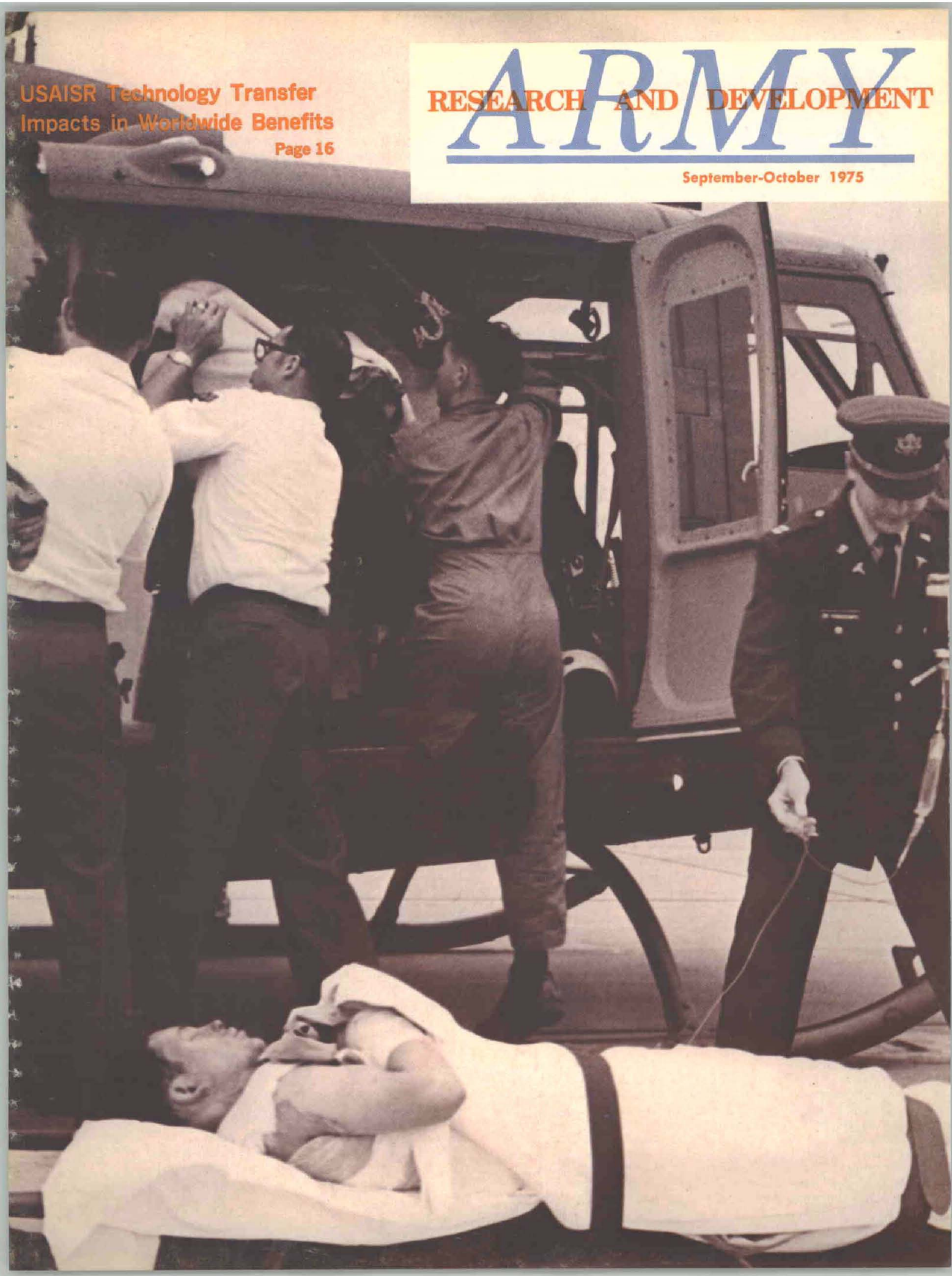

USAISR Technology Transfer Impacts in Worldwide Benefits

Page 16

# ARMY RESEARCH AND DEVELOPMENT

September-October 1975

# SPEAKING ON . . .

## Operation Dustoff: Army Medevac Civilian Spin-Off Benefits

MG Spurgeon H. Neel Jr.

*Twenty-four hours a day, seven days a week, in Project MAST (Medical Assistance to Safety and Traffic), and many other "mercy flights," one of the heroically inspiring humane dramas to come out of the Southeast Asia Conflict is being re-enacted by way of "Lessons Learned" applications.*

*Our cover and center-spread feature article this month describes the R&D role of the U.S. Army Institute of Surgical Research, and how critically burned patients receive life-saving treatment at Brooke Army Medical Center after being rushed there by aircraft. The story, however, is much bigger than the institute; it involves applications in the U.S. and throughout the world.*

*MG Spurgeon Neel, commander of the U.S. Army Health Services Command, paid a recent tribute to heroes of Operation Dustoff in saving thousands of lives during the Vietnam War. He also cited current spin-off benefits to the civilian population when he gave the following dedicatory address at the Army Medical Department 200th anniversary observance at Fort Sam Houston, TX, where the ISR is located.*

MAJ Charles L. Kelly, Medical Service Corps, was Dustoff, and Dustoff was "Combat Kelly." The two became synonymous in South Vietnam in 1964 when the most effective of all emergency medical evacuation systems emerged to full maturity in the mountains and paddies half way around the world.

As commander of the 57th Medical Detachment (Helicopter Ambulance) Kelly assumed the radio call sign "Dustoff." His skill, aplomb, dedication and daring soon made both famous throughout the Delta. The lonely silence of many a distant outpost was broken by his radio drawl: "This is Dustoff. Just checking in to see if everything is OK." And when there were wounded, here came Kelly, "hell-bent for leather!"

On such a mission on July 1, 1964, Kelly was making an approach into a hot area to pick up wounded only to find the enemy waiting with a withering barrage of fire. He was advised repeatedly to retire but refused. When a U.S. adviser on the ground gave him a direct order to withdraw, Kelly calmly replied, "When I have your wounded." Moments later, Kelly died with a single bullet wound through his heart.

Kelly was dead, but the legacy was only the beginning. Dustoff became the call-sign of all Army aeromedical evacuation in Vietnam, and "when I have your wounded" became the personal and collective credo of the many gallant medevac pilots who followed him.

MAJ Charles L. Kelly was highly decorated for his valor, and is memorialized by a heliport named in his honor at Fort Sam Houston, TX. A far more appropriate and living memorial to him are thousands of young Americans and other nationalities alive today as the result of Dustoff, the system that Kelly died for.

Regardless of the criteria utilized, the American soldier wounded in Vietnam had the best chance of survival of any war to date. The mortality rate among wounded reaching medical treatment facilities was only 2.6 percent, compared to 4.5 percent in World War II, and 2.5 percent in Korea.

But this is not the complete picture. Many more seriously wounded reached medical facilities alive to receive the benefits of modern medical care. Our surgeons have never been more challenged and never have they performed more magnificently.

In previous wars most of these mortally wounded would have died en route and would have been recorded as KIA (killed in action). Assuming that those who died within the first 24 hours of hospitalization were in this category, the real comparable mortality rate was closer to only one percent.

A more realistic index of comparison of the effectiveness of the combat evacuation/treatment systems between wars is the "deaths as percent of hits," or ratio of deaths to deaths plus surviving wounded, which adjusts for the effect of the rapidity of evacuation upon the echelon at which death occurs.

In World War II, 29.3 percent of the wounded died; in Korea it was 26.3 percent, while in Vietnam it was only 19 percent. Further, the ratio of KIA to WIA (wounded in action) was 1 to 3.1 in WWII, 1 to 4.1 in Korea and 1 to 5.6 in Vietnam.

The major factors contributing to this outstanding accomplishment in the management of battle wounds were swift, reliable helicopter evacuation; ready availability of ample amounts of whole blood; highly skilled, well organized surgical teams; effective management of medical resources.

Of these important factors, helicopter evacuation is considered the common denominator of the success achieved. Without Dustoff it would have been impossible to exploit the other factors cited, and the management of medical resources would have been much less effective.

Helicopter evacuation in Vietnam was not a sometime thing, nor a fair-weather, day-time phenomenon. Dustoff was *the* method of emergency medical evacuation, with ground means in a secondary role. A high percentage of night sorties were flown; weather was not a significant deterrent.

The number of patients evacuated by Dustoff rose from 13,004 in 1965, to 67,910 in 1966, to 85,804 in 1967, and peaked at 206,229 in 1969. In 1969, Dustoff completed more than 104,112 missions while flying about 78,652 combat hours.

These statistics include evacuation of Vietnamese soldiers and civilians, Free World Forces and even Viet Cong, as well as U.S. casualties. One has only to relate these statistics to the survival data previously cited to extrapolate the tremendous number of lives saved by Dustoff.

In addition to significant contributions to saving lives, amelioration of suffering and improving medical efficiencies, Dustoff contributed immeasurably to the morale and combat effectiveness of our soldiers.

The soldier committed to battle in an isolated situation *knew* that he was within 35 minutes of definitive surgical care should he become wounded, and he *knew* that Dustoff would be there when needed. For each of the thousands of wounded actually evacuated, tens of thousands of his comrades were reassured by the red crosses and later the white ships of Dustoff.

On Oct. 9, 1969, the President of the United States recognized the contributions of Dustoff when he awarded the Medal of Honor to MAJ Patrick H. Brady, Medical Service Corps, for conspicuous gallantry and intrepidity in action at the risk of his life and beyond the call of duty.

Brady learned to fly Dustoff with Kelly and continued the tradition. On Jan. 6, 1968, he utilized three helicopters in succession on multiple missions under heavy fire to evacuate 51 seriously wounded men, many of whom would have died without prompt medical attention.

Nor is this the end of Dustoff's proud story. The system which reached perfection in Vietnam is now being applied to the significant emergency medical care problems within the United States. Lives are being saved daily on our highways, in our factories and in our homes by the use of helicopter evacuation and the Lessons Learned in Vietnam. Project MAST has demonstrated clearly the feasibility and necessity for expansion of this service to our citizens.

The right to live is a basic American right, whether on the field of battle or in our metropolitan and rural areas at home. Helicopter evacuation adds meaning to such innovative health care delivery systems as the Regional Medical Programs. A health care system incorporating helicopter evacuation is economically competitive with present systems without this capability.

I am convinced that Dustoff is the brightest light in the dark shadows of Vietnam. Dustoff, with its Kellys and Bradys, exemplifies the highest dedication of the Army Medical Department—when I have your wounded. I knew them well and am proud.


# ARMY RESEARCH AND DEVELOPMENT

Vol. 16 No. 5 September-October 1975

## ABOUT THE COVER:

*The U.S. Army Institute of Surgical Research (USAISR) has a proud tradition of notable contributions to the civilian as well as the military community, dating back to 1947 when it was established to investigate the use of antibiotics in treating infection in wounds. Our cover depicts how physicians, nurses and technicians interact for prompt movement of critically burned patients to the institute. The practice of rushing patients to specialized treatment centers by helicopter, developed to speedy precision during the Southeast Asia Conflict, is widely practiced in the United States.*

**Editor**.....**Clarence T. Smith**
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*Purpose:* To improve informal communication among all segments of the Army scientific community and other Government R&D agencies; to further understanding of Army R&D progress, problem areas and program planning; to stimulate more closely integrated and coordinated effort among Army R&D activities; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

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*Submission of Material:* All articles submitted for publication must be channeled through the technical liaison or public information officer at installation or command level.

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## FEATURES



## DEPARTMENTS



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# Selective Scanner . . .

## Army Awards $22 Million for Pershing II R&D

Award of $22 million for the advanced development program started early in 1974 for Pershing II missile system componentry has been announced by the Army.

The multiyear funding contract with Martin Marietta Aerospace calls for continued development and captive flight tests on the radar correlation guidance equipment, followed by test firings of prototype missiles with the terminal guidance.

The first-phase tests with the equipment, mounted in an Army Chinook helicopter for low-altitude runs, has been successfully completed and high-speed, high-altitude trajectory tests are next. White Sands Missile Range, NM, will be used for further captive flight tests.

Accuracy improvement providing increased military effectiveness against a broad spectrum of targets is built into the modular advances of the Pershing II as compared to the currently deployed Pershing 1-A, the first and second-stage motors and ground equipment of which are retained.

Like the Pershing 1-A, the improved system is launched on an inertially guided trajectory to the point where the reentry vehicle separates. The missile proceeds on a ballistic path to the terminal phase, where the all-weather radar is activated to correlate returns from the target area for updating the reentry vehicle's inertial position.

## Transparent Armor Installed on UH-1D Helicopter

Transparent armor for aircraft developed under contract with the U.S. Army Materials and Mechanics Research Center, Watertown, MA, is incorporated in a test UH-1D helicopter.

AMMRC researchers consider the new high-performance multiple-ply glass-plastic laminate armor installed in the windshield, crew door and lower cabin window areas of the aircraft a "milestone in aircrew protection and aircraft survivability."

Goodyear Aerospace Corp. recently completed contract work on the laminated armor, including fabrication of eight complete shipsets of the armor for installation on existing aircraft. Environmental and ballistic tests defined performance.

One set of the armor installed in a UH-1H helicopter has received favorable comment during initial evaluation of tests on crew vision and performance, aircraft weight and balance, and flying characteristics. Flight tests are continuing.

Design to scaled protection levels (specific ballistic threats) can be accomplished by variation of the laminate construction. Technology exists, it was reported, to provide the added protection in current inventory aircraft by direct replacement of sections, and to support design of "high survivability" aircraft.

## Computer System May Save MICOM $300,000 Annually

U.S. Army Missile Command headquarters electrical power consumption savings of about $25,000 monthly are expected by use of a computerized power management system.

Believed the first of its kind being installed within the Department of Defense, the system at Redstone Arsenal, AL, has been used successfully by numerous large corporations.

Termed a process controller, the system monitors electricity consumption by not letting it exceed a programed amount. Telephone lines tie the computer to key locations within MICOM.

Phase one includes servicing for 125 buildings. Phase two installation is scheduled for completion in several months and will add about 60 or 70 more buildings serviced by the computer. Although the final Phase three is sometime off, the project will cost about $100,000.

Jim Campbell and Ron Harmon, Utilities Branch leaders of the installation project, claim that Redstone is the Army's largest consumer of electrical energy, and that it ranks fourth or fifth among all Department of Defense activities.

## Stinger Weapon Scores 'Complete Success'

Fired from the shoulder of a man for the first time, in the first test of its Design Flight Program, the U.S. Army's Stinger weapon system defeated tactical countermeasures of a T33 jet plane to score a "complete success."

Although the missile did not carry a warhead, the plane was knocked out of control and was destroyed by range command at White Sands (NM) Missile Range. Stinger Project Manager COL David E. Green termed the result "a major milestone" in the development program.

Earlier Stinger firings from a modified Chaparral launcher with no man in the loop were similarly successful. Green said manned firings will be continued, including some with live warheads, to test both the missile and equipment pre-conditioned in hot and cold environments prior to flight.

## Edgewood Arsenal Employes Earn U.S. Patents

Patents granted recently to Abraham Flatau and Howard L. Stroterhoff, Edgewood Arsenal, Aberdeen (MD) Proving Ground, are for invention of the Army Ring Airfoil Grenade (RAG), and new process of producing aluminized paper used in testing chemical agents.

Chief of the Development and Engineering Directorate Weapons Systems Concepts Office, Flatau is a 21-year employe of the arsenal who has earned more than 15 U.S. and foreign patents. Invention of RAG also earned him a 1975 Army Research and Development Achievement Award, as announced in July-August *Army Research and Development Newsmagazine*.

The Ring Airfoil Grenade uses a radically new aeroballistic concept of rotating while following a flat trajectory, resulting in substantially increased range for delivery of nonlethal civil disturbance control chemicals. RAG also is envisioned for numerous other military applications.

Stroterhoff, a chemist in the same directorate, received a patent for a new process of producing aluminized paper by mixing fibers and aluminum particles, along with molding, heating, cutting and drying, to form composite discs used in chemical agents spot test procedures.

## Rust-Proofing Expected to Save Army $1 Million

Initiation of a rust-proofing program in future production of the U.S. Army's most common tactical wheeled vehicles will save about $1 million over a 5-year period, the U.S. Army Tank-Automotive Command claims after a year-long survey.

Rust problems that surfaced during the survey involved the ¼-ton truck, the 2½, 5 and 10-ton truck cabs, and the M101 and M105 trailers, including vehicles used in the United States and Europe. Future specifications for these vehicles will deal with the rust problem, but vehicles now in the field will not be rust-proofed except as designated during overhaul.

Rust-proofing of new vehicles is expected to extend their life cycle about five years, according to TACOM. Commercial 1¼-ton Dodge trucks currently being delivered to the Army will be rust-proofed—recommended also for the M416 trailer.

## Contract Calls for Interactive Computer Panel

Design and development of a new flat panel to display computer generated information for military use is ordered under competitive prototype contracts announced by the U.S. Army Electronics Command, Fort Monmouth, NJ.

Awards for the Interactive Computer Presentation Panel (ICPP) were made to Litton Display Systems ($277,500), and Control Data Corp. ($249,369). ICPP is an international cooperative R&D program between the U.S. and the Federal Republic of Germany.

The ICPP advanced development program will result in the design, development and field evaluation of a flat, solid-state, low-volume display system. Alphanumeric and military symbols are superimposed on a standard Army map, and located to an accuracy of 80 meters on a 1:50,000 scale.

## Bushmaster Full-Scale Development Ordered

Full-scale development of a candidate for the Bushmaster weapon system, a 25mm rapid-firing cannon designed to replace the U.S. Army's present 20mm gun, is orderd in a contract awarded recently by Armament Command, Rock Island, IL.

The $22.8 million contract with the Aeronutronic Division, Philco-Ford Corp., is for design and manufacture of the Bushmaster weapon system—specifically for 26 weapons and 439,599 rounds of ammunition. The Aeronutronic Division has been working on the Bushmaster program since May 1972 under a competitive prototype validation program contract.

When made available to the field, the Bushmaster will be used as the primary armament on the Mechanized Infantry Combat Vehicle (MICV). The system takes its name from the fast-striking deadly snake in American tropical forests.

BG Stan Sheridan is project manager for the MICV and Bushmaster programs.

## Device Earns Patent Award for Watervliet Team

Invention of a device claimed to have "significantly improved ultrasonic inspection of gun tube metals" has earned a U.S. Patent Office award for two Watervliet (NY) Arsenal scientists.

Electronic engineer Donald C. Winters and metallurgist James J. Miller teamed their inventive talents to present a patent application titled "Two-Coordinate Locating Device for an Ultrasonic Probe."

During random ultrasonic scanning of exteriors of large-caliber gun tubes, the device continuously locates and records the position of cracks or other metallurgical flaws.

Recording of this information has been done tediously by use of a grease pencil, straight edge and protractor. Data also had to be transmitted manually to a computer, as compared to automatic transmission with the new device, a one-of-a-kind prototype.

The patent award earned each of the inventors a $50 honorarium through the Army Incentive Awards Program.

## EPA Proposes Solid Waste Disposal Guidelines

Guidelines for the storage and collection of residential, commercial and institutional solid wastes have been proposed by the U.S. Environmental Protection Agency (EPA), in line with the Solid Waste Disposal Act of 1965.

These guidelines would be legally binding for federal agencies, but would be recommended for adoption by state and local governments. Exemptions may be made for U.S. Post Offices and military recruiting stations which use local waste collection systems.

Proposed provisions define practices for waste storage so as to prevent fire, health or safety hazards. Trash containing food wastes would have to be stored in covered or closed containers, and be picked up once every seven days.

Other provisions set guidelines for collection vehicles, plastic and paper disposal bags, appliances, bulky wastes and protective clothing. Copies of these guidelines are available from EPA, Office of Public Affairs, Washington, DC 20460 (755-0872).

## $44 Million Designated for CLGP Engineering

Initiation of a $44 million multiyear program for engineering development and producibility engineering of the XM712 Cannon-Launched Guided Projectile (CLGP) was announced in August by the U.S. Army Armament Command (ARMCOM).

Expected to require at least three years to complete, the CLGP program was initiated with the signing of a $5 million contract by ARMCOM and Martin Marietta Corp. officials. Termed a "significant advance in defense technology," the CLGP will enable artillerymen to attack hardpoint targets at long range.

In recent tests at White Sands (NM) Missile Range, the CLGP scored six hits out of the final seven rounds on stationary and moving tanks at ranges up to 10 miles (16 kilometers). Projectiles were maneuvered in flight to compensate for off-target errors of several hundred meters.

The demonstration of a high probability of a single round "kill," by use of a reflected laser beam to home-in on moving or other hard-point targets, indicates a potential saving of millions of dollars on ammunition costs and logistics.

COL Frank P. Ragano is project manager for Cannon Artillery Weapon Systems at HQ U.S. Army Armament Command, Rock Island, IL.

## Uniform Board Approves Army Green Sweater

Following six months of field tests by more than 250 personnel, the U.S. Army Uniform Board has announced approval, on an optional purchase basis, of a man's Army green sweater. The garment, expected to be available in Post Exchanges this fall, may be worn without or under the Army green coat in offices.

John Hansen, director of the Clothing, Equipment and Materials Engineering Laboratory, U.S. Army Natick Development Center, anticipates wide acceptance of the garment—due at least partially to continuing DoD efforts to cut installation heating costs during cold months.

## LOGC Studies Combat General Support Concept

Integrated general support maintenance and supply service for six system-oriented centers, to replace parts of the COSTAR combat service support system, is being considered by the U.S. Army Logistics Center (LOGC).

Known as COGS (Combat Oriented General Support), and planned for test and evaluation this fall, the new concept will apply to weapons and combat vehicles, wheel vehicles, communications-electronics, ground support equipment, aircraft, missiles and munitions.

The LOGC announcement explained that each of the six centers, proposed for establishment during fiscal year 1976, will provide across-the-board services for Corps Support Command units. Included will be Class VII and IX supply; collection, classification and controlled cannibalization; full general service maintenance; operational readiness; and direct exchange.

The COGS concept is being developed for test and evaluation by LOGC and its associated Ordnance School at Fort Lee, VA. The plan calls for augmentation of COSCOM capabilities by staffing the COGS center with a large technical inspection/quality control section.

This nucleus of experts will serve for contact, technical assistance, and battle damage assessment to aid direct support units and using units.

## Film Depicts Engineers' Recreation Resources

Beautiful recreation areas available to the public through the U.S. Army Corps of Engineers—which in 1974 attracted 350 million visitors including 40 million campers—are depicted in a new color film, "A Whole Lot Proud."

Obtainable on loan free of charge from all Corps Division and District Offices, and the Public Affairs Office, Office of the Chief of Engineers, Washington, DC 20314, the 25-minute 16mm film tells the story of the park rangers' role in recreation resource management.

Among Corps recreation resources shown are areas along the White River in Arkansas and Missouri, the Missouri River in South Dakota, and Stones River in Tennessee. The Corps also manages camping facilities along more than 43,000 miles of shorelines of about 400 lakes throughout the United States.

# R&D News . . .

## Materiel Command Headquarters Reorganization Goals Explained

Objectives of a major reorganization of U.S. Army Materiel Command Headquarters, scheduled for completion by December 1976, include corporate-type management, concentration on plans, programing, policy and evaluation, and decentralization of operational functions to AMC field elements.

Other goals are reduced layering of decision authority, better assurance of readiness of combat materiel, reliability under field requirements, and a streamlined hard-hitting capability for management of future materiel development centers and logistics commands. (*See p. 6*).

Organizational changes—involving a reduction of the headquarters staff from 2,128 to about 1,420, with about 400 transfers to field elements—are based on recommendations of the Army Materiel Acquisition Review Committee.

AMC Commander GEN John R. Deane Jr. organized an AMARC recommendations implementation study group in April that was chaired by AMC Comptroller MG Leslie R. Sears Jr.

Consideration of reduced HQ staffing by the group included study of the materiel management structure of the other U.S. Military Services and a number of major corporations.

In view of AMC's responsibility to report and respond to HQ Department of the Army, the Office of the Secretary of Defense, various Congressional committees, and certain other federal agencies, the study showed that a substantially larger staff is essential than the typical industrial headquarters staff of 200 to 500 personnel. Participative management from subordinate commanders is part of the new philosophy.

The reorganization eliminates the position of AMC deputy commander, a 3-star rank title, and creates a new deputy CG for Materiel Readiness parallel to the long-established deputy CG for Materiel Acquisition. The plan calls for 3-star rank for both deputies. Abolished also is the PL-313 position of chief scientist.

Functioning director under the AMC commander will be a powerful AMC Select Committee (SELCOM), actually a strengthening of an existing committee. SELCOM will be composed of GEN Deane, the deputy CGs for MA and MR, key directors of AMC, and appropriate field commanders (that is, as necessary, commanders of eight development centers and six commands/centers managing AMC's combat readiness mission).

SELCOM's function will be to determine over-all policy, establish goals and objectives, allocate resources, and provide top-level guidance. The committee is planned as the AMC Headquarters' primary mechanism for integrating plans and activities of the materiel acquisition and materiel readiness organizations.

Much of the reduction in staffing will be absorbed in activities assigned to the deputy CG for Materiel Acquisition, reduced from 608 to about 370 personnel.

This reduction is explained by elimination of commodity item and specific project orientation from the Directorate of Research, Development and Engineering (redesignated the Directorate of Development and Engineering), and Directorate of Requirements and Procurement (redesignated the Directorate of Requirements and Production).

A sharp reduction is effected in staffing of the office of former deputy CG for Logistics Support—now the deputy CG for Materiel Readiness—from 533 to about 294, mainly through transfers of functions to subordinate commands and field activities. Some personnel will move to the International Logistics Center, New Cumberland Army Depot, PA.

Directorates of Supply, and Maintenance are eliminated and restructured into three new directorates: Readiness; Materiel Management; Plans, Doctrine and Systems. Two former elements of the Directorate of Development and Engineering are now directly under the deputy CG for Materiel Acquisition, namely the International Development Office, and the Product Improvement Program (PIP) Office, both of which have increased importance in the new AMC HQ structure.

The new organizational structure of the Office of the Deputy CG for Materiel Acquisition shows an Office of Laboratory and Development Center Management. Its function is to provide an overview responsibility for labs and DCs, plan for

## ETL Building Memorializes First Technical Adviser

A $5.5 million memorial to the first technical adviser of the Army Engineer Topographic Laboratories was named the William C. Cude Building Sept. 5 in dedication ceremonies at the Corps of Engineers 565-acre research and development complex, Fort Belvoir, VA.

Army Deputy Chief of Engineers MG John W. Morris, guest speaker, joined with other dignitaries in paying tribute to Cude for numerous contributions including organization of the nucleus of what is now the USAETL in 1960.

Cude also was acclaimed for providing technical and managerial excellence in mapping, surveying and geodesy during a 33-year career as a U.S. Government employe and an Army officer. He retired in 1962 and died nine years later. His service as a civilian started in 1928 and included employment with Soil Conservation Service, Dept. of Agriculture.

USAETL Commander and Director COL Maurice K. Kurtz Jr. opened the ceremonies with welcoming remarks, including a tribute to Cude's memory. John T. Pennington, a former scientist and administrator at the laboratories, also presented a dedicatory address.

Ceremonies included the unveiling of a bronze plaque of Cude placed in the entrance hall and a tour of laboratories.

Established Aug. 1, 1960, as the U.S. Army Engineer Goedesy, Intelligence and Mapping R&D Agency, and changed to USAETL July 28, 1967, the labs are organized into five R&D elements: The Research Institute, Computer Sciences Lab, Geographic Sciences Lab, Topographic Developments Lab, and Terrain Analysis Center.

## APG Completes Tests on Stabilized Viewing Devices

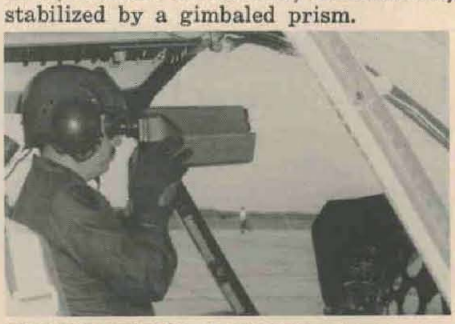
Directed to the Product Improvement Program (PIP) for the Interim Scout Helicopter Program, to meet an approved requirement, four prototype "Hand Held Stabilized Viewing Devices" have completed field and laboratory tests.

Aberdeen (MD) Proving Ground announced completion of field tests there Aug. 21. Dr. Andrew J. Britten, project coordinator for Frankford Arsenal, stated that earlier "extensive laboratory testing" established evaluative data for a report being prepared.

Field testing by the APG's Materiel Testing Directorate, using a modified LOH-58 (Light Observation Helicopter), was conducted in coordination with the Fire Control Development and Engineering Directorate of Frankford Arsenal.

Soldiers might term the prototype devices "binoculars," as they appear to be, but the stabilizers do not blur as binoculars may do when trained on a target by an operator with hand or body tremors. The stabilizers look like the Army's standard 7x50 M17 binocular.

The devices tested are: Kenyon Gyro Stabilizer with M19 7x50 binocular and a gyro operating off aircraft power; British Aircraft Corp. Steadyscope, 7x50 power with a built-in gyroscope powered by batteries; Optus Corp. Mark 1610 Stabilized Image Monocular, long-range 10x50 power with internal gryoscope, optical components and power supply (operable also from aircraft power); Fraser-Volpe Corp. Steadi-Eye Mark IIIM, smallest of the four, nonelectrical, stabilized by a gimbaled prism.



**PROTOTYPE Mark 1610 Viewing Device.**

future structures, and give guidance for training and career planning for science and technology personnel. The office also has responsibility for Research and Technology Program (6.1, 6.2, 6.3A funds).

The Director of D&E is charged with supervising the program and budget, and providing the technical overview for AMC development & engineering activities.

Reduced by 40 civilian and 5 military personnel in the reorganization effected June 30, 1975, the Directorate sustained a further cutback from 290 to 117 total staffing (92 civilians, 25 military).

Newly established under the deputy CG for Materiel Acquisition is the Directorate for Battlefield Systems Integration (*see page 6*), and an Office of Manufacturing Methods and Technology.

Adjustments to the over-all structure of the new AMC Headquarters and certain field elements are still under consideration in some areas. In its August report, "Study to Align AMC's Functions," the special committee headed by MG Leslie R. Sears Jr. assumed that the new headquarters will receive reports from 8 development centers, 6 commands managing the materiel readiness mission, a Test & Evaluation Command, 44 field activities, approximately 9 project managers, and 14 depots.

# AMC Studies Lead to Product Improvement Office

A Product Improvement Program (PIP) Office has been established at HQ U.S. Army Materiel Command as the result of two recent studies on decentralization of authority with the objective of increasing management visibility at headquarters.

Reporting directly to Deputy Commanding General for Materiel Acquisition MG George Sammet Jr., the office will provide for management of life-cycle materiel configuration, program and budget control, technical overview of program execution, and materiel modification functions. Areas of emphasis will include Department of Army (DA) coordination, U.S. Army Training and Doctrine Command (TRADOC) requirements validation, and user agency liaison.

Defined as a formally proposed configuration change to a type-classified standard or limited production item, involving substantial engineering and testing effort, Product Improvement is receiving high-level DA interest as the viable alternative technical approach to development of new materiel.

Director of Defense Research and Engineering Malcolm R. Currie stated in 1974: "Greater emphasis is placed on Product Improvement as a potentially effective alternative to new weapon systems development."

Former Assistant Secretary of the Army (R&D) Norman R. Augustine (now Under Secretary of the Army) designated Product Improvement as the No. 2 peacetime R&D strategy in view of inflation and continuing budget constrictions. He said, "Rely upon evolutionary development (PI) as the most effective means of maintaining an adequate force structure."

Military materiel and weapons systems product improvements may be made as essential to the military mission, operational readiness, and to correct deficiencies or to assure safety and/or security of materiel. Design changes may also be necessary to upgrade capabilities of materiel, or to improve through RAM (Reliability, Availability and Maintainability), reduce costs, or facilitate logistical support.

Formalized in 1963, the PI Program moved ahead in 1968 when an office was established within AMC under the director of Research, Development and Engineering. AMC's responsibilities and PIP approval authority were increased by the Department of the Army in 1973. AMC redelegated a portion of this authority to the Major Subordinate Commands (MSCs) to correct urgent deficiencies in materiel.

The PI Program within AMC has grown from less than 200 projects totaling $125 million for FY 72 to more than 300 projects totaling $434 million for FY 76. PIP importance is evidenced by statistics showing that the FY 76 total AMC RDTE budget is $1.7 billion; procurement $3.4 billion; and OMA (Operations, Maintenance, Army) $1.5 billion.

This year, for the first time, the Department of the Army conducted a detailed General Officer Review of the FY 77 Product Improvement Program. Participants included representatives from the Office of the Deputy Chief of Staff for Logistics, Deputy Chief of Staff for Research, Development and Acquisition, Deputy Chief of Staff for Operations and Plans, U.S. Army Training and Doctrine Command and AMC. BG Harry A. Griffith, director of the Research, Development and Engineering Directorate, represented AMC.

The review was held to provide fiscal and commodity guidance for developing future PI programs and to approve those FY 77 programs that exceed AMC approval authority. Planning estimates for FY 77 total 508 PIPS aggregating over $3 billion, over the 5-year planning period (FY 77–81).

Managment of the PI Program is complicated by the numerous functional areas and budget appropriations involved.

The AMC studies mentioned earlier showed that a typical PI project may require as many as six different types of funds—RDTE, PEMA, OMA, OMAR, OMNG and SF— (Research, Development, Test and Evaluation; Procurement of Equipment and Missiles, Army; Operations and Maintenance, Army; O&M, Army Reserve; O&M, National Guard; and Stock Fund). Control is fragmented among various organizations and may impact downstream on numerous technical areas —quality assurance, reliability, maintainability, logistics.

Because of extensive coordination and planning required to complete a PI project, the HQ AMC Configuration Control Board that evaluates product improvements includes representation from the Office of the Comptroller and the Directorates for Quality Assurance; Maintenance; Requirements and Procurement; Supply; and RD&E.

In reviewing the PI Program, the studies identified four key problem areas, of which timeliness is considered the most significant. The PI time element extends from proposal preparation, staffing, funding cycle, engineering development and testing, production of kits, "deadtime" (OMA money availability), through kit installation/retrofit during rebuild.

The study groups' recommendations included: Establishment of a funding focal point at AMC HQ and similar funding alignment by major subordinate commands; that HQ AMC be given responsibility and authority (i.e., budget and control of OMA, OMNG, and OMAR funds) for worldwide kit installation; that HQ AMC be permitted to consolidate control these accounts; and that "user" money be in the PI projects.

The report further recommends that DA consider modifying the Operational Readiness rating to identify equipments upon which required modifications have not been accomplished within the specified time—as less than 100 percent ready.

The second key problem identification area is total program visibility, i.e., front-end orientation, whereby primary emphasis of HQ has been placed on the formulation phase of the program and execution of the projects is left to the MSCs. In other words, how much information is necessary to top management overview of program effectiveness?

Other recommendations stem from this: that HQ AMC delegate increased approval levels to the MSCs; increase visibility during implementation by adopting a semiannual report on selected items; develop appropriate "measures of effectiveness" to assess MSC performance; and that Action Officers in the Product Improvement Office chair the Configuration Control Board working groups.

The third problem area addressed in the study is to determine the appropriate level of authority that *should* be delegated to the MSCs for the most effective implementation of the program within the resources. Recommendations included steps for further decentralization of PI authority to the MSCs. The first action to implement was taken July 22, 1975. Further guidance should be available soon to MSCs.

The fourth problem is the fragmentation of PIP funds among several appropriations (and among numerous accounts within OMA) without a single controlling authority. Recommendations include a request to permit consolidation of OMA application money into one account and authority to reprogram PIP-identified funds. AMC has made DA aware of this problem and the PI Office is working with the Maintenance Directorate on modification kit application and control.

Initiated by the DCGMA, the in-house ad hoc study report was compiled by participants from AMC and the major subordinate commands. Additionally, a contract study was conducted by Forecasting International Ltd which supplemented the in-house effort.

# Coastal Engineering Research Laboratory Dedicated

Dedication of the Jay V. Hall Jr. Laboratory as part of a $5.5 million facility of the U.S. Army Coastal Engineering Research Center (CERC) at Fort Belvoir, VA, on Aug. 21, was highlighted by participation of Chief of Engineers LTG William C. Gribble Jr.

In the principal address, LTG Gribble termed the laboratory an investment in the future of the nation's coastal resources. The new laboratory, he said, is dedicated to a search for scientific and engineering knowledge to help mold the nation's shorelines and improve management of these resources.

The laboratory is an "in-kind replacement" for CERC's former long-used facilities in the Decarlia Reservation in Washington, DC, and is part of the Corps of Engineers' consolidation of Washington metropolitan area facilities in a 565-acre research and development complex at Fort Belvoir.

Present as an honored guest at the ceremonies was Mrs. Lillian Steuart, widow of Jay V. Hall Jr., who until his death in 1966 was chief of the Engineering Division of the Beach Erosion Board and later of the Coastal Engineering Research Center. In 1931 Hall became the first engineer on the staff of the board, predecessor organization to the CERC.

CERC Commander and Director COL James L. Trayers opened the ceremonies with welcoming remarks. CERC Technical Director Thorndike Saville Jr., in a tribute to Jay V. Hall Jr., commented on his 35-year record of continuous contributions to the Beach Erosion Board and CERC in design and programing of construction of buildings and facilities.

A large portrait of Hall was unveiled during the ceremonies and is placed, along with an in-memoriam bronze plaque, in the laboratory entrance.

Facilities include a 300-by-150-foot shore processes test basin and three wave tanks inside the laboratory, complemented by a 635-foot-long, 20-feet deep, 15-feet-wide wave tank located outside. The large tank can generate waves six feet high for test purposes.

Coastal engineering research is conducted in five general areas: wave- and water-level characteristics; sedimentation transport, erosion and shoaling; functional and engineering design of coastal projects, including effects on physical and biological environments; ecological engineering for mitigation or enhancement of these effects; and application of research results.

# Battlefield Systems Integration Directorate Established

Described as an action to close a gap in the U.S. Army materiel acquisition process is the establishment of a Directorate for Battlefield Systems Integration, announced Aug. 15 by GEN John R. Deane Jr., commander of the U.S. Army Materiel Command.

GEN Deane termed the new organization essential to forging the weapons and equipment being produced by modern technology into a more effective fighting capability for the future. An integrated combat system, he said, is highly dependent on the interaction of all elements of the system for achieving maximum combat capability.

The mission of the Battlefield Systems Integration Directorate, staffed by a small, highly select group of military officers and professional scientists and engineers, is to translate operational requirements established by the U.S. Army Training and Doctrine Command (TRADOC) into technical specifications; also, to analyze equipment under development to insure that it meets the specifications.

GEN Deane cited, as an example of the role of the directorate, that significant increases in range, precision and lethality of artillery weapons under development will be of little practical value—unless accompanied by parallel advances in target acquisition capability that will permit locating targets deep in enemy territory, and processing accurate location data instantaneously to artillery fire-direction centers.

MG Ira A. Hunt Jr., recently returned from duty in Thailand as deputy commander, U.S. Support Activities Group, heads the new directorate. He commanded a brigade of the 9th Infantry Division in Vietnam and an engineer battalion in Europe. Among his educational qualifications are PhD degrees in engineering and in business administration, and graduation from the National War College.

Officers who will serve with GEN Hunt will be selected on the basis of combat experience coupled with technical education and materiel development experience. Civilian scientists and engineers will be selected for demonstrated technical competence and proved ability to perceive interactions of the combat system necessary to exploit the technological state-of-the-art and significant R&D advances.

# Development Centers Status: 3 Set Up, 5 in Staffing

All of the remaining five of eight U.S. Army Materiel Development Centers under consideration to implement recommendations of the Army Materiel Acquisition Review Committee (AMARC) are in various stages of staff study.

Announcement of Department of the Army approval of the plan to create a Tank-Automotive Systems Development Center (TASDC) and a Tank-Automotive Logistics Command (TALC), from resources of the present Tank-Automotive Command Headquarters and the Mobile Systems Laboratory in Warren, MI, was made Aug. 14.

The realignment will not transfer personnel into or out of the metropolitan area of Detroit, the announcement stated. The reorganization concept was submitted in the AMARC final report, which advocated establishment of separate development centers for R&D, engineering and materiel acquisition in specific materiel acquisition areas.

TASDC will be responsible for development and introduction to field elements of new tanks and automotive systems as well as product improvements. TALC will be concerned primarily with logistical aspects of field systems. Both TASDC and TALC will report directly to Headquarters U.S. Army Materiel Command, 5001 Eisenhower Ave., Alexandria, VA.

Realignment of functions and personnel involved in establishment of TASDC and TALC is scheduled for completion in five to six months. TASDC is the third of the eight development centers under consideration to receive Department of the Army approval. Announcement of approval of the Mobility Equipment Development Center (MERDC), Fort Belvoir, VA, and the Natick Development Center (formerly Natick Laboratories) at Natick, MA, was made Mar. 8

Establishment of the Harry Diamond Development Center, involving consideration of three alternative proposals prepared by an ad hoc study group, as reported in the July-August edition of the *Army Research and Development Newsmagazine*, was being reviewed by an "Advocacy Team" at press time. The objective is to "flush out all possible alternatives in the final decision process."

Other proposals undergoing a similarly thorough review process are an Armament Development Center, upon which Congress has been briefed and has returned comments, a Missile DC, an Air Mobility DC, and a Communications/Automated Data Processing DC. As of press time, no plans had been announced for obtaining comments of Congress on the latter three centers.

It is planned that the Congressional comments will be provided to the Secretary of the Army for consideration prior to final decision documentation to be provided by the Secretary of the Army to the Secretary of Defense.

# MICOM Sets Up Computer Center

Establishment of a Missile Computer Software and Hardware Center to support systems such as SAM-D, SHORADS, Hawk, the AN/TSQ-73 Missile Minder, and others, was announced Aug. 18 by Army Missile Command, Redstone Arsenal, AL.

Donald Ciliax, acting chief of the facility, explained that the Army is automating many functions of missile systems with digital computers. The center will provide technical support to system project managers with software and hardware services ranging from design through deployment and maintenance.

The center's software projects will utilize tactical computers to provide design information and recommendations to project officers. Exchange of computer technology with other government agencies, industry and education institutions is planned.

# ATACS PM Emphasizes 'User Satisfaction' Criteria

"User satisfaction" with respect to Army materiel involved in Project Hand-Off, an objective detailed in a recent letter from GEN John R. Deane Jr. to all Army Materiel Command elements, is guaranteed for the new Army Tactical Communications System (ATACS).

Stated by the ATACS Project Manager's Office at HQ U.S. Army Electronics Command, Fort Monmouth, NJ, the guarantee is "unqualified and unconditional."

*"Our commitment to the user," it states, "is that the AN/TTC-38 system will provide an automatic telephone switch capability as defined in the qualitative materiel requirements document. If the AN/TTC-38, its ancillary equipment, manuals or supplies fail to do the job, corrective action will be taken by the developer. Our commitment also carries with it the AMC pledge to give first priority to the user's needs."*

Similar guarantees will be applied to all materiel delivered in Project Hand-Off as part of the Army Materiel Command top-priority goal of upgrading standards to assure combat-ready equipment to the soldier in the field.

MG Hugh F. Foster Jr., commander of ECOM and Fort Monmouth, recently made the first call to the initial units operational in Germany at U.S. Army Signal Corps bases. Fifteen units will be placed in operation this winter.

Any complaint by a user of the system will be an "on the double" dictated response to a special team of technicians "ready to move anywhere, any time." A representative of the ATACS Project Manager's Office is the team leader.

When the "warranty" team encounters a problem not readily solvable, a second team gets into the causative check-out at Fort Monmouth. There a duplicate AN/TTC-38 unit is set up in the ECOM Communications/Automatic Data Processing Laboratory. The "standby" experts thus can work with the repair team in going over the system to ferret out the trouble, and direct immediate corrective action.

Neither of the teams has had any requirement to move into action to date.

When all 15 AN/TTC-38s are operational, U.S. Army tactical units in Europe will have touch-dialing anywhere within the worldwide telephone system.

Compared to manual-switch systems, the solid-state AN/TTC-38 is smaller and lighter, requires less power and fewer personnel to operate, is faster and more reliable, and is easier to maintain. It also has a self-contained power unit as its primary power source.

**MG Hugh F. Foster Jr., recently retired commander of ECOM and Fort Monmouth, makes the first telephone call over a new automatic, computerized telephone central office in Germany, which is now part of a worldwide, pushbutton telephone system. Looking on is COL John P. Dobbins (left), project manager, ATACS, and MG H. B. Gibson Jr., DCS (Logistics), USAREUR.**

Specific advantages of the new system are the conference call and "flash-override" ability of some of the command position lines, enabling selected lines to cut off lower-priority calls to make emergency mission-essential contacts. Lines with a conference-call button will enable the user to address all concerned parties at the same time. Moreover, the automatic switch will search all lines in the immediate office for an open line in response to a busy signal.

# MASSTER Studies New Tent, Van Shelters

Two new types of military shelters and a possible replacement for the Army's small general-purpose tent are being evaluated by personnel at MASSTER (Modern Army Selected Systems Test, Evaluation and Review), Fort Hood, TX.

MAJ Kenneth W. Allen, test officer, said the Army has about 180 different types of shelters. One of the objectives of the current tests is to determine the feasibility of reducing this large inventory and the logistical support burden.

One shelter is a "3 for 1" expandable unit with a carrying capacity of 6,000 pounds. Measuring 8 feet by 8 feet by 20 feet, its width can be tripled when two outer sections, including walls, floors and ceilings, are folded out.

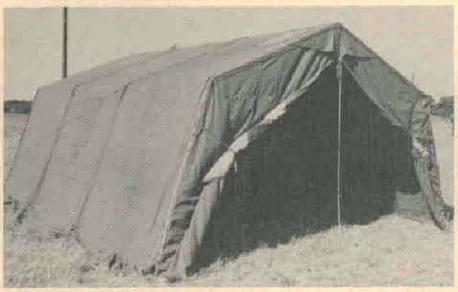
A second, nonexpandable type shelter measures 8 feet by 8 feet by 10 feet and features removable walls. Two or more of these shelters, each with a carrying capacity of 3,000 pounds, may be joined together.

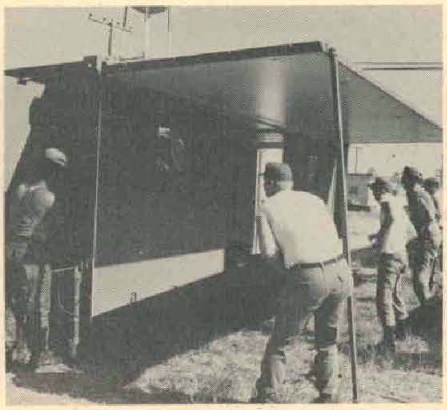
Neither shelter is designed specifically for cargo storage or moving. Equipment within these shelters, however, need not be removed when the shelters are transferred to a new location. Potential uses include office space, living quarters, photo labs, dining facilities, and maintenance shops. etc.

Both shelters are handled in the same manner as present military cargo containers and meet international standards for shipping. They are also designed to fit standard wheeled dolly sets for transport.

A frame, consisting of 31 aluminum tubes of 6-foot lengths and 20 cast aluminum fittings, replaces the standard series of poles and guywires used for tents the new units are designed to replace. However, both stakes and guywires may be used for extra support.

Another advantage of not using stakes is that the tent may be set up on hard surfaces, such as asphalt or concrete. The tent can be expanded in length simply by adding more frame tubes and canvas sections.





**EXPERIMENTAL tent frame has 31 tubes and 20 cast-aluminum fittings. The tent and two new types of military van shelters, similar to the "30 for 1" expandable unit shown are evaluated at MASSTER.**

# MASSTER Views CATE System For Maintenance of Equipment

Military potential of the CATE (commercial, automatic test system) to pinpoint faults in electronic equipment is being evaluated at HQ MASSTER (Modern Army Selected Systems Test, Evaluation and Review).

Testing of the system at Fort Hood, TX, involves three specific types of military communications-electronics devices —the AN/PRC-77 ground radio communications; the AN/ARC-115, avionic communications; and the TD-342 wire and carrier communications.

Effectiveness of CATE-assisted repair techniques is being compared with the current manual method of checking defective (unserviceable) electronic equipment. The CATE system enables maintenance men to connect defective electronic equipment to a computer by means of interconnecting cables.

Diagnosis of defective equipment data is scheduled over a 6-month period and each disc pack can store 2.4 million bits.

When the fault in equipment is diagnosed, the equipment is repaired by CATE personnel. Repair time and data are recorded. Then the units are restored to defective condition and returned to the maintenance shops for repair using current methods.

Repair data from both methods are evaluated in terms of time and completeness to determine the military potential of the CATE system. Finally, results are considered with respect to the impact that might occur if CATE were incorporated into regular Army maintenance.

# DNA Funds Joint Nuclear Simulation Tests

Phase II of the Dice Throw High Explosive Field Test Program, detonation Aug. 12 of a 100-ton charge of TNT at White Sands (NM) Missile Range, was termed "highly successful."

Funded by the Defense Nuclear Agency (DNA), Dice Throw will climax in October 1976 when a 600-ton detonation of ammonium nitrate/fuel oil is programed to simulate blast effects of a nuclear weapon on a large array of experimental test items. A 120-ton detonation of AN/FO is scheduled during September 1975.

DNA Project Officer MAJ Todd D. Stong, stationed at DNA Headquarters in Alexandria, VA, said expenditures to date have totaled about $2.5 million in eight months, and that project completion will cost over $10 million.

Involved in testing items in "Main Event," as the climactic test is termed, will be about 35 U.S. Government agencies and sponsored companies including the Army, Navy and Air Force, along with three foreign countries (United Kingdom, Canada and West Germany). Sweden, Norway and The Netherlands also are considering participation.

Objective of the test program is to determine realistically, by simulation, nuclear weapons blast effects on other weapons systems components, other military materiel, and ground shock and impact on military structures.

Dice Throw is designed to show how well weapons such as tanks, wheeled vehicles, missiles, reentry bodies, and radar system withstand shock and blast.

Since atmospheric nuclear detonations are probibited by the Limited Test Ban Treaty among major powers, Dice Throw is directed toward alternative methods of nuclear weapons effects simulation. Another goal is to develop low-cost methods. TNT costs about $1.50 a pound. Under consideration is the use of ammonium nitrate/fuel oil at 12 cents a pound.

An advantage of above-ground nonnuclear testing, such as Dice Throw offers, is that many more participating agencies can test items over a wide area, up to a mile from the test site. Underground nuclear testing can accommodate only a few items in a narrow tunnel.

Mushroom of 100-Ton TNT Blast.

# New Regulation Details Disposal of Dredged Material

Disposal of dredged material without detrimental effects environmentally upon the nation's waterways resources, a high priority R&D problem area to which the U.S. Army Corps of Engineers is directing a multi-year effort programed at about $30 million, is under new control.

Assuming that the R&D program achieves envisioned technological advances, spin-off applications could help the Corps to administer its civilian permit program, which regulates discharge of dredged or fill material by industry or private enterprises into rivers, lakes, waterways adjacent wetlands throughout the U.S.

Prescribed procedures developed in cooperation with the Environmental Protection Agency are detailed in a regulation published recently in the Federal Register. About 4,500 comments received on the draft regulation published in May were considered in the new rules.

Issued in compliance with a Mar. 27, 1975, order of the U.S. District Court for the District of Columbia, the regulation extends previous permit procedures for disposal of dredged material, including wetlands adjacent to traditional navigable waters of the U.S.

Assistant Secretary of the Army Victor V. Veysey has announced that the regulation will be implemented in a 3-phase 2-year program. Phase I provides for control of wetlands adjacent to navigable waters.

Phase II, effective July 1, 1976, will initiate regulation of discharges of dredged or fill material into primary tributaries of navigable U.S. waters, natural lakes greater than five acres in surface, and adjacent wetlands.

Phase III, effective July 1, 1977, will extend the Corps of Engineers' authority as directed by Congress to regulate discharges of dredged or fill material into other waters generally, up to the headwaters where streams flow less than five cubic feet per second.

Discharges of dredged material and placement of fill material that are necessary for construction of any structures in waters of the United States are covered in the program.

Secretary Veysey said that no permits will be required for operations other than dredge or fill; for work outside navigable waters as defined; for normal farming, ranching and forestry operations such as plowing and seeding, cultivating and harvesting; and other exceptions.

# ARMCOM Reports Progress on Multishot Area-Fire Grenade Launcher

Design feasibility of a first-generation prototype of a multishot area-fire grenade launcher, under development as an integral part of a proposed Future Rifle System, has been demonstrated at HQ U.S. Army Armament Command.

ARMCOM's General Thomas J. Rodman Laboratory has announced success of the design feasibility tests of the launcher, designed to fire a 30mm grenade cartridge. Infantrymen using the launcher will have a capability of accurate and rapid fire of grenades to ranges in excess of 500 meters, the developmental team reported.

Mounted in the forestock of the rifle, the launcher is semiautomatic with a 4-shot capacity. The trigger is fired through a selector lever and the launcher is fed from a tubular magazine lying alongside the barrel.

Work is under way on development of a second-generation prototype that will undergo extensive testing for reliability prior to Army evaluation of both the hardware and the multishot concept. Current effort is an outgrowth of exploratory development under the Army Small Arms Program which in 1968 led to the adoption of the M203, a single shot 40mm attachment for the M16A1.

It became possible to achieve a multishot capability with an improved tactical rate of fire, in a weapon of practical size and weight, because of a reduction in the over-all size and weight of the ammunition, i.e., the design of a 30mm grenade.

This launcher system is the product of a Rock Island Arsenal Small Arms Laboratory design team led by Robert E. Duncan and assisted by George E. Cooksey and George L. Reynolds.

GRENADE LAUNCHER prototype mounted on rifle concept.

# SAM-D Missile Guidance System Completes 5th Successful Flight

Only one major objective remained to prove out the SAM-D track-via-missile guidance concept, following a fifth straight success in the proof-of-principle flight test program, and the system's 14th consecutive successful flight test.

SAM-D Project Manager MG Charles F. Means stated in August that the remaining objective is the intercept of a target flying at low altitude. This test is programed during September.

In the fifth proof-of-principle test flight, SAM-D intercepted a short-range target before motor burn out, demonstrated that command signals between the missile and ground support equipment can be transmitted through the missile plume, and in response to radar commands performed various maneuvers after intercept of the target.

# Mobility Equipment R&D Center Reports Reorganization Proceeding on Schedule

Organizational and functional realignments incident to designation of the U.S. Army Mobility Equipment Research and Development Center, the first of eight planned DCs expected to be announced in coming months, is reported progressing on schedule at Fort Belvoir, VA.

Under the changes implemented in accordance with AMC General Order No. 34, dated Mar. 7, the MERDC now reports directly to HQ Army Materiel Command in Alexandria, VA, only a few miles distant. Reports formerly were made directly to Troop Support Command, St. Louis, MO.

Eight numbered laboratories have been organized from elements of the five former MERDC Technical Departments. "Fine tuning" of functional responsibilities and "nominal mission adjustments" are programed during coming months.

Expansion of the MERDC mission, as reported in the May-June edition of the *Army Research and Development Newsmagazine*, includes responsibility for first-production buys in assigned areas and, in some cases, additional buys until a logistical command takes over.

The center also is charged with initial testing of production items in conjunction with the Test and Evaluation Command, new equipment training, and the initial release of equipment to meet AMC-guaranteed "User Satisfaction" goals.

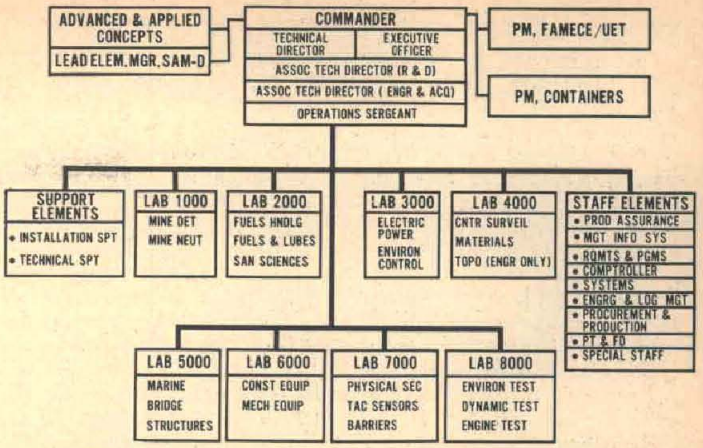
Additions made to the MERDC organization include the product manager for Army Container-Oriented Distribution Systems (ACODS), and the product manager for Family of Military Engineer Construction Equipment (FAMECE) and the Universal Engineer Tractor (UET).

The PM for FAMECE/UET is on duty at Fort Belvoir and will function in response to AMC directives, carrying full-line AMC authority as delegated to the MERDC commander. He will operate independently, relying on the center to provide administrative and other required support.

Phase II of the General Order No. 34 implementation plan is concerned with reorganizing MERDC support elements to improve service to the laboratories and help carry out MERDC's expanded mission and functions.

Creation of a Production Division and redesignation of the R&D Procurement Office as the Procurement and Production Office was the first of these support changes. First production buys, production reporting formerly performed by TROSCOM, and the production acquisition function for newly developed items are included in functions of the new office.

Responsibility for MERDC's new equipment training function will be assigned to the Engineering and Logistics Management Office (ELMO), one of two new offices created from what was formerly MERDC's Standardization and Quality Reliability Office. ELMO will be the primary interface with logistic commands relative to their support of MERDC.




Product Assurance, a new element, includes functions of quality and human factors engineering, calibration, reliability and maintainability; also, MERDC's new responsibility for initial equipment release, including certification that equipment is field operational and repair parts are in normal supply channels.

Other realignments planned on a step-by-step basis during coming months will minimize turbulence of changes, based on an approved concept plan that has a July 1, 1976 completion date. One of the proposed changes that could have a far-reaching impact on MERDC's over-all R&D effort is establishment of an Advanced and Applied Concepts Office (AACO) reporting directly to the commander.

The AACO, as proposed, will be responsible for surveillance of technological advances in the scientific community, creative leadership in applying this knowledge to technical advances and to military problem solutions, processing unsolicited proposals, and assuring relevance of programs to Army needs.

MERDC Commander COL T. R. Hukkala said that implementation of the Development Center concept, in line with recommendations of AMARC (Army Materiel Acquisition Review Committee), is expected to provide better utilization of the center's 1,466 civilian and military personnel, a better grouping of skills, improvement of budget balancing between research and support functions, and a general upgrading of over-all mission performance.

## Picatinny Terms Frisbee Flinger Mine Dispenser Tests 'Successful'

Frisbee flinging is an exercise that improves physical condition of many millions of U.S. citizens but at Picatinny Arsenal, Dover, NJ, Frisbee Flinger is the nickname of the XM128 Ground Vehicle Mine Dispensing System.

Technical development is credited to the arsenal's Engineer Mine Branch, Ammunition Development and Engineering Directorate. Under development for about 20 months, the GVMDS was returned to Picatinny in September after "successful" testing by the U.S. Army 3d Infantry Division in Germany. Development and testing are expected to continue "several years."

Capable of hurling different types of mines simultaneously over a wide variety of terrains, according to preselected minefield patterns and densities, the GVDMS is being developed under contract with the Food Machinery and Chemical Corp., which also makes armored personnel carriers. The rate of fire is "classified information."

A hydraulic drum magazine holds the small, specially built mines. The dispenser flips the mines through a directional tunnel and sends them spinning accurately to the predesignated pattern. Mounted on a 4-ton trailer towable by truck, armored personnel carrier or tank, the dispenser can lay a wide or thin trail of antitank or antipersonnel mines.

Robert Resch of the Ammunition Development and Engineering Directorate is heading the arsenal engineers working on system development. He made the trip to Germany for the recent first demonstration in the company of arsenal engineers Hal Henville, William Carldon and Harold Weasner.

XM 128 Mine Dispensing System

## 'Dissemination Conference' Themes Design Progress

Labeled an "Instant Dissemination Conference" on progress in Computer-Aided Design in Structural Engineering is a Sept. 22-26 meeting that will draw about 200 U.S. Army Corps of Engineers personnel to New Orleans, LA.

Top-level management engineers are programed as speakers and all Corps of Engineers field offices will be represented.

A 2-day organizational and planning meeting was held at the Corps of Engineers Waterways Experiment Station, Vicksburg, MS, involving 17 engineers who will serve as moderators of specialty sessions at the conference. Dr. N. Radhakrishnan, special technical assistant at the WES automatic data processing center, is conference coordinator.

Move It 'With a Sense of Urgency' . . .

# Edgewood Arsenal Plans 5-Year $48 Million Protective Screening Effort

"Get the program moving with a sense of urgency." Responsive to this order, Edgewood Arsenal has assigned a select team of scientists and engineers to develop new smoke and aerosol screening systems in a 5-year effort planned over-all at a cost of $48 million.

Sophisticated weapon systems used in modern warfare and the art of smoke screens concealment from the enemy, dating to biblical times, may appear incongruous to the uninitiated—that is, those unaware of how tanks in the 1973 Arab-Israeli Conflict were destroyed at an awesome rate.

The lack of adequate protective screening for U.S. and allied forces during modern battlefield operations spurred the U.S. Army Training and Doctrine Command (TRADOC), headquartered at Fort Monroe, VA, to establish a series of priority requirements for smoke systems. In April this year, the Army Materiel Command launched an extensive smoke development program.

Based upon its pioneering background in chemical and smoke research, Edgewood Arsenal was designated as the AMC focal point for management and implementation of the program. Donald M. Cohen, a member of the arsenal staff since 1948, was named Smoke Program officer.

Goals of the program include development of an adequate capability for employment of smoke or aerosols in counter-surveillance, counter-target acquisition, screening, signaling and marking roles; also, to maintain awareness of the threat, and to establish and maintain a centralized AMC data bank catalog on smoke/aerosol technology, R&D, and test results.

The U.S. Army's smoke priorities give the arsenal nine challenging projects. These include a rapid smoke screen for tanks and other armored vehicles, developing advanced smoke rounds and warheads for existing artillery projectiles, mortars and rockets, and screening large combat areas.

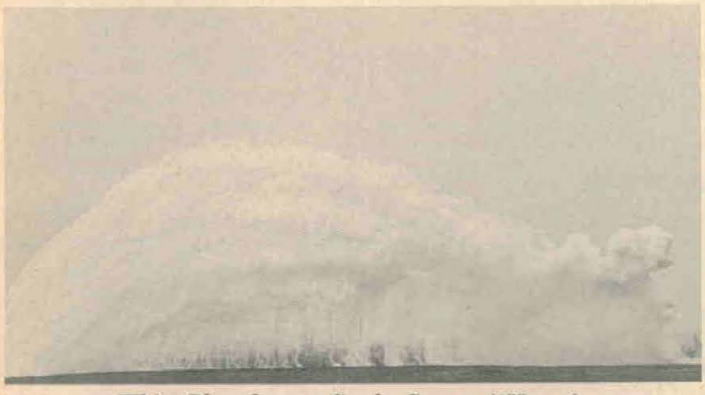
Edgewood's programed expenditure of $3 million in FY 1976 includes effort on a new family of smoke/aerosol materials and dissemination devices to combat threats which employ the infrared region of the electromagnetic spectrum for target acquisition, aiming and guidance.

Improved smoke systems also are required to counter electro-optical directed threats. All of these new systems, as planned in the current 5-year program, call for use of a nontoxic smoke agent that will not be hazardous to U.S. and allied forces.

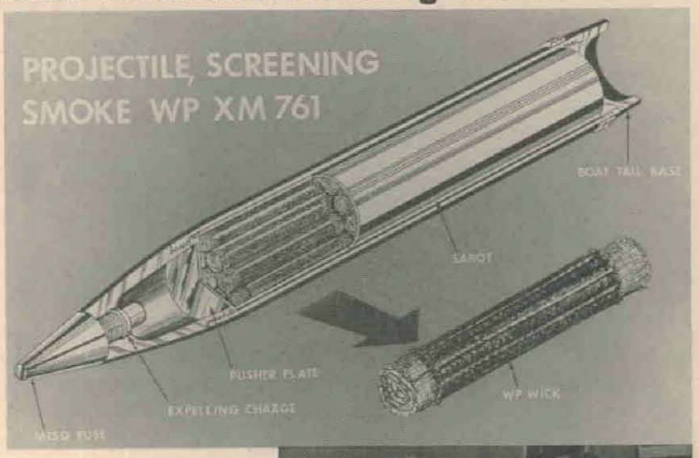
Top priority is given to smoke systems that will screen tanks and other armored vehicles—a grenade launching system to produce rapid smoke curtains within 2–3 seconds lasting at least 2 minutes in a 15–20 mph wind and a vehicle exhaust smoke system using the vehicles on-board diesel fuel.

The British Armored Fighting Vehicle (AFV) Smoke System, used on their Chieftain tank, appeared to provide the required U.S. capability for an instantaneous grenade-launched armored vehicle smoke system.

Edgewood Arsenal and U.S. Army European Procurement Agency personnel met with the UK Ministry of Defense in July 1975 and obtained cost and delivery schedules for UK production of this system to meet U.S. requirements.



White Phosphorous Smoke Screen (155 mm)




EDGEWOOD ARSENAL engineers Malverne Michie (left) and Donald Brown examine cutaway model of 155mm projectile with cotton wicks saturated with white phosphorous.

Following a joint AMC/TRADOC smoke trial on Aug. 26, which included a demonstration of the UK AFV system mounted on a U.S. M60A1 tank, the CG's of TRADOC and AMC jointly approved the British system and requested its initial fielding on the M60A1 tank as soon as possible.

The Army's second requirement in order of priority is the development of improved artillery smoke projectiles. A 155mm howitzer projectile filled with cotton wicks saturated with white phosphorous (WP) is in the advanced development stage and has been successfully tested. Concurrently, development of a 105mm WP wick projectile has been initiated.

"These smoke projectiles burn about five minutes and are 200 to 300 percent better than current WP artillery projectiles," the arsenal director of Development and Engineering reports.

Developed originally by the Naval Ammunition Depot, Crane, IN, the WP wick concept was applied to the 2.75-inch rocket. Use of WP plastic wedges also is being studied.

Plans provide for competitive prototyping on both the wick and wedge systems at a cost of $2.4 million. Evaluation testing is tentatively scheduled to begin soon.

Third in order of the Army smoke priorities for Edgewood effort is development of improved mortar smoke projectiles. WP-wick 81mm mortar projectiles were demonstrated at the 26 August smoke trial, but the requirement for a specific caliber mortar round depends upon results of a current Army mortar requirements study.

In response to the fourth priority, advanced development is being conducted on the WP wick for the 2.75-inch rocket. Recent firing of 50 rounds, each with a payload of 10 wicks, demonstrated the effectiveness of this concept. Acceptance testing of 1,000 rounds is scheduled in early 1976 by MASSTER evaluaters at Fort Hood, TX.

Five of the arsenal's nine priority smoke screen requirements are in a technological rather than a developmental stage. Detailed plans are being prepared to include participation of industry, university researchers and scientists of other federal agencies.

Project officer Cohen said a "major thrust" is needed to advance technology for development of a large-area screening system. The requirement is for a nontoxic, noncorrosive, multi-spectral region smoke agent which can be rapidly employed that will blend with the operational environment.

Three or more years of exploratory development will be needed to evolve the technology required to demonstrate a

first-generation, large-area screening system, according to current estimates. Major emphasis involves non-hazardous smoke-producing materials for full spectrum screening, from visual to infrared and microwave frequencies.

Capability for large-area smoke screening currently is based on use of smoke pots and fog-oil generators, both of which are large fuel consumers. Improvements in these systems are planned but the goal is a compact more efficient generator to disseminate all types of materials. One of the concepts is tiny plastic beads soaked in fog oil that will release a large volume of smoke when heated.

Miniaturization and weight reduction of existing smoke dispensers, marking and signaling devices are being studied in the technology advancement phase of the arsenal's program. This includes use of new dye agents or blends to increase visibility for signaling smokes, terrain blending for camouflage, and low visibility materials for covert signals.

New dye blends for desert and vegetated terrain blending smokes can be demonstrated, investigators report, but further effort will depend upon the type of dispenser and colors that eventually will be required.

Importantly linked to this effort is that of maintaining a continuing awareness of U.S. and foreign smoke/aerosol technology and applications. This task includes establishing and maintaining a centralized data bank for collection, storage and retrieval of data pertaining to smoke/aerosols; also, dissemination of data to users.

Consisting currently of a staff of nine research scientists and engineers, the arsenal's smoke program management office is coordinating technology advancement efforts with five allied nations, 13 U.S. Army commands in nine states, three U.S. Navy and two U.S. Marine Corps activities in similar effort.

# Army Reservists Participate in R&D Update '75

About 90 U.S. Army Reservists representative of Mobilization Designation units from all parts of the nation participated in R&D Update '75, a Seminar for Continuing Professional Awareness, as Aug. 10-22 guests of the 184th MobDes Detachment at HQ U.S. Army Missile Command, Redstone Arsenal, AL.

Attendees had two things in common—a MobDes assignment in Army research and development activities plus a scientific or engineering degree. Most of them had PhD or master's degrees. Nearly all of them held responsible positions as industrial executives, including a number of company presidents, or as college professors, researchers, teachers, and in other professions.

The purpose of the seminar was to give them, in two weeks, an insight into ongoing Army research and development with emphasis on missile and rocket programs. Most attendees commented to the effect that it was "good, fast-moving, cram course."

COL Jack Amos, a MICOM engineer and a member of the 184th MobDes Det., described the program as "too much, too fast, with not enough in-depth study."

COL Faison P. Gibson, commander of the 184th, gave the initial briefing on MICOM programs. Other briefers covered almost every operational aspect, including budgetary problems and national and international considerations.

Complementing the presentations were a tour of MICOM facilities including the Missile and Munitions Center and School as well as NASA's Marshall Space Flight Center (MSFC) and the Brown's Ferry Nuclear Plant near Athens, AL.

Climaxing the program at the concluding banquet session was an address by Dr. Ernst Stuhlinger, assistant director for science at the MSFC, who spoke on NASA's Future Projects and Potential Flights to Mars.

Another featured address at an earlier banquet was presented by Manfred Gale, who discussed the Army R&D mission and effects of reorganization that has greatly altered the structure of the Army R&D establishment. Gale is assistant director, Laboratory Activities, Office of the Army Chief Scientist and Director of Army Research, Office of the Deputy Chief of Staff for Research, Development, and Acquisition, HQ DA.

Other ODCSRDA speakers included most of the division chiefs, who reported on development progress of the "Big Five" of the Army's major military materiel systems, and other weapon systems development or product improvements.

Army Materiel Command speakers included BG George E. Turnmeyer, deputy commander, MICOM, who gave welcoming remarks; Dr. John L. McDaniel, MICOM technical director; Dr. Kelly Grider, COL Horace B. Dunn and Paul A. Wisner, all key staff members at MICOM HQ.

BG Lawrence D. Redden, deputy commander of the 121st Army Reserve Command, and COL David Smith, Army Missiles Munitions Center and School, also were speakers.

Additional AMC speakers included COL Louis G. Klinker (USA, Ret.), who talked about functions of the Army Foreign Science and Technology Center at Charlottesville, VA, and Al Loper, who explained many of the managerial aspects of Army R&D.

Roy D. Greene, chief of the Programs and Budget Office, HQ AMC RD&E Directorate, explained the budget formulation process. COL Bernard W. Bruns, chief, Office of International R&D, AMC, discussed international R&D.

184th MobDes Detachment Commander COL Faison Gibson (left); LTC Aubrey Messing, assistant for Reserve Affairs, ODCSRDA; and COL Marcus Whitfield, symposium director, look at equipment during tour of MICOM R&E facilities.

Army Medical R&D Command programs were discussed by COL Robert M. Johnson, deputy director, Surgical Research, and chief, Surgical Research Division. Representing the Office of the Chief of Engineers was LTC Douglas A. Hughes, who spoke on the Corps' overall responsibility and ongoing programs for pollution control and abatement, along with other R&D activities.

Army Research Office Commander COL Lothrop Mithenthal explained ARO's R&D contract activities, major program areas and interface responsibilities with academic institutions. LTC Donald B. Biesenbach discussed the programs of the U.S. Army Research Institute, developing agency for social and behavioral sciences, Arlington, VA.

Among numerous additional speakers who contributed to providing an understanding of the Army's programs and interests were LTC Delos McCoole, chief of the Long-Range Studies Group, U.S. Army Concepts Analysis Agency, Bethesda, MD; COL Bruce Jacobs, military executive of the Army Reserve Policies Committee; COL W. T. Prescott, Office of the Chief of Army Reserve, HQ DA; and COL George McDonald, Army Reserve Personnel and Administration Center, St. Louis, MO.

COL Marcus L. Whitfield, Ballistic Missile Defense Advanced Technology Center, was the symposium director.

## EPA Names R&D Executive

U.S. Environmental Protection Agency (EPA) Administrator Russell E. Train has announced the appointment of Carl Read Gerber as associate administrator, Office of Research and Development.

Employed as a consultant with the EPA since 1974, Gerber has a BA degree in chemistry from Oberlin College and a master's degree in organic chemistry from the University of Wisconsin. He served formerly with the U.S. Atomic Energy Commission (now the Energy R&D Agency).

A member of the American Chemical Society and the American Association for the Advancement of Science, Gerber is coauthor of *Plowshare* and has authored technical articles.

# CERL Studies Solar Energy . . .

# Heating and Cooling Army Buildings Considered

Twenty-four percent of the energy consumed in the United States during the past decade was used for heating domestic water and heating and cooling buildings. Comparable figures range from 60 to 80 percent at most Army facilities.

Facing up to the prospect of a long-term energy shortage in the United States, researchers at the U.S. Army Construction Engineering Research Center (CERL), Champaign, IL, are investigating the use of solar energy to meet this demand due to its "inexhaustible" availability and its clean, nonpolluting form. A contract study was initiated to evaluate the use of solar energy for heating and cooling Army buildings. Stated objectives were:

- To identify an existing Army building suitable for the retrofitting of a solar heating system and to prepare a preliminary design.
- To identify and define preliminary concepts for the application of solar energy for heating and cooling a new building being planned for construction.
- To evaluate pertinent solar energy system technologies.
- To develop implementation plans for heating and cooling applications to U.S. Army requirements.

The General Electric Co., Space Division, Valley Forge, PA, performed the study.

The major nonstandard components in any solar heating and cooling system collect the incident solar radiation and convert it into a hot liquid or gas. The remaining components are usually pieces of conventional heating and cooling systems.

Solar collectors are generally of two classes—the flat-plate type fixed in position, and focusing or tracking collectors that follow the sun and focus the radiation to intensify the energy density at the heat transfer point.

A major conclusion of the General Electric study is that the flat-plate collectors are more suitable for building heating and cooling systems because of lower costs.

A typical flat-plate collector consists of one or more transparent cover plates and an absorber (collector) plate as shown in Figure 1. The incident solar radiation passes through the cover plates and strikes the absorber plate which is painted black to absorb the radiation.

The cover plates (usually glass or polycarbonate plastic) are transparent to the frequency spectrum of the solar radiation but opaque to the lower frequency radiation from the heated absorber plate. This allows maximum solar radiation to enter the collector while minimizing radiation losses from the absorber plate back to free space (greenhouse effect).

Spectrally selective coatings that have a high absorbtivity to the solar spectrum but a low emittance to the spectrum at which the absorber radiates can be applied to maximize solar energy absorption and minimize radiation losses.

The collected solar energy is transferred to a working fluid flowing through tubes in thermal contact with the absorber plate for the heating and cooling system. The back and sides of the collectors are insulated to minimize conducted heat loss.

Flat-plate solar collectors can be used to meet heating and cooling needs in systems similar to that shown in Figure 2. Because of the diurnally varying nature of the solar source, energy must be stored to achieve effective system performance.

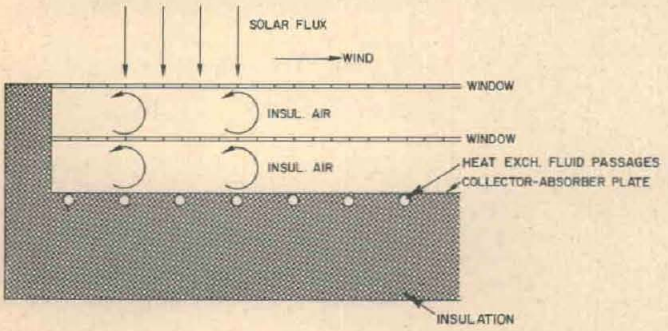



**Fig. 1. Basic Solar Collector Design**

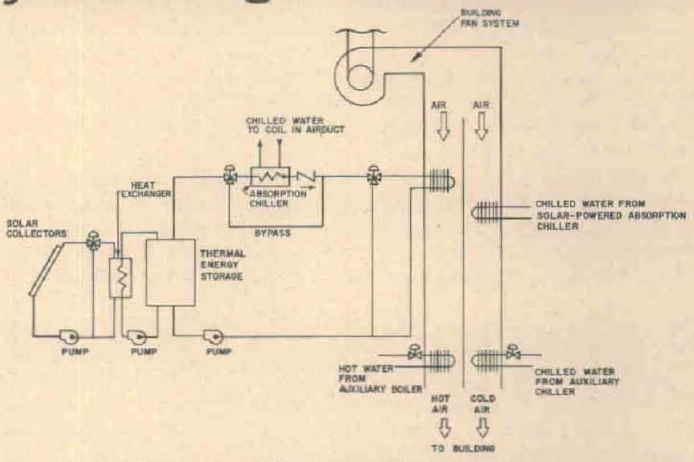



**Fig. 2. Solar Heating and Cooling System**

The study concluded that water is currently the most economical and reliable energy storage medium. Water from the thermal energy storage tank is circulated directly through coils in an air duct or fan system to provide building heat.

Cooling is provided by circulating the hot water from the storage tank through an absorption chiller to the building cooling system. The study concluded that this is the only readily applicable method for solar energy cooling.

In selecting sites for the application of solar energy, 20 Army installations in the United States were considered. An initial screening, based mainly on energy savings potential and location, narrowed this group to six sites. Fifty candidate buildings included barracks, bachelor officers quarters, administration buildings, and classroom buildings were considered.

A 2-story, flat-roofed, masonry building near Washington, DC, was selected for the retrofitting of a solar heating system. This 15,000-square-foot administrative building is heated with fan coil units. Since open space was not available around the buildings, the collectors would have to be roof-mounted. This limited the collector area to about 3,055 square feet.

Hour-by-hour computer simulations of various systems and control options were performed in considering comparative economy factors, using actual weather and incident solar radiation data for the site. Optimum thermal energy storage tank volume, collector type, collector tilt and azimuth angles, and control schemes for the concept design were determined by using this simulation technique.

Results indicated that 39 percent of the energy required for heating could be supplied by a solar system with a 2-cover selectively coated collector, and that an annual savings of 4,000 to 5,000 gallons of fuel oil would result.

Several cost scenarios were developed for the retrofit solar system. In general, they indicated that if fuel prices increase from 6 to 10 percent annually, retrofit would be economical if solar system costs approach $10 per square foot of collector.

If fuel prices escalate at 20 percent yearly, a solar heating system would be economical—even if system costs approach $20 per square foot of collector. However, the current price of collectors alone is $7 to $10 per square foot, and total solar system costs are $30 per square foot of collector.

A 16,000-square-foot, one-story, flat-roofed, classroom building in southern Arizona was selected for the application of solar energy for heating and cooling a building planned for construction. Computer simulations were again performed to evaluate various system options. Both ground- and roof-mounted systems were considered.

A collector area of 7,040 square feet was studied for this proposed system, which would provide an estimated 98 percent of the energy required for heating, and 90 percent of the energy required for cooling, using single-cover selectively coated collectors. Estimated yearly fuel savings equivalent to 17,000 gallons of oil could be realized.

Cost scenarios were again developed, with results similar

to those for the retrofit system. These results were based on a fuel price about one-half the price for fuel in the Washington, DC, area. In spite of this, the cost scenarios were similar because the performance of the solar system proposed for the Arizona location far exceeds that from the retrofit application.

This variation is largely due to climatological differences between the sites, but other factors such as building insulation, relative amounts of glass, and relative collector area also influence the system performance and life-cycle cost.

Several significant conclusions resulted from the study of solar heating and cooling of buildings. It was determined that solar energy can supply a significant percentage of the energy required to meet building heating and cooling loads in widely varying climates.

Although the buildings studied differed considerably in characteristics and location, a number of significant commonalities in design, type of thermal storage, and certain aspects of control indicated a potential for standardization.

Except for solar collectors, for which cost-saving developments are continuing, the design of the solar heating and cooling systems can be implemented using available hardware.

The study also produced a methodology for analyzing the performance of solar heating and cooling systems. With the definition of key building parameters, and the availability of hour-by-hour weather and solar data, the methodology can be applied to a wide range of building types, operating conditions, and geographical regions.

Areas identified as needing additional development to facilitate widespread application of solar systems include:

- Improvement of solar collectors to increase durability and efficiency and reduce costs.
- Improvement of applicable cooling equipment.
- Development of cost-saving innovations relative to installation and mounting of collectors, piping, heat exchangers, controls, and auxiliary equipment.
- Integration of solar collectors into the building structure provide roofing functions as well as collect solar energy.

To provide practical experience in the design, construction, operation, and maintenance of solar systems, and to permit the collection of real performance data, the study recommended the construction of both the retrofit solar heating system and the heating and cooling system.

## Don't Downgrade Dung . . . EPA Study Points to Potential as Ethylene Source

Don't Downgrade Dung could be a useful slogan for capitalizing on the resource potential of what has long been regarded as a pollution problem for the beef cattle feedlot industry.

That is the "good news" from the U.S. Environmental Protection Agency, based on results of a research project.

Texas Tech University researchers came up with some interesting findings during their investigation of manure's potential to produce useful products. One of these is ethylene, derived normally from petroleum or natural gas.

Considered the "backbone of the plastics industry," ethylene finds its way into a large variety of conveniences and necessities for the American people—such as easy-care fabrics, toys, food wraps, and automobile parts.

"Significant amounts" of ethylene can be gleaned from beef cattle manure, the Texas Tech investigators discovered. EPA provided 73 percent of the funding for the $108,000 research project. Additional funding came from Pioneer Natural Gas Co., Amarillo, TX, and the Texas Cattle Feeders Association.

With "minor adjustments," the process used to produce ethylene from manure can produce anhydrous ammonia synthesis gas, methane and ethane along with the ethylene. Synthesis gas is used in manufacture of fertilizers. Methane and ethane are major components of natural gas used for fuel.

The investigators are highly respected Dr. James E. Halligan, chairman of the Texas Tech Department of Chemical Engineering, and fellow staff member Dr. William J. Hoffman along with Roger Paterson, a graduate student. They caution that their process is still in the developmental stage, and that additional data collection and analysis are necessary to establish its commercial feasibility.

However, EPA project officer R. Douglas Kreis points to possible future adaption of the process to include other animal wastes, municipal refuse, and other organic solid wastes as feedstock for production of ethylene.

*(Incidentally, ethylene can be produced from ethanol fermented from glucose which is the product of the process of enzymatic conversion of cellulosic waste developed by the U.S. Army Natick Development Center. Turn to page 26 for article on international conference.)*

Statistics compiled to point up possibilities of using manure to produce ethylene are impressive. Based on a 10 cents a pound for ethylene, a "conservative estimate" of the value of the ethylene that could be produced from manure from a 100,000-head feedlot in the Texas high plains alone is around $1.8 million annually—and about four million beef cattle graze in those plains.

Each beef animal in the area, it is estimated, will produce about one ton of dry manure a year. Ethylene could be produced, based on the research data, at the rate of 180 pounds per ton of manure.

Thus a commercial operation capable of processing manure from 100,000 cattle could produce 18 million pounds of ethylene a year. U.S. cattle feedlots are estimated to produce 12 to 14 million tons of manure annually.

Evidence to date indicates, Dr. Halligan said, that their process appears to be economically feasible for large concentrations of feedlots. Continuing research, he said, will be directed to improving the process to increase the yield of ethylene to make the profit incentive more attractive.

Production of ethylene, he explained, is dependent upon a "time-temperature factor. In the reactor we have achieved a different time-temperature history of both solids and gas—different from that of others who have experimented with similar processes. This allows us to generate significant quantities of useful petrochemical intermediates."

## 2 New Air-Delivered Countermine Systems Tested

Two helicopter-delivered mine warfare sytems are being examined by MASSTER (Modern Army Selected Systems Test, Evaluation and Review).

Concurrent tests are being conducted on the FAESHED (Fuel Air Explosive System Helicopter Delivered) and the M56 Mine Dispersing Subsystem.

FAESHED is designed to breach a minefield without causing the craters normally associated with explosive-type demolition charges. It consists of two dispersers, containing three bomblets, each containing 72 pounds of ethylene oxide fuel. A 4-foot electronic probe activates the bomblets at ground contact. An ethylene oxide cloud covering an area up to 1,960 square feet is formed and activated by two time delay detonators.

FAESHED neutralizes most antitank, antivehicle and antipersonnel devices, and is capable of collapsing tunnels. The only after effect is the depression left by the actuated mine or collapsed defensive position.

Potential FAESHED applications include mine neutralization and an offensive weapon against air defense artillery positions, radar installations, aircraft, airfields, and defensive constructions.

MASSTER Test Officer CPT John Pla said results indicate that the system can be used effectively against any blast-sensitive target. Dropped within 100 feet of a helicopter or aircraft, the system has demonstrated it can destroy the aircraft's combat usefulness without damaging the airfield or landing pad.

The M56 Mine Dispersing Subsystem is designed primarily for rapid distribution of mines in a specific area to restrict movement of enemy troops and equipment. Components include two dispensers, each containing 40 canisters. Two 6-pound mines are in each canister.

Antineutralization capabilities of the M56 system are enhanced by several roll-resistant and antidisturbance mines in each dispenser. An antidisturbance mine is designed to detonate if it is picked up or moved from its point of emplacement. The roller-resistant mine will only detonate under the sustained pressure of a tank or some other armored vehicle.

The minefield self destructs after its appointed life.

# Manned Target Tanks

**By CPT Robert D. Shadley**

Why not just fire at old tank hulls, panels, or drone targets? This is a question which is often asked when the subject of manned targets for use in antitank testing is discussed.

Because of the increased emphasis on realism in user testing, conventional targets, such as hulls, panels and drones, are not satisfactory. The U.S. Army Materiel Command designed and produced a manned, evasive target tank (METT) to provide a realistic, noncooperative target at which inert warhead antitank missiles can be safely fired.

The METT was successfully employed in three test programs. Experience gained from developing and using the METT paid off in design and fabrication of a modification kit for the M60A1 tank.

The M60A1 modification kit allowed the Dragon antitank missile system to be tested in a tactically realistic environment. It may be possible to adapt the modification kit concept to a training device for use during antitank missile and rocket gunner training.

The "heightened importance of testing" is one of the basic policies for systems acquisition prescribed in Army Regulation 1000-1, Nov. 5, 1974. "For the purpose of this policy," it states, "testing is considered to be grouped into two basic test categories, development testing (DT) and operational testing (OT)."

As defined in Department of Defense Directive 5000.3, Jan. 19, 1973, DT and OT are not peculiar to the Army; development test and evaluation (DT&E) and operational test and evaluation (OT&E) are applicable throughout the DoD. Operational testing is included with force development testing and experimentation (FDTE) and joint user testing in the generic term "user testing."

Basic definitions of DT, OT, FDTE, and joint user testing in AR 10-4 provide the key to understanding the need for manned targets in antitank missile testing.

DT is defined as "that test and evaluation conducted to demonstrate that the engineering design and development process is complete; demonstrate that the design risks have been minimized; demonstrate that they will meet specifications; and estimate the system's military utility when introduced."

OT is "testing of materiel systems which is conducted by an organization independent of the developer, and is accomplished with representative user troops in as realistic operational environment as possible."

Fig. 1. Manned Evasive Target Tank

Fig. 2. METT With Turret and Gun Removed

FDTE ranges from the "small in scope, highly instrumented, high resolution field experiment to the broader in scope, less instrumented, low resolution and highly subjective field tests, that are performed to support the force development process by examining the impact, potential, and effectiveness of selected concepts, tactics, doctrine, organization and materiel."

Joint user testing is Army participation with another service. "These tests are conducted to evaluate Army systems or concepts having an interface with or requiring a test environment of another service, or systems or concepts of another service which requires testing in an Army environment."

The objectives of antitank missile DT can be realized by using drone, towed or stationary targets. These types of targets enable the tester to replicate trials as required in the test design, and as needed to duplicate precisely conditions to determine causes of faults.

The key terms in the above definitions of OT, FDTE and joint user testing are operational environment, concepts, tactics, and doctrine. Two-sided, simulated battles, with relatively free-play by participants, are required in user testing to evaluate hardware, concepts and doctrine in an operational environment. Manned targets (METT or tanks with modification kits) can provide the required realism to test antitank missiles.

Currently the only METT is a modified M48A3 tank designed and produced for initial use in the U.S. Army Combat Developments Experimentation Command (USACDEC) Experiment 11.8. (See Fig. 1) This is part of the field test portion of the Department of Defense-directed Tactical Effectiveness Testing of Antitank Missiles (TETAM) Program.

During this experiment, the METT was engaged by inert warhead Shillelagh, TOW, Dragon, French-German MILAN, and British SWINGFIRE antitank missiles at the Hunter-Ligett Military Reservation in California.

Subsequently used in Cobra/TOW Operational Test II at Fort Knox, KY, during September and October 1973, the METT was modified with additional overhead armor to protect the vehicle and the crew from inert warhead TOW missiles launched from the Cobra helicopter.

METT was next employed in 1974 in Dragon Night Sight Operational Test II at Hohenfels, Germany. The overhead protection for Cobra/TOW Operational Test II was removed, and protection was added to the sides of the METT to allow engagement by the TOW as close as 600 meters, and by the Dragon with no minimum range limitation.

The crew suffered no injuries although the METT was impacted more than 150 times during the three series of tests. Only 30 hours of downtime did not coincide with regularly scheduled no-test periods.

Modifications to the M48A3 vehicle provided a simulated Soviet T-62 turret and gun, to insure total safety for the 2-man crew, and to protect critical areas of the tank from extensive damage that would delay testing.

Excluding special modification for Cobra/TOW OT II and Dragon Night Sight OT II, changes made to the M48A3 included (See Fig. 2):

- The standard M48 turret was cut approximately 15 inches above the turret ring. A roof of ¾-inch-thick armor plate was fabricated for the turret, the sides of which were similarly reinforced.
- Conventional periscopes were replaced with break-away periscopes and ballistic traps, which prevented glass from shattering into crew compartments.
- Skip plates were installed on the sides and frontal areas of the vehicle, and armor protection was provided for all ballistic trap areas. The rear (engine grille area) of the vehicle was protected by ¾-inch armor plate attached at a 45-degree angle.
- Three-eighths-inch armor plate was used for side skirts to protect the suspension system and prevent missile impact on the hull. All non-essential components were removed from the interior of the vehicle.

Modifications inside the tank included:

- In addition to the standard driver's engine cut-off switch, an emergency engine cutoff switch was provided for the vehicle commander.
- An improved fire protection system, which uses freon, was provided for the engine compartment, turret section, and the driver's section. Flame detectors were used to signal the crew in case of fire.
- The driver's and the commander's areas were completely enclosed with

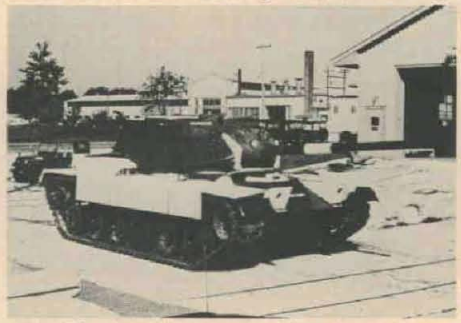


Fig. 3. M60A1 Modification Kit Components in White

nylon ballistic blankets to protect the crew from secondary fragmentation.

- The hatches were modified to allow opening from the outside in case of an emergency in which the crew is unable to open the hatches.
- A warning system of two electrically operated flare launchers was provided. The crew can use this system to signal for assistance when radio communication is lost.
- Modifications were designed for ease of inspection and maintenance, permitting the METT to be kept free of such fire hazards as excessive dirt and oil in the engine compartment.
- Crew members wore NOMEX uniforms, earplugs and helmets; alternate escape routes were provided by relocating interior components and designing passageways through ballistic blankets.
- Emergency procedures were documented, and the crews were trained to insure complete understanding of emergency actions. Noise and stock levels were measured to insure that the crew would not be subjected to unacceptable levels.

The outstanding performance of the METT during CDEC Experiment 11.8, Cobra/TOW Operational Test II, and Dragon Night Sight OT II was attributable to the many crew safety and vehicle protection features.

Since there is only one METT, it is not possible to provide a simulated "threat" unit force to antitank missile gunners. This limitation was not significant in the first three series of tests.

During planning for Dragon Operational Test III, the U.S. Army Operational Test and Evaluation Agency requested the U.S. Army Materiel Command to design and produce a modification kit for the M60A1 tank to provide a 9-tank threat force for MASSTER testing at Fort Hood, TX.

Since only the Dragon was involved in this test, the degree of protection required for the M60A1 was not as great as that afforded by the METT. Twelve kits were designed, produced, and safety qualified in less than 120 days. Primary components were safety vision blocks, additional external armor protection, ballistic blankets in crew compartments, and additional fire protection (Fig. 3.)

The kits allowed the Dragon to be tested in a simulated combat environment. The threat armor was capable of performing tactically realistic attacks, and the Dragon gunners were faced with several noncooperative, real tank targets.

Two efforts are planned or in progress with regard to future utilization of manned target tanks. The modification kit developed for Dragon Operational Test III may serve as the baseline for development of a training device for use in training antitank missile and rocket gunners.

Secondly, the USAMC is currently engaged in designing and producing five new METTs for the U.S. Army Operational Test and Evaluation Agency. Design concepts for the new METT incorporate knowledge gleaned from using the current METT.

Manned target tanks have provided antitank missile gunners with challenging targets to adequately test and evaluate missile materiel developments. Development of a training device similar to the modification kit used in Dragon Operational Test III should permit better training and evaluation of antitank missile and rocket gunners in the future.

*CPT ROBERT D. SHADLEY has been an R&D coordinator in the Test and Evaluation Division, Directorate for Research, Development and Engineering, USAMC HQ, since 1972.*

*He holds BS and MS degrees in industrial engineering from Purdue University. Upon graduation from the Ordnance Officer Advanced Course in 1972, he received the AUSA Award, Commandant's Award, and Alden Award.*

*During his military career he has served as commanding officer of missile maintenance detachments at Redstone Arsenal, AL, and Sagami, Japan. He has been awarded the Bronze Star Medal, Army Commendation Medal, and RVN Honor Medal (1st Class).*

# ODCSRDA International R&D Functions Moved To Army Materiel Command Consolidated Office

Vested in a new Army Materiel Command Office of International Research and Development are the combined functions of the former International Division, Office of the Deputy Chief of Staff for Research, Development and Acquisition, HQDA, and the former AMC International Branch, RD&E Directorate.

Explained as part of the continuing effort to decentralize responsibility for operational functions from Army General Staff level to field commands, the change places the new office under direct authority of AMC Deputy CG for Materiel Acquisition MG George Sammet Jr. The former AMC IO was a part of the Directorate of Research, Development and Engineering.

The Office of International Research and Development manages U.S. Army participation in international, bilateral and multilateral, research, development and standardization programs. It serves as Department of the Army and Army Materiel Command point of contact with foreign representatives and higher headquarters in connection with:

Mutual Weapons Development Data Exchange Program; Defense Development Exchange Program; Cooperative Research and Development Program; U.S./Canadian Defense Development Sharing Program; International Professional (Scientist and Engineer) Exchange Program; North Atlantic Treaty Organization (NATO) (*except Army Armaments Group AC/225 and Defense Research Group AC/243;* American-British-Canadian-Australian (ABCA) Standardization Agreement; Air Standardization Coordinating Committee (ASCC); The Technical Cooperation Program (TTCP); Southeast Asia Treaty Organization (SEATO); Central Treaty Organization (CENTO); and American-British-Canadian-Australian (Naval) (ABCS Naval) Inter-American Defense Board (IADB).

In addition the office develops, coordinates, and maintains basic international program objectives and plans; recommends establishment and cancellations of projects; directs and coordinates U.S. membership; directs and coordinates U.S. participation in comparative trials, tests and demonstrations; develops U.S. positions; and provides administrative services on assigned international programs.

Other responsibilities include: Approves and provides for loans of U.S. materiel to foreign countries for test and evaluation, and coordinates with foreign countries for loan of their materiel for test and evaluation in the United States; exercises staff supervision and management over the U.S. Army Standardization Groups in the United Kingdom, Canada and Australia; conducts negotiations of Data Exchange Annexes, Memorandum of Understanding, Project Agreements and Special Projects with foreign governments.

The Office of the Deputy Chief of Staff for Research, Development, and Acquisition, HQ DA, retains certain policy making authority for these programs. AMC Commander GEN John R. Deane Jr. has signature authority for all Data Exchange Agreements, Memorandums of Understanding, and Project Agreements with the foreign nations involved. MG Sammet shares this authority.

*Current Staff.* COL Bernard W. Bruns, former chief of the ODCSRDA International Division, moved from the Pentagon to HQ AMC and headed the consolidated office until he retired from the Army Aug. 29. LTC Walter J. Wosicki is acting chief.

Graduated from the U.S. Military Academy in 1959, LTC Wosicki also has a master's degree in aerospace management from the University of California. He served a year as executive officer, Plans and Programs Directorate, ODCSRDA, before moving into his new assignment, and for three years was with the Office of the Chief of Research and Development, HQ DA.

A GS–16 position established for an assistant deputy for International Programs was vacant at press time. Other staff members are Wayne Silbert, Albert Berman, Peter Pfeiffer, Dorothy Whitley, and Elizabeth Duke, formerly with AMC International Branch; Robert J. Facey, Myrain Y. Harvey and Annastasia Polynack, formerly with International Division; ODCSRDA; J. D. Wasko, Patricia Dickerson, Sarah Robertson, transferred from within HQ AMC.

*Technology Transfer Example . . .*

# Army Institute of Surgical Research Advances Impact Worldwide

Transfer of technology advances from federal agency R&D programs for applications to national social and economic problems—as initiated by action of the White House and Congress in 1972—has an outstanding example of widespread impact in the U.S. Army Institute of Surgical Research.

Whenever treatment of burn patients anywhere in the world saves lives of those who could not survive except for medical technology progress in recent years, the odds are good that the techniques have originated from R&D at the USAISR, known internationally as "The Burn Center."

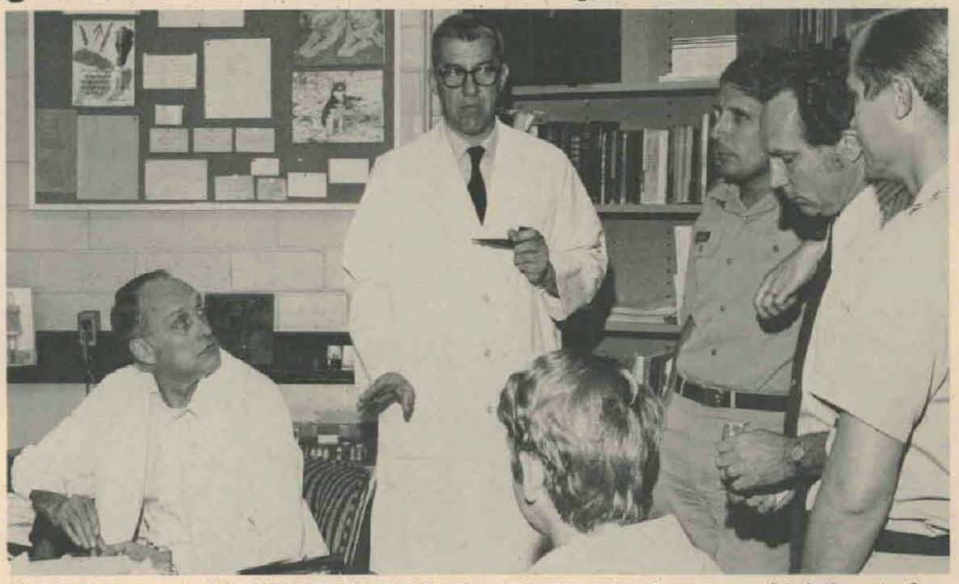
In 1975 the USAISR was selected for runner-up honors in Army Laboratory of the Year competition, a new program initiated by then Assistant Secretary of the Army (R&D) Norman R. Augustine, now Under Secretary of the Army.

Commander of the U.S. Army Health Services Command MG Spurgeon Neel later presented to USAISR Commander COL Basil A. Pruitt a Department of the Army Award for Excellence. The award was made on behalf of BG Kenneth R. Dirks, MC, commander, U.S. Army Medical Research and Development Command.

The USAISR has a proud tradition that dates to 1947 when it was established at Brooke Army Medical Center, Fort Sam Houston, TX. The institute was organized to investigate the use of antibiotics in treating infection in wounds. The added responsibility of researching and developing improved techniques for treating severe burn wounds was assigned to USAISR in 1949.

Currently, the institute treats severe burn cases from all U.S. Armed Services including retired servicemen, military dependents and veterans. Wards of the U.S. Government and certain civilian cases are referred to the institute when local medical facilities are inadequate.

More than 4,000 severe burn patients have received USAISR treatment since 1950. Many improvements in the care and management of patients have come from this experience, in addition to the direct benefit to the patients.



**USAISR Commander COL Basil Pruitt (standing) and laboratory chief Dr. Arthur Mason (left) talk with research specialists during informal discussion of problem.**

"Working to reduce the loss of life and property from natural disasters" was one of numerous goals established by the President in a special message to Congress in 1972 titled "Science and Technology." In this respect, the USAISR has established by its results a place of respect in world medical circles. Disaster victims in many countries benefit from USAISR techniques, as transferred through training programs.

The institute is a multi-disciplinary organization including physicians in various specialties, chemists, biochemists, physiologists, bioengineers, microbiologists, and other research scientists—all engaged in the study of improving burn treatment techniques.

Conducting research and caring for patients, however, is complemented by teaching and training other personnel in the management of thermal injuries. Scores of surgeons and other medical specialists, both military and civilian, from all over the world have visited the burn center to observe the latest treatment techniques, and to work actively in the wards with USAISR personnel.

USAISR physicians are lecturers in medical schools throughout the United States, and many send students for training at the institute. Affiliation agreements for teaching presently exist with 17 medical schools and hospitals, including Columbia, Louisiana State U., Tufts, and the Universities of Florida, Michigan, New Mexico, Pennsylvania, Virginia, and Texas at San Antonio.

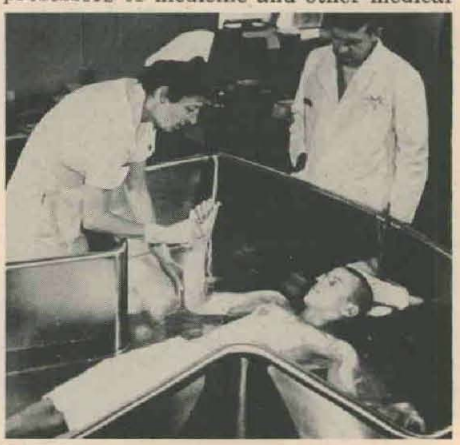
Knowledge of USAISR techniques also is disseminated through participation of professional staff members in numerous conferences and symposia, and publication of articles in technical journals and other media.

Members of the staff are active in national and international medical societies, such as the American Burn Association, the American Association for the Surgery of Trauma, and the International Society for Burn Research.

Another area of USAISR major impact is that of providing consultants to give guidance in development and establishment of other burn units in many hospitals and medical centers throughout the United States. The most notable of these are the Shrine Burn Centers in numerous states set up with assistance from USAISR specialists. Other units have been established by personnel trained at the institute.

Many USAISR professionals have retired from the Army Medical Corps to become productive members of the national medical community. Among these are four chairmen of departments of surgery, 10 professors of surgery, nine professors of medicine and other medical

**WITH PROPER PREPARATION, and specialists providing essential care, burn patients are flown from all over the world to the "Burn Center" at Brooke Army Medical Center, Fort Sam Houston, TX.**



**PATIENT undergoing treatment in Hubbard tank where dead tissue is snipped off. Wounds are not safe from infection until covered with grafts of patient's skin.**

specialties, and 51 associate and assistant professors of medicine, surgery, anesthesia and pathology.

ADVANCES IN TECHNOLOGY. When research in burn therapy was started at the USAISR, in 1949, many severely injured patients died after a short period of time no matter how intensively they were treated.

Over several centuries, treatment had evolved from the application of cobwebs, through immersion in tubs, application of various ointments and dyes, and the use of occlusive dressings under which infections frequently ran rampant.

Shortly after the institute became involved in burn therapy and research, the commander learned during a visit to England about the reintroduction of the exposure method of treatment. Exposure to air rather than covering injuries with dressings had been discontinued as proper therapy several years earlier.

Based upon the commander's report to the USAISR staff upon his return, Dr. Curtis Artz initiated a study of the exposure method involving 300 patients. Results showed the method was less painful and, more important, lowered the fever of patients. They lived longer though the eventual rate of mortality remained relatively unchanged.

While the exposure study was in progress, Dr. Eric Riess and Dr. Artz were also studying the problem of fluid resuscitation. Loss of body fluids, in the critical hours following a severe burn injury, can starve vital organs of blood flow and send patients into shock.

The "Brooke Formula" was published in 1953 as a result of the exposure treatment study. It is still widely used in hospitals and burn clinics in the United States to calculate how much fluid to administer to a burn patient immediately following injury.

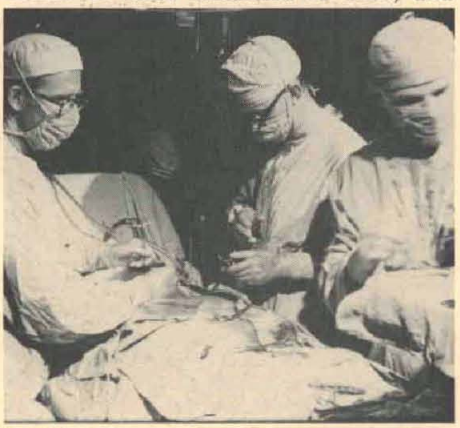
More patients given this improved treatment survived the early phase following burn injury, but many died after a few days with a variety of symptoms widely believed due to toxins absorbed from the wound.

Studies of such patients in England and at the USAISR established that their blood contained bacteria. Further studies indicated the symptoms were not due to toxemia, or poisoning, but were caused by septicemia, or infection.

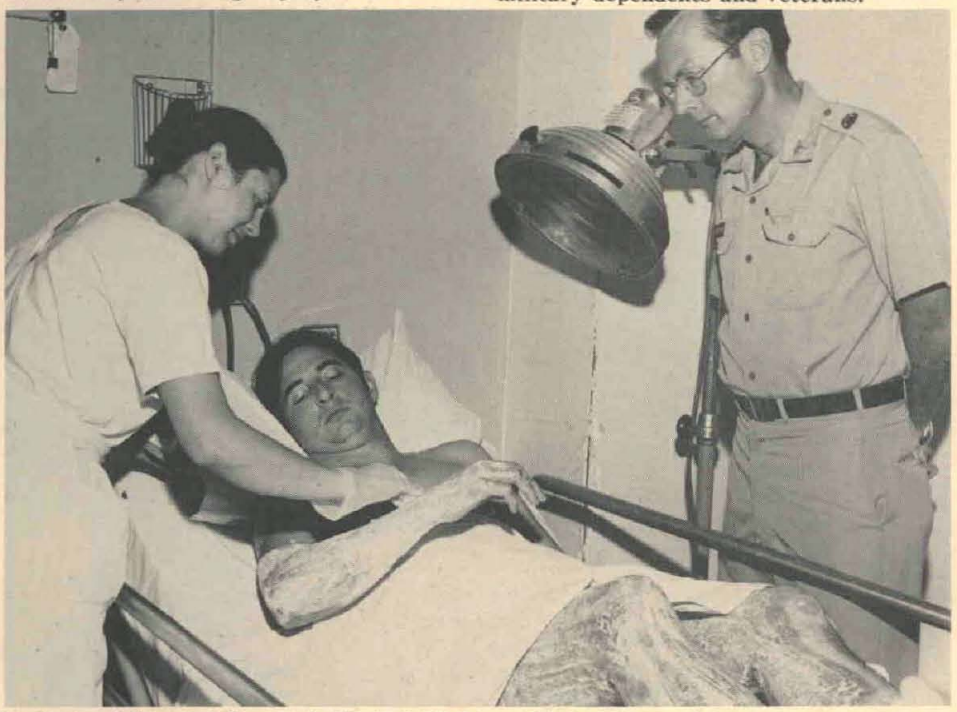
Over the next several years, a great deal of effort was devoted to identifying the death-causing organisms and, as antibiotic therapy gradually improved, certain of the organisms were controlled.

Septicemia due to antibiotic-resistant organisms, however, continued to cause a large number of deaths. Pseudomonas was foremost among these lethal organisms, and efforts to deal with it by use of antibiotics failed.

U.S. Army Institute of Surgical Research studies clearly established the source of these infections in 1960, and resulted in an animal model of Pseudomonas infection of the burn wound. The infected animals behaved in many respects like human burn patients.



USAISR treats severe burn cases from U.S. Armed Services including retirees, military dependents and veterans.



Institute of Surgical Research Clinical Division Chief, COL Hugh D. Peterson, watches as CPT Mary Lou Roberts, ANC, applies antibacterial cream, silver sulfadiazine, to arm of SGT Harlan M. Farque Jr., USA, who was burned over 24 percent of his body.

Continued studies during the next three years led to the conclusion that application of a chemotherapeutic agent, Sulfamylon, would control infection. After extensive testing, this approach was introduced into clinical treatment in 1964 on an experimental basis. The treatment successfully controlled infection.

Introduction of this therapy has had a dramatic effect in decreasing the mortality of patients with burns extending over 30 to 60 percent of the body surface. Survival of patients in this category has increased approximately 50 percent on the average.

Another technique pioneered by the USAISR is the use of temporary grafts of skin from cadavers or pigs as a "biologic dressing" after dead tissue has been sloughed off and before the wound is ready for permanent grafts of the patient's own skin. These temporary grafts act as a protective covering to prevent bacterial invasion of the wound.

Use of Sulfamylon and temporary grafts are the most effective new techniques developed by USAISR investigators, but there are other important advances in burn management. For example, removal of dead burned tissue must be accomplished rapidly if patients are to survive, and the institute has developed techniques to speed removal.

Patients are bathed in a stainless steel tank while dead tissue is snipped off. Wounds are never really safe from infection until they are covered with grafts of the patient's skin. Before grafts will grow into normal skin over the wound, dead tissue must be removed.

Still another USAISR innovation was the establishment of teams of physicians, nurses and technicians who fly to the patient and prepare him/her prompt movement to the institute. Formerly, it was generally believed that burn patients should not be moved—that this could/would seriously aggravate their condition.

With proper preparation, and specialists providing essential care, the patients are now flown to San Antonio, TX, from locations all over the country and overseas. No burn patient has died in flight during more than 20 years. The practice of moving burned patients to specialized treatment centers by air is now widely practiced in the U.S.

Currently, USAISR studies are being made in the hemodynamics of the early postburn period; pulmonary function changes and inhalation injury associated with burn injury; metabolic changes and nutritional needs of the thermally injured; development of skin substitutes; early burn wound excision; gastro-intestinal factors concerning liver function changes and Curling's ulcer; renal functions; and hematologic changes following burns—to list only a few.

Developments in these fields of research are expected to improve the care and management of burned servicemen in the future, and likewise improve the treatment of civilian burn casualties.

# An Improved Solid Propellant for Army Missiles

By H. C. Allen & Marjorie Cucksee

Composite propellants comprise one of the two major types of solid rocket propellants, the other type being nitroglycerine—nitrocellulose double-base propellants. The principal oxidizing components of composite propellants are granular solid salts such as ammonium nitrate or ammonium perchlorate (AP). Most modern composite propellants also contain a powered metal as a fuel.

These solid particulate materials are embedded in an elastomeric matrix called the binder, which imparts the principal mechanical responses and serves as a fuel during propellant combustion. This dual role, plus its dominant effect on propellant processing, makes the binder of first importance in formulating composite propellants. Advances in composite solid-rocket propellant technology have paralleled, to a large extent, advances in elastomeric binders.

A composite propellant starts with a liquid polymer which is the basic binder ingredient. The solid particulate materials are mixed into the liquid polymer, along with materials such as burn-rate modifiers, to form a viscous slurry. In modern propellants, the solids content may be as high as 90 percent by weight of the total propellant. A curing agent added to the mixture reacts slowly with the liquid polymer, converting the slurry to a flexible solid propellant.

Before the cure reaction has begun to thicken the slurry extensively, the propellant mix is poured or "cast" from the mixer into a rocket motor case (or other appropriate receptacle in the case of experimental mixes). The time interval from the end of mixing until the propellant has thickened to an unmanageable viscosity is termed the *pot life*. This is the time available to remove the propellant from the mixer and cast it into motors or other receivers.

After casting, the propellant is held at some elevated temperature—usually between 43°C (110°F) and 77°C (170°F)—until the cure reaction is completed. The propellant is then ready to perform its intended function, whether it be to serve as a test specimen or to fuel a rocket motor.

Development of composite rubber-base propellants made it possible to bond a propellant grain to the metal rocket motor case for production of very large solid-rocket motors. Systems such as Pershing and Sergeant owe their existence to the technology of case bondable composite propellants.

This type of propellant came into being soon after World War II when researchers at the Jet Propulsion Laboratory mixed AP (ammonium perchlorate) into polysulfide liquid polymers, and cured these to rubbery solids.[1] Advances in binder polymers followed rapidly.

Various polyurethanes were employed, which enabled increases in solids loading and thus energy content. Hydrocarbon rubbers were then introduced, first as a random copolymer of butadiene and acrylic acid (PBAA), or terpolymer with acrylonitrile (PBAN), then as a butadiene homopolymer with terminal carboxyl groups (CTPB).

Curing of these liquid hydrocarbon polymers was accomplished by chemical reaction of their carboxyl groups with epoxy or aziridine compounds. The most advanced type, CTPB could accept up to 88 percent solids (by weight) and still maintain good tensile strength and extensibility. All of these hydrocarbon binders contributed higher energy content to the propellants because of their fuel value to the combustion process.

All the binders except CTPB were limited by their processing characteristics to solids loadings of about 84 percent. CTPB gave superior mechanical properties up to 88 percent solids.

In many formulations, however, CTPB degraded in mechanical properties during environmental simulation tests above 130°F. This degradation, arising from limitations in the available curatives, seriously detracted from desirable features of CTPB binders.

Propellant binder studies[2] then in progress at the U.S. Army Missile Command (MICOM) suggested that a combination of the hydrocarbon polymer structure with the urethane cure reaction might represent yet another advance in binder technology, perhaps overcoming the problems of CTPB.

Consequently, a liquid hydrocarbon polymer with terminal hydroxyl groups was sought. For a true comparison of carboxyl versus hydroxyl groups as the curing function, a CTPB analog was needed. The simplest approach seemed to be conversion of CTPB to hydroxy-terminated polybutadiene by chemical reaction.

Experimentation showed that direct reduction of CTPB with lithium aluminum hydride gave an acceptable product. The resulting hydroxy-terminated polybutadiene (HTPB) was used to evaluate the concept of a urethane-cured hydrocarbon propellant binder.

In unfilled gumstock samples, HTPB had almost twice the extensibility of CTPB. It was also found that the HTPB polymer was substantially less viscous than the CTPB precursor. Preliminary studies showed HTPB to be a very promising binder polymer.

When propellant formulations were made with HTPB, it was found that mechanical properties were excellent down to 0°F, but that extensibility then became poorer with decreasing temperature. Army missiles must perform successfully in very cold environments. Since the extensibility requirement on a propellant is inversely related to temperature, this posed a serious threat to the future of the new binder.

Further research showed that unfilled HTPB rubber maintained excellent properties to −65°F and paralleled the behavior of a CTPB rubber over a wide temperature range. Thus it became clear that HTBP propellant behavior did not relate directly to gumstock properties at low temperatures. This phenomenon was attributed to poor interfacial adhesion between binder and filler.

A microscopic examination then was made of fractured surfaces of an HTPB propellant and a good CTPB propellant. The fractured HTPB propellant surface AP particles were loosened or completely dislodged; CTPB propellant surface particles were still tightly bonded in place.

Thus it became evident that good propellant properties resulted from a strong binder-filler bond. A similar conclusion had been reached independently at Aerojet Corp. by Oberth,[3] who had developed

SAM-D Missile Launch From Canister

Marjorie T. Cucksee

Henry C. Allen

*MARJORIE T. CUCKSEE received her AB degree in chemistry in 1959 from the University of Chattanooga, TN, and has done graduate work in organic chemistry at the University of Tennessee, Knoxville. Employed since 1964 by MICOM, she worked earlier for Eastman Chemical Products in an R&D laboratory for industrial additives and for Newport News Shipbuilding and Drydock Co. as an analytic chemist.*

*HENRY C. ALLEN received his BS degree in chemistry from the University of Georgia at Athens in 1954 and was employed by Monsanto Textile Division until he joined MICOM in 1960. He received an honorarium at the 1964 Army Science Conference for a paper on crystallization in propellant binder polymers.*

*Cucksee and Allen received the 1969 MICOM Scientific and Engineering Award for development of a composite solid rocket propellant based on hydroxy-terminated polybutadiene.*

a binder-filler promoter, or bonding agent, for polyurethane propellants.

These findings prompted a search for materials that would be effective bonding agents for HTPB propellants. Based on the observed good adhesion of CTPB, a series of bonding agents were prepared by making adducts of tris /1-(2-methyl)aziridinyl/phosphine oxide. The use of such adducts dramatically altered the low temperature properties of HTPB propellants, enabling them to exhibit the exceptional properties which the gum-stock studies had indicated.

Selection of curatives for HTPB proved to be dependent upon the type of propellant formulation and its intended use. Curatives available for HTPB included toluene di-isocyanate (TDI), hexamethylene di-isocyanate (HMDI), and DDI 1410.* In later work, the very slow-reacting isophorone di-isocyanate (IPDI) was also evaluated.

Having demonstrated feasibility of the HTPB binder concept, researchers evaluated commercially produced HTPB polymers. One such polymer selected was Poly B-D Resin R45M.**

Development studies with R45M confirmed the advantages expected of an HTPB binder. Its low viscosity enabled the formulation of propellants with over 88 percent solids, or with solids of the reduced particle sizes needed for high burn rates; also, excellent mechanical properties and good stability upon prolonged exposure to elevated temperatures.

The first operational application of HTPB propellant was in the XM75 meteorological sounding rocket, then being developed jointly by MICOM and Canada. When a CTPB propellant tailored for the rocket suffered severe degradation in a test involving 6-month storage at 140°F, it was recommended that HTPB propellant be substituted to increase the solids loading.

A maximum processing viscosity imposed on the propellant by equipment limitations of the contractor had limited the CTPB propellant to 84 percent solids. With HTPB it was possible to process 87.5 percent solids within the viscosity limitation.

Even with the higher solids loading, the HTPB propellant proved to be equal in mechanical properties to the CTPB propellant. When it also showed good aging behavior at 140°F, it was adopted for the XM75 rocket and has performed satisfactorily.

The ability to accept higher loadings of reduced particle size AP opened the way to formulation of high-performance composite propellants with quite high burn rates. Catalysts such as organo-iron compounds and others were added to achieve burn rates beyond those attainable through AP particle size reduction. High-burn-rate work with HTPB soon showed that in such propellants pot life was a serious problem.

Achieving adequate pot life became a formidable obstacle in HTPB propellant technology, but significant successes were achieved. Several Army missile systems currently under development are designed around high-burn-rate HTPB propellants.

An application of HTPB is in the SAM-D air-defense missile. It was in advanced development with a CTPB propellant when it was found that the propellant could not withstand environmental conditioning at the required elevated temperature for one year without severe mechanical properties degradation.

This problem led to a suggestion that HTPB propellant be used rather than to reformulate CTPB to a (hopefully) more stable type. The propellant tailoring and characterization work was carried out by the SAM-D propulsion contractor. Ballistic performance of the old propellant (total solids, burn rate, etc.) was matched in order that no hardware changes would be required.

The two most noteworthy events of this program were the development of an excellent bonding liner for use with HTPB propellant, and the occurrence of an unexpected pot life problem. The pot life problem was eliminated by a change to insure good AP coating.

Some superior characteristics of the HTPB SAM-D propellant, along with those of the CTPB propellant which it replaced, are given below.

| | CPTB | HTPB |
|---|---|---|
| End of mix viscosity, kP at 145°F | 14 | 3.4 |
| Raw materials cost/pound propellant | $0.65 | $0.43 |
| Strain endurance, % strain | 32 | 48 |

Aging behavior at 130°F, and tested at 77°F, aged tensile strength/original tensile strength:

| | (Bulk sealed samples) | (Desic-cated motor) | (Undesic-cated motor) |
|---|---|---|---|
| 6 mo | 0.73 | 0.99 | 0.96 |
| 12 mo | 0.34 | 0.98 | 0.76 |
| 18 mo | — | 0.93 | 0.66 |

Because of the increased strain capability of the HTPB propellant, it was possible to make some changes in the grain configuration and thus load more propellant into the motor, thereby upgrading SAM-D performance.

In this article, we have attempted to summarize the history of HTPB propellants. Benefits have been so impressive that most new solid-propulsion systems coming off the drawing boards are considering this new propellant.

Further research is needed to extend pot life of very-high-burn-rate propellants and to improve bonding agents for better processing and very-high-temperature aging behavior.

A joint Army-Navy-Air Force funded contract effort has just been completed in the latter area.

The versatility of the binder is such that it may lead to many more innovations in composite propellant technology. Even now, this new type of propellant is being employed to increase the effectiveness of the Army's missile weaponry.

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[1] Bartley, C. E., Progress Report No. 4-41, Jet Propulsion Laboratory, CA Institute of Technology (1948).

[2] Allen, H. C., Quarterly Progress Report, Report No. RK-TR-62-11, Propulsion Laboratory, DR&D, USAMICOM, 1962.

[3] Oberth, A. E., and R. S. Bruenner, Bulletin of the 4th Meeting of the ICRPG Working Group on Mechanical Behavior (1965).


* A trademark of General Mills, Inc.

** A trademark of ARCO Chemical Co.

# EPA Allocates $1.9 Million For Noise Pollution Studies

Contracts totaling $1.9 million for studies to help establish regulations for vehicles designated as major sources of noise pollution were announced by U.S. Environmental Protection Agency.

Studies will include motorcycles, buses, bulldozers, earth loaders, trash compactors mounted on solid-waste collection vehicles, and refrigerator units mounted on trucks and commercial interstate trailers; also, available technology for reducing noise in newly manufactured automobiles, snowmobiles, jackhammers and paving breakers.

These contracts include A. T. Kearney (buses and specialty truck components), $159,000; Bolt, Beranek & Newman (light trucks, and specialty truck components), $311,000; Booz-Allen & Hamilton (snowmobiles and buses),$153,000; Cambridge Collaborative (snowmobiles), $73,000; Dames & Moore (bulldozers, jackhammers, and paving breakers), $163,000; and

Energy Resources Co. (bulldozers), $73,000; General Electric Tempo (motorcycles, jackhammers, and paving breakers), $163,000; McDonnell Douglas Corp. (motorcycles), $139,000; Mechanical Technology Inc. (automobiles), $135,000; Science Applications Inc. (bulldozers, snowmobiles, jackhammers and paving breakers), $232,000; and Wyle Laboratories (snowmobiles, automobiles and buses), $249,000.

## New Microwave Antenna Tower Undergoes Army Evaluation

The Army is evaluating a newly developed lightweight, aluminum alloy, tactical microwave antenna tower, following two months of tests conducted by the U.S. Army Electronic Proving Ground (AEPG) at Fort Huachuca, AZ.

The transportable tower consists of 9-foot-long sections that can be assembled without special tools and constructed to offer variations in height from 106 to 135 feet, as required.

The U.S. Army Communications Command's (ACC) Electronics Engineering Installation Agency assisted AEPG in the testing by providing a 6-man antenna team to erect and disassemble the tower.

Results of the tests, which include data on durability, maintainability, and environmental survivability under fog, salt air, and fungus conditions, will assist the Army in deciding future procurement.

## Skibbie Commands RIA

COL Lawrence F. Skibbie, former chief of the Program Management Division, Office of the Program Manager for Munitions Production Base Modernization and Expansion, Picatinny Arsenal, NJ, now commands Rock Island Arsenal, IL.

A graduate of the U.S. Military Academy (USMA), he has a master's degree in mechanical engineering from New Mexico State University. During 1965-68, he was an assistant professor of engineering at the USMA. He has served tours in the U.S. and abroad.

# ARMCOM FY75 Savings Top AMC Elements

Validated Value Engineering savings of more than $57 million for FY 1975 have made the Armament Command the VE leader for the third consecutive year among U.S. Army Materiel Command elements.

ARMCOM accounted for more than 50 percent of the total savings of the Army Materiel Command's seven major subordinate commands during FY 1973 and 1974, and this year exceeded its goal of $26,615,000 by 217 percent. VE savings accounted for 51 percent of ARMCOM's 1975 Cost Reduction Program savings of $113,332,200.

**ARMCOM Value Engineering Division Chief (acting) Ed Lower (left) holds aluminum plug originally used in 105mm artillery shells. Al Sundfor, an ARMCOM value engineer, shows the space and weight saving plastic nose plug that replaced the metal unit. Work on the project at Kansas Army Ammunition Plant saved the Army $977,000 during FY74-75.**

Among ARMCOM's seven arsenals, Watervliet won top honors with VE savings of $21,867,000—actually 1,620 percent of its goal of $1,350,000. Most of this tremendous saving is attributed to cannon barrel fatigue research, involving a combination of simulation testing by a hydraulic cycling technique and comparison with a greatly reduced number of live firing tests.

Rocky Mountain Arsenal, Denver, CO, achieved VE savings of $984,500 against its goal of $200,000 and Edgewood Arsenal, Aberdeen Proving Ground, MD, finished third with $7,033,200 against its goal of $180,000.

Frankford Arsenal's VE savings of $3,219,000 were 179 percent of its goal of $1,800,000, Picatinny Arsenal saved 112 percent of its $7 million goal, Rock Island Arsenal exceeded its assigned goal of $1,350,000 with savings of $1,690,000, and Pine Bluff Arsenal saved $628,000 against a $500,000 goal.

## Field Telephone Work Eased

Tests of hundreds of splicing devices for connecting field telephone wires by three U.S. Army Electronics Command engineers have resulted in use of a splice described as "simple, effective and commercially available."

Nathan W. Feldman, Philip E. Mari and T. F. Scoville conducted tests of splices under consideration in extreme temperature and exposure to mechanical stress and moisture. They selected a 2-piece plastic splice assembly with built-in metal inserts, using a strain-relieving knot at each connection, as a "significant improvement over current methods."

Army troops at Fort Huachuca, AZ, evaluated the new technique during recent tests on the AN/TTC-38, an automatic, computerized telephone system developed by the Electronics Command and now being used in Europe.

The new splicing device eliminates removal of insulation from wires, requires no taping, and uses self-contained insulating grease for waterproofing. Normal life expectancy of the splice is reported "more than five years." The splice and its installation tool have been approved for U.S. Army use.

## McKnight Succeeds Musgrave As USACC Chief of Staff

COL Clarence E. McKnight Jr. became chief of staff, U.S. Army Communications Command (USACC), Fort Huachuca, AZ, upon retirement of COL Thomas C. Musgrave.

A 1952 graduate of the U.S. Military Academy, COL McKnight has an MS degree in electrical engineering from the University of Michigan. He completed the Army Command and General Staff College and U.S. Army War College.

Key assignments have included chief of staff of USACC's 5th Signal Command, Europe; chief, Program Management Office, Communications Electronics Engineering Installation Agency, Fort Huachuca; and signal adviser, U.S. Military Assistance Group, El Salvador.

He holds the Legion of Merit, Bronze Star Medal with two Oak Leaf Clusters (OLC), Meritorious Service Medal (OLC), Air Medal, Joint Service Commendation Medal, Army Commendation Medal (3 OLC).

# USAATB Continues AH-1S RAM Data Collection

Collection of RAM (Reliability, Availability and Maintainability) data on componentry of the AH-1S (improved version of the AH-1Q) helicopter, initiated Jan. 6, 1975, by the U.S. Army Aviation Test Board, is being continued in a 600-hour flight evaluation.

Flight tests were conducted from January through May 31 in line with guidance for the newly established Single Integrated Development Test Cycle program initiated by the U.S. Army Materiel Command. The concept is to maximize use of contractor test data, minimize cost, reduce redundant testing, and to establish a data base early in the testing cycle.

During the flight tests, data were collected at Forth Worth, TX, Edwards Air Force Base and Bishop, CA, Yuma Proving Ground, AZ, and Fort Hood, TX. Test pilots accumulated 165 hours of flight time. They represented Bell Helicopter Co., the Army Engineering Flight Activity, Edwards AFB, and the Air Combat Directorate of MASSTER (Modern Army Selected Systems, Test, Evaluation and Review) at Fort Hood.

All testing and maintenance performed by Bell Helicopter and military personnel were observed by a 2-man data collection team from the Army Aviation Test Board. They recorded "valuable and extensive" RAM data on improved components of the AH-1S, by remaining with the aircraft during test and maintenance.

This pilot program of data collection is reported to have accomplished objectives of establishing an accurate data base early in the testing cycle; also, it insured a maximum exchange of data between the contractor, tester, and the materiel developer.

# Reich Heads New JLC Technical Coordinating Group

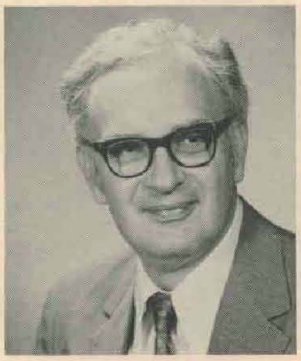
Electronics systems reliability, one of the U.S. Armed Forces' most critical areas of concern, is the mission of a new Technical Coordinating Group, established under the Joint Logistics Commanders and headed by Bernard Reich, a U.S. Army Electronics Command scientist.

Responsible for meeting the common logistics operational needs of the Army, Navy and Air Force, the JLC includes: commander, Army Materiel Command; chief, Naval Material Command, and commander, Air Force Logistics and Systems Command.

Reich has served as U.S. Army member and chairman of a JLC Electronics Equipment Reliability Technical Coordinating Group since 1973. The new group is a "logical extension of the earlier effort," with the ultimate objective of reducing life-cycle costs of materiel.

Stanley Grubman, ECOM Product Assurance Directorate, is the alternate U.S. Army member. Known for research achievements in the ECOM Product Assurance Directorate, Grubman is a professional staff veteran.

Reich also is serving as chairman of the NATO Group of Experts on Electronics Parts and of the NATO Special Working Group on Semiconductor Devices. A Fellow of the U.S. Institute of Electrical and Electronics Engineers (IEEE) and a charter member of the Institution of Electrical Engineers of the United Kingdom, he has been awarded six patents and has authored more than 50 technical papers and articles.



**Bernard Reich**

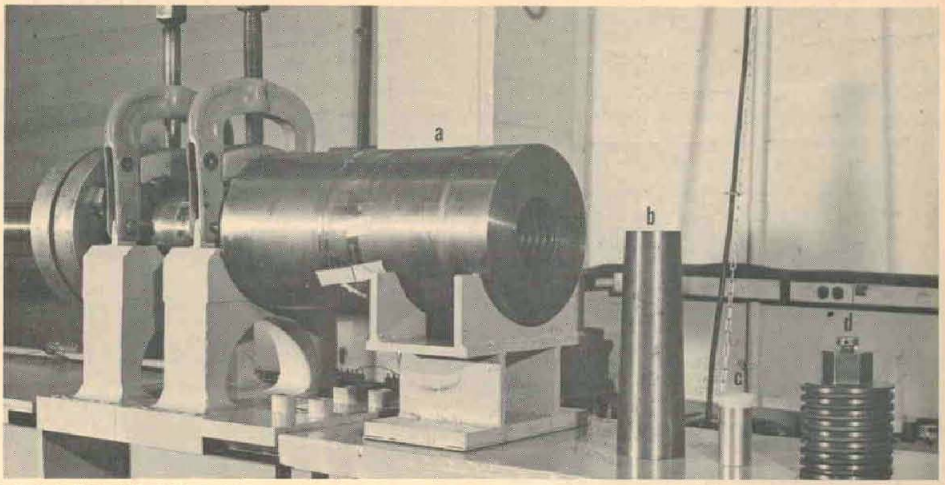
# 40mm Prototype Powder Gun Provides Improved Projectile Velocity

Terminal ballistic studies at high velocities using a new 40mm powder gun developed at Frankford Arsenal, under the FY 1975 In-House Laboratory Independent Research (ILIR) Program, have shown a 26 percent gain in speed for a 31.5-grams projectile.

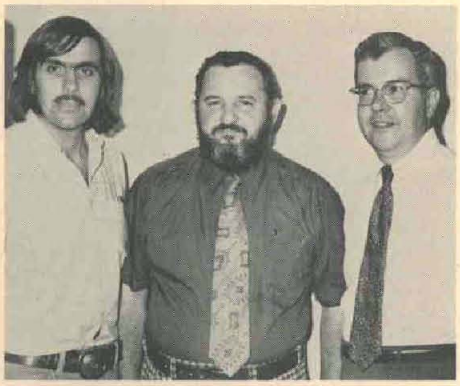
Frankford Arsenal physicists L. F. Baldini, P. D. Flynn and R. G. Audette—in continuance of arsenal efforts during more than 15 years to develop improved laboratory launchers and test facilities for high-velocity projectile studies—designed and tested a new 40mm gun for laboratory experiments that reportedly has "unique high-velocity characteristics."

The highest velocity was attained in the first series of experiments, in which 30 rounds were fired in the experimental gun, using two types of projectiles—an aluminum slug with a polypropylene obturator (Figure 1) and a lightweight polypropylene projectile.

Independent velocity measurements differed less than one percent. The highest velocity, 12,600 ft/s, exceeded by 26 percent the accepted practical limit of 10,000 ft/s for conventional propellant guns, the data compilation showed.




**HIGH PRESURE CHAMBER showing (from left) a. thick-walled steel case, b. projectile (aluminum, 200 grams), c. obturator (polypropylene, 18 grams), d. breech plug/primer.**



**AUTHORS of high-velocity studies with 40mm powder gun (l. to r.) R. G. Audette, L. F. Baldini and Dr. Paul D. Flynn.**

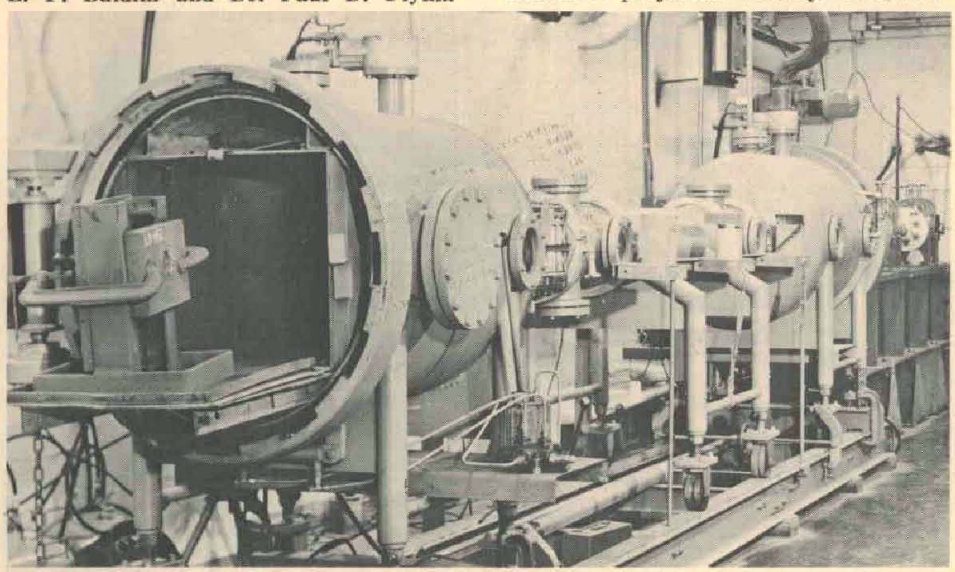
The three researchers reported that "for a given combination of charge and projectile, the reproducibility of the velocity and pressure was very good." The hypervelocity range can be operated with controlled atmosphere either evacuated or pressurized to 100 psi.

The high-pressure chamber (10 inches outside dimension, 200 ksi) was coupled to a smooth-bore barrel (1.630 inches, inside dimension, 10½ feet long). The test facility included a blast tank to contain powder gases and absorb blast.

An electric primer in the breech plug actuated a firing pin which struck a standard 40mm mechanical primer in the base of the steel case. Standard 40mm propellant (SPDN 8709) surrounded the mechanical primer to obtain good ignition.

The high-velocity technique is described as "using a relatively slow propellant adjacent to the primer, next a medium-speed propellant, and then a fast propellant." This layering of the propellant modifies the pressure-time behavior to maximize projectile velocity. The total charge filled the case "but did not exceed the maximum allowable chamber pressure during firing."

Results of the tests to date, the research team believes, indicate that the new gun "has considerable potential as a high velocity laboratory launcher for ballistic studies."



**HYPERVELOCITY test facility consisting of a blast tank, flight sections for independent optical and flash X-ray velocity measurements, and target tank.**

## APG's Materiel Test Directorate Exceeds 1975 Cost Reduction Goal

Cost Reduction Program ideas, one good for savings of $690,000, another for $590,400, enabled the Materiel Testing Directorate at Aberdeen Proving Ground, MD, to far exceed its 1975 goal of $353,000.

Morris W. Hutchins, an electronics technician with the MTD Air Defense and Fire Control Section, was credited with the largest saving. Runner-up honors went to a team comprised by Leo D. Heppner, a mathematician with the Ballistics Unit; James P. Finera, chief, Nondestructive Test Section; and Willard E. Caudill, engineering technician, NDT.

Hutchins used a Dynamic Field Evaluator to provide synthesized aircraft targets along selected flight courses for comparison of the lead angle solutions provided by the standard and modified analog computer.

Heppner, Finera and Caudill developed procedures for using multichannel and multifilm techniques in conjunction with flash X-ray to reduce time for firing and processing a round of ammunition.

Franklin P. Bryant was credited with saving $88,000 on fuel utilization economies. Kenneth I. Ruff, a mechanical engineering technician, Artillery Ammunition Branch, saved $59,200 by designing a multiple armor target fixture that permits each projectile to be tested under identical target conditions. Kenneth M. Koller saved $40,000 by suggesting that a purchase request for a service tower be cancelled, using an existing tower.

Cecil E. Martin was cited for saving 27,340; Willard E. Caudill, $16,682; Wilbur S. Ervin, $11,835.

# Management of Power Plant Waste Heat in Cold Regions

**By Dr. Haldor W. C. Aamot**

More energy is dissipated as waste heat than is converted into electricity in thermal power plants. Greater conversion efficiency could be achieved through advanced technology but essentially all energy generated is converted eventually into heat—the ultimate waste.

Transfer of waste heat to the earth, the water and the atmosphere leaves to nature the task of final disposition. In order to maintain equilibrium, the earth dissipates heat by radiation into space. Space is the ultimate heat sink.

This article discusses two aspects of a study of thermal waste problems in cold regions. The full study is contained in USACRREL Technical Report 257, Management of Power Plant Waste Heat in Cold Regions, December 1974.

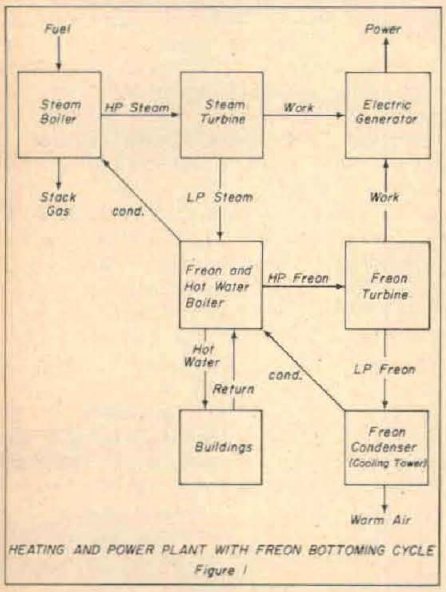
The usual and least expensive method of heat dissipation from power plants is through cooling with river or lake water. However, in the long term, the ever increasing cooling needs of power plants cannot be met by surface waters.

Even where open water is available, the method has disadvantages. There may be adverse weather modification effects. A heated body of water contributes to formation of fog, which is a hazard and becomes a psychological factor when it covers a city for days or possibly weeks. It also intensifies air pollution problems. The fog and pollution problem increases in cold weather.

*Alternatives* to open water cooling that technology can offer are acceptable only if they meet three criteria: economic feasibility—necessary to be viable; environmental compatibility—required by public interest and imposed by legal constraints; and resource conservation—arising from national interests and demanding careful consideration through advance planning.

Since these criteria are not necessarily compatible, there is frequently a need for engineering decision-making.

A radiator on the ground for direct dissipation of power plant waste heat into space is very effective during a clear night; less effective under cloud cover; and quite ineffective under solar radiation. For a 100-MW fossil fuel power plant, the size required is about that of a 10,000-foot runway, 300 feet wide. The large size and periodic availability make this method impractical.




HEATING AND POWER PLANT WITH FREON BOTTOMING CYCLE
Figure 1

For heat dissipation in the ground the same sized plant would require 100 miles of 10-foot-diameter tunnel to serve as a condenser and heat sink, or over 200 miles of a 2-foot-diameter pipeline serving as a cooling water loop. A wet cooling tower is not satisfactory because of its contribution to fog formation and difficulties with icing.

The most desirable facility for waste heat disposal is a dry or a hybrid cooling tower. The hybrid system has the desirable characteristics of a dry tower much of the time and the increased effectiveness of a wet tower during hot, dry weather through a supplementary water spray capability.

The heat disposal problem can be reduced by utilizing waste heat for a useful purpose. *A known but unexploited opportunity* is to utilize waste heat to generate electricity through a bottoming cycle. The low ambient air temperatures available in cold regions permit low condensing temperatures of an organic fluid Rankine cycle process to achieve high conversion efficiency.

Space heating is probably the largest potential application; it represents about 20 percent of total U.S. energy use, about the same as purchased electric energy. The waste heat from power plants potentially could serve all space heating needs. Use is made of it in some district heating systems with steam or hot water from heating and power plants.

*Bottoming Cycle Utilization* for electric generation requires a boiler, a turbine, and a condenser (Figure 1). All waste heat from the steam cycle not used for district heating is available.

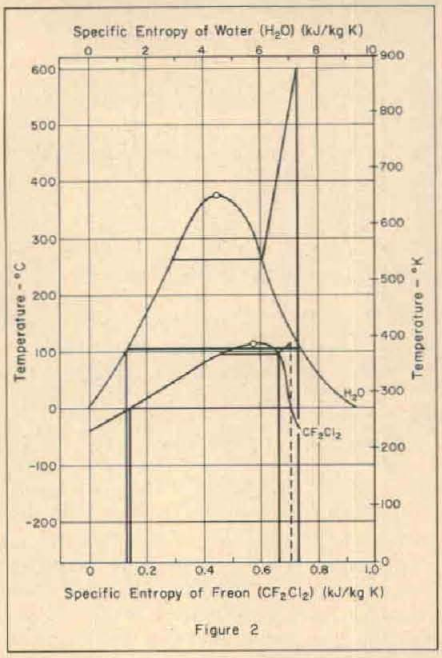



Figure 2

Figure 2 shows the subposition of the Freon cycle under the steam cycle in the temperature-entropy diagram. Ammonia and Freons 11, 12 and 21 are some of the best suitable working fluids.

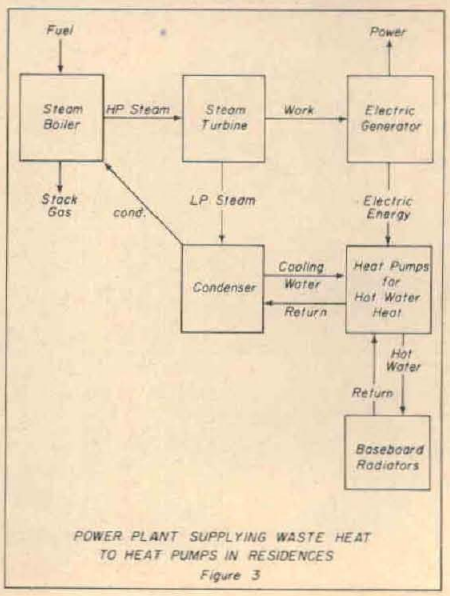
Freon 12 was chosen for this analysis because it is almost completely nontoxic and, next to ammonia, requires the smallest turbine for a given power rating. Its disadvantage is slightly lower cycle efficiency than ammonia.

The Freon and hot-water boilers serve as steam condensers. The Freon turbine differs from the steam turbine in the thermodynamic properties of the fluids. The Freon turbine has only one or two stages, due to the small drop in specific enthalpy. It is suitably designed as an inward radial flow turbine with gas velocities up to Mach 2. The velocity of sound in Freon is only about half of that in steam.

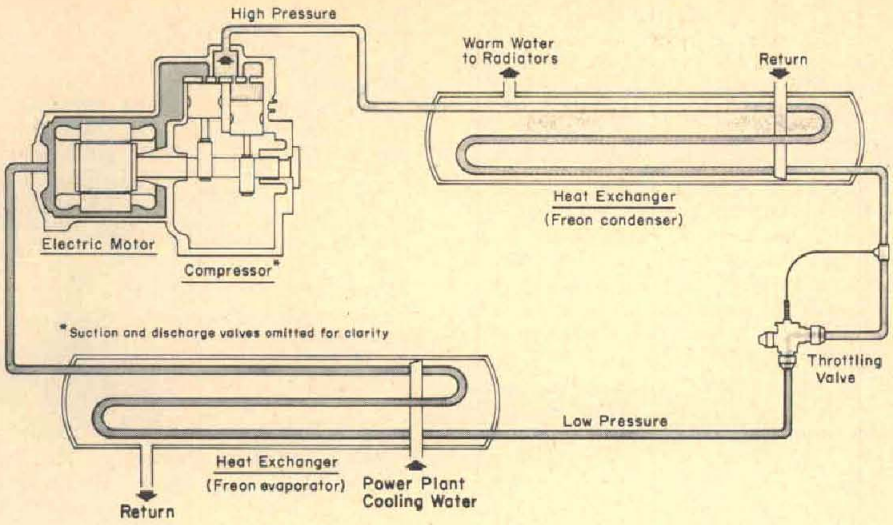
The Freon turbine becomes feasible when used in conjunction with a back-pressure steam turbine because the low-pressure stages of a condensing turbine are avoided. The low-pressure stages develop only about one-third of the total turbine power, but represent about 80 percent of the weight and cost about 5 to 6 times as much per kilowatt as the medium- and high-pressure stages.

The Freon turbine is relatively small, and its exhaust volume flow is about half that of the back presure steam turbine. Its cost is offset by the low-pressure section of a condensing steam turbine which it replaces.

The Freon condenser is an air-cooled heat exchanger in the dry cooling tower. The direct condensing system is practical, even for large plants, because the volumetric flow rate of the Freon vapor is only about 1/30 that of steam. The diameter of the duct from the Freon turbine to the cooling tower is not much greater than the size of a pipe required to move the cooling water of a comparable water-cooled system. There is no




POWER PLANT SUPPLYING WASTE HEAT TO HEAT PUMPS IN RESIDENCES
Figure 3




HEAT PUMP FOR HOME HEATING

Figure 4

danger of freezing in cold weather.

The plant with bottoming cycle is more costly but it is more efficient in cold regions. The cost difference is about 10 percent compared with a conventional plant with cooling tower. The increased efficiency achieved in cold regions can make the bottoming cycle economically feasible, in view of rising fuel prices.

*Space Heating.* The concept of using cooling water from an ordinary power plant to supply heat pumps for heating (or cooling) homes is illustrated in Figure 3. The power plant also provides electrical energy to operate the residential heat pumps.

Figure 4 shows a diagram of a heat pump in the home. The thermodynamic cycle of a heat pump, using Freon 12 as the working fluid, is shown in Figure 5. The power plant cooling water serves as the heat source for the Freon evaporator, and the Freon condenser heats water circulated through the heating system.

A measure of the efficiency of a heat pump is the coefficient of performance (CP) which is the ratio of useful heat delivered to the work required (to drive the compressor of the heat pump).

The CP of the system shown is 3 to 3.5. The advantage of the cooling water is its stable temperature compared with ambient air which provides a CP approaching 1.0 in cold weather (the same as electric resistance heating). CP is highest when the difference between the source temperature and output temperature is lowest.

The same heat pump can also provide air conditioning, using the cooling water as a heat sink. Its CP for cooling is about 7 as compared to the CP of a window air conditioner which is about 1.5 to 3.5. The cooling water distribution system requires a supplemental waste heat disposal facility when used for cooling because the waste heat from the residential area becomes a supplement to that of the power plant.

A cooling tower can serve as such a facility. Its cost is only a fraction of that of the distribution system and the impact on the estimated cost of a residence connection to the system is relatively small, less than 20 percent.

The reduced operating cost and energy used for air conditioning with this system (one-half to one-fourth when CP is double or quadruple), compared with window air conditioners, becomes very attractive—even more so for savings from the combined capability of heating and air conditioning.

*Heating System Economics.* The city of Fairbanks was selected to study the potential application of the heat pump concept. Power plant cooling water is a major contributor to fog in Fairbanks, especially severe ice fogs in winter. Therefore, any reduction in the discharge of cooling waters would have a direct, beneficial effect on the city's air pollution problem.

Acceptance of the system by individual homeowners requires that it be economically, as well as environmentally justified. An existing residential area was studied instead of a planned, new city because the value of the concept is enhanced if the conversion of existing heating systems is feasible.

The introduction of the heat pump system requires the conversion of all houses in an area in order to be feasible, as with the installation of a water supply or sewerage system.

In this study, a cooling water distribution and heat pump system was designed for the coal-burning Municipal Utilities System power plant and adjacent residential area. The power plant uses the Chena River for cooling.

Only the economic analysis is presented here. Figure 6 is a schematic layout of the circulating water distribution system and connection to the plant, with one of its two condenser sections connected to the closed-loop distribution system. Each section would serve 750 houses.

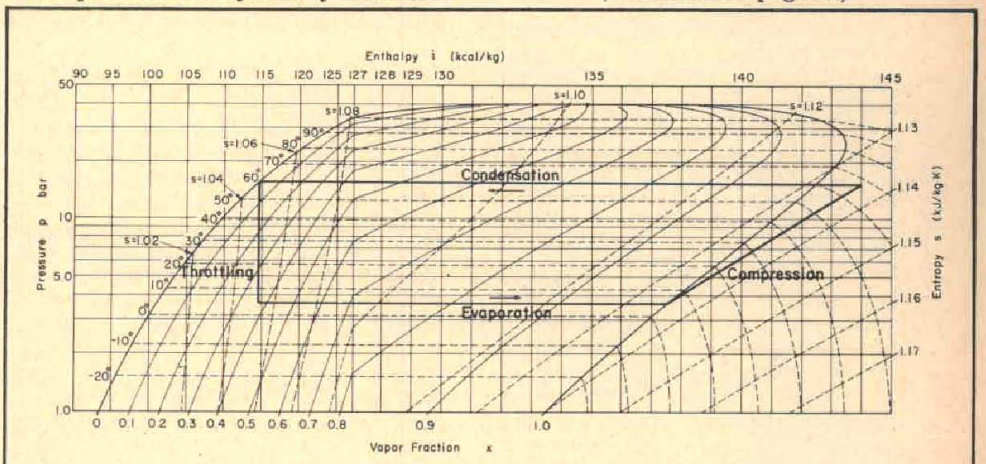
The connection to the system is about $1,500 per house, based on the comparison with costs of water supply and sewerage system connections. The cost of a heat pump capable of heating an average size insulated house at −50°F. is about $2,500. In a house already equipped with a furnace and hot water or hot air heating system, the heat pump can be installed parallel to the existing furnace.

The initial cost of connection and heat pump is higher than the initial cost of an oil-fired furnace or electric-resistance heating system. However, the operating cost is low enough to make the heat pump system competitive with either oil or electric heating.

The cost of heating such a house in Fairbanks with oil is $1,285 per year, based on a fuel oil price of 45 cents a gallon in 1974. The cost of electric resistance heating is $2,458 at an electric rate of 3 cents per kilowatt hour.

It is proposed that the system connection and heat pumps be offered on either a rental or puchase basis. The rental fee is calculated at $407 annually. The an-

(Continued on page 24)




THERMODYNAMIC CYCLE OF HEAT PUMP

Figure 5

(Continued from page 23)
nual cost of loan financing to the home owner who elects the purchase option is $623 for a 10-year, 9 percent loan. The annual cost of electricity to operate the heat pump system is 819 at a rate of 3 cents/kWh.

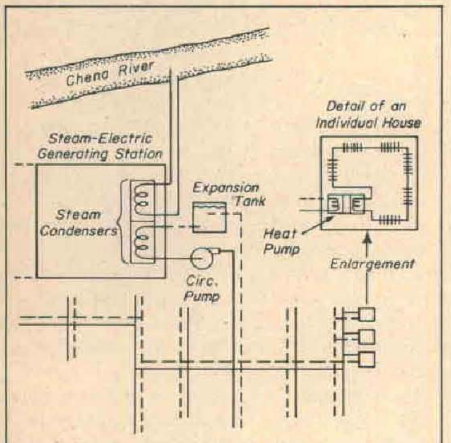
Thus, the annual cost of the home owner who elects the rental option is $1,226. For the home owner who elects the purchase option, the cost per year for the first 10 years is $1,442. Thereafter, the annual cost is $819.

The conversion to the heat pump system, based on these costs, is economically attractive, on a rental or purchase basis.

The cost to convert from an electric heating system to a heat pump system is estimated at between $1,000 and $1,500 higher because a heat distribution system must be installed in the house. However, the saving from the high annual cost for electric resistance heating is still greater than the saving for the home currently being heated with oil.

*Three principal environmental results* can be accomplished by converting to the proposed heat pump system. For each home converting from oil-burning equipment, the amount of waste heat discharged into the Chena River would be reduced by 75 million BTUs per year. The amount of smoke discharged into the air would come from 19 tons of coal at the plant instead of 10.6 tons of oil from the house chimney. Heating value yearly of fuel consumed would be reduced from 400 to 333 million BTU.

Similarly, for each home converting from electric-resistance heating, the amount of waste heat discharged into the river would be decreased by 593 million BTUs per year. The amount of smoke discharged into the air would come from 19 tons of coal instead of 57 tons of coal at the plant. The heating value of the fuel consumed would be reduced from 999 to 333 million BTUs per year.



SCHEMATIC LAYOUT OF FAIRBANKS PLAN
Figure 6

*DR. HALDOR W. C. AAMOT is a research mechanical engineer at the U.S. Army Cold Regions Research and Engineering Laboratory. He directs research programs on thermal waste management and utility distribution systems in cold regions and participates in a Corps of Engineers effort to develop an energy R&D program for Army fixed facilities. He received his master's degree in mechanical engineering from the University of Stuttgart, Germany, and a doctorate in engineering from the Thayer School of Engineering, Dartmouth College.*

# USALC Realigns Training Board, E&T Directorate

Newly established elements of the U.S. Army Logistics Center, Fort Lee, VA, announced as this edition of the *Army Research and Development Newsmagazine* was ready to go to press, include a realigned Logistics Training Board, and the Evaluation and Test Directorate.

The Army Materiel Command's consolidation of Test Boards formerly under the Test and Evaluation Command (TECOM), Aberdeen Proving Ground, MD, into the Army Training and Doctrine Command (TRADOC), headquartered at Fort Monroe, VA, created the requirement for the new ALC Evaluation and Test Directorate.

Factored into the requirement is the increased Army emphasis on in-the-field experimentation, plus use of the Scenario Oriented Recurring Evaluation System (SCORES) to research and identify combat service support needs and logistics concepts. The ALC, as the logistics integrating organization for TRADOC, has inherited many TECOM Test Board missions and functions.

The new directorate, it was announced, will function as the focal point for test management in the Army logistics area for the Army Logistics Center. COL George T. Morris Jr. was reassigned from duty as a division chief in the Materiel Directorate to head the E&TD.

A U.S. Military Academy graduate with an MS degree in electrical engineering, COL Morris served for several years at TECOM as director, Test Systems Analysis and later as director, Plans and Analysis.

The new Logistics Training Board retains most of the functions of the former Logistics Exercise Division in LOGEX and is headed by COL Raymond G. Rennebaum, formerly the LOGEX director. He has served in the Office of the Deputy Chief of Staff for Logistics, HQ DA; as deputy commander, 56th FA Artillery Brigade in Germany; and ACS, G4 of II Force in Vietnam.

James E. Coberly is the LTB deputy director. Division chiefs are: COL William T. Duba, Training Assistance, and LTC Joel J. Mikuta, Training Exercises.

## Silicon-Nitride Rotor Production Receives AMMRC High Priority

Production of a silicon-nitride rotor adaptable to high-temperature gas turbine engines is the objective of a high priority developmental program initiated at the Army Materials and Mechanics Research Center.

AMMRC Director Dr. Alvin E. Gorum recognizes that fabrication of the rotor presents one of the more formidable problems in producing an operational ceramic turbine engine. Alternate rotor designs and fabrication approaches are intended to provide a latitude of options for turbine engine performance testing.

The developmental program is sponsored by the Advanced Research Projects Agency (ARPA) and is programed for completion within 14 months under George E. Gazza of the Ceramics Research Division, AMMRC, as project officer. Yttria-doped hot-pressed silicon nitride, developed by the AMMRC, may be used to test engine performance at the higher operating temperatures.

Successful development of a ceramic turbine engine would permit use of higher operating temperatures resulting in improved efficiency, power per unit weight, fuel utilization and reduction in exhaust emissions.

Potential military and commercial applications of the technology advances of the new program include auxiliary power generation, aircraft engines, ground vehicle propulsion, and marine engines.

# Army Awards $100 Million Contract for M60A1 Tanks

Award of a $100 million fixed price with escalation letter contract to the Defense Division, Chrysler Corp, for production of M60A1 full-tracked combat tanks was announced recently by the Tank-Automotive Command, Warren, MI.

Other contract awards by the Army announced by the Department of Defense included $44,519,581 to Martin-Marietta Corp., with an initial $5 million for a multi-year program for the XM712 Cannon-Launched Guided Missile.

McDonnell Douglas Astronautics Co., received a $36,126,720 firm fixed-price contract for guided missiles and launchers, surface attack, Type M223. The Raytheon Co. will produce the M223 and the M222 type for $16,354,363.

In the category of contracts exceeding $5 million each, as announced recently, are: Blaw-Knox Foundry and Mill Machinery, Inc., $17,873,058, cost-reimbursable contract to provide improvements and plant equipment for production or rough machine castings of M60 hulls, turrets and gun shields.

Martin-Marietta Corp., $9,324,648 modification to a previously awarded cost plus incentive fee contract for automatic reference units, ARS/SLA Hardware Program, Pershing Missile System; Honeywell Inc., $8,175,618 fixed price with escalation third increment to a 5-year procurement contract for add-on stabilization systems and modification kits for the M60A1 tank; Kollsmen Instrument Co., $6,826,861 for Dragon Missile System infrared trackers.

## Improved Fatigue Testing . . .

# Keyed to Aircraft Rotor Blade Materials Progress

**By I. E. Figge Sr.**

Fatigue test equipment and procedures have not kept pace with the demanding requirements of aircraft rotor blade testing—due in part to lack of a complete understanding of rotor blade dynamics. Rotor blades are subjected simultaneously to centrifugal forces, span and chordwise bending forces, and torsional moments every revolution.

New materials such as composites (fiberglass, boron, graphite, Kevlar, etc.) behave differently from homogeneous metals to which the aircraft industry is accustomed—further complicating the problem and test techniques required.

In an attempt to provide a better understanding of the fatigue behavior of helicopter rotor blades, both metallic and composite, the Eustis (VA) Directorate of the U.S. Army Air Mobility Research and Development Laboratory has developed new test procedures.

Initial efforts used a filament-wound multitubular spar OH-6 main rotor blade constructed of Kevlar. Results demonstrated that it was possible, using resonance testing techniques, to excite simultaneous flapwise and torsional bending.

This was done by driving the root end of the blade with a single closed-loop actuator operating with a mixed-mode signal—the signal being a mixture of the flapwise resonant frequency and the torsional resonant frequency. A pendulum, mounted 90° to the spanwise axis at the tip of the blade, was used to achieve realistic torsional moments.

Experimentation showed that amplitude of the blade for each mode (torsional or flapwise bending) could be changed without apparent effect on the other mode by adjusting the corresponding input signal amplitude.

This technique was demonstrated successfully with and without simulated centrifugal force applied. Maximum stress was produced at or near the root end of the blade, since the blade is subjected to cantilever bending.

Under flight conditions, the maximum stresses occur in the mid or outboard sections of the blade. Adjusting the stress to be correct at some outboard section of the blade, by using this technique, produces undue root end stress.

A new rotor blade fatigue test machine has been designed to compensate for the undue stress. Placed in operation at the Eustis Directorate, it insures more realistic simulation of flight conditions by providing the following capabilities: Centrifugal Force, 100,000 pounds (200,000 with larger bumper); Flapwise Bending Moment, 2 x $10^6$ inch-pound (function of blade stiffness) (11-kip actuator); Chordwise Bending Moment, function of blade angle of attack and stiffness; Torsion Force, ± 5,000 pounds; Blade Length—up to 25 feet; Blade Chord—up to 40 inches.

The system uses a 70-gallon-per-minute closed-loop hydraulic system designed by MTS Inc. The flapping moment is achieved by exciting the blade, which is pinned at both ends, in its resonant mode. Combinations of flapwise and chordwise moments are achieved by installing the blade at a predetermined angle of attack.

The centrifugal force is applied by a natural rubber bumper system with a relatively flat force-deflection curve. This assures that the blade stays in resonance as the effective length changes due to the curvature of the blade during bending.

The load frame, bumper and resonant system were obtained under contract from Sikorsky Aircraft Division of United Aircraft Corp. Torsion capability was designed and incorporated by personnel at the Eustis Directorate.

The torsion is applied by a separate actuator operating through a pitch bearing at the root end of the blade. This is a forced rather than a resonant system. The two load inputs (bending, torsion) are controlled through a series of load-following devices (Data-Traks).

Relative amplitudes and phase relationships are programable, thus providing total simulation of in-flight conditions at a given blade station.

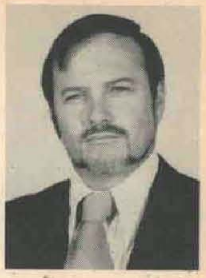
Studies are under way to determine the proper load levels and loading sequence to represent realistical service conditions; for example, it has been shown by the classic linear damage theory that the fatigue life calculations are sensitive to variations in maneuver levels as a function of air speed.

These and other factors will be evaluated experimentally on the new equipment. Initially, tests are being conducted on an AH-1G helicopter main rotor blade to evaluate procedures and correlation between flight and test stand results.

Bud Carper, who heads the Eustis Directorate's Structures area, summarizes the work being done:

"The equipment and test procedures developed by the directorate provide the Army with an up-to-date, unique capability for evaluating the fatigue behavior of helicopter rotor blades under representative flight load conditions.

"As new materials and blade design concepts evolve, they can be realistically evaluated by the Army prior to any production commitment. Further, the development of improved testing could result in fewer problems in the field."



*I. E. FIGGE SR. has been employed with the Eustis (VA) Directorate, U.S. Army Air Mobility R&D Laboratory (USAAMRDL), since 1968, and with NASA-Langley (VA) Research Center during 1956-68. Figge graduated from the Georgia Institute of Technology with a BA degree in aeronautical engineering (1960) and holds six patents. He has authored many structural design concept articles.*

# HDL Tests 60mm Mortar System Multioption Fuze

Options of firing for airburst, near-surface burst, impact detonation or delay burst are offered to mortarmen using a new fuze, the XM-734, being developed for the 60mm Company Lightweight Mortar System (CLMS).

The Harry Diamond Laboratories' development announcement reported that system verification tests at Aberdeen (MD) Proving Ground resulted in 99.3 percent "propers," exceeding all specified requirements.

This fuze is intended to replace several different fuzes in the U.S. Army inventory, the XM-734 reportedly offers advantages of simpler training requirements, increased safety and improved reliability. Incorporation of a fluidic sensor is said to assure a measure of safe air travel previously unavailable.

Coupled with the sensing of firing acceleration, the fluidic sensor initiates the arming action. Back-up functions built into the circuitry are expected to provide increased reliability. Tests last November at Hurricane Mesa, UT, integrated the fuze for the first time with the newly designed shell, tube and improved propellant of the CLMS. All four option modes were demonstrated.

The XM-734, HDL reported, "may be the first ordnance materiel to possess CMOS (complementary metal oxide semiconductor circuits). This circuitry requires little energy to operate yet provides increased reliability within a smaller volume and at an ever-decreasing price." The XM-734 conceivably can be designed to be compatible with the 81mm mortar system.

Additional fuzes are being procured for DT II tests and type classification of the XM-734 is scheduled for 1976.

## Chinook Shows Capability

Flying over the Amazon jungle region in Brazil and the Andes Mountains, a Boeing CH-47C Chinook recently became the first helicopter to cross the South American continent from coast to coast.

Upon its return late in August to Boeing Vertol's manufacturing facility in Philadelphia, the CH-47C had demonstrated its capabilities in flying at an elevation of 12,507 feet, performing a landing on Lake Titicaca for Peruvian Army personnel, and on the Amazon for Brazilian officers.

Demonstration flights were made for government officials and military officers in Venezuela, Columbia and Ecuador. A 14,000-pound truck was carried to an altitude of 9,300 feet in Ecuador and Boeing Co. reported a downed 19,000-pound B-57 Canberra bomber was airlifted 20 miles in Peru.

# Conferences & Symposia . . .

## Foreign Interest Shown at Natick DC In Meet on Waste Conversion System

Widespread interest in potential applications of enzymatic conversion of cellulosic waste materials into energy-rich foods, nonpolluting fuels and scarce-supply chemicals was shown, nationally and internationally at a Sept. 8–10 symposium.

Sponsored jointly by the U.S. Army Natick Development Center and the Advisory Board on Military Personnel Supplies of the National Research Council, National Academy of Sciences (NRC/NAS), Washington, DC, the symposium drew about 325 attendees. The enzymatic conversion process concept and technology were developed by the Natick DC.

Among scientists, engineers and administrators from U.S. Government agencies, industry, academic institutions, and other organizations, were about 40 foreign representatives.

Under Secretary of the Army Norman R. Augustine, who recently assumed that title after serving as Assistant Secretary of the Army (Research and Development), gave the keynote address on "Technology Transfer from Military Requirements to Public Need." Margaret M. Heckler, U.S. House of Representatives, spoke on "Energy—Innovative Solutions."

Presentations during the 3-day meeting focused on the state-of-the-art of production of cellulase, the enzyme used in the conversion process; also, the technical methods to convert cellulose in wood pulp, such as waste paper, and cotton products, to glucose as a base for human and animal foods as well as numerous other derivatives.

Natick DC Commander COL Rufus E. Lester Jr. welcomed participants after opening remarks by Dr. Elmer L. Gaden Jr., dean of the College of Engineering, Mathematics, and Business Administration, University of Vermont. Natick DC Technical Director Dr. Dale H. Sieling was the dinner MC.

*Technical Session I,* Cellulase Production, was chaired by Dr. Elwyn T. Reese, consultant to the Natick DC, and featured staff members of the center. Dr. Mary H. Mandels, research microbiologist credited with a major role in developing the enzymatic process, spoke on Measurement of Saccharifying Cellulase. Other speakers were Dr. David C. Sternberg, an NRC/NAS research associate, Production of *Trichoderma Viride* Cellulase, and Dr. John M. Nystrom, Pilot Plant Investigations and Economics of Cellulase Production.

Along with Dr. D. E. Brown, University of Manchester, Institute of Science and Technology, England, Dr. Arnold L. Demain, Massachusetts Institute of Technology, and Dr. Tah-Mun Su, General Electric Co., the session chairman and speakers participated as panel members for a discussion.

*Technical Session II,* Saccharification Technology, was chaired by Dr. Mandels. Speakers included Dr. Ellis B. Cowling, professor of Plant Pathology and Forest Resources, North Carolina State University, whose topic was Physical and Chemical Constrains on the Hydrolysis of Cellulose and Lignocellulosic Materials; and Dr. Merrill A. Millett, Forest Products Laboratory, U.S. Department of Agriculture, who discussed Physical and Chemical Pretreatments for Enhancing Cellulose Saccharification.

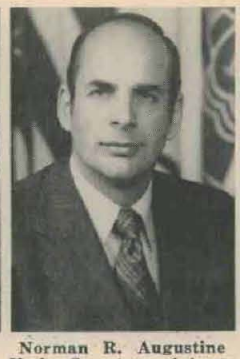
Economics of Saccharification was the topic of Dr. Charles R. Wilke, professor, Department of Chemical Engineering and Lawrence Berkeley Laboratory, University of California. Cellulosic Substrates for Enzymatic Saccharification was discussed by Dr. Robert K. Andren, Natick DC.

Panel members for a general discussion were the speakers complemented by Dr. Dixon E. Brandt, Stone and Webster Engineering Corp., Dr. John L. Fitzjohn, E. I. DuPont DeNemours & Co., Inc., and Dr. Nobuo Toyama, Japan.

*Technical Session III.* Chaired by Leo A. Spano, chief, Pollution Abatement Division, Food Sciences Laboratory, Natick DC, this session was a discussion of Raw Material Sources. Timber Wood Residue and Wood Pulp as Sources of Cellulose was the subject of Dr. Robert N. Stone, chief forest economist, USDA Forest Products Laboratory.

Dr. James H. Sloneker, research leader, Physical Properties and Composition Research, Cereal Properties Laboratory, Northern Regional Research Laboratory, ARS, USDA, spoke on Agricultural Residues Including Feedlot Wastes.

Leo A. Spano
Natick DC



Norman R. Augustine
Under Secretary of Army

Dr. Mary H. Mandels
Natick DC

Municipal Wastes Including Commercial and Industrial Wastes was the topic of J. Robert Halloway, environmental engineer, Resources Recovery Division, Solid Waste Management Office, U.S. Environmental Protection Agency.

The Potential of Food Processing Solid Wastes as a Source of Cellulose for Enzymatic Conversion was presented by Jack L. Cooper, assistant to the director, Agricultural and Environmental Affairs, National Canners Association.

Session speakers served on a panel for general discussion, along with Wayne F. Carr, Urban Wood and Fiber Products Inc., and Samuel Hale Jr., SCA Services Inc.

*Technical Session IV,* Applications. Dr. Elmer L. Gaden Jr. chaired this session, climaxed by a panel discussion featuring the speakers, complemented by William G. Allen III, Miles Laboratories Inc., and Dr. Dwight L. Miller, Northern Regional Research Laboratory, ARS, USDA.

Cellulose Saccharification as an Alternative Source of Glucose for Commercial and Food Use was presented by Dr. Albert L. Elder, consultant. Dr. Donald B. Seeley, assistant director, Fermentation R&D, Pfizer Central Research, spoke on Uses for Saccharified Cellulose in the Fermentation Industry.

Chemicals from Lignocellulose was the subject of Dr. Irving S. Goldstein, professor and head, Department of Wood and Paper Science, School of Forest Resources, North Carolina SU.

The Symposium closed with a 3½-hour workshop chaired by Dr. Gaden. Participants were also provided the opportunity to tour the enzymatic conversion process pre-pilot plant at the Natick DC. The pre-pilot plant has been in operation more than a year and hopefully will be scaled up to a full pilot plant capable of processing about 3 tons per day of cellulose waste products.

Based upon further technology advances—including processing time and cost decreases to establish economic feasibility of the system—the long-range goal is much larger enzymatic conversion processing plants that will turn millions of tons of waste annually throughout the nation into profitable products —and help solve energy and environmental pollution problems.

## AMMRC Hosts Nuclear Blue Ribbon Panel Meet

Discussions and presentations during a Blue Ribbon Panel Meeting on the M–422 Nuclear Projectile Development Program brought together more than 30 scientists, engineers and administrators of Department of Defense agencies at Watertown, MA, Army Materials and Mechanics Research Center.

The AMMRC Materials Application Division is involved in the M–422 modification program in a coordinated effort with the Nuclear Weapons Group of Picatinny Arsenal at Dover, NJ. Over-all materials responsibility is assigned to the AMMRC, including assessment, prototype component modification, materials and process development, prototype processing, and test shells fabrication.

Materials involved in the M–422 program include depleted uranium, titanium, steel, beryllium and aluminum alloys. Processing includes casting, extrusion, forging, plating, thermal treatment, tape control machining, and testing. The center has a completely integrated processing capability.

## NDC Hosts Armed Forces Food Meet

Technology advances in preparing, preserving and packaging foods will be reported in technical papers presented at the Third International Meeting on Foods for the Armed Forces at the U.S. Army Natick Development Center, Oct. 14–17. Representatives of eight nations had registered at press time.

Scheduled for the keynote address is MG John C. McWhorter Jr., former commander of the Natick (MA) Laboratories (now the Natick DC), currently serving as deputy director for Logistics (Strategic Mobility), Office, Joint Chiefs of Staff.

Delegates from the United States will include food and logistics experts from all the Armed Services, including Dr. Edward Anderson, special assistant for the Department of Defense Food Program and U.S. coordinator of the conference. Natick DC is assigned DoD responsibility for the program.

Foreign representation committed by registration at press time included food experts from West Germany, Denmark, Great Britain, Sweden, The Netherlands, Canada and Belgium. One of the top notables who will participate is Dr. E. W. Hellendoorn, Central Institute for Nutrition and Food Research, The Netherlands.

Among distinguished U.S. food experts who will be featured on the program are Dr. Marcus Karel, Massachusetts Institute of Technology, and Dr. Jean Mayer of Harvard University.

## 300 Participants to Consider 'Real Army Problems'

Operations research technology applications in support of U.S. Army manpower, training, acquisition of materiel, logistics and combat tactical capabilities will be considered by about 300 OR practitioners at the 14th annual Army Operations Research Symposium.

GEN John R. Deane Jr.

Scheduled Nov. 18–20 at Fort Lee, VA, under joint sponsorship of the U.S. Army Logistics Center and the U.S. Army Quartermaster Center for the second consecutive year, AORS XIV is being arranged by the Army Materiel Systems Analysis Activity (AMSAA), directed by Dr. Joseph Sperrazza. Cohosts are USALC Commander MG Erwin M. Graham Jr. and USAQC Commander MG Dean Van Lydegraf.

"Operations Research—Applications to Real Army Problems" is the theme of the symposium. GEN John R. Deane Jr., commander, Army Materiel Command, is programed for the keynote address. Following him on the podium will be GEN William E. DePuy, CG, Army Training and Doctrine Command.

BG S. L. A. Marshall (USA, Ret.) has accepted an invitation to give the banquet address. Army deputy chief of Information when he retired in 1960, BG Marshall is author of many books on military history and a noted lecturer at U.S. and foreign military schools.

More than 150 proposals to present technical papers had been received at *Army R&D Newsmagazine* press time.

## Edgewood Announces Technical Conference

About 250 scientific and technical personnel of the U.S. Armed Services, other U.S. Government agencies and invitees from Great Britain, Canada and Australia are expected to take part in Edgewood Arsenal's seventh semiannual Technical Conference, Nov. 11-12 at Aberdeen (MD) Proving Ground.

Invitees will include members of the British and Australian Embassy R&D staffs in Washington, DC, and the Canadian Defence Research Establishment. U.S. Government agencies expected to participate are the Arms Control and Disarmament Agency, Central Intelligence Agency, Defense Intelligence Agency, Public Health Agency and Environmental Protection Agency.

In competition for awards for "Best Research Paper" and "Best Engineering Paper," about 45 arsenal personnel will make technical presentations.

## AMMRC Programed for Role in 3 Major Conferences

Three major scientific meetings in a 3-week period during September will involve a substantial number of key personnel of the U.S. Army Materials and Mechanics Research Center, Watertown, MA, beginning with the 22d annual Sagamore Army Materials Research Conference.

Themed on the Application of Fracture Mechanics to Design, the Sagamore meeting is scheduled Sept. 9–12 at the Syracuse University Conference Center at Racquette Lake, NY. From 90 to 100 invitees are expected to take part in sessions on Test Methods; Pressure Vessels; Structures; Rotating Components; and Nondestructive Testing and Failure Analysis.

AMMRC Associate Director Dr. J. J. Burke is the conference chairman. The program committee includes experts from industry, academic institutions, the National Aeronautics and Space Administration, U.S. Air Force and the Army.

*Army Materials Technology Conference.* This fourth annual gathering, Sept. 16–19 in Boston, is planned for 150 to 200 specialists to discuss Advances in Joining Technology. AMMRC Director Dr. A. E. Gorum is chairman of the conference committee and Dr. J. J. Burke is program director.

The focus is on applicable developments in the art of joining metals, ceramics, polymers and composites. Consideration also will be given to the impact of joining methods on design concepts.

*Missile Manufacturing Technology.* This conference at Hilton-Head Island, SC, Sept. 22–26 will be cohosted by the Army Materiel Command and the AMMRC.

AMC Director of Research, Development and Engineering BG Harry A. Griffith is the conference director and AMMRC Director Dr. Gorum is cochairman. From 200 to 300 Army and industrial missile experts will consider the state-of-the-art and areas of desired technological advances to reduce missile systems acquisition costs through improved manufacturing and design methods.

## Suggestion Points to R&D Interface Possibilities

Professional societies should be used to serve the interest of a more effective interface between industry and the military establishment in exchange of technical information beneficial to the acquisition process for weapon systems and other materiel.

John F. X. Mannix, chief, Technical and Industrial Liaison Office (TILO), U.S. Army Electronics Command, Fort Monmouth, NJ, presents this view to the *Army Research and Development Newsmagazine* in a proposal that full publicity be given to exploit the potential of this information exchange.

In his opinion, this approach could prove one of the most mutually beneficial of all avenues of communication between the military and industry. A review of personnel at every military installation, academic institution and industrial contractor serving the Department of Defense, Mannix contends, would show that many engineers, scientists and managers are members of one or more professional societies.

Mannix suggests that the charters or mission statements of many of the professional societies, both specialized and general, could be revised to stress effort toward fostering exchange of information that would be in the interest of communicating plans, policies, procedures, and materiel acquisition objectives of the Department of Defense.

Professional societies, he points out, have numerous specialized working groups that conduct workshops and seminars on the state-of-the-art in various scientific and technological areas. Many of the groups work jointly with or conduct various tasks for the Department of Defense. ECOM personnel, for example, hold more than 1,000 memberships in non-federal technical societies and associations.

Conferences, symposia and working group sessions of professional scientific, engineering and management societies could be used, Mannix states, to serve the interest of maintaining interface between Defense Department agencies and industry. Speakers could explain materiel acquisition plans, goals and procedures; also, the possibilities of broadening understanding and participation to accomplish objectives at the lowest practicable cost.

# Awards . . .

## SARS Fellowships . . .

### *3 Army Scientists Win Year of Foreign Study*

Mrs. Miriam H. Thomas

Dr. Leonce E. Harris

Dr. Donald R. Messier

Secretary of the Army Research and Study Fellowships awarded recently to three scientists recognize achievements and potential for future important R&D assignments.

SARS Fellowships enable carefully selected Army civilian employes to perform research studies, on specific projects of potential military application, for one year at locations in the United States or abroad. The new recipients are:

*Mrs. Miriam H. Thomas*, a GS–13 research chemist at the U.S. Army Natick (MA) Development Center (NDC). She plans and directs comprehensive and detailed studies and laboratory projects designed to assure nutritional adequacy of military rations. She has served as a consultant to industry, universities and other government agencies.

Her SARS project is designed to expand her perspectives relative to nutrient analyses of foods and nutrient losses during processing. Scheduled to visit several countries, she will study techniques for determining food nutrient values.

Mrs. Thomas plans observation and studies at the National Food Research Institute, Tokyo, Japan; the Central Food Technological Research Institute, Mysore, India; the Institute of Nutrition, Moscow, USSR; the Central Institute for Nutrition and Food Research, Zeist, Netherlands; and the Institute de Nutricion de Centro America y Panama, Guatemala.

Author of more than 30 publications, Mrs. Thomas has a 1940 BS degree in nutrition and chemistry from Bennett College, and a 1942 MS degree in food chemistry from the University of Chicago. She has served as a chemist at the Quartermaster Food and Container Institute, IL, and as a research assistant, University of Chicago.

A Department of the Army nominee for the 11th, 12th and 13th Annual Federal Women's Awards, she is a member of the Association of Vitamin Chemists, the American Association for the Advancement of Science, and the Society for Nutritional Education.

Mrs. Thomas serves as a consultant for the Foods Research Laboratories, Inc., Boston, MA, and is a visiting faculty lecturer for the Department of Nutrition and Food Science, Massachusetts Institute of Technology.

*Dr. Leonce E. Harris* is a GS–12 research chemist at the Pitman-Dunn Laboratory, Frankford Arsenal, PA. His SARS project is considered to be of great significance in obtaining fundamental knowledge for development of new propellants.

Working in collaboration with Nobel Prize chemist Sir George Porter, Dr. Harris will conduct research at the Royal Institution of Great Britain's Davy Faraday Laboratory on the spectroscopy and photochemistry of nitro compounds.

Dr. Harris has BS and PhD degrees in chemistry from Louisiana State University. He served at LSU as an assistant professor, conducting research in molecular electronic spectroscopy relative to electronic structure and spectra of various nitro-containing molecules and ions.

Author of numerous technical papers, Dr. Harris took top honors for the best research paper presented in the "Basic and Applied Research" category at the first Frankford Arsenal Technical Symposium. He also won first and second place honors at FA's second technical symposium

*Dr. Donald R. Messier*, a GS–13 research ceramic engineer at the Army Materials and Mechanics Research Center, Watertown, MA, was a 1974 recipient of an Army Research and Development Achievement Award for his work in "Silicon Nitride for Gas Turbine and Random Applications."

Programed for the University of Leeds, England, his SARS project will be a comprehensive investigation of the alpha to beta phase transformation in silicon nitride. A determination will also be made of the topotactical relationships that may exist between these phases.

Justification for this research stems from the belief that it will aid the Army in meeting requirements for improved ceramic materials for applications such as turbine components, radar windows, and radomes. It may also provide insight into related ceramic fabrication problems.

Dr. Messier has a BS degree (cum laude) from Alfred University and MS and PhD degrees from the University of California, Berkeley, all in ceramic engineering. He has authored numerous technical articles and holds several patents. During 1964–68, he served as a research ceramic engineer at the Argonne National Laboratory.

## *MERDC Commander's Awards . . .*

### 4 of 33 Achievement Nominees Will Be Cited

Four winners out of a record 33 nominees for the annual Commander's Awards for MERDC achievements in science, technology, leadership, and administrative/technical support will be honored Oct. 2 at the Army Mobility Equipment R&D Center, Fort Belvoir, VA. *The winners, announced at press time, are indicated by boldface type.*

MG George Sammet Jr., Army Materiel Command Deputy CG for Materiel Acquisition, is programed as guest speaker.

The awards will be presented by Dr. K. C. Emerson, acting Assistant Secretary of the Army (R&D); Dr. Richard L. Haley, Army Materiel Command Deputy Director for Research, Development and Engineering; Manfred Gale, assistant director, Laboratory Activities, Office of the Deputy Chief of Staff for RDA, HQ DA; and MERDC Commander COL T. R. Hukkala.

**Gelini Medal.** Named in honor of a MERDC commander who died during his tour of duty, this award for *Technical and Administrative Support* will give judges a choice of nine nominees, as follows:

**J. C. Young**, for his work on second-stage developmental testing of the Multi-Leg Tanker Mooring System and Unloading Facility; *Marvin L. Priebe*, for contributions to FY 1974 procurements of high priority materiel; *Omer F. Long*, for expertise in counseling MERDC department and division chiefs; and

*Verna E. Kidwell*, for outstanding performance in conservation of petroleum fuels for MERDC and tenants; *Joseph P. Kennedy*, for work on a prototype waste water treatment pilot plant; *SFC Ronald W. Keller*, for support of Army commands in application of industrial gas equipment technology; and

*William H. Deavers*, for organizing craftsmen in his branch in efficient support through installation and equipment and utility systems for laboratories; *Hubert D. Bere*, for outstanding skill and judgment in managing the MERDC Computer Center; and *Erwin E. Baldridge*, for outstanding work in development of the new power supply and environmental equipment for integration into the SAM–D missile system.

**Leadership Award.** Eleven nominees are being considered for this award, namely: *Kenneth E. Hasle*, for work on complex major actions involving coordinated effort with all levels at the Army Materiel Command and HQ Department of the Army; *Herbert F. Freeman*, for direction of MERDC efforts to program reduced resources for accomplishment of high-priority projects; *Albert R. Zushin*, for his work in directing correction of deficiencies during development of the Joint Services Interior Intrusion Detection System; and

LTC Carl F. Trail, for his role as lead element manager in successful development of complex hardware items for the SAM–D system; *CWO Odis M. Smith*, for his work in implementing a cost accounting system and consolidation of a Central Test, Measuring and Diagnostic Equipment Pool; *Billy*

*J. Slinger,* for managerial excellence on the Commercial Construction Equipment Program; and

*James E. Montgomery,* for his role in successful test demonstration of the feasibility of a high-performance turbine engine for a 3kw generator set, and engineering design of a 30kw 50/60 Hz TB generator set to meet Department of Defense requirements; *James E. LeViner,* for his role in accomplishing MERDC's multimilhon dollar materiel procurement program;

*Robert A. Jordan,* for his direction of complex automating processing of technical documentation for scheduled and urgency requirements for competitive quantity procurements; *Martin E. Falk,* for outstanding performance in representing MERDC in multimillion dollar procurement of Ribbon Bridge equipment; and *Max P. Whitford,* for supervisory excellence as leader of the Climatic Test Branch, as reflected in Department of Defense use of its facilities.

**Technological Achievement.** Six nominees for this award are LTC Vincent J. Ciccone, for the concept, design and evaluation of a pilot plant for munitions wastewater treatment, resulting in design criteria for construction of a full-scale facility; *Harry H. Ellis,* for ingenuity in visual display of a program to provide the Army logistician with an invaluable tool for materiel distribution control; and

*Peter J. McConnell,* for contributions to characterizing and identifying tactical military targets in terms of nonlinear response, including a mathematical model of detection systems; *R. Brooks White,* for work on the concept, design, assembly and application of a laser power supply; *Francis M. Cevasco* and *Otis R. Pannell,* for ingenious creativity in contributions toward producing air-deployable tankship mooring and unloading facilities for containerized cargo delivery.

**Scientific Achievement.** Seven nominees for this award are *Dr. Jay A. Fox,* for research and analysis of short-pulsed and continuous-wave laser effects on metals, plastics and coatings, thereby significantly advancing the state-of-the-art; *Dr. David C Heberlein,* for contributions to the understanding of solid-state properties of trinitrotoluene and their significance in establishing mine ordnance vulnerability; and

Dr. Johann A. Joebstl, for catalytic surface research, including adsorption of carbon monoxide and oxygen on platinum surfaces, and tests showing correlation between selected heterogenous and electrocatalytic reactions; *Edward C. Russell,* for achievements in recognizing potential seriousness of petroleum-derived, water-soluble organic materials as pollutants, and evolving techniques to measure the pollutants; and

*Arthur B. Follansbee, Ashok S. Patil* and *James M. Dillon,* as a team, for research leading to an experimentally verified numerical solution for 3-dimension fluid flow in a vortex tube, providing a basis for optimizing design of inertial separators and other conducted flow applcations.

## *Sally Clements Wins Top Award, GS-16 Promotion*

Mrs. Sarah (Sally) W. Clements, assistant chief, Office of Project Management, HQ U.S Army Materiel Command, is one of six Department of Defense employes honored recently during the 20th annual presentation of the Decoration for Distinguished Civilian Service.

*(Civil Service Commission confirmation of her promotion to GS–16 supergrade status in a new position as assistant deputy for Materiel Acquisition to Harold L. Brownman, Assistant Secretary of the Army (Installations and Logistics) was announced at press time. Available records indicate she is the first Federal Civil Service career woman to achieve this status in the Department of the Army.)*

The first woman in the Army Materiel Command to achieve GS–15 grade, more than a decade ago, Mrs. Clements was cited specifically for her contributions to the efficiency, effectiveness and economy of system/project management operations of the AMC. Her responsibilities have involved organization and procedures for management of more than 40 major Department of the Army materiel acquisition programs.

Six women have been honored during the annual presentation of the Department of Defense Distinguished Civilian Service Award since the program was initiated in 1955 and all have been Department of the Army employes.

Other 1975 recipients are Richard G. Bruner, executive director, Technical and Logistics Services, Defense Supply Agency; Joseph J. Liebling, Deputy Assistant Secretary of Defense (Security Policy), Office of the Assistant Secretary of Defense (Comptroller); and

Billy J. Miller, deputy chief, Engine Item Management Division, Air Force Logistics Command; Dr. William W. Murray, associate technical director for Structures, Naval Ship R&D Center; and John Shada, director of International Logistics, Office of the Deputy Chief of Staff for Logistics, DA.

## *APG Suggestion Sets Record . . .*

## Audiologist Earns $2,500, Cuts Hearing Loss

The largest individual suggestion award presented at Aberdeen Proving Ground, MD, since the initiation of the Army Incentive Awards Suggestion Program was made recently to Dr. Doug Ohlin.

An audiologist with the Bio-Acoustics Division of the U.S. Army Environmental Hygiene Agency, Edgewood Arsenal area, he received a $2,500 check. His adopted suggestion involved design of a device to assist in the insertion and seating of the single-flange (V51R) and triple-flange (Comfit) earplugs, used to reduce loss of hearing in gun firing or other extremely noisy working conditions.

Since World War II, the Department of Defense has spent millions of dollars each year in compensation for hearing loss disability. Sixty-one million dollars were paid out during 1975 for hearing loss and Dr. Ohlin's device is expected to aid in reducing claims.

Dr. Ohlin was recently awarded $1,000 for a suggestion involving the color coding of earplugs according to size, as a further aid to proper fitting. He has been in federal Civil Service for three years and is chief of the Hearing Conservation Branch, Environmental Hygiene Agency.

Dr. Ohlin received his BS (cum laude) from Towson State College and MA and PhD degrees from Ohio State U.

## PMIAs Recognize 4 DoD Personnel, Activities

Presidential Management Improvement Awards (PMIA) presented by Secretary of Defense James R. Schlesinger on behalf of President Ford recently recognized four Department of Defense personnel and organizations.

*Meyer Lepor,* U.S. Naval Undersea Center, San Diego, CA, was cited for his contributions to design changes to the acoustic barrier of the SSN 688 Class submarine which saved the Navy $7.7 million.

*CPT John M. Wolff,* U.S. Naval Air Rework Facility, Alameda, CA, was credited with effecting operational changes responsible for validated savings of $9 million. His actions included paperwork reduction programs, changes in procurement services, and consolidation of functions.

*SMSG Xavier F. Corlis* (USAF, Ret.) received a PMIA for $2.9 million cost reduction achievements. He was cited for his efforts in meeting DoD requirements for deuterium (D2) while serving at USAF Weapons Laboratory, Kirtland AFB, N.M.

*The Fourteenth Aerospace Force, Aerospace Defense Command,* Ent AFB, CO, was recognized for saving $1.3 million through improved system efficiency, reduced manpower requirements, and establishment of a single management responsibility for their missile warning system.

## ACC Employes Cited for Outstanding Achievements

Secretary of the Army Awards for Outstanding Achievement in Materiel Acquisition have recently honored John S. Bezner and Wayne A. Wesson, operations research analysts in the Comptroller Office, U.S. Army Communications Command (USACC), Fort Huachuca, AZ.

Cited specifically for 1973 decision-risk analysis achievement, they were recognized for performance as course directors and consultants at the U.S. Army Logistics Management Center. USACC Comptroller William F. Mills made the awards.

Army Materiel Command Commander GEN John R. Deane Jr. approved their nomination, in which they were praised for "exemplary initiative and originality" on development of the Hawk and Lance Missile Systems, and the Remotely Monitored Battlefield Sensor System.

# Personnel Actions . . .

## Hoffmann Succeeds Callaway as Secretary of Army

Martin R. Hoffmann
Secretary of the Army

Secretary of the Army Martin R. Hoffmann, Department of Defense General Counsel since March 1974, assumed duties of his new office after Aug. 5 swearing-in ceremonies.

Hoffmann enlisted in the U.S. Army in 1954 and was graduated in 1955 from Officer Candidate School at Fort Sill, OK. He is a former "Screaming Eagle," having served with the 101st Airborne Division, Fort Campbell, KY, during 1956–58.

Graduated from the University of Virginia Law School and Princeton University, Hoffmann began his federal government career as a law clerk to Judge Albert V. Bryan of the U.S. Court of Appeals, and served briefly as minority counsel for the House Judiciary Committee.

Other key assignments have included Assistant U.S. Attorney, legal counsel for Illinois Senator Charles H. Percy, special assistant to the Secretary and Deputy Secretaries of Defense, and general counsel, Atomic Energy Commission.

Hoffmann has encouraged all civilian and military Army personnel to make a "lasting contribution" to the nation's future by assuring that traditional institutions "remain relevant and vital."

"As I assume my duties as your new Secretary," Hoffmann commented, "I am mindful of the Army's 200 years of proud heritage and service to this country. I am also aware of the many tough challenges that lie ahead for us."

A long-standing advocate of the All-Volunteer Army, Hoffmann has noted, "that the Army must be not only modern lean, and ready for combat, but bold, imaginative, and inventive as well. . . . Our goal will not only be to meet the challenges of the future, our goal, in action and example, will be to excel. . . . I ask you to join me in this 200th year in rededicating ourselves to our past and to our future."

## McKeen Returns to TACOM to Take Command

MG C. M. McKeen

MG Chester M McKeen, who recently concluded three years of duty as director of Requirements and Procurement, HQ U.S. Army Materiel Command, is the new commander of the Army Tank-Automotive Command (TACOM), Warren, MI.

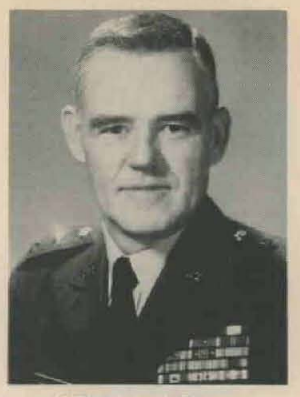
Graduated from Officer Candidate School in 1943, MG McKeen has a bachelor's degree in military science from the University of Maryland, a master's degree from Babson Institute, and is a graduate of the Army Command and General Staff College and the Industrial College of the Armed Forces.

MG McKeen served at TACOM in 1971 as director of Procurement and Production, and in 1972 from August to November was deputy commander. While assigned to AMC, he was Army program manager for Tank Production Acceleration.

Other key assignments include: commander, U.S. Army Procurement Agency, Vietnam; director of Materiel Acquisition, Office, Deputy Chief of Staff for Logistics, DA; and Army representative to the Arms Control and Disarmament Agency.

Among his military honors are the Legion of Merit with two Oak Leaf Clusters and Army Commendation Medal (OLC).

## Graves Named Engineers' Civil Works Director



MG Ernest Graves

MG Ernest Graves, former director of Military Application, U.S. Energy Research and Development Administration, has succeeded MG John W. Morris as director of Civil Works, Army Corps of Engineers.

A 1944 graduate of the U.S. Military Academy. MG Graves has a PhD in physics from the Massachusetts Institute of Technology. He has completed courses at the Army Engineer School, Army Command and General Staff College, Army War College and the Naval Postgraduate School.

Key assignments in recent years have included commander, 34th Engineer Group, Vietnam; Eighth Army Headquarters, Japan; Supreme Headquarters, Allied Powers Europe; deputy district engineer, Los Angeles; research associate, Lawrence Radiation Laboratory.

MG Graves is a recipient of the Distinguished Service Medal, Legion of Merit with Oak Leaf Cluster (OLC), Army Commendation Medal with three OLC, and Air Medal (OLC).

## Tobiason Takes Over as WSMR Commander

MG Orville LeRoy Tobiason, chief of staff of Allied Land Forces in Southeastern Europe since 1973, has assumed new duties as commander of White Sands (NM) Missile Range, following the retirement of MG Robert J. Proudfoot.

A veteran of almost 30 years of active military service, MG Tobiason has attended the Army Command and General Staff College, Armed Forces Staff College, and the National War College.

Among his previous assignments are chief of staff for Operations, Eighth U.S. Army Headquarters, Korea; director of the Field Artillery Materiel Test Directorate, U.S. Army Test and Evaluation Command, Aberdeen (MD) Proving Ground; and commander, 52d Artillery Group, Fort Sill, OK.

His military awards and decorations include the Legion of Merit with three Oak Leaf Clusters (OLC), Bronze Star Medal, Air Medal with four OLC, and the Army Commendation Medal with OLC.

## Adams Assumes Duties as USACSC Commander

BG Walter E. Adams

BG Walter E. Adams, former deputy commander of the U.S. Army Computer Systems Command (USACSC), Fort Belvoir, VA, has succeeded BG (MG designate) Paul T. Smith, as USACSC commander.

Graduated in 1950 from the U.S. Military Academy, BG Adams has a master's degree in international affairs from George Washington University. He has completed the Army Command and General Staff College, Armed Forces Staff College, National War College.

Key assignments have included commander, 1st Armored Division, Europe; special assistant to the Director of Management Systems, Office of the Army Assistant Vice Chief of Staff, Washington, DC; and troop command and staff positions in Southeast Asia.

BG Adams is a recipient of the Silver Star, Legion of Merit with two Oak Leaf Clusters (OLC), Distinguished Flying Cross, Bronze Star Medal with "V" device and two OLC, Air Medal (27 awards), Army Commendation Medal with OLC, and Purple Heart with two OLC.

## Berry Selected Deputy DDR&E (Policy & Plans)

Appointment of Robert E. Berry as Deputy Director (Policy and Planning), Office of the Director of Defense Research and Engineering, a newly created position, was announced Aug. 12 by Secretary of Defense James R. Schlesinger.

Berry will consolidate research and development portions of the Five-Year Defense Program; develop procedures for review and approval of individual programs; analyze proposed contracts; develop and recommend procurement and contracting procedues to reduce costs; and recommend policies and procedures to improve equipment.

Graduated with a BS degree in general science from Manhattan College in 1953, Berry has a 1958 MA degree in economics and industrial relations from U. of Pennsylvania.

During 1969-75, he was president and chairman of the board of IRT Corp. and managing partner of R. D. General Corp. Other assignments have included vice president of NavSat Systems, Inc., and instructor at the U. of Pennsylvania.

## Clarke Becomes Deputy Commander of TECOM

BG Frank P. Clarke

BG Frank P. Clarke, former assistant deputy chief of staff for Combat Developments, U.S. Army Training and Doctrine Command, is the new deputy commander of the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, MD.

Graduated from the U.S. Military Academy in 1949, BG Clarke holds an MS degree in engineering science from Purdue University. He has attended the Armed Forces Staff College and the Army Command and General Staff College.

During more than 27 years of Army service, BG Clarke has commanded in more recent assignments the 9th Support Battalion, 198th Infantry Brigade, Fort Hood, TX, and served as assistant chief of staff, G–4, Americal Division, Vietnam.

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

## Kurtz Becomes USAETL Commander/Director

COL M. K. Kurtz Jr.

COL Maurice K. Kurtz Jr., new commander and director, U.S. Army Engineer Topographic Laboratories (ETL), Fort Belvoir, VA, recently completed duty as director of the Defense Mapping School.

During his tenure the DMS evolved from a U.S. Army Engineer School instructional department into a DoD agency.

COL Kurtz has served as an R&D coordinator at what is now the Army Mobility Equipment R&D Center, in the Office of the Chief of Engineers, at HQ U.S. Army Materiel Command, and as director, U.S. Army Engineer Nuclear Cratering Group, a research activity.

Graduated from the U.S. Military Academy in 1949, COL Kurtz has an MS degree in structural dynamics from the University of Illinois (1955) and a PhD in photogrammetry from Purdue University (1971). He completed the U.S. Army Command and General Staff College, the U.S. Army War College and the Industrial College of the Armed Forces.

COL Kurtz is chairman of Working Group V/3 (Metric Aspects of Nonconventional Imageries) of the International Society of Photogrammetry. He has received the Toulmin Medal from the Society of American Military Engineers, and the Bausch and Lomb Photogrammetric Award.

## Wray Assigned as Assistant Chief of Engineers

Assistant chief of Engineers, Office of the Chief of Engineers (OCE), Department of the Army, is the new title of BG (MG designate) William R. Wray, following service as director of Facilities Engineering, OCE, Washington, DC.

Graduated from the U.S. Military Academy, he has a master's degree in civil engineering from Texas A&M College, and has completed the National War College course. He is a registered professional engineer in the District of Columbia.

BG Wray served during 1967 as commander of the 169th Engineer Construction Battalion, Vietnam, and in 1968 was assigned to the Safeguard Systems Command, Huntsville, AL. In 1971 he served in the Systems Directorate, Office of the Assistant Chief of Staff for Force Development.

His military honors include the Legion of Merit with two Oak Leaf Clusters (OLC), Bronze Star Medal with OLC, Meritorious Service Medal, and Air Medal with OLC.

## Meekison Takes Watervliet Arsenal Command

COL M. V. Meekison

COL Malcolm V. Meekison, since 1973 director of Military Planning and Force Development at the U.S. Army War College, Carlisle Barracks, PA, is the new commander of Watervliet Arsenal, NY.

Graduated in 1955 from the U.S. Military Academy, he has an MS degree in engineering science from Purdue University and has completed the Army Command, General Staff College, and Army War College.

His service record shows assignments in recent years as chief of Range Operations, Kwajalein Missile Range; commander, 5th Maintenance Battalion, Vietnam; and assistant chief of staff for Supply and Services, U.S. Army Support Command, Vietnam. He holds the Legion of Merit, Bronze Star Medal, Meritorious Service Medal, and Army Commendation Medal (2 OLC).

## McGregor Succeeds Einsel as HDL Commander

COLS Einsel & McGregor

More than five years duty as commander and director of the Harry Diamond Laboratories ended Sept. 12 for COL David W. Einsel Jr. when he turned over responsibility to COL Thomas McGregor.

COL Einsel's new assignment is chief, Chemical and Nuclear Office, Office of the Deputy Chief of Staff for Operations, Department of the Army. After serving as HDL leader from June 1970, he departed with a record of a longer assignment than any of HDL's seven commander/directors.

COL McGregor moved to his new duties from an assignment since 1974 in the Office of the Assistant Secretary of Defense (Intelligence, Reconnaissance and Surveillance). Graduated from the U.S. Military Academy in 1953, he has an MS degree in electrical engineering from the University of Arizona and an MS in physics from the West Texas College.

COL McGregor was assigned to duty in Korea after graduating from the Military Academy and he served in Vietnam as G3 adviser to the 23d Infantry Division during 1966–67.

Other assignments have included 1967–72 duty with the Defense Intelligence Agency and later with the U.S. Army Security Agency. He commanded the U.S. Army Field Station in Berlin, Germany, during 1972–73 and then served with the Office of the Chief of Research and Development, HQ DA.

COL McGregor graduated from the Army Command and General Staff College in 1966 and from the National War College in 1975. Among his military decorations are the Legion of Merit with two Oak Leaf Clusters, Air Medal with OLC, Meritorious Service Medal, Army Commendation Medal.

# Advancing the State of the Art in Test Instrumentation

**By William B. Milway**

Advanced instrumentation and test methodology, including numerous specially developed measurement devices, are essential to accomplishment of the mission of the U.S. Army Test and Evaluation Command.

Headquartered at Aberdeen Proving Ground, MD, TECOM is the principal test and evaluation agency of the U.S. Army Materiel Command. Frequently, TECOM successes are attributable substantially to new equipment conceived and developed by its Research and Development of Instrumentation (RDI) Program, directed to solving particularly difficult test problems through instrumentation development or improvement.

Specific test difficulties handled in the RDI Program generally originate at TECOM agencies when instrumentation currently available proves incapable of providing the precise measurement required in a materiel test to validate specified performance.

An RDI task is then established by the test agency to develop and fabricate an instrumentation system to perform an adequate test and evaluation. Criteria essential to establishment of an RDI task include: 1) that the problem cannot be solved by "off-the-shelf" instrumentation, and 2) the goal is development of a suitable prototype system.

Recent examples of RDI tasks directed to solving specific test problems include: several types of devices to measure gunner aiming error through electronic and visual techniques at Aberdeen PG and Yuma PG; automatic infrared and optical measuring systems at the Army Electronic PG and at White Sands Missile Range, NM; an integrated hazards classification facility at Dugway PG; and a radar system at the Air Defense Board, Fort Bliss, TX, which measures the vector miss-distance of 20mm rounds fired at a towed aerial target. The latter system is at White Sands Missile Range.

Acquisition of increasingly complex weapons and equipment raises unique and difficult test problems. The TECOM RDI Program goal is to advance the state-of-the-art in testing so as to keep pace with military systems development.

PATS (Precision Aircraft Tracking System) was developed by White Sands Missile Range and Yuma Proving Ground.

*WILLIAM B. MILWAY, an electronic engineer with the Test and Evaluation Command (TECOM) Instrumentation Directorate, has been involved with testing and test instrumentation throughout his career.*

*He has designed automated test equipment at Westinghouse Electric Corp., conducted tests and supervised field instrumentation activities at Aberdeen Proving Ground. He now is involved with the technical management of TECOM's instrumentation resources, particularly the Research and Development of Instrumentation Program. Milway holds a BS from the Johns Hopkins University and an MSA degree from George Washington University.*

One advantage of headquarters management of the RDI Program is that interagency effort can be applied to problems at individual test agencies. TECOM has a wide variety of technical expertise resident at various locations which can be brought to bear on problems.

Recent mission changes at Yuma PG resulted in the need for more sophisticated aerial tracking capability. White Sands Missile Range, the leading national range developer of tracking instrumentation, assisted YPG by overseeing the development of a highly accurate laser tracker and a real-time cinethedoloite system. Such inter-agency cooperation is routine in the program.

Cooperation with non-TECOM agencies also has been common. TECOM worked with representatives of the Navy and Air Force to share development effort and expense on two state-of-the-art instrumentation radars—the AN/MPS-36 and the brand new AN/TPQ-39 Digital Instrumentation Radar (DIR).

TECOM is now participating in joint development programs with the Army's Combat Development Experimentation Center (CDEC) on portable position location reference stations, with Picatinny Arsenal on artillery tracking radar systems, and with the Naval Weapons Center on air-defense instrumentation.

Another RDI aspect that cuts across agency lines involves projects to improve the general capability of TECOM. These are tasks which tackle problems common to several TECOM test locations, but which may be beyond the resources of any one agency to solve.

A major current RDI effort is development of a Projectile Airburst and Impact Location System (PAILS). This is intended to aid testing at Jefferson, Aberdeen and Yuma Proving Grounds, and the Field Artillery Board.

PAILS is a radar-based tri-lateration system. Automatically and accurately, it will locate the point of impact or airburst of artillery and mortar projectiles in all weather conditions.

TECOM is obtaining technical advice for the PAILS program from the U.S. Army Electronics Command and the Harry Diamond Laboratories. Close coordination also is being maintained with the U.S. Army Armaments Command and interested agencies in the Army and Navy. Like most RDI tasks, PAILS is assigned to a specific TECOM test agency for technical management, Aberdeen PG in this case, and is accomplished through a combination of government and contractor effort. Tests of a prototype PAILS radar are in progress.

With daily pressures to improve test quality, and at the same time reduce cost and time, the RDI Program has demonstrated it can be a valuable tool for TECOM management. The comprehensive effort provides the maximum coordination and cross-fertilization of concepts for new or improved instrumentation. Program results are contributing to the quality of TECOM's most important product, the test report. This directly influences the utility, reliability and availability of military equipment in the field. In addition, spin-off from the technology thus created influences nonmilitary testing operations and advances instrumentation state-of-the-art.

# Army Contracts Order Helicopter Improvements

Efforts to advance the state-of-the-art of Army helicopter performance and maintainability are being extended through three contracts totaling $489,000 awarded by the U.S. Army Air Mobility Research and Development Laboratory, Moffett Field, CA.

Improved methods for removing sand, dust and destructive foreign objects from the inlet separators of gas turbine engines are being investigated by the Lycoming Division of AVCO Corp., under a 30-month $197,000 contract.

Specifications call for reductions in Army aircraft engine maintenance requirements and spare parts cost.

A $193,000 contract with Hughes Helicopter Co. to investigate a safer, less expensive helicopter landing gear involves a 2-year program to investigate the application of advanced structural materials to the development of a wheel-type landing gear. The goal is improved strength-to-weight ratio for better crash survivability, and a gear less costly and easier to manufacture than the conventional landing gear.

Development of an advanced computer analysis of rotor natural vibratory frequencies and rotor stability for the C-81 Rotorcraft Flight Simulation Program is specified in a $99,000 contract with Bell Helicopter Co.

Capabiilties for conducting stability analysis will be extended by improving the mathematical representation of several aircraft systems and their interaction, and by incorporating in the C-81 the best existing stability analysis method or combination of methods.

# People in Perspective . . .

*Edie 'Still Going Strong'*

## Budget Analyst Ends 51st Year Gains Acclaim of Many Generals

More than a half century of U.S. Government career service, and "still going strong," is only part of Miss "Edie" Birkle's pride in her work. Few, if any, federal employes have won the demonstrated esteem and affection of more U.S. Army general officers than Edie for her budgetary educational role in their careers.

Autographed pictures of the generals who have expressed their appreciation to Miss Birkle, a budget analyst in the Office of the Deputy Chief of Staff for Research, Development, and Acquisition (ODCSRDA), Department of the Army, are displayed in her Pentagon office.

Among the 20 pictures hung there are those of GEN John R. Deane Jr., commander, U.S. Army Materiel Command; LTG Howard H. Cooksey, Deputy Chief of Staff for RDA; LTG William C. Gribble Jr., Chief of Engineers; LTG John R. Guthrie, now commander of IX Corps/U.S. Army, Japan and others holding 3-star, 2-star or 1-star rank.

On the opposite wall is a Letter of Commendation from President Ford as well as autographed photos of former Secretary of the Army Howard H. Callaway and Under Secretary of the Army Norman R. Augustine.

When LTG Cooksey presented Miss Birkle with a gold diamond-studded pin in recognition of 50 years of U.S. Government service, guests included Army Vice Chief of Staff Walter T. Kerwin, Under Secretary of the Army Norman R. Augustine (then Assistant Secretary of the Army for Research and Development), and numerous similarly high-ranking dignitaries.

Edie began her federal career in September 1924 with a temporary appointment as a typist with the U.S. Veterans Bureau, and in 1925 served with the Army Adjutant General's Office before transferring to the Department of Commerce. Her financial management career started in 1926 with the Army Chief of Finance and she became identified with the Army R&D effort in 1953 when she transferred to the Office of the Assistant Chief of Staff, G-4 (Logistics).

Numerous Outstanding and Sustained Superior Performance ratings have recognized Miss Birkle during her 50 years of service. One citation stated, in part, she is "unexcelled in her capability to consolidate masses of budgetary data into concise, useful exhibits and schedules." Her professional qualifications include a BS degree in commercial science from Benjamin Franklin Univ.

Queried about her possible retirement intentions, Edie countered: "Now, you're trying to find out how old I am! I intend to continue to work as long as The good Lord gives me strength and government regulations permit."

**LIFE WITH FATHER, the second-longest-run theatrical in Broadway history, was based on a "cheaper by the dozen" 12-children family. Dr. Richard L. Haley's acceptance of PL-313 appointment ceremonies as deputy director, Research, Development and Engineering, U.S. Army Materiel Command, brought 8 of his 11 children into the office of AMC Commander GEN John R. Deane Jr. Shown are (l. to r., foreground) Kimberly 9 and Vincent 7. Second row, Michele 15, Christopher 13, Mary 21, Rosemary 17, Margaret (Ferguson) 24. Back row, Mrs. (Peggy) Haley and her 84-year-old mother, Mrs. Charles H. Jacobsen, Dr. Haley and Barbara 19. Not shown are LT JG (U.S. Navy) Richard Haley 26, Paul 22, a student at William and Mary College, and Louis 18, attending Virginia Polytechnic Institute and State University. *At right*, Dr. Haley accepts his Certificate of Appointment.**

**IN RECOGNITION of 50 years of U.S. Government service, Deputy Chief of Staff for RDA LTG Howard H. Cooksey presents Miss Birkle with a gold, diamond-studded pin. Observing are (l. to r.) MG Peter G. Olenchuk, Assistant DCSRDA (now retired); MG George Sammet Jr., AMC Deputy CG for Materiel Acquisition; GEN John R. Deane Jr., AMC Commander; and GEN Walter T. Kerwin, U.S. Army Vice Chief of Staff.**

EDGEWOOD ARSENAL takes Army lead in management and implementation of 5-year program to develop new smoke and aerosol screening systems. (See story, page 10.)