Assistant Secretary of the Army (R&D) Edward A. Miller and Army Chief of Staff for Research, Development, and Acquisition LTG Howard H. Cooksey used an innovative approach in their FY 1978 budget proposal to the Committee on Armed Services, U.S. House of Representatives. They preceded their request with a presentation on Soviet philosophy, tactical concepts, characteristics and training of the Russian soldier, and the possibility of an intensive all-out surprise attack to gain victory in a short war, as follows:

Edward A. Miller

...Every American spends about ten dollars a year on Army R&D, and will be paying a considerable amount more to procure the weapons now under development. It is entirely appropriate, therefore, that Army R&D effort should be subjected to close scrutiny and detailed questioning. The need for these programs, as well as our management of them, should be subject to periodic and intensive review.

There are, and will continue to be for the foreseeable future, two super-powers on this planet. Either can, and has in the past, achieved victories and sustained setbacks in various proxy confrontations around the globe, without radically altering the basic power equations that have existed for several decades.

These equations will be upset, however, and changed irreversibly, by a confrontation—even a conventional one—between NATO and the Warsaw Pact in Europe. The forfeiture of a single inch of West European soil would instantly signal the acceptance by the United States of second-class power status, with the implications that acceptance would entail for this nation and the rest of the world.

It is not our function to predict whether such a confrontation is imminent or even likely, but it is our responsibility to assure a favorable outcome should one occur. Today we propose to inform the committee how the systems we are developing will help us do so.

An Oriental philosopher wrote over 2,500 years ago: “If you know the enemy and know yourself, you need not fear the result of a hundred battles.” We propose, therefore, to provide the committee with some observations on the strengths and weaknesses of our adversary—both cerebral and mechanical. Some aspects of Soviet thinking and force structure are encouraging; others are sources of deep concern.

There are two cliches of the Soviet psyche that must be understood if we are to deal with them effectively. The first, and most important on a strategic or theater level, is the senior leadership; the second is the mind of the individual soldier and junior officer.

Many of the top level officers in the Soviet Armed Forces are veterans of “The Great Patriotic War,” in which they saw almost constant combat of the most sustained and violent variety. However, with the exception of a few minor border clashes with the Chinese and the crushing of Hungarian, Polish, and East German insurrections, they have had no combat experience in three decades.

Many Soviet officers have expressed envy at the amount of combat experience the conflicts in Korea, the Dominican Republic and Vietnam have provided the American Army. An entire generation of career Soviet officers and NCOs is now retiring after 30 years of training, with only a few citations for “heroism” in disposing of old ordnance and minefields left behind by the Germans in World War II.

The Soviets learn their lessons well, but in many cases too well, and they may find themselves doomed to repeat history by paying too much attention to it. Virtually every major characteristic of the Soviet ground force structure and every attendant tactic is a result of a lesson learned (usually at great cost) during World War II. While (they are) diligent students of other nations’ conflicts, and avid military scientists, the Soviets almost inevitably revert to the lessons of that war when the big decisions in armament and tactics are made.

We do not, of course, bank too heavily on the Soviets adhering to rigid behavior patterns; that can leave us vulnerable to surprise. However, we naturally design many of our weapons with an eye toward countering “heavy” aspects of their force structure, and the tactics that the structure seem to necessitate.

THE LIKELIHOOD OF SURPRISE, for example, looms larger and larger when European war scenarios are discussed. The opinion of the Western intelligence community has lately been shifting incrementally toward the conclusion that there may very well be little warning time before a Warsaw Pact attack on Western Europe.

Fact strength and readiness in the border areas is such that it would be relatively easy to “roll off” a large scale “training” maneuver and head for the Rhine. Warning time for the West, if any, might well be measured in hours rather than days.

The Danes, several weeks ago, reported a Warsaw Pact exercise which illustrates the menace of the “roll off” option of attack on the west. Flights of up to 40 Pact bombers routinely streak toward Southern Denmark and veer off abruptly just before reaching the border. In case of an actual attack, they could merely continue on their course and be striking targets within minutes, giving the defenders virtually no time to react.

REQUIREMENT: WEAPONS MUST BE ABLE TO REACT RAPIDLY. We shall discuss our Patriot missile system later, but the situation described is precisely the threat it is designed to handle i.e., large numbers of ECM (electronic countermeasure) protected high-performance aircraft striking with little or no warning. Hawk or Nike Hercules would take a toll of the attackers before becoming saturated; Patriot might well clear the sky of all of them.

Soviet attitudes toward the employment of surprise are somewhat contradictory, and its value in warfare has been a subject of heated debate for decades. Employing the somewhat labyrinthine logic characteristic of them, they denied the critical importance of surprise because it was they who had been surprised by the Germans in June of 1941.

A decade after the war, however, a debate suddenly erupted in the military journals, and surprise suddenly was elevated in importance. Discussion of it presents something of a problem for the Soviets, because surprise implies aggression. Since the Soviet posture is that of a peaceful defense force standing between “militarist” NATO and the Russian motherland, it becomes difficult to discuss the desirability of blitzkrieg assaults in the open press without running into credibility problems. They do slip occasionally, however.

DEMONSTRATED ABILITY FOR SURPRISE ASSAULT. In 1956, Marshall of Tank Troops Rotmistrov, after reiterating the purely defensive mission of his troops, did mention the possibility of administering “heroes” to the enemy. More importantly, the Soviets have demonstrated, on more than one occasion, their capacity for large-scale, tactically sophisticated surprise combined arms assaults—in Hungary (1956) and Czechoslovakia (1968).

The latter invasion was particularly disconcerting to NATO because of the rapidity and security which accompanied it. Although the Soviets had been preparing for several months, it was not until after T-62s were rolling through Prague that we knew the dimensions of the intervention.

If further evidence of the feasibility of mass surprise assault is needed, one need only look to the Yom Kippur War of 1973 where an Arab army, maneuvering along one of the tensest and most volatile borders in the world, was able to achieve total surprise over a significantly more sophisticated foe with a renowned intelligence gathering capacity. The concept of the plan may well have originated in Moscow.

An attack on Western Europe may not be a surprise. A classic World War I type mobilization may well take place. We may have several days, or even months, to prepare ourselves for attack. However, if we do not take into account the possibility of a precipitate, powerful, combined arms blitzkrieg against Western Europe, we risk losing everything. Reacting to such an attack requires weapons with distinct characteristics.

REQUIREMENT: FIGHT NIGHT OR DAY IN WEATHER FAIR OR FOUL. The possibility that a surprise attack would occur under cover of darkness, adverse weather, or both, appears strong. Over 40 percent of Warsaw Pact exercises are conducted at night, and, as the Ardennes offensive of World War II proved, bad weather can cloak the movement of surprisingly large forces.

The war in the Middle East saw large tank battles fought in pitch dark (Continued on page 21)
ABOUT THE COVER:
Memorializing the U.S. Army physician, scientist and teacher whose research resulted in successful immunization against the scourge of yellow fever in Cuba. Walter Reed Army Institute of Research is world renowned for its work to alleviate suffering in many lands where deadly diseases prevail. The upper picture shows immunization work in the Vietnam conflict. Below is an artist's concept of the yellow fever prevention in Cuba. Back cover shows some of the foreign facilities used by WRAIR medical teams - upper left in Malaysia; upper right, Bangkok, Thailand; center left and right, in Brazilia, capital of Brazil; center, use of U.S. Army-developed jet injectors in Vietnam; lower left, Belem in Amazon Basin; right, in Kenya.

Editor ............... Clarence T. Smith
Associate Editor .... George J. Makuta
Editorial Assistant ... Harvey Bleicher
Staff Assistant ...... Mrs. Thelma Heisler

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MARCH-APRIL 1977

FEATURES

Ballistic Research Lab Achievements Earn Army's Top 1976 Award

DARCOM Realignment Climaxes with ERADCOM, CORADCOM, CERCOM Decision

Joint Conventional Ammunition Group Claims 3-Year Billion Savings

HDL Fuze Selected for General Support Rocket

Getting Sun Power Down to Earth — Donald D. Faehn

BRL Achieves Improved Projectile Performance — Anders S. Platou


WRAIR Activities in Many Lands Build Solid Base of World Renown

Utilizing Reliability in Materiel Acquisition — Jim McCrory

Bridge Reinforcing Systems for the 1980s — William R. Abell

Scientists-Astronaut Heads 5 Guest Speakers for 15th NJSHS

NARADCOM Annual Awards Cite Achievements in R&E, Administration

Perry Succeeds Currie as Director of Defense Research and Engineering

White Sands Installs $9 Million Drone Formation Control System

DEPARTMENTS

Selective Scanner

R&D News

Conferences and Symposia

Awards

People in Perspective

Reader's Guide

Women in Army Science

Personnel Actions

Army R&D — 15 Years Ago

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CHANGE OF ADDRESS for R&D and AE Officer Program enrollees should be addressed to U.S. Army Materiel Development and Readiness Command, ATTN: DRCDE-LS, 5001 Eisenhower Ave., Alexandria, VA 22333. R&D Mobilization Designees should report change of address to Commanding General, USAECMPAC, ATTN: AGUZ-CMD-M, F.O. Box 12487, Olivette Branch, St. Louis, MO 63132.

OTHER GOVERNMENT AGENCIES' requirements should be submitted directly to: DRCDE-LS, 5001 Eisenhower Ave., Alexandria, VA 22333.


ARMY RESEARCH AND DEVELOPMENT NEWS MAGAZINE 1
Selective Scanner
Army Accepts M198 Howitzer After Field Use Tests

Designed to provide an increased rate of fire with much greater range than the M114A1 it will replace, the M198, 155mm towed howitzer was accepted recently for field use and is expected to be available for troop use "within a couple of years."

During service testing, the M198 demonstrated it has a 100 percent increase in range and is 85 percent more effective than the M114A1, one of the oldest howitzers in the Army inventory. Life-cycle cost is estimated at only 15 percent more.

Enhancing the range of about 30 kilometers (nearly 19 miles) is the capability of the weapon to change direction of fire rapidly. A hydraulically operated lift enables a full 360 degrees traverse in "minimal time."

Night-firing accuracy is increased greatly through self-illuminated sight optics that eliminate the need for batteries, wiring and other vulnerable components of fire control instruments currently in service. Normally, two men adjust the weapon for direction and range, but one man can accomplish both functions when necessary.

The designed weight of 14,600 pounds permits the M198 to be airlifted by Army or Air Force helicopters, an advantage over a similar howitzer being developed trilaterally by the United Kingdom, Germany and Italy.

HDL Unveils Hand-Cranked Energy Generator

Believed the first device of its kind capable of producing 200 watts of electrical energy at 30 volts dc, a hand-cranked emergency power source developed by the U.S. Army Harry Diamond Laboratories was announced Apr. 26.

Weighing approximately 11 pounds, the device achieves its high-output levels by use of an alternator consisting of a multipole samarium magnet and a 3-phase multi-pole stator.

Optimum cranking speed is between 60-80 rpm, and the unit can be operated by one man for short periods or by a 2-man team in tandem. A harmonic drive increases the input rotational speed about 80 times, permitting the alternator rotor to turn at about 5,000 to 6,000 rpm.

Initially developed as a power source for radio communications at the request of the U.S. Army Institute for Military Assistance, the unit is also compatible with other electronic equipment and may be used to charge a battery pack.

BRL's Dr. Freedman Gets ASTM Dudley Award

Development of a screening program for testing potential explosive hazards of new organic compounds has earned Dr. Eli Freedman the Charles B. Dudley Award from the American Society for Testing and Materials (ASTM).

He is a research chemist in the Propulsion Division of the U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD.

Assisted by two award corecipients, Dr. Freedman developed the ASTM CHETAH Evaluation Program, expected to aid in analysis of numerous compounds having potential commercial applications.

The magnitude of new organic compounds precludes even rudimentary laboratory testing to isolate those having potential reactivity. The CHETAH program requires a minimal amount of data input to establish quickly and reliably compounds that are hazardous.

Assigned to BRL since 1960, Dr. Freedman received a BS degree (high honors) in chemistry from Carnegie Institute of Technology in 1947 and a PhD in 1952 from Cornell University.

His major area of expertise involves research on chemical mechanisms of sound absorption in liquids; chemical reactions in shock waves; reactions in microwave-induced discharges; and explosion limits of fuels in air.

Dr. Freedman is an affiliate member of the ASTM Committee E-27 on Hazard Potential of Chemicals, the American Chemical Society, American Physical Society, and the American Association for the Advancement of Science.

DACOWITS Meet Examines 'Changing Roles of Women'

"Changing Roles of Women in the Armed Forces" was the theme of the semi-annual meeting of the Defense Advisory Committee on Women in the Services (DACOWITS), April 17-20, in Washington, DC.

Highlights included a keynote address by Army Chief of Staff GEN Bernard W. Rogers and a visit to Walter Reed Army Medical Center to gain first-hand knowledge of work performed by Army medics.

Sponsored by the Department of the Army, the DACOWITS gathering placed strong emphasis on finding ways to improve utilization of women in the Services and dealing with their problems.

Three new members appointed to DACOWITS are Mrs. Sally Keadle Richardson, executive assistant to the Governor of West Virginia; Dr. Mildred W. Glover, representative, Georgia Legislature and associate professor, Atlanta University; and Mrs. Polly Baca Barragan, representative, Colorado House of State Representatives.

DACOWITS is composed of 25 prominent civilian women from business, the professions and civic associations. Members are appointed by the Secretary of Defense for 3-year terms to serve in an advisory capacity not representing any specific group with which they may be affiliated.

Army Studies Regional Food Preparation Centers

Regional food preparation centers for the U.S. Army, a concept of centralization of processing facilities similar to that used by airlines for in-flight meals, is being examined in tests scheduled for completion by early 1978.

Under the plan being studied, 24 food processing centers would serve all Army mess halls. Currently, the Army operates about 1,400 dining facilities that serve 241 million meals annually at a cost of $428 million.

Food prepared in regional centers would merely be reheated and served after arrival at mess hall destinations. Establishment of centralized dishwashing operations also is envisioned. If the plan is adopted, the first regional center could be operational by 1983.

A General Accounting Office report to the Department
of Defense indicated that the plan would undoubtedly save money. However, projected expenditures of $200 million over several years to modernize existing mess halls are in conflict with the regional plan.

Concurrently with the centralized test program, the Army will continue to build or modernize an additional 429 dining facilities with their own cooking equipment.

**Calibration Set May Aid CE Equipment Accuracy**

Problems of maintaining accuracy of nearly 20,000 items of U.S. Army Communications Command test measurement and diagnostic equipment, used for its global network of communications facilities, are expected to be eased by a prototype calibration set.

Scheduled for testing by the Communications Command and the U.S. Army Materiel Development and Readiness Command (DARCOM), beginning in March, the prototype AN/GSM-259 is a modification of the GSM-256 that is expected to virtually double its capabilities.

Changes include addition of microwave calibration equipment, substitution of more accurate or wider range standards and deletion of some items now considered unnecessary. The new unit is designed to service about 96 percent of ACC's communications/electronics equipment—dispersed at about 1,400 sites worldwide.

Plans provide for production of 22 AN/GSM-259 units, costing between $175,000 and $195,000 each, and deployment by FY 1979 at sites in Europe, Korea, Taiwan and Okinawa.

**Army Calls for Cost-Cutting Management Ideas**

Do you pride yourself on being creative, innovative, a managerial "good idea" type? Do you have a suggestion that might improve operating efficiency, manpower utilization or cost savings at your activity or installation? If so you have talents the Army wants to use during its Calendar Year 1977 management improvement program.

Army Chief of Staff GEN Bernard W. Rogers has called on commanders of all major Army commands and heads of staff agencies to encourage civilian and military personnel participation in "Project 77/77."

Project 77/77 was initiated to save $77 million in 1977 by putting improvement ideas to work for better use of manpower, money and military materiel. The emphasis is on RAM (reliability, availability and maintainability of weapon systems and equipment); also, increasing return-on-investment (ROI) in the materiel acquisition process.

Major commands and local activities have been directed to set their own campaign objectives for not less than 90 days. Commanders are encouraged to identify areas of effort in which management seeks improvement suggestions: also, to develop/provide special recognition for personnel whose suggestions result in first-year savings of $25,000 or more. Local commanders should provide recognition for first-year savings of $5,000 to $25,000.

Suggestions resulting in savings of $50,000 or more that have received local recognition will be forwarded to HQ DA (DAPE-CPL), Washington, DC 20310, for recognition.

**LTG Morris Recommends Canal Project Termination**

Termination of all activities leading to completion of the 107-mile-long Cross-Florida Barge Canal Project has been recommended to the Secretary of the Army by Chief of the Army Corps of Engineers LTG J. W. Morris.

More than $70 million has been spent to complete about one-third of the project, including 25 miles of channel, three of five locks, three dams and four relocated highway bridges in north central Florida.

Canal construction began in 1964 but was halted by Presidential order in 1971 until further study could be made. Congressional action initiated restudy of the project in 1972.

LTG Morris recently recommended a supplemental study to determine the best disposition of existing canals and lands. This study would be in participation with the U.S. Departments of Interior, Agriculture, Environmental Protection Agency and the State of Florida.

Completion of the canal was opposed by the governor and Florida State cabinet. Economic justification for the canal is termed marginal when considered against potential adverse environmental impacts.

**Infrared Device Aids USAF Heat Loss Survey**

Sophisticated infrared scanning equipment, developed by the Army to detect camouflaged vehicles and equipment in Vietnam, was used in a special Army-Air Force program designed to conserve energy.

Mounted in an OV-1D Mohawk reconnaissance plane, the AAS-24 Infrared Lined Scanner was used by CPT Don S. Callicott, pilot, and SP5 Dennis R. Deines, technical observer, to identify heat losses of facilities and buildings at 12 Air Force bases in the Continental United States.

At an altitude of 1,000 feet, the heat-sensitive infrared scanner (using 5-inch film) recorded radiation escaping from buildings, sewage lines and steam pipes. About 60 flight hours were required to complete the scanning, at a cost of $1,250 per base.

Information gained by the scanner was evaluated by image interpreters and reported to Air Force officials. Ground crews then went out to make necessary corrections at specific locations. The Air Force requested the tests after significant results were obtained last year in surveys of 65 Army installations.

**DoD Establishes New Military Airlift Command**

Establishment of the Military Airlift Command (MAC), headquartered at Scott Air Force Base, Belleville, IL, as a command reporting specifically to the President through the Secretary of Defense, was announced recently.

Military airlift services will be provided by MAC during wartime situations, periods of crisis, during Joint Chiefs of Staff exercises, and as necessary to insure operational support to other unified and specified commands.

MAC Commander GEN Paul K. Carlton, USAF, will operate in the normal chain of command under the National Command Authorities while the USAF retains service responsibility for administrative and logistic support.

**B-1 Bomber Flight Tests SRAM Safety System**

In preparation for weapons platform capability tests scheduled in June, a U.S. Air Force B-1 bomber made its first flight carrying an unarmed Short-Range Attack Missile (SRAM) above White Sands (NM) in a recent mission that originated and ended at Edwards Air Force Base, CA.

Except for its payload, the SRAM was comparable to an operational missile. The purpose was to check out the telemetry link between the SRAM's safety system and the White Sands Missile Range safety monitoring equipment.

Flight characteristics of the B-1 bomber already have been demonstrated successfully, as have various test drops of dummy SRAMs and gravity weapons.
Ballistic Research Laboratory Achievements Earn Top Army 1976 Award

Slammer VI Shows Lethal Saturation Capabilities

Evaluation testing of Slammer VI, the ground-based version of what was formerly the airborne 2.75-inch rocket, is demonstrating that it can rapidly saturate an area the size of several football fields with lethal fragments - as many as 114 rockets in less than 10 seconds.

Project Manager COL James L. Tow reports that testing to date has "gone very well," using a wheeled launcher mounting six standard helicopter M-200 rocket pods, each carrying 19 rockets.

Although mobile, multiple rocket systems are used by the armies of other nations, Slammer VI offers the first capability of its kind that will be available to the United States Army.

The launcher under test was developed originally to fire chemical rockets. Anniston Army Depot modified the 2-wheeled towed carriage to take the M-200 rockets, and the vehicle was soon in service at the Missile R&D Command's Redstone, AL, range. Later it was demonstrated in a large-scale operation at Fort Bragg, NC.

Senior Army leaders, impressed by the demonstration, gave the go-ahead for construction of five additional launchers used for safety and operational tests by the Army Test and Evaluation Command (TECOM) at Yuma Proving Ground, AZ, and in March at Fort Sill, OK, home of the Artillery School.

An advantage of the Slammer VI system is that it could be fielded on short notice at low cost since it uses readily available components. The rocket and the M-200 launcher are in Army stocks, as are many of the M-91 chemical launchers.

Use of the 2.75-inch rocket enables Slammer VI to accommodate all the varied warheads now operational with that system; also, warheads under development including smoke, multipurpose submunitions and illumination.

COL Tow's development team of MAJ Norm Patton, Bob Brock, Jack Still and Mel Bartlett foresaw a system that would require about five soldiers to operate. Missions could include destruction of area personnel and material targets, suppression of air defense, artillery, antitank weapons and mortars.

Major New Computer Capabilities for Terrain Analysis

R&D Laboratory; Night Vision Laboratory, a Fort Belvoir, VP Topographic Laboratories (ETL), Fort Belvoir, VA.

The ETL, however, was selected as the Most Improved Laboratory of the Year, a Special Award category. Other nominees for this honor were the Bioengineering Research and Development Laboratory, located at Fort Detrick, MD, as a part of the Medical R&D Command, and the Target Acquisition Laboratory, Electronics Command, Fort Monmouth, NJ.

Awards for Excellence will be presented to: Engineer Topographic Laboratories; Institute of Surgical Research; Medical Bioengineering R&D Laboratory; Ballistic Research Laboratory; Night Vision Laboratory, a Fort Belvoir, VA.

The ETL's accomplishments, as noted, include: "In the winter of 1975-76, the ETL produced a major new computer capability for handling, analyzing, and displaying large, correlated data arrays in real time, including elevation, scene and range location of weapons and other items of interest." (For a comprehensive review of ETL's capabilities, ongoing R&D programs, and outstanding achievements, the feature article in the January-February 1976 edition of the Army R&D News magazine is suggested.)

MERADCOM Expands Tech Support

With EPA Noise Control Office

Cooperation with the Environmental Protection Agency Office of Noise Abatement and Control is one of the least publicized activities of the U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA.

The scope of this support was expanded by an addition to an agreement reached initially in December 1975 between the EPA and MERADCOM.

That arrangement provided for technical support to the EPA in development of noise regulations for construction equipment, tracked and wheeled type bulldozers, and earth movers. Additions are rock drills, pavement breakers and motorcycles.

MERADCOM areas of expertise in noise abatement include acoustic analysis, test procedures development, selection of materials, vibration isolation, and quiet equipment design. The agreement helps ONAC to accomplish its mission without resorting to other in-house laboratories or contractor support.

Using off-the-shelf instrumentation procured from commercial suppliers, MERADCOM noise control researchers have participated in recent years in development of Society of Automotive Engineers (SAE) standards for measurement of noise of various types of equipment.

Data have been acquired for use in comparative testing, analysis of the impact of changing acoustical test methods, and determining the feasibility of various levels of noise control of equipment.

Project engineer Jerome Hoescer heads the MERADCOM effort with a variable staff of assistants ranging from five to eight.
JLCs Charter New Fuze Management Organization

U.S. Joint Logistics Commanders (JLC) chartered a new Fuze Management Organization (FMO), consisting of a Fuze Management Board (FMB) and a Joint Fuze Task Group (JFTG), in December 1976. The FMO mission is to maximize coordination of the Army, Navy and Air Force fuze research, development and engineering programs, including product improvement, for nonnuclear ordnance and munitions.

Empowered to decide for JLC on fuze development matters, the FMB members are: MG Harry A. Griffith, chairman, U.S. Army Material Development and Readiness Command (DARCOM) and director of Development and Engineering; Norman L. Klein, assistant deputy for Science and Technology, DARCOM; RADM C. P. Ekas Jr., deputy chief, Naval Material Development, Naval Material Command; RADM H. D. Arnold, director, Tactical Air, Surface and Electronic Division, Office of the Director of Research, Development and Testing, Office of the Chief of Naval Operations; MG Robert C. Mathis, deputy chief of staff for Systems, AF Systems Command; and MG Gerald K. Hendricks, DCS for Science and Technology, AFSC.

The JFTG is an intensive management Tri-Services action arm of the FMB and consists of a chairman, a technical assistant, Army, Navy, and Air Force principal members, a program analyst and secretary.

The JFTG strives to identify and clarify management and technical issues, and attain Tri-Services coordination of fuze programs. The JFTG will then effect an orderly transfer of its responsibilities and methods of operation to the Joint Technical Coordinating Group (Munitions Development) Working Party for Fuze. The FMB will continue to provide a decision and approval mechanism for DoD fuze development management.

JFTG duties include the formulation of a coordinated annual Joint Service Fuze Plan (JSFP), program monitoring, recommendations, studies and analyses - with a view toward eliminating unwarranted duplication of effort, and proliferation of fuzes in the stockpile. Potential benefits include interservice commonality of fuzes and economy in production.

The FMO charter assigns initial lead Service responsibility to the U.S. Army, including chairmanship of the FMB and JFTG. The responsibility will rotate among the Services.

JFTG address is: c/o Chairman, Joint Fuze Task Group, ATTN: DRDCE-JFTG, 2800 Powder Mill Road, Adelphi, MD 20783. The phone numbers are: Autovon, 290-2812; Commercial, 202-394-2812; FTS, 394-2812.

M110 Product Improvement

Material readiness objectives of Project Hand-Off - involving a warranty that starts after the receiving unit is satisfied each system weapon system unit or item of major combat equipment is modified correctly - are expected to save millions of dollars on product improvement of the M110 howitzer.

Upgrading the present artillery system, instead of developing a new weapon system that could cost about $700,000 a unit, is being accomplished with modifications having a unit cost of less than $80,000. That is the report of the project manager's office at HQ U.S. Army Artillery Material Readiness Command, Rock Island, IL.

Conversion of the M110 and M107 to the M110A1 is accomplished by the installation of the M201 cannon and the M139 direct-fire telescope. The M201 cannon tube is the first to be

...
DARCOM Realignments Climaxes With ERADCOM, CORADCOM, CERCOR Decision

Decisions directing realignment of major commands within the U.S. Army Materiel Development and Readiness Command, renamed from the Army Materiel Command in February 1975, climaxed with recent formation of three commands.

Prolonged controversy, involving options for reorganization of the staffs and the functions of the U.S. Army Electronics Command, Harry Diamond Laboratories, and portions of Army Security Agency, now INSCOM, ended late in March with Secretary of the Army Clifford L. Alexander Jr.'s announcement of his decision.

DARCOM will have 15 major subordinate commands as a result. MG Charles D. Daniel Jr., special assistant to the DARCOM commander for almost two years, has moved to the former Harry Diamond Laboratories' complex at Adelphi, MD, to take command of the Electronics Research and Development Command (ERADCOM), Provisional.

What was formerly the U.S. Army Electronics Command, since the 1962 Armywide reorganization, is now a separate Technical Services into the Army Materiel Command, will be split between ERADCOM, the Communications R&D Command (CORADCOM) and the new Communications and Electronics Materiel Readiness Command (CERCOR).

CORADCOM headquarters will be at Fort Monmouth, NJ, where ECOM HQ has operated since 1962, as will the headquarters of the new Communications and Electronics Materiel Readiness Command (CERCOR). Selection of leaders of these commands had not been announced at press time.

Implementation of the over-all reorganization of the three commands is phased over a 3-year period. Secretary Alexander's press conference announcement said realignment will affect 1,000 civilian jobs, with 433 to be eliminated and 576 transferred. Involved also are 22 military jobs.

Projected benefits of the total realignment include reduction of annual operating costs by $6.5 million. One-time costs of the change are estimated at $14.7 million - $13 million for ERADCOM and about $1.7 million for CORADCOM and CERCOR.

In general, the realignments and functional transfers within the new commands follows the concept advanced in recommendations of the blue ribbon panel known as AMARC (Army Materiel Acquisition Review Committee).

The principal objective is to separate research and development as well as initial procurement of new weapons systems, along with product improvements, from management of logistic functions.

Created for electronics research and the development and acquisition of electronic materiel, ERADCOM will accomplish programs in atmospheric sciences, electronic warfare, nuclear weapon effects, ordnance electronics, signal intelligence and target acquisition and combat surveillance.

Other areas of ERADCOM concern include sensors, night vision, radar frequency and optical devices, electronic fuzing, fluidics, instrumentation and simulation, battlefield technical vulnerability analysis, and nuclear weapons effects simulation and vulnerability analysis.

ERADCOM will operate with facilities including a Target Acquisition Center (TAC), a Signals Warfare Center (SWC) and a Harry Diamond Center (HDC) - the latter memorializing the brilliant scientist who died in 1948, five years before his division of National Bureau of Standards transferred to the Army's Ordnance Corps.

This plan of organization was recommended by a Technology and Review Committee directed by Dr. Paul W. Kruse, Honeywell Research Center, and LTG (USA, Ret.) Austin W. Betts, former Army Chief of R&D who is now an executive with Southwest Research Institute.

Each center director will have authority to manage his own resources in RDE programs, the preparation and maintenance of Technical Data Packages (TDPs), and the initial procurement and fielding of developed items. TAC will be headquartered at Fort Belvoir, VA, the HDC at Adelphi, and the SWC will be at Vint Hill Farms Station, VA. The Electronic and Devices Laboratory will remain at Fort Monmouth and the Atmospheric Sciences Laboratory will stay at White Sands (NM) Missile Range.

ERADCOM's mission is to integrate the electronic warfare programs of the Army Intelligence and Security Command, formerly the Army Security Agency, and ECOM's Electronic Warfare Laboratory at Vint Hill Farms Station, VA.

HDL Fluidic Sensor May Yield Huge Fuel Oil Saving

National concern about energy conservation action serves to accentuate the potential significance of a new temperature sensing device developed by the U.S. Army Harry Diamond Laboratories and announced Mar. 15.

HDL engineers Dr. Ted Drzewiecki and Frank Manion have applied for a patent. The invention is described as a means of sensing temperatures with high accuracy and rugged reliability in /hostile environments./

In progress as this edition of the Army Research and Development News magazine went to press was an initial application of the device for experimental research and evaluation in a blast furnace at Pennsylvania State University.

Envisioned is the possibility of industrial applications which experts believe offer a prospect of resultant daily savings of millions of barrels of fuel oil. The applications would include metal and oil refineries, blast furnaces, textile fiber mills, the glass container industry, and other processing plants.

The temperature sensor employs a fluidic thermistor - a control fluid passing through a capillary-tube arrangement, a technique analogous to a temperature sensitive resistor. Fluidic controls, HDL reported, have an advantage over electrical resistance sensors in that they can function in very severe environments, limited only by material endurance.

The HDL announcement of the fluidic thermistor listed among its advantages larger temperature measuring range; potential accuracy within 0.001 degree Centigrade; no moving parts, hence excellent reliability; fluid mediums can be used; and initial production as well as life cycle costs are low due to inherent simplicity of the sensor.

(Continued on page 12)
USAISR Provides Assistance to Tenerife Crash Victims

When commercial aviation’s worst tragedy occurred in March on Tenerife in the Canary Islands, killing 586 persons, 12 survivors were rushed to the USAISR at Fort Sam Houston, TX, in increasing numbers in recent years as its international renown has increased.

The Army Research and Development News-magazine carried a dramatic front cover picture and a center-spread feature article on the USAISR in the Sept.-Oct. 1975 edition. The article described the research program, the precision of the rapid aerial evacuation and care during flight, and the subsequent treatment of burn patients.

MERADCOM Provides Tech Guidance on LCU 1579

Strange, “off-beat” assignments are usually accepted almost casually by the Mobility Equipment Research and Development Command (MERADCOM), a major element of the U.S. Army Materiel Development and Readiness Command (DARCOM).

How about, for example, a task of providing technical guidance on pilot modernization of a Landing Craft Utility (LCU), with a view to application on 60 other Army LCU's - all as part of planned modernization by 1985 of the U.S. Army’s “Navy” of more than 1,300 vessels? The pilot LCU 1579 is scheduled for completion of modernization by May for removal to Fort Eustis, VA, for user acceptibility testing.

Improvements will include new mechanical gear, pollution abatement equipment, modernized engine, advanced communication equipment, electrical system and navigational instruments, and a new gyrocompass and radar system.

Many of the Army's LCU's are equipped with engines procured during the 1950s. LCU 1579 has a diesel “clean air” replacement engine, since all commercial and military ships now must meet Federal Water Pollution Standards. An oil bilge water separator prevents the film formerly left in an LCU's wake. Sewage from commodes and other facilities is ground up and pumped into a holding tank. Later, it is transferred ashore instead of into the water.

The new VHF/FM radio can send and receive up to several hundred calls, as compared to old communication gear limited to a range of about 50 miles. Communication with Navy and commercial ships is possible, instead of limited to other U.S. Army craft.

NBS, Battelle Labs Corrosion Study Nears Completion

Corrosion damage and bacterial deterioration of military materiel and equipment have been of concern to the U.S. Army ever since World War II studies showed costs totaling millions of dollars annually - which directs attention to a comprehensive corrosion study nearing completion.

Under contract with the U.S. Bureau of Standards, scientists of the Battelle Columbus Laboratories are scheduled to complete a study in June that will separate total corrosion costs into reducible and presently irreducible categories. Congress directed the NBS to make the study.

Army Announces Acceptance of Initial AH-1S Cobra

Acceptance of the initial production model of the AH-1S Cobra, described as the most modern U.S. antiarmor helicopter, has been announced by the Army.

Improvements in the aircraft, as compared to the Cobra used in the Vietnam war, include armament with the TOW missile system, an upgraded engine and power train, a flat canopy and a redesigned cockpit.

The engine is a Lycoming T53-L-703 rated at 1,825 shaft horsepower. The drive train has a 1,308 horsepower intermediate power transmission and a 280-horsepower tail rotor drive.

Project Manager Charles Drenz said a new gun and turret will be added next year and that a new fire control system is scheduled for 1979.

COL Drenz said the goal is to “modernize this bird so the guy in the field can fly it against the threat, if that threat should materialize on the battlefield ... do his lethal mission and get back.”

The first 148 AH-1S models are on order and the remaining aircraft of a planned total procurement of 305 are scheduled to come off the line in a “more modernized version,” COL Drenz said. The modernization program changes the Cobra from a low-intensity to a mid-intensity warfare aircraft.

60mm Lightweight Mortar Awaits Type Classification

Type classification of the 60mm Lightweight Company Mortar System (LCWMS) as standard, meaning that it has completed development and operational testing and is considered suitable for production, was awaiting approval by the Department of the Army at press time.

If approved, the system is expected to be made available for procurement in FY 1976, and is scheduled to replace the 81mm weapon currently used by nonmechanized infantry units. The LCWMS will offer increased firepower and mobility for combat effectiveness where man-portability is essential.

 Watervliet (NY) Arsenal had management responsibility for the complete system, with John P. Purtell as program director, Donald E. Jones as deputy, and Robin L. Elder as test director following the recent assignment of MAJ John R. Adams III to Germany.

The mortar barrel, base plate and mount were developed by Watervliet. Other agencies involved in the project included Frankford Arsenal, fire control; Picatinny Arsenal, ammunition; Harry Diamond Laboratories, fuzing; Test and Evaluation Command, testing.

Standardization of the system has been recommended by representatives of the Army Materiel Development and Readiness Command, Army Training and Doctrine Command, Logistics Evaluation Agency, and Marine Corps.
Savings of more than $1 billion during the past three fiscal years have been announced by the Joint Services Conventional Ammunition Program (JCAP) Coordinating Group.

Effectiveness of the group in achieving...efficient, economic management and operation for all conventional ammunition logistics programs and activities...was organized in May 1972, was announced during the 22d quarterly meeting at the Army Armament Materiel Readiness Command (ARRCOM), Rock Island, IL.

Participants discussed the ammunition “industry,” which includes 37 government-owned production facilities (operated by government or contractor personnel) worth more than $14 billion. Production and procurement of conventional ammunition involves over 21,000 items.

An Army estimate is that almost $13 billion will be spent on procurement of conventional ammunition for all three Services, spanning Fiscal Years 1976-1981, as follows: Army—$5.4 billion (43%); Air Force—$4.4 billion (34%); Navy/USMC—$3.3 billion (23%).

ARRCOM Commander MG Bennett L. Lewis, chairman of the JCAP Coordinating Group, revealed the 42-intra-service military and civilian officials and management and technical experts who discussed and took action on 15 conventional ammunition items on the agenda.

Other participants included MG William E. Eicher, ARRCOM deputy commander; RADM Donald P. Hall, deputy commander for Fleet Support, Naval Sea Systems Command; BG John R. Paulk, vice commander, Ogden (UT) Air Logistics Center; BG John S. Egbert, U.S. Army project manager for Munitions Production Base Modernization and Expansion, Picatinny Arsenal, Dover, NJ; COL James R. Lindsay, deputy commander for Armament Systems, Armament Development and Test Center, and Edward J. Jordan, JCAP Coordinating Group executive secretary.

Considered at the JCAP-CG meeting were industrial management, base modernization, procurement, production, supply, maintenance, quality assurance, logistics, engineering, security, management information systems, transportation and traffic management, manpower and personnel, budget and funding...and sensitive item coding for conventional ammunition.

In reviewing accomplishments over the past five years, the group reported development of “dynamic economic models” with supporting methodology and a management information system, and verification system that was acceptable by all of the Armed Services.

The group produced nine “managerial decision models” designed to provide ammunition managers with alternative solutions to problems such as item acquisition/production tradeoff, multiple bid evaluation, life-cycle cost subsystem, and storage space-allocation forecasts.

The item acquisition/production tradeoff model was demonstrated and evaluated for eight Army, Navy and Air Force ammunition items, with anticipated potential savings of one-half billion dollars.

The multiple bid evaluation model, now being used by the Army and under consideration by the Navy and Air Force, is another example of a managerial concept replacing planning practices that have changed very little in 40 years.

Two actions initiated by the JCAP Coordinating Group also crossed Service lines in meeting combat requirements for critical ammunition.

When the Navy needed 5-inch shell cases during the late stages of the Vietnam War, the Army (which had a plant producing 105mm shell cases) immediately made the “hot base” available to the Navy.

During the Middle East War, the reverse happened when the Navy made its “hot base” available to the Army for production of antitank shell cases.

These actions were accomplished in record time and accounted for savings of about $500,000 each by avoiding a need to reactivate munitions modernization, procurement and contractor personnel worth more than $14 billion.

After studying computer-aided analysis of data, the JCAP recommended that procurement of pressure-treated wood pallets, instead of metal boxes being considered, would be less expensive and still do the job. The Air Force ordered the wooden crates and saved $1.4 million ($3.3 instead of $4.7 million).

The JCAP-CG also is responsible for initiating a management information system which provides ammunition managers with unified data and information that enables them to communicate across Service lines. Managers receive complete information on what each Service has and is planning to procure or demilitarize. This results in less duplication, less waste, and better use of available resources throughout the Defense establishment.

**Video Instrumentation Credited With $800,000 Savings**

Video instrumentation, a relatively new approach to reading material test data, is credited with saving about $800,000, and has greatly reduced manhours of test time during the past two years at Aberdeen Proving Ground, MD.

Advances in video and electro-optics technology are credited largely to APG’s Instrument Development Branch, Materiel Testing Directorate. One of APG’s new developments is the Automated Video Target Scoring System, consisting of a camera, video digitizer and programmable calculator. AVTSS permits test fire scorings without requiring down-range access.

This system produces immediate data for onthe-spot corrections, is reportedly more accurate than “spotters,” provides a permanent record of test results and requires less manpower.

Development of a Target Simulation Facility is credited with “really starting the ball rolling in video instrumentation.” The TSF features target projection, digital computer control and video data acquisition, without dependence on weather conditions. Used as a prelude to actual range firing, it has cut range testing in many instances from several weeks to a couple of days.

New developments in video instrumentation have proved invaluable in testing the MICV (Mechanized Infantry Combat Vehicle), the XM-1 and M60 tanks and other major systems, ID Branch Chief James Fasig reports.

CPT C. David Brown, a 27-year-old electronist engineer with an MS degree, was credited by Fasig with achieving many of the video and electrooptics advances since he was assigned to APG about two years ago. John Wallace, also an electronics engineer, was the first APG researcher to make video instrumentation work in the field.

Brown is involved in development, design, construction, and field evaluation of new instrumentation and training field operators.

**MT Project Seeks Improved Batteries**

One of 13 manufacturing technology projects at the U.S. Army Mobility Equipment Research and Development Command (MERADCOM) has the objective of producing better batteries for use in electric propulsion.

Prototypes from a production line are being evaluated to determine performance characteristics. One of the project's objectives is to produce a new, more powerful battery system that can be used in electric vehicles, particularly in ammunition handling.

Batteries of this type offer high energy density, high power density, rapid recharge and increased capability as compared to lead-acid batteries. MERADCOM believes that these features are expected to increase forklift trucks' reliability and maneuverability, also, to reduce fuel consumption, pollution and logistics.
HDL Fuze Selected for General Support Rocket System

Selection of the U.S. Army Harry Diamond Laboratories’ fusing system for the General Support Rocket System was announced early in April by GSRS Project Manager COL Kenneth S. Heitzke. The fuze will be supplied to the contractor as government-furnished equipment.

The GSRS is a large-caliber multiple rocket launch system intended to support conventional artillery by providing heavy firepower, especially in a battlefield surge operation. To achieve high survivability, a “shoot and scoot” concept is utilized.

Two 6-round expendable launch pods, which serve as both shipping container and launch platforms, are mounted on a self-propelled vehicle.

USCSC Study Traces Educational/Pay Level Parallel

Educational levels are compared with pay levels in a recent U.S. Civil Service Commission news release on results of the first such study ever made of the federal white-collar work force, involving 1.16 million GS employees.

The compilation of statistics showed 30 percent had bachelor’s degrees or advanced study beyond that level; 25 percent had attended college without earning a bachelor’s degree; 13 percent had technical training beyond high school but no college courses; and 32 percent had no education or training beyond H.S.

Further, the study revealed that 53 percent of General Schedule employees in the GS-9 through 10 salary grades had bachelor’s degrees and 32 percent had engaged in graduate study. Among male employees in grades GS-14 and above, 58 percent had bachelor’s degrees or beyond.

HumRRO Publication Collects Data On Team Training Effectiveness

Literature relevant to instructional techniques is contained in Team Training and Evaluation Strategies: State-of-the-Art, a new publication of the Human Resources Research Organization (HumRRO).

Technical Report 77-1 is prepared as an information base that the Defense Advanced Research Projects Agency could use as a foundation to facilitate decisions relative to future research program support.

Sources of information used in this research include the Educational Resources Information Center, National Technical Information Service, Defense Documentation Center indices, DoD-sponsored reports and social psychological publications.

Conclusions of the study indicated that team training effectiveness depends upon development of objective team performance measurement instruments and procedures. Current problems include lack of standard test conditions and accepted test criteria.

Armament Command Contract Orders Development of XM235 Prototype

Development of a prototype infantry squad automatic weapon (SAW), designated as the XM235, was ordered in a contract awarded in March by the U.S. Armament Materiel Readiness Command, Rock Island, IL.

Intended to satisfy an Army requirement for a one-man, lightweight, man portable, capable of sustained fire at long range, the SAW will replace the M16A1 in the automatic fire mission and may replace one or more M60 machineguns in an infantry rifle platoon.

Weight of the SAW, including 200 rounds of an improved 50mm ball and tracer type of ammunition (SM777 and MX778), will be less than 21 pounds, the contract news release said.

MARCH-APRIL 1977
Getting Sun Power Down to Earth

SOLAR POWER FOR REMOTE LABORATORY

By Donald D. Faehn

Archimedes is believed to have set fire to an attacking Roman fleet in 200 B.C. by directing the sun's rays off large mirrors. Solar-heated stills were used for life-craft survival in World War II. The U.S. space program in the 1950s developed a solar cell to power satellites.

Although solar energy has been successfully used in warfare, however, until now there have been few military applications.

Now the U.S. Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA, is engaged in an experimental program - putting the sun to work to power military equipment ordinarily operated by engine generators or batteries.

Results in Defense-wide benefits are also expected to contribute significantly to increasingly widespread civilian use of the sun's energy in homes and businesses.

Designated the lead R&D center of the Department of Defense for terrestrial applications of solar photovoltaic energy conversion systems, MERADCOM is engaged in a program with the Energy Research and Development Administration (ERDA) to demonstrate this technology in a variety of military uses.

Photovoltaic cell systems convert solar energy into electricity without the intermediate heat process. Cells of this type have been used extensively in spacecraft. The terrestrial solar cell industry, however, is just emerging and the main problem to widespread usage - as a means of reducing dependence on short supply gas and oil - is cost.

Progress in providing Defense forces with an alternative source of electric power is the objective of the ERDA-funded program initiated by the Department of Defense in 1975.

Called MAPS (Military Applications of Photovoltaic Systems), the program was placed under the general management of MERADCOM on the basis of the command's long-standing work on electric power generation, including fuel cells and other energy conversion methods.

ERDA sponsorship of the program stems from its quest - in the interests of national energy self-sufficiency - for the development of low-cost, reliable solar cells that could be mass produced for widespread use in residential and commercial applications. Development of the substantial anticipated early market for solar cell equipment within the Department of Defense could be a major step toward low-cost solar energy for the civilian community.

Potential military benefits from the use of solar cells are viewed as 5-fold: energy and cost savings in reduced use and storage of petroleum products; decrease in logistic burden of continual replenishment of fuel and batteries; energy self-sufficiency for a variety of remote or isolated military applications; improved reliability, availability, and maintainability of energy-consuming systems; and the option of a silent, alternative source of electric power.

To explore the DoD solar cell market, six military systems covering a broad range of power, voltage and duty requirements were selected for a demonstration of solar cell potential. In September 1976, three of these systems - a battery charger, a radio relay system, and a telephone communications station - were put into operation on solar power in an open area at MERADCOM.

A water purification plant will become operational in February. A remote radar station at the Naval Weapons Center, China Lake, CA, is scheduled for completion in March.

The sixth and largest system, designed to demonstrate energy self-sufficiency for DoD remote island facilities, is planned for Bermuda. It will interface with the electric utility grid system of the Navy's Tudor Hill Laboratory to provide power for lighting, air conditioning, ventilation and other personnel support.

Two projects, the telephone station and the radio relay, incorporate significant storage battery subsystems. The battery charger, water purification plant, and remote radar are essentially day-light-only systems. All the projects, with the exception of the battery charger (which was developed exclusively for solar power), are existing military systems.

The five operational demonstrations required a 30-KW allocation of solar cell modules from the 46-KW block procured by the Jet Propulsion Laboratory for the ERDA-sponsored test and demonstration program. System engineering support and array design and construction were supplied by the NASA Lewis Research Center.

Solar-array construction was common to all projects except the telephone communications system. Produced by three manufacturers, the modules were fastened to A-frame stands designed to be compatible with this variety. Frames were 4 x 4 feet each except for the 2 x 4 foot size for the radio relay. Array power varies from 35 watts at 12 volts to 11 KW at 240 volts. Adjustable in tilt angle from 15 to 62 degrees from the horizontal, they fold flat for transportation.

The solar array for the telephone system is located on the tops and sides of the truck-mounted shelters. Peak power is 2.4 KW (1,200 W per shelter), providing average net continuous electrical power of 300 W.

The array may be positioned at several discreet angles between 15 and 60 degrees from the horizontal by means of telescoping support struts. For transportation, the hinged arrays are folded flat against the tops and sides of the vehicles for transportation, requiring only a 3-inch extension of vertical and horizontal dimensions.

Battery Charger. This is the only new item in the demonstration program and it is intended to charge multiple nickel-cadmium batteries with solar cell power. The objective is to reduce military dependence on primary batteries used in numerous military applications, such as night vision devices for which expendable batteries must be replaced.

The logistics and cost burdens of night operations could be diminished by recharging storage batteries with solar cells during the day, when the viewers are idle. Airport lighting is a similar application area.

The demonstration charger is designed to recharge completely simultaneously 84 D-cell NiCd batteries during five hours of daylight. Current-limiting circuits in each of the six control sections of the charger prevent damage to

MOBILE communications center is powered by two van-mounted solar arrays, each consisting of 2,592 3-inch diameter cells that produce 56 volts and 22 amps at peak sun. This is enough power to operate the center and charge 32 deep-discharge electric vehicle-type batteries that provide power during periods of darkness and cloud cover.

Eighteen 3-inch diameter silicon solar cells are used in individual modules having a peak output of 8.6 watts. Four of these modules are used to power radio relay equipment designed to report intrusions to a remote monitor for an area security system.
the batteries, even in the event of prolonged over-charge in full sun.

Indicators have been provided to show battery state of charge, 0 to 100 percent in 20 percent increments. Batteries are discharged to a low level prior to being placed in the charger.

The array contains 28 solar cell modules. Groups of four modules are wired in a 2-by-2 series/parallel arrangement to form seven independent circuits, connected to the charger sections by a multiple conductor cable. Blocking diodes in each charger section prevent discharge of batteries. Control power is obtained from one of the circuits and 10 additional batteries in series.

Radio Relay. The existing military item forming the basis of the radio relay system demonstration is a multiple point intrusion detector having radio links to a monitor console. Subsystems (sensors, relays and monitor) are each powered by primary batteries and sensors transmit data to the radio relay, which in turn transmits the data to the monitor.

Generally, up to eight sensors are assigned to one relay and transmission begins as soon as one of the sensors is triggered. Each of the sensors, however, has a different identification code. The monitor interprets this code and displays information revealing the active sensor.

The IDS was modified for the demonstration program by replacing the expendable batteries with primary batteries in one relay and two monitors with photovoltaic power systems, each consisting of an array, voltage regulator and lead-acid batteries.

Repowering a sensor was considered feasible at this time, since in tactical situations they are camouflaged and often buried. However, as a means of demonstrating non-tactical applications in civilian security systems, five sensors also were solar cell powered.

The setup for the system included Washington, DC, solar radiation (insolation) patterns, seven days battery storage without input from the arrays, and complete recharge of the batteries within two days after discharge. Batteries for the relay are of the gelled electrolyte type, and for the monitor, are automotive lead-acid batteries.

Telephone Station. The demonstration AN/MTC-1 Telephone Central Office operates essentially as a local operator's switchboard, with 200 local lines and 20 trunk lines. Normally, operating power is obtained from an engine-driven generator set.

The 48 volt d.c. system can operate about 24 hours without power from the generator, using an internal lead-acid battery bank. Switchboard stations, relay equipment and power system are housed two 8 x 12-foot communications shelters, each normally mounted on 2½-ton trucks.

Because the telephone system must operate 24 hours daily, good weather or bad, additional batteries were added. Capacity was limited to allow for operation only two days (three nights) without any input from the sun.

This capacity was determined to be the minimum storage required with an acceptable risk that the system would function properly, thus permitting a reasonably low battery weight addition to the vehicles. Because of the desire for minimum weight, and the relatively deep daily discharge of the batteries (due to the minimum amp-hour capacity), electric vehicle type batteries were employed.

Junction boxes on each vehicle contain blocking diodes for each 8-module series string, BATTERY CHARGER used in MAPS demonstration can energize 84 D-cell batteries at a time. Future editions may also be capable of charging storage batteries that would replace expendable types now used.

Although this system is designed for d.c. power, an inverter was incorporated for the initial demonstration phase. This 1.5 KW MERADCOM development device provided either 60 Hz or 400 Hz, 120/240 volt single phase a.c. power for demonstrating convenience items, such as the instrumentation section, and was used to provide some of the dummy load during portions of the demonstration program.

Water Purification Plant. This is a prototype of a representative item for producing potable water from ground sources such as lakes and streams. Consisting of large, prefabricated water storage and processing tanks, filters, purification modules, and electric motor-driven pumps, it operates on the reverse-osmosis principle.

The pumps force water through the purification membrane tubes. Electric power requirement is approximately 7 KW to operate the system at 360 gallons an hour rated capacity. Two a.c. motors employed in the standard configuration were replaced by d.c. motors for the solar demonstration and a small commercial inverter also was used to drive a.c.-powered chemical feeders.

This project was configured as a daylight-only system, with energy stored in the form of purified water in the tanks, rather than in storage batteries. However, a small 240-volt pack of automotive batteries is needed to provide surge capacity for motor starting, and to smooth power variations caused by passing clouds.

The 240-volt d.c. potential from the array is achieved by connecting sufficient modules in series. Each series string is paralleled at a control cabinet.

The cabinet contains switches for each series string, diodes, bus bars, recording instrumentation similar to that used in the telephone system, main power circuit breaker, and receptacles to allow for individual monitoring of the performance of each solar cell string. Rated at 10.8 KW (peak), the solar array contains modules from three manufacturers, but only one module type is used in each string.

Remote Radar. This is the highest power project, also requires alternating current, and is representative of many types of instrumentation used at military sites in the south-west. Demonstration of this equipment will be conducted solely at the Naval Weapons Center, China Lake, CA.

Because the radar is used only during periods of good visibility (high insolation), battery requirements are minimal. The system is not operated more than one day without an inactive interval, allowing for some battery/array sizing trade-offs. The demonstration array was sized at 12 KW (peak) to power the nominal 15 KW load. A traction type (forklift truck) 240-volt, 300-amp-hour battery is employed. A custom-built motor-generator is used to supply the 120/208 volt 3-phase a.c. power for the radar.

The initial centralized solar energy demonstration was completed at MERADCOM in November 1976. Indications are that it was successful in promoting an awareness of solar photovoltaic systems as an attractive alternative source of electric power for military equipment.

Although the MERADCOM demonstrations were operated for only two months, the absence of failures of the photovoltaic systems proved encouraging.

Operating experience with the radio relay system was excellent. The only problem occurred in the failure of the primary batteries in some of the non-solar powered sensors. The telephone system operated round-the-clock without failure.

REVERSE OSMOSIS water purifier is being powered by solar energy at Fort Belvoir, VA, where the U.S. Army Mobility Equipment R&D Command is demonstrating military potential.
Getting Sun Power Down to Earth

(Continued from page 11)

In addition, the hinged solar arrays on the telephone vans made it clear that although considerable illuminated area may be required for some photovoltaic applications, due to the diffuse nature of the sun energy source, size and weight of solar arrays need not be excessive. No failure or severe degradation of solar cell modules was experienced.

MERADCOM projects shown at Fort Belvoir are being dispersed to other military facilities for field demonstrations under a more representative military environment. The intent is to promote more widespread awareness on the part of the military of terrestrial photovoltaic technology.

Upon completion of modifications to reduce its size and weight, and eliminate some of its control and instrumentation hardware, the battery charger will be evaluated by the Marine Corps, Navy and Air Force.

The telephone communications system is being operated at Fort Hood, TX, and will later be driven to White Sands Missile Range, NM, and Fort Bragg, NC. The remote relay will be in operation at China Lake, and the water purification unit at MERADCOM. The radio relay is being refurbished for delivery to Eglin Air Force Base, FL, and Fort Huachuca, AZ.

The only one of the six planned solar energy systems not constructed is scheduled for demonstrations in 1977. Designed to interface with the electric utility system at the Navy's underwater research facility in Bermuda, it will be connected to a low-voltage service panel which powers a 100-KW laboratory load.

In this way, the 60-KW (peak) alternate energy source will closely match load requirements, thereby making a distinct contribution to system needs. Solar array power will be converted by a conditioner or inverter to be located in the laboratory basement from a variable d.c. voltage, normally 350 volts, to the required 120-208 volt 3-phase, a.c.

The array will require about 30,000 square feet of land area. Part of the array will be on an existing south-facing slope. Cables will conduct the direct current solar cell power to the inverter via an underground conduit. Storing electricity in batteries is not required.

This solar energy application is expected to be productively useful in its initial form for many years. However, it is anticipated that it will be augmented from time to time with wind power or improved photovoltaic components so that the Tudor Hill Laboratory could become energy self-sufficient.

The objective of the six demonstration projects, as stated earlier, is to prove ultimately the feasibility of solar energy systems for a large number of similar applications within the Defense Department and the private sector.

Initial results are encouraging. Much more R&D will be needed, however, before the small-size, lightweight solar arrays necessary for mobility in tactical situations are a reality. Vulnerability and survivability measures, including defeating the threat of detection, must be developed.

Feasibility includes not only technical but costs and logistics factors. Concurrently with the demonstration program, MERADCOM is making a market survey of the Defense Department potential as a user of solar photovoltaic systems, under an agreement with the Federal Energy Administration. As its third task in MAPS program management, the command has established a tri-service coordinating body. Members are: Army, Donald D. Faehn; Navy, Dr. G.W. Leonard; Naval Weapons Center, China Lake, CA; Air Force, Joseph F. Wise, Aero Propulsion Laboratory, Wright-Patterson AFB, Dayton, OH.

DONALD D. FAEHN was awarded the 1975 Dr. L.M. Ames R&D Award by the Mount Vernon-Lee Chamber of Commerce for his work as program manager for military applications of photovoltaic systems at the U.S. Army Mobility Equipment Research and Development Command (MERADCOM).

The MERADCOM program is a new effort involving coordination with the Department of Defense, the Federal Energy Administration, and the U.S. Energy Research and Development Administration. MERADCOM is responsible for five demonstration projects, identification of early markets within DoD for photovoltaic systems, at the request of the DoD establishing a tri-service coordinating body for photovoltaic application surveys, and R&D programs management.

Faehn has been at MERADCOM since 1961 and was senior project engineer in the Electromechanical Division, Electrical Power Laboratory prior to his selection as program manager. Electrical Power Laboratory is responsible for MERADCOM's power generation efforts.

A member of the Society of Automotive Engineers and a registered professional engineer with the District of Columbia, Faehn received his BS degree in mechanical engineering from Iowa State University in 1958 and an MS in mechanical engineering from Stanford University in 1969.

The Ames R&D Award citation states, in part, that Faehn "has demonstrated an ability to supervise and administer an activity which is a significant facet of the national energy program... (he) has demonstrated diligence, initiative and competence in this work, which frequently demanded actions for which no precedent was established."

Dr. Ames was a Mount Vernon Chamber of Commerce member and a MERADCOM scientist who worked in the old materials lab from 1944 through 1958. He was chief of the fungus control group, now the Biodeterioration Research Group, Lab 9000.

DARCOM Realignment Climaxes With ERADCOM, CORADCOM, CERCOM Decision

(Continued from page 6)

changes of the reorganization is based on the following breakout: of the $5.9 million for construction and facilities modification for ERADCOM, $4.7 million will be used at Fort Monmouth; $1.7 million for CORADCOM and CERCOM facilities; $7.1 million for personnel relocation, severance pay, terminal leave pay, home owners' assistance, equipment relocation and purchase of new equipment.

About $400,000 will be spent for modifications at Vint Hills Farms Station; $850,000 for development of laser test ranges at Fort Belvoir and at Fort A. P. Hill, VA; and roughly $175,000 for enlargement of photographic facilities of the Night Vision and Optical Devices Laboratory at Fort Belvoir.

Some of the manpower transferred to ERADCOM will be accomplished by personnel who will remain in the Fort Monmouth area, but 112 civilian jobs and 3 military spaces will be transferred to Adelphi, MD, where a net loss of 29 jobs will take place. The Harry Diamond Labs will lose 162 civilian spaces, of which 150 will be reductions in force and 12 transfers.

Over-all, formation of ERADCOM, CORADCOM and CERCOM will result eventually in an environmental impact payroll loss estimated at $16.5 million annually in the Fort Monmouth business area (loss of 756 spaces, civilian and military jobs).

However, 7,404 civilian and 745 military spaces will remain in place. The loss breakdown is 576 civilian jobs and 22 military transferred, and 433 civilian positions eliminated.

ALMC Library Redesignated as 'The Army Logistics Library'

Redesignation of the U.S. Army Logistics Management Center's Logistics Library as "The Army Logistics Library" was announced Mar. 28.

Publications stored in the former ALMC, Army Quartermaster School and Army Management School libraries are consolidated in Bunker Hall, the principal academic building. More than 4,000 periodicals, 85,128 books and 1,674,571 government publications are available.

More than 500 current subscriptions to periodicals have been purchased by the library, many of which have been converted to microfilm or microfiche. Readers and printers are provided for use of these film documents. Microfilmed military and federal specifications and standards, audio cassettes, audio visual films and slides and a small legal library also are available.

The Logistics Reading Course, offered to active military, civilian DoD employees and Reserve officers, is administered by the AL Library. Supported also are the Florida Institute of Technology master's degree program and Chapman College Courses.
By Anders S. Platou

Research and development efforts to maximize firepower of U.S. combat forces and thereby improve odds for victory against a numerically superior opponent are of primary concern as strength of the potential foe increases. Many modern weapons use projectiles having ballistic trajectories and improvement in performance can be achieved through one of these approaches:

- Increasing the projectile length so a greater payload can be carried without destabilizing the projectile motion. (The projectile length is limited by the gyroscopic stability factor, which must remain greater than one for all flight conditions.)
- Giving the projectile a trajectory with lower angles of attack so that the probability of hitting the target is increased.

These approaches apply to all projectiles — small-caliber, antipersonnel, antitank, antiaircraft, or large-caliber indirect-fire projectiles. Improved performance will increase the usefulness and flexibility of many weapons.

Wind tunnel and aerodynamic range tests conducted by the U.S. Army Ballistic Research Laboratory (BRL), several years ago, showed that the conical boattail (Figure 1a) used on most projectiles to increase range has a very adverse effect on projectile flight stability.

As the conical boattail reduces the projectile drag and increases the maximum range, it reduces the projectile flight stability. Stability can be maintained only by shortening the projectile length. The shorter length, of course, reduces the available payload volume.

Due to the projectile spin, the conical boattail also develops large aerodynamic forces and moments — called the Magnus forces and moments — at transonic velocities. A large Magnus moment may lead to serious flight instabilities which, in turn, will cause the projectile to fall far short of its intended target by a significant distance.

Conventional projectiles are limited to 5 to 6 caliber lengths as a result of incorporating conical boattails. Longer lengths would require faster, impractical spin rates to maintain flight stability.

After determining the poor flight characteristics of the conical boattail, Ballistic Research Laboratories scientists found that projectile flight characteristics could be improved markedly by a new boattail shape.

This boattail is formed by cutting the main projectile cylindrical body at three skewed planes so that the shape shown in Figure 1b is formed. The base is triangular and the three skewed planes form aerodynamic lifting surfaces on the projectile’s rear portion, providing added lift and increasing flight stability.

Skewing the surface maintains the spin and reduces the Magnus forces and moments generated on the projectile. Low Magnus forces and moments permit the use of projectiles in which the centers of gravity can be moved further forward, increasing flight stability.

The new shape also permits the air to flow more efficiently over the boattail, thereby reducing viscous or drag losses. This shape also has portions of the main body cylinder extending to the base, thereby increasing the projectile “wheel base” and reducing gun tube balloting.

Wind tunnel and aerodynamic range tests have shown that a projectile with the new boattail (Figure 1b) has a low or lower drag than a similar conical boattail configuration. It also can be made longer than a similar projectile with a conical boattail and still maintain good flight stability.

For example, the M549 or M706 projectile (Figure 1a) is 5.7 calibers long. The new projectile can be 6.2 calibers long.

The configuration also can use a center of gravity further forward due to the smaller Magnus forces and moments generated on it. In turn, this adds to projectile flight stability. The projectile can have the same or less weight than one with a conical boattail. The forward center of gravity requires lightweight materials in the rear portion so that the longer projectile will not weigh more than one with the shorter conical boattail.

Another projectile shape which has very interesting and useful aerodynamic properties may be useful for certain military applications which require a long projectile. This shape meshes the skewed triangular boattail, as described, with a skewed triangular nose (Figure 2) — hence the nickname Corkscrew.

The streamlined corkscrew has very low drag and extremely good flight stability for long-length projectiles. So far 6-caliber long corkscrews have been flown under practical conditions in the BRL aerodynamics range. From these flights, it is estimated that corkscrew projectiles up to at least 11 calibers can be flown successfully. Flights during the past winter were designed to prove out these estimates. The pointed nose would have to be blunted for military field conditions, but this is not expected to increase appreciably the drag or lower the flight stability.

Conventional projectiles are limited to approximately 6-caliber lengths and have a maximum volume equal to approximately 3d⁴ where d is the projectile diameter. The corkscrew, if flyable in 11-caliber lengths, will have a volume of over 4d³, thereby making it possible to fly larger and heavier payloads to the target.

The difficulty limiting use of the corkscrew projectile is fabrication of the configuration. If made from one homogeneous piece, fabrication of the exterior shape poses special but not insurmountable problems. However, hollowing out the interior to accept a payload may be difficult.

The triangular form is expected to become the projectile boattail of the future since its aerodynamic properties are far superior to those of the conical boattail. Projectiles of all sizes will gain in flight performance, increased payload, and increased probability of hit. The corkscrew projectile has yet to be tried as a military projectile. Superior aerodynamics and long length make this configuration attractive, but fabrication difficulties may limit its use.

ANDERS A. PLATOU is an aerospace engineer with the Launch and Flight Division, U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD. Since 1944 he has worked with the BRL mainly in wind tunnel and range aerodynamic measurements. Graduated from Purdue University with a BSME degree, he served in the U.S. Army during WWII. He received a U.S. Army R&D Achievement Award in 1975 and is the inventor of a new projectile boattail.
NATO’s Tactical and Logistical Concepts Panel: Guide to Long-Range RD&E

By MAJ John D. Elliott

Presidential approval of the Department of Defense 1977 Appropriation Act, Public Law 94-361, has provided a much needed “strategy for military standardization,” for the research, development and engineering (RD&E) activities of the North Atlantic Treaty Organization. PL 94-361 states clearly the intent of Congress that “weapons systems being developed for employment in the NATO theater shall conform to a common NATO requirement.”

The Secretary of Defense is now authorized to buy other than U.S. military equipment to implement this important objective of fielding military equipment in conformance with NATO’s standardization principles and long-range (10-20 years) operational concepts, such as those developed by NATO’s Tactical and Logistical Concepts Panel XI.

Implementation of this policy, in the near and mid-range time frames, may result in more U.S. procurement of arms and equipment from NATO member nations. Greater reliance will be placed on licensing and coproduction agreements within the alliance. New initiatives will be required by Panel XI to develop operational concepts for the long-range time frame sufficiently broad to guide future NATO armies RD&E.

Material standardization has been a persistent concern of NATO because of the advantages it contributes to over-all military effectiveness and cost savings in RD&E. GEN Goodpaster, former Supreme Allied Commander, Europe (SACEUR), estimated that lack of standardization has taken a toll of at least 30 percent of NATO military effectiveness.

The extent of the problem is illustrated by the current costly duplication of equipment types among major NATO nations (see Table 1). Elimination of this problem is among primary new initiatives targets.

TABLE 1. Duplication of Equipment Among NATO Allies

<table>
<thead>
<tr>
<th>Alliance Member</th>
<th>NATO Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>Belgium</td>
</tr>
<tr>
<td>France</td>
<td>West Germany</td>
</tr>
<tr>
<td>West Germany</td>
<td>Luxembourg</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Canada</td>
</tr>
<tr>
<td>Italy</td>
<td>Denmark</td>
</tr>
<tr>
<td>Canada</td>
<td>France</td>
</tr>
<tr>
<td>Norway</td>
<td>Denmark</td>
</tr>
<tr>
<td>Portugal</td>
<td>France</td>
</tr>
<tr>
<td>United States</td>
<td>Canada</td>
</tr>
</tbody>
</table>

This article attempts to describe standardization goals and organization with emphasis on NATO’s Tactical and Logistical Concepts Panel XI, including its method of operation, current work program, and some suggested new initiatives for consideration.

The NATO Glossary defines standardization as the process by which member nations achieve the closest practicable cooperation among forces, the most efficient use of research, development and production resources, and agree to adopt on the broadest possible basis the use of:

- Common or compatible operational, administrative and logistic or technical procedures and criteria.
- Common, compatible or interchangeable supplies, components, weapons or equipment.
- Common or compatible tactical doctrine with corresponding organizational compatibility.

Standardization of specific materiel or tactical items in NATO is sought at one of three levels, depending upon need and other factors. These are interchangeability, interoperability, compatibility. Interchangeability exists when two or more items can be exchanged for each other between NATO armed forces. Interoperability is the ability of systems, units or forces to provide services and to accept services from other NATO armed forces. Compatibility is the capability of two or more items or components of equipment to exist or function in the same system with other NATO armed forces.

Achievement of the appropriate level of standardization, in each case, contributes to the broader aim of “rationalization,” defined as “any action which makes more efficient or effective use of the resources devoted by the alliance to defense.”

One of the key mechanisms specifically designed to achieve standardization of armaments and other equipment in NATO is the Conference of National Armaments Directors (CNAD). The Director of Defense Research and Engineering is the U.S. representative. CNAD is on the civilian side of NATO’s organizational structure, as

Fig. 1. NATO Organization

Fig. 2. NATO Standardization Organization

Fig. 3. NATO Army Armaments Group (NAGG) Panels
shown at Figure 1, but is, in fact, a hybrid civil-military organization; its supporting Armaments Group and subelements consist of national military officers. The CNAD proper has a major general representing the Military Committee and two or three of the National Armaments directors are general officers.

Reporting directly to the North Atlantic Council, CNAD thus has a speedy means of channeling forward the results of its forum activities in which it strives for “cooperation as easy and advantageous as possible.”

The Service Armament Groups, composed of national military officers, are a major component of the CNAD forum (Figure 2). Each group supports the CNAD by exchanging information “to identify common concepts, doctrine, national equipment programs and policies, and the logistic aspects thereof.” The NATO Army Armaments Group (NAAG) is of primary interest because it relies on Panel XI as one of its 11 equipment panels and one working group, as shown at Figure 3, to accomplish NATO Army materiel and nonmateriel military standardization.

Accomplishment of these objectives and adherence to operational principles are aided by the Military Agency for Standardization (MAS). The MAS (Figure 2) is the Military Committee's primary agency to implement formal standardization agreements in NATO.

While the CNAD is concerned primarily with future armaments, the MAS is concerned with the interoperability of existing equipment and with procedural and doctrinal standardization. Policy is formulated by the Military Committee, reporting to the North Atlantic Council.

Panel XI is charged with the development of long-range (10-20 years) operational concepts to provide guidance in research and development for the 11 NAAG equipment panels. Panel XI has a key role in the CNAD forum because these long-range operational concepts result in nonmateriel standardization policy that decisively impacts on NATO RD&E.

Ideally, this process begins at the long-range conceptual stage and continues through to the NATO adoption of standardized operational policies and procedures for fielding equipments and weapons systems. Panel XI seeks to establish commonality by developing and reviewing long-range concepts to identify capability requirements of future military material.

Military personnel are charged with developing and obtaining approval for Panel XI operational concepts, even though the panel works on the civilian side of NATO, as mentioned earlier. Currently, BG J. J. M. Antonietti of the Netherlands is the panel chairman. The secretary is a Belgian officer assigned to the international staff. Primary and alternate Panel XI members represent each of the participating NATO countries, along with an observer/assistant officer from Supreme Headquarters Allied Powers, Europe (SHAPE). This group represents national defense decision-making bodies at meetings. It also prepares and processes long-range concepts for final approval, usually at HQ NATO in Brussels, Belgium.

NATO Panel XI

CA leaves

Long-Range Operational Concepts

HQ DA Approval

DSRD-I

CD

OSR

Fig. 4. U.S. Processing of Panel XI Operational Concepts

Operational concepts are prepared by designated national sponsors who generally have preeminence qualifications within specific subject matter areas. Some inputs are prepared jointly by groups of nations such as EUROGROUP (Belgium, Denmark, Germany, Greece, Italy, Luxembourg, Netherlands, Norway, Turkey, United Kingdom.)

After a nationally or multinationally approved first draft is prepared, it is staffed with NATO member armies and revisions are discussed at panel meetings and by correspondence between meetings. Revisions are staffed until consensus is reached. When this occurs, an approved NATO operational concept is published and distributed to the NAAG equipment panels and other interested parties.

Preparation and staffing of operational concepts within the U.S. Army is accomplished by the Strategic Planning Group of the Army's Concepts Analysis Agency (CAA), Bethesda, MD, which provides the U.S. delegation to Panel XI. As the Action Agency for Panel XI, CAA responds to directives of the Deputy Chief of Staff for Research, Development and Acquisition (DCSRDA), the Administrative Agent.

The U.S. Army Deputy Chief of Staff for Operations (DCSOPS) provides the point of contact on the HQ DA staff for national coordination and approval. Accordingly, CAA supports the decision-making process by coordinating and staffing input with the Training and Doctrine Command (TRADOC), the Materiel Development and Readiness Command (DARCOM), and other interested Army agencies, as well as initial development of U.S.-sponsored operational concepts.

After HQ DA approval, CAA represents the United States in further coordination with Panel XI and ensures that required follow-up actions are taken. See Figure 4 for an overview of this process.

Panel XI has completed nine operational concepts to provide guidance to the NAAG equipment panels on R&D in the long-range time frame. These documents, sponsors, and dates of approval are shown below.

### Approved Panel XI Operational Concepts

<table>
<thead>
<tr>
<th>Subject</th>
<th>Sponsor</th>
<th>Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low and Very Low Ground Based Air Defense</td>
<td>UK</td>
<td>Sep 73</td>
</tr>
<tr>
<td>Attack of Armor by Direct and Indirect Fire</td>
<td>US</td>
<td>Jan 74</td>
</tr>
<tr>
<td>The Armored Vehicle Family</td>
<td>FRG</td>
<td>Jan 74</td>
</tr>
<tr>
<td>Maintenance of Mobility</td>
<td>UK</td>
<td>Feb 74</td>
</tr>
<tr>
<td>Requirements for Indirect Fire Support</td>
<td>FRG</td>
<td>May 75</td>
</tr>
<tr>
<td>Battlefield Surveillance and Target Acquisition</td>
<td>Italy</td>
<td>Apr 76</td>
</tr>
<tr>
<td>Urban Warfare</td>
<td>FRG</td>
<td>May 75</td>
</tr>
<tr>
<td>Command and Control With an Emphasis on ADP</td>
<td>US</td>
<td>Apr 76</td>
</tr>
<tr>
<td>Long-Range Countermobility Concepts</td>
<td>US</td>
<td>Jan 77</td>
</tr>
</tbody>
</table>

The Panel XI work program currently contains three operational concepts in preparation, as shown here:

### Panel XI Operational Concepts in Preparation

<table>
<thead>
<tr>
<th>Subject</th>
<th>Sponsor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of the Main Battle Tank in Future Warfare</td>
<td>BE</td>
</tr>
<tr>
<td>The Implications of Sustained Day and Night Operations</td>
<td>US</td>
</tr>
</tbody>
</table>

Three operational concepts now being processed are expected to be available for distribution to the NAAG equipment panels by late 1977. With their completion in sight, this is a good point in time to begin consideration of new initiatives for Panel XI.

New initiatives will be determined by the entire panel under guidance of its chairman. These will be affected by any restructuring of the NAAG in response to CNAD management. The NAAG is continuing its efforts to develop an organization with military standardization as its primary mission. Ultimately, this will produce an organization more fully capable of translating the long-range military commonality identified by Panel XI into hardware-oriented operational requirements.

My opinion is that as standardization efforts continue to make progress, Panel XI's new initiatives supporting the objectives of the NAAG should include, among others, the following "core" operational concepts.

A NATO overall operational concept, similar in scope to the ABCA (American, British, Canadian, Australian) 86-95 Operational Concept, to guide research and development of tactics, equipment, and logistics for the NATO armies during the long-range time frame. This would provide the general framework necessary for developing two additional operational concepts—a NATO tactical-operational concept to support armies executing NATO tactics and strategy in the long-range time frame.

Agreement on a tactical, logistical, and an overall operational concept will require extensive research and reasoned exchange of views over several years. Considering that Panel XI will complete its current work program, it is in an excellent position to accomplish "core" operational concepts such as those outlined above.

Public law 94-361 has given new impetus to NATO military standardization. This legislation will make it far easier to achieve two objectives for United States cooperation RD&E efforts announced earlier this year as:

- Reducing the shortfall, in real terms, between the United States RD&E program and that of the Soviets by making greater use of the RD&E of our allies.
- Increasing NATO military force effectiveness through increased common or interoperable hardware and the resultant efficiencies in procurement, training, logistics, manpower and operational flexibility.

Panel XI's new work program will benefit greatly, I believe, from this "strategy for military standardization" as it contributes to achieving these objectives by developing long-range RD&E operational concepts.

MAJ JOHN D. ELLIOTT is assigned to the Strategic Planning Group, U.S. Army Concepts Analysis Agency, Bethesda, MD. He received a B.A. degree from the University of Maryland, and a doctoral student in political science at George Washington University.

MAJ Elliott's assignments have included duty with the Army Ordnance School, HQ U.S. Army Europe, Office of the Deputy Chief of Staff for Logistics, and Special Forces in Europe and Asia.

A frequent writer on defense issues, MAJ Elliott has prepared a more in-depth analysis of this subject in his essay, "The Impact of Military Standardization on American National Security," to be published soon in a book on related subjects by the International Studies Association.
Walter Reed Army Institute of Research . . .
Activities in Many Lands Build Solid Base of World Renown

World renowned is a descriptive distinction term too often applied loosely by publicists of agencies and individuals contending for top recognition and honors awards. When applied to 84-year-old Walter Reed Army Institute of Research, it prompts an international chorus of concurrence.

WRAIR's history of exceptional scientific achievements—starting with those of the U.S. Army physician for whom the institute is named—has been acclaimed by a continuing expression of gratitude for "medical marvels" and humanitarian service in many nations.

Assistant Secretary of the Army for Research and Development Edward A. Miller gave the WRAIR staff members one of their proud moments in 1975 when he presented to them the "Army Laboratory of the Year" award.

Criteria for this selection include "the degree to which each Army laboratory realizes its full potential impact in enhancing operational force capabilities." An ad hoc panel of noted scientists makes the evaluation.

Accomplishments cited by the panel included: Characterization of virus antigens; establishing more firmly the military requirements (with civilian community "spinoff" benefits) for the hepatitis vaccine; demonstrating the feasibility of development an immunizing agent using microbial genetics—that is, studies of diarrhea-producing bacteria.

Another achievement considered by the
-WRAMC Reports

Severing Laryngeal Nerve Remedies Loss of Speech

Spastic dysphonia, a voicebox disorder that had worsened steadily since 1964 until a Washington, DC, woman was almost completely deprived of oral communication, was corrected, except for a lingering huskiness, by a recent operation at Walter Reed Army Medical Center. Dr. (LTC) Robert Henderson, chief of the WRAMC Ear, Nose and Throat Service, commented that the resection of the laryngeal nerve operation may be the first of its kind in the U.S. outside the San Francisco area.

Louise Barkin had been virtually unable to talk to her husband, a retired officer, since 1975 because of her affliction and the loss of hearing she suffered from bombs during World War II.

When she was told by her doctor, Dr. James McFarland, that her condition was rare, and that the only U.S. doctor known to have performed corrective surgery was Dr. Herbert Dedo at the University of California, she remembered WRAIR's famed capabilities.

"I thought it was inconceivable," she said, "that at a teaching hospital like Walter Reed there would be nobody who was not familiar with the procedure. It turned out that Dr. Henderson had operated on a similar case with Dr. Dedo while he was stationed in California."

Dr. Henderson explained that the operation, involving cutting one of the nerves in the voicebox, is a comparatively simple procedure. This paralyzes the vocal chord on one side of the larynx. Normally the two chords come together and air passing between them causes them to vibrate and produce sound.

In her case, they came together with such force that no vibration was possible. Keeping the chord on one side in place by severing it enabled the other chord to come all the way across the larynx opening to produce vibration for the power of speech.

WRAIR Headquarters is located on the grounds of the Walter Reed Army Medical Center, Washington, DC, along with the Armed Forces Institute of Pathology, the Walter Reed Army Hospital, and other tenant activities, laboratories and animal-holding facilities.

Results served to instill a properly respectful appreciation of the worldwide impact of WRAIR activities.

WRAIR R&D to advance medical technology and improve patient treatment procedures are managed by a director and commandant. The dual title is used because the responsibilities are those of a director of a research laboratory and commandant of a school.

With his headquarters staff, the director/commandant manages 14 WRAIR divisions, and the Special Foreign Activities (SFA) in Malaysia, Brazil, Thailand and Kenya. The divisions dealing with research are: Communicable Disease and Immunology, Surgery, Medicinal Chemistry, Neuropsychiatry, Veterinary Resources, Biochemistry, Medicine and Pathology.

Each of these divisions pursues independent research but they also serve each other. Interdisciplinary studies and resources provide enrichment across the broad lines of study encompassed by the WRAIR.

Additional service divisions support all of the WRAIR research, providing data processing (Division of Biometrics and Medical Information Processing); and the development and fabrication of special laboratory tools (Division of Instrumentation).

Other areas of effort are motion picture and still photography and medical illustration (Division of Medical Audio Visual Services); purchasing and contracting, supply and maintenance (Supply and Service Division).

Training, both the courses taught by WRAIR, and that provided for WRAIR, is the respon-
sibility of the Division of Academic Operations. Currently, courses at WRAIR range from individual student programs, under the Clinical Clerkship and Health Professional Scholarship Programs, to the Veterinary Animal Specialist Course (MOS-91T10), conducted by the Department of Instruction, Division of Veterinary Resources.

WRAIR is the parent laboratory for all OCONUS (outside continental U.S.) activities of the Army Medical Research and Development Command. Research is carried out in infectious and communicable diseases, combat injury, and psychophysiological disturbances related to military situations.

Staff is about evenly split between military and civilian, with the military staff divided about 50-50 between enlisted and officer personnel. The current WRAIR staff professional qualifications are attested by 84 MD (Doctor of Medicine) degrees, 119 PhDs, 28 DVM (Doctor of Veterinary Medicine), 152 master’s and 381 bachelor’s degrees.

Personnel are presently operating in five OCONUS locations, at the main headquarters located at the Walter Reed Army Medical Center, and several substations in CONUS. Recent field Army medical emergencies required WRAIR teams in Europe, Korea, Alaska and Fort Dix, NJ.

ROLE IN EDUCATION. The 1893 General Order establishing the Army Medical School stated its purpose was to instruct “approved candidates for admission to the Medical Corps of the Army in their duties as medical officers.” The faculty of four taught: duties of medical officers in war and peace; military surgery; military hygiene; clinical and sanitary microscopy. Over the years, WRAIR has established courses ranging from one-day seminars to year-long studies.

Courses like “Global Medicine” provided for many years the “finest, most authoritative interdisciplinary study of preventive medicine techniques available to the uniformed medical services”—whose members might find themselves faced with medical problems anywhere in the world.

Course sizes range from one or two students, pursuing a narrow field of training, to more than 100 students. The number and sizes of classes, as well as the subjects taught, reflect the changing challenges of military medicine.

ROLE IN RESEARCH. WRAIR’s annual reports reflect its enviable record of continuous contribution to medical knowledge and technology. The Jet Injection Gun for mass immunization programs is a product of WRAIR research familiar to many people all over the world. So are vaccines for Rubella (German measles) and Meningococcus type “O.”

In recent years WRAIR laboratories have explored: characterization of virus antigens through studies of the composition and structure of the dengue virus; epidemiology of hepatitis and the co-occurrence of hepatitis and drug abuse; potential of a vaccine for trypanosomiasis, developed from irradiated trypanosomes, and of possible value in preventing sleeping sickness in humans; feasibility of providing a stockpile of freeze-dried veins in a donor bank for use in blood vessel replacement (the latter two items as reported early in this article).

WRAIR (pronounced “rare”) today represents and exemplifies the man who was soldier, scientist and teacher. Walter Reed was a member of the first faculty, a captain and assistant surgeon. His great work in Yellow Fever made his name synonymous with research in preventive medicine.

Evolution of the Army Medical School into the WRAIR was also the evolution of the science of preventive medicine, as exemplified by Walter Reed’s own work. Now, under the command of COL Garrison Rumpman, MC, WRAIR’s mission still is to research and teach those subjects that are significant in preserving America’s fighting strength.

Malaria Research. Some concerns are of long standing at WRAIR. Malaria, for instance, has been termed the “most persistent enemy we have ever fought.” It is still a threat to military and civilian populations.

As recently as the war in Vietnam, malaria was the number one cause of medical disability for the U.S. Army. In 1968 alone, almost 250,000 man-days were lost, at a cost of over $11 million in medical care.

Part of the problem in Vietnam was caused by the occurrence of a new, drug-resistant strain of malaria. A new system developed at WRAIR, it has been possible to break down, screen and test for anti-malarial activity more than 225,000 chemical substances.

The computer system is able to print-out 2-dimensional representations of the chemical compounds. Once a substance has been put into the computerized system, it is instantly available to the other antiparasitic drug development programs at the institute.

Presently, one such drug, mefloquine, resulting from the $4.2 million annual program, has advanced to the point of clinical evaluation. Investigators report that, so far, it has proven reliable and safe.

Adenoviral Acute Respiratory Disease. In the past, basic training centers routinely figured on 50 percent hospitalization rates for mid-winter trainees due to this disease. WRAIR first isolated adenovirus Type 4 in the early 1960s and by 1965 a successful vaccine had been developed for testing.

In 1968, WRAIR began development and testing of a vaccine against Type 7. Since 1974, oral vaccines have been given routinely against both types with great success. For instance, adenovirus has been isolated in less than 5 percent of the trainees hospitalized since 1973 at Fort Dix, NJ.

The two vaccines were developed at a cost of $4.84 million. In the first two years of administering them, manpower savings to the Army alone were reported at $7.53 million.

More than 30 strains of adenovirus are known to affect humans, which explains why WRAIR maintains a continuous surveillance of long-term assessment program. One payoff has been in the vaccine developed for ADV 21.

First identified in 1966, ADV 21 did not appear as a problem until October 1975, when a vaccine was already under development at WRAIR. The surveillance program indicated that ADV 21 would have Department of Defense-wide impact, and plans were made to field test it among recruits in the Air Force and the Army.

Results of the serologic testing conducted at WRAIR proved not only the efficacy of the vaccine, but also that it could be taken together with the type 4 and 7 oral vaccines without difficulty.

Microwave Research. New developments in battlefield technology bring new concerns in military medicine. Microwaves, usually associated with communications and cooking, are also a part of missile guidance and tracking systems, navigation and portable radar.

In modern warfare, the over-abundance of microwave propagation can create a hazard to the unprotected soldier fighting beneath what should be a protective shield. Research, leading to a better understanding of these high-frequency electromagnetic waves is essential to establish levels of exposure that can be absorbed safely by the human body.

Working through its resources in neuro-psychiatric research, WRAIR has developed a program that seeks, first, ways of measuring behavioral and morphological changes. The second task is to define safe levels of exposure to the wide variety of possible microwave sources. It is not unusual for WRAIR scientists to find themselves in a situation where progress (Continued on page 18)
WRAIR Activities Build Solid Base of World Renown

in research depends on tools not yet developed. In microwave biohazards research, for example, computers have been adapted to provide constant analysis and monitoring of the minute amounts of microwave energy delivered to test animals to produce the desired exposure. Tests are performed in specially constructed anechoic chambers at the institute's microwave research facility. One major barrier, when the microwave project was started, was the inability of existing instrumentation to measure directly the effects of exposure on living tissue. Measuring devices would succumb to exposure effects before the tissue being tested. WRAIR has succeeded in developing devices capable of withstanding microwave radiation while the surrounding tissue responds in a measurable way.

OVERSEAS OPERATIONS. Since the days of the Yellow Fever Commission, when Walter Reed did his famous work in Cuba, the WRAIR has relied on overseas research stations to provide the core of its research. Field teams and overseas research laboratories have operated since 1945 in Japan, Puerto Rico, Korea, Germany, the Ivory Coast, Argentina, Vietnam, and Alaska. Today, WRAIR researchers are at work in Malaysia and Thailand, Kenya, and Brazil. This year, WRAIR researchers will return to Europe.

EUROPE. Modern concepts of sustained mobility and continuous combat operations have raised new questions as to the limit of men's capacity to function in extended operational demands. WRAIR team deployed to Europe will be testing medical hypotheses about relationships in units, maintaining individual and unit effectiveness, and examining the extent to which these factors contribute to the dis- tribution and spread of medical problems among U.S. Army Europe personnel.

KENYA. Trypanosomiasis (African Sleeping Sickness) has been the major concern of this laboratory. Research performed in-country, with continental U.S. support, has demonstrated that certain trypanosomes causing this illness in man are serologically indistinguishable from parasites infecting domestic cattle. This finding has yielded an important inter-epidemic reservoir of trypanosomes that may contribute to understanding periodic trypanosome epidemics in man. It has also shown Central Nervous System abnormalities in cattle infected with trypanosomes have, for the first time, proven very similar to changes observed in man.

Consequently, cattle might be an appropriate model for the development and testing of vac- cines and other protective measures. In another test, gamma-irradiated trypanosomes used to inoculate cattle produced immunity against the same but nonirradiated strain, thereby demon- strating the feasibility of vaccine protection.

BRAZIL. Two separate projects are underway at Belen and at Brasilia. In the Amazon Basin, WRAIR researchers are studying the effects of disturbance of virgin tropical forested terrain, as the Brazilian Government moves to open new settlements along the route of a new highway to the Peruvian border. The first cooperative research into the causes of febrile disease among Amazon Basin residents has been completed. Malaria and certain arbovirus infections have been identified as the major diseases.

In military terms, the investigation provides an insight into the health consequences of a large-scale disturbance of virgin terrain, such as may occur in wartime.

The second research effort is a joint venture with the University of Brasilia. WRAIR is working to identify new drugs effective in the prevention and control of sleeping sickness. This is considered the number two parasitic disease in the world. It poses a severe threat to U.S. Forces which may be required to operate in endemic areas of the World.

Presently, there are no effective drugs that will prevent this disease, also known as "sleeping sickness." Until a measuring device would succumb to exposure effects before the tissue being tested. WRAIR has succeeded in developing devices capable of withstanding microwave radiation while the surrounding tissue responds in a measurable way.

The call for submission of proposals states in information and develop potential solutions to vector-borne diseases. In another area, WRAIR has focused its efforts on dengue fever. Recent studies have characterized more than 18 ARMY RESEARCH AND DEVELOPMENT NEWS MAGAZINE MARCH-APRIL 1977

18 ARMY RESEARCH AND DEVELOPMENT NEWS MAGAZINE MARCH-APRIL 1977
Utilizing Reliability in Materiel Acquisition

By Jim McCrory

Applied to U.S. Army materiel requirements, reliability is used most often in the context of designing in, demonstrating or improving reliability. This is in keeping with the concept of having reliability as a major goal in the design stage and then providing for it to grow to maturity goals by the process of find-and-fix.

This find-and-fix process is accomplished by testing to define areas requiring improvement, initiating essential product improvement, and testing to verify its adequacy. These steps of designing in, demonstrating, improving, and again demonstrating reliability constitute the bridge between concept formulation and the fielded system. They are thus characteristic of reliability growth.

Almost all major development programs in Army aviation today are based on the concept of reliability growth. Considerable methodology has been developed in this area by the Army Materiel Systems Analysis Activity (AMSSA). The Army can, by tracking reliability growth through the various stages of materiel development, insure that reliability gets proper attention to achieve maturity goals on schedule.

Another aspect of reliability related to the test function, and which completes the reliability bridge of design, demonstration, and improvement mentioned earlier. This link in the bridge is utilizing reliability, which is the real payoff. An example of how reliability can be and has been utilized to the benefit of the Army is evident in the T53-L-13 engine that powers the UH-1H and AH-1GQ aircraft. When the T53-L-13 engine was introduced into Army testing, the time-between-overhaul (TBO) was 300 hours. The time-between-inspection (TBI) was 150 hours.

Early in the flight test program at the U.S. Army Aircraft Development Test Activity (USAADTA), Fort Rucker, AL, several problems were identified. The engine’s hot-end inspection interval, for example, was limited due to a circumferential cracking problem in the first-stage gas producer nozzle.

The Powerplants Branch, Aviation Systems Command (AVSCOM), St. Louis, MO, initiated and managed development of several types of modified nozzles by Lycoming Division of AVCO Corp. Each type of nozzle that appeared to offer some tangible improvement was flight tested at USAADTA. A cast nozzle was found to be the solution to the circumferential cracking problem and it was adopted as standard.

A number of other problems were encountered during the USAADTA flight test program. Solutions were developed by the engine manufacturer through AVSCOM management. One of the most significant problems was a catastrophic failure associated with the aluminum axial compressor disc. Introduction of a titanium compressor blade resulted in a solution to this problem. The original T53-L-13 engine, by this process of find-and-fix, evolved to the T53-L-13B configuration.

As problems were identified during the flight test program and solutions demonstrated to be acceptable, it became more evident that the hot-end inspection interval and the time-between-overhaul could be extended.

The TBO, for example, was rapidly extended to 1,200 hours with a 300-hour TBI. This made the TBO and TBI of the T53-L-13 series engines comparable in those respects to other turbine engines operating in Army helicopters.

The substantial investment in achieving solutions to problems, however, appeared to the testers at USAADTA and the personnel in the AVSCOM Powerplant Branch to have purchased a considerable improvement in reliability over and above that necessary to support the then established TBO and TBI.

Based on this evidence, USAADTA, with the concurrence of AVSCOM, initiated an effort to utilize the reliability of the improved T53-L-13B engine by investigating, through flight testing, the feasibility of extending the TBO and TBI.

Test engines were flown beyond the authorized TBO and TBI. Detailed documentation was developed for the condition of individual parts at selected inspection intervals. Performance of the engines was monitored by daily engine data acquisition and by the newly developed engine health indication test (HIT) system.

Performance data were reviewed daily and all inspections were conducted by USAADTA aerospace engineers. Results were documented to AVSCOM in reports, and recommendations relative to the TBO and TBI with supporting rationale were forwarded to AVSCOM, as appropriate. Test flying was done by Army aviators and was designed to duplicate field flight conditions to which it was expected the engines would be exposed.

Test profiles were based on interviews with personnel returning from Southeast Asia and were coordinated with AVSCOM to assure validity of test conditions and the integrity of the test data. The U.S. Army Aircraft Development Test Activity thus became the spearhead used to break the barrier of the then established TBO and TBI, which, as noted previously, were comparable with other existing turbine engines used in Army helicopters.

Once USAADTA had demonstrated in a controlled test environment and documented by detailed inspections the feasibility of longer inspection intervals and higher TBOs, AVSCOM was able to broaden the sample from the two or three engines at USAADTA by directing selected units to operate helicopters to the higher TBO and TBI intervals.

The TBO of the T53-L-13B engine was increased by this method in an orderly manner to the current field level of 1,800 hours and the hot-end inspection interval was deleted. T53-L-13B engines at the Fort Rucker Aviation Center now operate with a 2,400 hour TBO and no scheduled hot-end inspections.

The engine HIT system, developed at USAADTA, is used to monitor engines during operation to indicate the need for a hot-end inspection. The deletion of the scheduled hot-end inspection is based in part on the use of the HIT system. The extended TBO, and to a considerable degree, the deleted scheduled hot-end inspection interval, however, were made possible by the significant improvement in reliability achieved through the product improvement programs initiated by AVSCOM’s Powerplant Branch.

The increase in TBO and deletion of the scheduled hot-end inspection requirement should have salutary effects on the operational availability of aircraft powered by the T53-L-13B engine and on the maintenance manhour requirements. Improvements in operational availability and maintenance manhour requirements were made possible by completing the reliability bridge.

To the link of designing in reliability, and to the iterative reliability growth links of demonstrating and improving reliability, must be added the link of utilizing reliability. A major effort to design in reliability, when coupled with an active program of tracking and growing reliability, during development by the iterative process of demonstrating and improving reliability, can lead to a fielded system that achieves goals set during concept formulation.

Setting of maturity reliability goals and the improvement actions taken during the reliability growth period, however, do not represent a pure science. Concept formulation goals and any improvements realized during the development period are not likely to converge precisely to reach a previously envisaged design objective relative to inspection or overhaul policy. What constitutes the reliability limits relative to inspection and overhaul periods may not be known.

This twilight zone of reliability can best be investigated by a controlled flight test program during which the boundaries of safe, reliable operation can be surveyed. This can lead to the increased operational availability and reduced maintenance manhours that are characteristics of a cost-effective system. The T53-L-13B engine has, by utilizing reliability, established a benchmark of success for future helicopter turbine engines.

The advances achieved with the T53-L-13B engine may be transferred to other helicopter dynamic components by properly planned and executed test programs. To achieve early cost-effective operation of newly developed aircraft, maturity phase test programs should be designed to investigate the boundaries within which reliability can be safely utilized.

This policy will benefit the Army in the years ahead in both operational availability and the dollars required to support fleet operations.
Bridge Reinforcing Systems for the 1980s

By William R. Abell

U.S. Army Mobility Equipment Research and Development Command engineers have proved again that because something has been done a certain way for many years, it does not necessarily mean that it is the best way—that innovative thinking may lead to improvement.

This example involves the reinforcing systems used to reinforce the Bailey Bridge and the Medium Girder Bridge (MGB) to extend them from their basic design span to longer spans. To extend the MGB from its basic 30-meter design to 50 meters, a reinforcing kit (Figure 1) with 8 steel cables with queen post frames is used.

When the cables and frames are in place, each cable is tensioned to 22 tons with a hydraulic jack. When fully prestressed, the bridge has 176 tons of energy built into the cables, which results in a bridge camber of approximately 22 inches.

During recent tests on the MGB, it was observed that when a 60-ton tank crossed the bridge, it just about resulted in elimination of the camber. Obvious also was that the bridge's inherent strength was not being challenged in the least by the crossing load, due to the built-in prestress.

Since the bridge has sufficient strength to span 30 meters when subjected to class 60 loads, the first question was why not utilize this strength in extending to longer spans? It seems logical that at the longer spans, the top and bottom chords should be stressed to the same level as they are at the 30-meter span.

Similarly logical to assume was that, by utilizing this inherent bridge strength, the number of reinforcing members could be reduced, and also the amount of pretensioning would be almost as much as any, of pretensioning. We knew, if our assumptions were correct, we would not only effect a vast saving in material but also in time and manpower requirements.

We decided that the best approach to test our theory would be to construct a 50-meter bridge and prestress it to the 22-ton per cable level, then to subject it to a class 60 load and record the stress levels and deflections. Further, we would reduce the prestress loads in 1-ton increments, and load the bridge at each prestress level with a class 60 load—recording the data until we had attained the desired stress in the top chord of the bridge.

How did our theories prove out? I will give a few of the prestress levels with their results; however, this is sufficient to show the trend. Please keep in mind that the prestress introduces a camber in the bridge, and that deflections given are the changes in deck elevation from the unloaded prestressed condition to the class 60 loaded condition.

Remember also that the stress in the top chord when subjected to a class 60 load at an unreinforced condition and at a 30-meter span is approximately 31.5 Ksi (thousand pounds per square inch).

With each cable prestressed to 22 tons, the load in the cables increased to 42.5 tons when the bridge was subjected to the class 60 load. The maximum top chord stress was 9 Ksi; compression and the resultant deflection was approximately 22 inches.

The load in the cables increased to 33.5 tons at a cable prestress of 15 tons. The maximum top chord stress was 16 Ksi; compression and the resultant deflection was about 16.4 inches.

The load in the cables at a prestress level of eight tons increased to 24.5 tons, resulting in a top chord stress of about 19.7 Ksi and deflection of roughly 11 inches.

When the load in the cables was increased to 15.6 tons at a prestress level of two tons, the top chord stress was 23.6 Ksi and the deflection approximately 6.5 inches.

Unfortunately, our test setup did not permit us to reduce the cable prestress below two tons. Indications were that the stresses in the top chord at the 30-meter unreinforced condition could readily be balanced with the stress at the 50-meter reinforced span by proper adjustment of the reinforcing cables. Results at selected prestress levels are shown in Figure 2.

Every indication in research to date, it can be seen, is that the number of prestressing cables can be reduced by at least 50 percent. In all probability, no prestressing will be required. Thus, savings in time, money, and manpower to be realized become very significant. Further savings and simplifications can be realized.

Because of the high prestress and the resultant high forces in the cables while under load, it was necessary to reinforce substantially the bridge members where the cables are terminated. Due to the vast reduction in prestress loads in the cable, these members in all probability can be changed back to their original designed condition without the necessity of adding weight and cost.

Before these reductions can be made, extensive traffic tests will be needed to assure there are no secondary stresses, bridge reactions, etc., which might be detrimental as a result of reducing the prestress. However, it appears almost a certainty that this approach will be the subject of subsequent product improvement projects on these items in the near future.

Investigations to date are having an influence on our Bridging in the 80s reinforcing system. Based on our calculations and test results, our design will incorporate only one reinforcing tension member per girder and a very small amount, if any, of pretensioning. This will permit us to attain the rapid bridge construction times required for highly mobile forces.

Our research results, we believe, point out that Army scientists, engineers, technicians and program planners should always be alert to possible ways of improving equipment to make it cost less and require less manpower to use.

Figure 2

WILLIAM R. ABELL, chief of the Bridge and Structures Division of Lab 5000, U.S. Army Mobility Equipment R&D Command (MERADCOM), began his Civil Service career in 1957 and has worked at the Fort Belvoir, VA, activity since 1955. He received his BS degree in civil engineering from the University of Kentucky and is a registered professional engineer.
Speaking On . . . (Continued from inside front cover)

ness. In addition, the Soviet soldier has traditionally, and with justification, prided himself on his night-fighting capability. He trains constantly in snow and bad weather.

Our weaponry must not be limited by ambient light or fair weather or it will be of little use to us the majority of the time. Hence we give our attack helicopters a day-night adverse weather capability and our tanks and antitank missile systems an excellent passive night-vision capability. We fortunately have the capability on the Soviets in thermal imaging, and need to continue pursuing that technology.

ARE THE SOVIETS ADDICTED TO ARMOR? A debate of moderate proportions has been continuing in this country over the survivability of the tank on the modern battlefield. An echo of it may be seen in the military journals of the Soviet Army. The future of the tank was questioned as early as 1919 by Brussel, who after witnessing an antitank guided missile destroy one in a demonstration.

The doubts were magnified, of course, by the temporary but significant success of the Stug (missile) against Israeli armor in 1973. The tankers have apparently prevailed, however, and the Soviets have concluded (correctly in our opinion) that the importance of the tank on the battlefield has not diminished, but that some alterations in tactics are required to accommodate the increasing antitank missile threat.

There is, however, a trace of stubbornness to be noted in the Soviet dismissal of the increasing variety of threats to the tank. They may be sticking with the tank out of habit and the dusty World War II memories of the decision-makers rather than out of sound reasoning.

As recently as September of last year, Marshal of Tank Troops Babadzhanyan was quoted in Pravda as saying: "It is true that in some capitalist countries' armies, the opinion has lately been voiced that, in connection with the appearance of... antitank guided missiles, helicopters and so forth, tanks are beginning to lose their former significance."

We do not think so. Soviet military art assigns to tank troops the role of the main strike and maneuver force of the ground forces. Soviet Tankmen Day, and many other occasions, carry forth ringing and deserved tributes to Soviet armor in World War II, and its vital role today.

The Soviets are accomplished tankers and tank producers. We tend to think of tank expertise as a German forte, but often forget that the vast majority of German tanks that fought in World War II were greatly outclassed by the T-34, easily the outstanding ground weapon of World War II. The Russians, despite unbelievable wartime devastation, managed to produce over 95,000 tanks in four years, and about as many since then.

WHY SO MANY TANKS? Soviet ground forces, especially in Europe, are the most tank-heavy of any nation in the world, with a density of almost 16 tanks per thousand troops. The emphasis on armor stems primarily from two sources. The first is the ever-present Soviet eye to the past. The second, and more ominous, is the probable nature of a Soviet and Pact concept of a successful attack on Western Europe.

The Soviets are reputed to regard "General Winter" as "fascist propaganda." They feel that the destruction of the German forces was effected not by the cold, nor the blundering of Hitler, but by the heroism of the Soviet soldier, specifically the tank.

The Russians, one must remember, were the victors at Kursk. The largest tank battle ever fought saw such a density of armor on the battlefield that, in some cases, opposing tanks began ramming each other because they were too close to each other to bring their guns to bear.

BLITZKRIEG IS HIGHLY REGARDED. The Soviets also considered themselves, and not the Germans, as the originators of the blitzkrieg, and with point with pride to the Manchurian campaign of August-September 1945 which they claim caused the surrender of Japan. (In Soviet mythology, the atomic bombs were dropped by the United States to intimidate the Soviets, not the Japanese. The really telling blow to Japan they feel was the Manchurian blitzkrieg).

The blitzkrieg did make spectacular advances but against weak, often decimated, Japanese forces, which were equipped and demoralized. Still, one suspects that the Soviets are confident of a European repetition of the Manchurian campaign in the event of war.

This, in conjunction with the tank-heavy nature of their combined arms forces, forces our conviction that any conflict in Europe could be initiated by the Pact on a surprise basis, with a virtual absence of mobilization or warning.

The Soviets consider the offensive to be paramount in combat. Forced to be on the offensive through much of the war when their erstwhile Nazi friends surprised them, they suffered as many as 20 million dead and the ravishment of much of their homeland.

In some cases, they were reduced to training explosives-laden dogs to run under advancing German tanks and blow themselves up. They do not intend to let it happen again. Should the situation require, they will be the attackers, and to do so they have invested heavily in the preeminent instrument of ground offense—the tank.

The Soviets consider the tank to be strictly an offensive weapon that accomplishes their senior officers' request: "the main strike force of land-based troops." Chief Marshal Rotmistrov, last September, saw evidence of "imperialism" and aggressive tendencies in the U.S.—FRG tank standardization efforts (saying: "Let us note that we are talking of offensive and not defensive propositions."

REQUIREMENT: STOP HUGE TANK ATTACKS. Clearly, then, stopping Western Pact armor is essential to winning any war which might break out in Europe. The Army has been criticized at times for its seeming preoccupation with antitank weaponry and the apparent redundancy of some of its systems. Hellfire, TOW, Dragon, Copperhead, Viper, mines, Javelins, the AAH, and the XM-90, all apparently fulfill precisely the same primary mission: the destruction of enemy armor.

Clearly, we are being defensive in our approach to stopping the Pact. But considering the fact that we have accepted a defensive rather than an offensive role for ourselves, tank-haters armed against us will be the tank, complementary, flexible antitank weaponry is essential to our success.

Other Soviet strong suits are also the result of sad experiences in the Great Patriotic War. The Luftwaffe degraded their troops and tank formations and supply columns in the early stages of the war, with several German pilots destroying or damaging hundreds of vehicles.

The Soviet concern for effective air defense was reinforced by the effectiveness of the U.S. Air Force in Korea and Vietnam. The Israeli destruction of virtually the entire Arab Air Force by surprise attack in 1967 drove home this lesson further;

AIR DEFENSE MAY BE OFFENSIVE. The result of the understandable Soviet deterrence to protect their assets from a sophisticated air threat may be seen in two other "heavy" areas of the Soviet force structure: An enormous fleet of fast, maneuverable interceptors, and a redundant, sophisticated, interlocking air-defense missile and gun system.

While the system, or at least a segment of it, may be interpreted as offensive in design, for the SA-6, SA-7, SA-8, SA-9, ZSU-23-4 gun and several other gun systems can keep up with blunting armor and mechanized infantry. They will have to. Based on projected rates of Pact advance (exceeding 50 km per day), the forward elements would run out from under the protection of the larger SA-2, 3, 4 and 5 systems within a matter of days from jump-off.

The Arabs, to their dismay, ran out from under their umbrella in 1973 and suffered tremendous losses from the Israeli attack helicopters. Their HIND, which they have been busily upgrading, are the Soviet equivalent of the SAM-2 and the SA-14 (9K27) system, and we can expect them to do likewise in the face of a formidable NATO ground attack capability would be unthinkable.

Requirement: Aircraft that Can Function and Survive in a High-Related Defense Environment. In this case, the answer is a reaction to one of our strong points, and promises to pose problems for both Air Force and Army aviation. Our tactics and our weapons must accommodate the threat, or our use to our ground forces will be severely constrained.

A steady upgrading may also be noted in the ground attack capability of the Soviet Air Force. Increasing numbers of Soviet high-performance aircraft are now being built to fill a dual role: interception and ground attack. Some, such as the first-line SU-15 and SU-19 Fencer, are being introduced in exclusive ground attack versions.

Protect Our Forces From Ground Attack Aircraft. Standard Soviet fighters, in vast array, also have a ground attack capability, although they cannot perform that role in all aircraft.

While the debate continues on the strategic capability of the Backfire bomber, there is no question of its ability to deliver conventional or nuclear payloads on high value targets anywhere in Western Europe, the British Isles, or the Mediterranean. It would quite possibly be used to attack a short while prior to or concurrent with a westward ground assault.

The Russians, it should be remembered, are no novices in the use of air power in the ground attack and interdiction role, and the Red Air Force delivered over 30 million bombs during the last war. Whether their Air Force is now dominated by the outmoded thinking of "old pilots," as is claimed by the MIG-25 defector, LT Belyenko, remains to be seen.

If the Soviets are impressed by the performance of the U.S. and Israeli Air Forces, they also did not permit the role of the attack helicopter to go unnoticed, and it is now we who are behind in numbers of antitank capable attack helicopters. Their HIND, which they have been busily upgrading, is now the most deadly armed helicopter in the world, and will continue to be until the AAH joins the U.S. Army inventory.

The story, thus, in the Soviet air defense and ground attack area is the same as in virtually all their other departments: massive, redundant and increasingly sophisticated.

The Armada: Remarkable, Increasingly Mobile. Soviet, preoccupation with artillery may be traced to the lessons learned in that nation's disastrous participation in World War I, where she wasted the lives of millions of pitifully equipped, poorly led men before crumbling international opposition. Her stock is now less than half the number of guns as their German counterparts and, worse, only 850 (Continued on page 22)
rounds were available for each gun in the inventory.

Artillery: Biggest Killer on the Battlefield, World War II was the last time the Russians were to be caught short in the fire support area. They claim that artillery inflicts over 50 percent of the casualties on the battlefield (which is generally accepted as a conservative estimate), and have worked incessantly at increasing and improving theirs.

During World War II, in several operations, the Soviets managed to provide one gun in support of every 4-5 attacking soldiers, and in April of 1945 massed an incredible 376 guns per kilometer in support of their crossing of the Teletov Canal.

Marshall of Artillery Kuleshov stated, a few months ago, that a salvo fired by the guns in a Soviet division has increased in aggregate weight over 30-fold from its 1939 figure, and the Commander in Chief of the Warsaw Pact has claimed an 8-fold increase in the firepower of Bulgarian and Polish divisions since the end of the War.

There is little question that a surprise attack on NATO would be preceded by an artillery preparation of devastating proportions. With 152, 130, 122, and 100mm weapons accompanied by 2-ton salvos from multiple rocket launchers and short-range missiles. Their artillery strength is currently three times ours, and the rocket launchers provide a separation capability that we do not possess at all.

The Soviets and their allies do have one weakness in the artillery area, and that is they chose in the past to equip their forces with large quantities of towed tubes, and sacrificed the mobility that self-propelled pieces provide. A 70-kilometer a day advance would encounter almost insurmountable fire-support problems if forced to depend on truck-towed artillery of low cross-country mobility.

Needless to say, the Soviets are now rapidly fielding their own self-propelled pieces, a development which, of course, only serves to reinforce the growing trend toward the blitzkrieg特征 of their weaponry.

Chemical or Nuclear Blitzkrieg? Both! Will a Warsaw Pact assault on Western Europe employ nuclear and chemical weapons? We obviously do not know for sure, but there are indications these weapons would encounter almost insurmountable fire-support problems if forced to depend on truck-towed artillery of low cross-country mobility.

Our tactical nuclear weaponry in Europe poses a tremendous problem for any Soviet plans for an assault on the West. Since we have wisely reserved the option of first use in the event of a Pact invasion, the Kremlin would have to choose options which do not depend on nuclear support. The Soviets have nuclear weapons sites in Europe. 2) Attack conventionally or with chemical munitions in penetrate-and-speed, mass armed forces. Take the chance that we will not employ nuclear weapons to avoid the possibility of strategic escalation. 3) Attack on a broad, dispersed front and present a minimum of attractive targets, thereby losing mass but lowering the risk of nuclear warfare.

Requirement: Insure the Deterrent Value of Tactical Nuclear Weapons by Insuring Their Survivability. Considering some of these possibilities, the importance of the U.S. Army's tactical nuclear weapons, Pershing, Lance and nuclear artillery projectiles, becomes clear. It is impossible to target all of them—especially the projectiles—because of their mobility and ease of concealment.

Soviet Chemical Capability: Awesome. Chemical warfare would almost certainly be employed by the Soviets in the event of a tactical nuclear war in Europe—because if a strategic exchange did not result from tactical use of nuclear weapons, it would obviously not be provoked by chemicals. The more important question is whether chemicals would be employed by the Soviets in a nonnuclear attack? The answer is quite probably yes.

The Soviets are so immersed in chemical weaponry, tactics, doctrine, equipment and personnel, and so much of their training centers around the use of lethal agents, that it would be odd, from a military standpoint, if they did not employ them.

Their offensive chemical capability dwarfs ours to the point that they would be throwing away a possible decisive advantage by not using chemical weapons. Our own offensive chemical weapon arsenal, while not puny, is, at this point probably not a sufficient deterrent, and it is unlikely that we would reply to the use of chemicals against us by initiating atomic warfare.

Chemical warfare, to the Soviet leadership, is just another means of winning. This form of warfare holds for them none of the disgust and fear with which it is justly regarded in the West.

Should a Pact advance be made up of a well-entrenched or massed NATO defense, the use of Soviet chemicals would probably be ordered almost routinely. It would be strange if it were not, for the imbalance in capabilities is so great. Scores of Soviet generals and some 70-100 thousand full-time chemical warfare officers in their armies are not employed in developing a capability which will be ignored should its need arise.

Requirement: A Credible Deterrent to Chemical Warfare. We often forget the pressure on our own government during World War II to use our chemical weapons on the Japanese-held islands in the Pacific. The argument most commonly advanced in favor of the idea was that we had the means to employ it on them while they could not retaliate in kind.

That situation does not prevail in Europe today, but it can be safely stated that to employ chemical weapons on the enemy would be more popular if we were to employ it on them while they could not retaliate in kind.

The answer is quite clear. Despite the fact that the English Charlemagne and move, we are going to have to in fact is that our Japanese-held Chief of the Arsenal, and agnostic about whether chemicals would be employed. They advance.

MARCH-APRIL 1977
SPEAKING ON...

Conscript. He is housed in barracks which are surrounded by barbed wire. His family, if he has one, must fend for themselves in nearby towns. He is not permitted to drive a car, and couldn't afford one if he were, on his three dollars a month salary, He is fed a carefully calculated ration of food, much like a farm animal, and undergoes rigorous physical training and hours of political indoctrination.

Suicide and alcoholism rates are quite high. Garrison life in Eastern Europe is even more dismal. The conscript, when not on maneuvers, is a virtual prisoner in camp, and is permitted no contact with the inhabitants of the host country.

Dissatisfaction with this miserable existence occasionally erupts into mutiny, as on the Soviet destroyer last year, or in defections or desertions, which are punishable by death. Mostly it is stoically accepted as "the way things are." This blind and even brutish obedience permeates every activity of the Soviet soldier, and it will undoubtedly manifest itself in combat.

Requirements: Break the Chain of Communication and Command.

The Soviet conscript or noncommissioned officer is taught not to think but to obey; not to improve or make snap decisions, but to follow regulations to the letter and the chain of command to the link. Enlisted men are normally not familiar with field radios and are frequently denied access to maps, which are classified.

Twenty-nine percent of the troops are not fluent in Russian. Compartmentalization is so strict, for security purposes, that men working only a few feet apart don't learn to speak to each other. A radar van, cannot perform each other's functions, even in an emergency. They can, however, usually perform their own functions quite well.

Training often consists of endless hours of repetitious practice, sometimes on simulators or with crude facsimiles. A Sagger gunner, for instance, performs thousands of simulations before he is even allowed near the real thing.

One of the most profound shocks to Soviet defectors who are given the opportunity to see a few strewn bodies deep behind the lines is the relatively awesome responsibility that our NCOs are permitted. Functions performed routinely here by NCOs are entrusted to field-grade officers in the USSR.

LT Belenko visited an American aircraft carrier for a day and was astonished by the freedom and initiative possessed by the enlisted men, and the effortlessness in which they performed their functions without being badgered or shouted at by officers.

The rigidity and robot-like performance of duty characteristics of the Soviet soldier is a 2-edged sword. In certain types of combat situations, particularly defensive, it can be advantageous as far as allocating (artillery) fire and executing limited precise movements.

In a blitzkrieg-type offensive, with a mobile FEBA (forward edge of the battle area), strange terrain, and the mass confusion associated with intense combat, it is almost impossible for the Soviets, for unit commanders have a pronounced tendency to do nothing rather than make a mistake.

Requirements: Surprise Them on the Battlefield. Expose Them to Weapons and Combat Tactics Alien to Their Training. A Warsaw Pact advance could rapidly degenerate into a disaster if we can A) keep them off balance and surprised, and B) destroy their communications and command and control structure.

If we disrupt their planned routes and rates of advance, we will be forcing hundreds of thousands of soldiers, from squad to division level, to make snap decisions and use their own initiative—things they have been taught to avoid all of their military and civilian lives.

Since a sizable number of troops participating in any attack on the West would be drawn from other Pact nations, primarily Poland and East Germany, they form a part of the equation. Soviet planners must sometimes wonder if they can expect willing support from nations who have been virtual captives of the Soviet Union for almost three decades.

What are some of the phenomena we could expect in the event of a Pact attack on the West? It is almost certain that it would be preceded by an artillery and rocket barrage of tremendous proportions. The Soviets, as we have mentioned, are highly professional artillerymen and are armed with a variety of cannons which equal or exceed ours in quality.

The destructive power of massed modern artillery can be best comprehended by its effectiveness and volume in past wars. At the outset of World War I, planners on both sides projected ammunition expenditures of about seven rounds per day. One of the first great lessons of that war, and one that had to be relearned in the Middle East, was that large conflicts consume almost more of everything than planned. In the case of the artillerist, the field had been undersupplied by expenditures of 500 rounds per day and more.

In 51 months of fighting both sides fired between 650 and 700 million artillery projectiles at each other and almost literally shot their way into bankruptcy. The 6-day artillery barrage at Malmaison consumed the equivalent of 266 30-car trainloads of artillery ammunition alone.

(In the battle of Verdun, four million rounds were fired in seven days along a 7-kilometer front. Soviet explosives were such that the terrain was actually altered in many areas, with hills and forest disappearing.)

Soviet Doctrine: Short Intense Artillery Preparation, then Attack. The Soviets have quarreled with such expenditures, but stress the necessity to reduce the duration of the barrage and increase its intensity. They point out that this magnifies its shock value, scatters and demoralizes the survivors, preventing preparation for defense against the ground attack which follows immediately.

The Soviets are admirably equipped for this type of preparation. Their artillery is accurate and fast-firing, and their multiple rocket launchers produce a carpet pattern of high explosives which reminds one of a B-52 strike.

The initial preparation would coincide with mass air attacks against high-value targets, in order to disrupt attempts to organize the defense. A form of rolling barrage would then precede the armored-heavy spearhead of the assault. This technique, perfected during the first World War to the point where it was claimed that the troops had to stoop so as to allow the shells to clear their heads, has a new significance since the October War in the Middle East.

The Israelis in the early Sinai counterattacks, neglected artillery cover and indulged in a series of disastrous armor attacks against unsuspressed Sagger and RPG armed infantry. It did not take them long to learn their lesson, and it is certain that the Soviets will employ this tactic whenever feasible, despite the difficult terrain in which they are operating.

What would this advance consist of? It is estimated that with a short, limited mobilization the Warsaw Pact could hit NATO forces in Central Europe with 58 divisions armed with 16,000 tanks, and supported by over 3,000 tactical aircraft. A total of 40,000 aircraft could be drawn from the Western USSR in a matter of weeks.

The objective of this colossal force would be to achieve by mass, shock and surprise a large enough hole, or holes, in the NATO defenses to allow a split Allied force, disrupt supply lines and deny NATO the time to organize an effective defense. Tank battles would quickly develop that would exceed, in ferocity and numbers of vehicles committed, anything heretofore seen in warfare.

Requirements: Where It's Needed—Fast. That penetration will be achieved in the early stages of such a war is unquestionable. The Pact will have in its favor not only surprise and mass, but the option of picking the spot to hit (and there are too many possibilities for us to bank on any one in particular).

Our problem then will be to plug the initial holes, and concentrate our forces and fire on the enemy forces which have penetrated. Since we will have to use virtually every man, gun and vehicle we can muster, high mobility is critical. It will be a "come as you are" war, and dependence on anything except forces in place, or readily available, during the first critical days or weeks of the battle would be hazardous and perhaps fatal to our defense.

We obviously feel that the troops who will participate in such a violent type of war must be armed with nothing but the very best we can afford; that mere parity in quality in the face of such an imbalance in quantity is inadequate. The old formula which claims that the attacker requires a 3:1 superiority of force over the defender may be true in small-scale attacks, but anything except an enveloping force invites disaster.

The Soviets will be racing against time as they move toward the Rhine and then the Channel. The German debacle during World War II taught them what happens when a blitzkrieg bogs down and is stopped. If we can stop them before they begin to develop their heavy, self-maligned "tail" in our tooth-to-tail ratio will begin to show its worth; superior staying power of NATO will begin to grind them down and roll them up.

We must, of course, be prepared to fight a longer war, but dependence on anything except forces in place, or readily available, during the first critical days or weeks of the battle would be hazardous and perhaps fatal to our defense.

We definitely feel that the troops who will participate in such a violent type of war must be armed with nothing but the very best we can afford; that mere parity in quality in the face of such an imbalance in quantity is inadequate. The old formula which claims that the attacker requires a 3:1 superiority of force over the defender may be true in small-scale attacks, but anything except an enveloping force invites disaster.

Let us now consider the major types of Soviet equipment and how they match up against both our present equipment and the items that we are asking the committee to approve today.

Assistant Secretary of the Army (R&D) Miller and Deputy Chief of Staff for Research, Development, and Acquisition LTG Cooksey closed their FY 1978 budget proposal with a detailed discussion of comparative qualities of U.S.-NATO Pact weapons systems vis-a-vis those of the Soviets and the Warsaw Pact nations.

Included in their presentation were tanks, their firepower and other capabilities; aircraft systems, firepower, protective armament and ground support qualities; artillery mobility and firepower, armored personnel carriers, the link, projectors, and launchers; antiarmor capabilities; individual ground-launched missiles; sensor systems; tactical communications, radar and laser system target locator; electronic warfare; chemical, biological and radiological warfare aspects; and remotely piloted defense and attack vehicles.
Conferences & Symposia... National JSFH Marks 15th Anniversary... Scientist-Astronaut Heads Guest Speakers

Befitting the 15th anniversary of the National Junior Science and Humanities Symposium, scheduled May 4-7 at the United States Military Academy, West Point, NY, is an all-star group of five guest speakers, headed by NASA's celebrity scientist-astronaut, Dr. John L. Lind.

Dr. Lind will speak on "A Scientific View of Space - Skylab to Shuttle." His address will mark back to the keynote speech given at the NJSHS in 1972 in the Morehead Planetarium, in the Durham, NC, area by Astronaut Russell Schweikert. The unforgettable account of his Earth orbital observations included a Skylab Project description.

One of the most controversial issues in modern science will be the topic of Dr. David Young, Maryland (TN College, when he speaks on "Genetic Engineering" — involving all of the speculative human mutational risks of this developing new art.

Dr. Maynard Miller, who held his young audience spellbound when he addressed the 1971 NJSHS on the subject of "The Environmental Crisis," will return as a featured speaker on "The Coming Crisis in Vital Metals." Dr. Miller is dean of the University of Colorado School of Mines.

Dr. Ernst Herbert Soudek, professor in the School of Engineering and Applied Sciences, University of Virginia, is programed to present the featured "humanities" address. His subject has not been announced.

Numerous distinguished academic and military leaders will give presentations preceding the opening of 10 or more concurrent panel discussions of topics in various scientific disciplines.

Five outstanding science students from each of 41 regional Junior Science and Humanities Symposia will be selected to attend the 15th NJSHS, and one from each region will prepare technical papers on their basic research projects.

The papers will be judged by a select panel and five presenters will be selected to go to England for the "London International Youth Science Fortnight" in July and August.

Six long-time outstanding members of the recently abolished Advisory Committee of the Junior Science and Humanities Symposia Program (names not available at press time) will be honored. The committee will be succeeded by a U.S. Army Youth Science Activities Steering Group scheduled to convene for its first meeting May 5.

Including the regional symposia directors and high school science teachers accompanying their students at their own expense, total attendance at the NJSHS is expected to range from 300 to 325. More than 50 percent of the expense of conducting the NJSHS program is paid by academic institutions and industrial organizations sharing support of the program in cooperation with the U.S. Army.

The objective of Army support is to stimulate career goals and point out to the young participants in the JSFH Program the scientific and engineering career opportunities in Army research and development laboratories - thus facilitating recruitment of outstanding university and college graduates interested in Federal Civil Service employment.

Watervliet Researchers Address Foreign Parleys

Four Watervliet (NY) Arsenal scientists are representing the U.S. Army by presenting technical papers at conferences in Germany, England, Canada and France within a 3-month period.

Dr. Garry C. Corofano led off with a paper titled "Laboratory Simulation of Recoilless Rifle Backblast," presented at the 3rd International Symposium on Ballistics at Karlsruhe, Germany. The symposium was sponsored by the West Germany Federal Ministry of Defense in cooperation with the American Defense Preparedness Association.

The paper describes results of arsenal efforts to simulate, in the laboratory, blast phenomena when weapons are fired. Simulation equipment developed by Watervliet scientists permits study of such effects at greatly reduced cost.

Dr. Michael H. Kamdar gave the keynote lecture on liquid metal embrittlement at the International Conference on Mechanisms of Environment Sensitive Cracking of Materials, held early in April at the University of Surrey, Guildford, England. He also served on the organizing committee for the conference, sponsored by the Metals Society of Great Britain supported by the U.S. Army European Research Office. He has led a successful effort to determine the cause of embrittlement, a problem for materials scientists for nearly half a century.

During his investigation of fracture in gun steels, he determined that the embrittlement occurs in a ductile metal, such as steel, when it comes in contact with certain liquid metals. Among these are lead, mercury and gallium. His lecture described advances made during the past decade toward understanding this embrittlement and suggested possible directions for future research.

Dr. Kamdar will make keynote lectures on liquid metal embrittlement at the 4th International Conference on Fracture at Waterloo, Canada in June, and at the Conference on Environmental Degradation of Engineering Materials at Virginia Polytechnic Institute in October.

Two papers relating to research carried out at Watervliet Arsenal for the U.S. Army Air Mobility Research and Development Laboratories, Moffett Field, CA, will be presented in Canada and France.

Joseph F. Throop will discuss "A Fatigue Resistant Titanium-Aluminum Lamine," prepared in collaboration with his fellow mechanical engineer, Robert R. Fujczak, at a symposium on "Toughness and Fracture Behavior of Titanium." Sponsored by the American Society for Testing and Materials, the symposium is scheduled at Toronto, May 2-3. His conclusions derive from an exploratory program for development of damage-tolerant materials for aircraft and helicopter structures.

Arsenal mathematician Dr. Julian Wu will participate in the International Symposium on Innovative Numerical Analysis in Engineering Science, May 23-24, in Paris. His paper describes development of efficient numerical methods in solving the dynamics problem related to the Research in Structure Program of the Air Mobility Command. This symposium is sponsored by the U.S. Air Force in conjunction with various French scientific organizations.

ASAP Meet Themed on Soldier's Armor Environment

More than 75 U.S. Army Scientific Advisory Panel members, associate members and invited dignitaries are expected to attend the ASAP spring meeting on "The Modern Soldier in the Armor Environment," May 9-10, Fort Knox, KY.

The theme parallels that of the fall meeting held at the Infantry Center, Fort Benning, GA, on "The Modern Soldier in the Environment." Invites will include research and development leaders of the Navy, Air Force and Marines, the Medical R&D Command, Corps of Engineers, Office of the Deputy Chief of Staff for Research, Development, and Acquisition, the Office of the Deputy Chief of Staff for Operations, the Army Material Development and Readiness Command, and other major agencies.

MG John W. McNerney will give the welcoming address as host, commander of the Armor Center and director of the Armor School. He also has accepted an invitation to make the banquet address.

Featured will be a presentation by MG Robert J. Baer, the recent winner of the Secretary of the Army's first annual Project Manager Award as PM for the XM-1 tank. COL Robert E. Butler will report as PM for the M-60 tank. The Fort Knox Tank Force Management Group is programmed for a briefing on tank tactics in future warfare.

Other briefings on the Armor Center and the envisioned threat will be made by Fort Knox staff members, the Armor and Engineer Board, and a group on training doctrine and technology.

Highlighting the business meeting will be reports by five ad hoc groups, with comments by Assistant Secretary of the Army (R&D) Edward A. Miller and Deputy Chief of Staff for Research, Development, and Acquisition LTG Howard H. Cooksey.

Electronic Warfare Intelligence will be chaired by former ASAP vice chairman, Dr. Richard Montgomery; Systems Engineering Technology, headed by former ASAP chairman, Lawrence (Larry) O'Neill; Gun Tube Wear and Erosion, Dr. Joseph Sternberg; Command and Control, Robert M. Lockerd; and Optical Countermeasures, Dr. Paul Kruze.

Navy Hosts Army 23d Design of Experiments Meet

Texas A&M University Prof. H. O. Hartley is programed for the keynote address on "The Design and Analysis of Field Experiments," at the 23d Conference on the Design of Experiments in Army Research, Development and Testing, Oct. 19-21, at the U.S. Naval Postgraduate School, Monterey, CA.

The conference theme is "The Design and Analysis of Field Experiments," with emphasis on application of the analysis of data to uncontrolled variation.

Dr. George P. E. Box, University of Wisconsin at Madison, is scheduled to speak on "The Analysis of Time Series." He received the American Statistical Association's Samuel S. Wilks Award in 1972 and is the incumbent of the Ronald A. Fisher Chair of Statistics.

Presentation of the Wilks Award, given for contributions to the advancement of scientific or technical knowledge in statistics, is a special...
Wastewater Overland Flow Treatment Reviewed

Treatments of wastewater (contaminated effluents), currently one of the nation's broad problems, by improved overland flow systems was demonstrated and discussed at a "field day" at the Environmental Effects Laboratory (EEL) of the U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Attended by 70 representatives of a wide diversity of interested organizations and agencies, the event was sponsored jointly by Office of the Chief of Army Engineers, Cold Regions Research and Engineering Laboratory, the Environmental Protection Agency, Cooperative Extension Service of Mississippi State University, and the Town of Utica.

Participants included city managers, officials from environmental and health regulatory agencies, agricultural extension specialists, farmers, soil and water conservationists, and others interested in the system.

Experimentation at the Overland Flow Research Facility, an element of WES at Utica, MS, is programmed to determine the most effective system operation and the crop management practices relevant to wastewater use.

The field day included a tour of the OFRF and the showing of a film, "Wastewater Bonanza," the program was planned to enable participants to evaluate overland flow treatment as an alternative for treatment in accord with Section 201 of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500).

A high level panel discussion group included Richard Thomas and Robert S. Kerr of the Environmental Protection Agency's EP Laboratory; Russ Wright, Water Division, EPA at Atlanta, GA; Barry Henson, Mississippi Air and Water Pollution Control Commission; Ronald Crites, Melville and Eddy Consulting Engineers, Palo Alto, CA; Joseph Brown, Bureau of Environmental Health, Mississippi State Board of Health; Fred Beckett, consulting engineer, Bruce, MS; Dr. Paul Murrmann, Army Cold Regions Research and Engineering Laboratory, Hanover, NH; Dr. Richard Lee, panel moderator, Robert Peters and Andy Green of WES.

WSMR Employes Present Papers at National Parleys

Research papers authored or coauthored by three White Sands Missile Range employees while working with New Mexico State University will be presented at national scientific conferences.

H.P. Huddleston Jr., an engineering with the Army Materiel Test and Evaluation Directorate (ARMT E), and Dr. G.P. Mulholland of NMSU, are coauthors of "Evaluation of Thermal Soak Times," which will be presented at the 23rd annual Institute of Environmental Sciences in Los Angeles, Apr. 24-27.

The paper describes construction of a mathematical model for heat transfer within the electronic package of a Chaparral missile. The model is used to predict performance of the Chaparral system when exposed to excessively high and low temperatures in WSMR environmental tests.

"WSMR Fast Burst Reactor Irradiation Cavity Enlargement Thermal Stress Analysis" explains procedures and results of tests conducted by range employees, De La Paz, D.C.; Dr. W.C. Hull and Mulholland of NMSU's Mechanical Engineering Department.

The paper, which describes shock stress tests designed to insure structural soundness of the fast-burst reactor core after modification to provide an enlarged irradiation cavity, will be presented at the annual meeting in June of the American Nuclear Society in New York City.

Huddleston is a mechanical engineer with the WSMR Climates Branch of the Applied Sciences Division. De La Paz and Welch are nuclear engineers with the Nuclear Weapons Effects Branch, which De La Paz heads.

Conferees Examine Snow Impact on Transportation

The Impact of Snow on Transportation was the theme of a recent 3-day technical conference sponsored by U.S. and Canadian sections of the International Society for Terrain Vehicle Systems and the Army Cold Regions Research and Engineering Laboratory.

Hosted at CRREL, Hanover, NH, the meeting drew more than 80 attendees representing government agencies, research laboratories, industry and academia. Dr. D.R. Freitag, CRREL technical director, was conference chairman.

Topics of four major technical sessions, supported by individual presentations and panel discussions, were: evaluation and testing of winter tires; snow removal techniques and equipment research; snow mechanics, and cross-country vehicles.

The International Society for Terrain Vehicle Systems was established in 1961 to advance knowledge of the mechanics of terrain vehicle systems and soil working machinery capabilities in all types of environments. Dr. R.A. Liston of CRREL is U.S. national secretary.

Conferees Examine Organizational Effectiveness

Ways of integrating effort to aid in preparation of a coordinated organizational effectiveness (OE) research, development, test and evaluation program for Fiscal Year 1978 were discussed at a recent conference sponsored by the Army Deputy Chief of Staff for Personnel.

Conducted by the U.S. Army Research Institute for the Behavioral of Social Sciences, a DCSPER element, the 2-day meeting in Arlington, VA, attracted about 50 representatives of major Army agencies. The purpose was to identify research needed to improve organizational effectiveness and to ensure coordination of all ongoing OE efforts.

Principal speakers included BG Alfred B. Hale, director, Plans, Programs and Budget, DCSPER; COL William C. Maus, commander, Army Research Institute; and Dr. Julius E. Uhlaner, ARI technical director and Army chief psychologist.

The program also offered presentations by LTC Anthony Nadal, chief, OE Task Force, Office of the Army Chief of Staff; COL Clarence A. Miller Jr., chief, Leadership and Motivation Division, Office of the Director of Human Resources Development, DCSPER; and COL Ralph Canter, chief, ARI Personnel Accession and Utilization Technical Area; and COL J. A. Neuberger, chief, Research Office, Directorate of Plans, Programs and Budget, DCSPER.

COL Neuberger clarified the conference objective by stating it was directed to OE research and was not concerned with the question of organizational structure for implementing OE in the Army.

Featured also were presentations on the Training and Doctrine Command's Work Study Program, Administration Center, Fort Benjamin Harrison, IN; and the OE Training Center unit working on the Organizational Effectiveness Evaluation Plan, Fort Ord, CA.


Dr. Paul Thayer, president of the Division of Industrial and Organizational Psychology, American Psychological Association, and senior vice president, Life Insurance Marketing and Research Association, Hartford, CT, gave the conference summary.

Dr. Canter, Dr. Paul Duffy and Dr. Ray Kirk of the Army Research Institute staff had lead roles in arrangements for the conference. Proceedings will be available soon for distribution.
Awards...
Achievements Recognized in R&E, Administration

NARADCOM Commander COL Rufus E. Lester Jr., and Technical Director Dr. Dale H. Sieling flank Meritorious Civilian Service Medal winners Dr. Abdul R. Rahman and Henry Weigold.

Meritorious Civilian Service Medals and gold and silver pins recognizing achievements in research, engineering and administration were presented recently during annual awards ceremonies at the U.S. Army Natick (MA) Research and Development Command.

Dr. Abdul R. Rahman, head of the R&D Plant Products Branch, received the MCSM, the Army's second highest decoration for civilian employees, for contributions to development of compressed foods and dehydrated perishable vegetables.

Henry Weigold, a facilities engineer, also received an MCSM in recognition of engineering and management of all phases of NARADCOM's maintenance and energy conservation programs.

Thomas M. Keville was awarded the Technical Director's Gold Pin for Research. He was cited for design and development of new body armor for combat personnel to achieve improved user protection and comfort.

Arthur L. Murphy Jr., gained the TD's Silver Pin for Research for developing a theory for the guidance and control of gliding parachute systems, designed to overcome current delivery system inaccuracies.

Peter J. Macek was presented the TD's Gold Pin for Engineering as project engineer and sole Army airdrop representative on joint-service programs. The award justification states his work is expected to result in U.S. Government savings estimated at about $100,000.

Dr. Donald E. McKinney of Pine Bluff Arsenal, AR. was cited for interior ballistics research expected to have far-reaching applications in the design of propelling charges and their igniters—specifically in ensuring safe development of large-caliber weapons.

 Assigned to BRL's Propulsion Division, he has authored four technical papers and more than 20 government reports. He has a BS degree in chemistry from Gannon College, with MS and PhD degrees from Case Western University.

DR. MURPHY is chief of the Launch and Flight Division and received his MCSA for contributions to the theory of nonrigid payload behavior in projectiles, and verifying complex equations of motions of cargo-carrying projectiles.

Employed at BRL since 1948, he received his BS (cum laude) in mathematics from Georgetown University. He has an MA in math, an MS in engineering aeronautics and a PhD in aeronautics from Johns Hopkins University.

DEAN BORGMAN, chief of the Army Air Mobility R&D Lab's Systems Research Integration Office at AVSCOM, received the MCSA for outstanding contributions leading to establishment of an effective air mobility R&D program.

A former deputy program manager for the XV-15 Tilt-Rotor Research Aircraft Program, he has a BS degree in aeronautical engineering from California State Polytechnical University and an MS degree from Stanford University.

President of the St. Louis Chapter of the American Helicopter Society, he is a member of the American Institute of Aeronautics and Astronautics, and the Tau Sigma engineering fraternity.

Texas A&M University, pursued graduate study at Massachusetts Institute of Technology, and conducted his thesis research at the National Bureau of Standards. He has authored numerous technical publications and is a member of the Philosophical Society of Washington, Washington Academy of Science, Institute of Electronic and Electrical Engineers and Tau Beta Pi and Sigma Xi fraternities.

Other MCSA recipients include Drs. Ingo W. May and Charles H. Murphy of the U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, MD, and Dean C. Borgman, employed at HQ U.S. Army Aviation Systems Command, St. Louis, MO.

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Dr. Ingo W. May

Dr. Charles H. Murphy

Dean C. Borgman

Pine Bluff Man Patents Volumetric Filling System


A senior project engineer in the Directorate of Engineering and Technology, McKinney described his process before the American Defense Preparedness Association's 1977 meeting of the Loading Assembly and Packaging Section, Eglin AFB, FL.

Prior to development of the Volumetric Filling System, the only successful method for filling white phosphorus munitions was by a dip fill or wet fill process, in use at Pine Bluff since World War II.

Although basically simple in concept, dip filling required a large manpower effort for production operations and line maintenance, generated large quantities of water and air pollution, and thus presented a potential safety hazard to loading personnel. McKinney began developmental work on volumetric filling in 1973, followed by installation of a prototype production line. The first successful filling was completed in 1975.

MARCH-APRIL 1977
Eccleshall

Dr. Eccleshall, chief, Physical Sciences Branch, Ballistic Modeling Division, U.S. Army Ballistic Research Laboratory, Aberdeen (MD) Proving Ground, has been elected as a BRL Fellow in recognition of outstanding professional achievements.

Graduated in 1956 with a PhD in physics from the University of Liverpool, England, Dr. Eccleshall contributed to the design of one of the first tandem accelerometers. He also does research in nuclear physics and test diagnostics.

After working 10 years at the Atomic Weapons Research Establishment, Aldermaston, United Kingdom, he accepted a research appointment at the University of Pennsylvania in 1966. He has authored about 30 technical papers and seven U.S. Government reports.

In 1968 he was named to head Edgewood Arsenal's new Tandem Accelerometer Facility. Later he served as chief, BRL Radiation Laboratory and chief, Applied Mathematics and Science Laboratory.

Suggestion Earns HDL Employee $1,200 Award

Armywide adoption of a suggestion expected to net first-year U.S. Government savings of $20,000 has earned a $1,200 award for Mary F. Manby, an intelligence research specialist at the U.S. Army Harry Diamond Laboratories.

HDL Commander COL Thomas McGregor made the presentation in recognition of a suggestion titled "Change in Format of R&D Master List." This is a compilation of R&D projects and tasks requiring intelligence support throughout the U.S. Army Materiel Development and Readiness Command.

Mrs. Manby streamlined the list format. Assigned to HDL's Foreign Intelligence Office, she served from 1973-76 at HQ DARCOM, Alexandria, VA. Earlier civil service assignments were with the U.S. Department of Health, Education and Welfare, and the Foreign Science and Technology Center at Charlottesville, VA.

ARCOM Honors Reynolds as Inventor of Year

Selection of George Reynolds as the first recipient of the U.S. Army Armament Materiel Readiness Command Inventor of the Year Award was announced in mid-March by ARCOM, Rock Island, IL.

Employed as an engineering technician in the Small Caliber Weapons Division of the Thomas J. Rodman Laboratory, Reynolds was cited for numerous outstanding innovative achievements during 1976. He was granted patents for a combination cartridge extractor-ejector and a manually operated firearm with forward-moving barrel, including an automatic breech lock.

Other inventions that helped him to win the award include a firing rate reducer for the M16 rifle and a soft-feed mechanism for a grenade launcher. The extractor-ejector requires only one part for both operations; normally, two or three parts are used for each function.

The extractor-ejector has limited application to grenade launchers and large calibre shotguns but is expected to be less costly and more efficient than conventional mechanisms.

Reynolds is a gun enthusiast who constantly draws knowledge from which he frequently draws for his inventions. An example is a 10-shot grenade launcher developed with detailed knowledge about the U.S. Army M16 and M14 rifles, AK47 Russian rifle and German Luger.

Reynolds' interest in inventing started at age 18 when he was stimulated by his father who patented a fertilizer spreader, a corn planter and which he frequently draws for his inventions.

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Outstanding Achievements Cited...

4th Annual Awards for Materiel Acquisition Presented

Four individuals and a 3-man team have been selected as winners of the fourth annual Secretary of the Army Awards for Outstanding Achievement in Materiel Acquisition.

When the award was initiated, the first presentations covered the 1970-72 period. The award is presented in recognition of high-level effort in project, materiel and special-item management activities; procurement and production achievements; and scientific research.

A maximum of 10 winners are selected annually from among nominees serving in a staff or operating function in support of the materiel acquisition process for at least 12 months.

Consideration is based on the complexity of the problem and degree of initiative and originality in solving it; relative significance of the accomplishment or adoption of the contribution by other activities; and improvement in program management.

Civilian or military individuals or teams receive a silver medallion and a miniaturized lapel pin depicting the first U.S. Secretary of War Henry Knox. Starting early in April, award ceremonies at installations where the winners are employed will honor:


"Under his leadership," the citation states, "a new approach termed Project Hand-Off was developed which improved the fielding of Army materiel and established a closer relationship between the developer and the user in the field."

Federally employed for more than 26 years, Krakov has a BS degree in chemistry from the College of the City of New York, is an honorary faculty member of the Army Logistics Management Center and member American Society for Quality Control.


The device is credited with eliminating mid-air helicopter collisions in high-density training areas where it has been used. During a 2-year period, 2,000 helicopters have been equipped with the system.

Schoenberger is a native of Germany with BS and MS degrees in electrical engineering from the Institute of Technology in Munich. Employed by ECOM in 1958, he has served as project engineer and technical consultant.

Since 1959 he has represented the U.S. Army as a member of the Collision Prevention Advisory Group. He is a licensed pilot for fixed- and rotary-wing aircraft.

**William A. Wondisford**, Bent Weapons Laboratory, U.S. Army Watervliet (NY) Arsenal, was credited for achievements in developing and implementing a "guided-boring system which improved cannon tube quality and reduced production costs."

The system eliminates rework associated with previous methods and assures quality components on a production operation that formerly was a major source of rejects. The citation terms the system "revolutionary."

Employed at Watervliet Arsenal since 1959, Wondisford has served as a project leader and consultant on numerous machining projects, including rapid threading, compression forming, and guided boring techniques.

**Fred N. Newcomb**, a supervisory engineer at the U.S. Army Human Engineering Laboratory, Aberdeen (MD) Proving Ground, was selected for "significantly improving the accuracy of the Dragon Anti-Tank Missile System" by incorporating a viscous-clamped mount between the Dragon and the M113 Armored Personnel Carrier.

Integration was accomplished without modification to either of these systems, and is expected to provide infantry elements with a greater effectiveness in combat situations.

Fred Newcomb joined APG as a mechanical engineer in 1952 and received a BS degree in industrial management (magna cum laude) from the University of Baltimore in 1971. He is a member of Beta Alpha Scholarship Society and author of several technical reports.

**James T. Flood**, Robert L. Hutchison and Lawrence A. Runnels, employees at the U.S. Army Aviation Systems Command, St. Louis, MO, will be cited for development of an economic price adjustment clause for use in government procurement contracts.

The clause provides for "equitable adjustment" between contract participants during periods when labor and material costs vary from indices published by the Bureau of Labor Statistics.

Flood has been a Department of the Army civilian employee since 1946, and is a recipient of two Outstanding Performance Ratings and a Sustained Superior Performance Rating. He attended the St. Louis University Evening Division.

Hutchison also attended St. Louis University (School of Commerce and Finance) and has served as a contract assistant and specialist since 1965.

Runnels is a dean's list honors graduate of St. Louis University, has a 1968 J.D. degree from New York University and an LLM in taxation from Washington University Law School. He is a member of the Missouri and Illinois Bar Associations.

**Meat Science Association Honors Army Expert**

Dr. Eugen Wierbicki, a food technologist at the U.S. Army Natick (MA) Research and Development Command, has been appointed chairman of the 1976-77 Research Award Selection Committee of the American Meat Science Association.

Recipient of AMSA's 1976 Distinguished Research Award, Dr. Wierbicki will oversee the 6-man committee which will review nominations for the 1977 award. It is presented annually in recognition of outstanding R&D contributions to meat science.

Head of Natick's Irradiated Food Products Group, he has responsibilities for planning and supervising biochemical and technological programs to establish Armed Forces food irradiation processing systems.

Special emphasis is placed on sterilization of meats, poultry and seafoods to permit prolonged storage without refrigeration. Irradiated meats developed by his branch were used on the Apollo 12 and 17 flights and the Apollo-Soyuz U.S. and Soviet space link-up mission.

Dr. Wierbicki has authored numerous articles dealing with meat research and served as a member of the U.S. Food Processing Delegation to the USSR in 1960. In 1964 he was a U.S. Department of State official and escort for a Soviet delegation to the United States.


28 ARMY RESEARCH AND DEVELOPMENT NEWS MAGAZINE
People in Perspective...

Appalachian Music Man... Builds Dulcimers True to Colonial Specs

Woodworking and a love of American culture dating back more than 200 years have provided a rather unusual hobby and a satisfying lucrative avocation for LTC (Dr.) George Orthey. Deputy for Veterinary Activities at the U.S. Army Medical Department Activity, Carlisle Barracks, PA, LTC Orthey is termed by "those in the know" as one of the finest dulcimer makers in Pennsylvania's Appalachian Mountains. He estimates he sells annually about 100 of his handmade stringed instruments. All are made in his spare time and faithfully reproduced from those made by Appalachian residents more than 200 years ago.

"The colonists," he reports, "not only brought an old art to America but also developed a variation of their own. The 'stringed bagpipe' or Appalachian dulcimer originated with Scotch-Irish settlers. They also produced a hammered dulcimer and psalters--which date back to Biblical times."

Unlike the Appalachian dulcimer, the hammered version resembles the inside of a piano and is played by striking the strings with a mallet. The psaltery is much like the lyre in appearance and tone, and is played by plucking the strings.

LTC Orthey built his first dulcimer in 1964 while assigned to Walter Reed Army Medical Center in Washington, DC. He sold the first ones to a local music store manager and wishes he had them as mementos.

The sale, however, intensified his interest to continue the hobby. After reporting for duty at Fort Sam Houston, TX, he was asked to play and show his wares at San Antonio's 1968 HemisFair and to entertain at Lynda Bird Johnson's engagement party.

During a tour of duty in Pusan, Korea, he set up operations in a craft shop and later in an abandoned printing shop when he was assigned to Fort Devens, MA. He now quarters his hobby in a renovated carriage house near his home in Newport, PA.

Public demand for his dulcimers has grown to such an extent that the hobby has actually blossomed into a "family affair." His wife and two sons serve as salespersons. Mrs. Orthey also designs and makes authentic colonial costumes for public performances.

Reader's Guide...

ARI Reports on Questionnaires, Small Maps Use

Development of work environment questionnaires and use of reduced-detail maps for tactical operations are subjects of new documents issued by the Army Research Institute for the Behavioral and Social Sciences.

Technical Paper 275, The Development of a Work Environment Questionnaire for the Identification of Organizational Problem Areas in Specific Army Work Settings, is the result of a 3-year effort to improve organizational effectiveness at an Army field installation.

The questionnaire provides indexes of soldier perceptions, motivations, and satisfactions in specific terms to identify problem areas suitable for corrective action. A later survey has identified seven major problems.

Technical Paper 274, A Comparison Between a Standard Map and a Reduced Detail Map Within a Simulated Tactical Operations System, reports on whether reduced map detail lessens efficiency of human information processing and decision making.

Results indicate that no significant difference in performance during planning or combat was associated with the level of map detail factor. Further studies are suggested to determine the feasibility of using reduced maps in conjunction with computer graphic display capabilities.

CGSC Publishes Master's Theses Reference

Summaries of 240 Master of Military Art and Science theses completed at the U.S. Army Command and General Staff College from 1964-76 are contained in a new single-volume reference.

MARCH-APRIL 1977
Personnel Actions...
Perry Succeeds Currie as Director of Defense R&E

Dr. William J. Perry was sworn in to that office, following U.S. Senate confirmation of President Jimmy Carter's appointment of the industrial leader to succeed Dr. Malcolm R. Currie, who resigned Jan. 20.

When selected, Dr. Perry was president of ESL Inc., and director of ESL Laboratories in Sunnyvale, CA. He is one of the founders of ESL, incorporated in January 1964. For 10 years prior he was director of Electronic Defense Laboratories, Sylvania Electric Products Inc., Sunnyvale.

Concurrent with ESL management responsibility, Dr. Perry conducted analysis of missile systems and designed electronic reconnaisance systems. His technical expertise includes partial differential equations and propagation and statistical theory.

Awarded the Defense Intelligence Agency's Exceptional Civilian Service Medal for performance as a member of the DIA Scientific Advisory Committee, Dr. Perry earned a U.S. Army Outstanding Civilian Service Medal for "development of systems for collection of vitally important intelligence through the use of advanced electronics." He served on the National Security Council, and was an adviser to the U.S. Government on a panel study of the "missile gap" issue in 1960; also, a study of verification management.

Dr. Perry's academic credentials include bachelor's and master's degrees in mathematics from Stanford University and a doctor of philosophy in mathematics from Pennsylvania State University, where he was a mathematics instructor. Later he was a part-time lecturer at the University of Santa Clara, CA.

A member of the Scientific Research Society of America, American Mathematical Society, and the National Academy of Engineering, he has authored numerous reports on signal analysis, advanced systems design and mathematics analysis. He was born Oct. 11, 1927, in Vandergrift, PA.

Griffith Heads Korea J MAG...
Nord Directs DARCOM DE, Street PMs Patriot


MG Griffith will take over late in May as chief, Joint U.S. Military Advisory Group, Korea, succeeding MG Oliver Street, who is scheduled to report in July as new project manager for Patriot (formerly SAM-D), Redstone Arsenal.

BG Nord initially joined ARRCOM (formerly Army Armament Command) in 1975 as director of Development and Production, following an assignment as commander of Seneca Army Depot, Ramulus, NY.

During 1974 he served as executive officer of the Science and Technology Team, Army Materiel Acquisition Review Committee (AMARC), and on the Army Materiel Command Committee—Arms. Earlier he was PM for Safeguard Munitions at Picatinny Arsenal, including duty as lead project officer for the Sprint and Spartan missiles warheads.

Other career assignments have included duty in Germany as chief of Special Weapons Plans, Central Army Group, NATO; assistant secretary of the General Staff, Office of the Army Chief of Staff; and project officer, Nuclear, Chemical and Biological Division, Office, Army Chief of R&D.

He also served as an instructor and assistant professor in chemistry at the U.S. Military Academy; participated in the 1962 test series at the Nevada Test Site while assigned to the Combat Development Command Chemical Agency; and served with the XVIII Airborne Corps, including duty as secretary of the General Staff during the Cuban missile crisis.

BG Nord was commissioned in the Army Chemical Corps in 1952, following completion of ROTC requirements and award of a BA degree in chemistry from South Dakota State University. He also holds BA and MA degrees from Oxford University, and completed the master's program in international relations at George Washington University. He has completed the Command and General Staff College requirements, the National War College, and the Chemical Officers' Career and the Nuclear Effects Engineer courses.

His military decorations include the Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star Medal, Meritorious Service Medal, Air Medal with OLC, and the Army Commendation Medal with OLC.

MG Oliver Street is backed by more than 20 years of active military service. He graduated from the U.S. Military Academy with a BS degree in military science and engineering and from George Washington University with an MS in personnel management.

During 1973-74, he served as commander, 1st Region, U.S. Army Air Defense Command, Stewart Field, NY, following a 2-year tour as assistant chief of staff, Land Operations, and commander, U.S. Army Element, Allied Forces, Central Europe.

Assigned during 1969-1971 to the Office of the Deputy Chief of Staff for Military Operations, Washington, DC, he served successively as assistant chief, and chief, Strategic Forces Division, and acting deputy director of Plans.

Other assignments have included commander, 101st (later 18th Artillery Group), Lockport, NY, and member, Gaming Branch, General War Division, Joint War Games Agency, Organization, Joint Chiefs of Staff.

MG Street is a graduate of the Army Command and General Staff College, Armed Forces Staff College, Army War College, and Artillery and Guided Missile School Advanced Course. He wears the Legion of Merit with Oak Leaf Cluster (OLC), Joint Service Commendation Medal, and Army Commendation Medal with three OLC.

Eicher Heads Newly Established ARRCOM

Heading the newly established U.S. Army Armament Materiel Readiness Command, Rock Island Arsenal, IL, is MG William E. Eicher, who has served since January 1976 as deputy commander, U.S. Army Armament R&D Command at Rock Island.

MG Eicher was director of Maintenance at HQ U.S. Army Materiel Development and Readiness Command until he departed for duty at Rock Island. In 1972 he was chief, Installation Program Team, Office, Deputy Chief of Staff for Logistics, Department of the Army. He also has commanded the 26th General Support Group in Vietnam.

He is a veteran of 26 years military service and has a master's degree in business administration from Syracuse University. He received his commission after graduating from the State College of Washington.

Among his military awards are the Silver Star, Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star Medal with three OLC and "V" device, Joint Service Commendation Medal, Army Commendation Medal with OLC, Purple Heart, and Combat Infantryman's Badge.

Selection Board Announces PM Assignments

Colonels and promotable lieutenant colonels selected recently by the Project Manager Selection Board, U.S. Army Materiel Development and Readiness Command (DARCOM), will be assigned to new programs and to fill vacancies in the near future.

The Army R&D Newsmagazine featured U.S. Army Project Managers in the November-December 1976 issue, which included 55 programs and managers, and the first annual Project Management Award presentation made by Secretary of the Army Martin R. Hoffmann to MG Robert J. Baer for XM-1 tank development.

The 6 project managers selected for assignment to new programs, 3 product managers being changed to project managers and 16 designated...
to fill a vacancy are listed by project as follows.

COL Eugene Fox, Air Defense Command and Control System AN/TSQ-873 (Missile Minder); LTC Leonard S. Marrella, Army Gun Air Defense System AN/MPQ-39A; COL John W. Damas, Aircraft Survivability Equipment Program; COL Robert P. St. Louis, AH-1 Cobra Series Aircraft; COL Sammy J. Cannon, Corps and Echelons Above Corps Electronic Warfare and Intelligence; LTC (P) Thomas Cameron, Firefinder System (formerly MALOR - Mortar/Artillery Locating Radars); COL Benjamin J. Pellegrini, Ground Laser Designators; COL Barrie P. Masters, General Support Rocket Systems; COL John D. O'Donoghue to succeed COL Edwin Aguanno, Iranian Aircraft Program;

LTC (P) Ivar W. Rundgren Jr., Interim Advanced Target Acquisition Designation System; COL Alvin G. Rowe, Mobile Electric Power; COL Rodney W. Spotta, Mechanized Infantry Combat Vehicle Armament Systems; COL Joseph O. Lax Jr., Multipurpose Missile System; COL Anthony F. Albritton, Multiservice Communications Systems; COL Robert D. Morgan, Position Locating and Ranging System; COL Charles F. Lindberg, Satellite Communications; COL Lawrence F. Skibbie, Selected Ammunition Program; LTC (P) August M. Ciancio, Stand-off Target Acquisition System; COL Frank Hungerford, Tactical Fire Direction System;

COL Clarence A. Patnode Jr., Target Acquisition Designation System and the Pilot Night Vision System (TADS-PNVS) for the Advanced Attack Helicopter (AAH); COL Edward D. Bjorn, Tactical Operations System; COL Joseph H. Leszczynski, Training Devices.

The three programs being upgraded from product management to project management are: FAME/EUET (Family of Military Engineer Construction Equipment, Universal Engineer Tractor), COL Max Schreiber, SEMA (Special Electronic Mission Aircraft Material), COL John Top; SIGINT/EW (Signal Intelligence/Electronic Warfare Material), COL William Clingenpeel.

Hardin Assumes Duties as TARCOM Commander


MG Hardin has a bachelor's degree in history from Loyola University of Los Angeles and an MBA degree in industrial management from Babson Institute. He is a graduate from the Army Command and General Staff College, Naval War College and the Army War College.

He has also served with the Joint Chiefs of Staff, Department of the Army; Deputy Chief of Staff for Logistics, DA; commander, U.S. Army Strategic Logistics Command; and U.S. Army Armament Command.

Other assignments have included duty with the 7th Infantry Division in Korea; 9th Ordnance Battalion (now 101st Battalion), Germany; 1 Corps, Vietnam; commander, Support Command, 2nd Infantry Div., Korea.

MG Hardin wears the Bronze Star Medal with "V" Device (5th Oak Leaf Cluster), Meritorious Service Medal with two OLC, Army Commendation Medal with one OLC, and the Navy Unit Commendation Medal.

Corps of Engineers Announces District Assignments

COL William W. Brown, a strategic research analyst with the Strategic Studies Institute, U.S. Army War College, Carlisle Barracks, PA, is one of four personnel recently selected for U.S. Army Corps of Engineers district engineer assignments.

COL Brown will assume new duties in July as Charleston (SC) District engineer. He is a 1966 graduate from the U.S. Military Academy (USMA) and has a master's degree in geodetic science from Ohio State University.

COL John H. Moellering has been selected as Vicksburg (MS) District engineer, following completion of the Army War College course. He graduated from the USMA in 1959 and has an MS degree in civil engineering from the University of California (Berkeley).

COL Robert K. Tener will take over in August as Nashville (TN) District engineer upon completion of the Naval War College course. He graduated from the USMA in 1967, holds MS and doctor of philosophy degrees in structural engineering from Iowa State University.

COL Adolph A. Hight will succeed COL Homer Johnstone Jr. as Wilmington (NC) District engineer. He has an MS degree in civil engineering from Hampton Institute and is a graduate of the Command and General Staff College and National War College.

Bolte Assigned as TECOM Deputy Commander

BG Philip Bolte, former assistant project manager of the Main Tank Armament Development, XM1 Tank System, is the new deputy commander of the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, MD.

A 1960 graduate of the U.S. Military Academy, West Point, NY, BG Bolte completed the Canadian Army Staff College course in 1965 and has a master's degree in electrical engineering from Georgia Institute of Technology.

He has served tours in Germany, Japan, Vietnam and Korea. In Vietnam, he commanded the 1st Squadron, 1st Cavalry, Americal Division, and the 12th Support Command, Aberdeen Proving Ground, MD.

BG Bolte wears the Silver Star with Oak Leaf Cluster (OLC), Legion of Merit with three OLC, Meritorious Service Medal, Air Medal with three OLC, Purple Heart w/OLC, and Combat Infantryman's Badge w/star.

Tate Heads Defense Nuclear Agency Field Command

BG Grayson D. Tate Jr., commander, U.S. Army Missile Research and Development Command since January, has been selected to take over in August as commander, Defense Nuclear Agency Field Command, Kirtland Air Force Base, NM.

Graduated from the U.S. Military Academy in 1950, he has BS and MS degrees in aeronautical engineering from Georgia Institute of Technology. He has competed career development courses at the Command and General Staff College, Armed Forces Staff College and Industrial College of the Armed Forces.

BG Tate served during 1975-76 as deputy commander of the Army Missile Command following assignments as project manager, Lance Weapon System and special assistant to the MICOM commander.

His career record shows assignments as commander, Fourth U.S. Army Missile Command, Korea; assistant for Missiles, Office, Assistant Secretary of the Army (R&D); chief, Nike-X Branch and, later, chief, Nike-X and Space Division, Office, Chief of Army R&D, Washington, DC.

BG Tate wears the Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star Medal, Army Commendation Medal w/OLC, and Purple Heart.

Wright Directs Army Materials, Mechanics Research

Director of the U.S. Army Materials and Mechanics Research Center, Watertown, MA, is the new title of Dr. Edward S. Wright, former AMMC associate director of Operations, acting director for the past year and an AMMC employee since 1970.

Dr. Wright has a BS degree in physical metallurgy from Washington State University and a PhD in metallurgy from the University of Newcastle upon Tyne, Newcastle, England. He has served on academic staffs of Carnegie Institute of Technology and the University of California.

Engaged in materials R&D since 1949, he managed the Metallurgy Department of Stanford Research Institute until he transferred to the AMMC. He also has been employed by Westinghouse Electric Corp., the Los Alamos (NM) Scientific Laboratory, and Lockheed Aircraft Corp.

The Army Materials and Mechanics Research Center is the U.S. Army Materiel Development and Readiness Command's lead laboratory for R&D in materials, solid mechanics, and materials testing technology.
Burbules Appointed Joint Fuze Task Group Chairman

COL Peter G. Burbules is the initial chairman of the Joint Fuze Task Group, the action arm of the newly established Fuze Management Organization which is under cognizance of the Joint Logistics Commanders.

COL Burbules served in 1974-75 as the executive officer, Systems Review and Analysis, Office of the Deputy Chief of Staff for Research, Development, and Acquisition (ODCSRDA), HQ DA, with concurrent duty as the executive secretary, Army Systems Acquisition Review Council (ASARC). Prior to that duty, he was a weapon systems analyst, Office of the Army Chief of Staff.

A graduate of the Infantry Officer Candidate School, he was commissioned a second lieutenant in the Ordnance Corps in May 1945. He has served in numerous ammunition assignments, including tours of duty in Korea (1957-58), Defense Atomic Support Agency (1958-61), Turkey (1962-65), Vietnam (1967-68), and commander, Cornhusker Army Ammunition Plant (1968-69). COL Burbules commanded the Support Battalion of the 172d Arctic Light Infantry Brigade in Alaska from 1971-73.

Under the Army's "Bootstrap" Program, COL Burbules received a bachelor's degree in general engineering at the University of Omaha in 1962 and a master's degree from Babson College in 1970. He is a graduate of the Armed Forces Staff College (1971), Naval War College (1976). COL Burbules' awards include the Legion of Merit, Meritorious Service Medal, Joint Service Commendation Medal and the Army Commendation Medal with OLC.

Eckert Directs ECOM Personnel, Training, FD

COL Edward N. Eckert, a 1952 graduate of the U.S. Military Academy and former commander of the third ROTC Region, recently took over as director of Personnel, Training and Force Development, U.S. Army Electronics Command.

COL Eckert served during 1973-74 with the U.S. Army Training and Doctrine Command, following completion of his second duty tour with the Military Assistance Command in Vietnam. He is a field artillery officer with 25 years of military service.

Other key assignments include service in the Office of the Deputy Chief of Staff for Personnel, Washington, DC; commander, 8-inch Field Artillery Battalion, Dachau, Germany; and service in the Office of the Deputy Chief of Staff for Operation, Heidelberg.

COL Eckert has completed courses at the Army Command and General Staff College, Armed Forces Staff College, and flight training at Fort Rucker, AL. He is a senior Army aviator and holds a dual rating.

ECOM Chooses Thornton as ETD Lab Director

Dr. C. G. Thornton, a U.S. Army Electronics Command employee since 1972, was recently named director of ECOM's Electronics Technology and Devices Laboratory, filling a vacancy created by the retirement of Dr. Hans K. Ziegler.

Recipient of a 1976 Army Research and Development Achievement Award and an Army Science Conference Award for a technical paper on a research project, Dr. Thornton has bachelor's, master's and doctoral degrees from University of Michigan.

Prior to joining ECOM, Dr. Thornton was employed for 17 years with Philco-Ford Corp., during which time he served as director of research and engineering. He holds six patents and has authored 35 technical papers and numerous reports on process innovations.

Army R&D — 15 Years Ago

The Army R&D News magazine reported on...

5 Generals Head Reorganization Implementation

Congress has approved a plan for broad reorganization of the U.S. Army. Designated by Secretary of the Army Elvia J. Stahr, Jr., five general officers assumed duties as chairman of the formal groups to begin implementation of the plan. Commander of the Army LTG David W. Traub is project director for the reorganization which is scheduled for accomplishment within an 18-month period.


The directive states that headquarters of the Combat Developments Command and the Materiel Development Command "should be located in the general vicinity of Washington, DC." Existing facilities will be used because new construction funds are not available through FY 1963.

WRAIR Opens Institute for Dental Research

Coincident with the 51st anniversary of the founding of the U.S. Army Dental Corps, an Army Institute of Dental Research was dedicated Mar. 3 at Walter Reed Army Medical Center, Washington, DC.

Army Chief of R&D LTG Arthur G. Trudeau was guest speaker at the ceremonies. MG Joseph L. Bernier, chief of the Army Dental Corps, stated: "This Institute will enable us to meet the increasing need for more extensive research in the field of dentistry.

"Its main objective is to continue to find means of reducing the incidence of dental disease, with emphasis on prevention, and to devise simplified techniques which will permit rapid and effective dental treatment, including injuries to the jaw."

Future plans include establishment of five submarine research activities in existing military facilities located at Walter Reed Army Medical Center, Washington, DC; Brooke Army Medical Center, Fort Sam Houston, TX; Fort McPherson, GA; St. Louis, MO; Aleda, CA.

ABC Standardization Program Unites 3 Armies

Differences in weapons, ammunition, field equipment, procedures and doctrine often hindered battlefield performance when the United States, British and Canadian armies fought side by side in World War II. Through the American-British-Canadian (ABC) Standardization Program, the three armies are resolving differences and enhancing ability to fight together more effectively in any future war.

Standardization of materiel and nonmateriel items has progressed notably through this program during the past 15 years. Effort is directed toward the greatest possible economy for armies of the governments concerned through use of common technical and scientific resources.

Standardization effort is aimed to ensure that there will be no operational, materiel or technical obstacles to full cooperation and collaboration among the American, British and Canadian Armies to achieve the greatest benefits at lowest practicable cost.

Army Gets OK to Create Limited War Laboratory

Changing emphasis in national military concepts, responsive to the increasing need of readiness for any type of confined combat in remote undeveloped areas, backs a decision to expedite establishment of a U.S. Army Limited War Laboratory.

The proposal was presented by Chief of R&D LTG Arthur G. Trudeau. When fully staffed, the USALWL will be manned by about 70 highly trained officers, civilian scientists, technicians and clerical personnel. Its primary mission will be to generate new concepts and develop Army materiel having particular applicability to limited war in remote regions.

Role of In-House Laboratories Outlined to AMA

Assistant Secretary of the Army (R&D) Dr. Finn J. Larsen, in an address to the American Management Association in Chicago, discussed the various roles and responsibilities of Army in-house laboratories, saying:

"...One of the major responsibilities of the Federal Government is to ensure that the vast sums it spends on R&D are spent as fruitfully as possible. This means that due consideration must be given to work which can be performed in laboratories owned and operated by industry, universities, other private groups or individuals, and government labs.

"...Industry and the rest of our nation profit through this portion of the Army program because most of the work is in basic research and, therefore, results in benefits to society as a whole. In my opinion, we must continue to support research in our universities, but in the years ahead it is recognized that their capabilities will not increase significantly."
Formations of jet drones, executing high-speed flight patterns over White Sands Missile Range (WSMR), NM, are being controlled and tracked at the Drone Formation Control System (DFCS), a new $9 million addition to the range's instrumentation facilities.

Self-contained with its own tracking and control equipment, telemetry link and display consoles, the DFCS is the largest project to date in the Army's improvement and modernization program for range instrumentation, and the only system of its kind in the Free World.

The DFCS was conceived in 1974 when it became apparent that a means of controlling multiple targets, flying in formation, would be required for missile testing. Design specifications were prepared and a contract was awarded in 1975 to IBM Federal Systems, Huntsville, AL.

During demonstration and acceptance tests conducted late last year, the DFCS showed its ability to control formations of two, three and four BQM-34 Firebee drones and a formation of two PQM-102 (F-102) drone aircraft.

In future tests, the DFCS will control formations of four Firebees and two F-102s, simultaneously. While tracking and controlling up to six of these targets, the system also has a capability to track up to four other drones.

The DFCS combines telemetry, radar and distance measuring equipment with an IBM computer. Control consoles and the computer are located in the Drone Control Center, while a number of subsystems are located at various vantage points around the range.

Airborne drone units and interrogator stations located at the Drone Control Center and four other range sites form a data-link subsystem. The fixed interrogator stations, which are not manned during operation, are located at elevations ranging from 4,290 to 8,958 feet. A mobile interrogator station also is available for use wherever it is needed.

Flying at altitudes ranging from 600 feet above ground to 26,000 feet above sea level, drones can be controlled automatically by the computer or manually through the control consoles. Video screens allow operators to monitor flight paths of the drones at all times.

Patriot Interception of Drone Satisfies All Test Objectives

Countermeasures in a maneuvering environment failed to protect a Firebee Drone when it became the recent target of the U.S. Army's PATRIOT air defense missile. It was intercepted in a firing that "satisfied all test objectives" at White Sands (NM) Missile Range.

Distinction of being the first soldier to fire the PATRIOT at a flying drone, and putting it within the warhead's lethal distance, gave a thrill to SGT John Pearce while on loan to Raytheon Corp. from the U.S. Army Materiel Test and Development Directorate.

Countermeasures were generated by an Air Force jet flying directly in line with the drone but they gave no protection against PATRIOT's FF-1 (radar control station and launcher). The FF-1 was used for only the second time in PATRIOT's 16th fully guided flight in the test.

Project Manager MG Charles F. Means, assigned from the U.S. Army Materiel Materiel Development and Readiness Command to the Missile R&D Command facility at Huntsville, said the firing satisfied all test objectives.

Intended to be the U.S. Army's principal air defense against medium- to high-altitude targets in the highly sophisticated land warfare environment predicted for the 1980s and beyond, PATRIOT will replace Hawk and Nike Hercules.

PATRIOT is designed for a high kill probability and fast reaction time to handle saturation attacks against highly maneuverable targets in intense countermeasures environment.

Currently PATRIOT is in its final stage of full engineering development. The 49-month $425 million contract to complete the R&D phase was negotiated in August 1976.
WRAIR MEDICAL TEAMS conduct activities in many lands on a continuing basis, seeking to find research solutions to prevention and treatment of numerous deadly diseases. Shown are a few of the facilities where they are stationed. Above: Malaysia, where scrub typhus, leptospirosis and arthropod-borne virus infections are studied; right, SEATO hospital in Bangkok, Thailand, where prime effort is antimalarial testing; center, use of WRAIR-developed jet injector for immunization in Vietnam; center left and right, Brasilia, capital of Brazil, research on schistosomiasis; lower left, research in South America Amazon Basin; right, Kenya, where sleeping sickness is a major problem. Other WRAIR teams are at work in Africa, Puerto Rico, Panama, Korea and West Germany.