AIR DEFENSE TRENDS

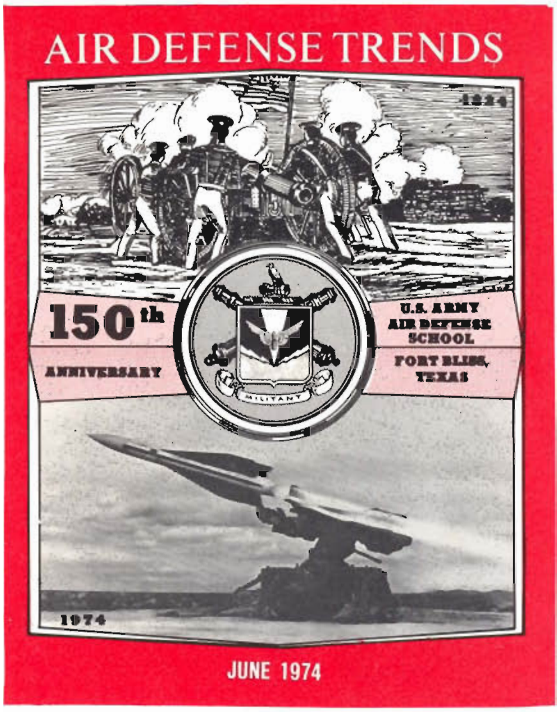
JUNE 1974

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

IN THIS ISSUE

Secretary Of The Army Visits Fort Bliss

The Honorable Howard H. Callaway, Secretary of the Army, visited Fort Bliss recently where he spoke at the class opening ceremony at the Sergeants Major Academy and also addressed the El Paso Chapter of the Association of the United States Army. He is shown above at a press conference held at the El Paso Chamber of Commerce during his visit. The thrust of Secretary Callaway's message to people in the Fort Bliss area was his faith in the future of the Volunteer Army: pointing out new methods for making the program a success, both in acquiring personnel and maintaining the Army's professional quality.



COVER. The US Army Air Defense School celebrated its 150th anniversary 5 April 1974 and our cover was specially designed to commemorate the occasion.

The School lineage dates back to 5 April 1824 when it was activated with the Artillery Corps for Instruction at Fortress Monroe, Virginia. On 18 May 1858 it was redesignated The Artillery School. In August 1907 the institution was renamed the Coast Artillery School. In 1942 the Antiaircraft Artillery School was established at Camp Davis, North Carolina, with directions to absorb the personnel and equipment utilized for antiaircraft artillery instruction at the Coast Artillery School, Fort Monroe, Virginia. On 30 September 1944 the Antiaircraft Artillery School transferred from Camp Davis, North Carolina, to Fort Bliss, Texas. With the coming of the guided missile age, the School was redesignated the Antiaircraft and Guided Missile School on 1 November 1946. Finally, on 1 July 1957 the School acquired its present name: The US Army Air Defense School. The School is the largest of its kind in the free world and has provided a tremendous contribution to air defense. For example, since moving to Fort Bliss, the School has graduated almost 190,000 air defense experts for duty with US services and 50 foreign countries. As the importance of air defense increases, so shall the importance of the Air Defense School increase. Her future looks as bright as her illustrious past.

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AIR DEFENSE TRENDS

A US Army Air Defense School periodical, Air Defense Trends is published on the basis of three issues annually. 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 75 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.

Use of funds for printing of this publication has been approved by Headquarters, Department of the Army, 1 September 1973, in accordance with AR 310-1.

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Middle East War
(Two Problems)

Lieutenant Colonel Rudy J. Wagner
US Army Air Defense School

Two problems field commanders and force planners have faced since the Germans employed close support aircraft so effectively during the early part of World War II are: how can mechanized armor forces attain some degree of freedom of maneuver when the enemy has the advantage of air superiority; how can a unit minimize equipment and personnel losses when attacked by aircraft so as to remain combat effective? Both problems were field tested during the recent Middle East War. This article, using unclassified research sources, focuses on these two problems with a view toward developing some answers and drawing some parallels to US air defense (AD) and non-AD weapons employment.

Both the Egyptian and Israeli AD and non-AD weapon (see note 1) employment contributed to providing some interesting insights into these two problems. The Egyptians had the air superiority dilemma; the Israelis (see note 2) had the maintenance of combat effectiveness problem.

It appears the Egyptian operations planner solved his problem by basing the AD employment philosophy on three significant factors: a deployment of a *complementary family* of surface-to-air missiles (SAM's) and AD guns; *mobility* of SAM's and AD guns; and the *massing* of SAM's and AD guns. These factors enabled the Egyptians to provide a protective AD envelope to maneuver units, from ground level to 70,000 feet. Weaponry involved included principally the self-propelled ZSU-23-4 quad-mounted gun, ZSU-57-2 dual-mounted guns, and the SA-7 Grail missile at low altitudes; the truck-mounted SA-3 and self-propelled SA-6 at low to medium altitudes; and the familiar SA-2 providing top cover. As long as Egyptian mechanized-armor forces remained under the SAM and AD gun umbrella, the airspace was essentially denied to Israeli fighter-bomber attack. When the Israelis counterattacked, the battle was largely a ground force vs. ground force battle.

In the early part of the war, both antagonists were relatively free from having their movement inhibited because of fighter-bomber attack. The all-altitude Egyptian AD umbrella was eventually penetrated, not by aircraft, but by direct ground assault which overran primarily the SA-2 and SA-3 sites. In short, the Egyptian AD employment demonstrated that the tracked-mobile (SA-6) and man-portable (SA-7) missile systems, when mixed with short-range mobile guns and supported by other less mobile, long-range AD weapons (SA-2 and SA-3), can counterbalance the disadvantage stemming from the lack of air superiority.

Lieutenant Colonel Wagner is assigned to the Office of The Deputy Commandant for Combat and Training Developments, US Army Air Defense School. He graduated in 1969 from the Command and General Staff College where he later served for 3 years as an instructor in the Department of Tactics, teaching division and corps offensive operations.

The Israelis also solved their problem. Although primary reliance had always been upon the air force to prevent attack upon deployed ground forces or convoys, they did acknowledge that the enemy could mount some measure of an air interdiction threat. The Israelis were right in their assumption. The bulk of Egyptian aircraft were not destroyed on the ground as was the case in the 1967

Note 1. The term non-AD weapons refers to weapons used in an antiair role.

Note 2. It is not the intent to imply that only the Israelis had this problem; however, the problem was more acute to the Israelis because of their smaller assets in terms of personnel, equipment, and availability of ground-based AD weapons when compared with the large inventory of enemy aircraft.

war. The Egyptians did manage to fly approximately 400-500 air interdiction sorties against combat, combat support, and combat service support assets. Many of these aircraft were engaged by Israeli aircraft; however, those that did attack deployed units were met by a large volume of integrated AD and non-AD gun fire resulting in a substantial kill percentage. Units without organic AD gun systems also were able to deliver a high volume of non-AD weapon fire that either caused aircraft destruction or, in many cases, resulted in the aircraft aborting its mission or completing only one pass at the target. The Israelis' ability to deliver this large volume of non-AD weapon fire was due to their practice of mounting an automatic weapon of some kind on every vehicle possible. Infantrymen, field artillery crewmen, or personnel in convoy would join in the firing whenever enemy aircraft appeared. They followed a simple rule: if you see an AD weapon firing at an aircraft or if you are being attacked, you (the individual soldier) can fire.

Some interesting parallels from these two problems can be drawn with reference to US air defense deployment in Europe and present US nonair defense weapon capability inherent in combat, combat support, and combat service support units.

First, one must assume that US forces in Europe will not have the air superiority advantage. It is generally agreed among the most enthusiastic supporters of Air Force capabilities that in the event of hostilities in Europe the air superiority advantage, at least initially, would be with the enemy. The attacker will have significant numbers of aircraft available (those not involved in the air-to-air battle) to perform close air support missions that could inflict substantial losses and inhibit NATO forces freedom of maneuver.

There are some obvious similarities between the Egyptian nonair superiority problem and that faced by US operations planners in NATO. There are also some notable similarities and dissimilarities between current US AD deployment concepts in NATO and those concepts used successfully by the Egyptians to solve their problem. Both concepts feature a complementary family of weapons (Nike Hercules for top cover, Hawk for medium to low, and C/V and Redeye for low altitude), and both have AD weapon systems with the necessary mobility to keep pace with ground forces (primarily Hawk, C/V, and Redeye). The dissimilarity is in the concept of mass; US AD SAM and gun deployment in NATO could, at best, be described as a thin deployment. This deployment raises doubts (given the assumptions and situation described above) whether the ground forces could attain the degree of freedom of maneuver they would require.

In translating the Egyptian air defense operations philosophy to the NATO situation, a notable difference exists. Whereas the Egyptian planner knew his air force would be a small, almost nonexistent factor in denying the airspace over the ground force to the enemy, the US planner has more options. He knows his Air Force has been combat tested, and its capability to contribute to the AD of the ground force is a known factor. However, the quality of the US Air Force does not solve the whole problem. In reference to the two previous statements (in a NATO war, the attacker would have the air superiority advantage and current thin deployment of ground-based AD), the ground force would still be subject to a significant close support or air interdiction threat. The solution may be an increase in short-range missile/gun combinations in the divisional area, and mobile missile systems operating in support of the corps and the division of the corps. The increase would provide a better balanced mix between the manned interceptor and ground-based AD weapons. This balanced AD force could provide the advantages of: a degree of freedom of maneuver for the ground force commander when the majority of aircraft are needed for the air battle; freeing more aircraft to carry the war to the enemy rather than possibly restricting their operations to the ground force area. PERHAPS THE EGYPTIAN PHILOSOPHY OF MASS OF GROUND-BASED, MOBILE, INTEGRATED FAMILY OF AD WEAPONS IS THE BEST SOLUTION!

With regard to use of non-AD weapons in an air role, the US Army has deemphasized the use of ring-mounted automatic weapons from almost all combat, combat support, and combat service support wheeled vehicles. The effectiveness of non-AD weapons used in an air role has been proven time and time again. Unfortunately, the effectiveness has been proven by former enemies and Israel. For example: Korea, the USAF lost 544 of all types of aircraft attributed to combined AD and non-AD ground fire, almost five times as many as were lost in air-to-air combat; Vietnam, in South Vietnam, 410 fixed wing aircraft and 2,100 helicopters were lost to ground fire; in North Vietnam, the losses were equally as significant; Middle East, although exact total numbers of aircraft lost are still classified, unclassified sources attribute 50-75 aircraft from both sides lost primarily to combined AD and non-AD ground fire.

What will non-AD fire do? Either by itself or in conjunction with other AD units/weapons (C/V, Redeye) that may be with a unit, good use of non-AD fire will provide a unit combat survival by aircraft destruction or aircraft damage. Failing destruction or damage, non-AD fire will affect pilot ordnance delivery accuracy and the number of passes or stay time over target.

PERHAPS ADOPTION OF THE ISRAELI CONCEPT OF MOUNTING WEAPONS ON SOME OR ALL COMBAT, COMBAT SUPPORT, AND COMBAT SERVICE WHEELED VEHICLES IS THE BEST SOLUTION!

Tactical Airspace Management — New Efforts

Major Heston W. Higginbotham
US Army Air Defense School

Airspace management, formerly called control, is again receiving avid attention from many camps. Once more the US Army Air Defense School is asserting interest and readiness to help solve the problem. The major differences between present efforts in resolving the airspace management problem and previous solutions are: first, a realistic attack on the problem; and second, solving the problem as best we can for the present instead of for the 1980's-1990's.

The two immediate objectives are to field approved joint doctrine and develop a unilateral doctrine governing how the Army will coordinate, integrate, and regulate its own airspace users. This latter effort must be constructed within the framework of the joint effort. In each of eight attempts since 1965 to obtain agreement to joint doctrine, the Air Force (the proponent service) has presented a candidate draft document to the other Services for review that has been rejected as unacceptable. The most recent document was rejected in late 1973.

A new effort to reach joint agreement involves a systematic approach. The first step is to develop an Air Force/Army position in the form of AFM/FM 100-42 (draft) by a joint Tactical Air Command/US Army Training and Doctrine Command (TAC/TRADOC) working group. The TAC and TRADOC communities are staffing the initial product. When committee agreement is reached, then full Air Force and Army agreement will be sought. Because many areas of conflict will have been smoothed out during the joint development of the document, service-level agreement should be easily obtained. After joint approval of the AFM/FM by the Air Force and Army, FM 100-42 will provide the basis to reach agreement with the Department of the Navy.

Simultaneously, the Army is revising its own "interim" doctrine in FM 44-10 (Test). The procedures outlined in FM 44-10 (Test) were evaluated by Modern Army Selected Systems Test, Evaluation, and Review (MASSTER) last year and the resulting recommended changes were forwarded to DA in Army Airspace Control Program of Evaluation Report No. 152. Those recommendations, in addition to air defense artillery doctrine to employ a Hawk battalion in direct support of each committed division, are impacting heavily on the new Army airspace management doctrine, which will be published as FM 100-44 (Test).

Major Higginbotham is assigned to the Studies and Concepts Division under the Deputy Commandant for Combat and Training Developments at the US Army Air Defense School. He received a B.S. from the USMA in 1961 and an M.S. in Operations Research from the Naval Postgraduate School in 1972. He has concentrated on the subject of this article since August 1973 and has participated in several working seminars with representatives from the other combat arms service schools during this time.

You may ask, "Why another 'test' manual?" First, it is anticipated that FM 100-44 will be in the field before an agreement on joint doctrine is reached. Second, some new and untested concepts appearing in the manual cannot be considered final doctrine until proved valid by field trials.

The new all-out effort in the airspace management has been enhanced by a general officer level working conference held at Fort Bliss earlier this year. The conference was cochaired by General DePuy, Commander, TRADOC, and Lieutenant General Pepke, representing General Kerwin, Commander, FORSCOM. The Commandants of the Command and General Staff College; Air

Defense, Armor, Aviation, Field Artillery, and Infantry Schools were present, as well as the Commanders of Modern Army Selected Systems Test, Evaluation, and Review, Combat Developments Evaluation Center, and the Combined Arms Combat Development Activity. Army Communications Command was also represented. The consensus reached at the conference has been referred to in the community as the "seven commandments" for developing an airspace management system.

- The USAF will retain a necessary degree of control.
- The system will be noncomplex.
- The system will be flexible and will adjust to situational priorities.
- Management aids used by the Army and Air Force will be closely coordinated.
- Standing operating procedures will afford maximum freedom to airspace users.
- Maneuver brigade will be an operator in the system by exception only. Brigade will not have an airspace control element (ACE).
- Field Artillery operations do not pose a significant airspace conflict problem.

The goal established was to modify Army doctrine NOW — do it for the NOW time-frame using what we have in the field NOW.

At the conference the Air Defense School presented its NOW proposal for helping to solve the airspace management problem. The remainder of this article deals with that proposal and the position maintained by the School.

- The principal consideration in development of an airspace management system is that the system will be required to manage activities in an air environment containing both friendlies and hostiles.
- The airspace management system must clearly and consistently reflect normal Air Force authority over all tactical airspace — particularly defensive authority. The rules and procedures specified unilaterally by the ground commander for Army airspace users must be consistent with the rules and procedures promulgated by the Air Force. The rules and procedures of the Air Force must provide sufficient latitude to the ground commander for the flexible employment of his combat assets.
- The Army does not require an automated airspace management system. Functionally unique systems such as air defense command and control, field artillery fire distribution, and air traffic control do need automation support to reduce reaction time and exchange information on a "one-among-equals" basis. However, we do not need another automated system — a super airspace management system — to coordinate the functionally unique systems.
- The airspace over the division, because of its high-density usage, must be "bulk-managed." Outside of the normal planning and coordination of fire support, air support, and maneuver in the division tactical operations centers (DTOC), command posts, etc., the best we can hope for during combat is to manage known information of the aggregate of activity — where and when are heavy concentrations of artillery fire, where are areas of hostile air activity, where is the FEBA "hot," when and where are high-performance aircraft operating, and

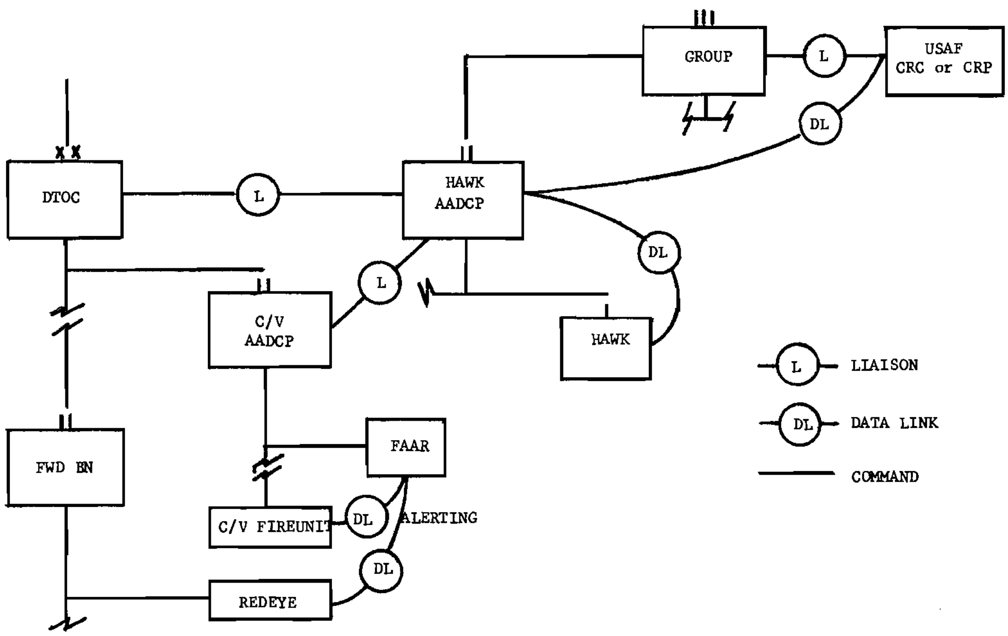

Figure 1.

where are areas of heavy concentrations of tactical Army aircraft? With this bulk information available to airspace users, each can control his own activities and the commander can manage the total activity.

Within the framework of bulk management, air defense artillery (ADA) elements can provide a significant service to the division commander and division forces, in addition to defending the airspace. The ADA proposal was generated to support the decision maker with timely information not currently available.

The ADA Proposal

The Hawk battalion, in direct support of each committed division, should be used to the maximum to help manage the three-dimensional battlefield. Principal Army airspace users are Army and Air Force aircraft and ADA. Close coordination and integration of ADA and friendly flight operations are necessary. Because of ADA's longstanding relationship with the USAF, that integration currently exists. But what about Army aviation elements? Though we wear the same uniform, that coordination, prior to effective ACE operations, did not exist. The ACE can function only as effectively as its information is timely. ADA proposes to collocate the flight coordination center (FCC) (or an FCC element) organic to the division and the DS Hawk battalion AADCP, thus extending the ADA/aviation interface beyond the planning level (ACE) to the execution level. Collocation should be habitual.

Because of the interfaces with the Hawk battalion AADCP (fig 1), the AADCP becomes a focal point for timely monitoring of air activity over the division. It receives track information from the Air Force's control and reporting center or control and reporting post over digital data link with back-up voice link through the ADA group at corps level. A liaison element from the Hawk battalion to the division ties it with the DTOC and the maneuver commander. A liaison team from the organic Chaparral/Vulcan battalion provides integration with the short-range air defense systems of the division. Figures 2 and 3 show the input and output flow through the AADCP/FCC interfaces.

The division commander uses this information when he plans areas and altitudes of critical concern to ongoing operations. The Hawk battalion can use its sensors to monitor and pass aircraft information to the DTOC. When aircraft are observed heading into conflict areas, the pilots can be warned directly from the AADCP through flight operations personnel. Radar position fixing and vectoring assistance can be given to flight leaders of critical missions.

The combined AADCP/FCC operation is illustrated in figure 4. The normal battalion AADCP consists of two sections — primary and back-up AADCP's. The primary AADCP is supported by the AN/TSQ-38 battalion operations central, which contains two radar and data display consoles (the AN/TSQ-38 is scheduled to be replaced by the AN/TSQ-73). The back-up AADCP can be housed in a second van or under canvas. Flight operations personnel are integrated into the back-up AADCP.

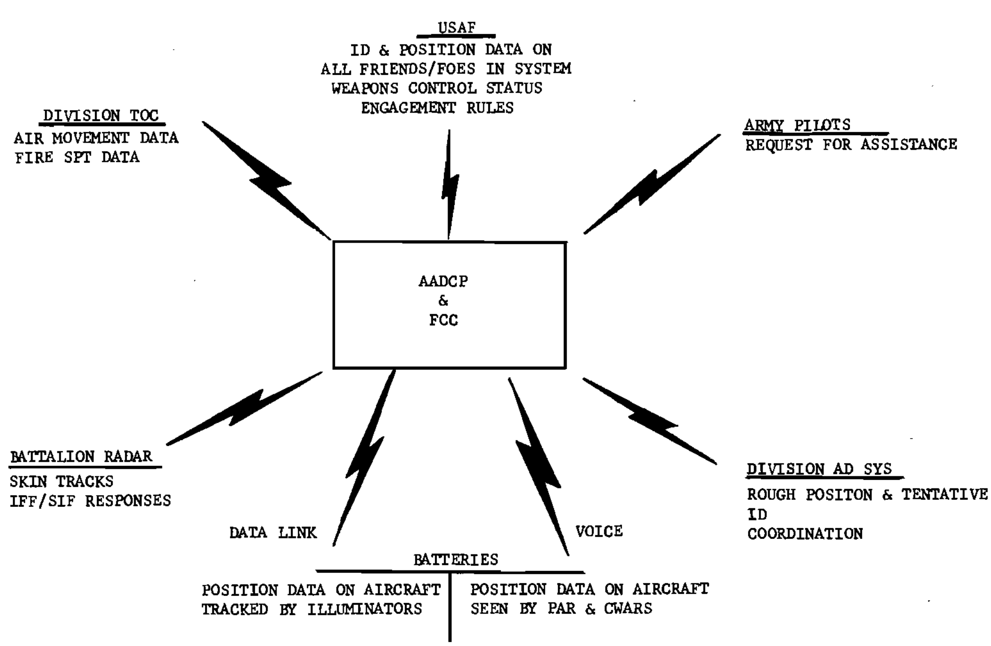

Figure 2.

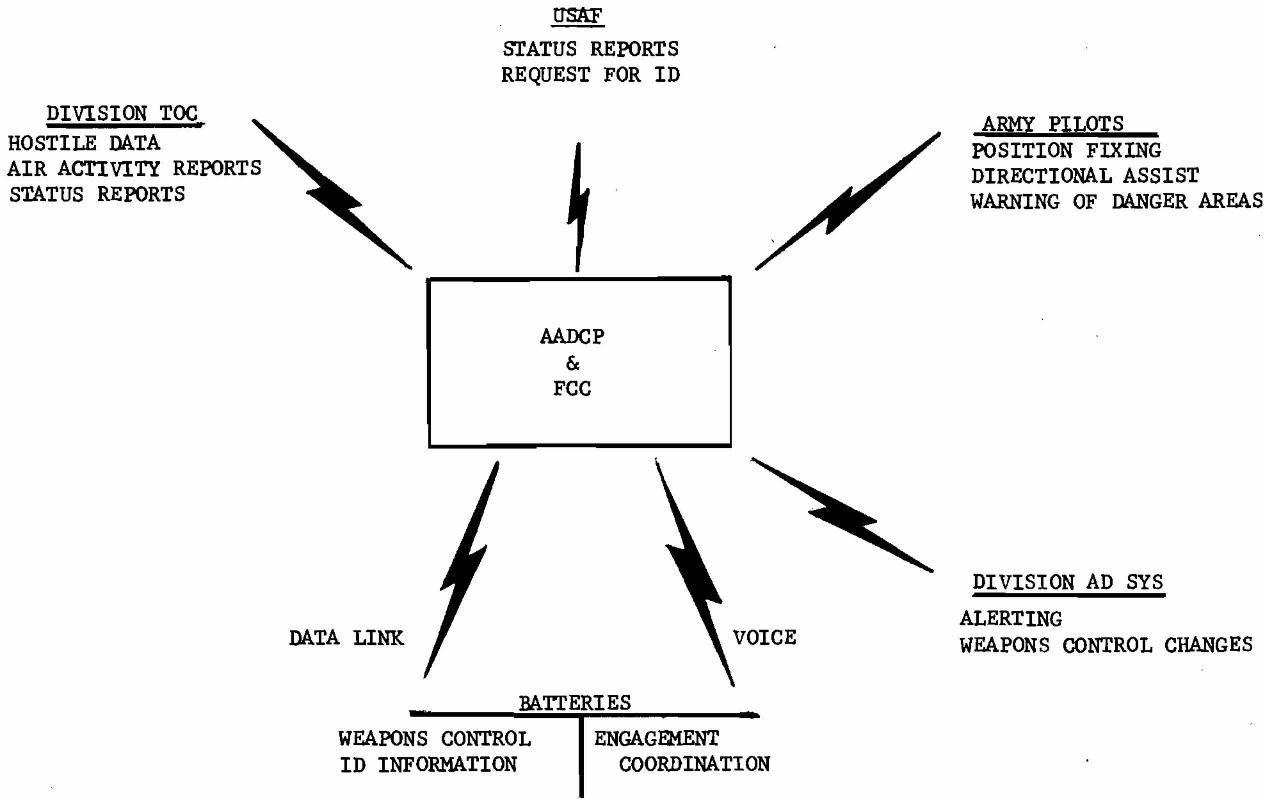

Figure 3.

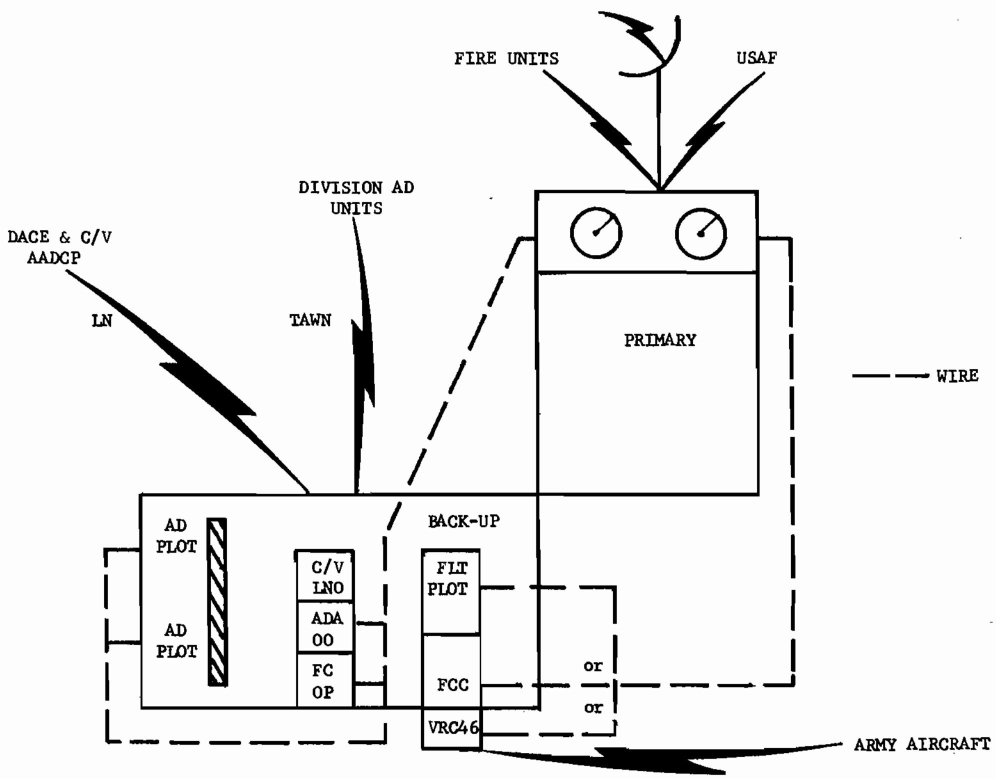

Figure 4.

In the primary AADCP, information received from the USAF control and reporting center (CRC) or control and reporting post (CRP), track information from the battery illuminator radars, and video from the battalion surveillance radar are displayed on the two consoles. The information concerns both hostiles and friendlies, Air Force and Army. The left console operator is normally concerned with fire distribution and the right console operator with surveillance and acquisition. The primary mission of both operators is to monitor and control the air battle — for this reason, they must always be ADA personnel.

The right-hand console will be used to support the flight operations activity in the back-up AADCP. To facilitate this support, every effort will be made to put a flight-rated ADA officer in that position. ADA currently has 406 officer aviators.

Information from the right console will be passed over the wire link shown, in the form of azimuth and range, to the flight operations element. Flight operations will convert the azimuth and range data to a common alphanumeric grid system. The common grid, which overlays the universal transverse mercator (grid) system, is key to a coordinated airspace management system — all airspace users in a corps should work from the same common-coded grid. Based on the common grid data, communications with aircraft take place. The left console operator passes data to the AD plotters in the back-up AADCP. It is plotted and displayed for the C/V liaison officer, the AD operations officer, and a fire control operator. Based on the total information available, the Division Airspace Control Element and C/V battalion are kept current. The C/V liaison officer also manages a tactical air warning net (TAWN) over which hostile advanced warning, alert of friendly flights, and weapons control received from the USAF can be passed to C/V and Redeye. Investigation of the adequacy of current communications assets to meet the TAWN requirement is ongoing.

This concept provides a cost-effective and feasible assist in air-space management. It can be implemented now and is a first step toward a dual-role air defensive/flight operations system for the Army. If approved, this will appear in new versions of FM 100-44 and FM 44-1.

From The Branch Chief Officer Personnel Directorate

Colonel Archie S. Cannon, Jr.
Chief Air Defense Artillery Branch
Officer Personnel Directorate

After being absent from the last two issues, the Air Defense Artillery Branch, OPD, is returning as a regular contributor to *Air Defense Trends*. We plan to present personnel information of interest to the Air Defense community. Other sources of personnel information are in TIPS, the Army Personnel Newsletter, *Soldiers Magazine,* and the Air Defense Artillery Branch Newsletter.

Update — Officer Personnel Management System

The officer personnel management system (OPMS) project which began in October 1970 has grown into one of the most thorough personnel management procedures since the Officer Personnel Act of 1947. OPMS has been approved for phased implementation during the next several years and is presently well underway.

During March DA Pamphlet 600-3, "Officer Professional Development and Utilization," was sent to the field on a one per officer distribution basis. This pamphlet, over a year in preparation and requiring coordination with over 70 agencies, outlines each OPMS specialty and provides guidance to individual officers, commanders, and personnel managers. The importance of this document to the management of your military career deserves great emphasis. It is strongly recommended that you read and understand its contents.

Each officer will develop his skills in two specialties. One specialty, a basic entry specialty, will be designated upon entry to active duty. A second or alternate specialty will be designated prior to completion of the eighth year of service. Following the April 1974 implementation schedule, lieutenant colonels will be advised of their primary specialty and asked for their preference for an alternate specialty. Replies are due to Officer Personnel Directorate (OPD) in June. This will start the matching of preferences and qualifications with Army requirements. By 1 September 1974 each officer will be notified of his designated alternate specialty. The same general system will be used for majors and captains one year later.

The Centralized Command Selection System for colonels is now in its second cycle. The program for lieutenant colonels is well underway. A complete determination of all command designated positions was completed in March. A Staff Summary Sheet is expected to be approved by the Chief of Staff in the April-May time frame. The first Department of the Army screening board met in the November-December period and the selection board itself met in January and February of 1974. The first command-designated lieutenant colonels will begin assignments in July 1975.

The education of officers to follow dual specialty development may require major changes in our Army education system. TRADOC serves as the principal coordinating manager and is tasked with developing the best education and training for officers with the least possible cost in resources, to include time. Milestone dates are presently being prepared by a TRADOC work group.

Perhaps the most significant aspect of OPMS is the management of the program. There have been three basic phases in developing the management system. Two phases, the designation of specialties and the identification of TOE & TDA positions by specialty, are almost complete. The third, internal management of the 47 specialties, is under development in the OPD at this time.

OPMS Milestone Schedule

EVENT	DATE
Publish DA Pamphlet 600-3 "Officer Professional Development and Utilization"	Mar 74
Complete documentation of specialty requirements (Project EASI)	Jun 74
Designate specialties for lieutenant colonels	Sep 74
Determine specialty qualifications	Jan 74 (complete)
Advise officers of primary specialties and solicit alternate specialty preferences	Apr 74
Advise LTC's of alternate specialty	Sep 74
Assign LTC command designated officers	Jul 75
Complete determination of positions to be included	Mar 74
CSA approves command selection for LTC's	May 74
Convene command selection boards	Jan 75
Assign command designated officers	Jul 75
Designate specialties for majors and captains	Sep 75

Air Defense Trends can be used as a medium of communication for discussion of officer personnel policies and programs. You are invited to write Branch relative to articles you would like presented. Our mailing address is: Department of the Army, US Army Military Personnel Center, ATTN: DAPC-OPD-AD, 200 Stovall Street, Alexandria, Virginia 22332.

Echelons Above Division (EAD)

This article; taken from a seminar paper prepared by CPT's Ronald J. Barrett, Daniel P. Cook, Martin A. Coulter, Edward A. Flowers, and John C. Yeisley, while attending the 2-44-C22 course, class No. 1-74, deals with employment of air defense assets with echelons above the division. The ideas expressed are those of the authors and are not to be construed as US Army Air Defense School doctrine.

On 8 June 1973, LTG E. H. Almquist, ACS, Force Development, DA, signed a letter to the Commander, US Continental Army Command, calling for the revision of doctrine, TOE's, and service school instruction as affected by the *Echelons Above Division Study (EADS)*. This study was conducted by the Army Combat Developments Command during the period 1969 to 1973. The study focused on the feasibility of reducing the number of command echelons above the division. The study concluded that it was feasible and desirable to eliminate the field army as a normal command echelon above corps. The Chief of Staff of the Army approved the concept on 24 May 1973, but explicitly did not approve fixed troop lists or subordinate organizations of specified size, since the composition of the corps will vary widely with different situations and operational environments. In so doing, the principle of flexible structuring was reiterated.

As students in the ADA Career Course, we see this as an opportunity for ADA to really establish itself as a key element in the corps and division. This is where our future can be brightest and where the Army really is. Currently, the Combined Arms Center at Fort Leavenworth, all the combat and combat support arms centers and schools, and many other associated activities are reviewing and revising the necessary doctrine and organizational documents to achieve this conversion.

Because of the myriad complexities involved in TOE changes particularly, this discussion will concern itself only with the highlights of the major changes we feel the Air Defense Artillery Branch should recommend to the Department of the Army. The monumental doctrinal changes suggested by the EAD Study dictate careful consideration be given this project. We feel the concept given in this paper offers a practical solution to the problem.

Major doctrinal changes must be made in FM 44-1 and FM 100-15. These field manuals deal with air defense operations and larger units, respectively. Other significant changes must be made in field manuals which reflect current doctrine in the employment of air defense. Among these are FM 44-1-1, FM 44-3, FM 44-95, FM 44-96, FM 61-100, FM 100-5, FM 100-10, and FM 101-5. There are other less significant references to the field army in regulations, field manuals, and pamphlets but they do not require the attention that the aforementioned field manuals do. Our concept for the employment of air defense in the US Army minus the field army is as follows:

The new air defense structure will: be responsive to the priorities of the area air defense commander in any theater; satisfy the requirement for local air defense at theater, corps, and division level; answer the requirement to assist the Air Force in gaining and maintaining air superiority after the outbreak of hostilities; be flexible enough to adapt itself to changing missions just as the division does; and finally, be responsive to the situation which requires air defense weapons to be used in the ground role (Nike Hercules and Vulcan).

Certain assumptions are essential to the logic of our doctrinal model:

- The US forces will not have air superiority at the outbreak of hostilities.
- The US will have prior warning of the outbreak of hostilities.
- Planning will be for combat operations in a high-intensity conflict with the use of tactical nuclear weapons.
- Air defense will continue to have the mission of assisting the Air Force in gaining air superiority.
- The Air Force component commander will release operational control of corps air defense assets to the corps commander (subject to AD rules and procedures) immediately prior to or upon the outbreak of hostilities.
- Corps will never have more than three divisions.
- Additional air defense units will be formed as necessary to support this concept.
- CONUS based air defense will be rapidly deployed to augment oversea units as required.

It is envisioned that all divisional and higher echelons will have air defense assets appropriate to their missions. Each division will have one Chaparral/Vulcan (C/V) battalion organic with the mission of providing local air defense in the division area against low-flying aircraft. The corps will have an organic ADA group with Hawk assets sufficient to provide one direct support Hawk battalion per committed division. Their mission, of course, will be to provide local air defense against the low- to medium-altitude threat. Also, the corps ADA group will have a Hawk battalion to provide local air defense in corps rear areas, plus one or more nondivisional C/V battalions with the mission of providing low-altitude air defense of corps vital areas. No Nike Hercules assets will be under the corps ADA group.

Theater army will be provided air defense by a theater army ADA brigade with all Nike Hercules assets in the theater under its control. In addition to the normal mission of providing long-range, high-altitude air defense to the theater army, the brigade will assist the USAF after the outbreak of hostilities. The theater army ADA brigade will also have Hawk assets sufficient to fill gaps in the Nike Hercules coverage along low- and medium-altitude avenues of approach into theater army fixed installations, airfields, and, generally, the COMMZ. Since these units will be protecting fixed targets, they will remain in place normally when the corps assumes an offensive role.

Flexibility as applied to air defense means allocating to the air defense commander at each echelon sufficient assets to accomplish assigned missions and allowing him to use these assets in the most efficient manner. Also, these air defense assets must have mobility commensurate with that of the supported elements to provide continuous air defense. This requirement is satisfied by giving the division, corps, and theater army commanders their own air defense elements. In this way Air Defense Artillery will be able to establish itself on the same basis as Field Artillery, as an integral part of the planning sequence at all levels. The air defense commander at each echelon will be a key advisor on matters pertaining to air defense and can plan for the use of his own assets without additional requirements being placed on him to support higher headquarters when the support is needed in his own area. Each division or higher commander will have the responsibility of providing his own air defense.

In line with the concept of providing balanced air defense at all echelons, the present structure is inadequate. With the loss of the field army and the additional responsibility being placed on corps, the requirement for organic air defense at corps becomes obvious. The corps will have an organic air defense group composed of Hawk and Chaparral/Vulcan assets. The size of this group will depend on the mission and area of operations. As a minimum it will have sufficient assets to provide one Hawk battalion in direct support of each division and one Hawk battalion for the protection of the corps rear area. Additionally, the air defense group will have C/V assets for protection of corps vital rear areas or to augment divisional units.

By providing corps with its own air defense, the division will be free to use organic C/V and the direct support Hawk in protection of the division without being tasked to provide air defense to the corps. Theater army, likewise, will have organic air defense in the form of an air defense brigade. This brigade will vary in composition but will basically consist of a mix of Hawk and Hercules units; the specific numbers of each vary with the given need. These units will provide a broad base of air defense. Operational control will be retained by the area air defense commander to assist in gaining air superiority, as well as protecting theater army assets.

The command and control relationships of air defense units are designed to provide maximum flexibility in our concept. At division level the organic C/V will be under full command of the division commander. The ADA group, prior to hostilities, will be under the command, less operational control, of the corps commander. Just prior to the outbreak of hostilities, operational control of air defense units will pass from the area or regional air defense commander to the corps commander. At this point he will have full command of the group assets, subject only to the established rules and procedures of air defense employment. At theater army we have a slightly different situation. The theater army commander will continue to exercise command, less operational control, even during combat.

In Europe our present air defense deployment is sufficient to form the two ADA groups required by this concept and an ADA brigade as a theater asset. Each of the two groups will be composed of three Hawk battalions and one C/V battalion. Assuming that the two corps will initially deploy with two divisions up and one back, there are enough assets to place one Hawk battalion in direct support of each on-line division and one Hawk battalion plus a C/V battalion for rear area protection.

The ADA brigade at theater army will consist of four Nike Hercules battalions and two Hawk battalions. The Hawk battalions could be deployed to the corps as needed. If the corps are reinforced by divisions from CONUS, there are four Hawk battalions to accompany the divisions. Initially, these battalions would be attached to the ADA brigade. Then the brigade could further attach them to the corps ADA groups as the requirements for air defense increase.

In Korea, our other oversea deployment of major portions, we find a similar situation. Army ADA will consist of an ADA brigade under the command, less operational control, of the theater army in peacetime and wartime. The ADA group will be under the command, less operational control, of the corps during peacetime and under full command of the corps (subject to the rules and procedures of air defense employment) during wartime.

Composition of the ADA brigade will include two Hercules battalions and one Hawk battalion. The size of this unit does not indicate the need for a brigade headquarters, but it is deemed necessary to be flexible enough to accommodate a changing situation. The ADA group will be composed of a minimum of one Hawk battalion per committed division, one Hawk battalion for the corps rear area, and one C/V battalion to protect rear area vital assets. If additional divisions are deployed to Korea, Hawk units from CONUS will accompany them and be attached to the ADA group already in country of the ADA brigade. In addition to supplementing the corps in Korea, it is possible that another corps could be deployed. In this instance, current air defense assets are not available to support our concept, and we are dependent on the assumption that more air defense units will be in existence than at present.

As we have seen, the *Echelons Above Division Study* has presented a unique opportunity for Air Defense Artillery to establish itself as an integral part of the combined arms force. The force concept developed by this paper can more than satisfactorily meet our current worldwide deployment. The so-called kicker appears when large numbers of divisions deploy to oversea areas from CONUS. Eventually we exhaust the number of air defense units necessary to protect the added units. We have three solutions to this problem. First, create the necessary air defense units (Active Army) to support all the divisions and corps in the US Army. Secondly, create new reserve air defense units and designate those already in existence for deployment with specific corps or theaters. Finally, the air defense forces in a theater not in conflict could attach air defense forces to the theater in need.

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RAPIER

LOW ALTITUDE AIR DEFENSE WEAPON SYSTEM

The US Army has recently been testing foreign-made all-weather SHORAD systems for possible adoption into the US air defense arsenal. We have described two of these weapon systems in previous issues of Air Defense Trends: Crotale, produced by France; and Roland, produced jointly by France and Germany. Now we bring our readers a comprehensive description of the Rapier system which is produced by England.

Introduction

Rapier is a lightweight, highly mobile, surface-to-air guided missile weapon system in which a supersonic, direct-hitting missile is automatically commanded to follow an optical or radar sightline to the target. It is in full production at the British Aircraft Corporation factories in the United Kingdom and has entered service with British and oversea defense forces.

In March 1972, Norden Division of United Aircraft Corporation, Norwalk, Connecticut, became the US licensee for system modifications. The McDonnell Douglas Astronautics Company, Huntington Beach, California, has responsibility to Norden for the missile subsystem. The Norden team will modify the Rapier system to meet US Army standards and then provide the on-shore manufacturing and support base to assure a continuing, reliable, low-altitude air defense capability.

The Roles of Rapier

Mobile

The battery is normally organized on a mobile basis to exploit to the fullest Rapier's lightweight and rapid deployment capability. It is thus able to keep pace with, and give support to, mobile field combat units, whatever the tactical situation (fig 1).

Figure 1. Rapier in march order.

Static

The Rapier battery is equally suitable for deployment in a static or semistatic role for the defense of base installations, such as ammunition depots, airfields, headquarters, and other high-priority installations (fig 2). The flexibility of the system permits the defense to be organized in the most effective way, whether the area to be defended is small or large, and whatever the problem terrain presents. The number and configuration of Rapier systems can be varied to meet the particular circumstances.

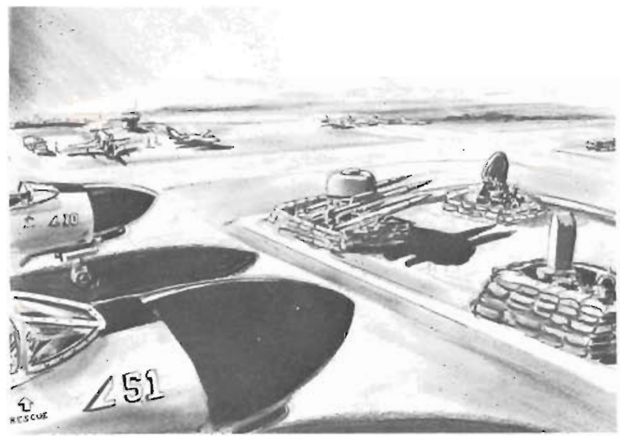


Figure 2. Artist's concept of the system in static defense.

The System

Rapier is a self-contained, low-level air defense system that can be operated by one soldier. It is capable of detecting and destroying low-flying, maneuvering, high-speed aircraft, helicopters, and drones.

Main elements of the Rapier system are a launcher, missiles, optical and radar trackers, selector engagement zone unit, turbine generators, and towing vehicles. One vehicle, a fire unit truck, tows the launcher with its generator and carries six missiles, the optical tracker, and the selector engagement zone unit. The second vehicle, a radar tracker truck, tows the radar tracker with its generator, and carries 11 spare missiles.

Launcher

The launcher (fig 3) consists of a specially designed trailer onto which are fitted:

- Surveillance radar
- IFF system
- Engagement/guidance computer
- Missile command transmitter
- Launching equipment

Quick release attachment points are provided at the rear of the trailer on which the turbine generator is carried in transit.

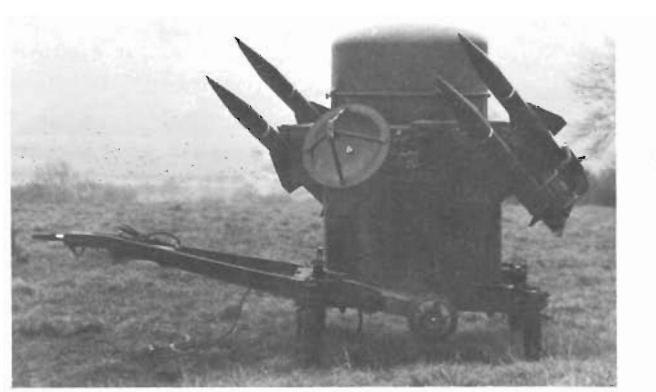


Figure 3. The Rapier launcher.

A 'taboo zone' generator, mounted within the launcher, inhibits firing over selected arcs in azimuth and elevation. The selected arcs are preset on deploying into action to prevent the system from firing dangerously close to obstructions or the operator. The design of the launcher permits fast, safe reloading of one or more missiles after an engagement. A sighting device is fitted to the launcher for azimuth alinement with the trackers.

Missile

The missile (fig 4) is of fixed-wing, cruciform configuration with rear control surfaces. It is lightweight, simply constructed, and powered by a two-stage, solid-fuel rocket motor. In the field, it is treated as a round of ammunition, requiring no test or assembly before use, and it can easily and quickly be loaded onto the launcher by two men.

Rapier's missile characteristics, as an expendable round, are:

Length	88 inches
Diameter	5 inches
Weight, Total	95 pounds
Warhead	9.5 pounds
Motor	2-stage solid
Guidance	command — line of sight
Control	tail fin
Container	reusable

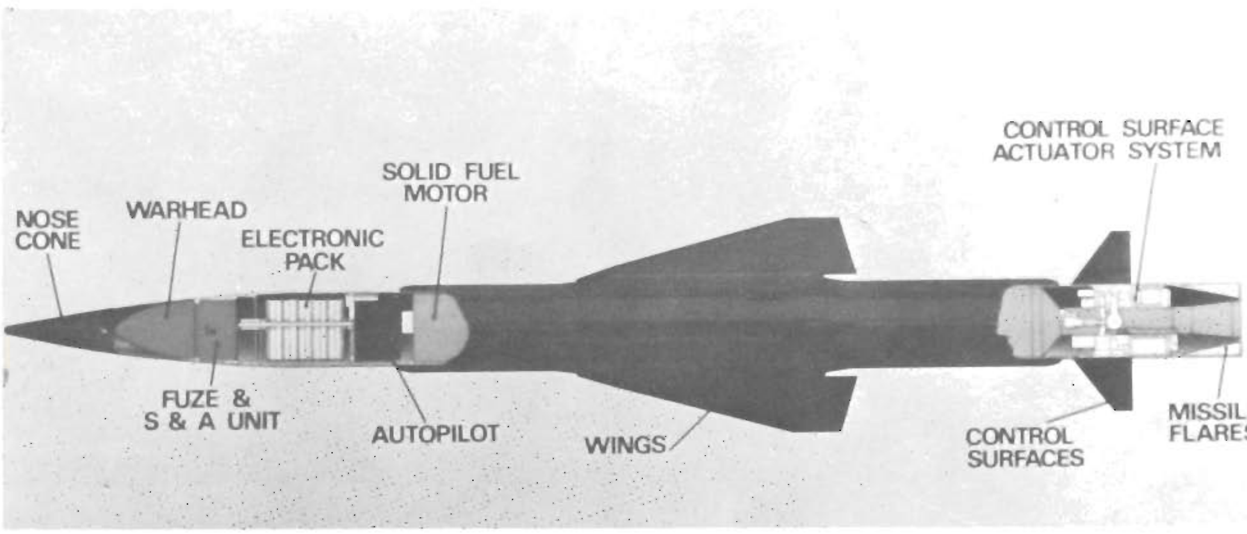


Figure 4. Rapier missile.

Optical Tracker

The optical tracker (fig 5) is transported in the back of the fire unit truck in a specially designed frame that gives the tracker a high degree of shock protection. When brought into action, the tracker is mounted on a tripod and connected to the launcher by a cable. The operator is provided with an adjustable folding chair and protective helmet incorporating earphones.

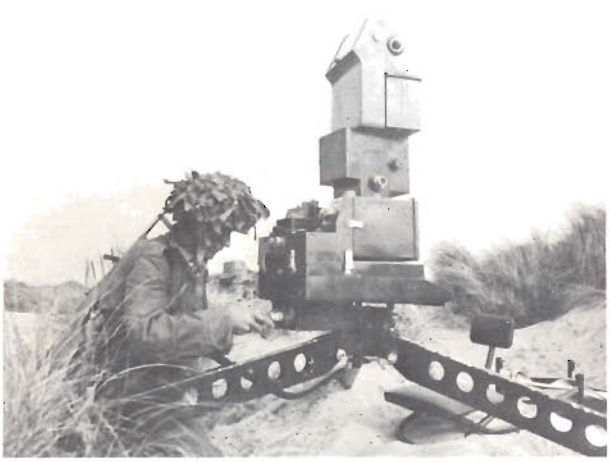


Figure 5. The optical tracker can be operated by one soldier.

The optical tracker is the engagement control station of the Rapier system. It houses the operational controls and indicators, together with a number of user facilities for testing and making adjustments and checks.

Operator controls are mounted near the base of the tracker body and consist of a small pressure joystick that the operator uses to direct the optical tracking system, a fire button for launching missiles, an optical field of view/magnification, and IFF controls. There are two collimated optical systems — the target tracking optics used by the operator to track the target, and a television system that monitors the missile flare image with respect to the optical sightline.

Radar Tracker

The radar tracker (fig 6) is mounted on a trailer identical to that of the launcher and is towed by a similar light vehicle. Its turbine generator is

Figure 6. A radar tracker can be plugged in during periods of poor visibility.

mounted on a bracket for transit. When brought into action, the main antenna reflector is elevated from its horizontal traveling position, and a cable connection is made to the launcher.

Using highly advanced radar technology, the tracker functions at night or in conditions of poor visibility to perform the same tasks accomplished by the optical tracker in good visibility conditions; i.e., to track target and missile and derive missile/target displacement information for use by the guidance computer.

Selector Engagement Zone Unit

The selector engagement zone unit is connected to the optical tracker and to the launcher, and is used for tactical control by adjusting the surveillance radar search and alarm arcs.

Turbine Generators

A stabilized and controlled power output will be provided by 10-kva turbine generators weighing 290 pounds each (fig 7). These generators are intended to be a triservice power source starting in 1975. Ground handling is facilitated by mounting the generator in a frame with two wheels.

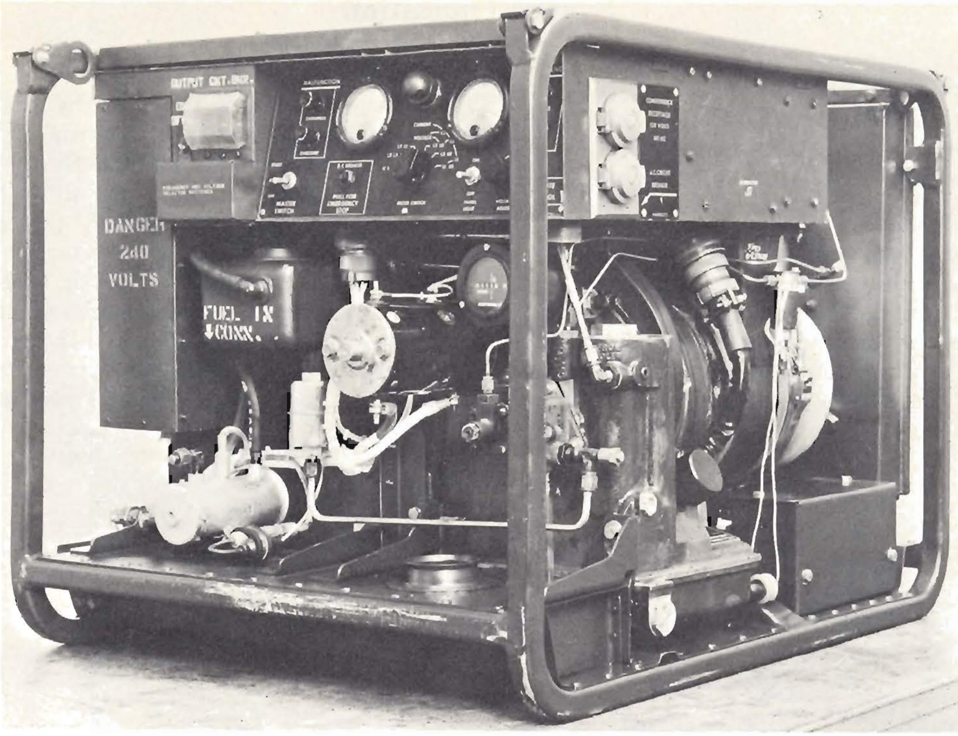


Figure 7. Rapier's power source is the US Army developed Solar 10-kva turbine generator.

Towing Vehicles

Rapier is directly compatible with a variety of existing or planned vehicles in the US Army inventory. For example, the 1¼-ton truck can tow the Rapier launcher and carry six missiles. A second 1¼-ton truck can carry 11 resupply missiles and tow the radar tracker. For higher mobility, Rapier is compatible with the M561 Gama Goat.

Although Rapier was designed to be transported using a wheeled vehicle as the prime mover towing the launcher as a trailer, the system can be installed in a wide range of suitable vehicles that provide a firm base for launching, permit space for the tracking head, and provide storage for missiles and other equipment (fig. 8).

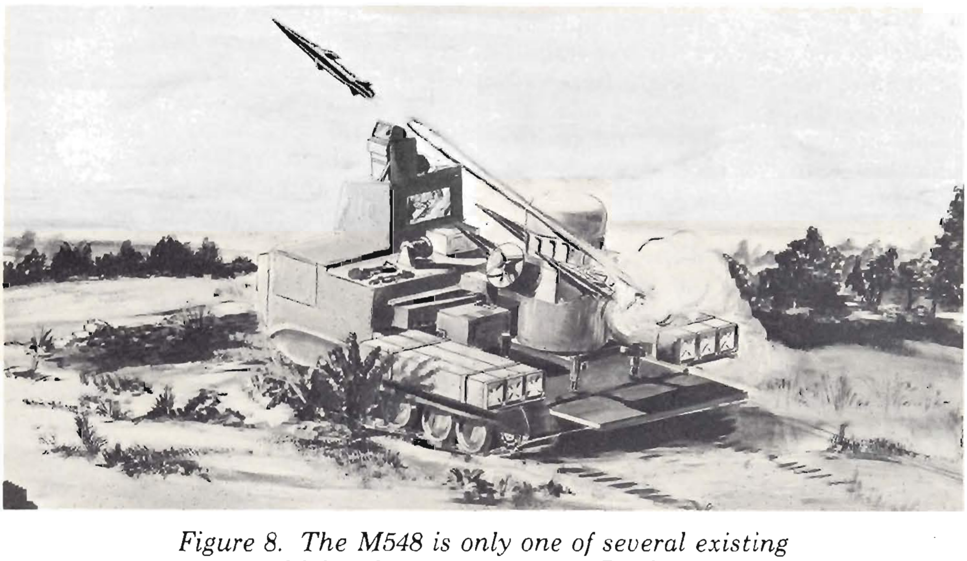


Figure 8. The M548 is only one of several existing Army vehicles that can transport Rapier.

System Operation

Each Rapier launcher has an integral pulse-doppler search radar that provides constant surveillance over 360°. Before a detected target can be engaged, however, it must be identified as hostile and then evaluated to determine if it is within missile range.

Each Rapier has its own IFF system that automatically interrogates each detected target and has its own computer that automatically evaluates the target for engagement. Thus, the time between aircraft detection and missile launch is reduced to the absolute minimum.

Optical Engagement (fig 9)

When a target is detected by the surveillance radar, it is automatically interrogated by the integral IFF system and, if no friendly reply is received, the operator is alerted by an audio alarm signal. Simultaneously, the optical tracker and the launcher automatically slew to target azimuth and are realined on target azimuth with each radar detection. The operator is thus assisted in acquiring the target. Having acquired the target in his optical sight, the operator commences to track it using the servo-assisted pressure joystick.

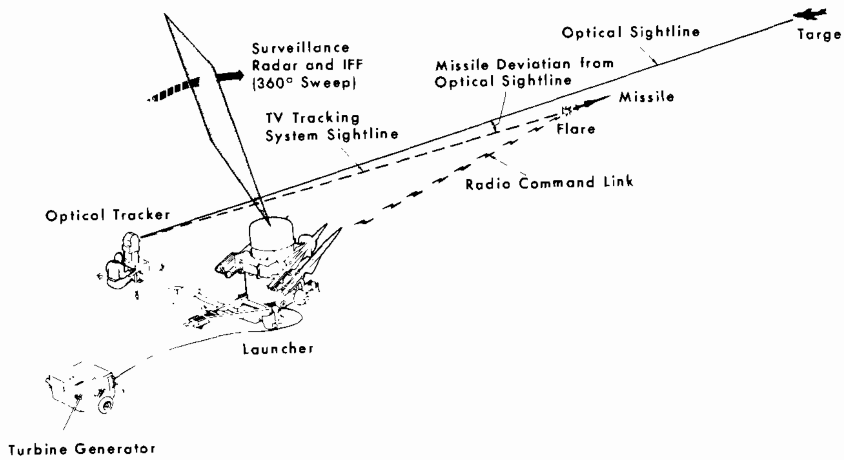


Figure 9. Optical tracking and missile guidance.

The computer in the launcher determines when the target is within system coverage and so indicates to the operator by means of a lamp signal. Upon receiving the signal, the operator immediately presses the firing button and launches a missile.

The optical tracker is fitted with a television missile-tracking system incorporating an optical path that is parallel to the operator's target tracking facility. The missile, which has bright flares in its tail, is launched into the television optical system field of view. The flare image is automatically focused onto the face of a vidicon tube in the television system. The center of the vidicon tube is matched with the center of the operator's field of view (optical sightline). Any displacement of the flare image from the center of the tube generates error signals from which corrective flight demands are computed to guide the missile back onto the optical sightline and maintain it there. These demands are coded and transmitted to the missile in flight by a microwave radio command link. They are converted into control surface movements by the missile guidance system. *The operator's only task is to track the target.* Thus, the missile is automatically commanded to fly down the optical sightline to impact with the target.

Radar Tracker Engagement

At night, or in other conditions of poor visibility, the radar tracker (fig 10) is used in place of the optical tracker for target tracking and missile-to-sightline error measurement. The operator is in control of the engagement, and, up to missile launch, he can choose between an optical or radar-directed engagement.

The target is detected and IFF interrogated in the normal way, and, if no friendly response is received, both radar and optical trackers are positioned and up-dated on target bearing. The radar tracker carries out an automatically controlled search, detects, locks onto the target, and commences tracking. This tracking lock is signaled to the operator by a tone, and, if he selects the radar mode, the optical system and launcher are slaved to the radar tracker in azimuth and elevation. At this stage, if the operator can see the target he may carry out an optically controlled firing.

In poor visibility, however, he retains the radar mode, awaits a coverage indication from the computer, and fires a missile when he gets an "in cover" indication. The missile is gathered into the radar tracking beam by a television gathering unit, and the radar tracker tracks both target and missile and determines the missile-to-target error. This information is used by the computer to generate the required guidance signals, and these signals are coded and relayed to the missile in flight by the radio command link. Thus, the missile is automatically commanded to follow the radar sightline to impact with the target. The supersonic missile is highly lethal, and in trials, target aircraft have been destroyed by missiles carrying only telemetry packs instead of the high-explosive warhead.

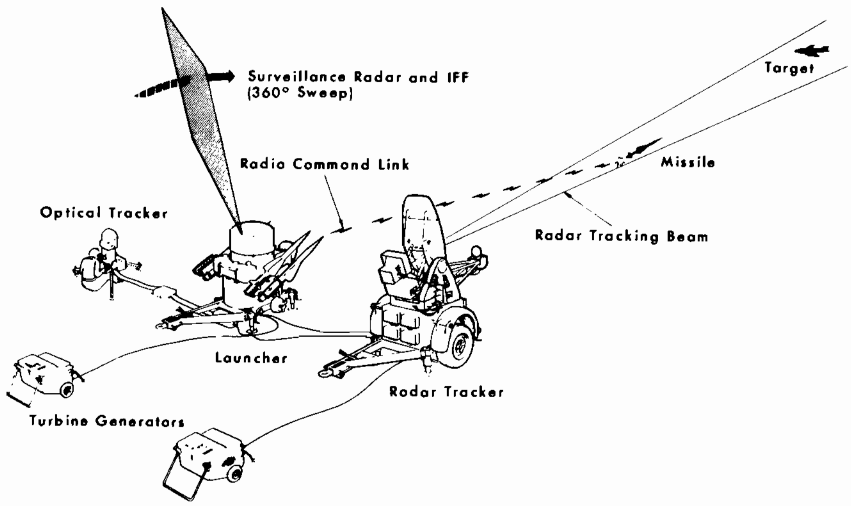


Figure 10. Radar tracking and missile guidance.

Manpower Requirements

Normal setup and 24-hour operation using both trackers requires a detachment of seven men. For optical operations only, the detachment can be reduced to five men. The system requires only one man for effective engagement operation. Compared with typical radar-controlled, light antiaircraft guns, Rapier produces significant savings in cost and manpower, with increased weapon coverage.

Maintenance

To maintain the Rapier system at the highest state of operational effectiveness, a maintenance philosophy of repair by replacement is employed.

Each element of the system is made up of a number of discrete major assemblies which, when diagnosed as faulty, can be readily replaced on site. The missile is treated as a round of ammunication and requires no servicing in the battery area.

Operator Maintenance

Maintenance is restricted to tests and adjustments within the capability of the operator. Certain of the functional tests enable him to check the performance of the equipment and satisfy himself that it is up to operational standards. The operator also performs routine mechanical servicing in accordance with appropriate task tables.

Forward Repair Team

The basis of the Rapier maintenance system is the forward repair team of two technicians who travel in the forward repair and test vehicle (FRTV). This vehicle is an M715/XM 852 and is fitted with diagnostic and performance test gear in the form of automatic test equipment (ATE). Additional space is available for peripheral equipment. Thus, the need for a second trailer is eliminated.

The forward repair team has the following functions:

- Carry out routine functioning and performance checks on the Rapier system.
- Trace a fault to a replaceable assembly.
- Replace the faulty assembly, thus bringing the equipment to full operational condition.

- Pass the faulty assembly back to the electronic repair vehicle or the optical and hydraulic repair vehicle for detailed repair. These are known as the second line repair vehicles.

One forward repair team can support a number of Rapier systems.

Base Workshop

The base workshop will contain test and repair facilities for the refurbishing of defective subassemblies returned from the second line repair vehicles. Missiles will be withdrawn for refurbishing on a rotation basis. The base area may contain a process facility (warhead fitment) and a magazine facility. Existing buildings could be adapted for these purposes.

Battery Organization

Although a Rapier system can be used entirely independently, it is normal to group a number of systems to form a Rapier battery. A battery containing a total of three platoons of three systems each, supported by a repair section, is a well-balanced unit and is an organization having sufficient repair capacity to ensure continuous, 24-hour operation and considerable deployment flexibility to meet varying threats. This organization enables each platoon's three systems to be used on independent tasks if necessary, each battery having its own first line repair facility.

The number of systems in a given defense may be varied, depending upon the requirement. The Rapier battery can operate as an independent unit, or, with suitable planning and communications, can operate in conjunction with other air defense systems.

Radar trackers can be added to an optical system without any modifications. The addition of radar trackers to a launcher battery provides a significant capability during conditions of poor visibility and darkness. A radar tracker can be assigned to any launcher as the tactical situation demands.

Air Portability

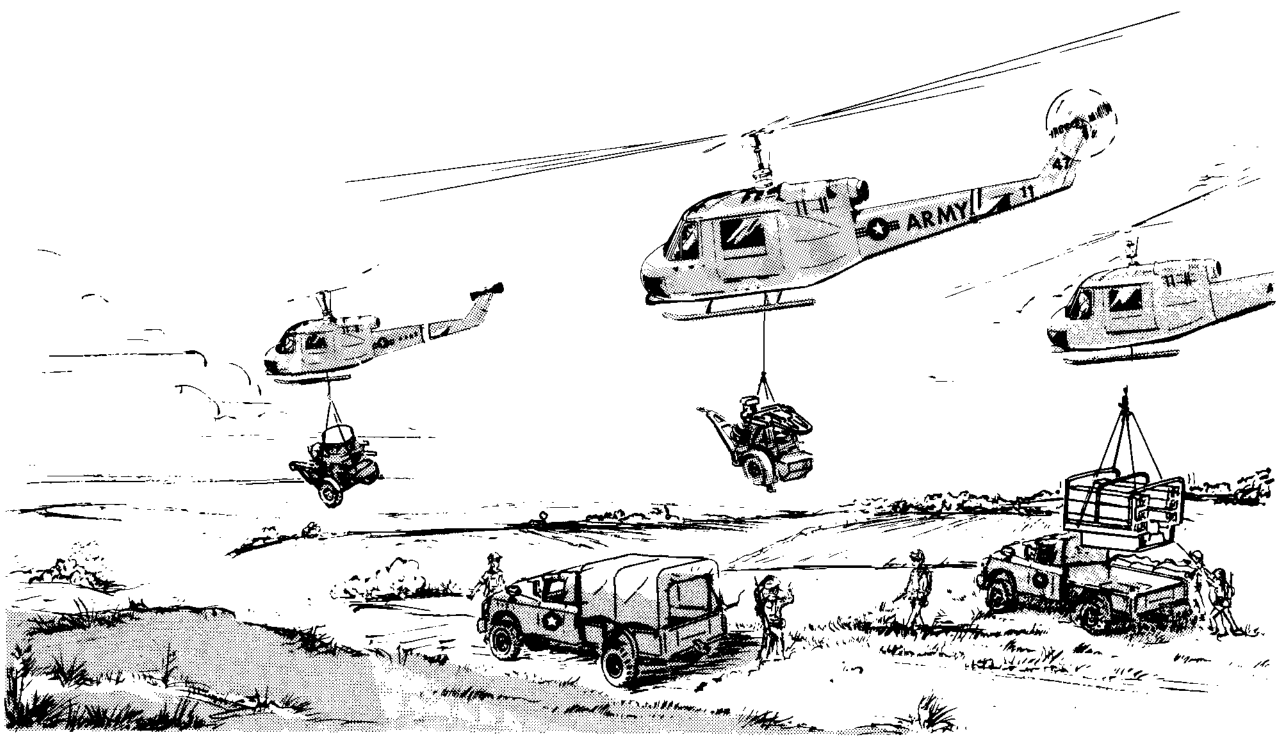


Figure 11. Rapier can easily be transported by UH-1 class helicopters.

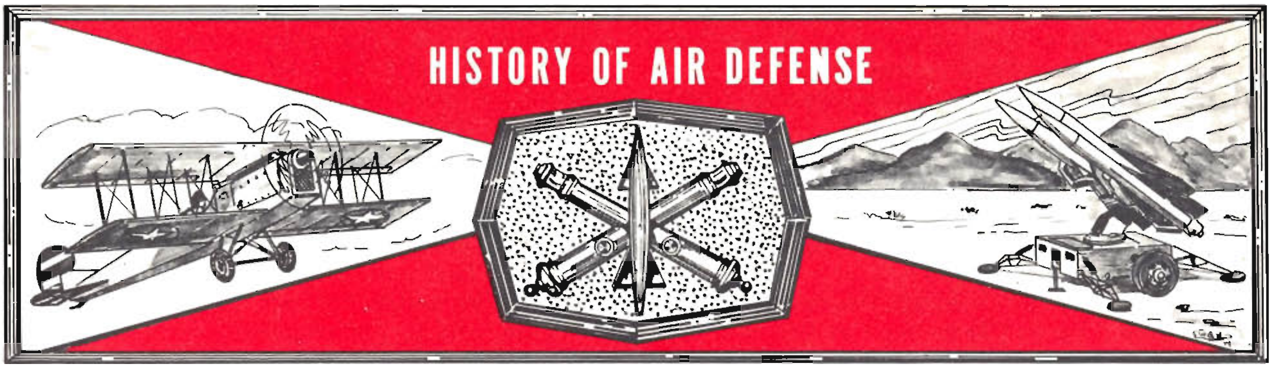
Rapier is a lightweight air defense weapon system and can be readily transported over long distances in conventional transport aircraft and can withstand the rigors of operations with highly mobile field forces.

- A complete Rapier weapon system and eight missiles can be stowed in two CH-47A Chinook helicopters. Typical range of transportation at limited altitude is 100 miles.
- Two C-7 Caribou aircraft can transport the Rapier system up to 200 miles. The height of the launcher and the radar tracker can be adjusted to clear the wing spar in the hold.
- Two Rapier launchers, two radar trackers, two optical trackers, and 64 missiles can be stowed in the hold of a C-130 Hercules transport aircraft. Typical range of transportation is 2,000 miles.

Rapier systems carry equipment mounted on removable pods. The pods, with other system elements, maintain a high degree of mobility through air lifting by various helicopters including the Bell Huey series (fig 11).

Introduction of Rapier into operational US field commands could be accomplished within 3 years. Drawings, manuals, procedures, documentation, and testing routines are in English; the only editing required is that which brings in the American vernacular. The design, tooling, and all drawings are in inches, and do not require conversion from the metric system.

The standard Rapier software program is fully developed in such areas as training manuals, field assembly, check out, repair, and repair parts provision. This software has been demonstrated and is being delivered against production contracts.



Having reported on the early development of radar in the United States and England, we turn now to similar efforts on the part of Germany. The period involved is from 1936 through World War II.

The first scientific discoveries and ensuing developments occurred about 1936 at the Naval Experimental Institute. Research and development began when Telefunken in 1938 initiated tests of the first prototype Wurzburg radar.

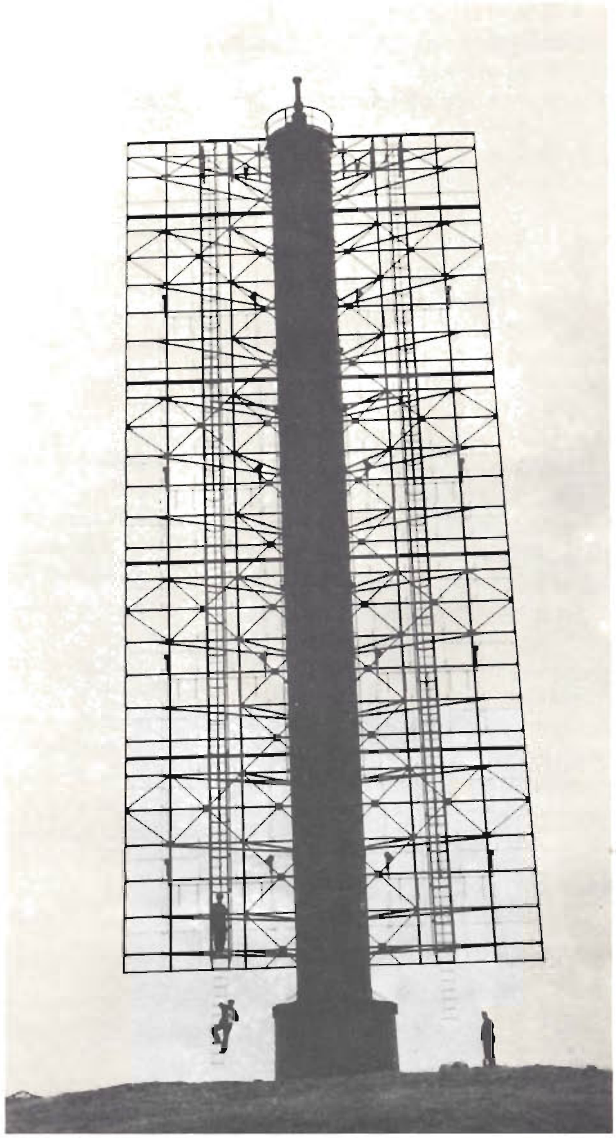
The first trials were regarded as failures; however, by 1939 a new model, the Wurzburg A, was developed and tested. Although it was regarded as not very accurate for gun laying, some 800 of these radars were ordered with a few being delivered prior to the start of World War II.

The importance which Germany attached to the development of radar is demonstrated by the reaction to a report that the United Kingdom had radar stations along the English Channel. The Graf Zeppelin was equipped with receivers designed for reception of high-frequency radio signals in the bands in which it was suspected the British were operating. In May 1939 it flew along the English coast, attempting to locate the British radar stations. The results achieved were inconclusive, although the radars were tracking the airship.

Radar development primarily concerned the gun-laying radar. Another phase of radar development, which at a later date was to assume major importance, was the continuing of work in the lower frequencies of 100 to 500 megacycles.

When Germany started World War II, the war machine was geared to an offensive war, and no provision was made for the possibility that the Blitzkrieg might not be successful. After the Battle of Britain, it became apparent that there were many deficiencies with respect to defense of the Reich from aerial attack.

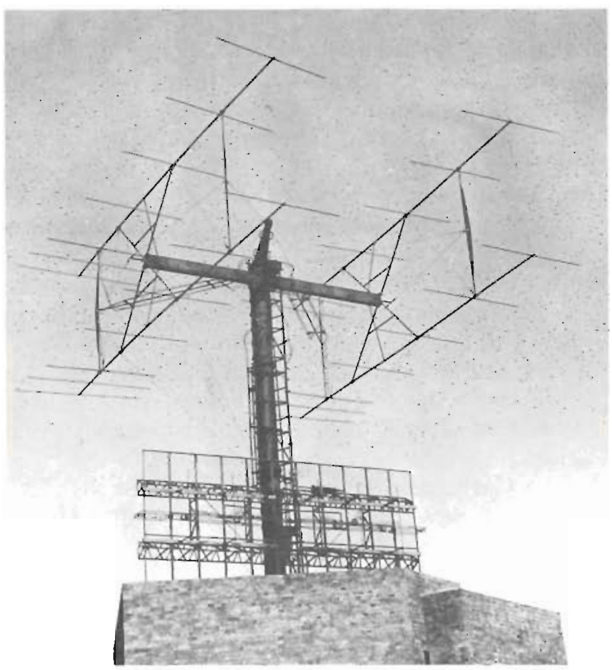
Germany then began developing identification, friend or foe (IFF) equipment; radar altimeters; navigational controls; and radars. However, there was poor coordination between the research laboratories and production agencies, both of which had little liaison with the military. Those who were controlling Germany's war effort, including the general staff, were devoid of technical background in the radio field and ability to ap-



Chimney Wasserman early warning radar.

preciate the possibilities of radar in the air defense field. Effort in the radar phase of air defense was, generally speaking, retarded some 2 years behind that of the United Kingdom. Although she made tremendous strides after the air defense research and development agencies were unleashed by Hitler and Goering, again it was too little and too late for Germany.

Several types of early warning radars included the Chimney Wasserman and Freya, which operated on 125 megacycles. Of the large number of variations of this model, the Freya LZ/Wismar I incorporated a quick frequency change capability, and the wide-band Freya included both a quick change and a single antenna using a duplexer. The Freya Fahrstul was capable of height determination, and the Freya Elefant operated on a lower frequency of 30 to 40 megacycles. One model used a plan position indicator (PPI) tube and thus could be used for ground control of interception.



Freya GCI radar.

The Wurzburg radar, originally designed in 1939 for gun laying, was continued with numerous variations. Its range determination was at first much too inaccurate, but later models gave accurate range data. The type D Wurzburg, operating at 450-600 megacycles, was the most numerous of the Wurzburg radars. It was relatively accurate and transmitted its data by means of selsyns. The giant Wurzburg Riese was not designed as a gun-laying radar and was largely used for early warning. However, it could be, and often was, used to provide accurate slant range to a gun battery.

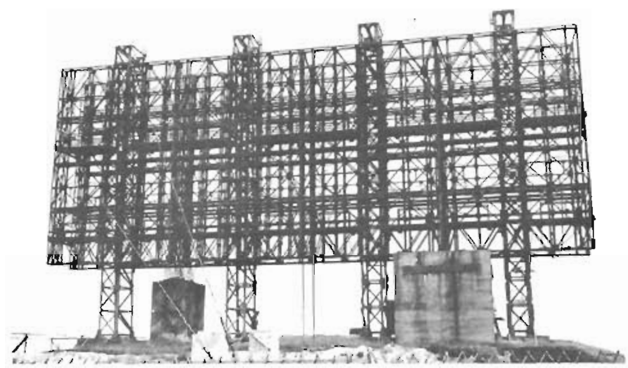
Germany's latest gun-laying radar was the Mannheim, a mobile and accurate set operating on about 560 megacycles, but very susceptible to Allied jamming. It was not found in large quantities.

Early use by the Allies of chaff and electronic jamming forced the Germans to develop electronic counter-countermeasure (ECCM) devices and circuitry. Of these, the Stendal A permitted the radar to track the jammer aircraft. The Stendal B was another modification which gave an indication of the jammer's range as well as its direction.

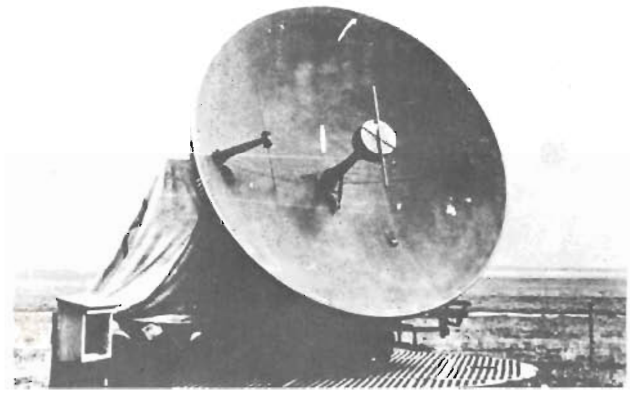
The third ECCM device, known as Michael, was a change of oscillators so that the operating frequency of the radar could be moved off the jammer's frequency.

Also developed was a coherent-pulse ECCM device that operated to obliterate all fixed echoes appearing on the PPI. It was similar to the American MTI (moving target indicator). Only a few of the German radars used a PPI.

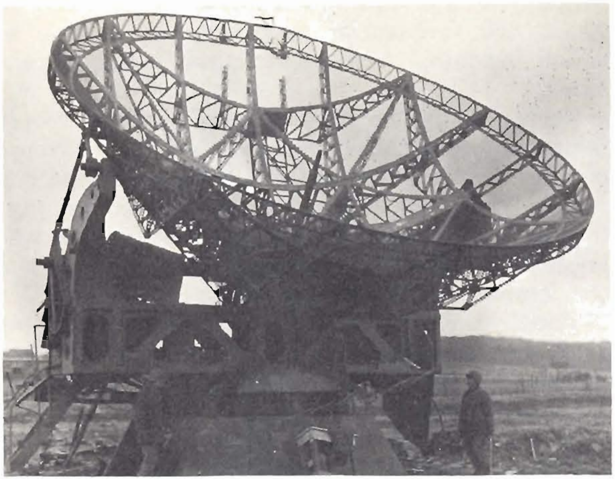
The Germans early recognized the need for a means of identifying radar targets as either friendly or enemy. The first IFF was modified and eventually became quite similar to the IFF used by the British and Americans.



The Germans concentrated on long-wave radars such as this Mammut early warning radar, and became masters of matching large stacks of dipoles.



Wurzburg D radar.



Wurzburg Reise, or Giant Wurzburg.

In 1942 jamming possibilities were recognized by German scientists, and antijamming measures were recommended. Goering believed his air force was a sufficient air defense and would not listen. On 25 July 1943, the Allies delivered a paralyzing raid on the city of Hamburg. One of the reasons for its success was lack of an effective air defense which, as far as flak was concerned, was directly attributable to the complete jamming of German radars by Allied electronic countermeasures (ECM).

After this demonstration, the German high command were believers; a frenzied rush followed to develop electronic counter-countermeasures (ECCM), and the Wurzlaus was produced in a few days. Some work on antichaff jamming had been done surreptitiously. Since the Germans had ignored the vulnerability of the low frequencies to both chaff and electronic jamming, not a great deal could be done without going to centimeter wavelengths — an impossibility at that stage. This caused a reversion from continuous laying to barrage fire by AA guns.

An ECCM device was developed for defense against bombing by planes which used radar sights. It consisted of designing corner reflectors and placing them in nonvulnerable areas so that the Allied aircraft radars would pick up increased electromagnetic radiation reflections in designed patterns, thus deceiving the bombardier. In this manner, Allied bombs were caused to be dropped in harmless areas. This was particularly successful in the Wilhelmshaven area.

At this stage, the Germans realized that their long-range air defense program was deficient, and they gave consideration to a large, automatic firing, high-velocity cannon, and to the development of a high-velocity homing-type rocket for air defense. They had neither the time, facilities, nor materials, to execute either development. Considerable research time was spent on the infrared detector, the device that the United States and the United Kingdom abandoned in 1938. The Germans also conceived the idea of a proximity-type fuze but were unable to achieve any concrete development by the end of the war.

Allied jamming forced Germany into frequency tunable radars to avoid or lessen the effects of jamming. One result of Allied attacks against radar positions was the Ansback technique which consisted of separating the control room from the antenna and operating the antenna by remote control to provide greater safety for the radar crews. Another development was the increased use of PPI on radars. In some cases, they dropped radar outputs to very low frequencies, such as the Wasserman M/Klein Heidelberg at 22-27 megacycles and the Freya Koethen at 75-95 megacycles. In two cases, this change was not detected by the Allies for an extended period of time. Scientists also developed a radar absorption paint for the under surfaces of aircraft to lessen the response to Allied radars.

The Germans withheld all really pertinent and late radar developments from Japan until late in the war, when it became apparent that Germany probably would be defeated.

If German scientists and development laboratories had been able to operate freely and in a coordinated atmosphere, the 2-year disparity between German and Allied radar developments would not have existed.

Canvas — Wires — Pulleys Combined To Give AA Gunners Firing "Feel"

From "The Camp News,"
Camp Edwards, Massachusetts,
16 June 1943

Any thought that Camp Edwards has gone "honky-tonk" can be dispelled, because the telephone poles from which hang gigantic pieces of canvas and around which run a series of wires and pulleys are all part of an Antiaircraft Machinegun Trainer. Located in an ack-ack training area, the trainer has the deadly purpose of giving 50-cal. machinegun operators the knowledge and "feel" of the weapon before they undertake actual firing at tow targets at Wellfleet and Scorton Neck beaches.

The apparatus in operation is realistic to the nth degree. Simulated models of a 50-cal. machinegun shooting plastic pellets at moving targets of scale model planes built to represent Zeros, Messerschmitts, and other enemy aircraft are used; actual vibration of the weapon and accompanying "battle" noises also are present.

In actual operation the AA Machinegun Trainer is fired and operated exactly as a real gun, using a full gun complement of men, and a firing officer. When the gun crews are "on target," two guns are fired simultaneously at the moving "target" planes which are propelled along guide wires by hand-operated trolleys which can simulate plane speeds up to 400 miles an hour.

Meanwhile the operating gun crews are receiving actual "baptism of fire" practice as the gun vibrates realistically at the touch of a button, as well as providing recoil reaction and simulated firing noises.

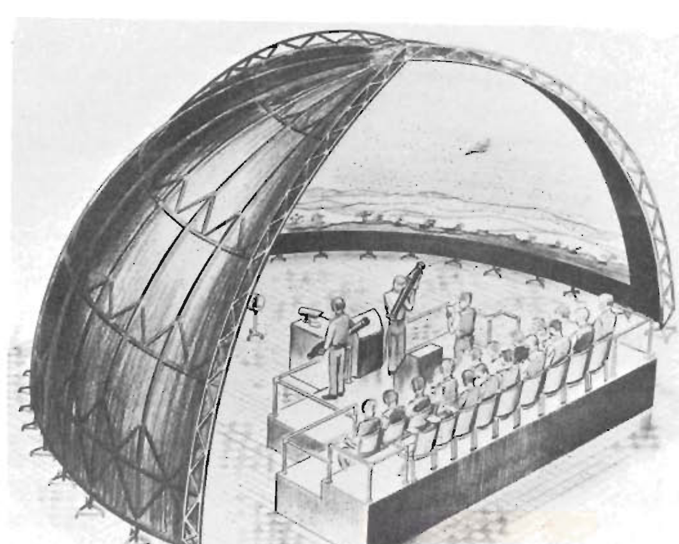
The aircraft guide wires are so arranged that they simulate a crossing constant-altitude course, dive course, and climbing course.

The outdoor trainer, when erected, is 100 feet in length, 30 feet in height, and the guns are fired some 50 feet from their miniature plane targets. The apparatus also can be built indoors on a smaller scale.

With a little imagination one can hear the sideshow "barker" luring World War II veterans into his gallery when the war is over by shouting "come on and try your luck. See if you can't knock that plane right out of the sky with some plain and fancy shooting."

He'll probably have plenty of AA-trained customers, too, who will be out to show the "little woman" how he used to do it while training at Camp Edwards.

Thirty Years Later



The Redeye moving target simulator device was developed to provide a means of presenting aircraft targets, in a controlled training environment, that represents types and flight paths that might be encountered in defended areas.

The Redeye moving target simulator provides the sights and sounds representing real tactical aircraft. Initial application employed the Redeye tracking head trainer M49 (part of the M76 training set). Environmental realism is achieved through the use of a large display area, color target presentation, and stereophonic sound. Target images are projected on a display screen, which is a segment of a 40-foot diameter sphere. Painted background horizons are used to increase realism and provide the trainee with reference points. Moving target images are projected from motion picture film which provides target size and aspect, with changes in azimuth and elevation controlled by a servo-driven, gimbaled mirror system that reflects the projected images onto the proper position of the screen. Stereophonic target sound is provided by magnetic recorded sound strips on the target motion picture film. Target infrared emission is furnished to complete the simulation of the tactical environment. The target infrared emission projector provides realistic target signature, in the proper spectrum, superimposed on the target image.

In the firing area, there are two trainee stations: each capable of accommodating an instructor and a trainee equipped with a Redeye tracking head trainer. Targets can be visually tracked and engagement procedures practiced from each of these stations.

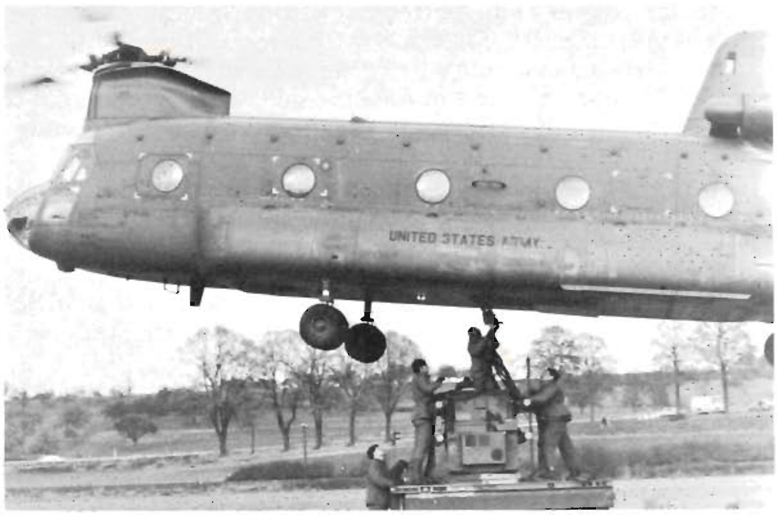
The projection console is located forward of the firing area between the two trainee stations. The console is soundproofed to reduce extraneous noise which could interfere with training. Instructor operating controls and displays are located on the instructor's station at the rear of the firing area.

The observation area is located to the rear of the firing area. This elevated platform is sufficiently close to the firing area to allow observing trainees to hear instructor comments directed toward trainees in the firing area and to permit personnel movement between the two areas.

Chaparral Airlift

Second Lieutenant Stephen K. Aker
Second Lieutenant Russell J. Wimberly

At approximately 1400, 7 November 1973, the powerful Chinook helicopter lifted its payload from the runway of the Budingen Heliport, Federal Republic of Germany. The payload was a Chaparral missile launching station and crew belonging to Battery C, 3d Battalion, 61st Air Defense Artillery. The primary mission — airlift the Chaparral to a remote hilltop, come up to BATTLE STATIONS, and provide air defense for a nearby American caserne. The secondary mission — be prepared to replace a Chaparral launching station damaged in combat.



Hooking up.

At approximately 1415 the helicopter was hovering with its payload above the landing zone. Ever so gently the system touched down and the rigging was released. Once free of its suspended burden the Chinook moved to one side and set down. The tailgate lowered and out charged the Chaparral crew led by SSG Silas Turner. While the crew established ground security and leveled and derigged the system, the Chinook, mission completed, faded into the distance.

On its own and alone, the crew busily begins preparing a tactically operational missile site. Once the launching station is level and free of rigging, the entire crew engages in preparing for action and loading missiles. The last missile is seated and the last wing is skillfully being torqued down. The launching station is nearly ready now. All that remains to be done is to man the forward observation post. Once that has been completed, the launching station is 100 percent tactically ready and the platoon headquarters is notified that the unit is at BATTLE STATIONS. At 1447, scarcely over 30 minutes after it was set down, the Chaparral missile launching station is combat ready.

A message from platoon headquarters comes over the radio. An M730 carrier and a recovery vehicle


Setting down.

are enroute to the squad position. Upon their arrival, the launching station will be mated to the carrier, thus replacing the unit damaged in combat. Minutes later the recovery vehicle and the carrier arrive and mating operations begin. Shortly the work is completed and the Chaparral and recovery vehicle rumble away.

The tactical application of this airmobility exercise is twofold. First, the launching station air portability and the speed with which it may be airlifted over natural and manmade obstacles, and emplaced in a remote location, are of great tactical importance. In this particular exercise, a distance of 10 kilometers was covered in 15 minutes. Second, a launching station damaged in combat may be quickly replaced on site. Within a short time a new launching station may be airlifted in to replace a damaged one that in turn may be airlifted out for salvage or repair.

The capability to airlift a launching station by helicopter is affected by inclement weather and the availability of aircraft. If the mission allows, have an alternate plan for moving a launch station system by its prime mover (carrier). A unique problem encountered was the loading of missiles on a demated launching station; the tailgate of the carrier could not be used as a step in the loading. Two methods were considered: loading from the side and loading from the front over the crew equipment compartment. Both of these methods provided the least distance from the edge of the deck and missile rails. The front-loading method was finally chosen because it provided maximum deck space to the crewman torquing the wings, and because the rounds had to be carried an excessive distance if side loaded. Using the front-loading method the rounds were simply removed from the missile compartment and carried to the front of the launching station. After some diligent practice with this new method, the crew managed to obtain a loading time of 7 minutes and 20 seconds on the day of the exercise. To our knowledge, this is the first TOE unit to airlift and tactically deploy a Chaparral missile launching station. Due to the current fuel shortage, no further airlift operations are being planned at this time, but our planners have it in their thinking caps to be the first to airlift an entire platoon of Chaparral launch stations into field positions.

Stinger
(January 1974)

Lieutenant Colonel Eugene Fox
Office Army Chief of Staff
Washington

Stinger is the Army's advanced man-portable air defense system which will replace Redeye. It is a shoulder-fired, passive, infrared homing missile which will have an all-aspect engagement capability against low-altitude, high-performance aircraft. Although Stinger is primarily a self-defense weapon for the combat arms troops, it will also contribute to the overall effectiveness of the defense of the theater army by attriting enemy aircraft while complementing the engagement envelope of longer range, higher altitude capable air defense weapons.

The Stinger Project Manager's Office was officially established 5 January 1972. The Secretary of the Army signed the Project Manager's Charter 21 April 1972, appointing COL David H. Souser as Project Manager. The Charter contains authority for Marine Corps participation in the Stinger project and delineates the duties of a Marine Corps Assistant to the Project Manager.

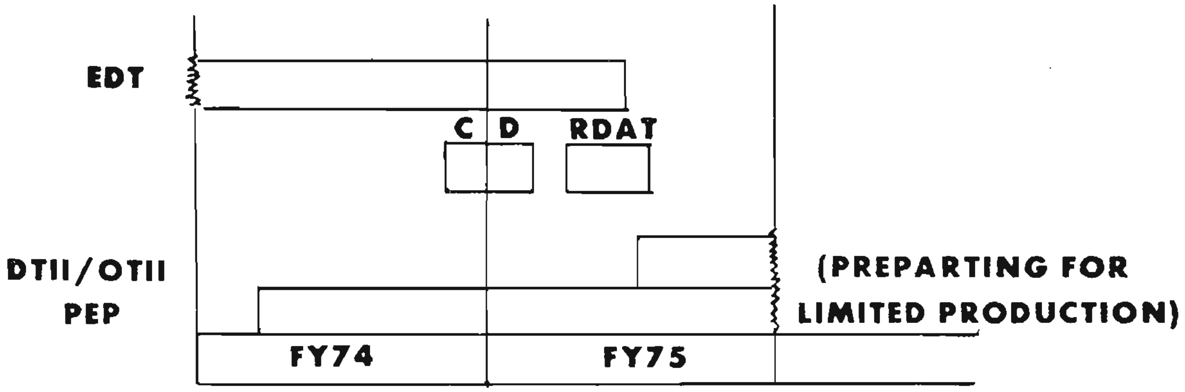
On 20 June 1972 the Deputy Secretary of Defense approved the entry of Stinger into full-scale engineering development (ED). The ED contract was signed with General Dynamics 27 June 1972. A Stinger alternative program to investigate a system not relying solely on passive infrared homing has been assigned to Aeronutronics Division of Philco Ford under contract signed 26 November 1973. The Stinger and alternate program will be evaluated prior to a decision to enter limited production.

The current ED program consists of five major parts (see figure below): engineering design testing (EDT); contractor demonstration (CD); research and development acceptance test (RDAT); development testing (DT) II/operational testing (OT) II; and producibility engineering and planning (PEP). Stinger is currently in the EDT phase, having successfully completed subsystem testing of eject test vehicles (ETV), launch test vehicles (LTV), and control test vehicles (CTV).

The ETV series of tests, conducted at General Dynamics, Pomona, California, used a live launch motor and a dummy missile. The tests measured such things as launch shock and vibration, missile eject velocity, and human factors aspects of the launch environment. In the LTV series a live-flight motor was added to the dummy missile and tested at White Sands Missile Range, New Mexico. The tests measured flight motor performance and fuzing parameters. The CTV series added a programmed control system. The tests measured flight parameters during controlled maneuvers or correlation with the computer simulations. System level testing was initiated by a successful firing of the first guided test vehicle (GTV) (or complete, fully guided missile) 30 November 1973. GTV-1 scored a direct hit against a drone target flying at a speed of 200 knots, at a range of approximately 2,100 meters, and at an altitude of approximately 1 kilometer. The time of flight from launch to intercept was less than 5 seconds. This successful test confirmed computer simulated operational characteristics and the results of previous controlled component tests. These guided test flights are scheduled to continue into FY 75.

During CD, missiles will be fired against full-scale aircraft. The weapons will be subjected to field environmental testing prior to these firings. A system level demonstration will be conducted during RDAT to assure that all performance requirements of the ED contract have been fulfilled. Successful completion of RDAT verifies that the system is suitable for test by independent Army agencies in development and operational testing (DT/OT II).

Changes in the Stinger development program will be made with the recent approval of Stingthrift. Stingthrift is a cost reduction program resulting from the contractor's design-to-cost requirements. A special committee of senior management personnel at General Dynamics has the express purpose of examining all the detailed requirements of each design item. They are charged with determining areas of possible trade-off which would have measurable impact on the estimated unit production cost. Twenty-six areas were identified by the contractor for potential cost reduction. Prospective trade-offs were reviewed and evaluated by the Stinger Project Office, MICOM directorates, other affected Army agencies, and the Marine Corps. This review eliminated those proposed items which were either not cost effective or would result in unacceptable performance changes. Further review reduced these to six areas where trade-offs are considered most desirable for implementation.



The objective of the Stinger program is to develop and field a man-portable air defense system to replace Redeye. Stinger will be similar to Redeye in size and weight but will have a much improved capability. Excellent progress continues in the development cycle with very encouraging results.

Antiballistic Missile Maintenance Training Facility

Major John D. Bieber
Rudy Loranca
US Army Air Defense School

Coincident with establishment of the Safeguard Antiballistic Missile Site at Grand Forks, North Dakota, development of MOS-qualified antiballistic missile technicians and specialists is underway. These specially trained individuals will have the responsibility for maintaining the Sprint and Spartan missile subsystems that are part of the Grand Forks Safeguard system.

The Sprint missile — an ultra-fast, highly maneuverable interceptor — provides terminal defense of point targets against the threat of intercontinental ballistic missiles. A two-stage, solid-propellant missile, Sprint is designed to make intercepts at ranges essentially in the earth's atmosphere. It reaches intercept altitude within seconds. Once launched, it accelerates so rapidly that air friction causes it to glow white-hot in a matter of seconds. The Sprint subsystem consists of the interceptor missile, underground launch station, launch preparation equipment, handling and test equipment, and three special-purpose vehicles.

The Spartan missile — a super-fast, long-range interceptor — provides large payload intercept capability for exoatmospheric attack of intercontinental ballistic missile targets. The Spartan is a three-stage guided missile, powered by solid-propellent motors, with second- and third-stage maneuverability. The first and second stages accelerate the third stage to peak velocity. The third stage contains the warhead, guidance, and control sections. The Spartan is aerodynamically controlled within the atmosphere and reaction controlled outside the sensible atmosphere. The Spartan subsystem consists of exactly the same type and number of items as the Sprint subsystem.

Maintenance of the missile subsystems is separated into two distinct categories: routine and corrective.

Routine maintenance includes:

- Missile preparation and installation.
- Launch station periodic test.
- Launch station maintenance test.

Corrective maintenance will be limited to organizational maintenance by replacement of selected chassis or missile sections and includes:

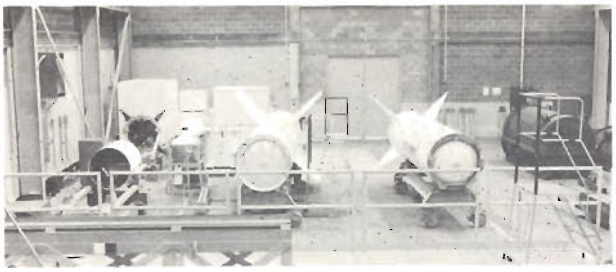
- Tests of the launch preparation equipment and launch station cabling. (The fault locator will be used to isolate faulty sections of the Sprint and Spartan missiles and faulty sections will be replaced online.)
- Launch station maintenance. (This action is taken only as a result of a major or minor alarm.)

Now, after many test flights and engineering changes, these two new missile subsystems are ready to be tactically deployed. Training personnel in appropriate MOS is the responsibility of the US Army Air Defense School's Ballistic Missile Defense Department (BMDD). MOS-qualified personnel must be trained to a level where they can install all missile subsystems on site for the life of the Safeguard system. The crew must perform all functions of receipt, inspection, assembly, testing, and cell installation — using all the associated tools, handling and test equipment, and service vehicles with proficiency.

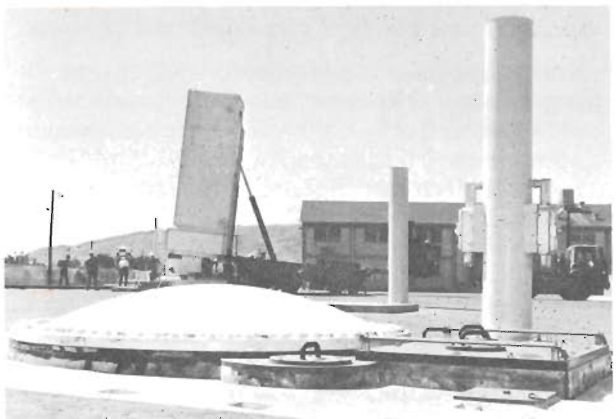
To prepare for training MOS-qualified crews, BMDD personnel developed a minimissile site, called the Missile Training Facility. The facility comprises a launch station training area and universal missile training building and provides the necessary elements for realistic training in the receipt, inspection, assembly, installation, checkout, and maintenance of the tactical Sprint and Spartan missile subsystems. The launch station training area consists of the Sprint and Spartan maneuver areas. The Sprint area comprises a modified tactical launch station and eight simulated launch stations. Five simulated launch stations are of concrete construction, simulating the above-ground configuration of the cell. The remaining three are painted on the asphalt surface. The Spartan area consists of a modified tactical launch station and two simulated launch stations. One simulated cell is of concrete construction, simulating the aboveground configuration of the cell. The other is painted on the asphalt surface.

The maneuvering area simulates the tactical site maneuvering constraints for the universal transporter loader, Spartan maintenance van, and Sprint service vehicle. The area has an asphalt surface capable of supporting repeated maneuvering of the loaded vehicles.

The universal missile training building will house the tactical receiving area, tactical missile



Receiving area for Spartan missile, including loading pallet in foreground and missile assembly area beyond rails, showing (L to R) first, second, and third stages.



Sprint launch station in foreground. In background is the universal transporter loader erected over the Spartan launch station. The tubular structures are reradiation antennas to provide communication facilities between the missile and the missile site radar.

assembly area, tactical warhead assembly area, vehicle storage area, and administrative and classroom space. The receiving area is elevated to provide the environmental interface between the receiving area and the universal transporter loader and sprint service vehicle. A winch and an overhead bridge crane are provided to perform all loading and unloading operations. The missile assembly area is used to remove the missile components from their container, to perform assembly operations, and to check out the missile components. The bridge crane is used to install the Spartan missile components on the hydraulic fixture or dollies during assembly and checkout operations. The tactical warhead assembly area is used to inspect and perform assembly and maintenance on the warhead. This area also serves to store the warhead containers. The vehicle storage area is used to store and maintain the universal transporter loader, Spartan maintenance van, and Sprint service vehicle. It also houses the environmental equipment and facilities necessary to provide the environmental control required for the vehicles. Administrative and classroom space is located on the second floor. This area houses the staff and faculty and provides the necessary classrooms to conduct theory training on the assigned missile subsystems.

At this writing, one Safeguard class has been graduated and two are in residence at the Air Defense School's Missile Training Facility. The design of the facility has proved an invaluable asset for training and will enable graduates to perform proficiently all functions of receipt, inspection, assembly, testing, and cell installation.

Moving Cross Country?

Betty Marcus

The author, who is a sociologist on the faculty of the El Paso Community College, has prepared this comprehensive checklist for the many families who will be receiving permanent change of station orders. Her personal experiences are reflected in the list and we think it will be a very helpful supplement to lists of do's and don'ts supplied by some Army transportation offices.

Checklist

For safety reasons, wear substantial shoes with closed toes on packing and unpacking days.

Remain on the premises until your possessions are completely loaded.

Make a final tour of the house to be sure that all items have been loaded before signing the inventory sheet and freight bill. Note the terms and conditions under which your goods are being moved. Save these papers; they are proof of ownership of your possessions.

Check the moving company inventory of your possessions. There are letters at the top of the inventory. They carry designations such as scratched, dented, rubbed. You may have a new, blemishless refrigerator and the operator may mark it as scratched or rubbed; then, when the refrigerator arrives at destination marked, the carrier will say, "No," to your claim.

Do not sign the bill of lading unless you are absolutely certain that:

- It is correct.
- Everything on the van is listed and marked correctly as to its condition.
- Your destination delivery address and telephone number to locate you enroute are correct.

Save all receipts from moving expense, including those for lodging, food, and transportation. Keep this documented proof of your expenses for reimbursement and for income tax purposes.

Avoid storing possessions. Try to move from the old residence directly into the new one if possible. There is more possibility of damage with the repeated handling.

Defrost and dry your refrigerator and freezer. Leave them open 24 hours before they are loaded.

Drain oil and fuel from your power lawnmower and similar types of machinery.

Unless an appliance is standard equipment in your new home, it may be best to move the one you have. For example, you probably would be fortunate to sell your refrigerator for $50.00. The cost of replacing it would be more, particularly in the light of today's inflated prices.

Do not dispose of items without the consideration of replacement cost in relationship to the moving costs.

Mark, "LOAD LAST," any cartons that contain soap, towels, coffee, cooking pots, and the like, that are needed immediately on arrival. They will be unloaded first and you can get to these items quickly.

Place items of personal luggage in one closet or bathroom of the house and (if possible) lock that area when the movers arrive. This prevents the movers from taking items you will need on the trip, otherwise you might have to wear the same underwear for 10 days!

Wrap sofa pillows and rugs before the movers arrive if possible.

Secure the turn table and needle arm of record players.

Call the local office of The State Department of Agriculture to arrange for permission to transport any plants you plan to take.

Dispose of inflammables such as fireworks, cleaning fluids, matches, chemicals, and other items that might ignite from excessive heat or freezing.

Take down curtains, rods, shelves, television antenna, etc., or make arrangements for the movers to do so.

Carry a list of your furniture measurements so you will know whether furniture will fit into your new residence.

Send valuables such as jewelry by parcel post, REGISTERED mail. The valuables may be fully insured in this way. (The carrier is not permitted to accept these valuables and, if you hide them in the shipment and they are lost, the carrier is not responsible.)

Ship any books that you need early by parcel post; rates are 18¢ for the first pound and 8¢ per pound thereafter. Pack the books in small, substantial cartons; bind them with nylon tape, and mark them "Books."

Pack a telephone book so you will have addresses that you may need.

Do not cancel your homeowner's insurance policy if it covers fire, theft, and mysterious disappearance of household items and personal property. Keep the policy in effect until you are settled into your new location and have inspected all your possessions. This policy covers your possessions even though you sell your home.

Use all of your store of frozen foods that you can and sell or give the rest away. It is very costly to ship frozen foods across country.

Close charge accounts with local department stores before you move. Your credit with any giant retailers such as Montgomery Ward, J.C. Penney, Sears and Roebuck will continue; but let them know your change of address.

Get all prescriptions filled for necessary medicines for the trip.

Cancel subscriptions to local newspapers and magazines. Cancel deliveries for such items as milk, mineral water, and the like.

Make arrangements to discontinue your utility services and pay the bills before you leave.

Fill out change of address cards at the Post Office. If you do not have your new address, give a General Delivery address with the zip code of the post office that will be serving you.

Notify all your personal and business correspondents of your new address.

Obtain any letters of introduction, travel orders, and such that you may need; put them in a place where you can find them quickly.

Take papers from your local veterinarian for any pet that requires protection from rabies. Also, ask the veterinarian about embargoes on birds that you may have.

Make arrangements with a commercial airline for shipment of pets if you do not wish to travel with them.

Make any motel reservations that are necessary. If you plan to travel with a pet, select from the AAA list motels that accept pets.

Plan to tow your second car using a towing hitch from a rental service. Load the second car with "immediate-use" items. Beware of "Drive Away Systems" who furnish drivers who may abuse your car as they drive across country. Leave the area around the steering wheel of the towed vehicle empty so the wheel can move freely, and secure items so that nothing falls in the way of the wheel.

Establish credit at the destination city. Tell the manager of the bank where you conduct business that you wish to use him as a credit reference at the destination bank.

Remember that "full value insurance" does not guarantee you full replacement value. For example, if a good refrigerator that cost $300 five years ago were lost, the carrier might offer you $35 for replacement according to "full value insurance." On the other hand, your homeowner's insurance policy would help cover the difference between the carrier's full replacement value and the actual replacement cost of a new refrigerator.

Watch the unloading to check for any damaged or missing items. They must be NOTED AS EXCEPTIONS ON THE BILL OF LADING (both your copy and the driver's copy). Make sure the driver signs his full name (not just initials) for damages or missing items.

Call the moving company's local office for an immediate inspection in the case of damaged or missing inventory items.

Have sufficient money in traveler's checks, or other negotiable form, to complete trip and extra money for an emergency situation. It is very difficult to cash personal checks on an out-of-state bank while traveling.

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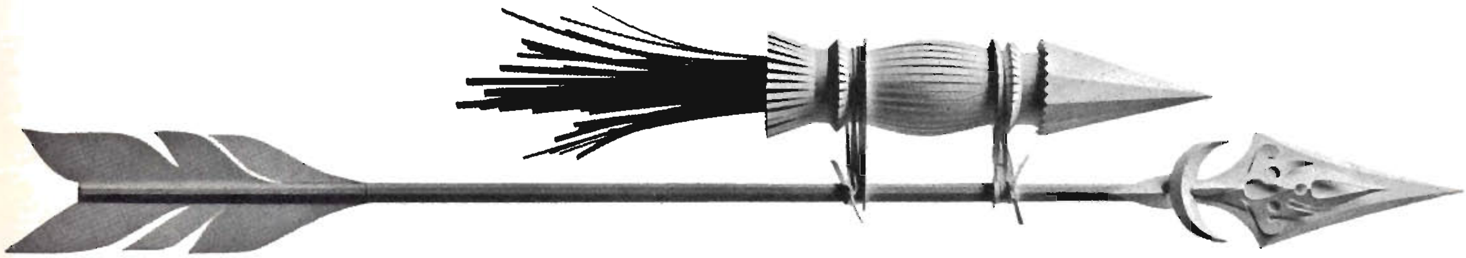
The Missile Flies



Whatever the purpose of a missile, it must travel through the atmosphere for part of its flight. Therefore, aerodynamic consideration of missiles is basically that of manned aircraft, and with nearly as many variables.

Since cave man learned to throw rocks at his enemy, missiles have been effective weapons. He learned that round rocks flew straighter than flat ones, but for the same weight they had less range. He may have achieved a skill comparable to a modern baseball pitcher, but the need for longer range and greater lethality led to spears and arrows – the first aerodynamically designed weapons. From this early day onward, the science of aerodynamics ended its crawl and began a faster pace toward the current gallop.

Pyrotechnic propulsion in rockets and guns, plus a new kind of stabilization through spin, evolved into weapons limited in range more by propulsive power and aiming accuracy than by drag. Blunt bodies permitted development of a front-end "eye" to see a target, movable flippers were coupled to body or tail surfaces for steering the missile, and lifting surfaces were added, resembling more the small fins of a fish than the broad wings of a bird. This was because a large-turning radius was sufficient to correct a well-launched missile, and low drag was vital when accuracy no longer depended on range.

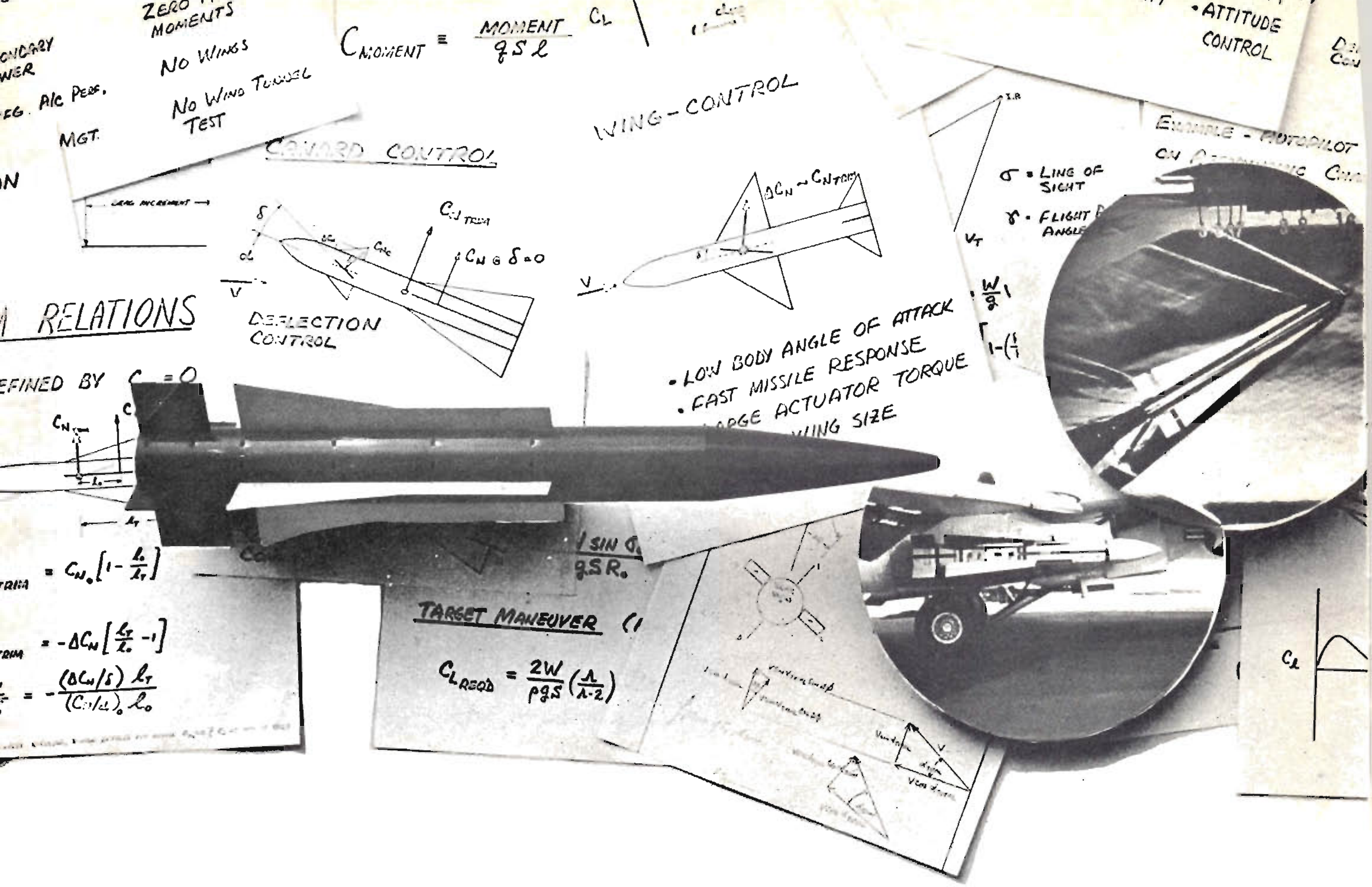
Finally, as speed and altitude increased, even merging into outer space, steering by internal reaction engines replaced aerodynamic control in some missiles.

Clearly the foregoing is a quick and incomplete genealogy of missile developments and configurations, but they are typical of those that aerodynamicists have been or may be called upon to develop. And always, at one extreme the emphasis is minimizing aerodynamic interference. At the other extreme are the considerations of sophisticated manipulation of the varying external air pressures developed in subsonic, transonic, supersonic, and hypersonic flight. And each flight category may involve shocks over a wide degree, a variety of flow separations, trailing vortices from a variety of wing, tail and flipper shapes, aerothermal heating of surfaces and electronics, and the fast transition from heavy air to high rarified gas in the upper atmosphere.

Because missiles are heavier-than-air vehicles, and resemble manned vehicles more or less in configuration, they are completely at one with them in being subject to all the multiplicity of forces acting on bodies moving through the air. Therefore, aerodynamic consideration of missiles is basically like that of aircraft.

However, as missiles do not normally carry human cargo as yet, their design can be simplified accordingly. Moreover, they can be hurled at their targets with any acceleration or speed desired or required. They can operate at extreme altitudes and execute violent twists, turns and rolls. And, the plan is for a one-way flight.

With this freedom, missile design decisions primarily involve only three aspects: body shape,



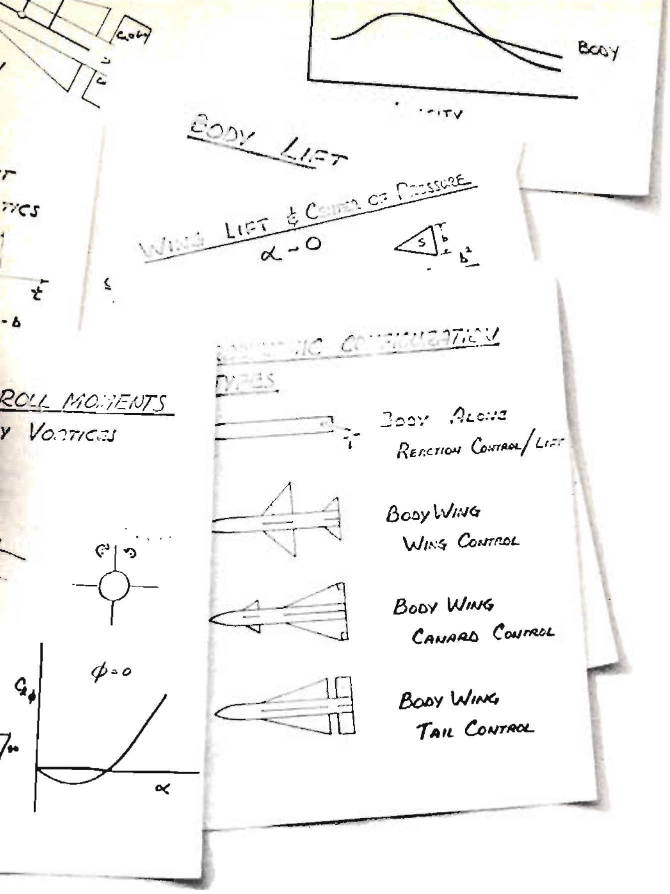
fin configuration, and surface materials. But the multitude of variables within these encompassing categories requires a first-rate working knowledge of aerodynamic effects if performance of a missile is to be first predicted on the drawing board and later confirmed by wind tunnel and flight tests. Moreover, a working knowledge of performance tradeoffs is a must if a missile is to compromise design but not its mission.

Certainly an aerodynamicist in considering a missile configuration first must know the mission. This is the easy part. It isn't too difficult to define the tactical requirements, such as so far, so high and so fast over a specified terrain, in given weather, during daylight, guided by a TV sensor.

But the *how* of accomplishing specified requirements can challenge a panel of experts for years, because there isn't a system, subsystem or unit placement or function that does not have a direct and vital bearing on at least one other. For every plus there's a minus. For every advantage there is a penalty. The optimal configuration of any missile is of necessity a series of selective gains and losses to achieve a desirable end-product.

Once the system requirements are established, the various components must interface with the missile without imposing weight and size penalties, and if air launched, the missile must compatibly interface with the airplane. For example, whether the missile is carried externally or internally presents a series of considerations. If it is carried externally, perhaps it can have more lift surface, larger span and body, and thus larger control surfaces. But will these larger configurations place the wings or fins over the warhead? Will larger wings cause an intolerable downdraft on the tail surfaces? If not, then should flight control ailerons or flippers be placed in the wings, fins or tail surfaces? Should the control be that of deflection, torque, canard? In two surfaces? Four? And how will this size, weight, fin and wings placement of an externally carried missile affect the performance of the airplane?

If the missile is to be carried internally a whole new set of ground rules comes into being. The missile is likely to be smaller and shorter, which



U.S. Navy's long range Phoenix missile, developed and built by Hughes for Grumman F-14A *Tomcat fighter.*

could present a danger of reducing payload, fuel supply and electronics. The guidance and seeker requirements may be affected. The delicate center of gravity may be thrown off, seriously affecting stability in the pitch, roll or yaw axis.

Plainly, the special aerodynamic problems that apply to missiles arise from all the factors of the mission requirements, from the interfacing aircraft to target location. The variables would seem to be endless. But tradeoffs are equally numerous and the solutions still lie within the applications of the classic physical laws — just as they did in the days of the rock throwers.

In one respect the full circle may be reached soon, because the same aerodynamic consideration that led to the preferred spherical rock also led to a defensive weapon of similar shape, thrown like a pitcher's fastball with a high spin-rate. It has an eye on the spin axis looking at and tracking the target by projectile attitude control. The missile is laterally steered by controlled expulsion of propellant in its equatorial plane. Strictly a defensive weapon, it would depend on target speed to close the gap, and merely move on to the target's path and wait for the impact.

Considered initially for high-altitude intercepts of ballistic missiles, brief paper studies from time to time at Hughes have employed the concept for space interception, and for bomber defense against tail attack. An elongated version fired from a rifled cannon also has been considered for terminal guidance to an illuminated target. Again the aerodynamicists were working at both extremes to develop a special missile for a special mission.

Obviously, the intent of a modern missile, and the basic design, for that matter, is not too dissimilar from that hurled by the Chinese warrior on the front cover of this issue of VECTORS. On the other hand, a missile today is not discharged quite so aimlessly or so invisibly as that of the poet Longfellow:

I shot an arrow into the air,
It fell to earth, I knew not where;
For, so swiftly it flew, the sight
Could not follow it in its flight.

An Innovative Training Device

Lieutenant Colonel De Reef A. Greene
US Army Air Defense School

What is a game of skill played on a board, typically containing a number of holes surrounded with responses and marked with two lights to give (or not to give) the player credit if he places the electric probe in the correct hole?

Give up? No, it's not a new pinball machine or even a child's new toy for Christmas. It's the Aircraft Recognition Game Board developed to aid the Redeye Gunners at B Battery, 4th Air Defense Artillery Training Battalion (FAW), The Air Defense Artillery Training Brigade of the US Army Air Defense School, in identifying aircraft. Here's how it works: Pictures of the 36 aircraft that are taught at the Air Defense School are placed on a board. Under each aircraft picture are four choices. The student places the electric jack in the hole next to his chosen response and one of two lamps at the top of the board lights indicating either "Correct" or "Try Again." Sound easy? Look at the typical decision the student must make: Is it a 106 Delta Dagger or a 102 Delta Dart, or is it the other way around?

Aircraft Recognition Game Board developed at US Army Air Defense School to aid students in identifying aircraft.

The game board is a novel approach to an old problem: the teaching and reinforcement of visual aircraft recognition. It incorporates many sound and proven learning principles. For example, it allows the student to respond and test himself on the classroom instruction received. In using the board to respond, the student is simultaneously reinforcing his instruction. Additionally, the student may move at a controlled pace. During training, the gunner learns to identify three aircraft an hour so that at the end of carefully distributed days, he learns a total of nine different aircraft on each day aircraft recognition instruction is presented. The student, using the game board in his off-duty hours, may move on to the next group of aircraft or review the previous ones. By placing all 36 aircraft pictures on the board, instead of just one of the groups of 9, opportunity for discrimination by the student for the aircraft he already knows is provided. Implied in this discrimination is a sense of achievement the student feels as he progresses and reaches the point where he can identify all 36 aircraft. Finally, one object of a teaching/learning device should be to make the learned material available in an atmosphere other than the typical classroom environment. The game board may ideally be located in the unit's dayroom or reading room.

Flexibility is the keynote of the board. Obviously, the board may be put to uses other than for aircraft recognition. Other branches of the Army, for example, might find it useful in identifying pictures of their hardware. As new models of hardware enter their inventory, it is a simple matter to replace the pictures. Different pictures of different aircraft, different angles of the same aircraft, or various pictures of hardware may be used. No two boards need be the same. What about a combination of boards?

The game board uses established teaching concepts in a novel format; however, the idea of a coin slot is harmonious with its future development. With this relatively minor addition, its use would be phenomenal.

Small Arms Have A Lot Of Punch

Albert L. Kubala, Ph.D.
Senior Staff Scientist
HUMRRO Western Division, Fort Bliss Office

The heavy aircraft losses sustained by the Israeli Air Force during the recent Middle East conflict have resulted in a renewed interest in air defense weapons and doctrine throughout the military. Most of the publicity has centered around the newer Soviet-built missile systems, which had not been seen in actual combat before. However, air defense artillery also exacted a toll. For example, of the 18 F-4 aircraft lost, 9 were lost to guns (Army Times, 2 Jan 74). Tube-type weaponry was apparently employed to successfully defend against aircraft that were able to penetrate the larger umbrella provided by the missile systems. Although more sophisticated air defense weapons were employed in the Middle East war than in Vietnam, quantity rather than quality appears to be the key to the great success enjoyed by the Egyptians during early phases of the conflict. A panel, headed by Representative Samuel S. Stratton, concluded that it was "not sophistication, but proliferation" of weapons that exacted the toll (Army Times, 2 Jan 74).

The trend in the US has been in the opposite direction. That is, we have been acquiring fewer numbers of more sophisticated and more expensive weapons. Proliferation of such weapons is not economically feasible. The question then is, "How can we achieve the great volume of fire that proved to be so successful around the Suez Canal?" It is believed that the answer may lie in a revival of techniques for the use of small arms as an adjunct means of air defense for field forces.

The use of small caliber, non-air defense weapons in an air defense role is certainly not a new idea. In fact, infantrymen were trained to use their organic small caliber weapons in an air defense capacity as early as 1903! While this means of defense had its critics, it also had some strong advocates. Writing in the November-December 1938 issue of the *Coast Artillery Journal,* CPT Joseph J. Greene pointed out that a brigade would sustain a rate of fire of over 5,000 rounds per second for five seconds employing only rifles and caliber 30 machineguns. Obviously, with this volume of fire, even very low hit rates can be tolerated.

While some were considering volume of fire as an answer, others were striving for accuracy. Prior to World War II, individual tracer control was the primary method of adjusting fires for machineguns. Various kinds of sights were tried, but apparently little improvement resulted. An article in the March-April 1938 issue of the *Coast Artillery Journal* surveyed fire control development up to that date. The speed ring sight, though not known by that name, had made its appearance in various forms. So had crude versions of computing sights. The captain who authored the article concluded that computing sights held little promise, and that "center tracer control plus the simplest possible lead computer," was the most promising direction for development in machinegun air defense.

The onset of World War II led to a number of developments which proved our captain wrong. The speed ring sight was improved. The Navy developed the gyro-stabilized sight for shipboard use. Usable mechanical computing sights were developed. Better fire control directors were developed for use with larger caliber weapons. These types of weapons remained in use for some time. The Skysweeper, our last large gun, remained in the inventory until the late 1950's. The M42 Twin 40-mm system, with its mechanical computing sight, was with us through the 1960's. The large guns were replaced by missile systems; the small guns by the Vulcan. The point to be made is that each of the developments was undertaken to increase the accuracy of fire. Accuracy, of course, came at an increased cost, so fewer systems could be bought. However, it was assumed that fewer systems would be needed, as effectiveness presumably increased with accuracy. And, as the sophistication of weaponry increased, interest in the use of non-air defense weapons in an air defense role waned in this country.

More than a passing interest in high-volume, conventional antiaircraft artillery was generated in the Vietnam conflict due to enemy successes. As early as February 1967, *Aviation Week and Space Technology* reported that we had lost 1,044 fighter and attack aircraft in Southeast Asia. In the February 6 issue of the same periodical, it was estimated that the North Vietnamese had between 6,000 and 10,000 pieces of conventional antiaircraft artillery, and that they were stacked "bumper-to-bumper" in vital areas. Barrage techniques were also employed in the south where the caliber 30 machineguns were the principal air defense weapons. Rifles were also reportedly used effectively in air defense, employing "pattern of fire: barrage technique." As normally employed, this technique required a group of weapons to fire continually at a common and fixed area of space well ahead of the target but along the projected target path. If the area is properly chosen, and the fire is sufficiently dense, the target will fly into the pattern of fire. Interestingly enough, a pattern of fire technique is also accepted air defense doctrine for US rifle squads. FM 7-10, The Rifle Company, Platoons, and Squads, dictates the use of the pattern of fire technique against high-performance targets. However, whether squad or platoon leaders would actually use the technique and whether they could employ it effectively, is not known.

The Human Resources Research Organization (HUMRRO) initiated a program of research in forward area air defense in the early 1960's. Much of the work dealt with the ability of air defense crewmen on visually sighted weapons to detect, recognize, and estimate the range to target aircraft. The results of these efforts are covered in a series of technical reports. Another effort dealt with actual engagement procedures with small arms. A procedure for training men to engage an aerial target with an M14 rifle was devised, and 20 men, in the grade of E-4 and below, were trained with this technique. They competed against a group of 20 cadremen in the grade of E-4 and above from the US Army Infantry School Weapons Department in firing at a towed sleeve target. The cadremen did not receive the special training. The less experienced HUMRRO-trained team achieved more than three times as many hits. As a result, the training procedure was adopted and published by the Department of the Army as Training Circular (TC) 23-15. The HUMRRO work really only scratched the surface of this area, but was terminated as other work was given higher priority.

Guns, aircraft, and tactics have all changed considerably since Captain Greene wrote his article extolling the value of small arms in air defense in 1938. Soldiers of all branches can pump a lot of metal into the air with organic, non-air defense weapons. Properly placed, this small arms fire can be extremely effective against attacking aircraft that penetrate the more sophisticated defenses. However, effective techniques for engaging various kinds of aircraft, and the best means for training men to use them, can be further exploited.

Redeye MOS Study

Captain Richard T. Childress
4th Battalion, 61st Air Defense Artillery

The current system of managing Redeye personnel through the use of an additional skill identifier (R6) is inadequate in several respects. The most serious shortcoming is the lack of a replacement system for trained personnel during combat. Redeye deployment in the forward portions of the combat zone will predictably cause combat attrition rates of a magnitude at least equal to that of forward maneuver battalions. Under the present system, qualified replacements would not be forthcoming. Individual replacements from the authorized infantry, armor, and field artillery MOS structure could be readily trained on actual firing of the weapon; however, airspace management conflicts would multiply. This would result from a lack of training in air defense control measures and visual aircraft recognition. The resultant degradation of air defense capabilities would be unacceptable.

Captain Richard T. Childress is a Distinguished Military Graduate of the University of Cincinnati. He has attended several service schools and has served in numerous positions of leadership in the US, Europe, Korea, and Vietnam.

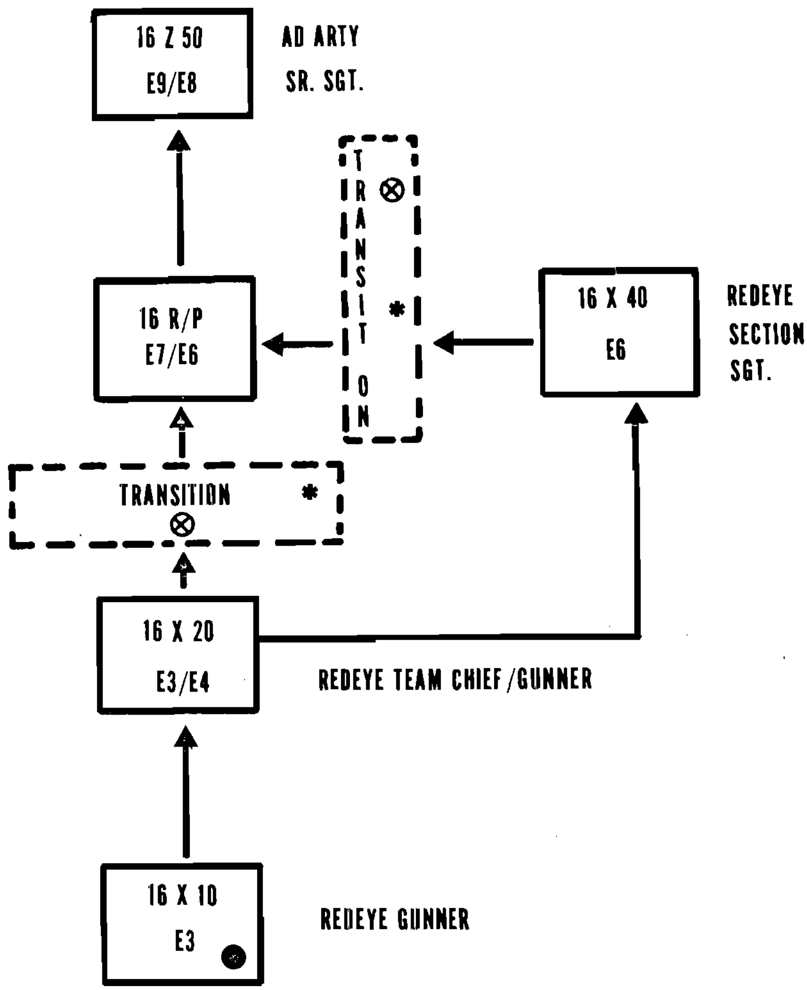
The current system also causes morale, retention, and recruiting problems. Redeye personnel currently hold all-arms combat MOS (armor, infantry, and field artillery) and are required to maintain basic MOS proficiency, remain competitive, and function as a full-time member of a Redeye section. The obvious disadvantage of attempting to remain competitive in an MOS in which they do not function daily adversely affects morale and lessens their competitive position for pro-pay. The rewards for volunteering or remaining in a Redeye position which also requires the dual MOS and Redeye qualification are not manifestly obvious to these personnel.

The requirement for a Redeye position was established under the criteria contained in AR 611-1, 22 March 1972. As a full-time duty, occupationally related to air defense artillery, it appears that Redeye positions should be converted to an ADA MOS. In the mechanized division, this conversion would affect 162 personnel. As presently organized, there is no rotation base for such personnel by requisition. The tedious "hard-massaging" of records is required to identify those personnel with the R6. Additionally, there are numerous Redeye-trained personnel who manage to either prevent the entry of R6 qualification in their records or have it removed because of the inequities addressed above.

The proposal addressed herein is to convert Redeye personnel to a 16-series ADA MOS, Redeye, with authorized grade to E-6, Redeye Section Sergeant. After reaching E-5 or E-6, dependent upon grade balance, these personnel could be programed into a transition training course at Fort Bliss, Texas, in an air defense MOS related to forward area weapons, 16P (Chaparral Crewman) or 16R (Vulcan Crewman). As a result of previous experience in Redeye, these personnel would already be qualified in forward area ADA tactics and employment. The transition course in Chaparral and Vulcan would be of short duration and would concentrate on these two weapon systems. A typical career pattern is shown in the following diagram.

Based upon lessons learned from the recent war in the Middle East, the criticality of effective forward area air defense is being recognized as

SAMPLE CAREER PROGRESSION – MOS 16X , REDEYE



* TRANSITION COULD BE PROGRAMMED AT EITHER POINT DEPENDING UPON STRENTH REQUIREMENTS IN THE FIELD.

● SCHOOL COURSE AVAILABLE (REDEYE)

⊗ SCHOOL COURSE AVAILABLE (CHAPARRAL/VULCAN)

a significant factor in the development of combat power. This effectiveness is directly related to competent, skilled, and motivated forward area air defense personnel. In response, weapons development projects are now underway or planned that will increase the complexity and variety of forward area ADA weapon systems and will require highly qualified personnel. The selection procedures now used are inadequate and tied almost solely to the maneuver battalion commander's priorities. In addition, personnel selected to be members of Redeye sections are frequently unqualified for that duty.

It is recommended that approval be given to this or a similar proposal to correct the problems addressed, and simultaneously provide a personnel management system for Redeye personnel that correlates with current requirements in the field.

Air Defense Briefs

Gun Low-Altitude Air Defense System (GLAADS)

The US Army Test and Evaluation Command has issued a planning directive to the US Army Defense Board for the testing of the GLAADS. It is expected that the following test program will evolve:

- Field testing in support of the contractor — Oct through Dec 74.
- Acceptance test for Armament Command — Dec 74.
- Field testing for Armament Command — Jan 75 through Mar 75.

The GLAADS program is designed to provide a test bed that will demonstrate the state-of-the-art capabilities of a forward area air defense gun system. The latest prediction techniques for engaging maneuvering targets will be employed as well as advanced sensor techniques.

The GLAADS system as presently configured consists of twin 25-mm, Philco-Ford Bushmaster-25, dual-feed weapons mounted in a turret on a mechanized infantry combat vehicle (MICV-65). The fire control system features integrated and stabilized optical, infrared, and laser sensors; a digital computer using advanced data processing techniques; and hydraulic drives for turret rotation and weapon elevation.

Air Defense Small Arms Sight

The British Army has for some years carried out training in all arms air defense. Courses are run at the Royal School of Artillery for instructors from all branches of the Army. Instruction, including firing practice, is carried out with unit weapons.

Research is now concentrating on producing a simple butterfly-type sight which can be clipped onto the general purpose machinegun (GPMG) or the light machinegun (LMG). The sight rings are being engraved on clear plastic rather than metal because this is considered more soldier-proof.

The British Infantry Trials and Development Unit has cooperated with the Royal School of Artillery in producing a number of trial air defense mountings for both weapons. A twin GPMG mounting called SCAT (scarcely costs a tenner) is already in use on British armored personnel carriers in Germany. Amongst others being tried are a simple canopy rail mounting for use on 4-ton cargo vehicles and a ring mounting that can be fixed on a vehicle cab or demounted and set up over a weapon pit (see photograph). Both the sights and mountings have been successfully tried out on the all arms air defense instructor courses.

Laser-Guided Sam

Under a 1968 agreement, Sweden and Switzerland, two countries well-known for their position of neutrality during past wars, combined their efforts to produce the first laser-guided surface-to-air missile, the RBS-70.

With a range of about 3 miles, the RBS-70 is expected to replace certain conventional antiaircraft guns. A laser beam seeks out the target and locks on it while a miniature computer emits steering commands (impulses) which direct the missile to home on the laser beam direct to the target.

The concept of the laser beam is not new. The US used "smart bombs" (laser-guided air-to-ground missiles) in the Vietnamese war. However, this is the first known missile designed for the primary purpose of surface-to-air employment. The fact that the North Vietnamese had little or no attacking air force may have limited the US use of the laser beam to an air-to-ground role.

The Bofors Arms Company of Stockholm is the prime contractor for the RBS-70 missile.

TACS/TADS Compatibility Test

Field experiences have proved that the command and control systems for air defense and air traffic control used by the various services are practically incompatible, limiting the exchange of information.

Consequently, the tactical air control system/tactical air defense system (TACS/TADS) program was initiated to develop and demonstrate the compatibility, interoperability, and operational effectiveness of the various systems for the secure exchange of digital data between military services and the National Security Agency on or near a real time basis.

The Chief of Naval Operations has been designated executive agent for the TACS/TADS program. The other service chiefs are responsible for providing assistance and resources as necessary. A Joint Interface Coordinating Committee (JICC) has been organized to design and coordinate the system. A Joint Interface Test Force (JITF) under the JICC will test and demonstrate the compatibility and interoperability of the interface. Operational effectiveness is to be demonstrated at a future time by the Commander in Chief, US Army Forces, Atlantic.

The US Army will use the AN/TSQ-73 command and control system. Modification to hardware and software will be required for compatibility with the system of other services. A detachment of 3 officers, 1 warrant officer, and 26 enlisted men from the US Army Air Defense Board is presently stationed at Fort MacArthur, California, to assist in the TACS/TADS Compatibility Test. Formal testing was initiated in January 1974.

SAM-D Flight Tests

Martin Marietta, principal subcontractor for the SAM-D missile, canister, and launcher, has initiated a new series of flight tests at its Orlando, Florida test range. The tests employ a prototype launcher mounted on the ground. The missile, launcher, and canister are all full-scale in size and tactically configured. A short-burn motor is used for the test. At present, a chemically treated pyroceram forward cover is used in this test; but in a second launch scheduled soon, syntatic foam glass microballoons in an epoxy base will be used. The two substances in the test will be evaluated for selection for tactical use. SAM-D, scheduled for operational use by the Army in the 1980's, is in the second year of engineering development.

Russia Developing Three New ICBMS

At least one of three new intercontinental ballistic missiles being developed in the USSR (the SS-18) is apparently designed to carry a multiple, independently targetable, reentry vehicle (MIRV) warhead. The new missiles include:

- SS-16. To replace the solid-propellent SS-13 which is considered to be a backup system to the SS-11, a 1-megaton warhead, solid-propellent missile.
- SS-17. To replace the SS-11. It has an improved guidance system and is designed to provide a first strike capability against Minuteman No. 3 ICBM silos.
- SS-18. To replace the SS-9 which is a liquid fuel missile with a 20-megaton warhead.

Reportedly, all three missiles are at the testing stage. Their goals are believed to be to provide better prelaunch survivability, accuracy, and reentry systems. The Soviet hard target capabilities would be greatly improved by deployment of 300 MIRV SS-9 follow-on ICBM's (SS-18) as allowed under the interim strategic arms limitation agreement. Tests indicate that this system can carry six MIRV-type warheads.

The Department of Defense estimates that the SS-16 missile will be more accurate than the SS-13 and may already be ready for deployment. Tests of the SS-17 were recently conducted in the Pacific. Deployment of the new SS-17 is considered imminent. Its multiple reentry warhead package, with three warheads, is much more accurate than the SS-11. The People's Republic of China is developing an ICBM, with three warheads and a 6,000-mile range, that is expected to be operational by 1976.

Dutch Extend Radar Coverage

The Royal Netherlands Air Force (RNAF) is extending the radar coverage of its Nieuw Milligan Air Defense Control Center by using an advanced computer program that recognizes return patterns from multiple radars and also detects aircraft and initiates tracking automatically. The new computer program, developed by Hughes Aircraft Company's ground systems group, will upgrade the original one completed in 1968 to provide greater automatic tracking accuracy. Aircraft tracks initiated automatically by the new computer program will be used by the original computer program to provide automated air defense operations.

The Nieuw Milligan Control Center now operates on information from one three-dimensional radar. When the improvement project is completed, information from a second 3-D radar will be used to present simultaneously a composite real-time picture based on the returns of one or both radars. Also, the improvement will eliminate need for operations personnel who, under manual operation, would be based on a remote radar site 100 kilometers away. Programs will accept information simultaneously from as many as 15 remotely located radars. The new radar, to be manufactured in France, will be identical to the original Nieuw Milligan radar purchased by the RNAF for the Nato Air Defense Ground Environment (NADGE) program.

Small Arms In AD Role

A working conference to obtain a coordinated effort between the combat arms on small arms for air defense was hosted by Fort Bliss last March. The one-day conference began with a briefing on methods used to emphasize doctrinal principles and proposed training programs and devices essential to small arms for air defense (SAFAD) unit proficiency. Other subjects addressed were: threat (attack tactics and ordnances), firing techniques, integration of AD and non-AD for convoys and small units, and convoy tactics when attacked. The end result of the conference will be development of a training circular on small arms for air defense.

HUMRRO Report

The Army's principal training research and development agency, The Human Resources Research Organization (HUMRRO), has been serving the Army since its inception in 1951. HUMRRO scientists first came to Fort Bliss in 1954, making this year the 20th anniversary of their arrival. HUMRRO personnel have worked on a variety of air defense problems, as well as other problems, in the areas of training, motivation, and leadership.

Two new efforts were initiated in this fiscal year:

- In Work Unit MBO workshops in management by objectives, participative problem solving, and behavior management have been developed and are ready for field testing. The workshops are designed to help Army leaders become better managers, especially in dealing with personnel.
- A new effort was initiated as a part of an already existing work unit called ATC-PERFORM. This work unit was initiated by CONARC in Fiscal Year 1973 in an effort to implement performance-oriented instruction and performance-type testing. "Hands on" training and testing in a job context are emphasized, while the lecture format for training and purely paper and pencil type testing are discouraged. HUMRRO personnel assigned to this work unit are also continuing work with The ADA Training Brigade on MOS training programs for 16B, 16C, 16D, 16E, 16P, and 16R.

Three new technical reports on research conducted at Fort Bliss have been published. These are: "A Model of the Functions of a Master Instructor," by William H. Melching and Paul G. Whitmore; "Use of the Job Model Concept to Guide Job Description Procedures for Army Officers," by Paul G. Whitmore; and "Research on Stadimetric Ranging: Visually Matching the Apparent Size of Objects," by Robert D. Baldwin. Copies of these and other HUMRRO publications from a bibliography containing approximately 2,000 entries are available on request.

Write to: Chief, US Army Air Defense Human Research Unit, Fort Bliss, Texas 79916.

Improved 1180A Nike Hercules Officers Course

To enhance new ADA officers' abilities to perform their duties in their initial assignments, an improved 1180A, Nike Hercules Officers Course, has been developed. The 4-week course has been extended 1 week and 1 day and contains additional BCO training, electronic warfare material, T1-simulator programing, record analysis, and a newly innovated "SASCOM" (Special Ammunition Support Command) track. The BCO training includes checks and adjustments and a review of tactical standing operating procedures. The checks and adjustments provide the officer an understanding of conditions with which his subordinates have to deal.

The SASCOM track was developed to prepare new ADA officers for assignment to SASCOM in Europe. Previously, the 1180A course concentrated on training the new officer to be a platoon leader in a Nike Hercules battery. Although still placing emphasis on BCO training, the course now provides training for the officer who is scheduled for assignment to a custodial detachment/team. The SASCOM track consists of specific instruction in special weapons warhead operations, emergency destruction procedures, custodial team activities, and security requirements, and concludes with a seminar conducted by personnel having SASCOM experience.

FAAR Improvements

Sanders Associates has been granted a contract to effect certain improvements in the Forward Area Alerting Radar (FAAR) to meet foreign market requirements.

Among the FAAR/TADDS technological advancements are a processor for a new type data link, an automatic track capability, and a packaging of the radar components for M113 vehicle application. Also included are two methods of netting the radiofrequency data link (RFDL) throughout division and corps areas so that all weapons can receive from all radars, or selective weapons from selective radars, and the ability to provide digital data to brigade, division, and corps operations centers. Proposed changes to the radar/TADDS include a method of converting digital data to universal transverse mercator (UTM) coordinates. The UTM coordinates of the FAAR and TADDS would then be inserted into the equipment and RFDL message. This would allow rapid adjustment of the message and provide for continuous data if the weapon were on the move. The grid location of the weapons would also be in the center of the TADDS, thus providing maximum alerting range in all directions from the weapons. Several changes to the FAAR relating to additional range, antenna rotation, pulse repetition frequency, accuracy, and frequency changes are classified. The foregoing changes and technological advancements can be incorporated into American FAAR systems but there are no publicized plans to do so.

Military Personnel Notes

Officer Professional Development

The new DA Pamphlet 600-3, "Officer Professional Development and Utilization," should now be in distribution to the field. The pamphlet contains detailed guidance for professional development of all commissioned officers affected by the new officer personnel management system. For information and career reference, personal copies will be provided through unit distribution for every commissioned officer on active duty.

Special Officer Career Programs

DA has announced the termination of MAJ (P) and LTC applications and nominations to Officer Special Career Programs in connection with the transition to the officer personnel management system. Applications received after 31 October 1973 are being used by the career branches to evaluate the alternate specialties of these officers. Applicants were notified during March and April 1974 of their tentative primary and alternate specialty designations, and will be notified in September 1974 of their designated alternate specialty. Applications for the Special Career Programs for captains and majors will still be processed according to AR's 614-104 and 614-131 through 614-142.

Warrant Officer Senior Course

One hundred warrant officers were selected to attend the first class of the newly established Warrant Officer Senior Course (WOSC) beginning 13 January 1974 at Fort Rucker, Alabama. The WOSC is the highest level of professional military education available to warrant officers. Selection to attend is a mark of distinction for the individual and is the means by which the senior warrant officer will be prepared to make maximum contribution to the service. Following is a profile of the selectees:

Selection Ratio: 1:6 (100 selected vs 592 eligible).

Grade Distribution: W4-26, W3-72, W2(P)-2.

Component: RA-51, Other-49.

Average Age: W4-44, W3-39, W2(P)-37, A11-40.

Average WO Service: W4-14, W3-10, W2(P)-7, A11-11.

Average Armed Forces Service: W4-20, W3-18, W2(P)-16, A11-18.

MOS Mix: Of the 99 WO MOS, 31 are represented in this group of selectees.

Civil Education Level: Non-HS Grad-5, High School Grad-61, Two-Year College Equiv-6, Associate Degree-13, Baccalaureate Degree-15.

Later this year, the WOSC Selection Board will convene to select the warrant officers who will attend the two classes that will be conducted in FY-75.

New Chief For EPD ADA Section

MAJ Richard F. McCrary has assumed the position of Chief, Air Defense Artillery Section, Enlisted Personnel Directorate, MILPERCEN. For a short time the Section was headed by SFC John Uffendell who will now head a team that will visit all ARADCOM AD units scheduled to be inactivated. The team function is to provide more personalized reassignments for ADA enlisted men involved.

ADA Turnaround Time
(Average time between oversea tours for EM)

Due to changes in oversea selection criteria, the table entitled, "Air Defense Artillery Turnaround Time," appearing in the February 1974 issue of *Air Defense Trends* (ADT) is being changed significantly by MILPERCEN. One of the reasons for the change is the recently announced ARADCOM drawdown. New average turnaround times are being computed and will be published in the September 1974 issue of ADT.

EPMS

Working toward more equitable career management, the Enlisted Personnel Management System (EPMS) Task Force is beginning to have a direct effect on enlisted career fields. Its purpose is to examine and, if necessary, realine the different career fields to provide equal opportunity for advancement and career development in all MOS, as well as prepare senior NCO's for broader supervisory responsibilities. Career fields currently under consideration include Field Artillery Cannon, Field Artillery Missile, Air Defense Artillery, and the Administrative career fields. The task force estimates it will be about 18 months before all of the 35 career fields have been analyzed.

MOS Testing

Soldiers in ETS processing during their MOS test period are not exempt from testing. Reports indicate that some soldiers whose ETS is imminent are being locally excluded from MOS testing. Commanders are reminded that:

Many soldiers who do separate eventually return to active duty. Others reverse their nonreenlistment intent just prior to separation. Under these circumstances, the evaluation scores are essential for management purposes.

Soldiers separated from active duty may incur a Reserve component (ARNG or USAR) obligation; the scoring information in this case can assist in assigning and utilizing the individual.

All soldiers meeting the requirements of paragraph 5-4, AR 600-200, who are not specifically exempted from testing in accordance with paragraph 5-5, AR 600-200, will be evaluated during the appropriate test period for their MOS.

Discharge Forms Revised

Discharge forms are being revised to help former soldiers with civilian employment placement and job counseling. As part of the ongoing program to enhance the civilian employment of veterans, discharge forms will now contain primary and secondary military occupational specialties and related civilian occupations. Space will also be provided for information pertaining to successful completion of formal in-service training courses. Army Regulation 635-5 is currently being changed to reflect these procedures. The new DD Form 214 became effective last fall.

Military Linguists

Military linguists who have not had their language proficiency evaluated within the last 2 years are reminded that this is required by AR 611-6. Linguists must be evaluated biannually either by a written or tape-recorded test to retain their proficiency level. The testing will be scheduled as near as possible to the date of the initial or most recent evaluation. Language proficiency questionnaires are to be prepared and submitted following the testing, or when an individual attends the Defense Language Institute, or at any time he attains language proficiency.

REP 63 Personnel

Four-month minimum active duty training (ADT) is required for Reserve Enlisted Program (REP) 63 personnel. Recent US Army Reserve Component Personnel and Admin Center message (AGUZ-RCP-PR, 061811Z Nov 73) points out that all ARNG and USAR REP 63 troops are ordered to ADT for periods of time required to qualify in the selected MOS, or four consecutive calendar months, whichever is longer. From now on, all REP 63 orders issued under TC 165 must carry the statement, "Four consecutive calendar months or completion of MOS training, whichever is longer," under the period of ADT lead line.

Form 20 Ratings Dropped

Conduct and efficiency ratings have been deleted from enlisted personnel's Form 20's as a result of frequent disparities between ratings on Form 20's and the enlisted evaluation reports (EER's). Conduct and efficiency ratings have been used primarily to determine eligibility for the Good Conduct Medal and different types of discharges. Enlisted personnel will now be rated only by time periods on the EER, instead of both conduct and efficiency, and EER assessments. Good Conduct Medals will still be awarded as directed, based on an individual's performance, but without reference to the Form 20 ratings.

Oversea Lead Time Extended

Good news for oversea-bound enlisted personnel. Effective February 1974, MILPERCEN phased in longer lead times for oversea EM/EW requisitions, meaning permanent party troops will get their oversea assignment orders much sooner. DA message DAPC-EPP-A, 121530 November 1973, extends current 5-month lead time by 4 months and sets the following schedule for requisitions for oversea commands and CONUS-based functional commands with oversea requirements:

REQUISITIONS DUE MILPERCEN	FOR REQUISITION MONTH	LEAD TIME
2 Feb 74	Jul, Aug 74	5, 6 months
2 Mar 74	Sep, Oct 74	6, 7 months
2 Apr 74	Nov, Dec 74	7, 8 months
2 May 74	Jan, Feb 75	8, 9 months
2 Jun 74 and after		9 months

The message also contains choice information on use of line numbers and instructions for requisitioning enlisted Army linguists and Army Security Agency personnel.

Be A Club Manager

Enlisted personnel who have experience and an interest in the club management field are being encouraged to submit applications for warrant officer appointments in MOS 021A, Club Management. See AR 135-100 for details.

Review of EM/EW Files

All enlisted men and women are reminded of the importance of keeping their official military personnel files up to date. Requests to review the files can be made either by letter or telephone to the review unit. Written requests should be submitted to:

CDR, MILPERCEN
ATTN: DAPC-PAR-S
200 Stovall Street
Alexandria, VA 22332

Persons wishing to arrange appointments by telephone should call, Autovon 221-7792 or 221-7730.

At least a week's notice should be given so that the records can be forwarded from Fort Benjamin Harrison. Once the records arrive at MILPERCEN's EPD, individuals will be contacted to confirm the time and date that they wish to review the records. EPD representatives will be present to assist in the review of OMPF's.

Postscripts

Callaway Comments On Army's Challenges.

The Secretary of the Army, Howard H. Callaway, has firmly laid down his plans for overseeing and directing the Army during his tenure.

Speaking on the subject of the greatest challenges in the Army today, he said during the 1973 United Way Kickoff Luncheon, "To solve the Army's problems of credibility, there is only one course of action, and that is for the Army to continue to tell the truth and the whole truth — to tell it like it is, to let the bad news out as quickly as the good. I don't mean that every time we have a little problem or something that needs correction we should go running to the Congress or the press to air our dirty linen."

"I simply mean that when we're asked a question, or asked about a situation, or when we're providing a report, we must and we will tell the whole story. If the story is a bad one, if we've done something we're not proud of, we'll take the lumps for the bad news, and we'll correct whatever's out of line to the best of our ability. But we won't add the problem of holding something back, of keeping the bad news in the back room. We're going to level with the people and their representatives, and we're going to do it in a timely fashion. As General Abrams wisely put it the other day, 'In all my Army experience, I've never known bad news to improve with age.'

"That doesn't mean we expect to be loved for our candor . . . . But by being completely open and honest, we expect that we'll recapture some of the credibility we seem to have lost. And if we regain that credibility, we'll be able to do a better job in maintaining the Army and in performing our vital mission."

MINI-RPV Organization Established

The Air Force is establishing a separate organization under its Deputy for Strike Reconnaissance and Electronic Warfare at Wright-Patterson AFB. The new organization will manage development of mini-remotely piloted vehicles (RPV's).

A rise is anticipated in the number of programs in small RPV's that the Air Force has been tasked to conduct for Defense Department's Advanced Research Projects Agency, the Navy and Marine Corps, and the USAF itself.

The idea of using small, inexpensive RPV's for diverse military missions, not simply for short-range battlefield reconnaissance and target designation, is getting strong support from all services. Interest arose independent of current conflicts throughout the world, but is expected to get a sharp impetus from events in the Middle East. Department of Defense, Air Force, and Army planners are taking a hard look at small, highly survivable armed RPV's. These RPV's could locate hostile ground targets, including radar-directed weapons and mortars, and could be driven remotely from the ground or air into a target. Every effort is being made to keep the cost of the RPV, with its avionics package and warhead, below $20,000.

The new group, under the Directorate of Reconnaissance/Strike Projects, will soon issue a contract for development of an air or ground rocket-launched, long-range, mini-RPV. The contractor selected to build the expendable RPV is currently being evaluated by the Air Force.

Flying Laser Lab

A modified Boeing NKC-135 aircraft has been converted to an airborne laser laboratory by the Air Force. Laboratory experiments will be conducted in high-energy laser propagation and air-to-air weapon effects. The laser pointing and tracking system optics are on top of the aircraft just behind the cockpit. The laser laboratory also has a new radar that will be used for navigation purposes and will locate an airborne target to aid acquisition by the optical tracking system. High-energy laser experiments will probably use drone targets.

A new facility, to be completed in mid-1974 near the Albuquerque International Airport, will be used to test and calibrate lasers in the NKC-135 prior to flight tests. The facility is near an 8,000-foot wide canyon. The aircraft's optical pointing/tracking system and laser can be aimed at instrumented target areas in the canyon. The canyon's high walls, plus dirt embankments and retaining fence, will assure safety of operation and deny access by unauthorized personnel.

A gas-dynamic-type laser, presently being designed by United Aircraft Corporation, is expected to provide continuous-wave (CW) outputs for the flying laboratory in the tens of kilowatt level. So far this type of laser has produced the highest CW power output.

Weapon System Improvements

Improvements in several important US weapons are being strongly advocated by Department of Defense officials as a necessity to keep pace with fast-moving Soviet programs. Threatened with being bypassed by the USSR in advanced weapon development, US leaders have indicated where they think some of our efforts at weapon advancement should be directed.

They propose that our ICBM's have greater range and accuracy and that they have the added capability to knock out hardsite targets, including ballistic missile silos. Our existing Minuteman ICBM is considered too limited, being designed mainly to destroy industrial complexes. It has been suggested that a higher yield warhead be developed for the Minuteman to replace the present warhead, and that all Minuteman missiles be provided with multiple independently targetable reentry vehicles.

Other missiles coming under consideration are the Air Force MX advanced ballistic missile and the Navy Trident. Accelerated development of these missiles could improve the US defense posture. Going a step further, some consideration has been given to the idea of an airborne configuration of the MX (or providing some other form of mobility), thus reducing vulnerability to an enemy first strike.

Concern has been expressed that development of the B-1 advanced manned strategic bomber be maintained at top priority. With our B-52's needing refurbishing to keep them operational (ADT Jan 74) the B-1 project is understandably considered urgent.

Finally, revival and modernization of the almost defunct US Air Force Aerospace Defense Command (USAF ADC) are being sought as one means of returning to a more balanced force structure. Essentially, this means replacing the F-106 interceptors with F-15 air superiority fighters. But it may also mean incorporating airborne warning and control system (AWACS) into ACD which would provide a great advancement in early warning.

It is clear that Russia is accelerating development of strategic weapons and will no doubt continue with a view to world supremacy in this area of armament. The specter of their probable success makes the concern of defense planners understandable and welcome.

Near-Simultaneous Phoenix Launch

The Navy recently conducted a near-simultaneous launch of six Phoenix air-to-air missiles which successfully intercepted four of six target drones at a range in excess of 50 miles. The missiles were launched from a Grumman F-14A air-superiority fighter off Point Mugu, California.

Two Lockheed QT-33 targets were destroyed by the unarmed missiles and a supersonic Ryan BQM-34E and a Teledyne Ryan subsonic BQM-34 were damaged by the Hughes Aircraft missiles.

About one-third of the way through its flight a fifth missile apparently experienced a hardware failure. The sixth missile was unable to intercept a BQM-34 drone, augmented to appear like a real target, due to an insufficient radar signature for tracking at that range.

This was the Navy's first test with a full complement of six Phoenix air-to-air missiles against six separate targets. The Hughes AWG-9 weapons control system in the aircraft tracked the six targets simultaneously and guided the missiles to their targets. The six missiles were launched within 37 seconds with two missiles fired in a 3½-second period.

Phoenix Air-To-Air System Tested In Shipboard Role.

An AWG-9 Phoenix weapon control system has been tested aboard a ship and has successfully performed the shipboard fire control mission. The Phoenix is used normally for launching missiles from the Navy's F-14 Tomcat fighter. The AWG-9, installed aboard the U.S.N.S. Wheeling, demonstrated it can detect and track multiple targets at both high and low altitudes from the deck of a ship, as it does in its air-to-air role. In the multiple target tests five aircraft were flown in the test area and were successfully tracked. No existing shipboard fire control system can acquire and track multiple targets simultaneously; but the AWG-9 has the capability to track more than 20 targets at the same time. Also, it can launch up to six missiles and guide them simultaneously.

For the sea trials, conducted under the auspices of Naval Air Development Center, the AWG-9 was housed in a portable shelter. The shelter provides for operating personnel and a near-autonomous capability. The Wheeling supplied primary power, cooling water, and heading-attitude reference.

The tests demonstrated the possibility of using the proven tracking capabilities and high firepower, lightweight, and low-volume aspects of the AWG-9 system in a modular surface-to-air shipboard defense role.

Mortar Locating Radar

A new radar system that can spot enemy mortar shells in flight and track them back to their firing point is under development by Hughes Aircraft Company. Five engineering development models of a mortar locating radar are being built under an $8.5-million contract awarded recently by the US Army Electronics Command, Fort Monmouth, NJ. The new system will meet a critical Army requirement for automatic first-round location of hostile mortar launchers, historically difficult to counter because of their easy transportability.

Development of a mortar-locating system is complicated by the high level of radar interference in combat caused by adverse weather, ground clutter, birds and insects that show up on radar returns, enemy jamming, and high-density enemy volley fire. Hughes' solution to the problem is an automatic radar that includes an electronic-scanning antenna, a computer, a sophisticated signal processor, and a rotating cylindrical map board.

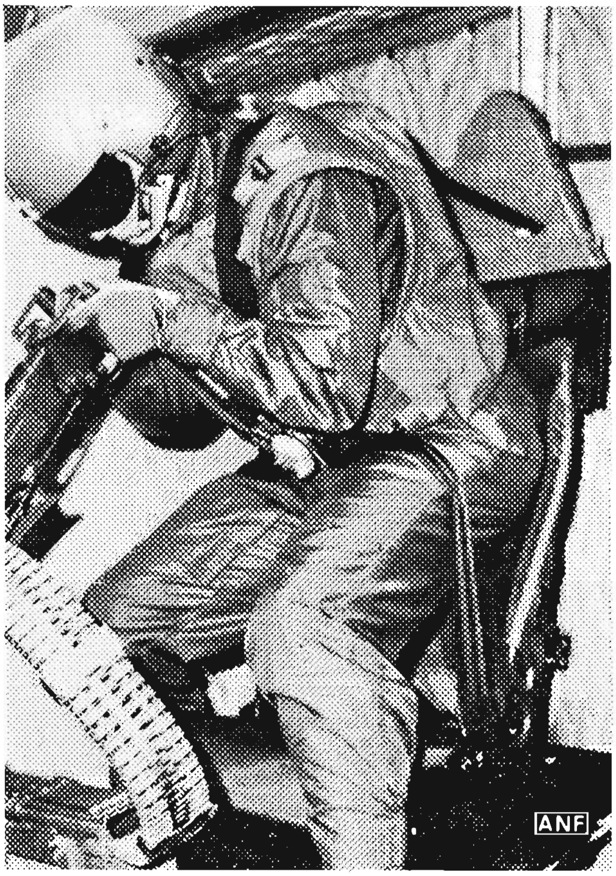
Known officially as the AN/TPQ-36, the mortar-locating radar will be lightweight and can be deployed quickly. It consists of two units: an equipment shelter, traveling on a Gama-Goat articulated vehicle, and an antenna assembly pallet carried on an M116 trailer. Both units can be airlifted by helicopter.

A high degree of automation is built into the system to allow a minimum number of personnel to handle high-density fire and to provide easy maintainability through computer controlled self-diagnostics and self-testing. In a combat situation the antenna's electronic-scanning search beam would sweep the horizon many times a second, forming a sensitive electronic barrier over any 90° sector of the radar's 360° coverage. Mortar projectiles fired in this area are detected as they pass through the barrier. When a signal is detected that looks like a projectile, the radar immediately directs beams at that location for verification. If a valid target is determined, beams are programed to track the shell, allowing the computer to calculate automatically the point of origin. Electronic scanning permits the radar beam to be placed anywhere in its field of view almost instantaneously. Thus the system can continue on a time-sharing basis to search the horizon at the same time it is tracking targets already detected. Sophisticated signal processing is employed to automatically filter out targets of no interest.

Portable Bridge Improved

A new method of transporting and erecting the ribbon bridge is currently being tested by the Army. The new system employs a hydraulic boom for launching and retrieving the bridge boat, which is carried on a modified M821 bridge transporter 5-ton truck. Under the old system two standard 2½-ton trucks were used to transport the two sections of the bridge. A 20-ton crane was necessary for the erection.

Improved Door Gunner's Seat



A new seat designed to protect helicopter gunners more effectively from injury during a crash is currently undergoing testing by the Army. The new seat is designed to withstand four times the impact force as the old seat design, providing protection from the effects of high, forward crashes which normally cause severe injuries to crewmen seated in the side-facing seats. The simple, low-cost, lightweight seat has suspension cables designed to absorb impact shock, a swivel seat that automatically moves to a forward position on impact, and an armored seat pan to protect the gunner from hostile fire.

Maxidecoy

The Air Force is reported to be testing a powered version of Celesco Industries' Maxidecoy at Eglin AFB. The 600-pound decoy, released from a strike aircraft, simulates manned aircraft to confuse enemy defenses.

Remotely Piloted Vehicles

The Navy recently announced a program to test various types of remotely piloted vehicles (RPV's) for antisubmarine and antiair warfare, weapons delivery, mine laying, reconnaissance, and surveillance missions. A big hurdle to be accomplished is vehicle recovery at sea. The ultimate goal is to give the Navy a RPV capability in 5 years.

Hologram Will Project Wide-Angle Image

A technique to provide aircraft pilots with information from a small cathode-ray tube (CRT) projected as a virtual image directly in front of him is currently under development at Hughes Aircraft Company. The technique combines a hologram lens with ordinary optical elements in a helmet-mounted display to project light from the CRT onto the helmet visor, from which it is reflected back to the eye. This enables the pilot to see a high quality virtual image of the CRT display appearing at infinity in front of him without interfering with normal vision.

The holographic visor helmet mounted display is a basic part of a new imaging method being studied. This method, called a visually coupled system, is a means of using the position of a pilot's flight helmet to control the direction in which a system on the aircraft — such as a weapon or sensor — is pointing.

Key element in the Hughes technique is the wide field-of-view holographic lens designed to provide a ready means for magnification and collimation of a projected CRT image within the confines of a standard helmet. This scheme is intended to afford excellent visibility and perform the required optical functions without incurring the unbalanced weight and obstructed view normally associated with conventional optical approaches.

The holographic lens is coupled to the CRT through a conventional optical relay system, thereby making it possible to install the CRT in a location on the helmet where it will result in a preferred weight distribution.

Nonholographic versions of helmet-mounted displays are a proven concept. However, they have many drawbacks — particularly in the air-combat maneuvering environment of fighter pilots — including obscuring of pilots' vision, excessive weight, and complexity and cost of optics. The use of holographic optics is intended to overcome these drawbacks.

Several studies of visually coupled systems incorporating holographic optics have been completed and work is currently proceeding on an engineering prototype of the helmet-mounted display. A large portion of the work undertaken was supported by the US Air Force's Aerospace Medical Research Laboratories, Wright Patterson Air Force Base.

Mobile Firepower

Since the days of catapults on wheels the field artillery has been mobile, but never this mobile. A CH-54B Skycrane helicopter of Fort Sill's 291st Aviation Company lifts and transports six 105-mm howitzers, the firepower of an entire battery. CW03 Marvin Nester, of Lakeland, Florida, designed the special rigging for the 19,900 pounds of cargo.

New Amphibian

A new high-mobility, high-speed reconnaissance vehicle, developed by Lockheed Missiles and Space Company for the Army, has entered an extensive competitive test and evaluation program at Aberdeen Proving Ground in Maryland. Called the Armored Reconnaissance Scout Vehicle (Scout), the vehicle is capable of speeds of 65 miles per hour and of swimming through water. The Scout is armed with a 20-mm M139 cannon and a M60D machinegun that can be fired independently.

Chinooks Set Record

"Operation Long Haul" ended recently as four CH-47 Chinook helicopters of the 159th Aviation Battalion, 101st Airborne Division (Airmobile), completed a 3,600-mile round trip to Puerto Rico. The trip from Florida's Homestead Air Force Base to the Isle Grande Army Airfield in Puerto Rico and return marked the first time an Army rotary-winged aircraft had made a nonstop trip over that length of water.

Space Shuttle Developments

• National Aeronautics and Space Administration officials are exploring a weight reduction program for the space shuttle system. A bipropellant reaction control system would save about 1,000 lbs of weight worth an estimated $32,000 a pound. Drawback of the bipropellant system is the complications it could cause in efforts to adapt it to the shuttle program. Another weight saver is the possibility of using titanium reinforced with boron epoxy, which would be economical in select areas.

• A plan to construct two space shuttle orbiter facilities at Kennedy Space Center has been abandoned in favor of a single facility. The facility's mission will be to handle shuttle maintenance and post-flight repair. The space agency has predicted that combining work in one facility will effect a saving of over $5 million in construction and operating costs.

• North American Aerospace Group of Rockwell International, prime shuttle system contractor for the space shuttle orbiter vehicle, has picked four main subcontractors. The National Aeronautics and Space Administration (NASA) has approved the selections. Negotiation of definitive contracts has begun. Companies selected to build parts of the orbiter are:

General Dynamics Corporation's Convair Aerospace Division — will build the midfuselage, the largest structural portion of the orbiter ($40 million).

Grumman Aerospace Corporation — will build orbiter double-delta main wing. This wing is expected to be a serious technical challenge ($40 million).

Fairchild Industries, Incorporated — Republic Divison — will build the vertical fin, a large structural element; it is not as much of a technical challenge as the main wing since it will not be subjected to such a severe thermal environment ($13 million).

McDonnell Douglas Corporation's Astronautics Co., East — will build the orbital maneuvering system (OMS). This contract is the largest due to the advanced technology required in the system ($50 million).

North American is retaining responsibility for the nose, cabin, and forward fuselage of the orbiter and the aft fuselage. The space shuttle main engine, under development by Rockwell's Rocketdyne Division, will be mounted in the aft fuselage.

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