircraft. It is a simple approach, the simplicity of which supports success in battle, as opposed to approaches that fail because of their complexity. Army air defenses would be coordinated with the Air Force in that the deployments and capability of each would be coordinated with the Air Force so as to be considered in the development of the overall force air defense plan. Army air defenses would still respond to changes in rules for engagement so that friendly aircraft would not be endangered. This environment, in fact, integrates the defenses but is not "controlled" on virtually a shot-by-shot basis at a high level as is the current trend.

The current communications recommended for air defense brigades and groups seem as though the list were prepared by a firm interested in selling communications equipment. It consists of numerous radio-teletype, VHF/UHF multichannel data links, HF/AM/SSB voice,

and the area communications system nets. Many are backup nets to principal nets, the need for which is open to serious question.

Communications must satisfy the needs of the functions of command, operations, logistics, and intelligence. These needs can be realistically and economically met by voice, radio, teletype, and the area communications system. Air defense artillery (ADA) battalions have differing amounts of communications depending on the type of battalion and proposed deployment. The Chaparral/Vulcan battalion represents the fundamental communications need that should be applied to other units; i.e., the need has been satisfied predominantly by FM and SSB (AM). This approach has been approved and implemented by Department of the Army and will hopefully cause the "real" need for communications in other units to be questioned.

The current communications monstrosity evolved under the philosophy that tight control must be maintained to prevent irresponsible triggering of a nuclear holocaust or destruction of friendly aircraft. It smacks of hysterical emotionalism. The air defense artilleryman must be recognized as a trained human being who is rational and who can be relied upon to do his job with a reasonable amount of commonsense. It appears that the upcoming command, control, and coordination system is oriented toward salving the consciences of overworried people during peacetime and that when "the balloon goes up" the system will fail and ADA will fight as it really should. Therefore, money should be spent to satisfy a wartime need. Si vi pacem parabellum (If you wish for peace, prepare for war) should be the guiding philosophy in the development of any military system, and, if done, can satisfy the requirements for both peace and war.

The advancements made by Army air defense have combined to cause the Army to have, for a number of years, a far greater capability for defending military assets than the Air Force. Army air defense is similar to the neighborhood fire department in that it is in the neighborhood all the time and is available for instant use. Although roles and missions are not the primary purpose of this paper, a reevaluation of roles and missions, as they pertain to air defense, appears to be in order. It also appears that the Army is best suited for the defense of military assets and, if it were given primary responsibility for the performance of that mission, the Air Force could be freed to concentrate on the gaining of air superiority, striking strategic targets, interdicting the battlefield, and performing air defense only in a gap-filler role.

The following steps are recommended as remedial actions to simplify, improve, and economize in the air defense of military assets:

- Use whatever IFF is available at the time as the primary means of identification for radar-directed systems. Augment this means by early warning and adherence by high-performance aircraft to simple air traffic control regulation (fly over 10,000 feet above ground level unless previously coordinated with the Army). Expedite the improvement of the identification capability.

- Obtain Army block airspace.

- Assign primary responsibility to the Army for the defense of military assets.

- Coordinate Army air defenses with the Air Force in the sense that USAF is advised of Army operations.

- Implement those communications required to perform the mission.

- Avoid adding communications "because the capability is there and for just a little more we can have this added sophistication."

- Use SOP to preempt the minute-to-minute control of standard activities by a higher echelon.

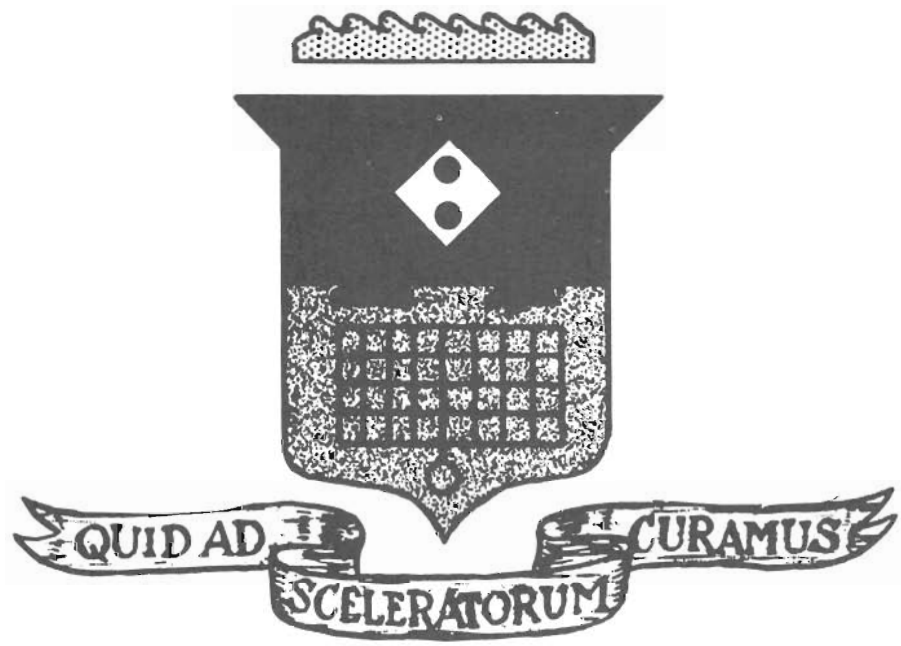
- Train air defense artillerymen to operate in the foregoing environment.

- Rely on the air defense artilleryman, after training, to react as trained.

- Provide organic air defense to each echelon; i.e., field army, corps, division, brigade, battalion, and company to protect the vital assets of those forces.

- Eliminate the current parallel chain of command for Army air defense units.

U.S. ARMY AIR DEFENSE



GUIDED MISSILE LORE

We introduced "Guided Missile Lore" in the June 1971 issue, and everyone was invited to join in contributing air defense stories, jokes, and anecdotes for publication. Send whatever you have heard, read, or created to the Editor.

Here are some more examples of what we are looking for.

THE MISSING BIRD

Two missile technicians rode a Hawk missile to a drive-in theater. After choosing a desirable viewing position and parking their bird, they went to get some popcorn. On their return, they found the missile gone. They immediately contacted the theater manager who in turn called the police. The police asked for a description of the vehicle. The soldiers described it as being OD in color with US Army stenciled in black on both sides. The senior policeman said, "Yes, but we need something more distinctive to enable us to distinguish your vehicle from the others we might intercept on the road. Is there anything special about yours?"

"Yes," they replied, "all the wheels are inside."

HAVE AMMO, WILL KILL

ON GUARD

One of the officers at a particular Nike Hercules site was noted for trying to befuddle soldiers walking post whenever he was commander of the guard. On one occasion he tried to creep up behind a sentry, but the alert sentry heard him and, spinning around, yelled, "Halt! Who's there?" "George Washington in a rowboat," came the reply. "Well paddle on over here George, and get yourself recognized," rejoined the guard.

A FREE RIDE

A PFC with a cigarette in one hand and one foot resting on a gasoline drum was observing another soldier refuelling a Hawk loader transporter when he was accosted by a lieutenant who suddenly appeared on the scene. "Soldier," he snapped, "you're out of uniform." The PFC, being correctly clad in the prescribed uniform, said, "Why, what do you mean, sir?" "You should be wearing an astronaut's gear," snapped the young officer. "I don't understand sir," replied the PFC. "It's very simple. Anyone smoking in a gasoline dump had better be ready to go into orbit."

NOTICE

Seen on the permanent section of a bulletin board in the headquarters of a unit that shall remain anonymous:

30 February 1971

SUBJECT: Objective Air Defense Mission Analyzation

Officers of This Air Defense Command:

1. The objective of all efficient air defense officers of this command should be to intelligently analyze all situations, anticipate all problems prior to their occurrence, have answers to these problems, and move swiftly to solve them.

2. However, this command appreciates that when you are up to your "hips" in alligators, it is difficult to remind yourself that the initial mission was to drain the swamp.

FOR THE COMMANDER:

N. ERSHELL GUYDNCE
LTC
Adjutant

AIR DEFENSEMAN'S TEN COMMANDMENTS ON SAFETY

1. Beware the lightning that lurketh in an undischarged capacitor lest it cause thee to bounce upon thy bottom in a most ungentlemanlike manner.

2. Cause thou the switch that supplieth large quantities of juice to be opened that thy days may be long to continue thy labor.

3. Prove to thyself that all circuits that radiateth and upon which thou worketh are grounded lest they lift thee to heavenly heights and causeth thee to make like a radiator too.

4. Tarry thou not amongst those fools that engage in intentional shocks, for they are surely nonbelievers and are not long for this world.

5. Take care thou useth the proper method when thou taketh the measure of a high-voltage circuit so that thou dost not incinerate both thee and thy test meter; for verily, though both thee and thy meter can be replaced, thy meter is Government property and its loss bringeth much woe to the accountable officer.

6. Take care thou tampereth not with interlocks and safety devices for this incurreth the wrath of the staff engineers and bringeth the fury of the unit commander upon thy head and shoulders.

7. Work not on energized equipment, for if thou doest so thy fellow workers will surely be consoling thy widow.

8. Verily, verily, I say unto thee, never work on equipment alone, for electrical cooking is sometimes a slothful process and thou might sizzle in thy own fat upon a hot circuit for hours on end before thy Maker sees fit to end thy misery and drag thee unto His fold.

9. Trifle thee not with radioactive tubes and rays lest thou commence to glow in the dark like a lightning bug.

10. Commit thou to memory all the words of the prophets which are written down in thy bible which is the Standing Operating Procedures, and which giveth out with the straight dope and consoleth thee when thou hast suffered the wrath of thy unit commander.

CALENDAR

Found on job order clerk's desk in production control section of a Hawk DSP.

CALENDAR FOR RUSH JOBS

GEN	FRI	FRI	THU	WED	TUE	MON
8	7	6	5	4	3	2
16	15	14	13	12	11	9
23	22	21	20	19	18	17
31	30	29	28	27	26	24
38	37	36	35	34	33	32

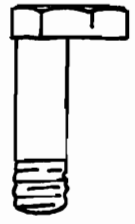
ADVANTAGES

1. Every job is in a rush. Everyone wants his order delivered yesterday. With this calendar customers can order on the 7th and have delivery on the 3d.
2. All customers want their jobs on Friday—so there are two Fridays in each week.
3. There are 7 extra days at the end of the month for those end-of-the-month rushes.
4. There are no "firsts of the month," no "tenths," or "twenty-fifths"; therefore, bills will not have to be paid.
5. There are no bothersome nonproductive Saturdays and Sundays.
6. There's a new day each week—General day. On this day, orders may be canceled, copy changes made, and other matters reopened. For instance, a copy change made on the 8th may reach you on the 5th. But you may make the change even though the goods were shipped on the 6th. Everybody will be happy, and we will have an ulcer-free organization.

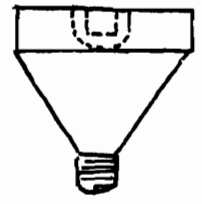
BOLTS

These bolts are suggested for use to alleviate some of the problems in the XM727 assembly area.

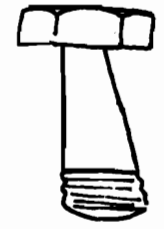
Mismatched bolt holes.



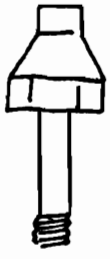
Shy of edge margin, head rides on radius.



Hole countersunk too deep.

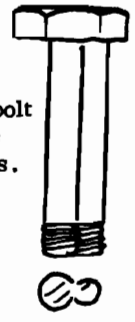


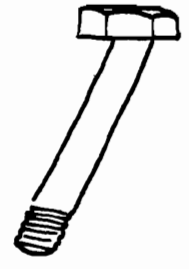
*Hole drilled at angle, then straightened.



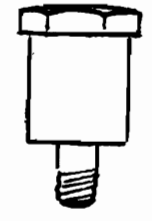
Countersunk wrong side.

"Binocular" bolt for double drilled holes.

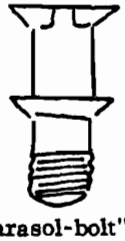




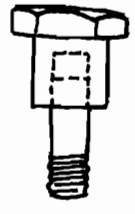
Hole not concentric with surface.



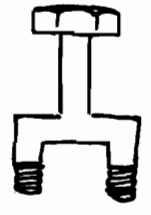
Oversize hole bolt.



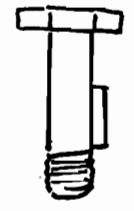
"Parasol-bolt" for countersink in inner and outer pieces.



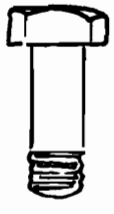
"Telescope-bolt," correct length in doubt.



Redrilled hole still didn't match.



"Parasite bolt." Pilot hole will not clean out.



Bolt called for by contact.

Serrated head for vice grip.

Oval-shank bolt for oval holes.

*Once the nut is started, it will go on easy.

A New Look for Chaparral/Vulcan Battalions

Obaldo Garcia
Office of Doctrine Development, Literature, and Plans
US Army Air Defense School

A forward area alerting radar (FAAR) system will soon be added to forward area air defense artillery battalions worldwide. This new system is a lightweight, mobile, short-range, pulse-doppler, C-band radar. Mounted in a modified electronics equipment shelter, it is transported on an M561 cargo truck (six-wheeled "Gamma Goat" configuration) (fig 1).

Figure 1. FAAR system in march order configuration.

Sanders Associates, Inc., Bedford, Massachusetts, was contracted in 1967 by US Army Materiel Command to design and develop the FAAR system. It is designed to provide the Chaparral/Vulcan (C/V) battalions and air defense sections (Redeye) in combat divisions with alerting information on aircraft operating at low altitude over the forward battle area.

The radar has clutter rejection circuitry that enables it to "see" targets ordinarily masked by the effects of ground clutter. An additional feature is a radiofrequency data link (RFDL) used to transmit target position and tentative identity information to target alert data display sets (TADDS) at each Chaparral, Vulcan, and Redeye fire unit location. Interrogator

equipment AN/TPX-50 is interfaced with the radar to challenge aircraft automatically or manually. Return radar signals containing identification replies are processed along with target information for presentation on a control-indicator display. The operator uses the indicator controls to encode and transmit target location and tentative identification (friend-foe) to all TADDS located on a line of sight with the radar. The radar antenna rotates continuously at 30 rpm to provide a capability of updating target data every 2 seconds.

RADAR PLATOON ORGANIZATION

Headquarters and headquarters battery of each C/V battalion will have a radar platoon of eight sections, each equipped with a FAAR system (fig 2). The platoon headquarters is authorized a lieutenant assisted by an E-7 (24M40) platoon sergeant, two FAAR mechanics (E-6 and E-5, 24M30), two power-generator operator/mechanics (E-4, 52B30), and one E-3 light vehicle driver (16R10). Each radar section is authorized an E-6 chief of section, one E-5 senior FAAR operator, and one E-4 FAAR operator.

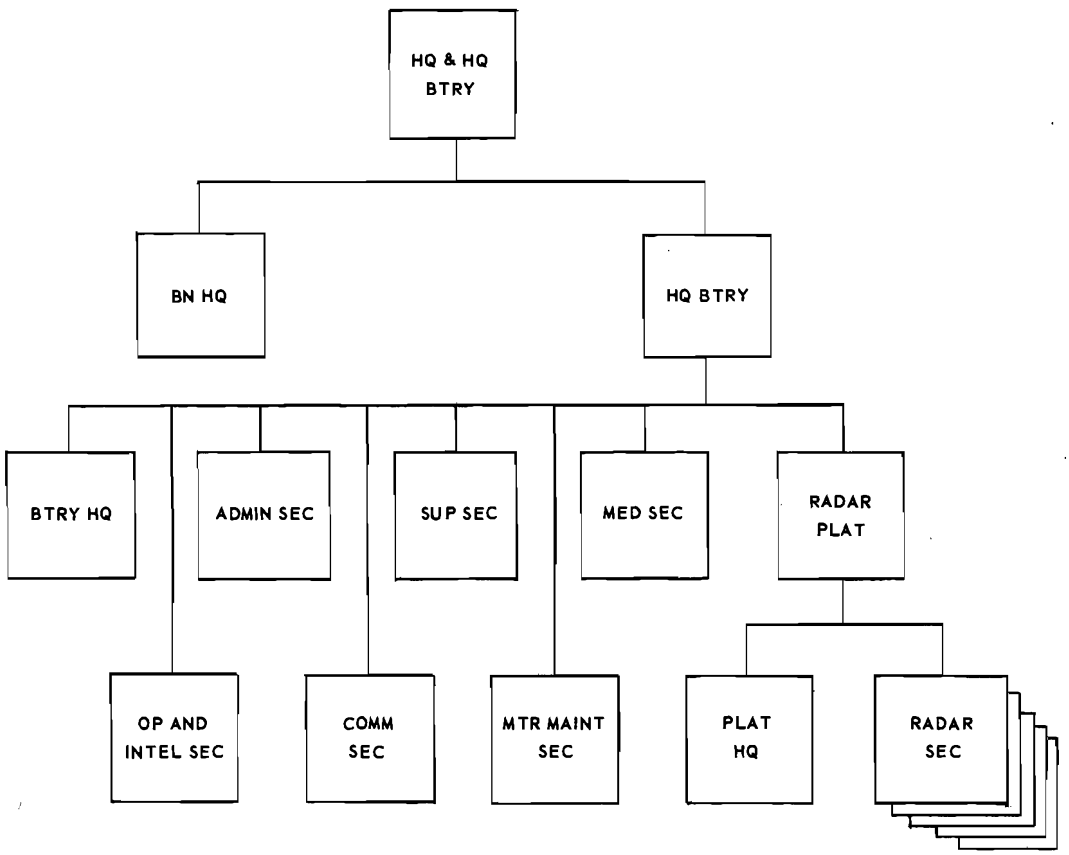


Figure 2. Headquarters and headquarters battery organization, Chaparral/Vulcan battalion.

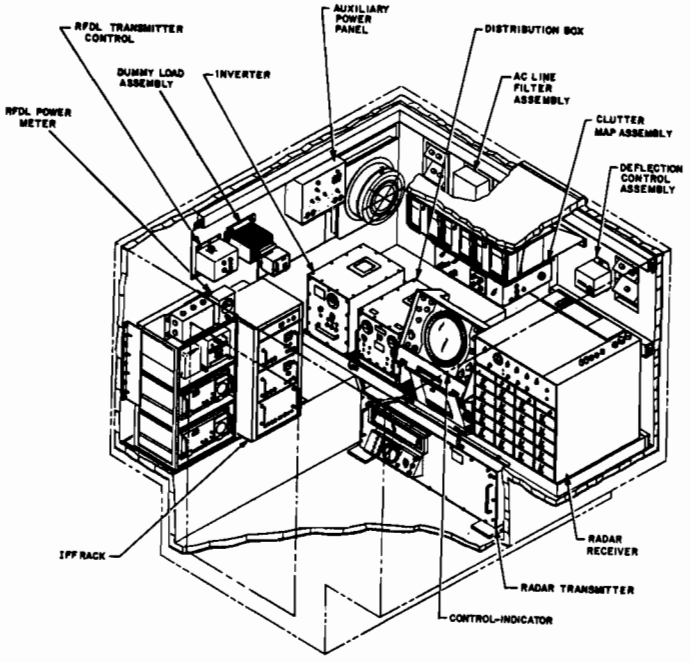


Figure 3. FAAR shelter interior.

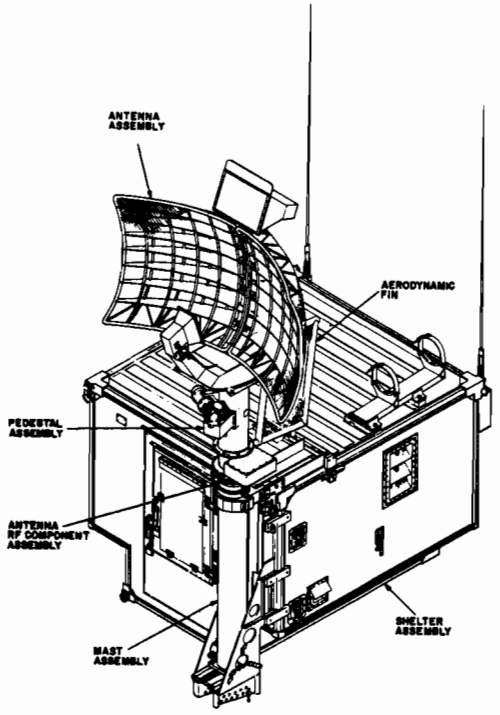


Figure 4. FAAR shelter exterior.

RADAR

The units, assemblies, and subassemblies of the radar are mounted within the equipment shelter (fig 3) with the exception of the antenna assembly, mast, and base which are externally mounted at the right rear of the shelter (fig 4).

The transmitter (fig 3), in addition to normal transmitter circuitry, contains such specialized circuitry as stabilized master oscillators (STAMO) and frequency multipliers. The only vacuum tubes in the entire radar are located in the transmitter. They consist of the traveling-wave tube and two grid modulators. The STAMO and frequency multiplier circuits generate 12 different RF drive signals which are fed into the antenna and transmitted in the C-band.

The radar receiver (fig 3) employs discreet transistorized circuits to process return RF signals and provide synthetic and raw video inputs to the control-indicator display system. The receiver includes self-test features to monitor system operation and generates signals to synchronize the radar system. The operating frequency of the receiver is changed to match the transmitter output by removing a bandpass filter and replacing it with one designed to accept return signals from targets. The transmitter operating frequency is established by any of the 12 STAMO settings. The receiver, therefore, is provided with 12 bandpass filters, each of which corresponds to a STAMO setting. The unused filters are stored in a cabinet on the right shelter wall.

A power distribution unit (PDU) and an inverter unit are mounted to the left of the control-indicator (fig 3). The PDU provides a control and distribution point for the power from the generator and also produces two levels of dc power for the radar. The inverter unit converts 115-volt, 400-hertz input power from the PDU into 115-volt, 6,000-hertz power for use in the STAMO, receiver, and transmitter.

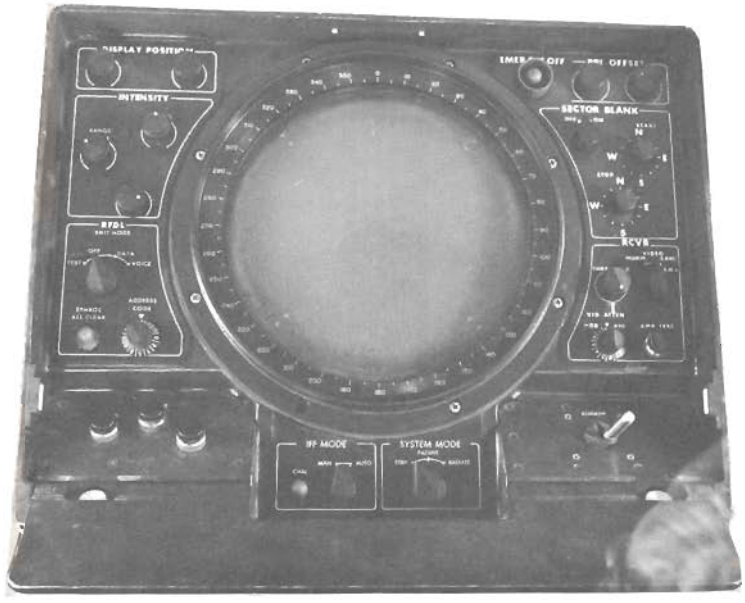


Figure 5. Control-indicator.

The control-indicator (fig 5) located at the center front of the shelter (fig 3), provides the radar operator with a video display and encoding controls to transmit target positions and identity via the RFDL system. Radar system mode controls are also provided for operator use. The control-indicator may be removed from the shelter and connected with a 150-foot-cable for remote system operation.

The interrogator subsystem is rack-mounted on the left side of the shelter. It provides coded interrogation signals that

may be transmitted automatically or manually as selected by operator controls at the control-indicator. Self-test features are incorporated to monitor system performance.

The RFDL and communications units are rack-mounted at the left rear of the shelter. These units are transceiver parts of radio set AN/VRC-46. Normally, the transmitter portion of one unit is used to provide the FM carrier for the encoded digital target information initiated by the operator. The other unit, a transceiver, is usually employed to provide two-way voice communications with the supported Chaparral or Vulcan battery. Both transceivers can be connected for simultaneous voice or digital data transmission. When the RFDL mode switch is set at VOICE and the RFDL transmitter control switch is set at COMM OVERRIDE, the operator can use a microphone connected at the control-indicator to transmit target information via both transceivers to TADDS at the fire units. The TADDS can receive either digital data or voice-modulated signals. When the RFDL mode switch is set at DATA and the RFDL transmitter control switch is set of COMM OVERRIDE, the operator transmits encoded digital data via both transceivers.

The equipment item mounted above the control-indicator is a clutter map/self-test unit, providing a method for displaying clutter on the PPI for clutter mapping of the area around the radar site and a means of determining overall system performance.

OPERATOR FUNCTIONS

All system controls have been designed for simplicity of operation by use of toggle, pushbutton, and rotary selector switches. With the radar system fully energized in its normal RADIATE mode, the operator observes the sweep rotating on the control-indicator at 30 rpm. A normal display will appear similar to that shown in figure 6. When no targets are received, the indicator is black except for the cursor symbol, rotating sweep, range marks, and grid lines. The cursor symbol can be moved by the cursor control (joystick) on the control-indicator from the center of one grid square to whichever square contains a synthetic target "paint." If the paint appears as in the square labeled "FOE" in figure 6, the cursor is moved to that grid square and the operator presses and releases the FOE pushbutton. A diamond symbol appears immediately on the cursor and the RFDL indicators (snake eyes) blink on and off three times at 3-second intervals, showing that target data has been encoded and is being transmitted by the RFDL transceiver. All TADDS at the fire units have a display matrix similar to the control-indicator display grid. Figure 7 shows a TADDS displaying one-half of a test pattern.

Receipt of encoded digital data causes several actions to occur at the TADDS: a warning tone will alert the fire unit crewman to look at the display, the NEW DATA disk will flip from black to orange, and one of 49 pairs of target indicator disks will flip from black to orange (FOE) in the same grid square as encoded at the radar display. These actions inform the weapon crewman that an unknown target is located at a certain azimuth and range from the radar. The entire sequence, including target detection, identification, data transmission, and data display (at the TADDS), can be accomplished by a well-trained FAAR operator in approximately 6 seconds. If a target previously identified as unknown (FOE) indicates an IFF response of FRIEND (or EMERGENCY), the FAAR operator can cancel the previous message with the CLEAR pushbutton, then press the FRIEND pushbutton while the cursor is still at the previous grid square. The orange disk at the TADDS will flip to black and a green disk will then be exposed. This shows the weapon crewman that the last target indication is now a friendly aircraft.

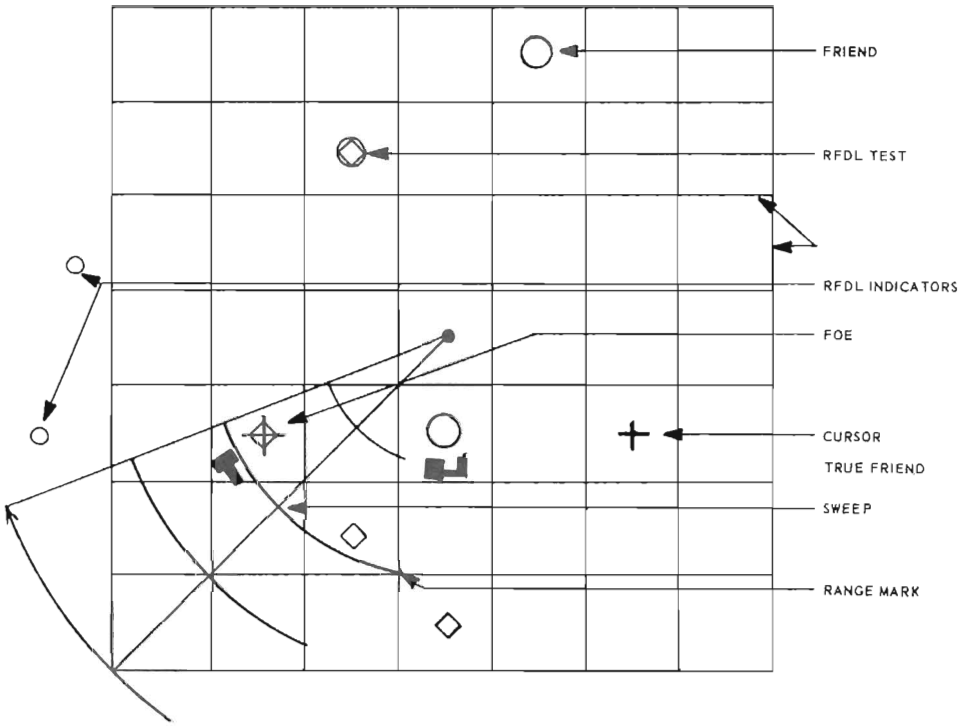


Figure 6. Composite indicator display.

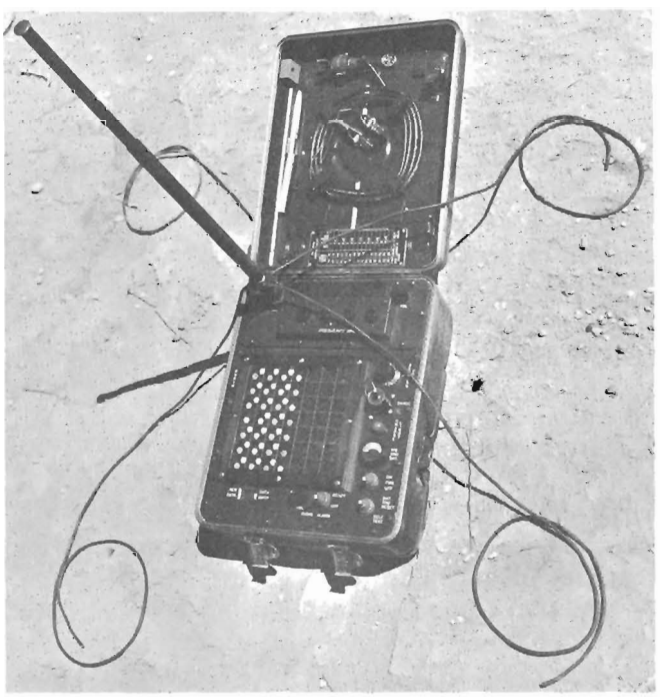


Figure 7. TADDS in operating condition.

Because the RFDL transmitter is basically part of radio set AN/VRC-46, the FAAR operator can transmit target data to the TADDS by standard radiotelephone procedure. This voice channel is a backup for use if the digital encoding circuitry becomes inoperative.

TRAINING FAAR PERSONNEL

It is anticipated that key individuals will soon be selected to attend an Instructor and Key Personnel New Equipment Training (IK&P/NET) course on the FAAR system prior to delivery of the radar systems to Fort Bliss, Texas. These personnel will then be used to instruct selected military personnel in operation, employment, and organizational maintenance of the FAAR system. FAAR mechanics will be trained by US Army Air Defense School (USAADS) instructors, and operators will be trained by 1st Advanced Individual Training Brigade (AD) instructors. The forward area weapons (FAW) portion of the Basic Officer Course will be modified to include instruction on the FAAR system.

The Office of Doctrine Development, Literature, and Plans (DDL&P), USAADS, is currently preparing several publications to support training of FAAR operators and sections. FM 44-6, Procedures and Drills for Forward Area Alerting Radar, is being written. ASubjScd 44-6 will prescribe FAAR section training, and a new ASubjScd 44-( ) will be prepared to train Chaparral and Vulcan crewmen as FAAR crewmen. These publications and the specific Department of the Army technical manuals for FAAR will also be used to support the training of Chaparral and Vulcan mechanics to be conducted by USAADS.

A Report on the German 20-mm Twin Gun

The 20-mm, twin-gun antiaircraft system described in this article was planned, developed, and produced by the Rheinmetall Manufacturing Company, Dusseldorf, Germany, for the Federal Department of Military Technology and Procurement.

The primary role of the weapon is air defense against all types of low-flying targets. As a secondary role, it can engage any ground target within its range.

Design characteristics indicate that it presents a truly formidable forward area air defense. A specifically designed computer sight insures full use of the 2,000-meter tactical range of the weapon. A mechanical auxiliary sight assists in rapid location of air targets.

The weapon has a 360° traverse, providing an all-round field of fire, and an elevation bracket of -5° to +83°. A hydraulic joystick provides fingertip control of both elevation and traverse. Manual control can be switched on if the hydraulic system falters.

The gunner may fire single shots or sustained bursts from either gun separately or both at once. Each gun has its own ammunition box containing 270 rounds. Top sustained rate of fire with both guns is 2,000 rounds per minute. Ammunition boxes are fitted for rapid change, either for replenishing aerial target ammunition or for switching to ammunition specially designed for ground targets.

The gun is highly effective against low and very low flying aircraft at ranges up to 1,200 meters and functions efficiently in conditions of cold, rain, snow, mud, dryness, or dust. It is fully automatic and gas operated. The ammunition feed is also operated by gas pressure and is independent of weapon and breech movement. An important feature of the weapon is that the recoil has been kept to an absolute minimum, thus avoiding strain on the cradle and mount.

For going into or out of action or changing position, a crew of three men is required (fig 1). During action, one man fires the weapon and the other two replenish ammunition. Because of simplicity of operation, any soldier can serve as gunner as a secondary duty.

The 20-mm twin gun is operated from a rugged three-leg lower carriage that can be deployed, even in difficult terrain (fig 2). Two of the outriggers are adjustable for leveling.

Affixed to the lower carriage is an upper carriage made of light metal alloy on whose sidewalls is fitted the laying mechanism. It also carries the adjustable gunner's seat and is fitted with trunnion bearings for a cradle. The cradle, also made of light alloy, is equipped with trunnions that engage the trunnion bearings of the upper carriage. The cradle rotates in elevation on these bearings. The guns, feed-belt mechanisms, and ejectors are fitted to the cradle. The guns can be quickly removed and reinstalled. They can be dismantled without tools and require little maintenance.

The laying mechanism, mounted on the upper carriage, is powered by an air-cooled gasoline engine. It is equipped with hydrostatic drives for elevation and traverse, powered

by an axial piston pump motor. Hydraulic dampers are provided for extremes of elevating swing. Reserve power and exceedingly sensitive control elements allow quick target acquisition and insure smooth tracking.

Figure 1. Changing position.

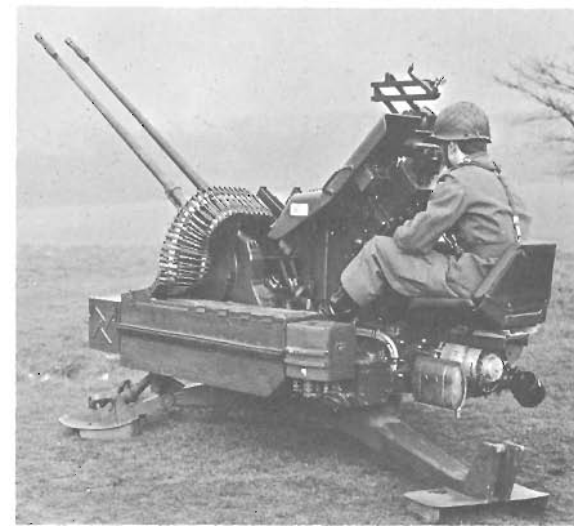


Figure 2. 20-mm AA gun ready for action.

The fire control equipment is mounted on the laying mechanism, and a shield is fitted to protect the gunner against armor-piercing bullets. The equipment consists of a lead computer of a high accuracy, target-tracking device, an optic element, and a drive for the lead marks in the optical AA sight. At the commencement of the engagement the gunner calculates and manually sets the target speed, and the probable or ordered range to the crossing point, on the lead computer. As soon as tracking begins, true information is mechanically fed into the lead computer which calculates the data used for controlling the lead marks in the monocular AA sight.

The upper reticle has an aiming mark in the form of a bar which pivots on one end and represents the apparent direction of flight. The lower reticle has a slightly curved spiral arranged to rotate about its optical axis.

It is the gunner's job to bring the point of intersection of the aiming bar and the spiral into coincidence with the target. Thereafter the gunner uses his knee to switch on the tracking aid. The tracking rates, determined by the lead computer, are transferred to the gears directly below a joystick. The movement is transmitted, almost error free, through the joystick to the gunner's controlling hands and then back again into the fire control system. To acquire the target, the sight mounted on the gun shield is used.

A second eyepiece on the fire control equipment is the telescopic sight for ground targets. It operates as soon as the mask has been switched over the aperture of the AA sight. Ranges for ground targets up to 4,000 meters can be set on the ground sight.

A two-wheel trailer (fig 1) is used to transport the twin gun and to change position in the field. The mount on its trailer can be towed by any military or commercial vehicle designed to pull a trailer, without brakes, of a total weight of 5,500 pounds (fig 3). When the weapon is placed on or taken off the trailer, the wheels are secured by wedges. This is the only task that requires three men.

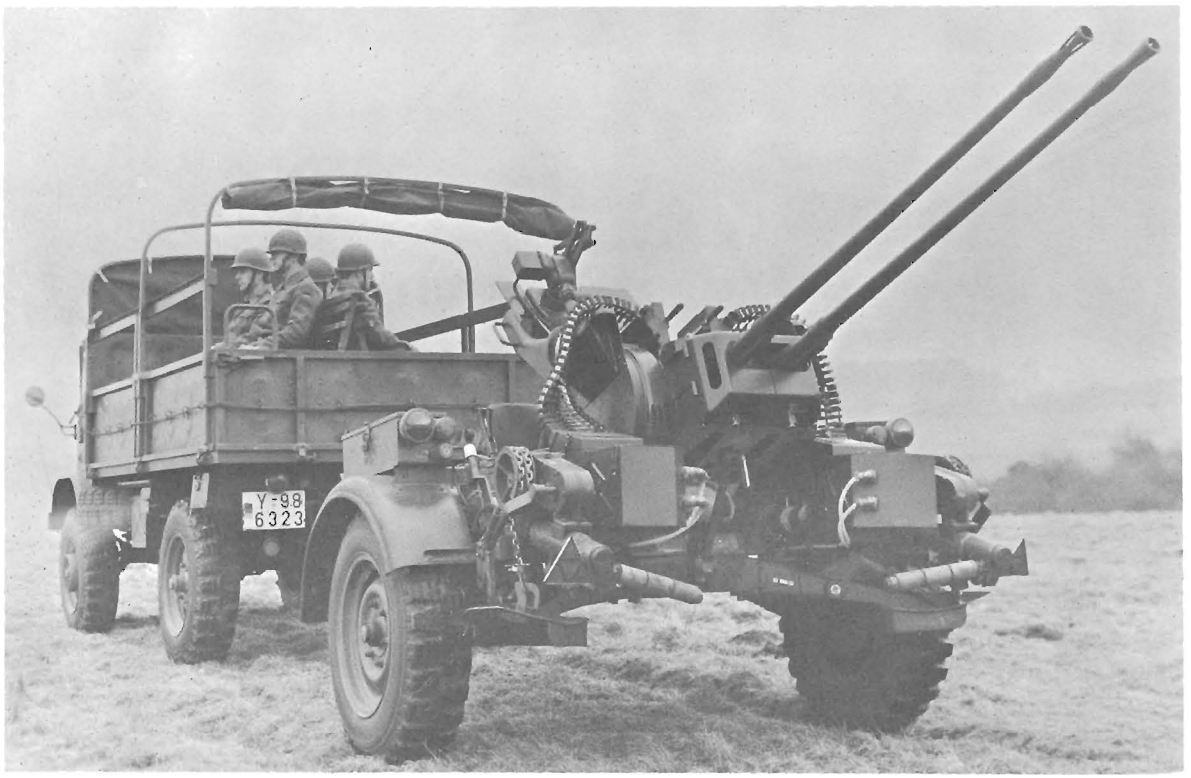


Figure 3. Weapon in march order.

A programed taboo facility (fire interrupter) has been built in as a safety device to prevent friendly troops or equipment from being accidentally fired upon. It consists essentially of an electronic control mechanism, an azimuth and elevation coder, and a switchbox which includes a switch for storage and erasure of the data obtained. The taboo facility divides the field of fire into a combat zone and neutral zone (fig 4). The guns cannot be fired below the boundary between the combat and neutral zones. If the guns swing into the neutral zone while tracking a target, fire will be interrupted.

To program the taboo interlock, the gunner tracks along the boundary line delineating through his optical sight the area not to be engaged, while the taboo interlock records electronically the limits of the neutral zone. Elevation limits can be established from -5° to +40°. There is no lateral limitation because the weapon has a 360° traverse. Should sudden action against ground targets become necessary, the taboo interlock can be temporarily overridden immediately.

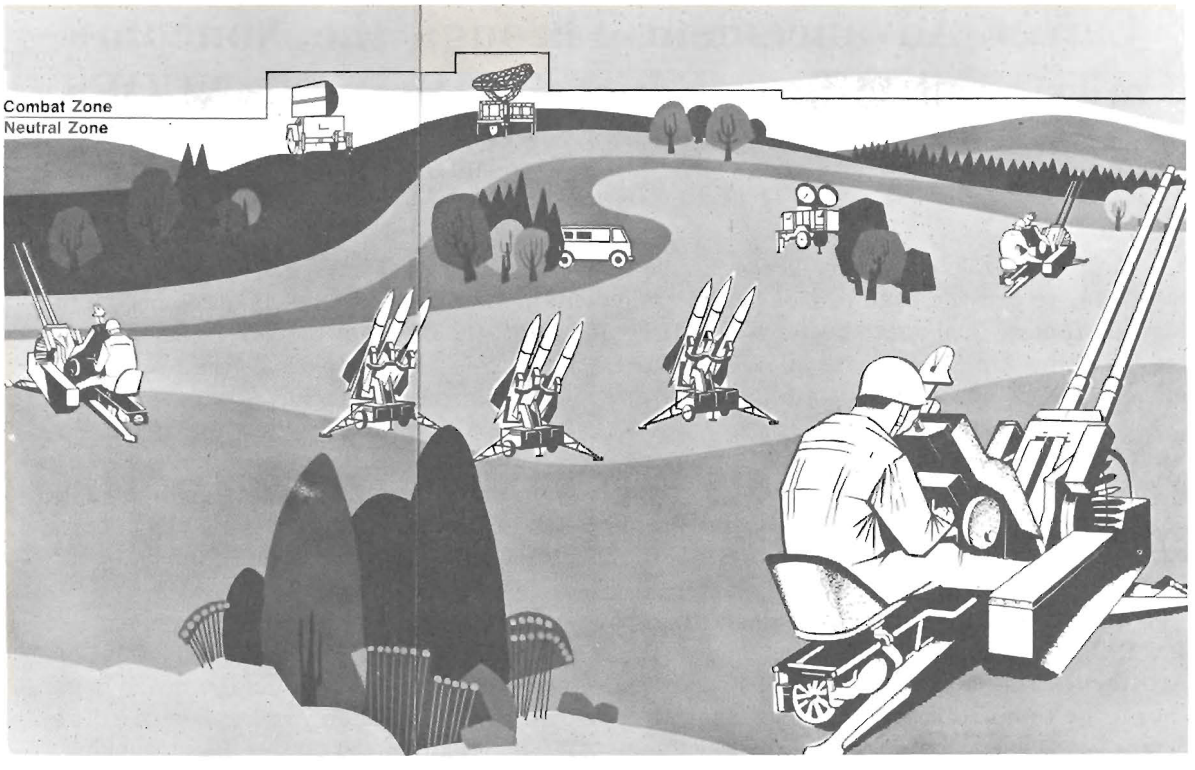


Figure 4. A taboo facility protects friendly forces.

The accuracy of the gun is attested to by the fact that the dispersion pattern of a 21-round burst, fired at a range of 100 meters, was only 21 inches high and 14 inches wide. A second burst of 24 rounds was fired at the same range. This time the dispersion pattern was 11 inches high and 16 inches wide.

Since trials under combat conditions are not possible, many authorities have made theoretical comparisons between the German 20-mm twin gun and others of different calibers and types. From facts obtained, gunnery experts give this weapon system a top rating.

Career Advancement Through the Noncommissioned Officer Education System (NCOES)

Sergeant Major Richard E. Roberts
NCOES Division, Director of Instruction
US Army Air Defense School

An Army-wide endeavor, known as the Noncommissioned Officer Education System (NCOES), to provide each branch of the Army with highly trained and dedicated noncommissioned officers is about to become a reality. To fulfill the needs of the Air Defense Artillery the US Army Air Defense School has developed two courses of instruction: the Noncommissioned Officer Education System Career Development Course, Basic and Advanced.

The basic course is designed to prepare selected enlisted personnel in grades E-4 and E-5 to perform duties in grade E-6. Emphasis is on those leadership skills and the knowledge of military subjects necessary to effectively command enlisted personnel at the team, squad, section, and comparable levels. The length of the basic course is 11 weeks.

The advanced course is designed to prepare selected enlisted personnel in grades E-6 and E-7 to perform duties as noncommissioned officers in grades E-8 and E-9 in Air Defense Artillery. This course emphasizes supervisory and managerial skills and the broad general knowledge of military subjects necessary to perform the duties of an Air Defense Artillery Senior Sergeant or comparable level assignment. The length of the course is 15 weeks.

Qualifications needed to be selected for the program are:

- Basic NCO course: Enlisted personnel of the Active Army or of a Reserve component in grades E-4 and E-5 who have demonstrated leadership potential for noncommissioned officer positions. Have 10 or more months' service remaining upon completion of the course and an interim SECRET security clearance. Qualified in one of the following MOS's: 16B20, Hercules Missile Crewman; 16C20, Hercules Fire Control Crewman; 16D20, Hawk Missile Crewman; 16E20, Hawk Fire Control Crewman; 16F20 or 16F30, Light Air Defense Artillery Crewman; 16H20, Air Defense Artillery Operations and Intelligence Assistant; 16J20, Defense Acquisition Crewman; 16K20, Fire Distribution Systems Controller; 16P20, Chaparral Crewman; or 16R20, Vulcan Crewman.

- Advanced NCO course: Enlisted personnel of the Active Army or of a Reserve component in grades E-6 and E-7, with 5 or more years' service. Must have demonstrated a potential for senior NCO positions and be recommended by their unit commander. Must have 2 years remaining upon completion of the course and a final SECRET security clearance.

Selection for attendance to the basic course will be made by the United States Continental Army Command, while selection for attendance to the advanced course will be made by Department of the Army.

As with all service schools, not everyone will be able to attend. For those not selected, a correspondence course paralleling the resident course is being prepared by the Nonresident Instruction Department, US Army Air Defense School.

An academic environment will exist to provide the noncommissioned officer the opportunity for progressive learning, continuing development, and enhancing career attractiveness, and yet still providing him with formal training.

Academic subjects common to both courses are in two divisions: the Management-Logistics Division and the Military Arts-Tactics-Techniques Division. The Management-Logistics Division will have classes in supply, maintenance management, personnel management, administration, leadership, and individual development. The Military Arts-Tactics-Techniques Division will have classes in general subjects, AD weapon systems orientation, AD tactics and techniques, and combined arms.

In addition to subjects common to both courses, advanced course students will also receive classes in the Air Defense of the United States and Air Defense of the Theater Army and Field Army.

The curricula, based on findings of systems engineering of training, will give the future junior and senior noncommissioned officers that knowledge in leadership and managerial skills, and military subjects needed to supervise effectively.

Attendance at either or both of the courses will be a distinct honor, privilege, and realistic challenge. This training will make each student more aware of his responsibilities and his role in air defense artillery and in the United States Army.

Members of the staff discuss Systems Engineering of Training phase plans used in developing the NCO Career Development Courses.

CURRICULA

BASIC NCOES CAREER DEVELOPMENT COURSE ACADEMIC SUBJECTS

Supply, Maintenance, and Administrative Procedures

Military Knowledge Survey
Unit Administration—Publications and Records
Unit Administration—Personnel Management
Unit Administration—Supply Operations
Maintenance
Unit Readiness

Leadership and Management

Military Leadership
Training Management
Enlisted Evaluation (Management)
Management—Financial
Drill and Ceremonies
Military Justice
Civil Affairs
Civil Disturbances
Prisoner of War—Humane Treatment
Race Relations Training
Physical Training
Inspections

Individual Development

Army Information Program
Character Guidance Program
Effective Military Writing
Methods of Instruction

General Subjects

Foreign Armies Orientation
Intelligence
Map and Aerial Photo Reading
Signal Security
Electronic Warfare
CBR Operations
Special Warfare Operations—Fundamentals of Internal Defense and Internal Operations
Special Warfare Operations—Psychological Operations
Special Warfare Operations—Survival Escape and Evasion
Special Warfare Operations—Brigade and/or Lower Units in Counter-Guerrilla Operations

Air Defense Systems Orientation

Current ADA Weapon Systems
New Developments ADA Systems
US Air Force—Aerospace Defense Systems
AD Weapon Systems—Nike Hercules
AD Weapon Systems—Hawk
AD Weapon Systems—Chaparral and Redeye
AD Weapon Systems—Vulcan, M42, M55

Air Defense Tactics and Techniques

Introduction to Army Air Defense
Organization, Characteristics, and Capabilities of ADA Units
Deployment and Employment of Army AD Weapon Systems
AD Communications, Procedures, and Equipment
ADA Fire Distribution Systems
AD Command Post and Tactical Operations Center

Command and Control of AD Fires
ADA Plans and Reports
The Air Threat
Army AD Forces in the Field Army—Roles and Missions
Army AD Organization for Combat
Reconnaissance, Selection, and Occupation of Positions (RSOP)
Camouflage, Concealment, and Deception
Employment of All-Arms as Weapons and Non-Air-Defense Weapons in an Air Defense Role
Visual Aircraft Recognition

Combined Arms

Army Aviation
Air/Ground Operations
Surveillance, Target Acquisition, and Night Observation (STANO)
Field Engineering
Tactical Cover and Deception
Organization of Army Divisions
Division Artillery
The Airmobile Division
Mine Warfare

Field Training and Air Defense Exercises

Field Exercise, Maneuvers, and Demonstrations
Summary and Critique

Two of the instructors discuss the leadership attributes of our present leaders and how the NCO will assist them after completion of one or both of the courses.

ADVANCED NCOES CAREER DEVELOPMENT COURSE ACADEMIC SUBJECTS

Supply, Maintenance, and Administrative Procedures

Military Knowledge Survey
Unit Administration—Publications and Records
Unit Administration—Mess Management
Unit Administration—Supply Operations
Maintenance (Operations)
Unit Readiness

Leadership and Management

Military Leadership
Training Management
Enlisted Evaluation (Management)
Management—Financial
Management—Personnel
Management—Records
Automatic Data Processing
Drill and Ceremonies
Weapons
Military Justice
Civil Affairs
Civil Disturbances
Emergency Medical Treatment
Prisoner of War—Humane Treatment
Race Relations Training
Drug Abuse Prevention and Control
Inspections

Individual Development

Army Information Program
Character Guidance Program
Effective Military Writing
Methods of Instruction

General Subjects

Foreign Armies Orientation
Intelligence
Map and Aerial Photo Reading
Signal Security
Electronic Warfare
CBR Operations
Special Warfare Operations—Fundamentals of Internal Defense and Internal Development
Special Warfare Operations—Brigade and/or Lower Units in Counter-Guerrilla Operations
Special Warfare Operations—Psychological Operations
Special Warfare Operations—Survival, Escape, and Evasion
The Insurgency Problem

Air Defense Systems Orientation

New Developments—ADA Systems R&D
New Developments—Aerospace Defense Systems R&D
New Developments—Tactics and Techniques Lessons Learned
Review of Current AD Systems

Air Defense Tactics and Techniques

Air Defense Planning
Displacement and Maneuver
Firing Techniques (Engagement)
Command, Control, and Coordination

Air Defense of the United States

Organization
Alaskan and Hawaiian Defense
ARADCOM

NORAD
CONAD

Air Defense of a Theater

Theater Army—COMMZ—ADA Operations
Field Army—Combined Arms Operations
Field Army—Combat Service Support
Corps—Combat Zone Operations
Corps—Nuclear Environment
Division—Surface-to-Surface Fire
Division—Support
Division—Special Operations
Division—Field and Command Post Exercises

Integrated-Concurrent Training

Combined Arms Operations—Survival, Escape, and Evasion
Combined Arms Operations—Psychological Warfare
Combined Arms Operations—Map Reading (Land Navigation)
AD Planning—Map Reading (GEOREF)
AD Planning—Field Fortifications

Training requirements for the basic course have been solicited from the field for inputs during fiscal years 1972 and 1973. Requests for inputs to the advanced course are expected to reach the field shortly.

In recent years noncommissioned officers have been faced with an almost impossible task of keeping up to date with the professional requirements of the Air Defense Artillery. Management today, in our present technologically complex Army, requires an NCO course of this type. The air defense subjects to be taught parallel closely many of the subjects taught in the Air Defense Officer Basic Course and the Air Defense Officer Advanced Course. We believe that this will enhance communication between our officers and noncommissioned officers and will promote the professionalism so important in Air Defense Artillery.

MERDC Uses Waste Heat for New Air Conditioner

An advanced air conditioner powered by waste heat from turbine exhaust is being tested by the US Army Mobility Equipment Research and Development Center, Fort Belvoir, Virginia.

Designed for use with the Army's missile fire-control vans and other mobile shelters requiring controlled environment, the experimental model operates from exhaust heat of a 15-kilowatt military turbine generator set to produce 5 tons of cooling.

A fuel savings of 40 percent and a size and weight reduction of 30 percent for combined power and environmental control equipment are anticipated through application of the waste heat recovery units.

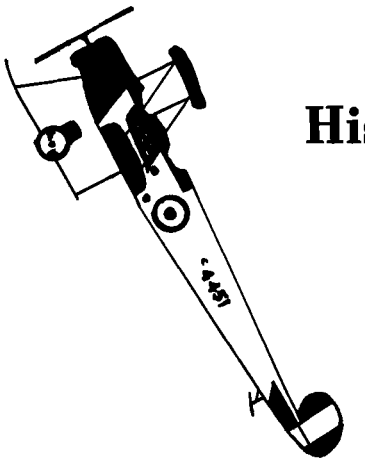
The experimental model incorporates a "double loop" design consisting of a power loop and a refrigeration loop, both operating with R-11 fluid with a common condenser circuit. Heat from the exhaust gases is transferred to the power loop fluid by means of a vapor generator heat exchanger. Exhaust gas energy thus recovered is transferred to the refrigeration loop by expanding the heated power fluid through a turbine which drives the refrigeration loop compressor.

The power loop operates on the Rankine power cycle principle, with the fluid circulating through a vapor generator, turbine, condenser, and pump. The refrigeration loop is a conventional vapor compression type consisting of a condenser, expansion device, evaporator, and condenser.

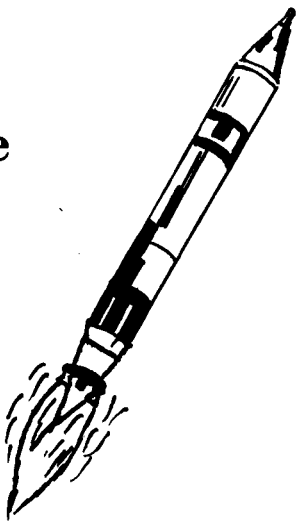
In the experimental model, which as a military unit must provide complete environmental control, heating and cooling are controlled by fully modulating bypass valves to maintain a constant return air temperature from full cooling to full heating conditions. Fluid-process bearings and new high-temperature lubricants are used to enable the fluids to operate at high-vapor generator temperatures without decomposition.

The experimental unit was designed and fabricated by the Garrett Corporation, AiResearch Manufacturing Company, under a contract with the Mobility Equipment R&D Center.

Army Research and Development
Vol 11, No. 7



History of Air Defense



Editor's Note:

The three principal powers of World War II continually improved their military aircraft. In addition, several new planes were produced during the war. These were the outgrowth of developmental work that was in process before the outbreak of hostilities. The trend was toward more powerful engines, better high-altitude performance, more and heavier armament, and better crew protection. In this installment we see the progression and expansion of combat aircraft.

England's Hawker Hurricane constituted the major portion of the RAF fighter strength in 1940. At the start of the Battle of Britain, there were 30 squadrons of Hurricanes and 19 squadrons of Spitfires; the Hurricanes bore the brunt of the fighting between July and November 1940. Although not fast enough to engage successfully the German Me-109's at high altitudes, they were very effective against bombers. Progressive development of the Hurricane resulted in improved performance and adaption for various combat roles. The Mark II, first operational in 1941, was produced in several variants. The Mark II B had a maximum speed of 340 mph at 21,000 feet and a service ceiling of 40,000 feet. Armament consisted of 12 caliber .303 machineguns; two 250-pound or two 500-pound bombs could be carried. The Mark II G was different only in armament, being equipped with four 20-mm Hispano cannon instead of machineguns. Antiaircraft was no match for German sea-raiding bombers, so Hurricanes were put on catapults on a freighter in each convoy. This was successful, but with no flight deck the pilot had to ditch on the rough sea or bail out in front of the convoy and hope that he would be picked up. In the spring of 1942, the Hurricane II D was operational in the Western desert. The Mark II D had a 40-mm cannon under each wing and a caliber .303 machinegun in each wing used for aiming purposes. Armor was added to protect the pilot, radiator, and engine from small arms fire. The additional armor and the heavy armament reduced the maximum speed to 286 mph at 18,800 feet. In 1943, the II B's, II C's, and IV's were fitted with four rockets under each wing.

The RAF Spitfire was a short-range fighter designed primarily for defense. It was produced in 40 major variants and was built in greater numbers than any other British aircraft. The Mark IX was produced in larger quantities and was more widely used than any other Spitfire. Spitfire I and II were the primary high-altitude fighters available during the Battle of Britain. The German Me-109's were superior to the Spitfire above 20,000 feet in every

respect except in radius of turn and firepower. The Spitfires performed fighter-to-fighter combat, and the slower Hurricanes tackled the bombers. Progressive development of the Spitfire sought to improve high-altitude performance and increase the armament and fuel capacity. Larger and more efficient engines were used, the cabin was pressurized, drop tanks were added, and armament was increased. The first Spitfire IX's, operational in July 1942, were equipped with a two-speed, two-stage, supercharged Merlin engine and a four-blade Rotol propeller which gave a maximum speed of 402 mph and a service ceiling of 36,000 feet. Armament consisted of two 20-mm cannon and four caliber .303 machine-guns, or four 20-mm cannon. It also carried a 500-pound bomb under the fuselage and a 250-pound bomb under each wing.

The Bristol Beaufighter twin-engine, long-range fighter became operational in July 1940. The Beaufighter was the only aircraft in production that could carry the airborne interception radar without sacrificing flight duration or firepower. As a result, it became a night fighter and the Beaufighter I-F bore the brunt of the action against German night bombers. It had a maximum speed of 323 mph at 15,000 feet, a service ceiling of 28,900 feet, and a range of 1,500 miles. Armament consisted of four 20-mm cannon in the lower portion of the nose and six caliber .303 machineguns in the wings. In early 1942, the Mark VI began to replace the earlier models. It had a maximum speed of 315 mph at 14,000 feet, a service ceiling of 26,000 feet, and a range of 1,540 miles. Two 500-pound bombs could be carried under the wings, and eight rocket projectiles could be carried in lieu of the wing guns. This was the first model used by the United States night-fighter squadrons.

The De Havilland Mosquito, originally designed as a bomber, became one of the war's most potent fighters. It was one of the most versatile of any twin-engine aircraft built during the war. The basic fighter Mosquito (NF Mark II), operational in 1942, was equipped primarily as a night fighter. It carried Mark IV or Mark V radar and was armed with four 20-mm cannon and four caliber .303 machineguns. Experience with the Mark II led to the development of the fighter bomber variant, the FB VI. The FB VI could carry 2,000 pounds of bombs, but eight 60-pound rocket projectiles usually were carried in lieu of bombs. The FB IV had a maximum speed of 378 mph at 13,200 feet and a range of 1,120 miles. A variant of the FB IV, produced for the RAF Coastal Command, was equipped with a 57-mm gun in lieu of the four 20-mm cannon. It could carry two 500-pound bombs or eight rocket projectiles. The NF XII, primarily developed for home defense, was the first British aircraft to carry centimetric airborne interception radar. Its range was extended by the use of underwing fuel tanks. The NF XIX was similar to the Mark XII but was designed to carry the American centimetric radar which was better than the British AI Mark X. The NF XIX had a maximum speed of 378 mph at 13,000 feet, a service ceiling of 28,000 feet, and a range with drop tanks of 1,905 miles. Armament consisted of four 20-mm cannon. Some 27 different versions of the Mosquito went into service during the war. Of these, the FB VI series was produced in larger numbers than any other variant.

The Hawker Typhoon was the heaviest and most powerful single-seat, single-engine warplane envisaged at the time of its design. The need for a fighter to counter the Focke-Wulf FW-190 caused the Typhoon to be put into service before it was fully developed. During the first 9 months of its service life, more planes were lost because of structural or engine troubles than were lost in combat. By 1942, most of the faults had been corrected and the accident rate declined. The Typhoon IA, operational in November 1942, enjoyed almost

immediate success over the FW-190's. Armament was later changed from 12 machineguns to four 20-mm cannon. As the Mark IB, it had a maximum speed of 417 mph at 20,500 feet. Continual development resulted in a plane with so many modifications that the name was changed from Typhoon II to Tempest. The first production model was the Tempest V (fig 1). Operational early in 1941, it was the fastest low- and medium-altitude fighter in service with the RAF. The Tempest became the mainstay of Britain's fighter defense against the flying bomb. It destroyed 638 pilotless missiles between 13 June and 1 September 1944. The Tempest V had a maximum speed of 435 mph at 17,000 feet, a service ceiling of 36,000 feet, and a range of 1,300 miles. Armament consisted of four 20-mm cannon, and it carried eight 60-pound rocket projectiles or two 1,000-pound bombs.

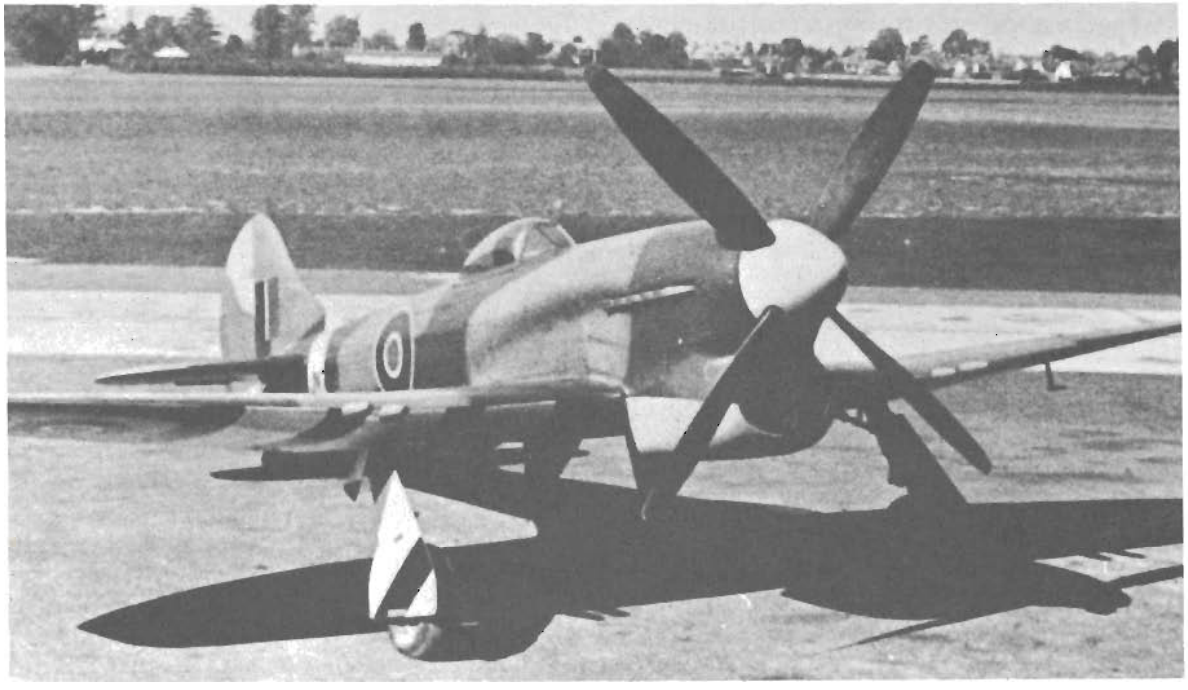


Figure 1. Hawker Tempest V.

In 1928, English Air Cadet Frank Whittle wrote a paper predicting the application of jet propulsion to aircraft. In 1936 Whittle was encouraged to begin experiments in constructing a gas turbine engine. Similar experiments were begun in Italy, France, and Germany. In April 1941, a Gloster plane had been constructed, was fitted with two of the new jet engines, and was ready for flight testing on 14 May 1941. The Whittle I engine weighed 650 pounds and gave more thrust than a comparable Rolls-Royce reciprocating engine that weighed 1,650 pounds. Although it required about twice as much fuel as the reciprocating engine, almost any kind of fuel seemed to be satisfactory—alcohol, kerosene, or diesel oil. At the end of 1941, the United States sent a technical representative to England to study the new plane and engine. Shortly thereafter, the General Electric Company and Bell Aircraft Company, with the assistance of British engineers, including Captain Whittle, built a copy. Laboratories in the United States began to explore the new system of propulsion in all its variations.

The Gloster Meteor 4, the first British aircraft to be fitted with the new Whittle jet engines, was a low-wing jet fighter. This was the only Allied jet aircraft to see service in World War II. In 1944, the twin jet Meteors were used against the V-1 bombs, and on 24 April 1945, RAF jet Meteors attacked Nordholz airfield near the mouth of the Elbe. The Meteor could fly at 580 mph at sea level. Armament consisted of four 20-mm cannon.

The Bell P-39 Airacobra (fig 2) and the Curtiss P-40 Warhawk, both in production in 1940, constituted more than half the strength of all United States fighters until July 1943. They saw service in every theater of war and were flown by other Allied air forces. The Bell XP-39 was equipped with a turbo-supercharger, but to facilitate production, the supercharger was omitted from production models. The result was a limited high-altitude capability and the P-39 was not considered suitable for combat in Europe. Assigned to North Africa in 1942, it achieved success in the ground attack role and had the lowest loss rate per sortie of any US fighter in the European theater. The P-39D had armor protection and self-sealing fuel tanks. It had a maximum speed of 368 mph at 13,800 feet, a service ceiling of 32,100 feet, and a range of 800 miles. Armament consisted of one 37-mm cannon, two caliber .50 machineguns, and four caliber .30 machineguns. It could carry a 500-pound bomb or a 75-gallon drop tank under the fuselage.

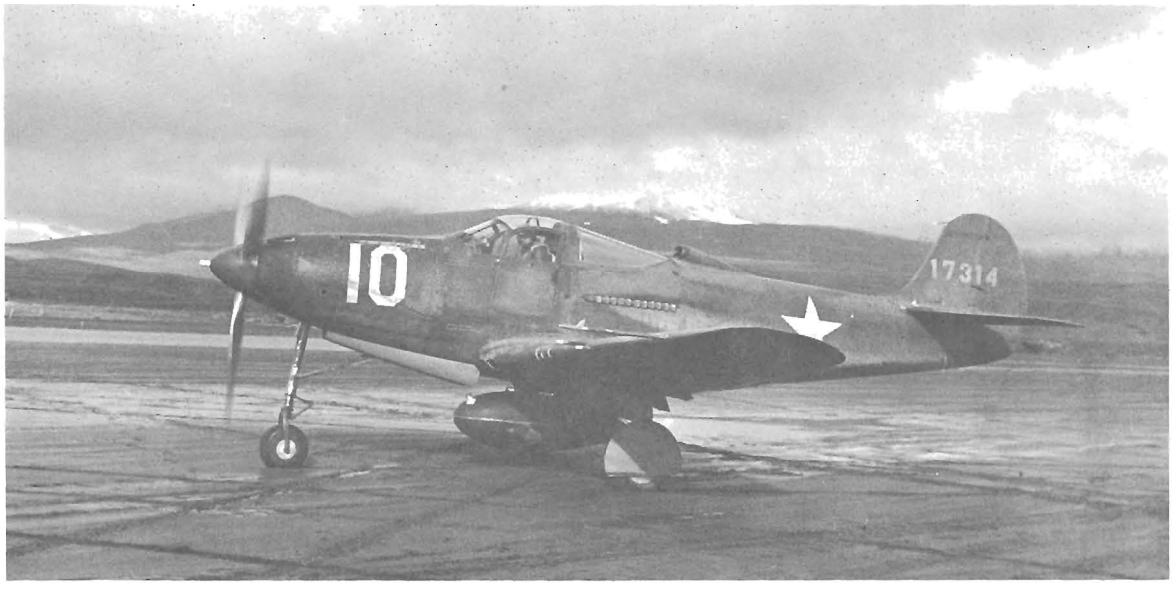


Figure 2. Bell P-39 Airacobra.

The P-40 (fig 3) was much superior to the P-39, but it also had a relatively limited high-altitude capability. The P-40 series included several models produced between 1940 and 1943. The maximum speed increased from 357 to 378 mph, service ceiling increased from 32,750 to 38,000 feet, and armament increased from two to six caliber .50 machineguns. Armor, self-sealing fuel tanks, and external shackles for a 1,500 bomb load were added.

The P-40A, called Tomahawk by the British, went into service with the RAF in 1940. The P-40E, as the American Warhawk and British Kittyhawk, was the first P-40 in Europe with the US air forces. The P-40 was inferior to foreign fighters above 16,000 feet but proved effective at lower altitudes. RAF Tomahawks destroyed 56 Axis planes in the desert during the summer of 1941. In Africa on 14 February 1942, 18 Kittyhawks shot down 20 enemy planes out of a formation of 30. Twelve other Kittyhawks destroyed thirty-six out of a flight of sixty enemy planes.

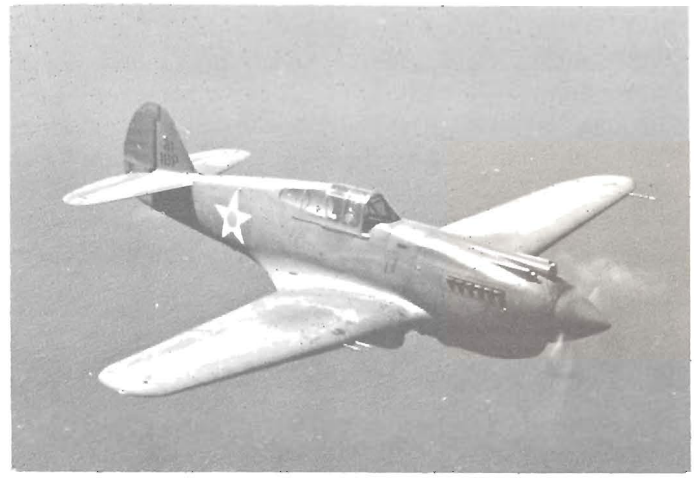


Figure 3. Curtiss P-40B, various versions of which were known as Warhawks, Tomahawks and Kittyhawks. It was used by the Americans, British, Russians, Chinese, Turks, and Egyptians.

Development of the Lockheed P-38 Lightning (fig 4) was somewhat slower than that of the P-39 and P-40. The first battleworthy version was delivered in August 1941 as the P-38D. Lightnings, exported to the United Kingdom in December 1941, were equipped with supercharged engines because of a ban on the export of turbo-superchargers. Performance was not impressive, and the export version did not prove satisfactory for use by the RAF. The P-38E was the first model to see large-scale service with the US air forces in Europe in mid-1942 and in North Africa in November 1942. The P-38F was equipped with turbo-superchargers, bulletproof fuel tanks, armor, and a low-pressure oxygen system. It had a top speed of 395 mph at 25,000 feet, a service ceiling of 39,000 feet, and a range of more than 1,500 miles. Armament consisted of one 20-mm cannon and four caliber .50 machineguns. The P-38F was not wholly successful in fighter-to-fighter combat against the Me-109 because of poorer maneuverability. Subsequent development tended to be for roles other than that of a fighter. Later models were used for fighter escort of bombers on deep penetration raids on Germany, night intruder missions, and ground attack and fighter bomber sorties.

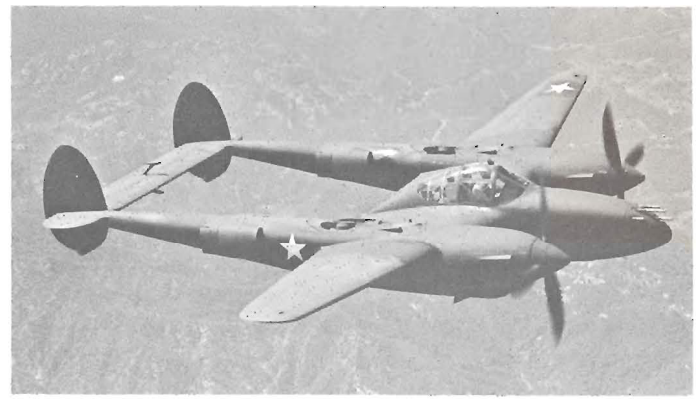


Figure 4. Lockheed P-38E Lightning.

Numerically, the most important Lightning was the P-38L. Performance of the L model was improved over the P-38F. Speed was increased from 395 to 414 mph, service ceiling increased from 39,000 to 44,000 feet, and bomb load increased from 2,000 to 3,200 pounds.

The Republic P-47 Thunderbolt (fig 5) was the largest and heaviest single-engine, single-seat fighter ever built. Operational with the US air forces in Europe in January 1943, it could outdive any enemy or Allied fighter and was at its best above 20,000 feet. However, at low and medium altitudes, it could not match the rate of climb or maneuverability of German fighters. The P-47 was used to escort bombers on daylight raids over Germany. Range was extended by the addition of drop tanks, and eventually Thunderbolts were escorting bombers from bases in the United Kingdom as far as Berlin. Low-altitude performance and rate of climb were improved by water injection into the intake manifold to boost engine power and by the adoption of a paddle-bladed propeller.

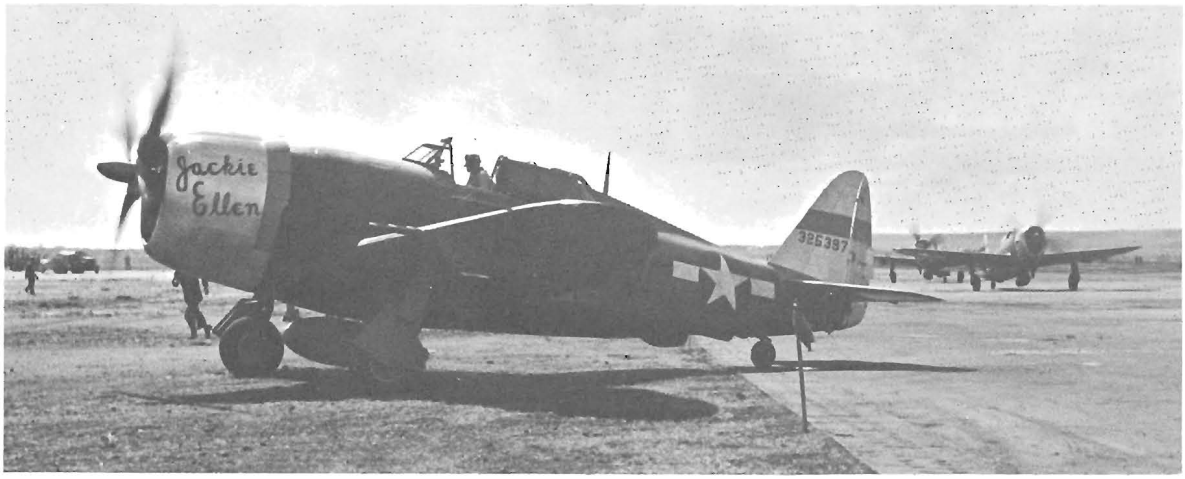


Figure 5. Republic P-47 Thunderbolt, sometimes called "The Jug" by its pilots.

The P-47 was produced in many models and variants. The one produced in the largest quantity was the D-series, with a maximum speed of 429 mph at 30,000 feet, a service ceiling of 40,000 feet, and a range of 950 miles at 10,000 feet. Armament consisted of six or eight caliber .50 machineguns; 2,500 pounds of bombs or 10 5-inch HVAR missiles could be carried. Thunderbolts were officially credited with destroying 4.6 enemy aircraft for each one lost in aerial combat.

The North American P-51 Mustang (fig 6) was unquestionably the best of all American wartime fighters. The Mustang, originally developed for the British, was operational with the RAF in July 1942. The P-51 was superior in speed and maneuverability to all the German piston-engine fighters above 20,000 feet. It had a range of 1,000 miles on internal tanks, and with the addition of external tanks, range was extended to 2,080 miles. The Mustang was used primarily for high-altitude escort for bombers. It was the only Allied fighter with sufficient range to escort bombers on shuttle missions, when deep penetration raids on Germany were made from bases in the United Kingdom and the planes would land in North Africa or Russia. The P-51D was the most widely produced model of all Mustangs. It had a top speed of 437 mph at 25,000 feet and a service ceiling of 40,000 feet. Armament consisted of four or six caliber .50 machineguns.

The P-70, a variant of the A-20 Havoc, was designed as a night fighter. Converted in 1942, it carried the British airborne interception radar which at that time was more advanced

than United States equipment. The P-70 had a maximum speed of 329 mph at 14,000 feet, a service ceiling of 28,250 feet, and a range of 1,060 miles. Armament consisted of four 20-mm cannon in a gun pack under the fuselage.

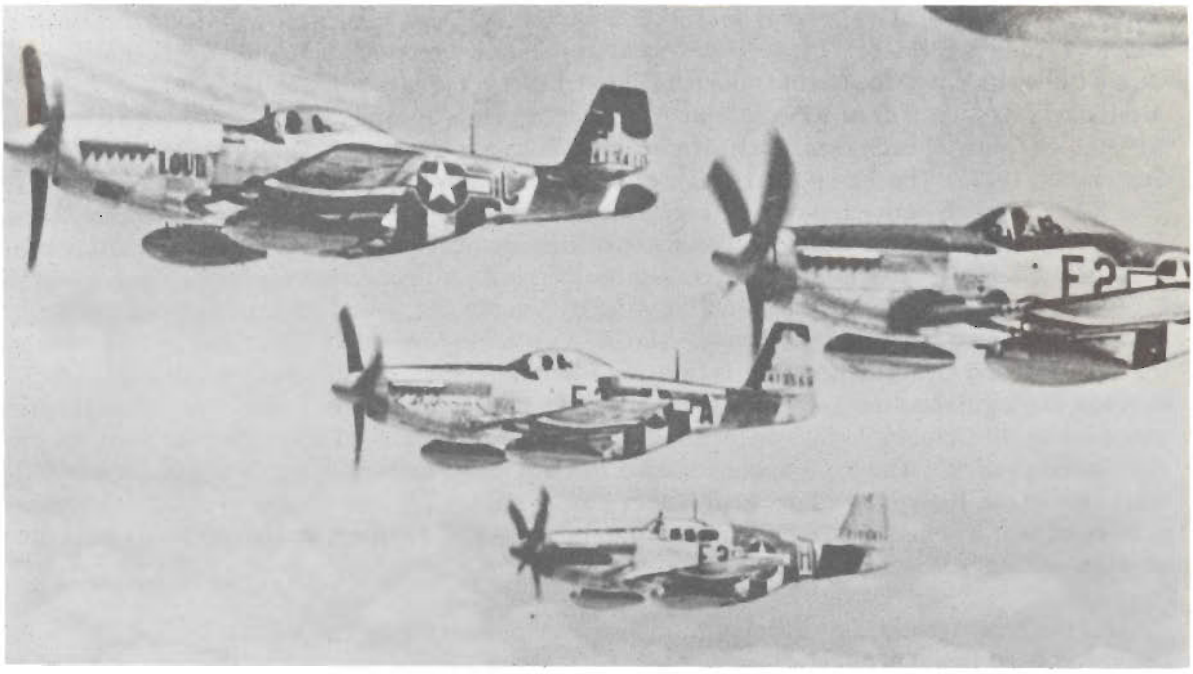


Figure 6. North American P-51 Mustangs, equipped with long-range drop tanks.

The Northrop P-61 Black Widow (fig 7) was operational in Europe in August 1944. It was equipped with a radar developed from the original British design. The Black Widow had a maximum speed of 366 mph at 20,000 feet, a service ceiling of 33,100 feet, and a ferrying range of 3,000 miles. Armament consisted of four fixed caliber .50 machineguns and four 20-mm cannon in a remote-controlled top turret. Four 1,600-pound bombs or 300-gallon drop tanks could be carried under the wings.

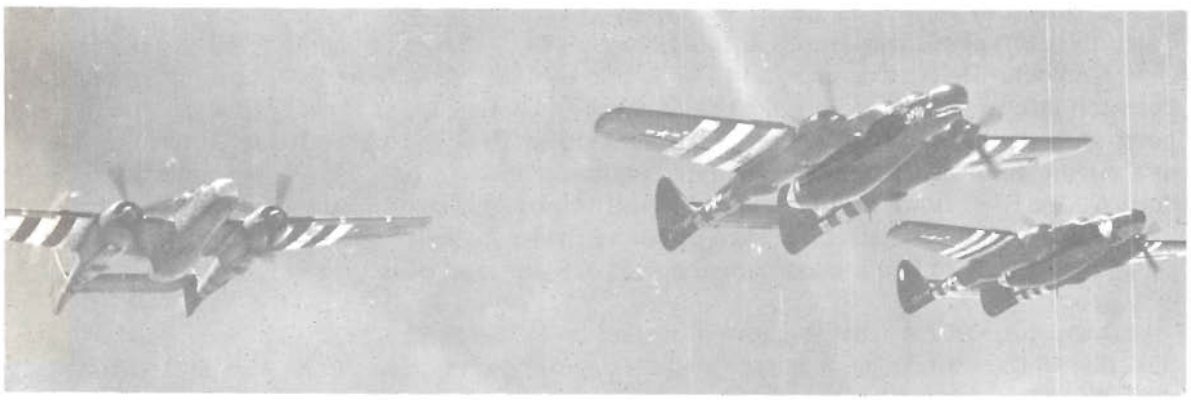


Figure 7. Northrop P-61 Black Widows.

In 1941, with the advent of the Whittle jet engine, the United States entered the jet age. In conjunction with the General Electric Company, Bell Aircraft developed the first United States prototype jet interceptor. This aircraft was the XP-59A, or P-59 Airacomet as later designated, and actual construction began in the spring of 1942. It was a midwing monoplane with a slender fuselage of conventional construction. This aircraft had two General Electric Type I-A turbojets, developed from the British Whittle Type I engine which had first been bench-tested on 18 March 1942. The turbojets were mounted on each side of the fuselage under the wings, and the main undercarriage units were further out on the wings, folding inward to retract. Three XP-59A's and thirteen YP-59A's were ordered, and the first XP-59A was moved to Muroc, California (later Edwards Air Force Base), for flight tests in September 1942. The XP-59A first taxied on 30 September and was flown on 1 October 1942. The XP-59's were delivered during 1944, after the first operational type had flown in August 1943, and were used for flight development of the engines. The engines used were forerunners of the later J-31 General Electric engine. The first production aircraft, designated the P-59A, were similar to the XP-59A, but slightly longer and with a shorter fin and rudder. The engines were 2,000-pound thrust J-31-GE-3's; but in November 1944, one P-59A flew with the 1,800-pound General Electric I-18's for the first time. Small changes and J-31-GE-5 engines distinguished the P-59B, only 30 of which had been delivered when the contract was canceled on 30 October 1943. Successful development of the P-80 made further work on the P-59 unnecessary. The P-59's were issued to the 412th Fighter Group, a specially formed trial unit in the Fourth Air Force, for operational evaluation and also were used for a great variety of test work. The P-59B had a maximum speed of 413 mph at 30,000 feet altitude; service ceiling was 46,000 feet.

As the first jet aircraft accepted for operational service by the US air forces, the Lockheed P-80 is assured of a lasting place in history. Developed in the latter part of World War II, it was one of the first new type aircraft operated by the USAF with considerable success in Korea. Development of the Lockheed jet began in June 1943 when the company was officially invited to design an aircraft around the De Havilland H-1 turbojet engine newly developed in the United Kingdom. The first prototype XP-80 was at Muroc Dry Lake, California, only 139 days after work started, and 4 days later, on 8 January 1944, two flights of the aircraft were made. The XP-80 was equipped with a 3,000-pound thrust engine. The armament was comprised of six .50 caliber machineguns grouped in the nose.

Plans for production of the P-80 on a large scale were made during 1944, and involved North American as well as Lockheed, with contracts for 5,000 either placed or planned. More than 3,000 of these were canceled after VJ Day. Lockheed actually built 917 of the P-80A model. Deliveries begain in December 1945. Although the P-80 had reached squadrons too late to see service in Europe or the Far East in 1945, it was on hand in large numbers when the Korean Conflict began in June 1950. F-80's were stationed in the Far East at the time as interceptors, but the type was used principally in Korea for tactical ground duties. An F-80 flown by Lieutenant Russell Brown destroyed a Mig-15 over Korea on 8 November 1950 in what is believed to be the first conclusive air combat between two jet fighters. The P-80 had a maximum speed of 558 mph and a service ceiling of 45,000 feet.

German fighters, until the advent of the Me-262 jet, were basically those available at the start of the war. The principal piston-engine fighters were the Me-109 and -110 and the FW-190.

Until the introduction of the much superior Focke-Wulf FW-190 (fig 8), the Messerschmitt Me-109 was the mainstay of the German fighter force. The G-series was produced in greater numbers than any other variant. Fastest of the G-series was the Me-109 G-10, with a maximum speed of 428 mph at 24,250 feet and a range of 350 miles. The Me-109 K-4, operational in the fall of 1944 had a maximum speed of 458 mph at 19,685 feet, a service ceiling of 41,000 feet, and a range of 355 miles. Armament consisted of two 15-mm and one 30-mm cannon.

Figure 8. Focke-Wulf FW-190.

The Messerschmitt Me-110C, developed as a long-range escort fighter, was far inferior to the British Hurricane and Spitfire. During the Battle of Britain, rather than protecting the bombers, the Me-110's were hard put to defend themselves. In some cases the escort fighters, in turn, had to be protected by Me-109's. The most successful Me-110 model was the G-series night fighter. It was no match for the Thunderbolts escorting American day bombers, but was adequate for dealing with the standard RAF heavy bombers. The Me-110 G-4 had a maximum speed of 342 mph at 22,900 feet, a service ceiling of 26,000 feet, and a range of 1,305 miles on internal fuel. Armament consisted of two 30-mm and two 20-mm cannon in the nose and two 7.9-mm machineguns in the rear cockpit.

The Focke-Wulf FW-190A, operational in July 1941, was the best of the German fighters. Produced in many variants, it was used as a high-altitude fighter, fighter-bomber, and dive bomber. By 1943, speed up to 440 mph at 37,000 feet was attained, but range on internal fuel was only 500 miles. Armament varied with the model and purpose for which the plane was intended. Heaviest armament was two 13-mm and four 20-mm cannon, or 12 R4M aerial rockets. As an all-weather flighter, the FW-190 was equipped with special radio equipment and an automatic pilot. Long before the war German research workers and scientists had turned their attention to the principle of jet propulsion. As early as 1935, Helmut Walter had designed the first serviceable liquid-fuel rocket and later developed it into an aircraft engine. In the midthirties, Professor Heinkel turned to the development of jet aircraft, and Messerschmitt started construction of the Me-262 (fig 9) as early as 1938. Heinkel's first effort revolved around the use of turbojet engines, and later the use of booster rockets for takeoff was tried. These experiments led to the design of the world's first jet-propelled aircraft, the He-176, which attained a speed of 528 mph at Peenemunde on 3 July 1939. Doctor Alexander Lippisch designed the first liquid-fuel, rocket-driven aircraft, the Me-163 Komet (fig 10), which flew 624 mph at Peenemunde on 10 May 1944.

The Me-262 was the first turbojet warplane to achieve operational status. It could have changed the course of the war, but modification to a bomber role, and then back to fighter, resulted in delays, and the Me-262 did not go into operation until the fall of 1944, too late to tip the air battle scales in favor of the Germans. More than 1,400 Me-262's were built, but

hardly more than 100 participated in operations. In its very first actions, the Me-262 showed itself far superior to Allied fighters. Maximum speed was 540 mph, and normal armament was four 30-mm cannon; by spring of 1945 armament consisted of 24 R4M missiles.

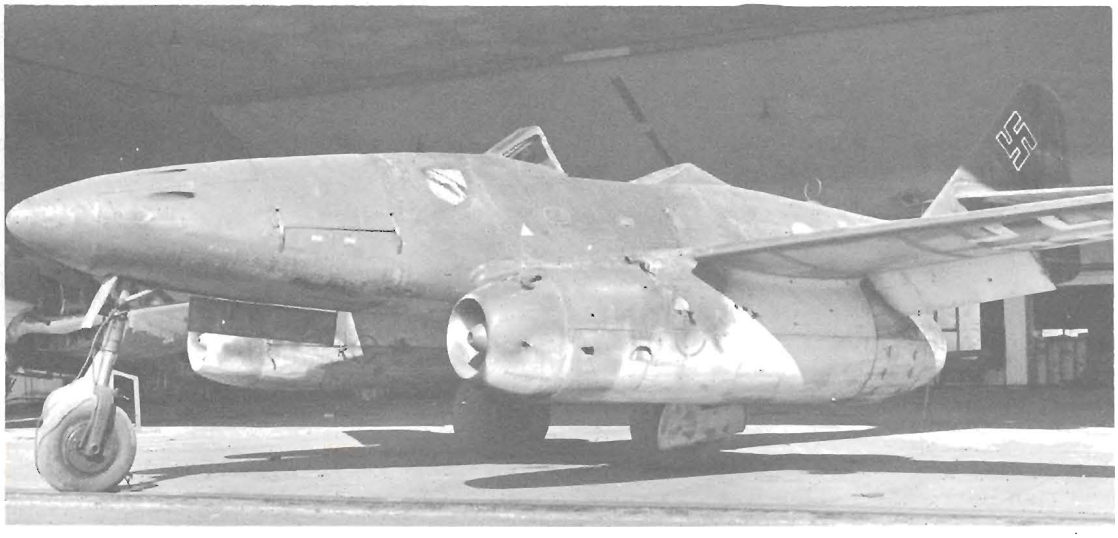


Figure 9. Captured Messerschmitt Me-262.

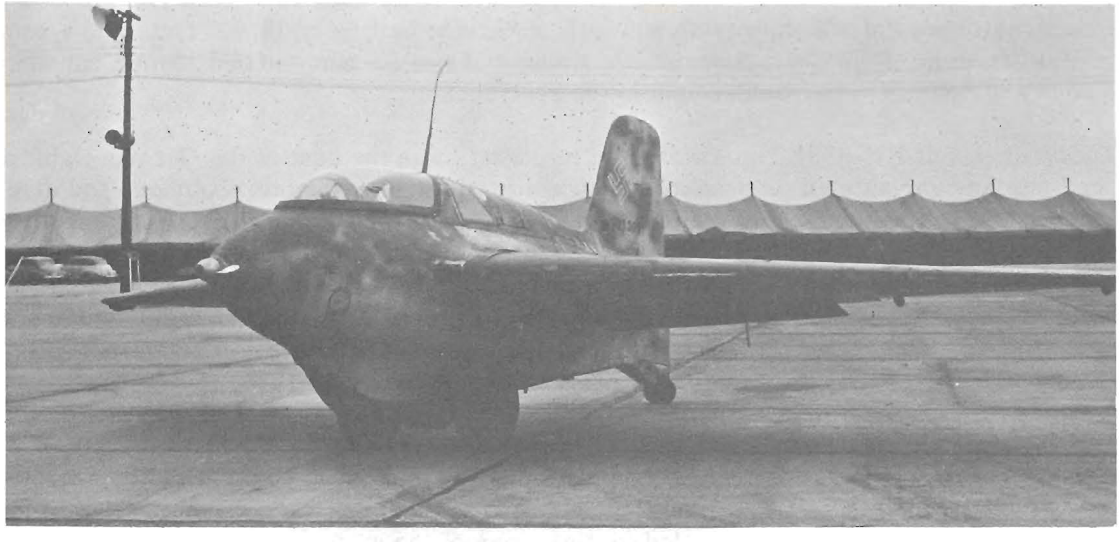


Figure 10. Messerschmitt Me-163. The small, wind-driven propeller turned a generator to provide electric power.

The Me-163 Komet tailless fighter, though limited to an operational range of 80 kilometers, went into action in the fall of 1944 and achieved marked success. Maximum speed was 590 mph, and its armament consisted of two 30-mm cannon. This later was developed into the Me-263 with a two-man crew.

The Arado Aircraft Works designed the Ar-234 which went into action in mid-1944 and was utilized as a light turbojet bomber, reconnaissance aircraft, and night fighter. Maximum speed was 540 mph, and armament as a night fighter consisted of four to five 30-mm cannon.

The He-162 Volksjager (People's Fighter) (fig 11), a cheaply built plane with its engine mounted on top of the fuselage, was designed to be flown by a young-age group of the Hitler Youth in mass attacks after a hurried training on gliders. The first aircraft went into service in February 1945, but only a small number saw action. Maximum speed was 500 mph, and armament consisted of two 30-mm cannon.

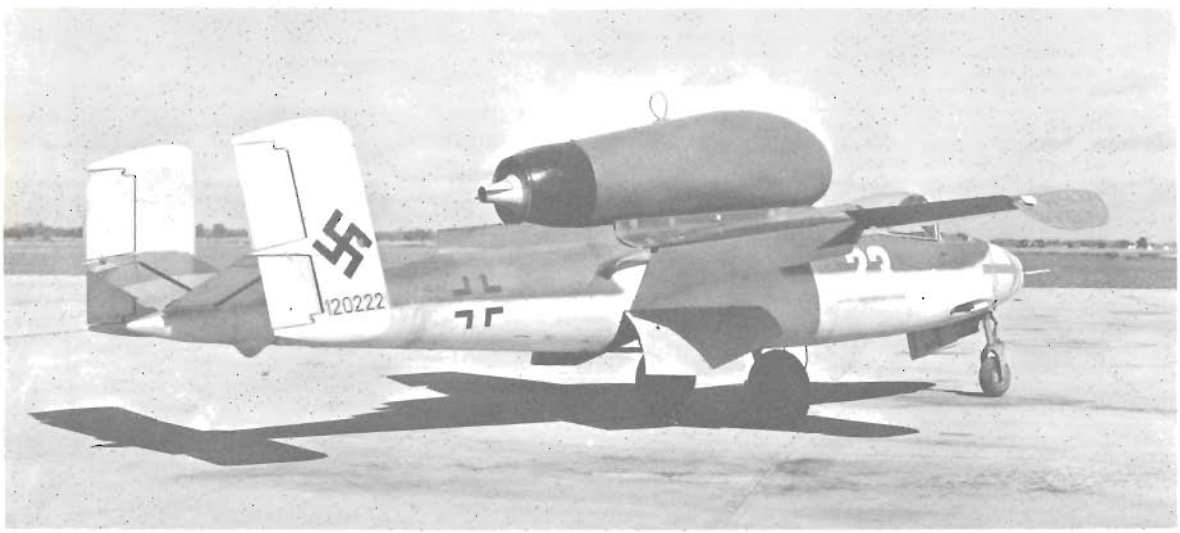


Figure 11. Heinkel He-162.

The Germans were working on other jet aircraft. Heinkel designed the He-178 and He-280 and was working on a long-range bomber, the He-343, and a long-range fighter, the He-P1075. The interceptors, P1101; rocket-driven fighter, P1104; fighter, P1110; and a delta wing, P111, designed by Doctor Lippisch, were in development by Messerschmitt. The Junkers factory was designing EF-127 (Dolly) and EF-128 (Walli). The EF-128, a tailless fighter, had achieved a speed of 600 mph.

With the termination of World War II came an end to jet aircraft development in Germany and a severe reduction in other nations. But it was now clear that the air defense problem had been compounded and a new challenge was at hand.

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The Oerlikon–Contraves 35 mm AA Tank

— a modern combat zone air defense system*

One of the main problems of vital concern to all land-based forces in the 1970s is the protection of troops in the combat zone against attacks from the air—attacks which are increasingly being made from very low level. It is, of course, true that attacking aircraft at present still require clear visibility, but this situation will radically change over the next few years. The next generation of strike aircraft will be equipped with combined navigation and attack systems which will allow low-level attacks to be carried out successfully under all weather conditions and by day or night, the use of terrain-following radar permitting more effective utilisation of the natural contours of the landscape to mask the aircraft's approach. Similar tactics will also be applied for airborne reconnaissance, so that air defense forces are obviously faced with some difficult problems. They must be capable of acquiring approaching air targets in a matter of seconds and immediately engaging them—a requirement which can only be fulfilled by use of an all-weather fire control system in conjunction with rapid-firing guns. In addition, the weapon system must be fully mobile, self-contained and armoured, in order to be capable of protecting mobile ground forces in action against any threat from the air.

In order to more clearly define these interrelated requirements, three Zurich-based companies, Oerlikon Machine Tool Works Bührle, Contraves, and Albiswerk formed a working partnership in 1963 and initiated basic studies on the concept of a mobile armoured anti-aircraft weapon system. The object of these co-operative studies was the fulfilment of the following main requirements:

- full combat autonomy, with Identification Friend or Foe (IFF) facility;
- high kill probability against strike and reconnaissance aircraft, especially those flying at low level;
- long effective combat range;
- short reaction time;
- all-weather capability;
- a high degree of immunity to electronic countermeasures;
- the mobility of a modern full-tracked vehicle;
- armour protection against small arms fire and shell splinters, plus NBC protection for the crew;
- effective self-defense against ground forces;
- simple operation, maintenance and support;
- large reserves of ready to fire ammunition for engagement of air and ground targets, with selective ammunition feed to the weapon;
- balanced overall system with high cost-effectiveness;
- availability of the system within a short and predictable timespan.

Development history

The urgent need of mechanized units for a mobile anti-aircraft system has been apparent for several years and has led to the production of various systems. Among these were the American M 42 twin-barrelled 40 mm AA gun, the French 30 mm twin mount on an AMX series tank chassis and an Oerlikon-designed 20 mm quadruple mount, again on an AMX chassis. All these, however, are only fair weather systems with limited combat range and therefore no longer meet today's requirements.

The basic design studies, functional type development and theoretical system tests which were begun in 1963 were followed in 1965 by a final proposal for a first generation 35 mm anti-aircraft tank. The decision to adopt the 35 mm automatic cannon in a

* This article has been contributed by the Panzer Flak project office of the Oerlikon-Contraves group.

◀ Oerlikon already had this fair-weather AA system on test in 1958. It incorporates four 20 mm cannons and is mounted on an AMX tank chassis.

Scale model of the 5 PFZ-B prototype, destined ▶ for delivery to Germany in the spring of 1971. This vehicle features, in addition to the 35 mm weapon mounting, a more advanced pulse Doppler tracking radar and a new pulse Doppler search radar with IFF equipment by Siemens.

◀ The first 5 PFZ-A prototype of the 35 mm AA tank was delivered to Federal Germany at the end of 1968. The turret is mounted on a *Leopard* chassis and visible in this view are the MTI search radar above the turret, the tracking radar on the turret front and the 35 mm weapon installation at the sides.

In 1968 the Netherlands ordered an AA tank which ▶ was designated 5 PFZ-C and was fitted with an integrated search and tracking radar by Hollandse Signaalapparaten. Shown here in mock-up form, this system is at present on final trials and should be delivered in late summer, 1970.

twin-mount configuration was based on extensive trials and testing which showed that the 35 mm calibre is particularly well suited to the tactical requirements. The 35 mm weapon and the size of the required fire control equipment necessitated the use of a 30 to 40 ton class battle tank chassis as carrier vehicle.

In 1966, the group of companies mentioned above started work on development and assembly of the first generation models of the 35 mm self-propelled AA defense system. In this same year a contract was signed with the Federal Republic of Germany for two prototypes, which were to consist of the following main components: search radar with Moving Target Indication (MTI) by N.V. Hollandse Signaalapparaten; a tracking radar by Albiswerk; a fire control system by Contraves; a 35 mm twin-barrelled weapon system by Oerlikon and a *Leopard* battle tank chassis from Krauss-Maffei. The MTI search radar was developed under contract to the Netherlands in view of their common military interest with Germany in such equipment.

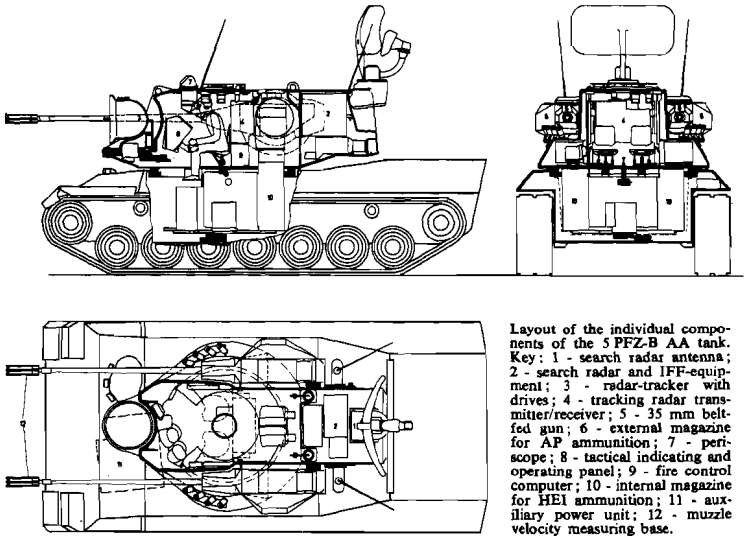
A third prototype was built by Oerlikon-Contraves for testing and development purposes, and manufacturer's tests on this started in May 1968. In November 1968 this prototype was used for a firing demonstration against towed targets before representatives of various countries. This effectively proved the basic functional capability of the overall system and in particular the high precision of the developed fire control and weapon system.

Utilising the experience gained with the works prototype, the first contract prototype, designated 5 PFZ-A, was completed for delivery to Germany at the end of 1968. The specification drawn up at the beginning of 1966 to meet the German military requirements had clearly been fulfilled. This first system has since been engaged on army technical tests, whilst the second prototype was accepted in the spring of 1969.

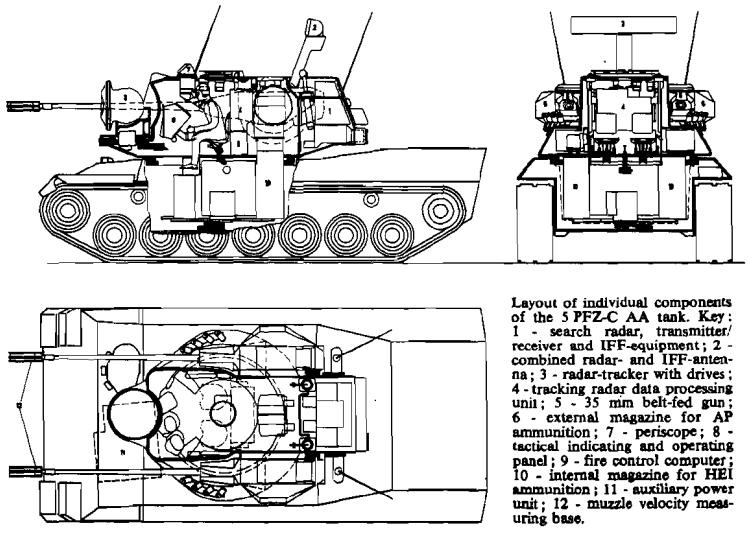
The technical trials of these two prototypes carried out in Germany by the army during 1969 were composed of three phases: fire control system testing, particularly the radar; weapons testing; and firing trials against towed targets and drones.

In terms of accuracy, tracking performance and range, and in reliability of components, the fire control system has fully met the requirements. The weapon installation has also produced equally favourable results, its functional reliability under unfavourable conditions—such as long intervals between maintenance, high gun barrel elevation and tilt—being subjected to very severe testing. This demonstrated that the concept of the externally mounted weapons, the automatic ammunition feed and the loading system was a good, neat and reliable solution. The weapon system can therefore now be considered ready for operational service.

The results obtained from the two first phases allowed the German test centres to carry out a comprehensive test firing programme with the two 5 PFZ-A prototypes against air targets on the Todendorf firing range. This evaluation resulted in both prototypes achieving a surprisingly high record of hits throughout the duration of the tests, both on faster targets (180 m/sec) and at longer ranges (up to 4,300 m). Throughout the whole of the firing programme no adjustments were found to be necessary. The accuracy which had already been demonstrated in the firing tests against air targets with the works prototype in Switzerland was fully corroborated with the prototypes built for Germany, under significantly more difficult conditions.



Layout of the individual components of the 5 PFZ-B AA tank. Key: 1 - search radar antenna; 2 - search radar and IFF-equipment; 3 - radar-tracker with drives; 4 - tracking radar transmitter/receiver; 5 - 35 mm belt-fed gun; 6 - external magazine for AP ammunition; 7 - periscope; 8 - tactical indicating and operating panel; 9 - fire control computer; 10 - internal magazine for HEI ammunition; 11 - auxiliary power unit; 12 - muzzle velocity measuring base.



Layout of individual components of the 5 PFZ-C AA tank. Key: 1 - search radar, transmitter/receiver and IFF-equipment; 2 - combined radar- and IFF-antenna; 3 - radar-tracker with drives; 4 - tracking radar data processing unit; 5 - 35 mm belt-fed gun; 6 - external magazine for AP ammunition; 7 - periscope; 8 - tactical indicating and operating panel; 9 - fire control computer; 10 - internal magazine for HEI ammunition; 11 - auxiliary power unit; 12 - muzzle velocity measuring base.

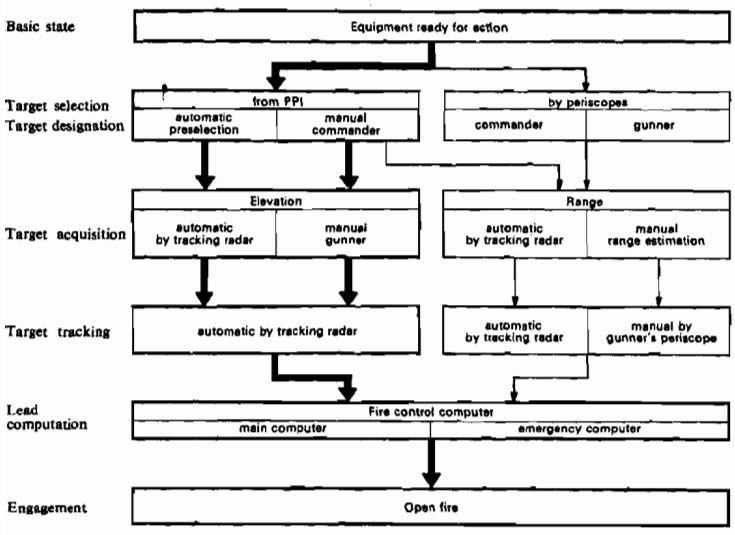
The technical testing by the military was expected to be complete by February 1970, and this was then to be followed by user trials. It is expected that these can be kept as short as possible since parts of the programme have already been carried out during the earlier technical tests.

The advances in radar technique which had taken place in the meantime, particularly in the field of clutter suppression, led to the construction of a second generation 35 mm self-propelled AA system with new or more advanced radars. The proven technical systems concept of the first generation AA vehicles was, however, retained. This minimum-risk modification of the radar installation resulted, for both variants of the weapon system, in improved surveillance and tracking of low-flying aircraft in addition to a significant reduction in reaction time.

The German 5 PFZ-B version uses the Siemens-developed MPDR 12 pulse Doppler system, coupled with the MSR 400 IFF equipment developed by the same company. Both these units have now successfully completed military testing. The tracking radar selected is the Albiswerk unit, developed into a pulse Doppler radar. Prototypes of the 5 PFZ-B version are at present being built and will be delivered in the spring of 1971.

The Netherlands, having a military requirement similar to Germany, ordered their own 35 mm anti-aircraft tank with the designation 5 PFZ-C in 1968. This version incorporates the integrated search and tracking radar system developed by Hollandse Signaalapparaten and which operates on the Doppler principle. This system too is

Main operation modes and phases of the 35 mm AA tank



fitted with the Siemens MSR 400 IFF system. The prototype is at present undergoing final testing and should be ready for delivery in the autumn of 1970.

Brief technical description of the 5 PFZ-B and 5 PFZ-C AA tanks

All components of the weapon system are housed in or on the turret, this being then mounted on a *Leopard* battle tank chassis. The system essentially consists of the search radar, the tracking radar, the fire control system with computer and the 35 mm twin gun mounting. The crew consists of the commander, the gunner and the driver.

The autonomy of the weapon system is achieved by the search radar. This permits continuous and reliable surveillance of the surrounding airspace, whether the vehicle is at rest or on the move, combined with an IFF capability. Initial recognition of a target results in automatic alert of the crew. Targets are presented on the search radar display screen in terms of bearing and range, and are simultaneously designated as friend or foe. This therefore facilitates a clear evaluation of the threat. The precise allocation of targets in terms of bearing and range from the search radar to the tracking radar can be effected either automatically or manually. Additional air situation displays can be transmitted in digital form by radio link from a remote long-range surveillance radar system and displayed on the same screen.

The tracking radar automatically acquires and tracks an allocated air target in azimuth, elevation and range, whilst air surveillance by the search radar can continue without restriction. The large unobstructed bearing sector of the tracking radar permits target acquisition in a sector of about 200 degrees without the necessity to slew the turret, a factor which contributes to a shorter system reaction time. The narrow radar beam and small range gate permit good resolution of multiple targets. Shifting targets can then be effected fully automatically by merely moving a range marker onto the new target's position on the screen.

This system therefore ensures target acquisition and tracking even under severe ground clutter conditions. The radar tracker is constructed in an armoured configuration, the antenna being turned towards the turret in the travelling position, so protecting it from damage.

Commander and gunner are each provided with their own periscopes, these being used for optical target acquisition and tracking, combat zone observation and laying the gun on ground targets. The optical lines of sight are stabilised in space by means of local rate gyros, enabling combat zone observation and engagement of ground targets to be carried out whilst the vehicle is on the move.

A miniaturized and transistorized analog computer calculates the lead angle for the weapon taking into account the meteorological data, the continuously measured MV and the tilt angle of the vehicle. This precise and rapid electronic computation results in a high hit probability for the system. The computer also simultaneously calculates the duration of fire in relation to the programmed range, in order to reduce expenditure of ammunition to a minimum.

The computer is fitted with self-testing equipment, by means of which the functional capability of the complete fire control unit can be fully checked out automatically within minutes. In case of failure of the main computer, the crew can switch over to an emergency computer.

The weapon installation incorporates the two 35 mm belt-fed guns in a twin mounting, the ammunition feed and the ammunition container. The two guns are positioned outside the turret cupola on trunnions allowing movement in elevation. This exterior mounting prevents any collection of powder fumes within the turret and so eliminates any danger of explosion. The direct accessibility for maintenance and repairs is another obvious advantage. The exposed parts of the cannon are armoured. The gun is a high-performance weapon with a rate of fire of 550 rounds per minute and a MV of 1,175 m/sec, and the high inertia of the weapon system contributes significantly to the required accuracy of fire.

The ammunition feed allows the firing of belted anti-aircraft or anti-tank ammunition, the changeover being effected by remote control from within the turret. The turret cage is designed as a storage magazine for anti-aircraft ammunition. Replenishment of the ammunition containers can be carried out by the crew in about 20 minutes, the linked ammunition belts being fed in from the exterior via the feeder channel and into the ammunition container. The anti-tank ammunition is stored externally in armoured magazines on the sides of the weapons. The ammunition carried on the vehicle totals 660 rounds of anti-aircraft ammunition plus 40 rounds of AP ammunition.

The trajectories of the types of ammunition used for anti-aircraft purposes are identical, and high explosive APHE and HEI shells—with or without tracer— can therefore be fired in mixed sequence if required. The performance of these ammunition types in terms of explosive, splinter and incendiary effect is practically equivalent to those of the well-known 40 L/70 shell. The effective aerodynamic form of the shell and its high muzzle velocity give the 35 mm calibre exceptionally short times of flight. An armour piercing round with high penetration power is also available for use against armoured ground targets.

The power source for the weapon system is housed in the hull of the tank, a separate diesel engine driving the generators necessary to feed power to the fire control and weapon systems. Also housed in the hull is the FNA-4 vehicle navigation system by Teldix. This equipment is only utilised for orientation in the field and for parallax correction of the air situation display from remote radar on the search radar scope. It has therefore no influence on accuracy during the engagement of airborne targets.

Operating concept

The main operating sequences of the weapon system are almost completely automated so that the crew has only a minimum of operational tasks to perform. The tactical as well as the technical operating and indicating controls and instruments for the complete system are all grouped in a central operation panel in front of the turret crew. These crew members have the following main tasks:
Commander: vehicle guidance while in action; monitoring the surveillance radar scope; assessment of the air threat; target selection and target assignment; choice of system operating mode; selection of ammunition type and firing mode; operating the radio.
Gunner: target acquisition, tracking and engagement (air and ground targets); shifting targets; sector search (electronic/optical).

Commander and gunner work as a team with shared tasks. The positioning of the indicating and operating sections does, however, permit either of the two men to fire the guns. The team can carry out all their tasks with closed or open hatches, and the design of the fighting compartment conforms to the latest human engineering practices.

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The test results with the first generation prototype and the present state of progress with the second generation prototype point to the fact that the 35 mm anti-aircraft weapon system by Oerlikon-Contraves mounted aboard the *Leopard* chassis will be the first autonomous all-weather air defense system to be ready for service, and which in addition will fully meet the requirements for a mobile field AA system for the protection of armoured divisions in the 1970s.

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INFANT

A night vision system that will give a helicopter crew the ability to swoop down out of a black sky and locate an enemy illuminated only by starlight has been developed for the US Army by Hughes Aircraft Company.

The new system uses a combination of the latest developments in low light-level television, image intensifier tubes, fiber optics, and covert illuminators to present an image almost as bright as day in the cockpit.

Called INFANT (for Iroquois Night Fighter and Night Tracker), the system has been installed in a UH-1M Iroquois helicopter (fig 1) and successfully demonstrated during night operations in the California desert. It was developed under direction of the Army Electronics Command's Night Vision Laboratory, Fort Belvoir, Virginia, and is being installed in a number of helicopters.

Figure 1. NIGHT FIGHTER—UH-1M Iroquois helicopter is shown equipped with INFANT night vision system that enables a helicopter crew to navigate, locate an enemy, and attack under low-light levels such as provided by starlight.

The system requires only a very small amount of light, and can "see" in what to the unaided human eye is virtually total darkness. It accomplishes this by concentrating and intensifying the available light through a series of image intensifier tubes and a low light-level television system.

Figure 2. The INFANT viewing system employs two sensors mounted on the front of the helicopter.

The INFANT equipment uses two sensors mounted on the front of the helicopter (fig 2), each serving a different viewing system. A remote system, using low light-level television, presents an image on three cockpit displays to the crew. The other, a direct-view system using an image intensifier, transmits an image to the copilot/gunner through a fiber optic cable (fig 3).

If sufficient light is not available for accurately pinpointing a target, a covert searchlight can be turned on to illuminate it.

Figure 3. An intensified image produced by the night vision system is viewed by copilot looking into the end of a fiber optic cable.

Laser Rangefinder

Laser rangefinders, which measure range to a target at the speed of light, will help insure the safety of crew members of two types of armored vehicles now in service in the US Army.

The project engineer displays the laser rangefinder developed for the Army's M60 tank.

Hughes Aircraft Company, under a contract awarded by Frankford Arsenal, Philadelphia, Pennsylvania, is producing 300 laser rangefinder systems for the Army's M60A1E2 battle tank. Recently, Hughes was awarded another contract to develop a similar system for the Army's M551 Sheridan armored reconnaissance vehicle.

Crew safety is increased by means of the laser system because it greatly improves the probability of scoring a direct hit on an enemy tank on the first try. This first-hit capability eliminates the need for firing bracketing rounds that could reveal the crew's position and invite enemy fire.

The rangefinder consists of a ruby laser, telescope-like optics, and associated control panels and electronics.

In operation, the rangefinder is aimed at a target and the laser fired. The light beam, traveling at 186,000 miles per second, reflects off the target and back into a receiver telescope. The system registers the elapsed time for the laser beam's round trip, automatically computes the distance to the target with extreme accuracy, and displays the range on a readout.

Installation of the rangefinders in armored vehicles represents a perfect marriage between the Army's reliable "workhorse" and one of the space age's most promising technological "glamour girls."

Nike Hercules Surface-to-Surface Battery

Captain John E. Clarke

Editor's Note:

The surface-to-surface battery is an idea of the author and not an actual or planned unit.

This article covers the major items of equipment and personnel required to deploy a fully mobile surface-to-surface Nike Hercules missile battery. To achieve maximum mobility, minimum reaction time, and minimum maintenance requirements, many items of equipment considered nonessential for surface-to-surface operations have been eliminated (table 1). In designing this surface-to-surface battery, every effort will be made to use items of equipment presently in the inventory in their present configuration or with as little modification as possible to insure minimum cost and delay in deployment. The battery is composed of a headquarters section, fire control platoon, and launching platoon (fig 1). No assembly and service section is included because the missiles are to be issued to the battery as "ready rounds." This function will be performed by an assembly and service section attached to the field army maintenance facility. A one-van concept will be employed in the fire control area, made possible by a data converter unit. The launcher platoon will be limited to one launcher with one missile on the launcher and one on the rail. This will allow two missiles to be fired in rapid succession with only a short delay for reloading the remaining two rounds for firing.

Major items of fire control equipment:

Firing control station. All items of equipment required for surface-to-surface operations normally found in the tracking station are combined in the director station. The unit in this one-van configuration is renamed the "firing control station."

Antenna-receiver-transmitter group. The missile tracking radar is the only radar required because the functions normally performed by the target tracking radar will be accomplished by the target data unit.

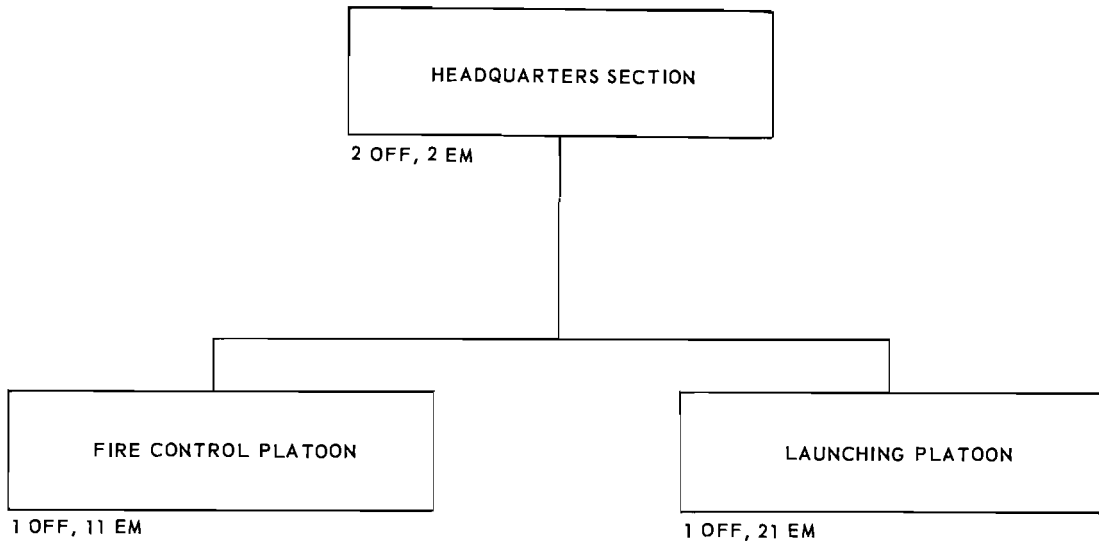


Figure 1. Proposed organization chart, Nike Hercules surface-to-surface battery.

Table 1. TOE 44-537G equipment not required for proposed Nike Hercules surface-to-surface battery

1. Fire control platoon:	
a. Antenna-receiver-transmitter group, acquisition	1 ea
b. Antenna-receiver-transmitter group, target	1 ea
c. Antenna-receiver-transmitter group, target ranging	1 ea
d. Coder-decoder group	1 ea
e. Tracking station, guided missile, trailer-mounted	1 ea
f. Generator set, diesel engine, 45-kw, 400-Hz	2 ea
2. Launching platoon:	
a. Launching control group, trailer-mounted	1 ea
b. Simulator, guided missile, flight	1 ea
c. Launching control-indicator	8 ea
d. Section control-indicator	2 ea
e. Launcher, monorail, guided missile	8 ea
f. Rail, launching and handling, guided missile	14 ea
g. Section simulator group	2 ea
h. Section equipment director station, trailer-mounted	2 ea
i. Generator set, diesel engine, 45-kw, 400-Hz	5 ea

Diesel engine, 45-kilowatt, 400-hertz generator set. All electrical elements in the fire control area can be powered by one 45-kw generator.

Radar test set. This test set and the associated combination antenna mast group are required to perform checks on the missile tracking radar.

Major items of launching equipment:

Monorail guided missile launcher. A single launcher was chosen because one round can be placed on the rail and another on the launcher. The remaining two rounds can be loaded in a short time. Personnel manning requirements are thus kept to a minimum and mobility to a maximum.

Section control group and trailer (command post for the launching platoon). The launching section will be controlled and the missiles fired from there.

Ready-round transporter. One transporter is required for the movement of each of the four missiles making up the recommended basic load.

Launching and handling rail. One rail must be issued with each assembled round because the missile is attached to it and fired from it.

Diesel engine, 45-kilowatt, 400-hertz generator set. One generator is sufficient to supply both the section control group and launcher. A second generator will be used as backup.

Mobile test unit. This unit will enable the firing battery to perform organizational maintenance on missiles and launching equipment. The primary means of communication with higher headquarters and within the battery will be wire with FM radio as backup. Since no data link will be used, no cabling will be required. The normal interarea and maximum distances will still apply because of radar tracking limits and dial setting limitations on the computer.

Four special rounds with yields determined by the field army commander based on the unit's mission is an adequate basic load for the battery. This arrangement will provide the field army commander with adequate and immediately available firepower and still keep launcher equipment and personnel requirements at a minimum. Resupply will be made as necessary from the assembly-service section facility at field army.

Mobility will be provided by two $\frac{1}{4}$-ton trucks, thirteen $2\frac{1}{2}$-ton trucks, and one 5-ton truck. The shop van is truck-mounted and does not require an additional vehicle.

Four officers and 34 enlisted men are needed to meet personnel requirements (table 2). Although this is fewer enlisted men than are normally supervised by a captain and three lieutenants, the ratio is justified by the special weapons responsibility. Maintenance personnel are included to give the battery an organizational repair capability for all authorized equipment (table 2).

Table 2. Personnel and equipment for proposed Nike Hercules surface-to-surface battery

1.	Major items of missile-peculiar equipment:	
	a. Fire control platoon.	
	(1) Firing control station, guided missile	1 ea
	(2) Antenna-receiver-transmitter group, missile tracking radar	1 ea
	(3) Generator set, diesel engine, 45-kw, 400-Hz	2 ea
	(4) Test set, radar w/antenna mast group	1 ea
	b. Launching platoon.	
	(1) Launcher, monorail, guided missile	1 ea
	(2) Section control group and trailer	1 ea
	(3) Ready round transporter	4 ea
	(4) Generator set, diesel engine, 45-kw, 400-Hz	2 ea
	(5) Mobile test unit	1 ea
2.	Vehicles:	
	a. Truck, $\frac{1}{4}$-ton	2 ea
	b. Truck, $2\frac{1}{2}$-ton	13 ea
	c. Truck, 5-ton	1 ea
3.	Personnel:	

a. Headquarters section.

	Rank	MOS	No.
Battery commander	CPT	1180	1
Battery executive	LT	1180	1
First sergeant	E-8	16Z50	1
Driver	E-3	16B10	1

b. Fire control platoon.

	Rank	MOS	No.
Platoon leader	LT	1180	1
Section leader	E-6	16C40	1
Assistant Section leader	E-5	16C40	1
Computer operator	E-5	16C20	2

Table 2. Personnel and equipment for proposed Nike Hercules surface-to-surface battery—Continued

	Rank	MOS	No.
Missile tracking radar operator	E-5	16C20	2
Radio/switchboard operator	E-4	16C20	2
Senior generator operator	E-4	52B20	1
Fire control technician	E-6	24Q40	1
Fire control technician	E-5	24Q40	1
c. Launching platoon.			
	Rank	MOS	No.
Platoon leader	LT	1180	1
Section leader	E-6	16B40	1
Assistant section leader	E-5	16B40	1
Senior launcher crewman	E-5	16B20	2
Senior generator operator	E-4	52B20	1
Firing panel operator	E-5	16B10	6
Launcher crewman	E-4	16B10	6
Launcher helper	E-3	16B10	2
Assembly sergeant	E-6	24U40	1
Electrical material specialist	E-5	24U20	1

Significant reductions in equipment and personnel are feasible in the deployment of the surface-to-surface battery. Mobility and economy are the prime benefits.

All fire control components required for surface-to-surface operations can be installed in the director station trailer.

The organization outlined in figure 1 and table 2 offers the optimum balance between economy and performance for the proposed battery.

Ready rounds will be issued to the battery by an assembly and service section attached to the field army maintenance facility.

The firing control section consists of:

The firing control station. The control station is designed to combine the functions of the tracking station and the director station into a single van solely for surface-to-surface operations. Every effort is made to use items of equipment presently in the inventory with

the fewest possible modifications. The director station is chosen as the van best suited for the required modifications. Figure 2, in nine sections, shows the modified director station (renamed firing control station); the components of this unit are discussed below.

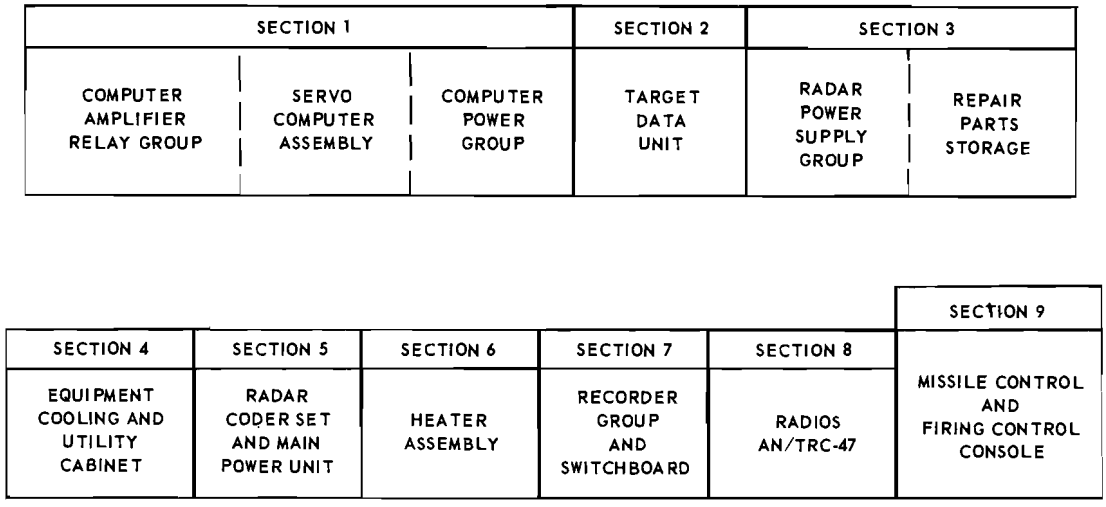


Figure 2. Firing control station, proposed Nike Hercules surface-to-surface battery.

Computer groups (sec 1). Each of the three computer groups is essential for surface-to-surface operations and remains located in the van as shown.

Target data unit (sec 2). This unit is positioned along the same wall as the computer, leaving just enough space to prevent blocking the escape hatch. The target data unit functions with the computer and is positioned as close to it as possible. That location is also convenient for the tactical control officer.

Radar power supply group (sec 3). This unit is located adjacent to the target data unit and occupies the remaining wall space. Only half the cabinet space is needed for the missile tracking radar components so it is proposed that the other half be modified for parts storage.

Equipment cooling and utility cabinet (sec 4). This component is kept intact in its present location. It is adequate to maintain a safe temperature in the van for all proposed electrical components.

Radar coder set and main power unit (sec 5). The radar coder set is a component taken from the tracking station that is necessary for the missile tracking radar. Only the bottom half of the cabinet contains missile tracking radar equipment. The top half, which was used for target tracking radar equipment, has been removed and the main power unit for the van installed in its place.

Heater assembly (sec 6). This director station element is adequate to be used "as is."

Recorder group and switchboard (sec 7). These items will be used intact. Only the rewiring caused by the removal of the battery control console will be made. All tactical and technical loops will be routed through the switchboard.

Radios, AN/TRC-47 (sec 8).

Missile control and firing control console (sec 9). This is the missile control console taken from the tracking station and modified to function also as the firing control console for the tactical control officer. Switches are installed to set the battery status (WHITE/YELLOW/RED), set proper minimum burst altitude, and send the fire command to the computer.

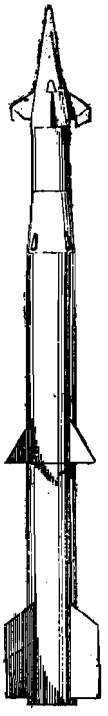
A general discussion of the target data unit follows:

The target data converter is a concept developed by the Bell Telephone Company in 1965. It includes the target data unit that sets target location into the computer without the necessity of converting the data to polar coordinates. Several modifications to surface-to-surface circuits in the computer are also included to improve the trajectory of the missile at several points. This corrects the center error probable to the extent that the use of the high-explosive warhead at maximum range is feasible.

An Improved Nike Hercules battery at White Sands Missile Range was outfitted with a prototype of the target data unit and the computer modifications in 1966 and was tested in the surface-to-surface role. The tests were successful in that problem computation time was reduced one-fifth to one-half, depending on the angle of guidance cutoff.

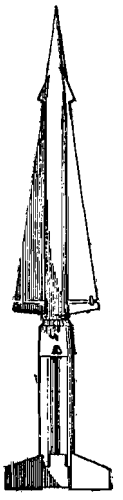
The Army decided it did not need the target data unit because the systems currently deployed were adequate for their assigned missions so the modification was not purchased. In designing a surface-to-surface battery, however, this equipment takes on new importance. It is the key to the one-van concept. Target data are set directly into the target data unit rather than the target tracking radar, making possible the elimination of the target tracking radar and all its associated equipment. The remaining equipment required for surface-to-surface operations can be combined into one van. The van in this configuration is called the firing control station.

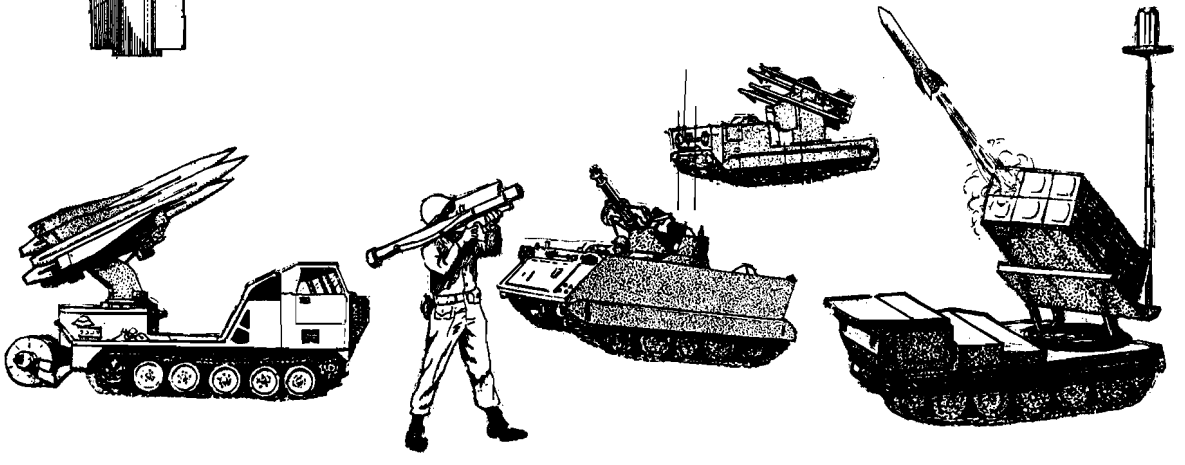
AIR DEFENSE SYSTEM PROGRAM REVIEW



The annual air defense system program review was held at US Army Air Defense Center and Fort Bliss, Fort Bliss, Texas, 10-11 August 1971. General Bruce Palmer, Jr, Vice Chief of Staff of the Army, was the senior representative attending with other senior Department of the Army staff members. The action began with a review of the U.S.S.R. air defense program followed by an intelligence briefing concerning the air threat to the field army and continental United States (CONUS) during the 1975-1990 period. Other briefings followed covering the air defense concept and doctrine for present and future air defense systems to counter the threat. The review also included briefings on existing, improved, and future programed air defense systems and supporting equipment.

In preparation for the air defense review, the Air Defense Center Team, consisting of the Commanding General, US Army Air Defense Center and Fort Bliss (who is also Commandant of the US Army Air Defense School); Commanding Officer, US Army Combat Developments Command Air Defense Agency; President, US Army Air Defense Board; and

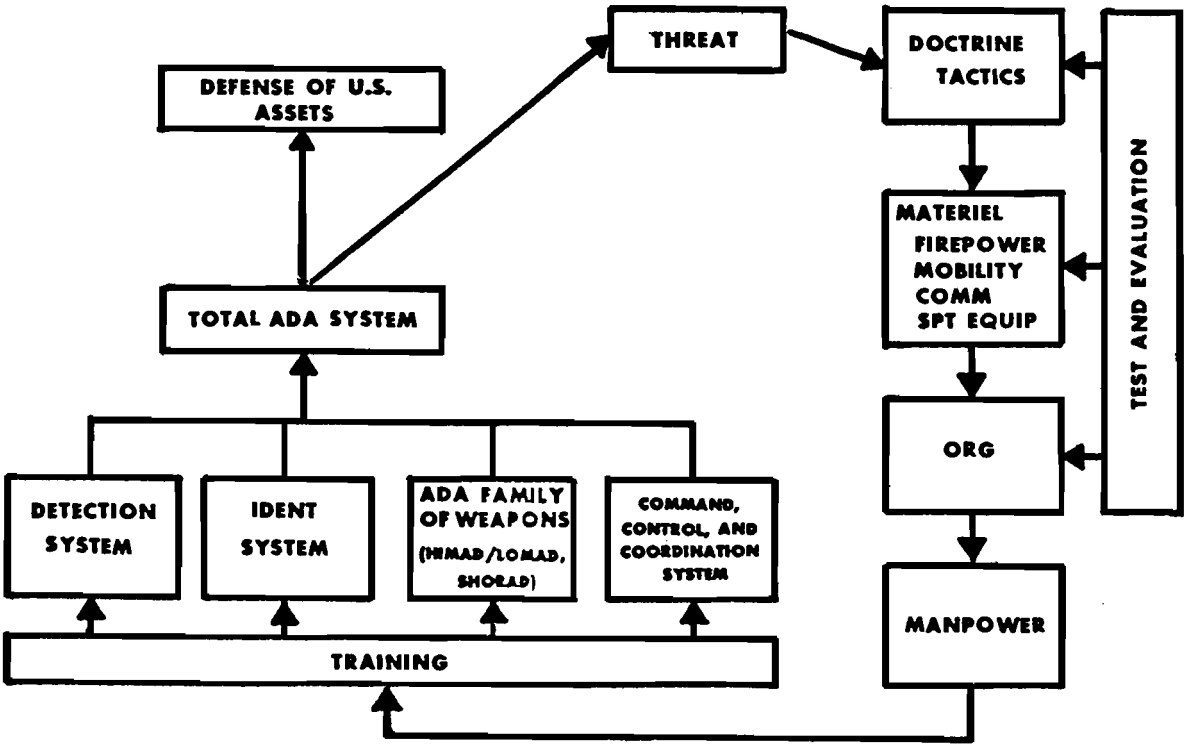




Chief, US Army Air Defense Human Research Unit, prepared the Air Defense Artillery Development Plan (ADAMDEP). ADAMDEP presented materiel requirements and recommended priority ordering of developments to satisfy requirements put on field army and CONUS commanders in establishing defense against air attack.

The mission of air defense artillery, which is to destroy, nullify, or reduce the effectiveness of any enemy aircraft or missile attack, and the air defense artillery system cycle (below) were used in formulating this plan.

AIR DEFENSE ARTILLERY SYSTEM CYCLE



Briefly, the overall driving force in the air defense artillery system cycle is the threat and the effect of this threat on the land battle. The threat is continually changing in pace with the updating of the aircraft inventory of a potential enemy. Doctrine responds both to the threat and our technological capability. Although airspace coordination requires centralized direction, the ability to decentralize engagement control is imperative to insure positive and timely execution of the air defense mission. Materiel supports doctrine in that it must have the ability to sustain 24-hour-day operations, fire unit integrity to permit the performance of all necessary engagement functions in seconds, and reliability to insure the ability to fire on short notice. A considerable amount of equipment sophistication inevitably results. Organization makes the most efficient and flexible use of materiel in support of doctrine.

The organization must provide trained tactical and logistical personnel to enable sustained operations and units to react rapidly. A highly efficient organization is required because of equipment sophistication and breadth of responsibility. Manpower is the most important single element in the system cycle. The soldier must be intensively and extensively trained in highly technical skills. The qualitative and quantitative personnel requirements are high because of the functional demands of air defense artillery systems. Training requirements are extensive, both in average course length and complexity of subject matter. System reaction time demands a high level of proficiency and the ability to make virtually instantaneous "fire/no-fire" decisions. Habitual decentralization requires unusually self-reliant commanders and senior NCO's. The total air defense system is made up of detection and identification systems and a family of weapon systems with associated command, control, and coordination systems. A family of complementary weapon systems with a method for positive identification must be deployed. No single weapon can counter the variety of enemy weapon systems constituting the air and missile threat. The end result of the air defense artillery system cycle is the fielding of modern weapon systems manned by well-trained personnel to meet the threat and provide for the defense of United States assets. This cycle is continuously in motion in an attempt to meet the ever-changing threat; hence, the reason for an annual air defense system program review.

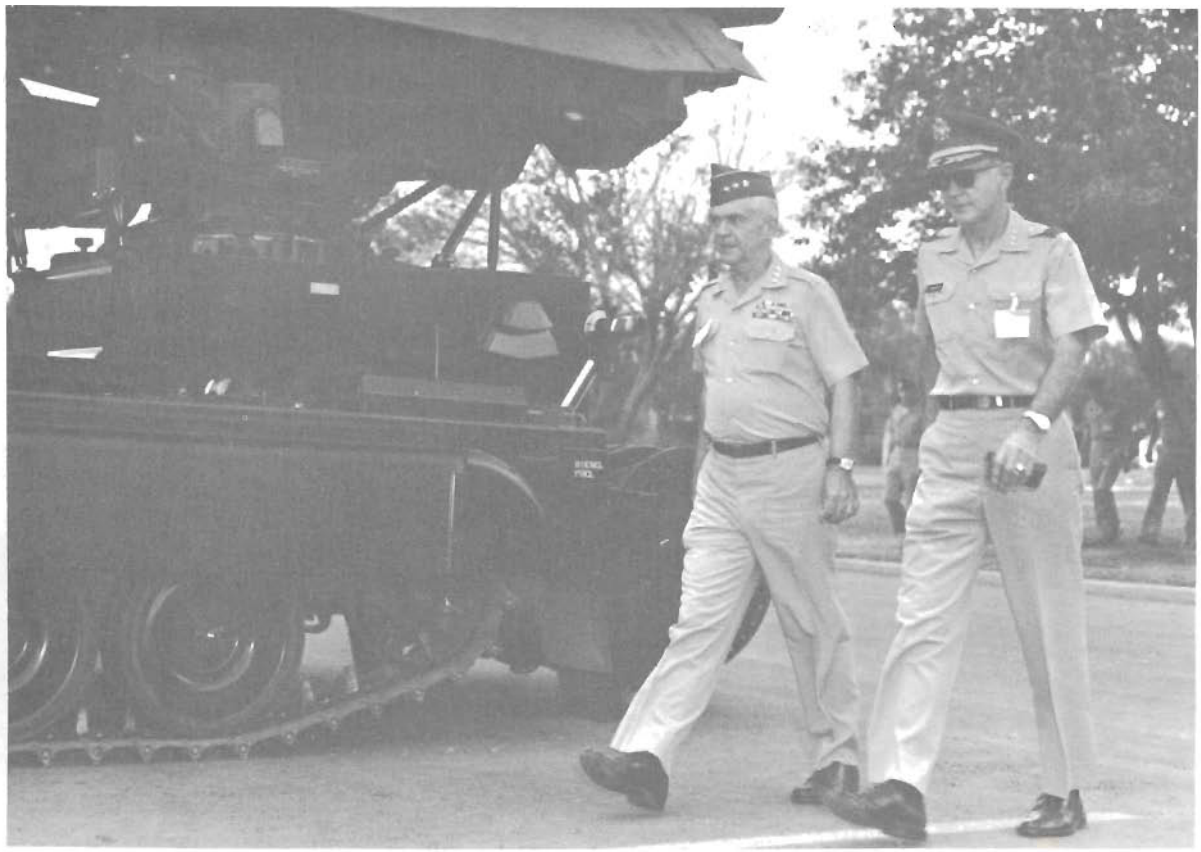
General Bruce Palmer, Jr, Army Vice Chief of Staff, and Major General Raymond L. Shoemaker, Commanding General, US Army Air Defense Center and Fort Bliss, at the static air defense display during the Air Defense System Program Review.

At the conclusion of the formal presentations, General Palmer made numerous observations, including these comments:

My reaction so far may be like most of you here. I have been getting a tremendous dose of a tremendous subject with a fire hose, perhaps more than any of us can assimilate at one time.

But when you get deeper into it, you can see how interrelated all air defense systems are. You can't look at them in isolation. You have to look at the entire spectrum from the Redeye all the way to Safeguard.

I also want to make a comment about the future of Air Defense. I think the air defense people are holding their own and doing extremely well. You now even have a four-star general in a very big political military job. And I think it is a tribute to the air defense community. And this is what you want to tell your young tigers now. Don't just narrowly stay in Air Defense for 30 years. You will be a much better air defense artilleryman if you get into broader fields. You can come back to Air Defense periodically, but you can't compete in this world if you are too narrow.



Lieutenant General Richard T. Cassidy, Jr, Commanding General, US Army Air Defense Command, and Lieutenant General William C. Gribble, Chief of US Army Research and Development, tour the static air defense display.

Operational Lessons Learned

EXPERIENCES OF DEPLOYED UNITS

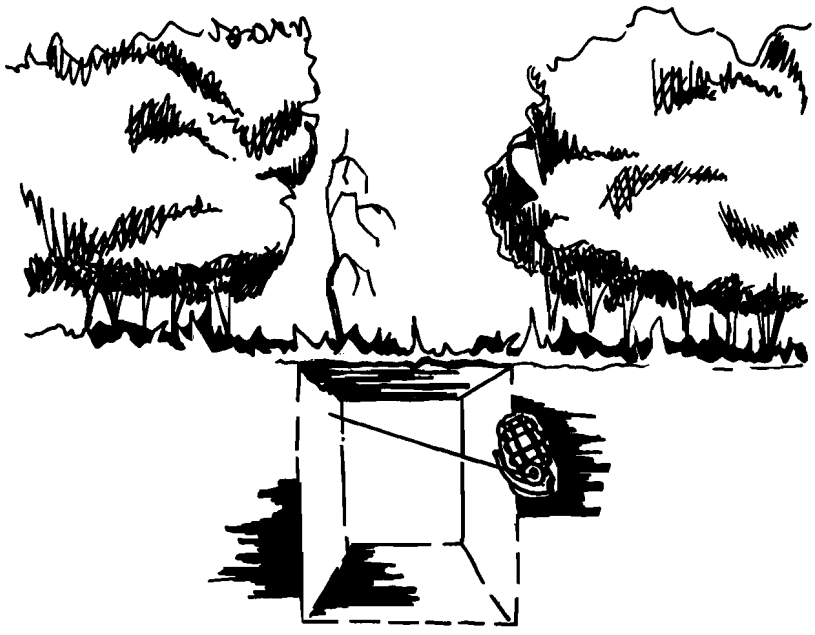
Vietnam

On many occasions when rapid fire is required, the length of the M16A1 rifle causes it to snag on vines and underbrush, interfering with effective immediate firing. When quick reaction is required, a long rifle is not sufficiently maneuverable; a man swinging to fire will often find his M16A1 caught in the vegetation. Long-range patrol operations require a compact, rapid-firing, accurate weapon that can be carried at the ready position through the thickest vegetation without becoming entangled. Such a weapon does not require the range of the M16A1 rifle because targets are seldom engaged beyond 25 meters. Because the M16A1 rifle is too long and cumbersome for long-range patrol operations in thick jungle, the CAR-15 assault rifle is recommended (DA Pam 350-15-14).

In many areas, because of vast, open, water-filled rice paddies, it is not possible to tie in defense positions except by fire. (Obviously, soldiers cannot occupy a position while standing or sitting in water all night; consequently, defenses are not tied in as closely as desired.) This problem has been overcome by using plastic assault boats which can be sling-loaded by helicopter into defensive positions. Plastic assault boats are positioned in the water to fill gaps in the defense, camouflaged with natural vegetation, and used as a fighting position. Sandbags used to fortify the inner walls of the boats give protection to the occupants, and the added weight lowers the silhouette in water.

A new type of boobytrap (called the football boobytrap) discovered recently employs a ChiCom pull-release or fragmentation handgrenade buried in a hole 15 to 18 inches long, 12 inches wide, and 15 to 18 inches deep. The grenade is emplaced in the side of the hole and pointed down at a 45° angle, with the handle of the grenade inserted slightly into the hole. A string from the pull-release in the handle of the grenade is strung across the hole and tied to an anchor on the opposite side. An individual stepping into the hole will hit the taut string and activate the grenade release, detonating the grenade. Boobytraps of this type have been found near doorways, in houses, under brick walkways, and along trails, expecially where a trail passes through a small opening in a hedgerow. The football boobytraps that have been found were well-camouflaged, and the grenades were encased in plastic bags to protect the

fuze and explosive charge from moisture. Most of these boobytraps were marked with a stick 3 or 4 feet tall, with three or four short branches pointing in the direction of the boobytrap.



Cutaway view of football boobytrap.

In populated areas under VC/NVA control or influence, boobytraps are one of the main hazards, often armed by old men, women, or children (when told to do so) who know the location of the boobytrap. Dud 105-mm rounds and M26 handgrenades are most often used, and a thin, transparent line is used as the trip wire. Trails, natural passages, areas of heavy vegetation, or hedgerows are the most frequently boobytrapped.

Grappling hooks can safely clear a trail. The best size is 8 inches long and 6 inches in diameter with a 100-inch nylon parachute cord attached. They should be light enough to be easily carried by troops in the field.

Korea

Winter in parts of Korea presents many equipment, personnel, and operational problems. Tactical sites in affected areas must be prepared for winter prior to 1 November. Snow causes the majority of problems during the winter months. In many instances tactical site roads become impassable.

Prior to the first snowfall, field ranges, immersion heaters, galvanized cans, and other mess equipment should be stored on the tactical site. The operational load of rations should be checked for age and quantity. The breakfast meal should be brought to the tactical site by the evening chow truck. This eliminates the need for a run on the road during the early morning hours when roads are still frozen. A cook should be assigned to the manning crew.

Action should be taken to minimize the effects of the snow by depositing piles of sand or gravel along hills and curves of roads that service the site. Rock salt or calcium chloride should be requisitioned early and stored in large quantities. This material can be used to melt snow and ice on paved roads or concrete pads, but should not be used around items of equipment. Battery personnel should prepare themselves for a severe snowstorm every time they go to the tactical site. They should bring toilet articles, a change of underwear, and a clean uniform. The senior NCO should check each man prior to movement to the tactical site to insure that he has all of his winter clothing (gloves, parka, insulated boots, etc.). Commanders of the reliefs must insure that each guard is dressed properly prior to being posted. Vehicle movement to the tactical site should be restricted until the road is cleared. It is very easy for a heavy vehicle to slide off the road when traveling on a snow-covered hill. If possible, troops should dismount and walk when icy hills are encountered. When it becomes apparent that vehicles will not be able to reach the tactical site, water should be rationed. A field trench latrine should be constructed to augment the waterborne system. Fuel is extremely critical during the winter months and must be replenished on the tactical site at every opportunity. The operational load of diesel fuel and motor gasoline should be used only when absolutely necessary. All heaters should be kept on low range for maximum fuel conservation. When all storage tanks are full, the fuel truck should be filled and parked on the tactical site.

Conductors and Insulators

Across

1. Where the total line length is 200 feet, the smallest size copper wire that will limit the line drop to 5 volts, with 120 volts applied and a 6-amp load, is No. _____.

4. The motion of _____ causes electric current.

6. The resistance of 100 feet of No. 10 copper wire and 200 feet of No. 7 copper wire are essentially _____.

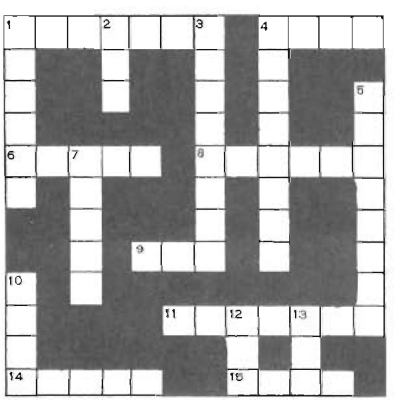
8. If a wire conductor of 0.1-ohm resistance is doubled in length, its resistance becomes two _____ ohm.

9. A 10-foot length of No. 20 copper wire has a total resistance of less than _____ ohm(s).

11. The _____ across a good fuse is practically zero.

14. A copper wire conductor with 0.2-inch diameter has an area of _____ thousand circular mils.

15. Insulation materials _____ off short circuiting between conducting wires.



Down

1. All metals are good conductors, the best being _____.

2. If a coil is wound with 3,000 turns of No. 20 wire averaging 4 inches per turn, the total resistance of the coil is _____ ohms.

3. Ionization current in liquids and gases results from a flow of positive and _____ ions.

4. An open fuse has a resistance of _____.

5. The hot resistance of the tungsten filament in a bulb is higher than its cold resistance because the filament's temperature coefficient is _____.

7. An ion is an atom with _____ (abbr) charges.

10. If two wire conductors are tied in parallel, their total resistance is _____ the resistance of one wire.

12. A closed switch offers extremely _____ resistance.

13. One of the most effective insulators is _____.

Answers on page 101.

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

A Programed Course in Algebra by Ancel C. Mewborn. Addison-Wesley Publishing Co., Reading, Mass.
"This course is designed to increase your understanding of some of the basic ideas of algebra."

Army Registry of Special Educational Materials (ARSEM) Catalog by U.S. Department of the Army. U.S. Government Printing Office, Washington, D.C.
"The Registry will benefit the Army as a whole, and be particularly valuable to Army instructors, students, and staff officers at all levels."

Anatomy of China by Richard G. Wilson. Weybright and Talley, New York.
"Communist China—her leaders, her new society, her past and present policies, her plans for the future."

The Papers of Dwight David Eisenhower; the War Years by Dwight David Eisenhower. Johns Hopkins Press, Baltimore.
"These papers, now being collected, collated, and indexed at the Eisenhower Library in Abilene, Kansas, promise to be one of the most significant collections of personal papers for the military and political history of the West during the mid-twentieth century."

1001 Valuable Things You Can Get Free by Mort Weisinger. Bantam Books, New York.
"The free albums, atlases, books, brochures, films, games, guides, kits, magazines, manuals, maps, paintings, plans, posters, samples, services, and all the other items listed in this book, are bona fide offers."

A Study of Resources and Major Subject Holdings Available in U.S. Federal Libraries Maintaining Extensive or Unique Collections of Research Materials by U.S. Department of Health, Education, and Welfare. Washington, D.C.
"It is, in essence, a guide to the research resources of 188 Federal Government libraries insofar as it was possible to obtain descriptive details regarding holdings identified as being of major significance."

The War Business; the International Trade in Armaments by George Thayer. Simon and Schuster, New York.
"A controversial, definitive, and revealing study of the international trade in armaments—a vast business whose end products are war and death and which currently runs to some five billion dollars a year."

Technical Writing by Richard W. Smith. Barnes and Noble, New York.
"A guide to manuals, reports, proposals, articles, etc., in industry and the Government."

Area Handbook for the United Arab Republic (Egypt) by American University, Washington, D.C.
"This volume is a revision of U.S. Army Area Handbook for the United Arab Republic (Egypt) published in December 1964."

The Military Specialist; Skilled Manpower for the Armed Forces by Harold Wool. Johns Hopkins Press, Baltimore.
"Dr. Wool provides a comprehensive analysis of the complex forces that brought about the existing pattern of military specialization and evaluates the ability of the Armed Services to attract and retain specialized manpower."

A Chronology of the Vietnam War by Institute for International Studies of the University of Plano. Plano, Texas.
"While the present study focuses its attention on events in Vietnam, it also includes events which contributed directly to the development of the conflict."

Events in Space by Willy Ley. McKay Co., New York.
"This is the first popular book to tell the story of space from early theory and experimentation to the development of the Apollo moon vehicle."

Calibration Requirements for the Maintenance of Army Materiel by U.S. Department of the Army. Washington, D.C.
"This bulletin lists the calibrations required for test measurement and diagnostic equipment (TMDE) used in the maintenance of materiel in the army in the field."

The Two Chinas by Daniel Lyons. Twin Circle Publishing Co., New York.
"In The Two Chinas the reader will find a conveniently succinct, penetrating, and illuminating comparison of freedom and slavery."

How Computers Do It by David G. Moursund. Wadsworth Publishing Co., Belmont, California.
"This book is designed to aid the reader in learning how to use a computer."

The Elements of Digital Computer Programming by Edwin D. Reilly. Holden-Day, San Francisco.
"We want to teach the fundamental principles of digital programming to college and university students who have had no prior exposure to the subject, and who do not necessarily have any mathematical preparation beyond high school algebra."

German Tank and Antitank in World War II by E. J. Hoffschmidt. WE, Inc., Old Greenwich, Connecticut.
This book describes the history and development of tanks in Germany plus individual sections on armored vehicles, armored cars, antitank guns, other miscellaneous antitank weapons and uniforms, badges, and small arms.

ARTICLES

"The Strategic Triad," G. W. Johnson and Others, Ordnance (January-February 1971), pp. 343-346.
"To deter the threat of Communist offensive weapons the United States has land-launched ICBM's, submarine-launched ballistic missiles, and manned bombers augmented with air-launched missiles."

"The Fastest Computer," D. L. Slotnick, Scientific American (February 1971), pp. 70-87.
"ILLIAC IV is made up of 64 independent processing units that by operating simultaneously will be capable of solving complex problems in a fraction of the time needed by any other machine."

"The Application of Electron/Ion Beam Technology to Microelectronics," George R. Brewer, IEEE Spectrum (January 1971), pp. 23-37.
"Although beam techniques are not yet widely used or fully developed, their unique features qualify them as a potential major element in the fabrication of future microelectronic devices."

"The Agony and the Ecstasy of Writing History," Martin Blumenson, Army (February 1971), pp. 30-33.
"It is a pleasant task when a military historian can write objectively about a campaign or a battle that succeeded. It takes a heap of moral courage to 'spill the beans' about how and why a popular commander's failure cost the lives of the men he led."

"Mariner to Venus and Mercury in 1973," Roger D. Bourke and J. G. Beerer, Astronautics & Aeronautics (January 1971), pp. 52-59.
"This first U.S. spacecraft to Mercury will sweep by Venus—in the initial use of the gravity-assist technique expected to play a prominent role in outer-planet missions—pass close to the sun's nearest neighbor, and, half a year later, owing to an unusual condition of celestrial mechanics, possibly revisit it for further studies."

"Systems Analysis: A Purely Intellectual Activity," Seth Bonder, Military Review (February 1971), pp. 14-23.
"The time has come to take stock and call systems analysis what it currently is—a purely intellectual activity. These thoughts are not new to many, yet military system analysts persist with the charade and operate as if system analysis were a scientific activity. This facade is surely some of the main causes of a credibility gap."

"The Way It Is," Tom Bailey, Army Digest (February 1971), pp. 20-22.
The author describes military life on the border in Germany and on other border areas in Europe.

"Military Discipline and National Security," Hamilton H. Howze, Army (January 1971), pp. 11-15.
"A distinguished retired soldier views with alarm what he perceives to be a general deterioration of discipline among U.S. fighting men. Unless this dangerous trend is halted, he argues, the nation may one day soon find itself a second-rate power."

"An Advanced Fire Control System," Richard M. Ogorkiewicz, Armor (January-February 1971), pp. 28-31.
"An advanced tank fire control system such as the Cobelda increases significantly the first-round hit probability of tank guns and strengthens their position as the most effective type of tank armament."

"Guerrilla Battalion, US Style," David H. Hackworth, Infantry (January-February 1971), pp. 22-28.
"By mid-1969 the 4th Battalion, 39th Infantry, had set Vietnam's guerrilla-dominated Delta on fire. This battalion's achievements weren't accomplished with conventionally trained soldiers . . . but by American soldiers who fought and thought like their guerrilla foes."

"Student Evaluation of Instruction: A Primary Feedback Method," Wm. A. Lang, Military Review (January 1971), pp. 48-55.
"Whether instructors like to admit it or not, students know what takes place between them and their teachers in the teaching-learning situations of the classroom. Students also understand their instructional needs. The student has the right and the desire to evaluate what facilitates or hinders his learning. Students can and do make reasonably accurate ratings of instructors and instruction."

"How Congress Should Change the Draft," Interview with Curtis W. Tarr, Selective Service Director, U.S. News & World Report (February 1, 1971), pp. 28-32.
"Keep the draft indefinitely but improve it—that is Draft Director Curtis Tarr's advice to Congress. In this interview, he favors calls by national numbers, no amnesty for draft violators, and ending college deferments."

"Meeting the Drug Challenge," Wm. Leavitt, Air Force Magazine (January 1971), pp. 28-35.
"Drug abuse in the military—including the Air Force—is reaching alarming proportions. Because of the enormous complexity of the problem, preachments and threats have failed to stem the tide. Here is a special report on drug abuse in the armed forces."

"The OER: A New Form or a New Look," Thomas G. Horst, Military Review (January 1971), pp. 12-22.
At present a new form is being considered to supersede the old form in use since April 1968. This author suggests that a whole new concept of reform be studied rather than merely a change in forms.

"Space in the Seventies," Thomas O. Paine, Ordnance (January-February 1971), pp. 328-330. "The Skylap orbital station and the space shuttles to supply it will be principal factors in making available to mankind the technology needed in the solution of many burdensome problems here on earth."

ANSWERS TO CROSSWORD PUZZLE

Across

1. sixteen
4. ions
6. equal
8. tenths
9. one
11. voltage
14. forty
15. ward

Down

1. silver
2. ten
3. negative
4. infinity
5. positive
7. unbal (abbr)
10. half
12. low
13. air

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

Direct communication to the editor is authorized:

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Shades of Meaning

One barrier to effective communication is related to words and is concerned with shades of meaning. We have many synonyms. But if one word can be substituted for another, why do we need both? Actually, it is because synonyms generally have different shades of meaning.

Many words don't have meaning of themselves; people give them meaning. A certain gentleman was pleased by the fact that his wife referred to him as a "model husband." His pleasure was short-lived, however, because he read in a dictionary that "model" can mean "an imitation of the real thing." A doctor, walking down the street with his wife, passed a beautiful girl who greeted him by name. His wife turned to him and said, "Who was that?" He said, "Why that's just a girl I know professionally." To this his wife retorted, "Whose profession, yours or hers?" The doctor and his wife used a common symbol but attached different meanings.

We further complicate and confuse communications by our excessive use of "sophisticated" language. Formerly, this may have been especially true of the military as well as doctors, lawyers, and some engineers.

Today we notice management engaging in what may be called "org" (organization) talk. Admiral Lawrence at the battle of Chesapeake Bay saw that things weren't going well, so in an effort to raise morale he shouted his famous challenge, "Don't give up the ship." His men heard it, understood it, and were inspired by it. In "org" talk, Admiral Lawrence might have said, "Personnel aboard this vessel are not authorized to initiate abandonment procedures." Sounds familiar, doesn't it? Many famous statements from history are remembered because they were short and to the point; "Don't shoot 'til you see the whites of their eyes," "I shall return," or the shortest of them all, "Nuts."

Aircraft Recognition

In the May 1971 issue of Air Defense Trends we introduced 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 using this method attained an average score of 95 percent as compared to 87 percent for those using other methods. We repeat the instructions here for the benefit of those who may not have seen them previously.

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 until currently employed military aircraft likely to be seen by the ground observer have been accounted for.