ARMY RESEARCH AND DEVELOPMENT

U.S. ARMY
TANK-AUTOMOTIVE
R&D COMMAND
T-A READINESS COMMAND

September-October 1976

XM-1 Prototype (Future Main Battle Tank)

German MBT Prototype (Leopard 2)

XM-1 Competitive Prototype (Future MBT)

M60A1E3 MBT

M561 Gama Goat Rough Terrain Vehicle

XM723 Mechanized Infantry Combat Vehicle

SPEAKING ON . . .

Army Science Conference Technology Transfer Panel

Our July-August edition Speaking On...feature was devoted to a presentation by Defense Advanced Research Projects Agency Director Dr. George H. Heilmeier titled: The Export of Technology: A 'Handle With Care' Commodity. The intent was to set the stage for coverage in this issue of the 1976 Army Science Conference panel discussion of Technology Transfer and the Army, reflecting a changing role for in-house laboratories, as follows.

MG Charles D. Daniel, Jr.
Panel Moderator,
Special Assistant to
DARCOM Commander

I welcome this opportunity to present to you the speakers on the panel session on technology transfer. This term has become increasingly popular and yet I wonder how many of us agree on what it means, who is affected by it, and how it is to be accomplished - assuming, of course, that technology transfer is a useful undertaking.

For example, some people say, and we might agree, that transferring the latest technological advances in computers to the Soviet Union is not advantageous to the United States. The point is that technology transfer is a mixed blessing, depending on many factors. Hopefully, today we can examine the positive as well as the potentially negative effects.

Technology transfer, or coupling science and technology to the user, has many definitions. A few examples are: transferring research results to operations - accelerating the application of research and exploratory development results to military applications transferring science and technology to the user at the earliest practicable date and in a language he can understand.

Army Regulation 70-57 on military-civilian technology transfer contains this definition: "As used herein this term is the process whereby existing Department of the Army technology or technical know-how is adapted to meet civil needs such as energy, environmental pollution control, law enforcement, transportation, housing, and health."

Although technology transfer from the Army to the civilian sector is important, *our emphasis today is going to be on technology transfer from the civilian community to the Army, and technology transfer from one Army activity to another.*

Technology transfer is not new to the U.S. Army, but it has come to the forefront of science and engineering management more urgently only recently in the United States - and for good reason. What has created the need for more effective and efficient technology transfer are the vast sums spent on research and development, most of which are provided to numerous agencies by the Federal Government.

In the United States there has been an increasing tempo of heavy Congressional, Presidential, corporate and public interest in getting more for the research and development dollar. Monies provided for R&D are leveling off and showing signs of diminishing - at least those funds publicly provided. This situation is something the science and technology community has not had to be concerned with since the Korean War.

While saving money may be a driving force for technology transfer, lives also may be saved. Take, for example, the discovery of penicillin by Fleming in 1929, followed by a decade to realize its full potential in the 1940s; also, Waksman's preparation of streptomycin and its large-scale use, roughly 10 years afterward. These are only two examples of the direct involvement of lives in the technology transfer question. Many others, I am sure, could be cited.

The main reason for better technology transfer, particularly in the U.S. Army, is to stay at least one step ahead of the enemy by transforming significant data into innovations which are "marketable" to the operational users, our combat forces.

Another reason for technology transfer concerns the use of our in-house expertise to help solve problems of state and local governments. The need for this assistance was recognized by the Federal Council for Science and Technology when it established the Federal Laboratory Consortium, currently consisting of 51 federal laboratories, including 12 Army laboratories.

This help is now only a very small part of the activities of our laboratories, but it may become more so as time goes on and as the Federal Laboratory Consortium becomes more active. The need for Army assistance in aiding state and local governments is also recognized by numerous bills introduced into the Congress to establish an Office of Technology Transfer.

What I have tried to do quickly is present a very limited background of the technology transfer problem — to set the stage, so to speak. I will leave the further amplification to our outstanding panel of speakers.

Our speakers, as you can see from the program, represent a spectrum of opinions including those of the Office of the Secretary of Defense, an Army developer, an Army user, and an industry user and developer.

The first speaker will be Dr. John Allen, Deputy Director (Research and Technology), Office of the Deputy Director for Research and Engineering. Dr. Allen graduated from Pennsylvania State University with a BS degree in engineering science and from the Massachusetts Institute of Technology with master's and doctoral degrees in electrical engineering. His PhD thesis concerned the optics of the compound eye of the invertebrates.

Dr. Allen's background includes extensive research in antennas and radar systems. He organized and was the first leader of Lincoln Laboratory's array radars group. He was formerly Associate Director of Research for Electronics at the Naval Research Laboratory, where he was awarded the Navy Distinguished Civilian Service Medal. In his present position he is responsible for the spectrum of research and exploratory development programs in the Department of Defense.

COL Thomas W. Kelly will present the Army user concept. Graduated from Temple University with a BS degree, he has commanded the 1st Tank Bn, 70th Armor, and 1st Tank Bn, 63d Armor, and served as staff officer in the Office of the Deputy Chief of Staff for Operations and Plans (ODCSOPS). COL Kelly now holds the position of chief, Doctrine and Systems Integration Division, Requirements Directorate in ODCSOPS. His military decorations include the Legion of Merit and the Bronze Star Medal for Valor with four Oak Leaf Clusters.

Dr. John L. McDaniel will present the developer's view of technology transfer. Director of the U.S. Army Missile Research and Engineering Laboratory, U.S. Army Missile Command, he graduated suma cum laude from Berry College with a BS degree in chemistry. He received an MS degree from the University of Alabama, a doctor of science degree from Auburn University, and a doctor of laws degree from Athens College.

Dr. McDaniel began his career with the Chemical Corps and later served as technical director of the Army Ballistic Missile Agency. He has received an Army Research and Development Achievement Award, Meritorious Civilian Service Award, the Decoration for Exceptional Civilian Service, and the Department of Defense Distinguished Civilian Service Award.

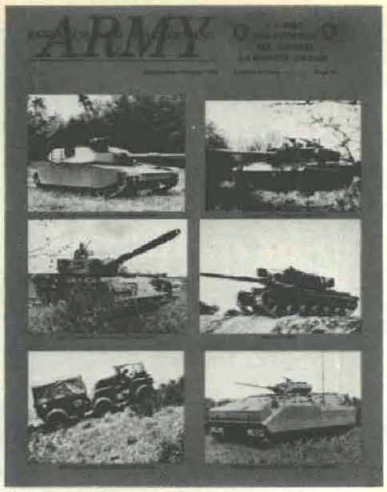
Giving us the industry approach is Dr. Joseph Sternberg, who holds a BS degree in engineering and an MS degree in aeronautics from California Institute of Technology, and a PhD in aeronautics from John Hopkins University.

Dr. Sternberg's background includes early work on the development of supersonic wind tunnels at California Institute of Technology and he received the Arthur S. Fleming Award for his work on research on triple shock wave intersections at the U.S. Army Ballistic Research Laboratories.

As a consultant in aerodynamics and missile design at Martin Marietta, he has been extensively involved in aerodynamic and heat shield problems of the Sprint Antiballistic Missile. He has directed work on advanced lifting body re-entry configurations and a new concept for a close support aircraft.

Dr. Sternberg has been concerned with the Viking Program to land R&D vehicles on the Planet Mars, and he served as scientific adviser to the Supreme Allied Commander Europe, where he was concerned with NATO defense planning and the application of tech-

(Continued on page 19)



ARMY RESEARCH AND DEVELOPMENT

ETL Feature Article — page 16

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ABOUT THE COVER. . .

Transitional changes incident to implementation of 'A New Way of Doing Business' within the parent U.S. Army Materiel Development and Readiness Command (DARCOM) are taking place within two new commands created from facilities and manpower resources of the former U.S. Army Tank-Automotive Command. The Tank Automotive Research and Development Command (TARADCOM) and the Tank-Automotive Readiness Command were activated July 1, and they are now in the throes of the natural turbulence of change. Collectively, their mission remains intact; to develop, acquire, field and support—in a continual combat readiness condition—the best possible tank-automotive equipment for forces in the field. The cover depicts competitive prototypes of the future Main Battle Tank—two versions of the XM-1 designed by rival U.S. firms and the Federal Republic of Germany version, the Leopart 2—along with other combat vehicles.

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Grateful acknowledgement is made for the valuable assistance of Information Offices within the Army Materiel Development and Readiness Command, Office of the Surgeon General, Office of the Chief of Engineers, Army Health Services Command, Army Training and Doctrine Command, Army Forces Command, Office of the Assistant Chief of Staff for Communications-Electronics, Computer Systems Command, and related activities. Use of funds for printing of this publication has been approved by Department of Army, Jan. 1, 1976.

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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FEATURES

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

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Selective Scanner . . .

HDL Unveils Dragon Missile Flight Simulator

Successful demonstration of a brassboard model of a prototype Dragon missile flight simulator at the Infantry School, Fort Benning, GA, was announced Aug. 16 by the U.S. Army Harry Diamond Laboratories, Adelphi, MD.

Developed by HDL under sponsorship of the Army project manager for training devices, the simulator has a color TV camera, infrared TV camera, color display screen, video and audio effects generators, an infrared tracker system and an interfaced programed minicomputer. Components are installed in a field-test van truck.

The demonstration simulated effects of firing a Dragon live round. Effects that contribute to gunner training requirements will be incorporated into a final version of the simulator. HDL reported that the test gave the gunner a physical interface identical to the Dragon weapon.

Instructional aids include a video-tape recorder for instant playback of each engagement, hard-copy data via teletype and a large screen monitor.

ETL Demonstrates PADS Survey Capabilities

Described by the U.S. Army Engineer Topographic Laboratories (ETL) as the "primary surveying system for the artillery of the future," PADS satisfactorily displayed its capabilities during a recent demonstration of the first engineering development model in California.

PADS is the acronym for Position and Azimuth Determing System, which was developed originally by ETL engineers. ETL contracted for five systems of the current engineering development prototype, produced by Litton Systems, Inc.

An extensive series of developmental and operational tests is scheduled to begin in October at the Field Artillery School to verify system readiness to meet field performance requirements.

COL James Barron, director of Combat Developments at the Field Artillery School, Fort Sill, OK, and Robert Macchia, ETL technical director, were presented pictures of the first prototype, in recognition of their roles in development of PADS. Litton Systems president Joe Caligiuri made the presentations.

FAAR Prototype Features Major Design Changes

Major design modifications are incorporated in the first prototype of the U.S. Army's Forward Area Alerting Radar (FAAR) for foreign sales.

Normally, the FAAR carrier is the Gama Goat vehicle, which was not available for sale to a foreign nation. The U.S. Army Missile Command Prototype Development Branch solved this problem by mounting the early warning system on the M-796 General Purpose Trailer and a standard 2½-ton Army truck.

Lester Ross, test engineer for the MICOM modifications, reported recently that air defense customers have indicated approval of the changes and that four orders have been placed. A complete set of documentation is being provided for industry to produce the modified prototype from MICOM drawings.

Completed in nine months, the modifications were made at the direction of the Chaparral-FAAR Project Office headed by COL H.C. Whittaker. FAAR is the warning radar for several U.S. Army systems including Chaparral, Redeye, the 20mm Vulcan gun and the new Stinger weapon when it is fielded.

Huey, CH-47 New Inspection Procedures Announced

Implemention by the end of 1976 of new scheduled inspection procedures for all UH-1 Huey and CH-47 helicopters, following a 15-month, 38,000 flying hours test termed Project INSPECT, has been announced by the Department of the Army.

Inspection of aircraft components is programed only where actual wear or potential failure can be seen or forecast. The phased system will use 100-hour intervals in lieu of current 25-hour intermediate and 100-hour periodic inspection.

The procedure is expected to reduce substantially maintenance manhours, improve operational readiness, and cut repair parts usage without a loss in safety, reliability or maintainability. A reduction in "man-made" maintenance also is expected.

Project INSPECT flying tests involved six Huey companies in the 101st Airborne Division, Fort Campbell, KY; Chinook units at Fort Hood, TX; and Hueys in one Army National Guard unit and two Reserve units.

DARCOM Regulation Gives Management Guidance

U.S. Army Materiel Development and Readiness Command Regulation 70–1, issued recently, prescribes transition of management responsibility from a research and development command manager to a materiel readiness command manager.

Policies, procedures, and guidance apply to DARCOM project/product managers, research and development command managers, and materiel readiness command managers.

An assigned R&D command manager or materiel readiness command manager may range from a junior manager responsible for a minor item to a senior manager responsible for an item deemed of major importance.

Included in the regulation are definitions of various types of managers, guidance relative to responsibilities and procedures, planning and tracking, and transition dates and criteria. An appendix contains guidance for preparation of a transition plan.

Arctic Test Center Renamed Cold Regions Center

Redesignation of the U.S. Army Arctic Test Center as the U.S. Army Cold Regions Test Center, a recent change, is explained as an action to reflect more accurately the nature of the climate and terrain at Fort Greely, AK.

Center Commander COL John M. Pickarts said arctic generally denotes ice caps, frozen terrain and trackless wastelands, which is not the case at Fort Greely. Temperatures vary from 40 degrees Fahrenheit to minus 50 degrees and below.

The Fort Greely facility is the only Army test activity where long periods of extreme cold permit adequate cold weather testing. The climate is similar to that of Northern Europe, Siberia, much of China, and many of the world's northerly mountainous regions.

$1 Million Saved Annually in Propellant Procurement

Savings of more than $1 million annually in development and procurement of propellant- and cartridge-actuated devices (PAD and CAD) through identification and elimination of an area of duplication was announced recently by the Joint Logistics Commanders.

Based on findings in a study on Consolidation of Facilities and Functions by a JLC panel, the move toward elimination of duplication is termed another forward step for improved coordination in continuing efforts to improve design, development and procurement of materiel.

Duplication of Army and Navy effort in research, development and procurement of PAD and CAD was terminated by transfer of Army personnel and 270 tons of material to Indianhead, MD, where the Naval Ordnance station is located. Military Interdepartmental Purchase Requests valued at over $8 million also were transferred.

NBS Publishes Metric Information Package

Publication of a concise package of metric information, in anticipation of U.S. conversion to the measurement, weight and volume used by nearly every nation, has been announced by the U.S. National Bureau of Standards.

The kit contains a wallet-size conversion card, a 15-centimeter ruler, a colorful chart explaining the metric system, and a copy of *What About Metric,* a publication explaining in simple terms the use of the metric system.

Designed specifically for use by the average consumer, the NBS kit is available for $2.00 from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Depot Systems Command Consolidates Functions

Centralized management of depots and consolidation of functions are objectives established for the new U.S. Army Depot System Command, Letterkenny Army Depot, PA, an element of the U.S. Army Materiel Development and Readiness Command.

DESCOM Commander BG Robert L. Berquist will draw his headquarters staff, authorized at 584 civilians, 17 officers and 15 enlisted men, largely from personnel transfers following termination of the U.S. Army Major Item Data Agency and transfer of its mission.

No personnel impact relative to grades or numbers is anticipated for the USAMIDA or the other remaining active DARCOM depot installations.

Picatinny Awards $12.6 Million for Altimeters

Acquisition of 2,000 Absolute Altimeter Systems (AN/APN-209) for installation in all new U.S. Army helicopters and many in service, is committed under a 3-year contract totaling about $12.6 million.

The purchase is a Department of Defense pilot program including a "price limited electronic prototype development" technique, with a reliability improvement warranty. Announcement of the award by HQ U.S. Army Electronics Command, Fort Monmouth, NJ, termed it the first production under "Design-to-Cost" for equipment.

The ECOM Avionics Laboratory was tasked to produce a universal absolute altimeter for use in all U.S. Army aircraft at or below a predetermined design-to-cost stipulation. Minneapolis Honeywell, Inc. is the contractor.

Army Consolidates Communications, Signal Schools

Consolidation of the U.S. Army Communications and Electronics School, Fort Monmouth, NJ, with the Southeastern Signal School at Fort Gordon, GA, termed the new "home of the signal corps," will be effective Oct. 31.

The U.S. Army Training and Doctrine Command (TRADOC) noted in its announcement that instruction at the new school will feature the latest in signal skills training devices, soldier's manuals, qualification tests, and audio visual courses.

Training is expanded from the manual semaphore to operation, repair, management and engineering of sophisticated satellite and computerized systems for worldwide communications. The Monmouth school graduated about 280,000 students since its inception in 1919.

4 Solar Air Conditioned Reserve Centers Ordered

Construction by Reserve components of the U.S. Army, Navy and Marine Corps of four solar-heated and cooled training centers, announced recently by the Department of Defense, is scheduled for completion in 1978.

Three of the four centers, initiated by the Office of the Chief, Army Reserve, are being designed by the Army Corps of Engineers, Southwest Division, Dallas, TX. Their locations are Seagoville near Dallas, TX; Greenwood, MS; and Albuquerque, NM.

The Albuquerque project will be a joint Armed Forces Reserve Center for use by Army, Navy and Marine units. A fourth site in Norwich, CT, featuring solar heating only, is under design by the National Guard and the Connecticut Adjutant General.

The latter project will also be a joint training center for utilization by Norwich units of the Army National Guard and Army Reserve. Work on this center began in August and construction on the others will begin in the spring of 1977.

Although initial construction costs for solar facilities are greater than those for conventional structures, the Department of Defense anticipates substantial long-term savings. Projections are based on energy savings and escalating fossil fuel costs.

ARI Report Issued on Order-of-Battle Elements

A Questionnaire-Based Analysis of Order-of-Battle Elements is the title of a new publication issued recently by the U.S. Army Research Institute for the Behavioral and Social Sciences.

Technical Report 271 was prepared from responses rating eight OB elements and 95 components of these elements. Questionnaire responses were received principally from field grade officers.

Viewpoints were solicited relative to composition, disposition, strength, training, tactics, logistics, combat effectiveness, and miscellaneous elements. Intelligence an enemy disposition received the highest rating.

Report findings may be used as a basis for structuring computerized OB files, allocated work loads, determining OB collection requirements, and as a research aid.

Correspondence relative to ARI Report 271 may be addressed to: U.S. Army Research Institute for the Behavioral and Social Sciences, ATTN: PERI-P, 1300 Wilson Boulevard, Arlington, VA 22209.

Army Delays Activation of Armament R&D Command Until Jan. 31

Activation of the U.S. Army Armament Research and Development Command with headquarters at Picatinny Arsenal, Dover, NJ, has been delayed from Oct. 1 to Jan. 31, 1977, the Department of the Army announced Sept. 20.

The adjustment in schedule was explained as necessary to insure that conditions are most favorable for successful transfer of personnel and programs. MG Bennett L. Lewis will head the new command and the Implementation Task Force is headed by BG David W. Einsel Jr. at Picatinny.

Dr. Robert W. Weigle, Watervliet (NY) Arsenal, is serving as technical director. Other members of the 140-man task force have been drawn from HQ DARCOM, Watervliet Arsenal, Edgewood (MD) Arsenal, Rock Island (IL) Arsenal, Picatinny Arsenal at Dover, NJ, Frankford Arsenal, Philadelphia, PA., and the Ballistic Research Laboratories (BRL) at APG, MD. Since BRL recently moved into its new posture, Dr. Eichelberger, its director, has been involved with ARRADCOM on a daily basis.

Graduated from the United States Military Academy in 1950, MG Lewis served as commander of the U.S. Army Mobility and Equipment R&D Center (now the Mobility Equipment R&D Command), Fort Belvoir, VA, after he attended the Army War College (1970).

MG Bennett L. Lewis

Dr. Robert W. Weigle

BG David Einsel

In addition to a variety of construction engineer assigments in Korea and Vietnam, and duty as chief of the Special Weapons Division, Office of the Army Chief of Engineers, MG Lewis has served as chief, Readiness Division, Office of the Assistant Secretary of the Army (Manpower and Reserve Affairs), and in the Land Forces Division, Office of the Assistant Secretary of Defense for Systems Analysis.

BG David W. Einsel Jr. started his career in R&D assignments in 1956 at Edgewood (MD) Arsenal as a nuclear effects engineer. He has served as an assistant professor at the U.S. Military Academy; with the U.S. Army Materiel Command; with the Office of the Joint Chiefs of Staff; and five years as commander/director, Harry Diamond Laboratories.

Dr. Weigle was chief scientist and director of the Benet Weapons Laboratory at Watervliet Arsenal when he was assigned to the ITF for ARRADCOM. Recipient in 1965 of a Presidential Citation for significant cost reduction in a program which developed new techniques for simulated test-firing of conventional weapons, he has long been associated with weapons development, including work on an international level.

DCSRDA, DARCOM Leaders Address Reserve R&D Update

R&D Update '76, A Seminar for Continuing Professional Awareness, held for Reserve R&D Mobilization Designees, attracted more than 50 participants to HQ U.S. Army Materiel Development and Readiness Command.

The Office of the Deputy Chief of Staff for Research, Development, and Acquisition (ODCSRDA) joined with DARCOM in sponsoring the 2-week seminar conducted by members of the 156th and 160th MOBDES Detachments, Fort Belvoir, VA.

Formal presentations and discussion sessions updated the conferees on progress, problem areas, and objectives in advanced and engineering development efforts, prototype and new initiative activities, basic research, and "real-world" budgetary constraints as related to international and political considerations.

Welcoming addresses were presented by sumposium co-directors COL Herbert L. Ley Jr., commander, 160th MOBDES Det., and COL R. L. Pendelton, commander, 156 MOBDES Det.

DARCOM Deputy Commander for Materiel Development LTG George Sammet Jr. detailed Army R&D achievements that have had widespread civilian applications, and stressed the importance of becoming aware of these "spin-off" benefits of efforts devoted primarily to building a strong national defense posture.

Cited as outstanding examples of Army technology transfers to the civilian community were freeze-dried foods, flexible food packaging, night vision devices for treatment of Retinitis Pigmentosa eye desease, the Xenon bulb for searchlight operations, and other applications.

MG Ernest D. Peixotto, director, Materiel Plans and Programs, ODCSRDA, discussed improved management of the Army's materiel acquisition program, and the Reservists' role under mobilization conditions.

He said the Department of the Army has demonstrated "infinite wisdom" by centralizing responsibility for research, development, test and evaluation programs, along with materiel acquisition under a Deputy Chief of Staff for Research, Development, and Acquisition, a position now held by LTG Howard H. Cooksey.

"Our nation," he said, "faces a world that could explode into battle in any of several obvious places such as the Middle East, Cyprus, Africa, Panama, Korea or Europe."

Dr. Ivan R. Hershner Jr., assistant director of Army Research (Programs), ODCSRDA, spoke on "The Army Research Program." E.J. Sheehan, director of the U.S. Army Night Vision Laboratory, "Night Vision R&D - An Update."

Other featured speakers and their topics included: COL W.C. Maus, commander, Army Research Institute for the Behavioral and Social Sciences, "Human Factors Research,"; COL Lothrop Mittenthal, commander, Army Research Office, "Army R&D-University Interface"; COL J.G. Ton, deputy chief, R&D Office, Chief of Engineers, "Environmental Quality";

Dr. C.H. Church, assistant director of Army Research (Technology), ODCSRDA, "Technology Overview"; MG L. L. Stahl, chairman, Subcommittee on Army Reserve Policy, HQ DA, "Army Reserve Forces Policy Committee"; Col R.J. Cuthbertson, chief, International R&D , HQ DARCOM, "International Aspects of R&D"; and LTC D.A. McCoole, chief, Long Range Study Group, Army Concepts Analysis Agency, "Battlefield of the Future."

TARCOM Awards $43.9 Million for 596 Heavy Equipment Tractors

Award of a $43,897,980 contract for 596 Heavy Equipment Transporter (HET) tractors, with a first-year obligation of $13,748,630, was announced by the U.S. Army Tank-Automotive Materiel Readiness Command at press time for this edition of the *Army R&D Newsmagazine.*

The award to the Oshkosh Truck Corp., Oshkosh, WI, is for the XM911, an 8x6 commercial truck tractor of 85,000 pounds gross weight, that will pull the U.S. Army's M747 60-ton semitrailer for transport of the main battle tank and other heavy military equipment.

Tests conducted at Fort Hood, TX, demonstrated that commercial HET tractors could be used successbully by the Army instead of the more costly military vehicle. The Army estimates that this commercial HET fleet will cost $40 million less than a military-designed fleet.

The XM911 is one of the Oshkosh Model J-2065 Series Trucks used extensively in the oil fields of Saudi Arabia, Bahrain and Egypt. It will be equipped with two rear-mounted winches to load and unload disables tanks, along with a non-driving axle which will reduce axle loadings to prevent road and highway damage.

XM911 Commercial HET Tractor

Laser Beamrider Test Program Maintains Successful Record

When a modified Shillelagh missile scored a direct hit on a radio-controlled target Sept. 16, the perfect record of successes in firings from the M60A2 tank and the M551 General Sheridan Vehicle was maintained-10 hits.

The Laser Beamrider Test Program is being conducted at HQ U.S. Army Missile Command (MITCOM), Redstone Arsenal, AL.

The test was part of a research program designed to demonstrate the new antitank guidance concept and to determine feasibility of a retrofit for Shillelagh missiles. The program is being conducted jointly by MICOM's Missile Research, Development and Engineering Laboratory and the contractor, Aeronutronic Ford.

DSD Selects Army as SM for Conventional Ammunition

Implementation of a 2-phased plan making the Army the joint services Single Manager for Conventional Ammunition is directed by Deputy Secretary of Defense William P. Clements Jr. in a Sept. 7 memorandum to Service secretaries.

Phase I begins Oct. 1 and extends through FY 1978, covering "what is achievable today." Phase II (FY 79-80) will implement a "full" Single Manager for Contentional Ammunition.

DSD Clements reaffirms in the memorandum his original desire to pursue two objectives: 1) integration of conventional ammunition logistics functions to the maximum extent practical, and 2) achievement of the highest possible degree of efficiency and effectiveness during peacetime, surge and mobilization.

Phase I will include transition of procurement, production, maintenance/renovation, storage and inventory/transportation management functions to the Single Manager. Phase II calls for expansion of SM responsibilities to "full" implementation, in accordance with a plan worked out between Secretaries of the Military Departments under DoD guidance.

Inventory transportation management responsibilities of the SMCA encompass wholesale and retail stocks, that is, stocks between point of production and point of receipt at the first intermediate CONUS activity, and (retail) the point of consumption.

The SMCA will report to each of the Services the wholesale assets by quantity, facility location, lot number, and readiness condition. Each Service retains the right to evaluate the condition of its ammunition and prepare summary reports on total inventories.

DSD Clement's memorandum requires the SMCA to coordinate with the Services in selection of depots to minimize cost of maintenance, and to optimize Service Requirements. The SMCA's decision, however, is final. Interservice transfers will continue to require approval by the affected Services.

With respect to items having a high degree of commonality, the Services are required to provide prearranged standing approvals permitting the SMCA to make Inter-Service transfers.

Another stipulation during Phase I is that the SMCA will coordinate with the Military Traffic Management Command (Army), Military Sealift Command (Navy) and Military Airlift Command (Air Force) and Service components prior to selection of which stocks are to be shipped and to what depot. The owning Service, on an exception basis, can challenge the SMCA's decision and provide specific instructions.

Kennedy Amendment Commends Armed Forces Pathology Institute

Congressional action, in the form of an amendment introduced by Senator Edward Kennedy, has recognized the Armed Forces Institute of Pathology as an internationally respected establishment and set the stage for creation of an American Registry of Pathology.

The rather lengthy commendation of the AFIP states in part: "The Congress hereby finds and declares the Armed Forces Institute of Pathology is an internatinally famous and highly respected medical establishment which offers unique pathologic support to military and international medicine.

"The Institute contains the nation's most comprehensive collection of pathologic specimens and a staff of pathologists engaged in consultation, education and research.

"The activities of the Institute are of unique and vital importance in support of health care of the Armed Services of the United States," and also civilian health care of the United States.

The amendment also authorizes establishment of a nonprofit, nonfederal corporation, the American Registry of Pathology (ARP) Inc. The AFIP will be sanctioned to contract with ARP Inc. for cooperative enterprises in medical research, consultation and education between the AFIP and the civilian medical profession.

ARP Inc. is to be organized and governed, effective Oct. 1, by a Board of Members consisting of representatives of the professional societies which sponsor the individual registries of pathology at the AFIP.

Further details relative to ARP Inc. were being worked out during committee meetings when the *R&D Newsmagazine* went to press.

CDEC Tests TOW Capability Against Attack Helicopters

Feasibility of using the TOW (Tube-launched, Optically tracked, Wire-guided) antitank weapon in an additional role, that of engaging attack helicopters when they become targets of opportunity, was tested in a recent experiment.

The U.S. Army Combat Developments Experimentation Command, Fort Ord, CA, conducted the TAHOE (TOW Against Helicopter Operational Equipment) experiment at Fort Hunter Liggett, CDEC's field laboratory.

TOW weapons were placed in six locations to perform their normal function of detecting and engaging threat tanks, in a simulated maneuver. The TOW squads also were instructed to fire weapon simulators at attack helicopters.

During the forward flight rocket-firing profile, the helicopters would approach the target area flying nap-of-the-earth (low altitude) and remain masked from the TOWs by terrain features. The helicopter then climbed steeply, at a predetermined point, and made a rocket-firing dive at a target about 1,000 yards away. After firing three pairs of rocket simulators, the helicopters returned to a masked position.

Three members of each 4-man TOW squad attempted to detect the helicopters on each flight and the fourth member, the gunner, tracked the helicopter when it was located, using the TOW system. Tracking was continued until the end of the flight or the helicopter was remasked by the terrain.

Contract Orders Completion of Patriot Missile Engineering

Completion of engineering development of the Patriot air defense system (formerly SAM-D) is ordered in a 49-month, $425 million contract awarded recently by HQ U.S. Army Missile Command, Redstone Arsenal, AL.

Raytheon Co., Bedford, MA, will design, fabricate, assemble and integrate test hardware and missiles, provide documentation to support production, and demonstrate Patriot's mission capability for requirements in the 1980s.

Hardware scheduled for delivery to the Army includes fire sections (radar, weapons control and launch equipment): a command and coordination group which links man, radar and missiles; and a quantity of missiles.

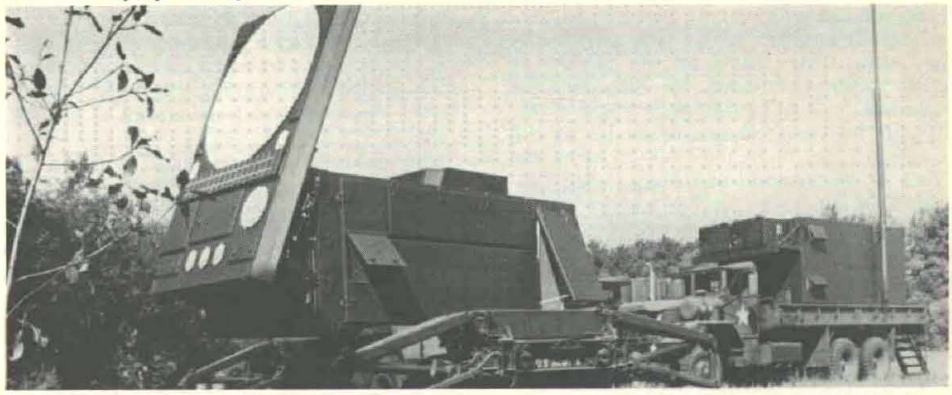
As prime contractor for the Patriot system, Raytheon will perform most of its work at its Bedford and Andover (MA) facilities. Principal subcontractor Martin-Marietta Co. will use its Orlando (FL) Division. Thiokol Corp is responsible for the propulsion system.

Integration testing on the first tactical prototype fire control section was completed in June and equipment has been sent to White Sands (NM) Missile Range for testing in an electronic countermeasures environment.

After one of the most successful flight test programs in DoD history, Deputy Secretary of Defense, William P. Clements approved completion of Patriot Engineering Development with congratulations "for a job well done."

Programed to replace the Hawk and the Nike Hercules air defense systems, Patriot features a long-range capability against high-and medium-altitude targets and low-altitude targets at ranges limited primarily by the radar horizon.

The all-weather Patriot system has a multifunction electronically scanned phased-array radar controlled automatically by a digital computer, and command guidance to mid-course followed by a track-via-missile terminal phase.



MOBILITY OF THE PATRIOT missile system was demonstrated recently when it was driven out of the Raytheon plant at Bedford, MA, mounted on an SM-860 trailer towed by an M818 tractor and set up in minutes in a wooded field by soldiers from HQ U.S. Army Mobility Equipment R&D Command, Fort Belvoir, VA. It was the first emplacement demonstration of the U.S. Army's new air-defense system. At the left is the radar and right the engagement control section. Equipment will be sent to White Sands (NM) Missile Range for testing this year.

CRREL Lays Cornerstone for $5 Million Ice Engineering Facility

Capabilities of the U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH, are being expanded by construction of an Ice Engineering Facility over an 18-month period at a cost near $5 million.

High-ranking leaders of the U.S. Army Corps of Engineers participated in Aug. 31 cornerstone laying ceremonies for the building, including Deputy Chief of Engineers MG Robert C. Marshall, William B. Taylor, technical director and assistant for R&D to the Chief of Engineers, and COL Ralph J. Garver, deputy engineer, New England Division. Former Senator Norris Cotton gave the principal address.

The 2-story structure, 210 feet by 160, will have a research area, a flume room and a test basin. Temperature in the 160 by 80 foot research area will be controlled within a range from +65° to −10° Fahrenheit. Models of small parts of rivers and streams can be constructed for testing of ways to alleviate ice jams through channel modification.

Other testing capabilities in the research area are designed for experimentation to alleviate flooding caused by ice jams, especially in New England, and for cold testing of vehicles and small structures.

The flume room temperature will be controllable within a range from +65° to −20° F. The 120-foot-long flume will have a refrigerated bottom, a flow capacity of about 14 cubic feet a second, and will tilt from +2 degrees to − 1° slope.

In effect, the ice sheet will be "turned upside down" in the flume for research on formation of cover ice, frazil ice and ice jams, the effect of ice covers on sediment transport, and the hydraulics of ice covered rivers.

Designed primarily for large-scale work on studies of ice forces on structures, such as drill platforms and bridge piers, the 30-foot-wide, 8-foot-deep and 120-foot-long test basin will have underwater windows and underwater lighting, for visual and photograph observation.

Model icebreakers will be used in some experiments. Rapid drain and fill capabilities will permit studies of effects of water level changes. Other studies will be concerned with formation of ice pressure ridges, ice problems in and around navigation locks, bearing capacity of large ice sheets, and vertical uplift forces.

One of the economy operation features of the building will be heat pumps for total heating requirements. Waste heat from refrigeration or well water will be used in the heat pump system. Installation costs reportedly will be lower than for an oil-fired hot-water system, and operation costs are estimated at 30 percent less.

CORNERSTONE for Ice Engineering Building is placed by former Senator Norris Cotton, USACRREL Commander and Director COL R.L. Crosby, and Deputy Chief of Engineers MG Robert C. Marshall.

Board of Engineers Recommends Extended GL Navigation Season

Based on a 5-year feasibility demonstration study (1971-76), the Board of Engineers for Rivers and Harbors has recommended a 6-week extension of the navigation season in the upper four Great Lakes.

Generally in accord with a plan prepared by the Detroit District Engineer, the proposal is being further evaluated by the Chief of Engineers prior to review by governors of the affected states and federal agencies. It then will be submitted to the Secretary of the Army, the Office of Management and Budget, and Congress.

Cost to the Federal Government of extending the navigation season through January each year, plus or minus two weeks depending on weather conditions, is estimated at $4,592,000. Normally, the season is from Apr. 1 through mid-December.

During the extended navigation test period, a bubbler-flusher system installed by the Corps of Engineers was used for the Sugar Island Ferry Dock in Michigan. The Board recommended that this be transferred to a non-federal entity along with a contribution of $213,000, provided the system is properly operated and maintained.

BRL Hosts International Combustion Colloquium

An International Combustion Colloquium at the U.S. Army Ballistic Research Laboratories (BRL), Aberdeen (MD) Proving Ground, recently attracted more than 75 scientists, engineers and R&D managers.

DoD participants represented the Army Research Office at Research Triangle Park, NC, Picatinny Arsenal, Dover, NJ, Frankford Arsenal, Philadelphia, PA, and Navy agencies.

Conducted as part of BRL's technical coordination responsibility under the Army's Ignition and Combustion Programs, the colloquium provided opportunities for foreign scientists to present lectures and participate in technical discussions with U.S. scientists.

Twelve lecturers attended under the auspices of the Army Research Office, Europe. Speakers and topics were: Prof. P.J. Van Tiggelen, University of Louvain, Belgium, Influence of Additives on Structure of Detonations; Dr. N. Chigier, University of Sheffield, United Kingdom, Laser Velocimetry for Combustion Measurements; Prof. A. Lefebvre, Cranfield Institute of Technology, U.S., Turbulent Flames; Dr. D. Waddington, University of York, UK, Gas Phase Oxidation of Hydrocarbons; and

Prof. R. Walker, Hull University, UK, High Temperature Gas Phase Oxidation of Aldehydes; Dr. R. Nataraian, Institute of Technology, India, Ballistics of Vaporizing Liquid Drops; Prof T. Hikita, University of Tokyo, Japan, Case Study of Explosion Accidents in Petrochemical Industries in Japan; Dr. D. Lewis, ICI Ltd., UK, Explosions of Nypro; A. Mitcheson, University of Leeds, UK, Thermal Explosions and Self Heating in Chemical Reactions; Prof. J. Bradley, University of Essex, UK, Mass Spectrometric Studies in RDX Decomposition; Dr. J. Griffiths, University of Leeds, UK, Chemical Oscillations in Gaseous Reactions.

Natick Investigates Combat Vehicle Induced Heat Illnesses

Avoidance or minimizing of heat illness, performance degradation and discomfort of crewmen in closed-in tanks and other combat vehicles is the goal of researchers investigating water-cooled clothing systems at the U.S. Army Natick Research and Development Command (NARADCOM).

One such system, known as the "cool head," is a development of Aerotherm Industries. Worn much like a scuba diver's cap, it cools the head and neck areas. A new polyurethane material has 1/8-inch waterflow channels built into its entire surface.

WATER-COOLED polyurethane "cool cap."

Since earlier water-cooled garments developed for the NASA space program used rigid ¼-inch tubing as the standard water carrier, the new material represents a breakthrough in wearer comfort and the "cool head" may be worn with the standard helmet.

The Aerotherm model permits more direct contact with the scalp and neck areas than NASA's earlier Apollo models, increasing heat transfer for more efficient cooling. The crewman uses a portable heat exchanger, a frozen cannister, in the cooling unit, and starts the fluid pump for circulation through the cap.

Difficulties of supplying frozen cannisters in the field are causing NARADCOM researchers to study alternative heat exchanger designs. Once design parameters are determined, the "cool head" will receive a closer inspection for possible Army use.

2 LACV 30s Undergo Operational/Development Tests

Operational and development tests are being conducted on the first two LACV-30s (Lighter Amphibious Air-Cushion Vehicles) delivered for validation to replace the Army's LARC-5 and LARC-15 amphibious resupply crafts.

A modified version of the Voyageur ACV built by Bell Aerospace Canada Division of Textron Canada Ltd., is undergoing operational testing by specially trained crews at Fort Story, VA. Testing is under auspices of the U.S. Army Mobility Equipment R&D Command (MERADCOM), Fort Belvoir, VA.

A military-adapted commercial Voyageur is at Aberdeen Proving Ground (APG), MD, for development testing to determine conformity to mobility, performance, transportability, and safety requirements.

The prototype LACV is 76½ feet long, 36 feet 9 inches wide, and has an over-all hovering height of 28 feet 11 inches. With a mounted, self-unloading crane, the vehicle's estimated weight is 58,000 pounds; carrying a maximum load, the weight is 115,000 pounds.

Powered by two, twin-pack, gas-turbine engines, each rated at 1,800 maximum shaft horsepower, the LACV-30 is expected to be capable of clearing vertical obstacles three feet high, climbing 20-percent slopes, maneuvering over 6-percent side slopes, crossing ditches up to 12 feet wide and 10 feet deep, and cruising with full payload over waters at 50 mph, with burst speeds up to 60 mph.

Additional Army requirements include operating over a wide variety of terrain including snow and ice-covered tundra in 40-degree below zero temperatures, operating in plunging 50 mph winds.

The LACV-30 is expected to give the Army, the capability of moving outsized cargo and containers from an offshore ship to inland destinations at speeds five times faster than existing non-ACV amphibians. It has 1,660 square feet of cargo deck area, compared with the 140 square feet for the LARC-5 and 240 square feet for the LARC-15. Load capacity of 30 tons makes it better suited to haul the standard 8' x 8' x 20' military and commercial containers used by the shipping industry.

Director Gary Jastrab said the test program at APG will be followed by three months of water performance testing at the Naval Coastal Systems Laboratory, Panama City, FL, six weeks of climate chamber testing at Eglin Air Force Base FL, and surf performance testing near Fort Ord, CA.

MICOM Establishes MATE Team For Test Equipment Management

Efforts to consolidate and reduce proliferation of missile test equipment have led to establishment of a MATE team to manage and coordinate development and operation of computer-controlled test equipment at the U.S. Army Missile Command (MICOM).

Unlike MICOM's current Land Combat Support Office, established to support Lance, Shillelagh, TOW and Dragon, MATE (the Army's acronym for Missile Automated Test Equipment) can support all MICOM systems including air-defense missiles.

"Our mission is to support only MICOM at this point," said MAJ Philip Williams, project officer, whose staff of six is part of the Army Missile R D & E Laboratory.

"We are already supporting Improved Hawk, have started contracting for TOW Cobra, and we are doing a study effort in conjunction with the project managers to define requirements for some of the other systems," Williams added.

Originally developed by Martin Marietta Corp. for the Army to test the Sprint missile, MATE can quickly diagnose a missile problem from the complete system to the printed circuit board. It can even fault isolate itself.

The MATE operator can run a complete or abbreviated test as desired. Extensive formal training is not needed since the language displayed on a cathode ray tube or computer printout is near conversational.

MATE is planned to be part of the missile development cycle, Williams said, from the contractor plant to Army depots, to field service.

Joint Effort Assures Accuracy of Army Test Equipment

Accuracy of U.S. Army test equipment may vary with the passage of time and the degree of manhandling it receives in field use. Periodic calibration is essential to make certain it performs properly.

That requirement makes critically important the mission of the Army Electronics Proving Ground Calibration Branch at Fort Huachuca, AZ, headquarters of the U.S. Army Communications Command. Without precisely accurate equipment, results of test measurements are invalid.

Before you can accurately calibrate test equipment, however, you must be sure that the calibration equipment is accurate - and that is the task of Redstone Arsenl, AL, responsible for maintaining Army-wide standards.

The National Bureau of Standards, Washington, DC, gets into the action as the primary source to ensure accuracy of calibration according to standards it specifies.

Calibration at Fort Huachuca is accomplished by comparing test equipment of unknown quality (accuracy) with equipment of known calibration standards.

Calibrating means constantly checking test equipment to make sure its margin of error is within an allowable range. For instance, the standard cell used at Fort Huachuca to measure voltage is capable of measuring within a millionth of a volt. The Calibration Branch processes about 1,200 items monthly.

MERADCOM Working to Improve M60A1 Tank Concealment

Concealment for the M60A1 tank is being improved by a camouflage skirt, gun barrel, disruptor, smoke launcher, slotted antenna and a heat-dissipating air foil. All of these camouflage techniques are under development by the U.S. Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA.

An expedited pilot program is seeking ways to compensate for the increased capabilities of detection equipment and improved accuracy of weapons. New and improved materiel items are being evaluated by MERADCOM and the U.S. Army Tank-Automotive Command (TACOM), Warren, MI.

Project Office MAJ William K. Emerson said the program "will provide camouflage for the tank against selected threats and second, it will document a sample case so other developers may have an example to follow."

The air foil was developed to prevent heat-seeking missiles from "locking on" exhaust fumes from the tank's engine by forcing exhaust gases up and out. The heat dissipates over a wider area, lowering the temperature, and thus decreases effectiveness of heat-seeking missiles.

Permanently mounted 6-foot fiberglass rods, which fold out above the tracks in seconds, support a special camouflage net. Twenty foliage brackets have been added to the tank to secure tree and brush branches, supplementing other camouflage techniques.

A camouflage disruptor, previously developed at MERADCOM, is a portion of a net mounted on a collapsible aluminum frame designed to disguise the gun barrel.

Turret-mounted prototype smoke launchers that propel rockets to form a rapid smoke screen are being evaluated at Edgewood Arsenal, MD. A prototype slotted antenna is being evaluated at the U.S. Army Electronics Command (ECOM), Fort Monmouth, NJ.

Special port filters were developed at TACOM to allow the crew to see outside the tank and to use lights inside without being seen.

CONCEALMENT for M60A1 Tank

Army Picks 2 XM-1 Main Battle Tank Production Sites

XM-1 Main Battle Tank Program development progress has included recent selection of the Lima Army Modification Center (LAMC), OH, as the initial production site and the U.S. Army Tank Plant, Detroit, MI, as a second production facility.

The Army announced its plan to revise the XM-1 development schedule to include a 120-day extension of the prototype production model competitive phase between General Motors and Chrysler Corps. This was scheduled to terminate in July and extension was granted to incorporate higher performance components; also, to standardize key components affecting logistical support with the Federal Republic of Germany's new tank, the Leopard 2.

A single contractor will be selected, based on prototype evaluation, to complete development of the revised configuration of the XM-1. The winning design will then be compared with the Leopard 2, being tested at Aberdeen Proving Ground, MD. The U.S. Army will then select the best over-all tank to introduce into production.

The plan is to establish an integrated production facility at Lima with capacity sufficient to produce 30 tanks a month, one-half of the ultimate projected production requirement. The Detroit plant will be used later to meet expanded production requirements, and Congress will be requested to provide funds for its conversion to begin XM-1 (or Leopard 2) production when M60A1 tank production phases down in the early 1980s.

Selection of the Lima facility for initial production will permit the modernization and optimal production layout of an existing Government-owned plant for efficient, cost-effective production of the XM-1 without interfering with M60A1 production at the Detroit plant — assuring that a crucial measure of defense readiness will be maintained as the new main battle tank is phased into production.

Army Receives German Leopard 2 Prototype MBT for Evaluation

U.S. Army acceptance of a prototype of the German Leopard 2 (AV) tank from the German Ministry of Defense, under terms of a December 1974 Memorandum of Understanding for test and comparative evaluation with the U.S. XM-1 Main Battle Tank, was announced Sept. 9.

The XM-1 is designed to incorporate "substantial improvements" in firepower, mobility, protection, reliability, availability, maintainability and durability. The Leopard 2 is being tested to determine if it meets the U.S. requirements and would be more cost effective than the U.S. candidates. During the tests it will be armed with the 105mm rifled gun, the same as

is mounted on the U.S. prototypes.

Testing is scheduled to continue through mid-December 1976 at the U.S. Army Aberdeen (MD) Proving Ground - applying the same criteria and constraints used in testing the Chrysler Corp. and General Motors XM-1 tanks.

The goal of the US/FRG Memorandum of Understanding is to make all reasonable efforts, within national requirements, to achieve maximum standardization of the American and German tanks on the date of introduction into their respective armies. A decision on selection of one of the U.S. prototypes is scheduled by the end of 1976. The follow-on U.S. decision between the selected XM-1 prototype and the Leopard 2 is scheduled for March 1977.

Work on the XM-1 dates to December 1971 when Congress directed termination of the development of the XM803 tank, the U.S. follow-on program to the joint US/FRG MBT-70 program, as unnecessarily complex, excessively sophisticated, and too expensive.

New Infantry Helmet Designed for Options in 3 Sizes

Infantry helmets reflecting knowledge gained in many years of research on design and new materials will be issued in three sizes instead of the single-size M-1 Hadfield steel helmet in use since World War II — if Army approval follows design and operational tests.

Designed at the U.S. Army Natick (MA) R&D Command (NARADCOM), the new helmet incorporates a one-piece construction with a low profile and low center of gravity. Engineering design tests have indicated that the new helmet is more comfortable to wear and does not rock back and forth or bounce as the wearer moves.

The precisely sized helmets sit much closer on the head, fit 98 percent of all Army personnel, and offer less percentage area as a target. A standoff space of one-half inch was found to be sufficient to provide adequate ventilation, and to prevent injuries from nonpenetrating fragments. More of the head is protected with a lower edge cut that covers most of the ear and temple areas, as compared to the M-1 helmet.

Abandoning the steel "pot" and liner, Army scientists investigated many ballistic materials, including fiberglass and Kevlar (DuPont tradename for an aramid fiber) which proved to be most effective against fragmenting munitions.

These fabrics are built up in layers and resin-laminated within a mold. The large size weighs 53 ounches, slightly less than the M-1. The small size weighs 47 ounces. The medium size weighs 49 ounces and will fit about 50 percent of all soldiers. An alternate Kevlar construction, more than one-half pound lighter in all three sizes, also is being evaluated.

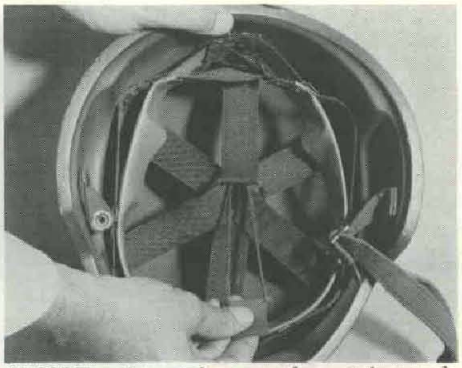
The simplified cradle suspension system, within the new helmet, is easier to adjust for a more comfortable fit. As in the M-1 system, a buckle on the headband adjusts for circumference; however, a single velcro tab on a drawstring web (see photo below) replaces the M-1's three buckles for height adjustment.

The new design eliminates the need for the M-1's nape-strap with its three buckles. The chin-strap has a 2-point open-chin cup, two adjustment buckles, and a snap fastener. With the addition of a nape pad for paratroppers, the new suspension system will serve both ground and airborne troops.

Working closely with NARADCOM, the Human Engineering Laboratory (HEL), Aberdeen, MD, and other Army laboratories have assured that the new helmet design does not interfere with the soldier's hearing, vision, movement, clothing or equipment.

Other tests to find the best possible construction material were conducted by the Naval Research Laboratory (NRL), Washington, DC, and the Army Ballistic Research Laboratories.

PROPOSED infantry helmet is designed in three sizes with a simplified cradle suspension and adjustable chin strap to provide better head coverage with comfort.



SINGLE velcro tab on a drawstring web replace the M-1 helmet's three buckles.

Collective Protection Equipment Climaxes 9 Years of Research

Advanced tactical fire control crews can work in a toxic-free environment with a collective protection equipment (CPE) system adopted recently by the U.S. Army.

CPE development was directed by Joseph J. Zuraw, project engineer in Edgewood Arsenal's Development & Engineering Directorate.

The system has radio and telephone connections to control over-all operations with subsystems located at various sites such as the battalion, division or corps battlefield HQ.

Air purification and pressurization are achieved by gas and particulate filters with a dust extractor, and an air flow valve.

Pressurization of the system entrance gives personnel entry and exit of the shelter without fear of contamination. The entrance is 7 feet high, 44 inches wide and more than 4 feet deep.

Weighing about 165 pounds, the unit is collapsible and fits into a self-contained package that can be hand-carried and erected by a crew of three in less than 30 minutes.

Part of advanced and engineering development of a family of collective protective measures, CPE was field tested at Dugway Proving Ground, UT, Army Tropic Test Center, CZ, Army Arctic Test Center, AK, and Yuma Proving Ground, AZ.

SEM Magnification Advances Materials Research at APG

Metallurgists using a new Scanning Electron Microscope (SEM) can magnify a quarter to the size of 26 football fields in studies of structure and materials at the Army's Aberdeen Proving Ground (APG), MD.

Touted as the most advanced state-of-the-art equipment in the materials evaluation field, the SEM gives APG scientists precision capabilities previously unattainable in research on failure analysis, fracture, and qualitative chemical analysis.

"SEM's advantages are many but the most notable are ease of operation, great depth of focus, and ability to switch over a wide range of magnifications from 20-power to 100,000-power," stated Charles Klarich, a metallurgist with the APG Materiel Testing Directorate.

SEM fires an electron beam through magnetic lenses and across the surface of a material sample in evaluations to find out why a gun barrel exploded prematurely, why a piece of equipment failed, or what chemicals and elements comprise an unknown substance. The surface, in turn, emits signals that produce a visible image for the metallurgist.

"X-ray chemical analyses tell us exactly what is there, because each element generates different emissions, giving us what you might call a 'fingerprint' of the specimen. Should a gun explode prematurely, the fracture surfaces and in-bore residues can be examined to determine what caused the failure. In case of a vehicle drive shaft fracture, components can be similarly analyzed," Klarich explained.

An attachment on the SEM can chemically analyze a foreign ammunition or weapon and identify its metals or alloys. If the sample is not an electrical conductor, such as a ceramic or matter composed of biological tissue, it is coated with vaporized gold to make it an electrical conductor without altering features.

The SEM is equipped with a television-like screen that shows a picture of the surface under scrutiny, thereby eliminating tedious peering through a conventional microscope.

A key to the whole process, however, is still a human element — the ability of the scientist to "read" the picture. "When something is magnified 5,000 times," Klarich said, "it is hard to know just what you're looking at. Therefore, the key to the successful use of this instrument is comparison. For example, when we try to determine the identity of a certain fracture, we compare its surface features, as seen under the SEM, to the classical surface features of known fracture types."

The SEM can determine what elements are present and where in a specimen. A photographic map permits the observer to analyze the cause for distribution of the elements.

Klarich commented that the SEM has far-reaching applications in biomedical procedures, the manufacture of semiconductors, metallurgy, and other scientific areas.

METALLURGIST observes surface characteristics of a part of a vehicle steering column magnified 1,000 times by using a new Electron Scanning Microscope at APG.

WP Loading Method May Ease Munitions Handling

An innovation to improve U.S. Army munitions handling is a semi-automatic method of loading white phosphorus (WP) at Pine Bluff Arsenal (PBA), AR.

"Volumetric dry filling" is primarily the mechanical engineering result of Frank Stewart in the Edgewood (MD) Arsenal Manufacturing Technology Directorate and Harold McKinney, PBA Engineering and Technology Directorate.

Since World War II, the Army has relied on a dip-filling method to produce WP munitions used for smoke screening and marking dispersed munitions, such as grenades, mortars and artillery rounds.

The method has produced large quantities of contaminated water and gases, and required each round to be cleaned as well as leak-tested. Moreover, it took considerable manual labor — sometimes more than 40 employes to operate a production line while working with uncomfortable protective equipment.

Edgewood Arsenal developed a new method in the late 60s known as dry-filling, which utilized a filling nozzle to direct WP into a shell placed in an inert atmosphere cabinet. Then, in 1974, at PBA, McKinney developed "volumetric dry filling."

The PBA Project Manager's Office for Munitions Production Base Modernization and Expansion approved funds for the prototype of the volumetric system. Edgewood Arsenal was assigned management responsibility for the project, with PBA personnel performing design, fabrication, installation and testing.

Stewart was named Edgewood Arsenal project manager and McKinney was put in charge of the project at PBA, assisted by Larry Davenport, an engineering technician. Stewart states that success of the project can be attributed largely to "excellent cooperation between Edgewood and PBA engineers, technicians, craftsmen and production workers."

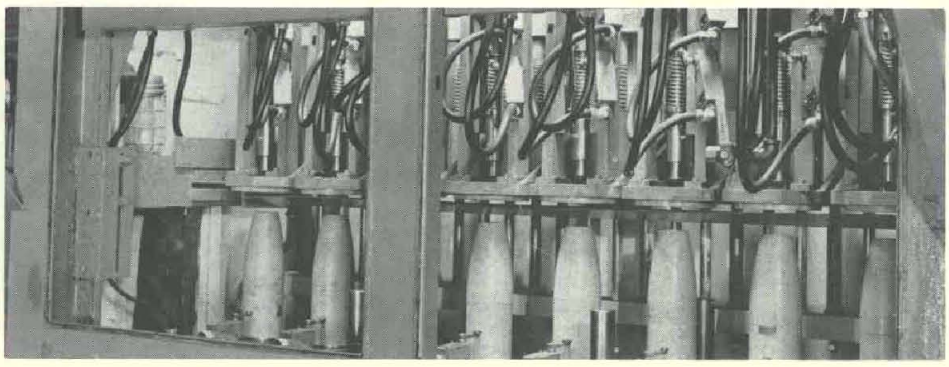
The method utilizes an automatic filling station containing nozzles, cylinders and auxiliary equipment to fill about 25 munitions rounds a minute. A cabinetized filling station, operating in an atmosphere of less than three percent oxygen, eliminates WP smoking and burning.

The system includes a 120- x 15-foot closed-loop slat conveyor to move manually loaded munitions into individual pallets, in a vertical nose-up position automatically centered at all the line stations.

When the filled munition is removed from its carrier at the end of the production line, a conveyor returns the pallet to the head of the line for reloading.

A follow-up project will provide a production line capable of automatically filling two separate mortar rounds, a rocket warhead, and an artillery round. Plans also call for a fully automated level-check, aspirator and burster-casing press equipment; also, an additional station to clean the burster and fuze cavity.

Six to eight employes will be required to perform handling functions of the otherwise fully computer-controlled production line, which is expected to be completed in 1977. By that time, it has been estimated that air and water pollutants will be reduced over 90 percent and production to gain over 25 percent.



WHITE PHOSPHORUS filling machine at Pine Bluff Arsenal, AR.

ALCM Launched From B-52 Bomber Satisfies Navigation Test at WSMR

Navigation and guidance systems for an Air Launched Cruise Missile (ALCM) satisfied all test objectives in a 200-mile flight at White Sands Missile Range, NM, Sept. 9, the fourth of seven scheduled ALCM firings.

The flight of the AGM-86, launched by the U.S. Air Force, was the first test of the navigation and guidance systems. The missile was released from a B-52 bomber at an altitude of 20,000 feet. Two "figure 8" courses were flown during the 30-minute flight, including maneuvering through a series of checkpoints ranging in altitude from 1,000 to 2,000 feet. Speeds ranged from 417 to 455 miles an hour.

Scheduled for use in both the Air Force and Navy ALCM programs, the AGM-86 navigation and guidance system was developed under a Navy contract with McDonnell Douglas: Astronautics Co.

The ALCM is intended to enhance the penetration capability of long-range, manned bombers and advanced development flight tests will be completed in December. Earlier flights confirmed design and operation of the turbofan engines, controls and radar altimeter. Williams Research Corp. developed the F107 engine.

Natick Food Sciences Lab Publishes Research Abstracts

Abstracts of 99 research tasks performed at the Food Sciences Laboratory (FSL) during Calendar Year 1975, the first full year of the lab's existence, are presented in the Annual Report of the FSL, Natick R&D Command.

FSL is concerned primarily with those sciences recognized as basic to the solution of food processing and preservation, and the acceptability of food related to military feeding systems. Since the FSL program is primarily engaged in this type of support, most of the research task reports relate to identified problems or anticipated future needs of all the military services and the Defense Supply Agency.

The report summarizes 73 research tasks listed in microbiology, nutrition, analytical chemistry, food chemistry, human factors, field studies, food habits and methodology, taste, olfaction, appetite, and food acceptance.

Pretreatment of Cellulose for Enzymatic Hydrolysis, investigated by F.J. Snyder and John M. Nystrom, and Aspect of Mild Acid Pretreatment in Enzymatic Hydrolysis of Cellulosic Wastes to Glucose by Snyder and Leo A. Spano, report progress of test operation of the pilot plant for conversion of waste paper to glucose food products, clean-burning fuel, and many short-supply chemicals.

Other reports include Food Science Support of Field Feeding System, G. Silverman, D.T. Munsey and D.B. Rowley; Effect of Irradiation Upon the Nutrient Content of Food, M.H. Thomas, J.J. McMullen, B.M. Atwood and W.K. Calhoun.

Detection and Measurement of Infestation in Cereal Products, M. Bazinet, S. Cohen, J. Cornell, L. Holmes, F. Robbins, and W. Yeomans; Chemical Changes Associated With Flavor in Irradiated Meat, C. Merritt, P. Angelini, E. Wierbicki, and G. Shults; Use of Natural Antioxidants to Extend Shelf Life of Ration Items, S.J. Bishow and J.G. Kapsalis.

Food Preference and Consumption, J.R. Siebold and D.L. Maas. A Method for the Reduction and Analysis of Data in the Design of Body Armor, T.L. Nichols, E.W. Ross and E.R. Barron. Effect of Portion Size on Intake and Responses Toward Food, E. Becker and R. Cotta.

Long-Term Individual Human Food Preferences and Consumption Patterns, R.C. Graeber, F. Halberg, H. Levine, T.L. Nichols and R. Gatty. Dehydrated Beef Patties: The Effect of Unflavored and Flavored Textured Soy Protein on Quality and Acceptability, S.R. Drake, L.C. Hinnergardt and R.A. Kluter.

Evaluation of Mixtures of Four Component Odors, H.R. Moskowitz, M. Reuben and C. DuBose. Menu Combinations in Cash Food Systems, J.R. Siebold. Carbohydrate Chemistry With Emphasis on Food Problems Related to Subsistence, D.H. Ball and J.K. Palmer.

Computer System for Analytical Chemistry Laboratories, D.H. Robertson, R.A. Graham and C. Merrit. Identification of Flavor Producing Constituents in Meat, D.M. Alabran. Validity of Extrapolating Wholesomeness Data, I.A. Taub, P. Angelini and C. Merritt.

Tasks in Pollution Abatement Research involved biotechnology, enzyme technology, engineering technology, solid-waste management, and physiochemical technology.

Among 26 listed abstracts are: Mechanisms of Biodegradation of Aromatic Compounds, N. McCormick and D. Carpenter. Biodegradation of Water Pollutants From Nitroglycerine, T.M. Wendt and A.M. Kaplan. Pilot Scale Production of Cellulase, J.M. Nystrom, R.D. Acuff and R.E. Mortensen.

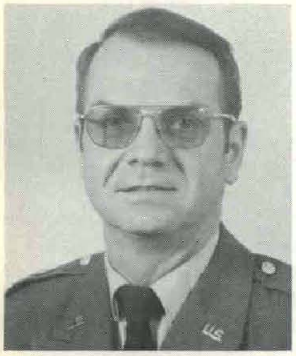
Enzymatic Hydrolysis of Cellulosic Materials, R.K. Andren, R.J. Erickson and J.E. Medeiros. Economics of Cellulose Saccharification, A.L. Allen and J.M. Nystrom. Industrial Waste Treatment Research, C. Blodgett, R. Andren.

Three abstracts in Appendix A summarize research in services, namely: Sensory Evaluation Services, R.A. Kluter, D.E. Sherman, B.L. Bell and R.S. Lund. Study Design for the San Diego School Food Service System, J.R. Siebold. Nutrition Analysis Service, M.H. Thomas, B.M. Atwood, J.J. McMullen and W.K. Calhoun.

General Support Rocket System Provisional Office Established

General Support Rocket System (GSRS) development is being managed through a new provisional project office, pending formal U.S. Army approval, at U.S. Army Missile Command, Redstone, AL.

Concept definition studies for the free-flight rocket are being made under contracts with Boeing Aerospace Co., Emerson Electric Co., Martin Marietta Corp., Northrop Corp., and Vought Corp. Results will enable the Army to determine the best technical approach for GSRS development.



COL Kenneth S. Heitzke

COL Kenneth S. Heitzke, who has served six months as GSRS special assistant, has been named project manager. Larry Seggel, who served with MICOM's Advanced Systems Concepts Office and with the Lance missile development, is his civilian deputy. Plans call for an increase in staff from 4 at present to 18.

MICOM has conducted extensive research on free-flight rockets. Much of the early effort toward establishing the GSRS program was directed by LTC William B. Ward, chief of the Artillery Systems Concepts Team, Advanced Systems Concepts.

COL Heitzke is a graduate of the U.S. Military Academy, and he served at Fort Monmouth, NJ, as assistant project manager for TACFIRE, an automated system for field artillery fire control. He has served overseas in Vietnam, Korea and Ethiopia. His military honors include the Legion of Merit with 2d Oak Leaf Cluster (OLC), Distinguished Flying Cross, Bronze Star (2d OLC), Korean Wharang with Gold Star, Republic of Vietnam Gallantry Cross with Palm, and Republic of Vietnam Honor Medal.

CAWS PM's Office Relocates to Picatinny Arsenal

The Office of the Project Manager (PM) for Cannon Artillery Weapons Systems (CAWS) is the first Armament Command segment to transfer from Rock Island Arsenal (RIA), IL, to Picatinny Arsenal, Dover, NJ, as a result of creation of a separate U.S. Army Armament R&D Command (ARRADCOM) and a Materiel Readiness Command.

The CAWS Project Manager's Office (PMO) is responsible for all 155mm weapons and ammunition, from development through first procurement, and has two assigned major systems, the XM198 Towed Howitzer and Copperhead (Cannon-Launched Guided Projectile).

Headed by COL Ronald E. Philipp, the CAWS PMO consists of 77 civilians and 5 military personnel. Successor to BG Frank P. Ragano, COL Philipp reports to MG Bennett L. Lewis, ARRADCOM commander.

In addition to the CAWS PMO, two similar organizations will be at Picatinny Arsenal - the PM for selected Ammunition (there since 1962), and the PM for Army Air Defense Gun Systems, at RIA by mid-1977.

Other groups involved in forming ARRADCOM are the Ballistics Research Laboratories at APG, the Chemical Systems Laboratory at Edgewood Arsenal, MD, and the Benet Weapons Laboratory at Watervliet Arsenal, NY. These segments will remain in place, although their missions and structures will be altered.

Thirty-seven positions at Picatinny Arsenal will be transferred to the newly formed U.S. Army Armament Materiel Readiness Command (ARRCOM) at Rock Island, IL (See *Army R&D Newsmagazine*, July-August 1976, p. 16, for more on ARMCOM reorganization).

COL PHILIPP was until recently commander of the Army Tank-Automotive Center, as it was provisionally organized in response to the recommendation of the Army Materiel Acquisition Review Committee.

Since 1973 he had been with the Tank-Automotive Command, Warren, MI, as director of Research, Development and Engineering, U.S. Army Mobility Systems Laboratories. During 1971-72 he served in the Combat Materiel Division, Office of the Chief of Research and Development.

COL. Philipp's overseas tours include Vietnam (1970) where he was commander of two support battalions, and Korea (1965) where he planned the reorganization of all U.S. support forces, as the technical operations officer for the Eighth Army Support Command.

In 1969 he was maintenance battalion commander at Fort Hood, TX. During 1968 he developed an unmanned sensor system for the U.S. Army Control and Disarmament Agency, Washington, DC. He was an instructor in automotive maintenance and repair at Aberdeen Proving Ground (APG), MD (1956-58).

COL. Philipp received a BS degree in mechanical engineering from Lafayette College in 1954 and an MS degree in mechanical engineering in 1956 from Lehigh University. Integrated in 1961 into the Regular Army, he began studies leading to a doctorate at Columbia University in 1964. He is also a graduate from the National War College (1973) and the Command and General Staff College.

Among his military honors are the Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star w/OLC, Meritorious Service Medal w/OLC, Air Medal w/3 OLC, and Army Commendation Medal w/2 OLC.

COL Ronald E. Philipp

EPA, CE Sign Interagency Wastewater Agreement

Metropolitan area water resources planning program officials of the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (CE) recently signed an Interagency Agreement to enhance the Corp's computer-based system for cost estimating wastewater treatment.

Since 1972 passage of the Federal Water Pollution Control Act to clean up the national waterways and improve the general quality of life, personnel of the EPA Office of Water Program Operations and the Corps' Urban Studies Program have been helping regional governments develop long-range plans for water and wastewater requirements.

The goal is to have all waters of the nation "fishable and swimmable" by 1983 - an objective the National Commission on Water Quality estimates will cost $109 billion. The U.S. Army Engineer Waterways Experiment Station at Vicksburg, MI, reports:

"Briefly, a community of 10,000 people would have to remove the following from their sewage before discharging it into the receiving waters: 260 tons of suspended solids and 1,460 cubic feet of rags, rocks and grit per year. More oxygen must be added to the waste stream than is breathed by all the children in the community for a full year."

Under Congressional direction, the CE instituted the Urban Studies Program to help community leaders prepare long-range plans to include wastewater management, urban storm water runoff, floodplain development/management, and water reuse.

The Urban Study must show how funding for existing or new facilities will be used, how the concensus on alternative solutions must be obtained from all local authorities, and how all this can be done in an urgently short time.

WES scientists have commented: "Such a comprehensive program will need the best talents of professional engineers, concerned citizens and modern analytic techniques. Not one study manager has all the necessary manpower, time or funds for such a breathtaking project; instead, he will need all the assistance modern technology can provide."

The WES Environmental Effects Laboratory (EEL) has developed a Computer-Assisted Procedure for the Design and Evaluation of (Wastewater) Treatment (CAPDET), calling for the laboratory to serve as principal agent.

CAPDET originated in 1972 when the Office of the Chief of Engineers requested WES to develop a design manual for wastewater treatment systems. A. J. Green and N. R. Francingues of EEL concepted a model to complement the manual, and planned development.

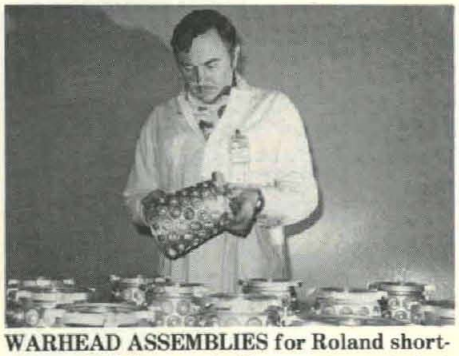
Much of the credit for CAPDET development, WES personnel acknowledge, goes to Drs. M. W. Corey and A. Shindala of Mississippi State University. LT Dave Binning of OCE, M. R. Walsh, Ms. Trish Spaine of EEL, and users from field offices in Alaska and Hawaii contributed.

Actually, CAPDET is not a single model, but a system of models that permits planners to consider existing wastewater treatment facilities, community growth patterns, and restriction when developing designs and costs for upgrading sewage plant capabilities.

One of its major requirements is preparation of capital and operating/maintenance cost for thousands of possible designs. The system permits large-scale design and cost analysis.

Other uses for an expanded CAPDET system are wastewater routing alternatives, optimization of staged construction of facilities, and management of water and wastewater to meet long-range needs of the growing population.

As pollution control technology develops, the Corps' mission in urban and regional planning may include requirements for management planning related to solid waste, water supply and air pollution, which could lead to development of additional concept models.



WARHEAD ASSEMBLIES for Roland short-range air-defense missiles are inspected at Boeing Aerospace Co. in Seattle, WA. Boeing's Army Systems Division is teamed with Hughes Aircraft Co. to build the European-developed surface-to-air missile system in the U.S. Designed to provide all-weather defense against low-flying, high-performance aircraft, Roland is being procured by the U.S. Army Missile Command.

USAIDR Bone Loss Replacement Research Continues

Directed toward treatment of selected bone loss problems in humans, as often occur in combat wounds or disease, a project approved by the U.S. Food and Drug Administration is progressing toward that goal at the U.S. Army Institute of Dental Research, Walter Reed Army Medical Center.

USAIDR research is now in its third year, using tricalcium phosphate *[*Ca3(PO4)2*]* initially proved as a highly satisfactory substance in treating bone wounds in animals. The material was well tolerated when placed in prepared bone defects in rat bone models. Connective tissue buds grew into the ceramic pores within four days, new bone formation occurred within one week, and the ceramic was completely replaced by bone within 14 weeks.

Follow-on experiments with dogs and monkeys, involving the replacement of jawbone sections supporting teeth, were similarly successful. Even when a one-inch segment of the inferior border of a mandible was removed and grafted with a ceramic block — particularly challenging as an experiment because of the difficulty of bone grafts in this area — the defect was totally replaced by bone within eight months, restored to normal form and function.

Conventional treatment of bone wounds in humans often involves transplantation of marrow and bone chips from the iliac (hip) to the site of the wound. Successful completion of the new FDA-approved experiments may eliminate need of this operation, according to a 4-man team report by USAIDR Commander COL Duane E. Cutright (MS, DDS, PhD) and COL Marvin P. Levin (BS, DDS).

Based upon research results to date, they believe that tricalcium phosphate may eventually provide a readily available, inexpensive, prepackaged, presterilized material for bone losses due to combat, disease or trauma.

Findings of this research were presented in a meritorious award winning paper at the 10th U.S. Army Science Conference, June 22-25. COL Levin reported on "Lactic Acid Derived Biodegradable Implant Materials."

Computer-Aided Design Discussed for Tainter Gates

Computer-aided design of tainter gates was the subject of a recent week-long workshop conducted at the U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, to teach structural engineers to use the system.

The WES Automatic Data Processing Center collaborated with the Corps of Engineers Lower Mississippi Valley Division (LMVD) as part of a cooperative program to stage the workshop. Computer-aided design and analysis is considered the most cost-effective way engineers have found to obtain more reliable and economically feasible designs for tainter gates.

Tainter gates are essential to all hydraulic engineering projects to control water flow. Expensive and complex structures, they are made up of curved steel plates and supporting frames that must be designed to withstand many different loads. The computer aids the engineers in designing a gate that operates satisfactorily while being no stronger than essential and at minimal practicable cost.

Attendees at the seminar included LMVD executives, structural engineers and managers from the St. Louis, Memphis, Vicksburg, New Orleans, Mobile, and the Huntington Engineer Districts, and specially invited guests. Fair sex engineers Deborah Kaufman, WES, and Wendy Truman, Memphis District, participated.

WES Technical Director Frederick R. Brown welcomed conferees and was followed at the podium by J.B. Cheek and W.A. Price, both of WES, who discussed "What Computer-Aided Design Is" and "How the Timesharing Program Designs Tainter Gates."

D.R. Dressler, Office of the Chief of Engineers, presented "How Tainter Gates are Designed," and was followed by Dr. L.Z. Emkin of Georgia Institute of Technology, speaking on "How STRUDL Designs Tainter Gates." The remainder of the workshop was devoted to the WES/LMVD CAD program.

Design-oriented features are: the user may enter part of the design data, and the program estimates the rest; the user controls each step of the design through commands that link the analysis routines in required order; the user controls how much information he gets back.

Tutorial features guide the engineer through each stage in the design, serving as a "check list" to assure that all features are evaluated; error recovery procedures identify incompatible data and prompt the engineer to give values that lead to a good design and least cost.

This program took several manyears to develop and is one of the largest engineering programs developed within the Corps of Engineers. It represents a major step forward in computer-aided design by making the best use of a powerful computer system to do the well-defined numerical work, thus free engineers to think about results and the next step.

CDEC Examines Options of Improved Foxhole Protection

Gertrude Stein's fame as an author mounted with such classics as "A rose is a rose is a rose," as a change from "A rose by any other name would smell as sweet." Similarly, it might be said, "A foxhole is a foxhole is a foxhole," but the Army Combat Developments Experimentation Command says, "It ain't necessarily so."

Recognizing the possibility of progressive change, CDEC researchers at Fort Hunter Liggett, CA, are working long and hard to give the infantryman better protection and improved fire effectiveness.

PARFOX VII is an experiment designed to provide an evaluation of a parapet in front of the foxhole, with the defender firing to the side instead of straight ahead. The alternative is a "split parapet," having a cut in the center of the frontal mound of dirt to give the defender the option of observing and deciding to fire through the slot or from the side.

CDEC field trials in recent months used 23-man platoons attacking 8-man squads of defenders "dug in" to the three types of foxholes - the two experimental types and the conventional FH. More than 100 attacks were made to get a thorough evaluation. Closely controlled conditions used sophisticated computer and laser beam technology to collect scientific data.

Rifles and machineguns equipped with live-fire simulators and low-intensity laser systems coupled with computers provided information on "hit and misses." Highly instrumented backpacks worn by each player in the experiment relayed information on each player's moves into a master computer.

After a 3-second interval for analysis following each firing of a round, the computer notified a player, by use of distinctive audio alarms, whether he had been killed or engaged by a hostile player. Additional integration of simulated mortar fire and hand grenades contributed to creation of a realistic battle, recorded and evaluated by the master computer.

CDEC reports that data collected during the PARFOX experiment are being compiled, edited and sent to the U.S. Army Infantry School for further detailed analysis, evaluation and conclusions. Final determinations are expected to provide sufficient empirical scientific data to enable Army designers to come up with a foxhole that will be a life-saving advance.

INFANTRYMAN defends his position in a parapet foxhole during simulated battles conducted by CDEC as part of PARFOX VII.

REMBASS Engineering Development Starts

Engineering development of the Remotely Monitored Battlefield Sensor System, including delivery of final design plans for the basic REMBASS system in March 1977, is ordered in three recently awarded contracts.

Totaling $726,000, the awards are in support of Phase I (system design). Prime contractors are American Electronics Labs., Colmar, PA, RCA Corp., Camden, NJ, and GTE Sylvania, Mountain View, CA.

Under the Department of Army approval of REMBASS full-scale development approved in May 1976, the system ordered in the design contracts will be capable of performing the basic REMBASS functions - target classification, data transmission, and data display.

REMBASS functions that will remain in advanced development will require imaging sensors, an advanced data transmission system, and the incorporation of a data processing capability. Full system capabilities will include early warning, surveillance, and target acquisition in a worldwide environment.

Plans call for employment of electronic sensors in areas where activity of interest may be expected. Placed by hand, air delivery or projectiles, the sensors will be responsive to passage of target objects, including sensitivity to seismic, acoustic, magnetic or infrared disturbances, or a combination of these conditions.

Electronic logic within senors will reject most disturbances from unwanted sources. Sensors known as classifiers will determine the nature of the target object - personnel movements or a wheeled or tracked vehicle. Information will be transmitted in code (digital format).

Messages also will identify the reporting sensor and may pass through radio relays to overcome extreme range or terrain masking. The operator analyzes the decoded data and reports the activity observed.

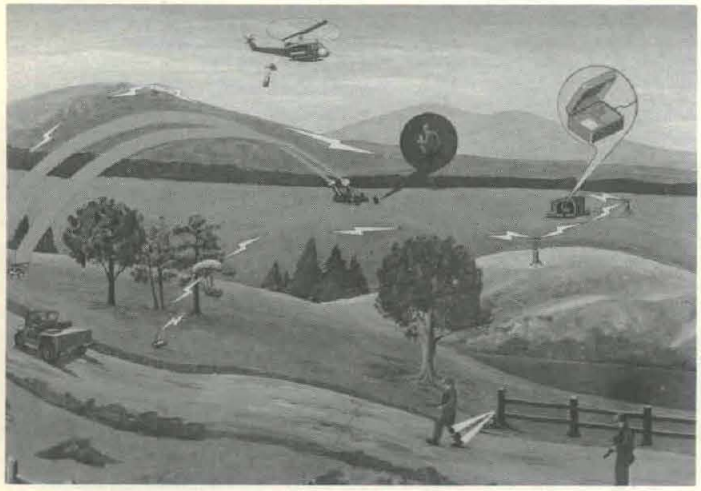


Fig. 1. REMBASS Concept

REMBASS will replace the sensor system currently in limited use within the military services, formerly known as the Southeast Asia Operational Sensor System and now termed the Phase III Sensor system.

Figure 2 illustrates the unusual combined Advanced Development and Engineering Development Program. Contracts for competitive design of the basic REMBASS will result in delivery of design plans for fabrication of Engineering Development (ED) models, and will lead to an ED fabrication contract. The models will be evaluated during the REMBASS Development Testing-II and Operational Testing-II.

The production phase (Figure 2) is scheduled to begin in FY 1980 with Initial Operational Capability to be established in FY 1983. Advanced Development programing is illustrated at the bottom of Figure 2. Engineering development of the basic REMBASS and advance development work will be done concurrently. As the advanced development work warrants, additional hardware will be identified for engineering development and be added to the system until the material need is satisfied.

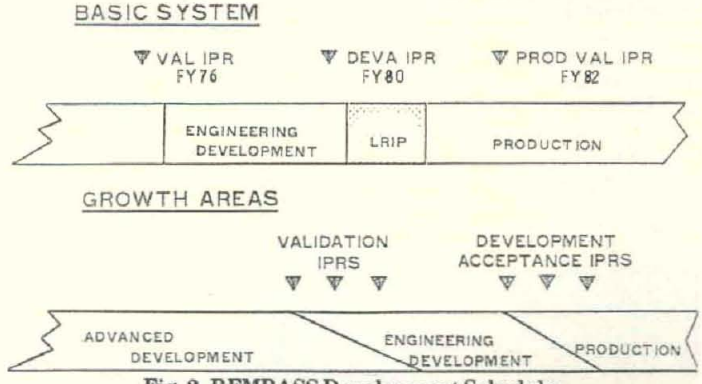


Fig. 2. REMBASS Development Schedule

COL Louis Friedersdorff is the project manager for REMBASS, with LTC Kenneth B. Stinson as assistant PM, and the PM Office is at Fort Monmouth, NJ. COL Friedersdorff is also responsible for management of the Platoon Early Warning System (PEWS), the Field Artillery Acoustic Locating System, (FAALS) and the Phase III Sensor System.

PEWS is a lightweight mini-sensor system, designed for use by small units and expected to enter production in the near future.

FAALS is a system of acoustic sensors, designed to be distributed well forward of the Forward Edge of the Battle Area to detect and locate hostile artillery, and is entering validation phase development. The Phase III Sensor System, the present tactical family is used by the U.S. Army, Marine Corps and Air Force.

17 AMRDL Helicopter R&D Contracts Total $1,675,314

Fifteen companies are involved in 17 helicopter R&D contracts totaling $1,675,314 awarded recently by the Eustis (Fort Eustis, VA) Directorate, U.S. Army Air Mobility R&D Laboratory (AMRDL), NASA-Ames Research Center, Moffett Field, CA. The AMRDL is an element of the U.S. Army Aviation Systems Command, St. Louis, MO.

General Electric Co. (Aircraft Engine Group) will develop, under a $424,000 award, manufacturing methods and technology and establish pilot production capabilities for making precision-cast titanium compressor castings for small turbine engines.

Under two contracts totaling $165,614, Boeing Vertol Co. will investigate capabilities of CH-47 and UTTAS helicopters to accomplish low-level terrain flying while carrying external cargo loads. Under a $97,113 contract to Boeing, a CH-47A helicopter was deliberately crash tested in August at the Impact Dynamics Research Facility, NASA Langley (VA) Research Center to determine dynamic structural response with a goal of reducing damage and personnel injury.

Two contracts aimed at developing new helicopter rotor blade deicing concepts were awarded to Mechanics Research, Inc. ($99,429) and Bell Helicopter Textron ($69,921).

Sikorsky Aircraft Division of United Technologies Corp. will create a Helicopter Drive System Reliability and Maintainability Design Guide under a $164,910 contract. Fiber Science, Inc., will get $99,000 to design, fabricate and test experimental remotely piloted vehicle (RPV) wing and fuselage structures.

An ultrasonic mass fuel flow meter for future Army helicopters will be developed by Panmetrics, Inc., under an $85,961 contract. Vehicle Systems Development Corp. will be paid $82,549 for a concept formulation, selection and design layout of an advanced technology experimental helicopter ground mobility system.

A $69,710 award to Teledyne Ryan Aeronautical calls for recovery of the Army battlefield surveillance "mini" RPVs. Chrysler Corp. Space Division will receive $69,318 to develop a device to interface between an Army helicopter's electrical system and a Nickel-Cadmium (NiCad) battery.

Hamilton Standard Division of United Technologies Corp. will create for $64,214 a conceptual analysis and preliminary design of a crash-survivable Accident Information Retrieval System (AIRS) for installation on helicopters to help determine crash conditions and accident causes.

Developmental Sciences Inc. will investigate, under a $63,693 contract, the use of a vertical net and wing tip engagement device to terminate the flight of a Remotely Piloted Vehicle of about 120 pounds. RAIL Co. of Valley, MD, will receive $50,000 to modify the Aircraft Reliability and Maintainability Simulation (ARMS) Model.

A $34,031 contract was awarded to RASA Division of Systems Research Laboratories for evaluation of stability and dynamic problems associated with a new rotor concept called the Bearingless Main Rotor (BMR). The Cortland Line Co. will be paid $31,845 to make advanced technology helicopter cargo slings.

Corps' Civil Works Program Budgeted at $2.47 Billion

Magnitude of the nationwide Civil Works Program responsibilities of the U.S. Army Corps of Engineers (CE) is reflected in the FY 77 budgetary appropriation of $2,471,550,000 for planned or ongoing work.

The program provides for water resources development, including investigations and surveys, planning, construction and the operation and maintenance of federal flood control, rivers and harbors, and beach erosion control projects; also, multipurpose power projects, as authorized by Congress.

Funds appropriated under general construction provide for 254 projects. Included are 24 new construction starts, continuation of construction on 224 projects, 2 land acquisition projects, 3 continuing major rehabilitation projects, and reimbursement to local interests on 1 project.

General construction funds provide also for 19 new planning starts and 85 continuing planning projects. Funds appropriated for the Mississippi River and tributaries project will provide for continuation of 5 planning efforts and for 16 continuations of construction.

Congress indicated specific program amounts for individual projects and surveys. It then reduced the general construction, appropriation by an undistributed reduction of $80,300,000 for anticipated savings and slippages.

The Fiscal Year 1977 budget breakdown is: general investigations, $71,920,000; general construction, $1,436,745,000; operation and maintenance, $648,900,000; general expenses, $47,200,000; flood control, Mississippi River and tributaries, $231,497,000; flood control and coastal emergencies, $22,140,000; special recreation use fees, $2,000,000; permanent appropriations (estimated), $4,548,000; revolving fund, $6,600,000.

Eustis Orders Acoustical Holography Unit

Delivery and installation of an acoustical holography imaging system at the Eustis Directorate (Fort Eustis, VA) of the U.S. Army Air Mobility Research and Development Laboratory (AMRDL), NASA-Ames Center, Moffett Field, CA, is ordered under a recent $86,000 contract.

Acoustical holography employs high-frequency sound (ultrasound) to obtain 3-dimensional information on the internal structure of material under study. Phillip J. Haselbauer, project engineer with the Eustis Directorate, said the nondestructive system will be used to evaluate its application to inspection problems with current Army aircraft; also, to examine advance materials and designs being considered for future Army aircraft.

Coast Guard Adopts Army's EOD Protective Clothing

When toxic chemicals or petroleum products are accidentally spewed into coastal or other navigable waterways, cleaning up the mess becomes one of the U.S. Coast Guard's most hazardous duties - necessitating properly designed protective clothing to minimize risk of serious injury or loss of life.

That explains why the Coast Guard recently adopted a U.S. Army-developed Explosive Ordnance Disposal (EOD) protective clothing system. Originally designed and developed by the Army's Natick (MA) Research and Development Command, for protection during deactivation and disposal of bombs and other munitions, the system has been only slightly modified for Coast Guard use.

Chemical protection is provided without hindering body movement. An airtight butyl rubber layer is sealed at the boots, gloves, helmet and front zipper closure to guard against any gas leakage or direct liquid splash. A non-sealed, durable over-glove serves for the handling of heavy and abrasive items.

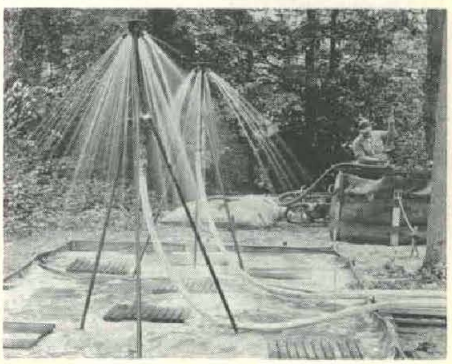
Plastic ducts within the helmet carry clean air across the viewing area to prevent fogging and carbon dioxide buildup. Filtered air for breathing and ventilation comes from the battery-operated life-support system, worn as a backpack assembly. The Coast Guard suit includes an oxygen monitor to sense concentration inside the helmet. An alarm is activated when the oxygen level falls below 19.5 percent.

The life support system draws in outside air, filters it and then blows ⅓ of the clean air to the helmet, with the remainder circulated over the torso, arms and legs by an inner-layer air ventilating system.

Once the clean air reaches the extremities, it flows into an outer layer and is discharged through exhaust valves. The suit provides comfort more than two hours, even in hot/humid weather. The Coast Guard suit has a back-up breathing system for emergency situations. A 5-minute supply of compressed air will be supplied from an air bottle to the helmet mouth upon demand.

To protect the suit and its wearer from abrasion and flash fires, a fire resistant NOMEX coverall is worn as the outermost layer. For the Coast Guard version of the suit, a flotation and safety harness for water operations also has been added.

As a final safety precaution, the Coast Guard version of the suit is now in production and should be in the supply system next year. A similar but less complex version is now being developed for use by personnel of the Environmental Protection Agency.



FIELD SHOWER UNITS take on a new look, through pollution abatement techniques developed by the U.S. Army Mobility Equipment R&D Command (MERADCOM). A collection base permits waste water to be drained into the pillow tank shown at rear center, then pumped into the collapsible treatment tank (right), where it is agitated and mixed with polymers. When the solution settles, the clean water is drawn off, leaving a carbon-laden sludge of approximately 17 percent of the original volume.

AMMRC Expands Fracture Mechanics Technology Applications

Increased usage of fracture mechanics technology to predict the life and reliability of engineering hardware during early stages of design, as well as in post-failure analysis, is being directed at the Army Materials and Mechanics Research Center (AMMRC), Watertown, MA.

AMMRC researchers and designers are stimulating an exchange of information with industry, universities and U.S. Government agencies to insure that FM technology is being applied at the design level.

FM technology applications have expanded greatly during the past 20 years. What was once thought to be a technique concerned narrowly with the mathematical modeling of linear elastic fracture mechanics is becoming widely accepted to encompass all aspects of the mechanisms of fracture in solids.

FM research and applications range from theoretical to experimental, structures to materials, predicting critical crack sizes to finding flaws of critical dimensions, elastic to plastic, crack initiation to catastrophic fault.

The first phase of effort included a "Survey of Fracture Mechanics Applications in the United States," conducted during 1975 to measure the extent to which FM concepts are being employed in engineering design.

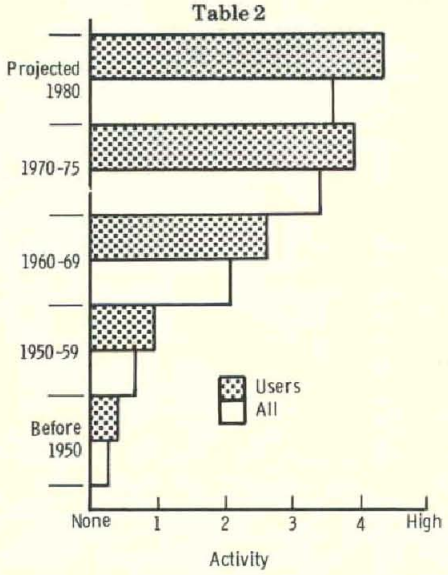
The survey was organized and analyzed by Dr. Thomas Rich and Peter Tracy of the Mechanics Research Lab, AMMRC, and Dr. David Cartwright of the Mechanical Engineering Dept., University of Southampton, England.

Questionnaires were distributed to approximately 700 designers, engineers and scientists throughout the United States as indicated in Table 1. The 235 questionnaires returned represent 32 percent of individuals reached and 46 percent of all places initially contacted.

Results are presented graphically in 35 individual figures as typified by Tables 2 and 3. Various sorting categories were established to add perspective to the results. Of special interest is a sorting and weighing on all questions according to the participants' indicated actual usage of fracture mechanics in design applications.

Other FM usage sortings in the survey include industrial organizations, U.S. Government agencies, universities, and material developers, for applications such as engines, pressure vessels, aero and ship structures.

Table 2



Growth of Activity in Fracture Mechanics Applications

FM applications also are categorized under Profile of Participants and Their Fracture Activity Area; Growth of Fracture Mechanics in Design; Use and Selection of Materials; General Design Aspects of Fracture Mechanics; Slow Cyclic Crack Growth; Fast Fracture; Nondestructive Testing; NDT Detection Data; and Future Considerations for Fracture Mechanics Use.

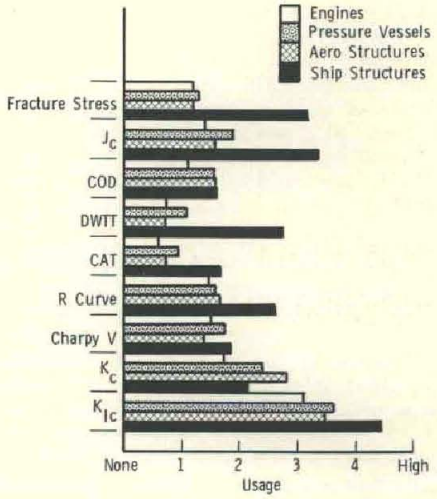
The questionnaire used in the survey is given in the appendix of the final report, *AMMRC MS 76-1*, dated February 1976, which is available from AMMRC. Information in the report can:

- Stimulate the increased interchange of FM information between researchers and designers by identifying areas of mutual interest.
- Determine areas and direction for future FM research by identifying important problems.
- Identify FM educational needs for the revision and extension of short-course offerings.

Continuing input to the established data base of fracture in design is being sought. Persons desiring to participate may contact Dr. Thomas Rich, AMMRC, Watertown, MA 02172.

The current phase of the AMMRC program

Table 3



Usage of Toughness Tests in Selection of Materials

involves the development of a format and selection of application areas for a collection of case studies that delve more deeply into FM usage.

Completion of this project, when coupled with the ongoing research efforts is expected to enable AMMRC personnel to consult more effectively with Army laboratories and manufacturers for the design of Army materiel.

Table 1 — Number of .....

NUMBER OF PARTICIPANTS IDENTIFIED WITH EACH DESIGN TYPE			
TYPE OF DESIGN	NO.	TYPE OF DESIGN	NO.
1. Adhesive Joints	29	23. Mechanical Joints & Fasteners	35
2. Aerospace Vehicles	52	24. Metal Forming & Casting	13
3. Aircraft Engines	15	25. Microstructures	29
4. Aircraft Structures/Airframe	77	26. Missile Structures	25
5. Analytical Methods/Mechanics	89	27. NDT	45
6. Bearings	7	28. Nuclear Structures	25
7. Bridges and Buildings	13	29. Passenger-Land Vehicles	2
8. Cargo-Land Vehicles	2	30. Piping	24
9. Control Systems	4	31. Pressure Vessels/Gases	35
10. Dental Structures	4	32. Pressure Vessels/Launch Tube	15
11. Electronics Equipment	2	33. Pressure Vessels/Submarine	15
12. Fatigue Prediction	115	34. Reliability Analysis	35
13. Fracture Control Planning	85	35. Rigs - Off-Shore Structures	4
14. General Structures	54	36. Rocket Motors	15
15. Geological Applications	6	37. Rotating Machinery/Electric	8
16. Helicopter Structures	17	38. Rotating Machinery/Turbines	22
17. High Temperature Applications	42	39. Shells	19
18. Internal Combustion Engines	6	40. Ships Structures	29
19. Materials Development	61	41. Standards Development	33
20. Materials Fracture Characterization	119	42. Structures Testing	55
21. Materials Production	13	43. Surface Coatings	10
22. Materials Testing/Evaluation	127	44. Welding/Fabrication	31

NOTE: The above totals are not meant to be interpreted as representing total effort in the field; they are intended to give a breakdown of the employment areas of the survey participants.

Cost Schedule Control System Accepted for Use at Edgewood

The Cost Schedule Performance Control System (CSPCS), designed as an improved management system to provide a tangible base for operating R&D programs and determining budgetary requirements, has been test proven and accepted for use at Edgewood Arsenal.

MG Harold F. Hardin, director of Procurement and Production at the U.S. Army Materiel Development and Readiness Command (DARCOM) recently visited the arsenal. He informed the management control system development team that CSPCS — as used on the Chemical Agent Munitions Disposal System Project — has been accepted as satisfying Cost Schedule Control Systems Criteria (CSCSC).

CSPCS has demonstrated it meets requirements for effective techniques to organize, plan, schedule, budget, collect costs and evaluate performance of all R&D projects under the system, and is designed to assist managers at all levels.

"The system's benefits have been proven and accepted, as evidenced by its current use throughout the Department of Defense," General Hardin said, in noting that this was the fifth successful Armywide application of CSCSC to in-house management systems. "However, while other applications have been limited to project-managed items CSCSC is used on a broader basis at Edgewood."

Department of the Army Letters of Commendation for their parts in implementing the criteria and operation of the system at the arsenal were presented recently to Bernard Aiken, comptroller; Charles J. Glebas, chief of the Cost Analysis Division; Albert E. Porkorny, a program analyst who served as the CSPCS project officer, and Harry L. Wilson, a computer system analyst in the Management Information Systems Directorate.

Laboratory Cross Section Measurement and Imaging Radar

By William G. Anaya

Development of a laboratory Radar Cross Section (RCS) Measurement and Imaging Radar, using scaled target models, is proving an analyses tool of significant utility resulting from camouflage R&D efforts at HQ U.S. Army Mobility Equipment R & D Command.

This article discusses the basic operation of the equipment at Fort Belvoir, VA, and its application in measuring and evaluating RCS and microwave imagery of tactical Army materiel.

The primary purpose of this laboratory equipment is to develop counter-surveillance techniques to reduce probability of detection of tactical materiel from radar surveillance.

Radar Cross Section analyses, using full-scale targets, present several limitations/problems that provided the impetus for developing this equipment. Testing problems and limitations are described as follows: 1) uncontrolled environment; 2) large complex testing and target mounting equipment results in time-consuming and costly testing; 3) lack of flexibility in the measurement facility generally provides analysis of only a limited number of aspect and grazing angles; 4) corrective countermeasures are difficult to implement and evaluate.

Laboratory radar equipment is utilizing an illumination frequency of 100GHz, which permits the target's physical dimensions to be scaled by the ratio of the frequency being analyzed to the illumination frequency of equipment.

For example, a 1/10th scale model of a target is employed to obtain cross-section and imaging data corresponding to a full-scale target at I-band (10GHz). Target features greater than a quarter wavelength contribute significantly to a target's radar return.

The degree of accuracy and fidelity of the target model is thus dependent on the objective. The dominant target return is generally from particular geometries that make up the complex target structure. Consequently, the linear and angular accuracy of these geometries are critical to the model's fidelity.

Two modes of operation are embodied in this equipment - the RCS mode and the diagnostic mode for imaging studies. A 100GHz CW source is used to illuminate the target area. A portion of the transmitted energy is sampled and used as the local oscillator source for the receiver, resulting in a homodyne receiver configuration.

The transmit and receive antennas are spatially separated and at right angles to each other, thus providing the isolation required for low noise measurement. A half silvered mirror is used to redirect the transmitted and target reflected energy, allowing this right angle configuration.

Separation of the target from the background is done by radially oscillating the target to the receiver, thus developing a target doppler procesed in the receiver. The ground plane can be completely reflective or absorbing, thereby allowing the target return for natural terrain to be weighted between these two extremes.

The RCS Mode is used to measure the total backscatter from the target at all aspect angles and at most grazing angles. The target model is continuously rotated in azimuth at a grazing angle determined by tilting the ground plane with target mount to the angle of interest. In operation, the transmitted energy is directed toward the half-silvered mirror.

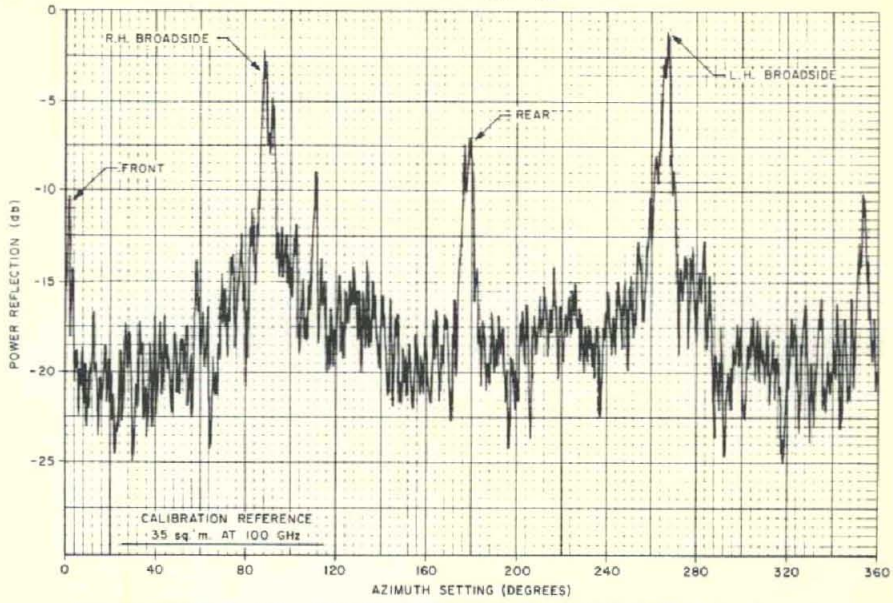


Fig. 1. RCS Plot of One-25th Scale Chieftain Tank Vehicle Polarization; 18-degree Elevation Angle Metallic Ground Plane

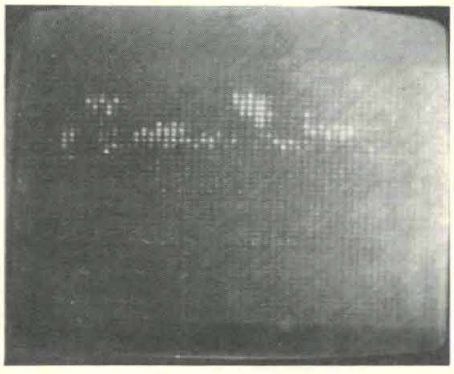


Fig. 2. Microwave Imagery

About half of this energy passes through the mirror and is absorbed by the Radar Absorbing Material (RAM); the remainder is reflected toward the target area. The entire target is illuminated with the target backscatter, then directed through the half-silvered mirror to the receiver.

Since the target is being oscillated at a known velocity, a target doppler of known frequency is generated. The receiver extracts and processes this doppler, recording amplitude as the target model is rotated resulting in an X-Y plot of RCS (dbsm) over a continuous range (360°) of target aspect angles.

Figure 1 depicts this type of data display. Target statistics can be derived and high amplitude returns requiring further analysis can be identified from this data. A calibrated target with a known RCS is used to establish a reference amplitude level.

Diagnostic Imaging Mode main components are the same as used in the Monostatic Mode, i.e., the transmitter, receiver, the half-silvered mirror and the target mounting equipment. Additions to provide an imaging capability for locating dominant target scatters include a vertically traversing microwave lens, a lateral indexing system for incrementally displacing the target and ground plane, and a closed circuit TV system.

The energy ray path is identical to the path described in the Monostatic Mode. The design of the micorwave lens provides a resolution of one-half inch, which for a 1/10th scale target would be equivalent to a 5-inch full scale resolution at 10GHz. The complete scan results in a 2-dimensional microwave image of the dominate scatters that make up the target return.

This imagery is stored on a data conversion and storage unit (DCSU) whose contents can be read out and displayed in real time, or as-needed basis on a CRT monitor. The location, pattern and intensity or cross section can now be analyzed and photographed as shown on Figure 2. The DCSU contains several modes of operation which permit calibration, summing, and weighting of the scatters of target areas.

The equipment described can be made available to interested government or civilian activities. Further information and technical details can be obtained through several reports on this equipment or by contacting Commander, MERADCOM, Fort Belvoir, VA 22060, ATTN: DRXFB-R.

WILLIAM G. ANAYA has been engaged in camouflage assessment and research and development since joining Lab 4000 at MERADCOM in January 1975. Prior to that time, he spent nine years in electronic engineering design at Fairchild Industries. He holds a BSEE from George Washington University, and is working toward an MSEE at Johns Hopkins. From 1959 to 1963 he served in the U.S. Navy as a fire control technician.

Implementing DARCOM 'New Way of Doing Business'...

TACOM Realignment Separates R&D From Logistics Functions

Transitional changes phased into the U.S. Army Materiel Development and Readiness Command (DARCOM) "new way of doing business" are progressing in two new organizations, activated July 1 from facilities and manpower resources of the former U.S. Army Tank-Automotive Command (TACOM), Warren, MI.

The U.S. Army Tank-Automotive Research and Development Command (TARADCOM) headed by MG Oscar C. Decker and the U.S. Army Tank-Automotive Materiel Readiness Command (TARCOM), headed by MG Chester M. McKeen, collectively have the same basic mission as under TACOM.

General Decker succinctly defined the over-all goal as "To develop, acquire, field and support the best tank-automotive equipment available." General McKeen, former commander of TACOM, emphasized that the two commands will have to work closely together to make the new concept of operation succeed.

DARCOM's new way of doing business, being implemented throughout all its major subordinate commands, stems - as nearly everyone knows by now through the news media - from recommendations adopted substantially from the report of the Army Materiel Acquisition Review Committee (AMARC).

AMARC's long study of U.S. Army Materiel Command acquisition of weapons systems and equipment showed that research and development activities were hampered by ever pressing concern with logistics support for materiel already in the field.

This determination resulted in a proposal that the total materiel acquisition process (RDT&E) be separated and oriented on a systems basis from the logistics and materiel readiness functions by command-wide reorganization.

Following the AMARC basic operational concept, all research, development, and new materiel acquisition-oriented functions are now assigned to TARADCOM. This includes initial procurement and deployment of tank-automotive equipment.

The Readiness Command then takes over responsibility for follow-on procurement of end items and repair parts, as well as follow-on logistics, for the equipment's complete life cycle.

With the formation of the AMARC recommendations implementation team in March 1973, under the direction of COL Frank A. Matthews, the groundwork for the establishment of the new commands started on a sequential, time-phased basis.

The Command Group and the Office of the Secretary of the General Staff of what is now TARADCOM were established Oct. 15, 1975. TACOM Research, Development and Engineering Director COL Ronald E. Philipp was given additional duty at that time as acting deputy commander of the provisional organization.

Shortly afterward, TACOM's RD&E Directorate, the Plans and Readiness Division, Engineering Support Division, Foreign Intelligence Office, and the Office of the Educational Adviser were placed under operational control of the Development Command Control Group.

Additional provisional TARADCOM elements established by early January 1976 included the Engineer Support Directorate, Configuration and Data Management Office, Test Management Office, the Sheridan M551 Special Project Office, Administrative Services Office, and the Office of the Comptroller.

M60A1s waiting to be taken to the one-mile oval test track adjacent to the Detroit Arsenal Tank Plant where a final 50-mile test is conducted before shipment to combat elements.

Meantime, the Engineering Directorate, comprised of the Technical Data Division and the Engineering Division, both originally part of the RD&E Directorate, separated from the provisional Development Command and returned to TACOM.

TACOM directorates such as Product Assurance Procurement and Maintenance also began separating development from logistics functions. TARADCOM and TARCOM became a reality with their activation July 1, 1976.

TARADCOM responsibilities encompass management of basic design, development, and modification of tank-automotive items and other assigned research projects, including reliability and maintainability assessment, test policy and over-all test management.

Additionally, TARADCOM manages the integrated logistics support for initial fielding of these systems, and performs quality assurance through development and early deployment of weapon systems, secondary items, system-peculiar parts, and subsystems.

TARADCOM engineering functions include research, development, advanced development, engineering development, and EPR (Equipment Procurement Report) correction. Approximately 4,000 Equipment Improvement Reports (EIRs) on tank automotive equipment items are received from the field each year.

EIRs are now being divided between each command according to requirements. Major product improvements will be done by TARADCOM for both commands, but each command will handle minor product improvements in assigned areas.

TARADCOM's Research and Development Laboratories carry a major share of the command's mission assignment. More than a third of the total TARADCOM staff of 838 civilians and 37 military are assigned to the laboratories, headed by Paul Denn.

The in-house RD&E Laboratory is comprised of an Armor and Components Division, Propulsion Systems Division and a Science and Technology Division. The mission is to direct RD&E methodology for materiel development, including design of armor, components, track suspension, power package, as well as systems engineering, and also support project managers.

Chief Scientist Dr. Ernest Petrick provides an overview of the research, development and engineering efforts for the commanding general - to insure integration of these command activities for maximum effectiveness - and provides technical liaison with other governmental agencies, civilian activities and the research elements of foreign governments.

The Cost and Systems Analysis Office is a TARADCOM element which prepares study results to aid decision-makers. Widely diversified studies that may be assigned to the mechanical engineers and operations research analysts reflect an ability to react quickly. The analyses are expected to be significant factors in the Decision Risk Analysis Program.

The Foreign Intelligence Office, moved from TACOM to TARADCOM, is responsible for acquisition, evaluation, use and dissemination of foreign scientific and technical information. Similarly shifted, the Test Management Office plans, coordinates, directs, controls and manages test activities and pertinent information.

Integrated Logistics Support is another important TARADCOM function. This includes responsibility for initiating, developing and publishing policies, doctrine and techniques for adequate logistics support of tank-automotive vehicles, and weapons systems being introduced to the customer. Initial provisioning, preparing manuals and other publications, logistics engineering support, repair parts, tools and training are concerns of this activity.

The Engineering Support Directorate directs and manages assigned programs in support of product and project managers. Organized into four units, each with its specialized functions, the ESD has Design Fabrication, Tech Data, and Tech Support Divisions.

A Plans and Force Development Office has been incorporated into the TARADCOM organization to direct research and planning; also, to

MG Oscar C. Decker
TARADCOM Commander

MG Chester M. McKeen
TARCOM Commander

MG Robert Baer
XM-1 Project Manager

BG Stan R. Sheridan
MICV Project Manager

BG Donald M. Babers
TARCOM Deputy Commander

assure availability and preparation of technical plans, resources and budgetary requirements.

Two TARADCOM special offices, reporting directly to the commanding general, are the Improved TOW Vehicle (ITV) Project Manager's Office and PO.M551 (Sheridan) Systems

Project Manager COL Charles C. Adsit is working on the Improved TOW Vehicle, which will provide additional protection for the crew when the Army's Tube-launched, Optically tracked, Wire-guided antitank missile is used on the M113 Armored Personnel Carrier.

The charter for the TOW Project Manager's Office was approved Mar. 8, 1976. Competitive development with three contractors (Northrop, Emerson and Chrysler) is under way and a winner will be selected before the end of the year.

A comprehensive M551 (Sheridan) Product Improvement Program has been developed by TARADCOM, including nearly 50 sub-PIP tasks having an estimated cost of more than $45 million.

Under the reorganized structure, TARADCOM is assigned a contractor-operated Advanced Concepts Laboratory (ACL). Battelle Memorial Institute, Columbus (OH) Laboratories, was awarded a 3-year contract in March 1976 to establish, manage and operate the ACL.

An ACL Technical Office provides management direction by monitoring, supporting and evaluating contract performance. Standards are applied to effectiveness in support of ground mobility concepts, systems and components.

While some functions are shared, each of the new commands has separate financial management capabilities. TARADCOM programs and budgets its own RD&E programs. Both TARCOM and TARADCOM have their own procurement appropriations for major items. TARCOM has the appropriation and the procurement function for secondary items, stock fund, and financial and accounting services for both commands.

TARADCOM has an Initial Acquisition Directorate as part of its basic structure. Each command will handle its own procurement planning, contract evaluations and executions, but TARCOM will furnish procurement support and small business aid for both commands.

TARCOM will provide support for both commands, including: publications, initial provisioning, maintenance engineering, NICP functions, international logistics, depot operations, modification work orders, and the methods operational research procedures (MOP) shop.

In the product assurance area, TARADCOM

(Continued on page 18)

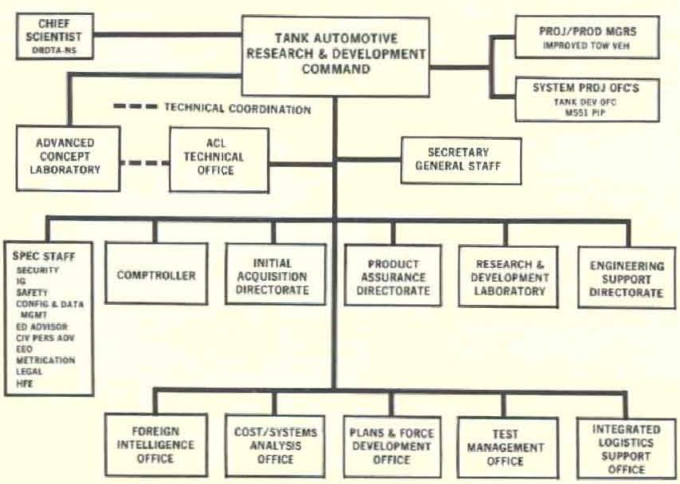
Dr. Ernest Petrick
TARADCOM Chief Scientist

Systems Assigned to TARADCOM

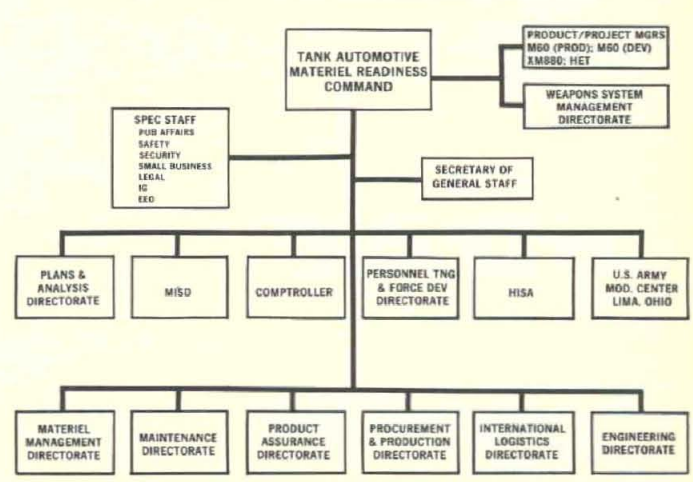
Improved TOW Vehicle (TOW Under Armor)
Improved Infantry Fighting Vehicle
Extended M113 (APC)
ROLAND Vehicle System
XM860 Patriot (SAM-D) Trailer
XM871 - 22 ½-Ton Trailer
M857 - 5,000 Gallon Fuel Tanker
¾-Ton High Mobility Truck
4-Ton High Mobility Truck
8-10-Ton High Mobility Truck
Advanced Air Defense Demonstration System Vehicle
Forward Observer Vehicle
Small Unit Support Vehicle (SUSV)
Combat Support Vehicle
22 ½-Ton Trailer, Self load/unload
Remote Controlled Target Vehicles
HIMAG (High Mobility Agility)
ATE/ICE (Internal combustion engine diagnosis)
STE/ICE (Internal combustion engine diagnosis)
Manned Evasive Target Tank (METT)
Command and Contractor Training Vehicle (CCTV)
Miniature Moving Target (MMT)

Paul D. Denn
Acting Director, T-A R&D Labs

TANK-AUTOMOTIVE RESEARCH & DEVELOPMENT COMMAND



TANK-AUTOMOTIVE MATERIEL READINESS COMMAND



Tank-Automotive Command Reorganization

(Continued from page 17)

will provide the Reliability, Availability, Maintenance (RAM) Data Base for both commands. Each command will perform RAM engineering, first-article testing, quality assurance planning and execution, and production. Product assurance in depot overhaul is TARCOM's responsibility.

Additionally, TARCOM will furnish support by providing facilities, utilities, communications and such services as automatic data processing, a civilian-military personnel office, and legal, small business, public affairs, and historical reports.

TARCOM's principal staff includes a director for each of such functions as Personnel Training and Force Development; Procurement and Production; Materiel Management; Maintenance; Weapon Systems Management; International Logistics; Management Information Systems; Engineering; Plans and Analysis; and Product Assurance.

Financial control is maintained through the TARCOM comptroller. Separate office chiefs manage such areas of responsibility as Equal Opportunity, Safety Business, Legal, Inspector General, Public Affairs, and Security.

TARCOM's M60 tank program has a project manager for development, COL Robert Butler, and a project manager for production, COL Richard H. Sawyer. MAJ John W. Hocking is acting product manager for the Heavy Equipment Transporter (HET) Systems, COL Fred Hissong Jr. is product manager for the M880 1¼-ton Commercial Truck Systems, and COL Roy A. Cunniff is product manager of the newly chartered M113/M113A1 Family of Vehicles.

Completing TARCOM's key staff are commanders of Headquarters and Installation Activity, COL Fredrick B. White; the Lima Army Modification Center (LAMC), Lima, OH, CPT Roy Beauchamp; and the Support Activity-Selfridge Air National Guard Base, Mount Clemens, MI, COL Frank A. Matthews (after phasing out his AMARC Implementation Team).

TARCOM tenant organizations include offices of project managers for the Mechanized Infantry Combat Vehicle (MICV), BG Stan R. Sheridan, and XM-1 Tank Systems, MG Robert J. Baer.

Attached to the command are liaison representatives from the U.S. Army Audit Agency, Federal Republic of Germany, the Canadian Forces, Canadian Defence Production, U.S. Contract Budget Agency, U.S. Defense Contract Agency (Procurement), U.S. Army Electronics Command, U.S. General Accounting Office, U.S. Marine Corps, U.S. Army Training and Doctrine Command, Vehicle Rapid Fire Weapons Systems, and *PS Magazine*.

TARCOM's current authorized strength is 4,520 civilian and 259 military personnel. Command responsibilities include integrated management of procurement, production, maintenance, supply and repair parts support of fielded tank-automotive systems, including construction and material handling equipment. Similar services are provided to friendly foreign nations involved in Foreign Military Sales, and Military Aid and Assistance Programs.

TARCOM provides a major logistic function as the National Inventory Control Point (NICP) and National Maintenance Point (NMP) for the vehicles and equipment it manages. The TARCOM Support Activity-Selfridge, with its 224 military and civilian personnel, is responsible for selected maintenance and facilities engineering, and related support services.

An Army Tank Office (ATO) commanded by LTC Harry A. Baker was established in 1974 as a focal point to strengthen management responsibilities associated with M60 tank production.

The Materiel Management Directorate (NICP), headed by COL Edgar L. Weathers, has a current operations and maintenance budget of $14.6 million, and a Secondary Items budget of $87 million. About 40,873 Army Stock Fund items are listed. Inventory value as of June 30 was $701.9 million.

The directorate's emphasis on quality performance was recognized when it was selected by DARCOM in 1974-75 as the most improved NICP in effectiveness. In DARCOM's most recent evaluation of the performance of its NICPs, TARCOM still ranked number one.

The Maintenance Directorate (NMP) has a commitment in excess of $15.2 million, and total contractual obligations in excess of $3.5 million. Budgetary items include provisioning requirements, maintenance engineering/evaluation applications, depot conversion, modification and retrofit programs, modification kits, and publications development.

The directorate operates under a systems-oriented concept which places major maintenance emphasis on field support, and it has NMP responsibilities for fielded tank-automotive equipment around the world. Its Systems Support Division responsibilities include maintenance analyses, master data record file purification, publication assessment and control, and development and management of test, measurement and diagnostic equipment.

Technical Assistance and New Equipment Training are also directorate responsibilities. In-house training programs have been established at direct support maintenance level to coincide with introduction of new equipment to the field.

NET teams are sent worldwide to conduct training efforts. Mobile maintenance technicians act upon requests in support of the NMP mission, some for logistics assistance, others in support of new equipment training.

Depot maintenance responsibilities remain essentially unchanged under the reorganization. These involve surveillance of overhaul, repair, renovation, fabrication, reclamation, conversion and modification programs.

The Product Assurance Directorate is charged with maintaining the highest standards of quality tank-automotive equipment in the field. It relies on obtaining timely feedback data on the quality of products being used to establish appropriate control procedures. Quality assurance is centered on the reliability, availability, maintainability and durability (RAM-D) areas.

Tank-automotive assigned items requiring a special level of intensive management are handled by TARCOM's Special Item Management Office. Included are the GOER family of vehicles (M559 tanker, M520 cargo and M533 wrecker trucks), the M561 Gama Goat rough terrain vehicle, M88/M88A1 medium recovery vehicles, and commercial construction items.

The International Logistics Directorate, under COL Richard L. Bryant, is responsible for all international logistics aspects of assigned tank-automotive items. Total sales increased from $1.7 billion (FY 75) to $3.1-billion (FY 76).

Specific programs include Foreign Military Sales (FMS), Supply Support Arrangement (SSA), Constructive Deliveries, Grant Aid (GA), Quality Assurance, Co-Production, Materiel Handling Equipment (MHE), Commercial Construction Equipment, and utilization of MIMEX (Major Items for Map Military Assistance Program from Long Supply for Excess).

Open foreign military sales totaled about 1,271 transactions at the end of FY 76 with international logistics deliveries totaling $705.5 million. SSA programs reached 12,250 (total sales of $18 million for FY 76).

The IL Directorate is responsible for insuring that standards of quality are maintained on all assigned tank-automotive items in the IL Program. Under DARCOM guidance, quality assurance teams are sent to recipient countries to provide required support services.

The Directorate for Management Information Systems has responsibilities for TARADCOM and TARCOM, involving systems planning, review and design, and development and programing management. The MISD manages data processing equipment, Class A microfilm programs, the technical data center, and the over-all information systems program.

MISD personnel provide around-the-clock service, operating on a 24-hour, 7-day week schedule. Five major digital computer system types are employed.

The Headquarters and Installation Support Activity (HISA) has management responsibility for use of Detroit Arsenal, and provides logistics support for both TARADCOM and TARCOM. Both commands are located on a 333-acre tract in Warren, MI, 17 miles from the heart of Detroit. This site is also the home of the Detroit Army Tank Plant, a government-owned Chrysler-operated facility currently producing the M60A1 Main Battle Tank.

The establishment of the two commands (TARADCOM and TARCOM), while not requiring additional space, required relocation of organizations and personnel within the existing facilities. This was to group functionally related organizations to provide an integrated effort toward mission accomplishment.

Spokesmen for both commands are quick to agree that TARADCOM and TARCOM have not been spared the normal administrative headaches generally associated with implementation of a major reorganization. Almost everyone expected problems in affecting the change, so when they came, no one was surprised.

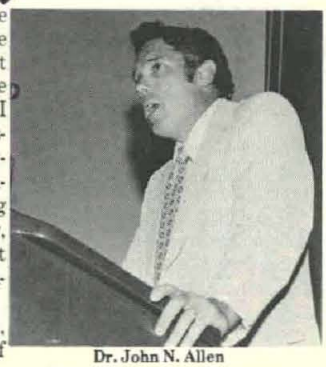
What has surprised most sources is how smoothly the transition has been accomplished so far. The commanders have expressed determination to resolve problem areas, get on with the job, and prove the soundness of the new operational concept.

M551 Armor Reconnaissance/Airborne Assault Vehicle, assigned to TARCOM Weapon Systems Management Directorate, is involved in Product Improvement Program.

Speaking On . . .

(Continued from inside front cover)

nological advances to improve force capabilities. He is presently director of Advanced Systems with Martin Marietta Aerospace.



Dr. John N. Allen
Deputy Director (R&T) ODDR&E

It is widely agreed that, at the present, the U.S. has both the strongest and the most efficient technological capability in the world. The basic reason for this, I believe, is that we have historically, and perhaps unwittingly, enjoyed good technology transfer. That is nothing to get complacent about, however, since it is also widely agreed that the U.S. dominance in high technology is eroding.

The DoD Technology Base, although only about 20 percent of all federally funded technology base work, has been the country's dominant contributor of useful new technology. Everyone here is certainly familiar with our success story on computers, jet aircraft and integrated circuit technology.

I recently did a back of the envelope calculation and concluded that these three industries and their direct off-shoots provide about two million jobs in the U.S. and $50 billion a year cash flow. This success is clear evidence of successful - if fortuitous - technology transfer. Again, this is nothing to get complacent about - DoD's contribution is said to be slowing down.

I believe that we - the nation as a whole and the Department of Defense in particular - have been lucky so far in having stumbled into good technology transfer. We did this without either understanding why we had it or even appreciating that we did. However, the time has come when things are starting to degrade and this degradation is, I believe, in no small way due to a loss in our technology transfer effectiveness.

Furthermore, things will continue to degrade unless we understand our technology transfer strengths and exploit them, and understand our technology transfer weaknesses and fix them.

Since it is clear to me that the future of our military capability, and indeed of the economic strength of the country as a whole, depends in no small way on the productivity of DoD technology, I welcome this opportunity to share views of this situation with you.

The subject of this session is *technology* transfer; not *science* transfer or *product* transfer. To understand this subject, one must make a clear distinction between science and technology and the way in which they are transferred.

The dictionary is of little help in this regard - although you might be amused to note that it defines science as "any activity that *appears* to require study and method." It also simply defines technology as the application of science.

During this discussion, I think it is more useful to define science as the discovery and verification of new facts, and technology as the *process* of transferring scientific fact into useful products.

Note that, to a first approximation, I do not include the products themselves as part of technology. I subscribe to the view of the recent Defense Science Board Task Force on Technology Export, that one conveys technology only to a small degree (and with a large time lag) by conveying the end product of the process.

I think it is obvious that most *science* transfer is accomplished quite satisfactorily by the written word. On the other hand, *technology* is very different from *science*, and *technology* transfer is very different from *science* transfer. There are many factors that contribute to effective technology transfer.

Rather than try to be encyclopedic - and thus steal much of the thunder from those who follow - I would like to concentrate on one contributing factor out of many. I believe this particular factor to be one of the most important, if not the most important, in the transfer of so-called "high technology."

I must warn you, however, that the point of view I am about to express and enlarge upon is one that this audience may feel a bit uncomfortable with, and I will feel a bit uncomfortable expounding on it here. However, it is a point of view that may shed some light on some of the actions from my office, so I believe we should all endure the discomfort and address the issue.

My central thesis is this: since technology is the part (art part) science of *doing* things and *making* things, it is most effectively transferred by people *showing* other people, using the tools of the trade - a sort of apprenticeship.

It follows logically then that transfer of really elegant and complex technology - our much touted "high technology" - is greatly facilitated by the relatively free movement of people from one organization to another carrying their know-how with them.

I think this recognition explains an important reason why the U.S. has, as I said earlier, excelled at technology transfer. The general mobility of the U.S. society, aided and abetted by the competitive, free enterprise system, has led to a high mobility of its engineers and technologists, with much job swapping and even pirating, especially in the 1950s and early 1960s.

That observation can, in itself, lead to some interesting thoughts about the national technological posture; also, steps that the nation should take to preserve it. However, let's not pursue that now.

I would like instead to concentrate here on the implications of my perception of the importance of personnel mobility - on how I believe the DoD technology base program should be organized and executed to maximize our technology transfer.

New technology finds its way into military systems almost always through the proposal route. What shows up in proposals need not - and often does not - originate in the proposing industry. Frequently the Requests for Proposals or other guidance contain strong "suggestions" regarding new technology that would be welcome.

These "suggestions" are often stimulated by the DoD laboratories, by industry salesmanship, or occasionally even by Office of the Secretary of Defense direction. Wherever they come from, however, the ultimate burden of proposing and *executing* the technological advances falls on the contractor.

Under the current constraints of design-to-cost, fixed-price contracts, cost-plus incentive-fee contracts, etc., a company is reluctant to bid on a technology that it does not feel it understands thoroughly and has the capability to deliver well in hand.

Therefore, it seems reasonable to conclude it is a prerequisite for effective technology transfer that a new technology must be widely disseminated to industry. One should not lose sight of the fact that, as other nations become more technologically sophisticated, all technological innovation becomes a race against the clock, so speed of transfer as well as efficiency is important.

These are formidable problems in transferring technology from our laboratories to industry. We can help the situation in ways to be discussed by the other speakers. But we must overcome a substantial drawback at the outset. There is very little personnel flow from the (DoD in-house) labs to industry.

We can argue about why this is so and we can even try to change it. For now, though, that is how it is. Consequently, to get high technology into industry rapidly, one just about has to develop the technology there in the first place.

Getting technology widely disseminated throughout industry, once it is there, is not difficult, if it is technology with an evident application (that is, high expectation of commercial payoff). Financial incentives in areas of high interest assure rapid diffusion of new technology, sometimes referred to as "pirating."

My conclusion is, therefore, that the generation of new technology - in those fields with commercial interest - will be much more intensive and extensive if most of the new technology is developed in industry in the first place.

The trend of past years of an increasing in-house DoD Technology Base is therefore to be viewed with serious concern. I believe it is a significant factor in diminishing our technology transfer both to military systems and to civilian use.

What does this leave for the laboratories? Well, first of all, there are clearly some areas of little industrial interest in which the laboratories can and must be the dominant force. Even in those areas of intense industrial interest, I believe there are strong roles for our in-house laboratories working in partnership with industry as (1) *sources* of new ideas, (2) *filters* of ideas for useful applicability, (3) *formulaters* and executers of both the in-house and contract of Technology Base programs, (4) *direct contributors* to systems developments, and (5) *advocates and promoters* of quality technology throughout DoD.

(Continued on page 20)

SPEAKING ON . . . *(Continued from page 19)*

People of high technical sophistication, who put the interests of the DoD above those of any stockholders, are needed to decide what technologies should be pursued, to prioritize the new starts, to decide which routes to new technology are most likely to pay off, to monitor efforts to keep them properly oriented, and to insure that the results of the contract program are recognized and communicated throughout the relevant parts of the industrial world.

These considerations are factors underlying the Deputy Director of Research and Engineering's move to reverse the growth of the Technology Base in-house ratio and to somewhat reorient the laboratories' role in R&D. Specifically, we are proposing to offset the decrease in in-house Technology Base execution by increased lab participation in the Technology Base planning and monitoring process and by increased support to System Development Managers.

We have directed that the Technology Base in-house ratio, which stood at 24 percent in 1968 and subsequenly reached 43 percent in 1974, should be reduced substantially. The apportionment of this over-all direction to the Army, which is by far the most in-house of the three Services at over 60 percent, has led to an agreement that an appropriate over-all ratio would be about 40 percent.

It should be carefully noted, however, that our guidance concerned only the over-all ratio and general guidance on a few specific areas that we felt were especially out of line. We have not directed - nor do we believe - that each and every program element or laboratory should adhere to the same percentage. The apportionment has been left to the Army. Let me summarize then by restating my beliefs:

- The economic welfare of the U.S. depends strongly on an aggressive innovative technology program.
- DoD can and must continue to be the major factor in driving new technology in the U.S.
- Time is of the essence in maintaining our technology leads against potential adversaries and our competitors and, consequently, effective technology transfer is of paramount importance.
- The single most important contribution to effective transfer of high technology is the inter-organizational movement of skilled scientific and technical personnel carrying know-how with them.
- Since the mobility of people is greater in industry than in our in-house establishments or from in-house establishment to industry, technology transfer is better within the industrial community in areas of industrial interest.
- Consequently, in areas of the Technology Base of high industrial interest, the bulk of the program should be done in industry. The historic trend in the past 10 years to increase the in-house program is adversely affecting technology transfer and must be reversed.
- There are important roles that the laboratories are uniquely capable of playing, even in those areas of high industrial interest, and it is important that we get the laboratories into these areas and that they perform them well.

Recent changes instituted in the Technology Base are driven by our desire to produce the most innovative and productive technological program possible within our resources.

Technology transfer is a major key to the success of such a program. I hope I have convinced you that we take it very seriously. It is a major motivation behind the changes in the Technology Base which have been initiated in recent years.

Technology transfer has been defined as a planned effort to move technology from the laboratory to meaningful applications. An important part of technology transfer is deciding what to work on in the first place.

Our primary objective is to develop a research and development program, both Independent R&D and contract R&D, that focuses on the critical technical issues for our weapon system and space system activities and ambitions. That is, we want to be generating meaningful technology to transfer.

Dr. Joseph Sternberg
Director, Advanced Systems
Martin Marietta Aerospace

Since a substantial part of the over-all technology base is developed in government centers, it is essential that we have extensive working relationships with them.

In the time available, I want to make a few remarks about how we go about deciding how to spend our Independent R&D funds, with the emphasis on military applications. Our criteria for effective technology transfer include: 1) technological edge in new business competion; 2) technical performance on system development programs. This leads to two principal objectives, developing convictions on future requirements and developing problem solutions.

Future requirements are a tough problem. We recognize its complexity and pitfalls - but we cannot wait for someone to tell us. Our convictions have to be strong enough for us to fund the work.

Our approach to these objectives may be summarized as: 1) emphasize future system studies; 2) focus IR&D program; 3) give R&D director the authority to pursue innovative technology; 4) seek R&D contracts in relevant technological areas (develop from IR&D results and compete for government initiated technology programs; 5) arrange dialogue for program directors and key investigators.

System studies are intended to develop an understanding of the military problem, the limitations of current systems, and the potential of new systems. We bring our own slant on technological possibilities to these studies, which provide a basis for an effective interchange with government experts struggling with these issues.

The results of these studies are an important element in focusing our IR&D program on the critical technical issues. At the same time, it is important to give each R&D director the necessary authority to pursue innovative technology, even if we are not yet clear how it can be effectively used in a new system.

While we actively seek relevant R&D contracts, the IR&D program enables us to enter new areas and to follow our convictions where there may be different views than in the government laboratories. This flexibility is vital to effective IR&D.

Many formalized reviews are established to examine the rationale and context of our IR&D program. But that is not a substitute for direct and frequent dialogue between program directors, who should have the best grasp of new system requirements, and principal investigators, who should have the best grasp of new technology.

Because of our size, we have an inherent advantage in providing for this necessary direct interchange between system requirements and technology. The government has to struggle continually against formidable institutional barriers.

The internal allocation of IR&D resources usually can be described as a fierce controversy. The result inevitably reflects a compromise between short-term and long-term objectives. We devoted about 20 percent of our resources on research, 45 percent on development, and 35 percent to new system and technological studies. This shows the importance we attach to studies as a key way to focus the R&D.

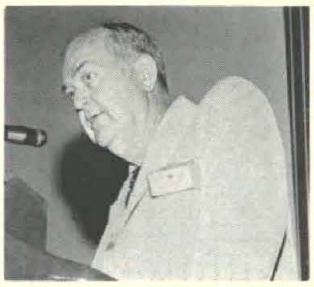
R&D directors determine about 57 percent of the research, 28 percent of the development and 61 percent of the studies. While I have emphasized IR&D, this effort accounts for only about 28 percent of the total R&D technology base program (excluding advanced and engineering development). In many cases, the contract R&D work, totaling roughly 72 percent, has developed from previous IR&D.

I would like to close by mentioning a good example of successful technology transfer, the cannon-launched guided projectile (CLGP), now called Copperhead. The advanced development phase of the CLGP program has convincingly demonstrated the feasibility of accurate delivery of artillery shells against moving tank targets by means of semi-active laser guidance.

Government work in semi-active laser and high-g technology has been under way for some time. In the early 1960s, the Army Ballistic Research Laboratories and others were experimenting with cannon-launched upper atmosphere probes. The first work on the application of semi-active laser technology was initiated by the Army Missile Command.

Our programs on semi-active laser applied to missile systems started in the early 1960s and represented a large contract and IR&D investment before the initiation of the CLGP competition. We first became involved in high-g technology in the late 60s when a hard lander was being considered for the Viking mission to the planet Mars. More recently, we have been involved in this area in connection with applications of earth penetrators.

The CLGP program was a timely and effective application of these technological developments, in government and in industry.



Dr. John McDaniel
Director, MICOM R&E Lab

My remarks on Technology Transfer from the Developer's View will highlight the mechanisms we employ at the Army Missile Command. As MG Daniel stated earlier, our emphasis is on technology transfer from one Army activity to another, between the Army and other DoD and Federal Government agencies, between the industrial community and the Army, and from the Army to state and local government agencies.

To effect the transfer of technology, one must be aware of its origin. Within the development community we depend on many sources of technical information. Much of our technology base is derived in-house and from other Department of Defense (DoD) and government-wide laboratories.

We also consider the importance of an adequate data-gathering system that permits our bench scientists and engineers to draw from the Independent Research and Development (IR&D) of industry.

The outputs of research institutes and universities are also considered in the formulation of our own programs. Our laboratories participate with the Army Research Office-Durham in its research programs by maintaining primary scientific cognizance over contracts and grant tasks.

Finally, to keep us current with respect to the full spectrum of systems technology, we look at foreign systems and often undertake evaluations to determine whether we can derive useful information for Army missile requirements.

Our transfer mechanisms include: personal contact; selective disemination of information; information and analysis centers; technology utilization offices; international technical coordination programs; technical conferences and symposia.

Over the past 10 years these transfer mechanisms have evolved, survived the test of usage, and are generally employed in some combination by the development community to overcome the barriers to effective technology transfer.

For example, a MICOM Inventors Council was established to accelerate the coupling of novel ideas with mission requirements. What we have tried to do is provide the bench scientists with an easily accessible "channel to management." We use approaches such as the technology base, matrix management, IR&D technology utilization system, research and technology resumes, and a terminal homing data bank.

Our objective is to build hardware to satisfy requirements in the four areas of close combat, fire support, airmobile, and air defense. I should note that requirements in these areas are defined in the Army Scientific and Technology Objectives Guide (STOG) which was mentioned by the previous speaker . . . . The management trick is to use effectively functional disciplines and existing or emerging technologies for application to future and fielded weapon systems.

Our laboratory matrix organization has been set up to achieve transfer, using the technology base generated by our functional directorates and the couplers for conceptual, developmental and fielded systems. This involves working with the users (Infantry, Armor, Field Artillery, Air Defense, and Aviation Centers) and through our Advanced Systems Concept Office with the Concept Teams (Close Combat, Fire Support, Air Defense, and Airmobile) on componentry for various missile systems (Patriot, Pershing, Stinger, Lance, Hawk, Roland and others).

The Advanced Systems Concepts Teams were formed to enhance the initiation of new missile concepts and to decrease over-all missile system life cycle development time. Teams are each assigned material concepts and have a responsibility to review and analyze state-of-the-art technology in MICOM laboratory's functional activities as well as other government agencies and industry.

Team members closely coordinate their efforts with key laboratory personnel, in each of the technology areas, and the user centers and schools. Finally, they establish and manage programs to integrate technology into viable weapon systems concepts that have the potential of satisfying an Army need or requirement.

Each concept team is headed by a free-thinking, uninhibited career military officer. These officers maintain close liaison with the combat development activities of the user community and other DoD elements. Each military leader is assisted by engineer(s) having an ability to integrate advanced technology. The teams are intentionally kept small because the required technical support is provided by laboratory personnel.

In the case of developmental and fielded systems, we enhance the Technology Transfer process by means of what we refer to as Ad Hoc Laboratory Representatives. They attend all project staff meetings, are totally cognizant of all current and potential technical problem areas related to that project, provide feedback to the laboratory, and coordinate laboratory support to project managers.

The charter under which these representatives function requires that they be familiar with the capabilities of the Missile Command Laboratory, and with the DARCOM laboratories, so that existing expertise can be applied to solution of pressing technical problems.

This type organization is the best I have found to maximize technology transfer from functional areas to project and conceptual areas. The effectiveness of our matrix organization can be inferred by the fact that at least one major project office has been established each year as a result of coupling technology to established needs.

Our contractor IR&D technology utilization system is another management innovation to enhance our technology transfer capability. I should note that we devised the first automated IR&D data base within the Department of Defense.

IR&D is a program supported by the government and not sponsored by contract or grant, but by a negotiated agreement. It is in this area that the contractor does much of his research and technology homework in anticipation of future contracts.

The IR&D technology utilization system analyzes and indexes the tasks being performed by about 125 companies or profit centers under the government's $800 million annual investment.

Bibliographic information on each task is stored in a computer, and each month new entries are selectively disseminated to the functional activities of the laboratory, depending upon technical interest profiles. Additionally, retrospective searches of the computerized base are performed upon request.

The IR&D utilization program assures that our scientists engineers and scientific management are kept aware of the latest industrial advances in their fields. In addition to IR&D, our laboratory has on-line access to the Defense Documentation Center in Alexandria, VA, and the NASA Research and Technology Resumes.

Each year before we forward proposed tasks to higher headquarters for approval, we check our tasks against on-going DoD, NASA, and IR&D tasks to assure ourselves that we are not duplicating the efforts of others.

Though we have and use transfer mechanisms to check our in-house tasks against those being performed by Army, Navy, Air Force, NASA and industry, no convenient mechanism for checking against other departments of government exists. We are working on this problem now. The Army's Terminal Homing Data Bank was established along the lines of an information and analysis center to support MICOM's major-thrust area of terminal homing.

The data bank provides an Armywide target signature measurements data base of over 19,000 records that enhance the development of unique and effective terminal homing weapon systems. Timely transfer of technology is effected by the acquisition, analysis, storage, retrieval and dissemination of information.

Interest profiles have been established with Army, Navy and Air Force agencies concerned with terminal homing. These profiles are used to disseminate selective, on a monthly basis, current information to each terminal homing activity. Points of contact have been established with 28 Army agencies concerned with terminal homing disciplines to coordinate, for over-all visibility, data bank activities.

THDB users are afforded timely responses to stated data needs by means of our retrospective searching capability. This features an in-house developed computerized data base. Points of contact have also been established with 4 Air Force, 3 Navy and 1 Marine Corps research activities. The DARCOM THDB and the IR&D utilization system have proved very effective Technology Transfer couplers.

Up to now, I have talked about the philosophy of technology transfer, transfer mechanisms, and our approach to enhance the timely transfer of technology into viable weapon systems. Next, I should like to present some examples of Technology Transfer that reveal the "fruit of our laboratory and contractors' labor."

TABLE 1—IR&D TRANSFER TO MISSILE SYSTEMS

Technology	Company	Application
Storable Liquid Propellant	Ling Temco Vought	Lance
Signal Processing	Bell Telephone Labs	Spartan and Sprint
Radar Digital Processor	Raytheon	Patriot (Sam—D)
Microelectronics	Raytheon	Patriot (Sam—D)
Infrared Homing	Philco Ford	Chaparral
Laser Guidance	Hughes Aircraft	Hellfire
Terminal Guidance	Martin Marietta	Copperhead
Command and Control	Raytheon	Hawk
Simulation Documentation	Boeing	Roland

Table 1 shows some examples of how IR&D technology advances have been incorporated into military systems. The storable liquid propellant utilized by the Lance Missile System was an innovative approach to decreasing prelaunch preparation time while having the advantages available only from liquid propellant.

In Hellfire, the time for concept formulation was reduced by the application of IR&D technology. We have also analyzed the Raytheon IR&D program and can show a savings of approximately $70

million in research, development and production costs for Army, Navy, and Air Force systems over a 10-year period.

The MICOM IR&D data bank is being phased out coincident with full implementation of a Defense Documentation Center data bank.

A rather lengthly list might be used to show examples of technology transfer from the MICOM Laboratory to other Military Services, other U.S. Government agencies, and the nation's scientific community at large. My allotted time permits citation of only a few.

Some of you may not be aware that laser semi-active guidance technology was invented at MICOM. Through the use of informal tri-service working groups, the technology needed to build laser-guided "smart" bombs was transfered to other Department of Defense agencies - resulting in a new era of tactical warfare.

TABLE 2—MICOM Laboratory Technology Used by Other Agencies

Technology	Application
Propulsion	
First castable composite	Falcon
Manufacturing process for large solid rocket motors	Polaris, Poseidon, Minuteman
Polyurethane propellants	Polaris
Polyvinyl chloride propellant	Terrier
Aluminum fuel	Sparrow, Terrier, Polaris, Poseidon, Minuteman, Scout (All high-performance missiles)
Polybutadiene propellant	
M3 Squib	Sparrow, Falcon, Minuteman
Stablizing cast double-base composite propellant	Poseidon, Minuteman
Carboxyl-terminated polybutadiene	Sparrow, Minuteman
Nitroglycerin analysis	Pharmaceutical industry

The laser scalpel example represents an achievement that satisfies the intent of AR 70-57, as mentioned by General Daniel in his opening remarks. Personnel of the National Cancer Institute requested the Army's assistance in conducting experiments to assess the potential of a high-energy laser to destroy cancerous tumors in experimental animals.

This joint venture was made possible because of the high-energy laser technology that had been developed in our laboratory. Although we were pursuing only military missions, the fact that we possessed a capability to deliver large amounts of laser energy made us a unique source for such experimental equipment.

The progress of understanding laser energy effects on biological materials has been slow. Adverse effects have been observed. However, a beginning has been made and that beginning was made possible by the effective transfer of Army laser technology.

The subject of castable solid propellants (CSP) is one of the most prolific examples of technology transfer. We can see the long shadow that the Army has cast in CSP technology. Our advancements have been dynamic and have found their way into many missile systems of our sister services.

The last example listed relates to a recent in-house developed technique for improving the speed and accuracy of determining the content of nitroglycerin in rocket fuels. Since nitroglycerin tablets are used to treat certain heart problems, the parmaceutical industry has expressed interest in this new rapid and accurate technique. This example also falls within the purview of AR 70-57.

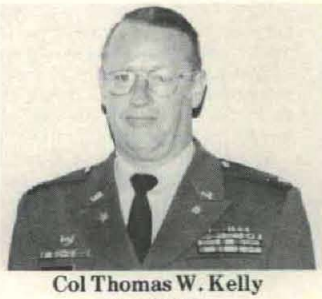
My last set of examples illustrates our use and adaption of technology generated by other services, NASA, and industry. As you can see, technology invented elsewhere has found its way into Army systems and system concepts - Hellfire, small rockets, long-range missiles, Lance, lasers and radar. (See Table 3.)

To conclude my discussion of the developer's view of technology transfer, I should like to leave this thought with each of you. Developers must not only plan to meet technology change; they must plan so as to cause technological change! This, I feel, is the secret to successful technology transfer.

TABLE 3—Laboratory Use of Technology From Others

Technology	Source	Application
Sidewinder Gyro & Seeker	Navy	Hellfire
2.75-Inch Rocket	Navy	2.75-Inch Rocket System
Lacquer Grade Nitrocellulose	Navy	IMP Chaparral Propellant
Hornet Missile	Air Force	Hellfire Test Bed
Directional Measurement Gear	Air Force	Long-Range Missile
Pulse Code Modulation	Air Force	Lance Telemetry
Aerodynamics	NASA Langley	Improved Hawk
Gas Dynamic Laser	AVCO	Army Gas Dynamic Laser
YAG Laser Materials	Union Carbide	Laser Designators
Pulse Doppler	Sanders Raytheon	FAAR/Radar
Pulsed Co, Lasers	Bell Labs	High-Power Lasers

COL Thomas W. Kelly, chief of the Doctrine and Systems Integration Division, Office of the deputy Chief of Staff for Operations, Department of the Army, opened his presentation on "An Army User's Approach to Technology Transfer" by showing a film clip depicting Soviet Army firepower. He continued:



Col Thomas W. Kelly
ODCSOPS

You have just witnessed the situation the U.S. Army in the field faces today - we look down the Soviet barrel. Our collective mission - yours and mine - is to "win the land war," while being outnumbered both in manpower and materiel.

In order to achieve this objective, we need highly trained troops and the best equipment that our technology can develop. In striving to achieve this goal, it is important that we understand the increasing threat on the modern lethal battlefield. I will limit my comments to the Soviets' quantitative advantage over the United States and their strategic doctrine.

In numerous critical areas, we are outnumbered and outgunned. The Soviets have a 7:1 advantage over the United States in numbers of divisions. The Soviets have five times as many tanks as we have.

In armored personnel carriers and fighting vehicles, the Soviets have approximately a 2:1 advantage. However, the Soviet BMP is a fighting vehicle and our M113 is a personnel carrier. Therefore, in considering fighting vehicles separately, the ratio will increase. The Soviets have a 3:1 advantage in artillery.

It is important to note that they have doubled the number of artillery tubes since 1965. They also have a 3:1 advantage in heavy mortars. We presently enjoy the lead in helicopters; however, the Soviets have begun to make gains in this area. And finally, the Soviet overall present production capabilities for producing war materiel are significantly greater than ours.

To defeat this threat, we must combine our tactical doctrine with our technological developments and create a combat force that will "win the battle." In doing this, we are not only challenged by the enemy, but also by our own resource constraints, especially in numbers of men and quantities of equipment. To overcome these shortcomings, we must continue research in those areas that have the greatest battlefield payoff.

Our scientific community must help our Army in the field to use technology to gain an advantage, forcing the enemy to spend his efforts, time and resources on countering our capabilities. Our goal must be to develop simple, capable, cheap and reliable weapons that will force and keep potential enemies on the defensive.

This is a "must" if we are to win outnumbered. In order to achieve these goals, the user and developer must work toward a common, integrated end. We must develop a continuous and institutionalized dialogue. The technological improvements we need must be a joint process resulting from the best thinking of both communities.

In our part of the dialogue we are faced with several dilemmas. We are like a horse being led by a carrot, seeing opportunities that look good to us and wanting them. However, this desire many times results in excessive expense and complexity. An example is NV goggles.

These image intensification goggles will be issued to all combat vehicle drivers operating in the forward area. They are designed to enable a vehicle driver to operate at night under blackout conditions. Our problem is that each set of goggles costs approximately $9,000. Complicating this is the fact that the two image intensification tubes on the goggles will need to be replaced about every two years of average use. The replacement tube cost is about $1,300.

In programing for only the minimum essential needs, a purchase of over 30,000 sets of goggles is required. Obviously, you can see the cost of this capability is very high. We need to challenge our innovative thinking and develop a system that will provide the same capability, yet cost much less, allowing us to issue night vision equipment to all vehicle drivers on the battlefield.

In addition to acquiring new systems that turn out to be very expensive, a major dilemma is that technology offers so much that we don't know what we want most. Recognizing our resource constraints, it is apparent that we can't afford all the systems we either want or technology promises - night vision devices, all types of anti-armor systems, precision guided munitions, new radios with secure

Speaking On ... *(Continued from p. 22)*

equipment, tactical automated systems, etc., etc. These resource constraints require us to prioritize our needs, and to make decisions that will provide us with the greatest battlefield payoff.

Sometimes we are victimized by new technology. We are driven into developing systems we may not need. Since we hesitate to lose a technological opportunity, we let the materiel acquisition system drive us toward a letter of agreement (LOA) requirement.

What we really need to do is continue research to build our technology base, and search for other needed battlefield applications technology can provide us. We are proceeding along these lines.

We are also victimized by our own development cycle. It takes too long for a system to go through the development cycle (often seven years or longer). During this time, the system may be affected by many things such as changes in the threat, or the administration, and changes in the Office of the Secretary of Defense and Army decision-makers - or new technology is discovered that presents opportunities to provide a better system.

Finally, budget constraints affect the cycle on a yearly basis. As you can see, this impacts both on the success of the system and the time it takes to get it fielded. These are some of the user problems.

As the user, we feel the scientific community needs to evaluate responsibilities in this dialogue. Today, scientists are challenged to develop weapon systems that are acceptable politically, fiscally and doctrinally. This task is not easy when the end product must provide the user the means to "win the war."

In order to accomplish this, it is your responsibility to develop new technology and recommend alternative ways to achieve our goals. These technological opportunities must be known to the user who, in conjunction with the developer, must decide on the cheapest and most effective way to achieve our joint goals.

Together, we must develop systems that are not overly complex yet possess a high degree of capability. We must understand that sophistication, in and of itself, is not bad so long as the system developed is simple to operate, cheap, reliable and built for rugged use.

In addressing sophistication, we must remind ourselves of the quality of soldiers who will be operating and maintaining these systems. In a recent analysis conducted by the Army Training and Doctrine Command, it was noted that the proficiency curve of a weapon system was greater when operated by a higher quality soldier . . .

However, we cannot afford to limit our systems to a select group of soldiers with high IQs. The systems must be designed so that the average soldier can employ the weapon with a minimum of training.

After discussing briefly some of the dilemmas confronting the user and developer to have a successful materiel development effort, I think we agree there must be an institutionalized user-developer dialogue. Currently, there has been progress toward improving this dialogue in the establishment of the science and tehcnology objective guide (STOG). The mission of the STOG is: to discover new capabilities and to find scientific or technical solutions to problems which restrict the Army's present/future mission performance.

This document provides definitive user technology objective guidance to the Army's R&D organizations and civilian industry. In the past there have been complaints that documents such as the combat development objectives guide were too general.

The STOG is more specific in nature. However, the development community will still have the flexibility to pursue alternative approaches to achieve the desired ends.

A key factor of the STOG is that the objectives are prioritized within their capability categories, providing relative comparisons.

In the Office of the Deputy Chief of Staff for Operations we feel that the STOG will contribute significantly to increasing user-developer dialogue, and that it represents a major step forward. We will continue to search for methods of improving this document and expanding the quality of user input.

Gentlemen, with the potential enemy threat that faces us on the lethal battlefield, a dynamic challenge is before us today. We must stay ahead in technology and insure that our efforts in the technology base are product directed. Our goal is to field an Army that if called upon, is capable of defeating the enemy.

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(Continued from outside back cover)

Sunday, Aug. 14, gave group members free time to get acquainted at Georgetown University or to visit places of individual interest in Washington, until the presentation of student technical papers in the evening.

The Aug. 16 program opened with two presentations that were soundly applauded. The first was "What is the Creature in Loch Ness?" This was a fascinating account of the several expeditions headed by Dean Robert Rines, Franklin Pierce Law Center and president of the Academy of Applied Sciences, Boston, MA, to determine - using the most sophisticated sounding and photographic techniques known to modern science - whether there actually is a "monster" in Scotland's Loch Ness.

The U.S. Army's acknowledged top expert on poisonous snakes, LTC James A. Vick of the Office of the Surgeon General, currently assigned as representative to NATO for medical operations, followed with an address on "Natural Toxins: A Benefit to Man."

Monday afternoon was devoted to a special program at the Smithsonian Institution and the evening offered scientific films at Georgetown University. Tuesday was a day of tours of scientific institutions and laboratories in the Washington area, rounded off in the evening with a performance of the special Bicentennial Celebration show, "1776."

Group members had a choice of tours to: National Institutes of Health, National Cancer Institute, the National Heart, Lung and Blood Institute, National Library of Medicine, National Institute of Allergy and Infectious Disease, National Institute of Child Health and Human Development, National Institute on Aging, National Institute of Dental Research, National Institute of General Medical Sciences, National Institute of Neurobiological and Communicative Disorders and Stroke, National Eye Institute, National Institutes of Mental Health (Alcohol, Drug Abuse, and Mental Health Administration), the Goddard Space Flight Center, and National Aeronautics and Space Administration.

Picatinny Arsenal technician Ed Mihok (right) explains mission of Quality Evaluation Laboratory to Bicentennial of American Science participants (from left) Norka Mulet, Florida, U.S., Diane Medved (rear), Kansas, U.S., Cathy Dennemeyer, Luxembourg, Wolfgang Meyer, Germany, and Dave Dalnodar, New Jersey, U.S.

Wednesday morning, Aug. 18, offered an insight into Georgetown University's scientific and laboratory resources in a series of 10 "mini courses," presented by faculty members. Visits were made to the Van de Graaff Accelerator and the computer laboratories.

Dr. Edward J. Finn, associate professor of physics at Georgetown, presided at the afternoon session. Addresses were presented by Dr. Samuel Globe, Battelle-Columbus Laboratories, on "Science, Technology and Innovation" and on 'Fluidics" by Richard N. Gottron, U.S. Army Harry Diamond Laboratories.

Thursday, Aug. 19, opened with a session at the University of Maryland Science Center in Baltimore, MD. Director of Education at the center, Raymond O. Trimmer, presided and the featured address was "The Changing Mosaic of Ocean Continents," a discussion of geological plate tectonics, by Dr. John M. Bird, professor of geology, Department of Geological Sciences, Cornell University.

The program included a tour of the Frigate "Constellation followed by a choice of tours to: Agricultural Research Center, U.S. Department of Agriculture, Beltsville, MD; McCormick & Co. (famed spices and other food products manufacturing), Hunt Valley, MD; Maryland Psychiatric Center, and the Martin Marietta Corp. Laboratories.

Busses departed from Washington Friday, Aug. 20, making a visit to Independence Hall in Philadelphia, PA, en route to Fairleigh Dickinson University, Madison, NJ. Dr. James Griffo, university provost, presided at an evening session featuring an address by Dr. Michael Mahoney, associate professor, History and Philosophy of Science, Princeton University, titled "The Use of Our Scientific Past."

Aug. 21 was spent in New York City where the group toured the United Nations Headquarters, did some sightseeing and attended a performance of "Pippin" at the Imperial Theater. Sunday was "free time."

Picatinny Arsenal, Dover, NJ, was host to the group Aug. 23 for a series of laboratory tours, followed by tours to industrial labs in the area. Dr. Malcolm Sturchio, FDU professor of education who arranged the program for the week in the New York City area, presided at an evening address titled "What is Going on in Telephones Today." The speaker was Dr. James Fitzwilliam, director, Station Systems Division Bell Labs.

Aug. 24 was a full day of laboratory tours until an evening session chaired by COL Peter Kenyon, Picatinny Arsenal commander. Dr. Robert Denkewalter, vice president of Allied Chemical Corp., gave an address on "The Scientist: Leader or Follower."

Aug. 25 and 26, the concluding days of the Bicentennial of American Science, were full days of industrial laboratory tours and evening sessions. The speakers were Dr. Hubert Alyea, professor of chemistry emeritus at Princeton University, and Dr. Robert Hofstadter.

Known as one of the best lecturers in the world on chemistry, Dr. Alyea held the group spellbound for an hour and 50 minutes with his presentation and demonstration on "Lucky Accidents, Great Discoveries and the Prepared Mind." Nobel Prize Laureate in physics as a faculty member of Stanford University in California, Dr. Hofstadter spoke on "Quantum Theory and Electrodynamics." Many listeners commented that the address was the highlight of the Bicentennial of American Science.

Soviet Advances in Ionospheric and Magnetospheric Research

By Dr. Robert A. Jones

Soviet scientists have scored numerous successes in investigations of the Earth's upper atmosphere since they launched Sputnik as the world's first artificial satellite in 1957. Traditional Soviet concern with the ionosphere is based on fundamental importance to radiowave propagation.

Improvements in ionospheric telecommunication systems would reap significant returns because the large expanse of Soviet land mass requires increasingly efficient communications.

Soviet scientific literature on ionospheric research in recent years reflects interest in satellite communications, secure military communications, long-range communications in general, and propagation paths for a variety of radar systems.

The motivation for near-Earth plasma research was reiterated recently by the director of the Institution of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation of the USSR Academy of Sciences (IZMIRAN). Soviet interest in the ionosphere and circumterrestrial space is attributable to:

- Importance in delineation of the system consisting of the Earth's atmosphere, circumterrestrial space, and the Sun.
- Considerable influence on the propagation of radiowaves.

In addition to comprising the primary media for electromagnetic-wave propagation, the ionosphere and magnetosphere are a natural laboratory for studying the behavior of weakly ionized gases, plasma instabilities, electron and ion chemistry, ambipolar diffusion, etc. This plasma laboratory, with its natural electric and magnetic fields, is devoid of man-made boundaries.

Most of the near-Earth plasma research has involved the *passive* acquisition of data. The development of techniques for modifying the ionosphere/magnetosphere represents an *active* means of conducting experiments, rather than merely a *passive* means of observation.

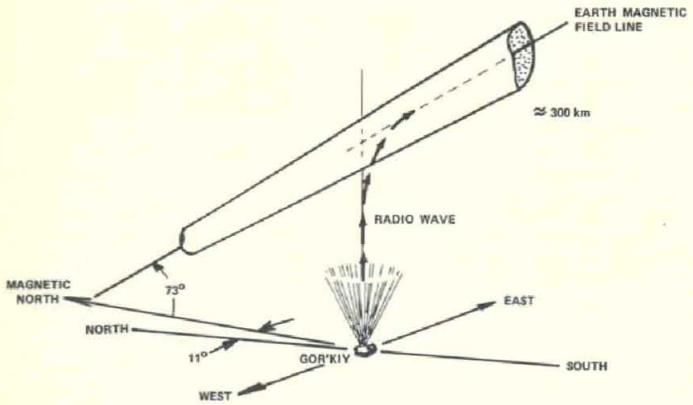
The Soviets are employing both active and passive techniques for investigating the near-Earth plasma, but artificial modification techniques are receiving increased emphasis. Localized ionosphere modification "will eventually become a reality," Soviet scientists believe, and their goal is "to control the ionosphere so as to guarantee (beyond doubt) the reliability of communications."

The modification technique known as "ionosphere heating" has received considerable attention in the United States and the Soviet Union. Ionospheric heaters operate on a principle similar to that of microwave ovens.

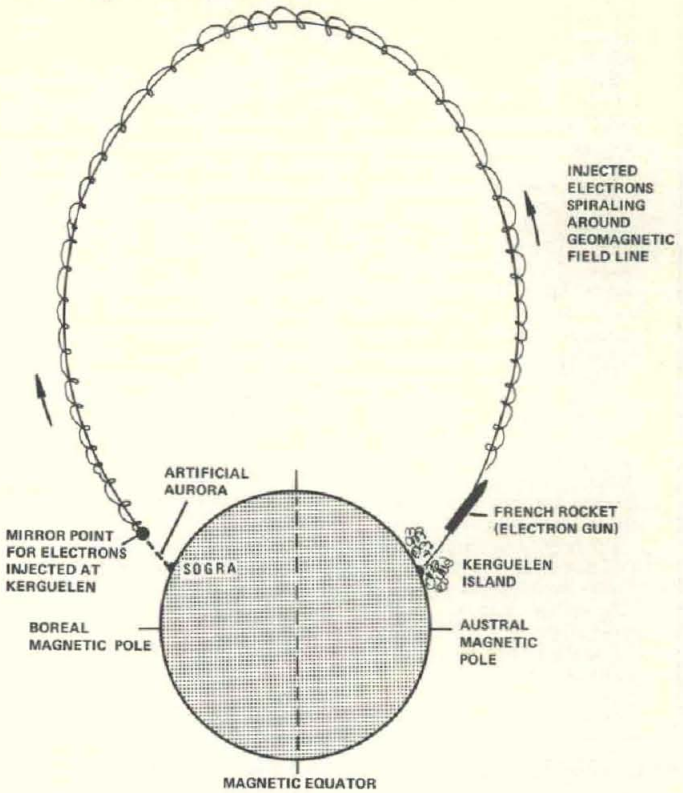
Local heating of the ionosphere is produced by the interaction of very high-power, high-frequency, ground-based radio waves directed vertically upward. Since plasma frequencies vary according to altitude, the frequency of the radiated power must be near that of the altitude regime where the perturbation is to occur.

Upon absorption of this power, the kinetic energy of the resonant electrons (and hence the electron temperature) is increased. In U.S. experiments, radiated energy was deposited into a pancake-shaped region of the ionosphere roughly 15 kilometers thick and 100 kilometers in diameter.

Possibility of temporary ionospheric modification by very high-power, ground-based radio transmissions has long been recognized by U.S. and Soviet researchers as a desirable means of active experimentation.



SCHEMATIC view of ionospheric heating experiment at Gor'kiy, USSR, where the ionosonde and high-power transmitter are located. The arrows represent a path by which radiation of the X-mode is deposited into a typical flux tube surrounding a geomagnetic field line - shown oriented with a declination of 11 degrees east of north and at a dip angle of 73 degrees from the horizontal.



GEOMETRY for artificial particle injection. The Earth is shown "tipped over on its side" with the north pole pointing to the left. Electrons artificially injected from a rocket over Kerguelen spiral around "omega-shaped" geomagnetic field lines toward the conjugate point near Sogra. Although they have not yet released any results, the Soviets expected the injected electrons would create an artificial aurora in the ionosphere over Sogra, and that some electrons would bounce back to the southern hemisphere.

Ground-based radio techniques provide an attractive alternative to other means of modifying the ionosphere and, in contrast with other methods, offer the following advantages.

- *Relative Controllability.* Electromagnetic waves are much easier to vary and direct (localize in both space and time) than chemical releases.
- *Repeatability.* The frequency band, intensity (amplitude), polarization, etc., of the radiated electromagnetic energy can be readily duplicated. Hence, the input heating conditions for a given ionospheric modification experiment can be reproduced easily.
- *Rapid Reversibility.* Radio modifications are transitory and self-reversible, with life-times of seconds, minutes, or hours.
- *Residual Free.* No particulate matter is deposited in the ionosphere, as is the case with chemical modification.

Experiments to modify the electron temperature and density have been conducted in the United States since 1970. New experimental and theoretical results on ionospheric modification are reported in the November 1974 issue of *Radio Science.*

Pioneering Soviet theoretical work provided much of the impetus for developing radio methods of modifying the ionosphere. Soviet scientists have been investigating a broad spectrum of plasma phenomena. During the 1960s, more than 50 of their theoretical papers relating to ionospheric heating were published on such topics as plasma cloud motions, nonlinear plasma effects, experimental plasma oscillations, interactions of radiowaves and hypersonic vehicles with the ionosphere, and nuclear-reactor plasma and magnetospheric phenomena.

The majority of this theoretical research was conducted at the Lebedev Physics Institute of the USSR Academy of Sciences, Moscow.

Although the Soviets were ahead of Western scientists in publishing good *theoretical* papers, which actually inspired some of the Western experimental efforts, the first Soviet paper dealing with ionospheric heating *experiments* did not appear until November 1973. The experiment reported was conducted between March and June 1973 by scientists from the Radiophysics Institute, Gor'kiy State University. Subsequent papers indicate that the Soviets conducted ionospheric heating experiments dur-

ing the early sixties.

A circularly polarized pump wave was radiated vertically upward at 5.75 MHz by an antenna with a gain of 150. The transmitter had an average power of 60 kilowatts and could operate in either a continuous wave or pulsed mode. An auxiliary ionospheric sounding station, located at the same site, was used to diagnose the F-layer of the ionosphere.

The reflected sounding wave showed an anomalous attenuation that increased in intensity as the transmitter power was slowly increased. This diagnosis is similar to effects observed in United States experiments. It is thought to result from field-aligned scattering phenomena, which have received the most experimental attention in the U.S.

One unexpected result of the ionospheric heating experiments is the discovery that very-high frequency (VHF) radio waves can be reflected off the artificially created, field-aligned scattering irregularity. The Soviets evidently intend to pursue plasma physics investigations in the "ionospheric laboratory" and will probably conduct some field-aligned scattering experiments. "Prolonged measurements" are considered essential to obtain results that the Soviets view as "crucial for the development of the theory of nonlinear interaction between powerful electromagnetic radiation and a plasma."

Future Soviet ionospheric heating experiments could be of considerable value in determining possible effects of perturbations on the propagation of electromagnetic waves. The most promising application of this technology appears to be in telecommunications.

New techniques could be used to bounce VHF radio waves off artificially created ionospheric irregularities, thus providing telecommunications to underdeveloped areas, such as Siberia, that previously lacked efficient networks.

Although this application of an "ionospheric cooker" can be constructed for a fraction of the cost of launching a satellite, it would be expected to supplement satellite communication systems rather than replace them.

Many French and Soviet scientists have been conducting joint geophysical experiments during the last decade, and IZMIRAN has been the primary coordinating agency. Most of these have been magnetically conjugate point studies conducted between Sogra, in Arkhangel'sk Province, USSR, and Kerguelen Island, a French possession in the Indian Ocean.

This pair of conjugate points is unique because both ends of the Earth's magnetic field line arrive on dry land in subauroral zones. (Disturbances of the Earth's magnetosphere are observed more often in subauroral zones than in the middle latitudes, and more rarely than in the auroral zones.) The geomagnetic field line that connects Sogra and Kerguelen Island extends over 20,000 kilometers into space and resembles a capital Greek letter "omega" (Ω).

Previous French and Soviet investigations of circumterrestrial space were passive observations of natural phenomena from these conjugate points. In January and February 1975, conjugate point experiments were conducted to create an artificial aurora borealis, and thereby use the magnetosphere as an active plasma laboratory.

This joint, controlled space experiment, called the ARAKS (artificial radiation and aurora at Kerguelen and Sogra) Project, consisted of launching French ERIDAN rockets with Soviet electron accelerators and other Soviet- and French-made apparatus from Kerguelen Island.

Electrons injected from the rocket gyrated about the Earth's magnetic field and moved upward and away from the rocket along field lines toward the northern conjugate point near Sogra. A large complement of scientific instruments was used at both sites to observe the effects of electron scattering on the ionosphere and magnetosphere.

The ARAKS experiment is basically a continuation of earlier United States experiments. Although more ambitious than its predecessors, it incorporates many of the same techniques and devices. A 1969 U.S. experiment demonstrated the feasibility of using a rocket-launched electron accelerator to generate small artificial aurora.

A follow-up experiment in 1970 demonstrated that a rocket-borne electron gun could be used as a magnetospheric probe. This U.S. project was the first in a series designed to study the origin and distribution of naturally trapped radiation in the Earth's magnetosphere. It also provided electromagnetic radiation to study wave-particle interactions.

In preparation for the ARAKS experiment, the Soviets launched a meteorological rocket, MR-12, from the USSR during the night of May 29-30, 1973. This experimental creation of an artificial polar aurora was called "Zarnitsa" (summer-lightning or heat-lightning).

The sounding rocket reportedly carried an electron accelerator to an altitude of about 100 kilometers, where electrons were injected downward along geomagnetic field lines. Injection of the electron beam into near-Earth space lasted several minutes, and interaction of the beam with the ambient atmosphere generated auroral rays bright enough to be photographed from the ground.

In addition to the Zarnitsa experiment, French and Soviet scientists carried out extensive theoretical calculations in preparation for the ARAKS experiment. The Soviets believe that "this type of controlled experiment opens up great possibilities for research in space physics." The ARAKS and follow-on experiments can be expected to yield information related to several scientific objectives.

- To investigate mechanisms for auroral generation, particularly auroral particle acceleration.
- To search for instabilities in the electron beam composition.
- To determine the validity of the adiabatic invariants as they apply to particles artificially injected into the Earth's magnetic field.
- To study the drift of the electrons in the beam caused by the Earth's crossed electric and magnetic fields.
- To determine the configuration of the Earth's magnetic field.
- To obtain valuable information on solar radio noise bursts and radio noise generated during auroras.

Practical applications of this research could lead to new or improved magnetospheric propagation modes. For example, wave-particle interactions at cyclotron resonance in the magnetosphere could provide a compact, coherent source (propagation path) of ultra-low frequency radiation.

The ARAKS experiment has had spin-off benefits for electron beam welding. The rocket-borne electron accelerator used in the experiment was developed by the Paton Electric Welding Institute of the Ukrainian SSR Academy of Sciences. Reportedly some "engineering decisions used to develop the system (for the ARAKS experiment) were applied in developing industrial welding equipment."

Beyond their spectacular aspects, controlled ionospheric and magnetospheric experiments, such as those conducted by the Soviets, should provide valuable new information about the near-Earth plasma. Precise measurements of phenomena associated with charged particles in the Earth's magnetic field and its configuration will be useful in determining the effect that ionospheric and magnetospheric perturbations have on the propagation of electromagnetic waves.

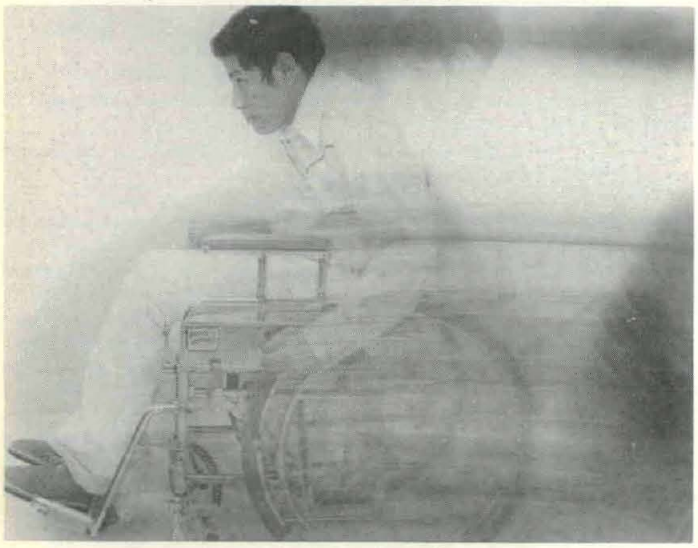
Experiments conducted in the "near-Earth plasma laboratory" could thus lead to the realization of the Soviet goal of guaranteeing the reliability of communications.

DR. ROBERT A. JONES has been a physicist at the U.S. Army Foreign Science and Technology Center, Charlottesville, VA, an element of the Army Materiel Development and Readiness Command, since 1971. Primarily responsible for the FSTC assessment of foreign research in geomagnetism, aeronomy, and electromagnetic propagation through the near-Earth plasma, he is now analyzing disturbed-air chemistry research.

SIGNING of a $2.485 million procurement contract for 250 refrigerated containers, representing a major milestone for the U.S. Army Mobility Equipment R&D Command (MERADCOM), Fort Belvoir, VA, is Paul R. Kittle, chief of the Production Division, Procurement and Production Office. This is the first major contract processed by MERADCOM in compliance with Army policy requiring development commands to retain complete responsibility in the development cycle for initial introduction of hardware into the logistics system. The contract was awarded to the American Air Filter Co., Inc., which will fabricate the containers in St. Louis, MO. The first 12 containers, which are a military adaption of commercial equipment widely used for transportation of refrigerated and frozen foods, are in full production and are scheduled to roll off the line in January 1978. Looking on (l. to r.) are Wendell L. Keyes, chief of Lab 6000; William C. Hall, chief of the Procurement and Production Office; Emil Czul, project engineer for Lab 6000 and contracting officer's technical representative; and Irwin S. Rosen, principal engineer, Mechanical Equipment Division, Lab 6000.

People in Perspective . . .

Beaumont Handicapped Employe Earns Esteem



"Hot Wheels" Espejo

Confined to a wheelchair, possibly for the rest of his life, James C. Espejo, a PBX operator at William Beaumont Army Medical Center, El Paso, TX, has earned from coworkers the nickname of "Hot Wheels."

Hired as an Army civilian employe in 1974, Espejo is assigned to the Department of Obstetrics/Gynecology, considered by many to be one of the busiest departments at the William Beaumont Center.

He works with about 20 physicians who see about 7,000 patients, deliver 160 babies and perform each month about 150 OB/GYN procedures. Primarily, he answers and transfers phone calls, takes messages and assists patients in making appointments, but at times he departs the switchboard and speeds the halls to retrieve medical records and deliver items.

Born at William Beaumont General Hospital 21 years ago, Espejo was physically healthy until 1973. Then he fell down a flight of stairs while helping a friend move from an apartment, fracturing his neck.

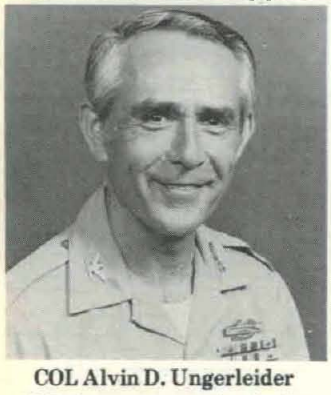
Despite numerous operations, he was left paralyzed—ending his high school athletic and ROTC careers and his hopes of working with mentally retarded children. Aided by tutors, he graduated in 1973.

While enrolled in the Rehabilitation Center for the Handicapped at Roswell, NM, he relearned the mechanics of life, also taught others to dress, eat and get in and out of a car. His plans include learning to drive a car.

He completed PBX equipment courses at the Texas Rehabilitation Commission just prior to accepting his job at William Beaumont.

Camp Concern Achieves Goal ...

APG Continues Support for Inner-City Youth Project



COL Alvin D. Ungerleider

LTC George Griffin

U.S. Army cooperation in Camp Concern gave about 5,000 inner-city children of Baltimore a fresh look at life and opportunity, in an atmosphere of respect for law, order and justice, during a 9-week project.

Director of Personnel Management at Aberdeen PG, LTC George Griffin, described Camp Concern as "an attempt to let them see there is another side of the world, something else to strive for."

Recreational and educational activities were conducted under joint funding by the mayor of Baltimore's Office of Manpower Resources, Baltimore City Council, and a federal grant. Activities supervised by LTC Griffin involved aobut 600 children each week, with 400 going to the Bainbridge Naval Training Center property and 200 to APG.

James W. Smith of the Baltimore Department of Education, coordinator of Camp Concern, characterized most of the children, ranging from 9 to 18 years of age, with most in their teens, as "hard-core who otherwise might be causing trouble in the city." Most came from welfare families.

Good behavior born of respect for the goals of Camp Concern prevailed throughout the project. LTC Griffin reported "they have been perfect guests." Smith explained: "In Baltimore City, we like to think of this program in terms of providing new experiences from the locked-in, jungle-like atmosphere in which the children live."

Success of the program, both LTC Griffin and Smith agreed, was creditable substantially to "one-on-one counseling" provided in a "relaxed environment to help the children with genuine problems, socially, economically or educationally." All of the counselors were college seniors or graduates, including several with doctorates or doing graduate work.

"Each of these counselors," Smith commented, "represents a success story. The young campers can relate to these young counselors. They can truthfully tell them 'Hey, there is something in life you can reach towards, because we've been that way. If you want to make it, you can, if you try hard enough.'"

Camp Concern this summer marked the third year that Aberdeen PG was a cosponsor. Baltimore Mayor William D. Schaefer in 1975 presented "Mayor's Citations" to APG Commander COL Alvin D. Ungerleider and LTC Griffin, stating in part that the award was "an earnest expression of appreciation and a symbol of gratitude for the splendid quality of public service you have rendered."

Career Programs . . .

FRG Employes Serve Assignments at MERADCOM

Under a joint program sponsored by the United States and the Federal Republic of Germany for more than 10 years, five FRG employes are serving one-year assignments at the U.S. Army Mobility Equipment R&D Command, Fort Belvoir, VA.

Dr. Helmut K. Neubauer, experimentation manager at the German Naval Proving Grounds, is assigned to MERADCOM's mine neutralization program. He feels his work here greatly reduces duplication of effort of joint interest between the United States and the FRG as NATO allies.

"Both countries," he says, "are working in the same areas, but have different approaches." Dr. Neubauer finds a greater freedom of experimentation in the U.S. He explains, "Our structure is more formalized, the Proving Ground is not a place of free research. Our goal is defense."

Dr. Neubauer is a graduate of Justus-Liebig University in Giessen, and has taught at National University, Bogota, Columbia.

Wolf-Rudiger Pauls, a section chief in the Federal Armed Forces Test Center 51, is working on a MERADCOM project to winterize the Family of Military Engineer Construction Equipment (FAMECE). He has a master's degree in civil engineering (Technical University of Braunschweig).

Dieter Rosenthal, a master's graduate of Munich Technical University, coordinated his work on new bridge concepts with MERADCOM, prior to his assignment, as part of a NATO equipment standardization effort.

Dieter O. Schaefer, also involved in MERADCOM's "Bridging for the 80s" program, attended the Engineer School in Holzminden, and was assigned to the Procurement Center for the Ministry of Defense.

Dr. Henning Willke, a metal physics graduate of the University of Stuttgart, is from the German Naval Proving Ground where he heads experimentation on demagnetization of ships. He is engaged at MERADCOM in the REMBASS battlefield sensor program.

Picatinny Employes Chosen for Vocational Training

Under a new apprenticeship program sponsored and funded by the Office, Chief of Engineeers, Army Corps of Engineers, nine Picatinny Arsenal employes will receive four years of training leading to journeymen-level positions. On-the-job training with accomplished journeymen in various trades will be supplemented with a minimum of 144 hours of related training at a country vocational technical school.

Selectees and their respective trade goals are John Hens, Nancy Jaksetic and Lawrence D'Amico (WG-9 carpenters); Marty Zeek, William Mack and Peter Waterman (WG-10 electricians); Richard Bossen and James Jennings (WG-10 air conditioning mechanics); and Alfred Kepler (WG-10 pipe fitter).

The Army had 300 such training slots available for 1976 and will provide 300 more in 1977 and 400 in 1978. Certification for all successful trainees is from the U.S. Department of Labor.

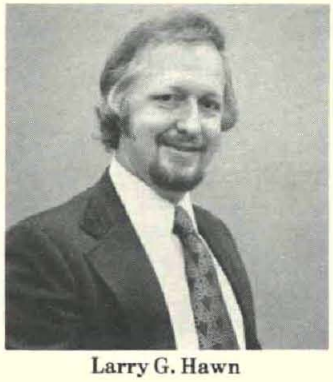
USACSC Man Selected for Cornell Graduate Studies

Selection of Larry G. Hawn, U.S. Army Computer Systems Command, Fort Belvoir, VA, for participation in an academic year 1976-77 graduate study program at Cornell University was announced Aug. 25.

A senior supervisory computer specialist and executive software division chief, Hawn is one of 67 federal employes chosen to attend one of eight universities under the U.S. Civil Service Commission's Education for Public Management Program.

The program is designed also for professional development of promising young executives with senior management potential. Hawn's studies will provide an opportunity to enhance his computer science and operations research skills.

Hawn has 15 years civilian experience in automatic data processing and has been with the USACSC since 1970. He served in the Army as an ADP officer, has a BS degree and is working on a master's degree in management of technology at American University.



Larry G. Hawn

U.S., Soviets Initiate Cooperative Exchange Program

Research programs, procedures and facilities in Siberia, Soviet Union, are being studied by two U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) employes in a cooperative exchange program.

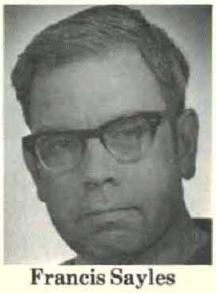
Thaddeus C. Johnson and Francis H. Sayles, civil engineers, are spending two months working with the staff of the USSR Permafrost Institute in Siberia. The exchange program has been established through an agreement between the U.S. National Academy of Sciences and the USSR Academy of Sciences.

The CRREL engineers will investigate Soviet research in permafrost and applications to practical engineering and construction on permafrost. Emphasis of the studies will be on the construction of hydro-structures in permafrost areas. The team will visit research institutes, field stations, and construction sites for discussions with Soviet experts. An exchange visit to CRREL will be made this fall by two staff members of the Soviet Permafrost Institute.

Thaddeus Johnson

These exchanges will result in the preparation and publication of state-of-the-art reports on engineering and construction on permafrost. Future exchanges will be considered to develop cooperative studies in mutual areas of interest.

Johnson has been on the CRREL staff since 1970. A graduate of the University of Colorado, he has a master's degree in soil mechanics from Harvard University. Sayles has been with CRREL since 1962. He has a bachelor's degree in civil engineering from Massachusetts Institute of Technology and a master's in soil mechanics from Northeastern University.



Francis Sayles

'Best of Both Worlds'. . .

Enlisted Psychophysiologist Is Also An Officer

SSG Michael "Scott" Cameron, a psychophysiologist with the U.S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD, believes he lives in the "best of both possible worlds."

A veteran of eight years of Army service, Cameron is one of a select few enlisted men to hold concurrent rank as an officer. He was recently commissioned a Reserve second lieutenant throuth the Dual Component Program.

His Army career began eight years ago after he became disillusioned with college. He served initially as a Green Beret medic and explosives expert; he has since amassed more than 300 parachute jumps.

Michael "Scott" Cameron

During an assignment with the 82d Airborne Division, he was selected as one of the first enlisted men to complete his college education in the Army's Bootstrap Program, now restricted to officers.

Cameron graduated in 1973 from Campbell College, NC, with a BS degree, receiving a double major in sociology and psychology, is completing master's degree work in behavioral science and plans to obtain a PhD. He credits the Army for rekindling his interest in higher education, stating:

"I think the Army's education benefits are outstanding. If you want an education while you're in, you can certainly get it."

Cameron's present duties in psychophysiology involve studies of the relationship between the mind and body - of determining where the mind and body cease to work cohesively.

Despite his rank as a commissioned officer, Cameron was elected to the board of trustees of the Chesapeake Bay Chapter of the Noncommissioned Officers Association.

Enlisted Personnel Management System Realigned

Grade and skill realignments under the Enlisted Personnel Management System, announced recently by the Army Military Personnel Center (MILPERCEN), are intended to enhance career progression opportunities.

Realignments are conforming with Revised Standards of Grade Authorization which do not permit NCO and specialist ranks in the same military occupational specialty and skill level. Some specialists and NCOs may be converted.

MILPERCEN officials note that conversions are based on Armywide MOS structure evaluations. Conversions are not a reflection on a soldier's performance or his/her professional development.

Awards...

Test Evaluation Earns Meritorious Service Award

Leo R. St. Jean, HQ U.S. Army Materiel Development and Readiness Command, is a recent Meritorious Civilian Service Award recipient.

A general engineer assigned to DARCOM's Development and Engineering Directorate, St. Jean earned the Army's second highest award for civilian employes by 1969-75 "exemplary contributions" to the fulfillment of the Army's test and evaluation program. He was cited for "exceptional professionalism and test management expertise which resulted in new Army testing philosophies and significant improvements in over-all testing missions."

The award justification also states that St. Jean's "technical background, dedication and competence have earned him the reputation as one of the Army's foremost testing experts." He is a coauthor of the Army's new test regulations.

Leo R. St. Jean

A federal employe for 15 years, St. Jean served (1964-69) with the Lance Missile Program at the U.S. Army Missile Command, Redstone Arsenal, AL, and 1961-64 at the U.S. Naval Air Station, Quonset Point, RI.

His credentials include a 1958 BS degree in industrial/mechanical engineering from the University of Rhode Island, and a 1971 MS degree in systems management from the University of Southern California at Los Angeles, where he studied under the Army's graduate level program.

Kirkland Receives Meritorious Service Award

Terence G. Kirkland, technical director of the U.S. Army Mobility Equipment R&D Command (MERADCOM), Fort Belvoir, VA, is a recent recipient of the Meritorious Civilian Service Award, the Army's second highest award for civilian employes.

Employed at MERADCOM since 1964, Kirkland was cited for his major role in assuring the ongoing achievement of MERADCOM's mission during recent reorganizational changes. He is responsible for programs having an annual budget of more than $100 million.

Additionally, he was credited for prior service as chief of MERADCOM's Countermine/Counter Intrusion Department. Kirkland has a BS degree from the Montana School of Mines and has done graduate work at the University of Wisconsin.

Lorenz Honored as Distinguished ETL Employe

Admission to the Gallery of Distinguished Civilian Employes, the highest honor awarded by the U.S. Army Engineer Topographic Laboratories (ETL), was accorded recently to Gilbert Lorenz who retired as technical director in 1973. ETL Technical Director Robert Macchia presented the award that made Lorenz the sixth member of the Gallery.

Associated with ETL and its predecessor organizations for 36 years, Lorenz distinguished himself through his "leadership, judgment, administrative ability, and professional skill." His career has covered a broad range of work associated with the development of aerial mapping techniques.

An outstanding example is his initiation of developmental programs in Radar Mapping and Automatic Map Compilation which culminated in 1965 with the development of UNAMACE. This achievement gained ETL widespread recognition and in 1968 Lorenz was appointed technical director of ETL.

Dehn, Hauver Selected as Ballistic Labs Fellows

Dr. James T. Dehn and George E. Hauver, employes at the U.S. Army Ballistic Research Laboratories, Aberdeen (MD) Proving Ground, were recently named BRL Fellows for scientific and engineering excellence."

Dr. Dehn, a team leader in the Fragmentation Branch, Detonation and Deflagration Dynamics Laboratory, received an invention disclosure award for a method of making diesel and turbine fuels safe from fire hazards.

Dr. James T. Dehn

Employed at BRL since 1968, Dr. Dehn has worked on analyses of radioactive effects on solid materials bombarded by ions produced by a Van de Graaff accelerator, processes of combustion, decomposition of propellants, and has directed investigations of the oxidation of hydrocarbons.

Hauver is a physicist with the Shock Mechanics Branch, Terminal Ballistics Laboratory and has been a BRL employe since 1957. His special expertise is in transient high-pressure phenomena that occur during impact or detonation.

George E. Hauver

He was credited for developing a technique that provides reliable residual temperature data for shaped-charged liner materials at pressures equivalent to those experienced during explosive loading and common projectile impact.

Additionally, he has been recognized for discovery and identification of shock-induced polarization in molecular solids, liquids and ionic crystals, and its application to designs of solid-state transducers for high-shock pressure measurements.

BRL's Dr. Murphy Receives AIAA's Flight Award

Dr. Charles H. Murphy Jr., U.S. Army Ballistic Research Laboratories, Aberdeen (MD) Proving Ground, is a recent recipient of the Mechanics and Control of Flight Award of the American Institute of Aeronautics and Astronautics (AIAA).

Established in 1967, the annual award recognizes "an outstanding recent technical or scientific contribution by an individual on the mechanics, guidance or control of flight in space or the atmosphere."

Comprised of a medal and a certificate of appreciation, the award was presented at AIAA's 1976 Guidance, Control and Flight Dynamics Conference in San Diego, CA.

Dr. Murphy was cited specifically for his orginal work in nonlinear motion of symmetric missiles. U.S. Navy engineers have termed it a major breakthrough which allows a simple analysis to be made of the unusual behavior of their Weapon "A."

Dr. Murphy has elaborated on his work through 14 articles in scientific journals and 13 BRL reports. Applications of the technology are deemed by many to be essential to the analysis of various Army projectiles.

More than 300 aerospace engineers have attended Dr. Murphy's short course, "Free Flight Motion of Symmetric Missiles," given periodically since 1960. His BRL report with the same title is regarded by many as a standard reference source in the aerospace field.

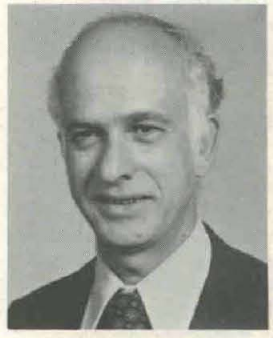
Chief of BRL's Launch and Flight Division, Dr. Murphy has been employed at BRL since 1948. He has a BS degree (cum laude) in mathematics from Georgetown University and an MA in math, an MS in engineering aeronautics and PhD in aeronautics from Johns Hopkins University.

Additionally, he is an Associate Fellow of the AIAA, member of AIAA's Technical Committee on Atmospheric Flight Mechanics, and has served as an instructor at the University of Delaware and U. of Maryland.

Journal Names Kapsalis to Editorial Board

Success in application of rheological and physico-chemical principles to food processing has earned Dr. John G. Kapsalis, a biochemist at the U.S. Army Natick (MA) R&D Command, appointment to the editorial board of the *Journal of Texture Studies*, an international quarterly publication.

Head of Natick's Food Chemistry Group, Physical Sciences Division, Food Sciences Laboratory, Dr. Kapsalis began his federal employment in 1960 as a food technologist at the Armed Forces Food and Container Institute in Chicago.



Dr. John G. Kapsalis

Selected as a Fulbright Fellow, Ohio State University post-doctoral Fellow, and a recipient of a 1965 Army Research and Study (SARS) Fellowship, he has authored more than 50 research papers and is a member of the Research Society of America. He has bachelor's and master's degrees from Athens College of Agriculture, a master's degree in food science from the University of Florida, and a PhD in food science and biochemistry from Texas A&M.

ARI's MAJ Wood Receives Codd Memorial Award

Achievements as one of the nation's outstanding Reserve Officer Training Corps instructors recently earned the COL Leo A. Codd Memorial Award for MAJ Shelton E. Wood of the U.S. Army Research Institute for the Behavioral and Social Sciences.

MAJ Wood was nominated while serving as an assistant professor of military science at Norfolk (VA) State College. Designated "Recruiter of the Year" by College President Lyman B. Brooks, MAJ Wood was selected to organize and conduct an ROTC recruiting workshop for all military science professors in the First ROTC Region (HQ Fort Bragg, NC).

MAJ Wood was cited for his creativeness and imagination which resulted in a "complete update of the entire program of instruction at Norfolk State." A survey also indicated that 123 of 124 students rated him as a "truly outstanding instructor."

Recipients for the Codd Award are selected from among junior officers not above the major/lieutenant commander rank. Three awards are presented annually by each of the three military services.

ARMCOM Employe Wins Special Features Award

Nancy Minnich, U.S. Army Armament Command, Rock Island Arsenal, IL, has been selected as the first winner of the Army Materiel Development and Readiness Command's annual Special Features Award.

Titled Arsenal Finds Deaf Workers First Rate, her feature article, published initially in the *Rock Island Target*, was termed "an effective dramatization of DARCOM missions."

Outstanding effectiveness in presenting a technical subject to a general audience earned an Honorable Mention for MAJ John P. Bulger of the Office, Project Manager for Remotely Monitored Battlefield Sensor System (REMBASS). Titled Tactical Sensors for the Modern Army, the article was published in *National Defense Magazine*.

Established to recognize outstanding effort by DARCOM employes in telling the DARCOM mission to internal and external publics, the DARCOM Special Features Program details are outlined in DARCOM Supplement 1 to Army Regulation 672-20, "Incentive Awards," dated April 13, 1976, paragraph 8-19, pages 14-15.

Other entries from among the 17 nominations submitted for this year's competition included: HEL Employe Pioneers New Frontiers for the Blind, James M. Allingham, Aberdeen (MD) Proving Ground (APG); The Army Approach to Missile Electronic Warfare Vulnerability, Joseph E. Bert, Army Electronics Command (ECOM); Military Applications in Flu-

idics, Lyndon S. Cox and Richard N. Gottron, Harry Diamond Labs;

The Rebirth of Matt Burnaw, Edwin E. Dwyer, APG; Computer Aided Design Simulation and Optimization, Vladimir G. Gelnovatch, ECOM; Hit Your Engine, Flucher J. McCrory Jr., Aircraft Development Test Activity; Soviet Night Operations, Arthur W. McMaster, Foreign Science and Technology Center; Army Aircraft Survivability - A Desired End by Many Means, MAJ Norbert I. Patla, Army Aviation Systems Command;

Quick Work Contains Oil Spill, Henry F. Paulick, APG; The White Sands Missile Range Laser Ranging and Tracking System, John A. Roth, White Sands Missile Range; Ballistics in War and Peace, John G. Schmidt, Army Ballistic Research Laboratories; and

The Army's Computerized Logistic Support Analysis Data System, Mark A. Schrock, Maintenance Management Center; Natick Trains Its Interns, Carolyn Williams, Natick Research and Development Command; and Evaluating Performance and Cost by Computer, Robert F. Williams, Army Logistics Management Center.

Academy of Microbiology Elects Dr. El-Bisi as Fellow

Dr. Hamed El-Bisi, deputy technical director, Food Service Systems Program, U.S. Army Natick (MA) Research and Development Command, has been elected a Fellow of the American Academy of Microbiology.

Known for his research on microbiological aspects and principles of food preservation, food-borne pathogenesis, and enzymatic conversion of waste cellulose products to glucose syrup, sugar, a clean-burning fuel for vehicle motors, and various short-supply chemicals, Dr. El-Bisi has authored or coauthored more than 60 scientific papers. He is credited also with development of a $40,000 Vapor Phase Resistometer for the study of kinetics and the mode of microbicidal activity of chemicals in the vapor phase.

Dr. Hamed El-Bisi

Dr. El-Bisi has served as adviser to the National Aeronautics and Space Administration on policy and procedures for the sterilization of space probes, and has authored microbiological standards for the early foods for astronauts.

Among his professional organization memberships are the American Society for Microbiology, Society of Industrial Microbiology, American Association of University Professors, and the American Institute of Biological Sciences.

Conferences & Symposia . . .

ADPA Sponsors Future Combat Vehicles Meeting

Combat Vehicle Technology for the 1990s was the theme of the 1976 annual meeting of the Tank and Automotive Division of the American Defense Preparedness Association, held at Fort Belvoir, VA.

Primary purpose of the meeting was to "leapfrog" existing systems and current development programs with a view toward future requirements. Emphasis was placed on armor, self-propelled artillery, mechanized infantry and amphibious assault systems.

Discussions involving about 350 participants, representative of 15 U.S. Government agencies and more than 200 corporations, were tailored to interests of advance system planners, directors of research, development, engineering and production, designers and engineers, test and evaluation programers, and weapon system project managers.

ADPA Executive Vice President and former Commander, U.S. Army Materiel Development and Readiness Command, GEN Henry A. Miley (USA, Ret.) introduced the keynote speaker, Commander of the U.S. Army Training and Doctrine Command GEN William E. DePuy.

GEN DePuy spoke on "The Modern Battlefield," a concept which has attracted wide defense and industry attention because of its promise for drastic and dynamic changes - with emphasis on a capability of winning the first major battle as the possible decisive factor in modern warfare.

William E. Stoney, deputy director, Tactical Warfare Programs, Office, Director of Defense, Research and Engineering, Department of the Army, delivered a banquet address on "R&D Perspectives."

Dr. George P. Psihas, Chrysler Corp., moderated the first of four discussion sessions titled "Future Materiel Requirements." Other sessions and their moderators were: "Ways and Means," George A. Tuttle, AVCO Lycoming Division; "Advanced Components and Subsystems," Charles R. Lehner Jr., Defense Advanced Research Projects Agency; and "Foreign Systems and Evaluations," Ira W. Nichol (conference chairman), Teledyne Continental Motors.

Elizabeth F. Preston, industrial liaison officer, DA/DARCOM Technical Industrial Liaison Office displayed a TILO exhibit on "Qualitative Requirements Information." Joining her were Joseph A. Fortin, supervisory mechanical engineer, QRI, TILO, U.S. Army Tank-Automotive Command, and Howard Grizzle, small business specialist, Mobility Equipment R&D Command, Fort Belvoir, VA.

TILO booth at Combat Vehicle Technology for the 1990s is explained by Elizabeth F. Preston, DARCOM Technical and Industrial Liaison officer, to COL T.R. Hukkala (then commander of the U.S. Army Mobility Equipment R&D Command and now reassigned to HQ DARCOM) and Donald J. Looft, deputy director, Defense Advanced Research Projects Agency, Department of Defense.

Conferees to Discuss Adhesive Bonding Problems

Factors relative to lifetime strength retention will be considered at a National Symposium on Durability of Adhesive Bonded Structures, Oct. 27-29, at Picatinny Arsenal, Dover, NJ.

Personnel from the U.S. Army, Navy, Air Force, industry and academia will present more than 20 research papers. A discussion of Army durability adhesive bonding problems will follow the last presentation session.

MG Bennett L. Lewis, commander of the Army Armament R&D Command, activated Oct. 1 at Picatinny Arsenal, is scheduled for the keynote address. Picatinny Arsenal Commander COL Peter B. Kenyon will welcome the conferees.

Additional information may be obtained from: Michael Bodnar, chairman, Symposium on Durability of Adhesive Bonded Structures, Picatinny Arsenal, Dover, NJ 07801, or Marie Ross, Area Code 201,328-6517.

Power Sources Symposium Proceedings Available

The 27th Power Sources Symposium, sponsored biennially by the U.S. Army Electronics Command in cooperation with numerous U.S. Government agencies and industrial organizations as the largest meeting of its kind in the world, was featured in the July-August Army Research and Development Newsmagazine.

Inadvertantly omitted was a reference to the availability of the symposium proceedings, published at no cost to the government by the Power Sources Publications Committee, a nonprofit industrial group - an unusual if not unique arrangement.

The proceedings provide a major contribution to the research and development activities in the field of batteries and fuel cells, and are used widely as a reference source in support of ongoing effort and to minimize or avoid duplication of effort. Technical reports on U.S. Government sponsored work (internally and under contract) and industry/university programs are presented.

Copies of the proceedings are provided without cost to university and major public libraries, and are widely distributed to government agencies. Copies of the proceedings may be purchased through the Power Sources Symposium Publications Committee, P.O. Box 891, Red Bank, NJ 07701.

Cosponsors of the symposium cooperating with the U.S. Army Electronics Command are the U.S. Air Force, U.S. Navy, National Aeronautics and Space Administration, U.S. Energy Research and Development Administration, Communications Satellite Laboratories, the Army's Harry Diamond Laboratories, and the Army Mobility Equipment R&D Command.

Personnel Actions . .

Rogers Succeeds Weyand as Army Chief of Staff

GEN Bernard W. Rogers

GEN Bernard W. Rogers, commander since 1975 of the U.S. Army Forces Command, Fort McPherson, GA, is the new Army Chief of Staff, following GEN Fred C. Weyand's retirement after serving since October 1974.

A Rhodes Scholar and a 1943 graduate of the U.S. Military Academy (USMA), GEN Rogers earned bachelor's and master's degrees in philosophy, politics and economics from Oxford University, England. He is a graduate from the Army Command and General Staff College (C&GSC), Army War College and Infantry School Advanced Course.

During 1971-72 GEN Rogers served as chief of Legislative Liaison, Office of the Secretary of the Army, following an assignment as commander, 5th Infantry Division (Mechanized) and Fort Carson, CO. He was assistant division commander, 1st Infantry Division, Vietnam, 1966-67.

Other assignments have included military assistant and executive officer to the chairman, Joint Chiefs of Staff, Washington, DC; chief, Troop Operations Branch, Operations Division, HQ, U.S. Army Europe; and chief of staff, 24th Infantry Division, Germany.

GEN Rogers is a recipient of the Distinguished Service Cross (DSC), Silver Star (SS), Legion of Merit (LM) with three Oak Leaf Clusters (OLC), Distinguished Flying Cross (DFC) with OLC, Bronze Star Medal (BSM) with "V" and OLC, and the Air Medal (AM) with "V" device and 35 OLC.

Army Assigns Marshall as Deputy Chief of Engineers

MG Robert C. Marshall

MG Robert C. Marshall, a 1943 graduate of the USMA, took over recently as deputy chief, U.S. Army Corps of Engineers, succeeding LTG John W. Morris when he became Chief of Engineers and was raised to 3-star rank.

MG Marshall began his involvement with heavy construction projects and water resources utilization and conservation projects during an assignment as assistant engineer of the Philadelphia Engineer District. He served also as an engineer adviser, Joint U.S. Military Aid Group, Greece.

Other key assignments have included deputy chief of staff for Logistics, U.S. Army Forces Command, Fort McPherson, GA; director, Site Activation Directorate, SENTINEL Systems Command, Redstone Arsenal, AL; and commander, 937th Engineer Combat Group and Corps engineer, Provisional Corps, Vietnam.

MG Marshall also has served as district engineer, Mobile, AL; assistant director of Civil Works, Office, Chief of Engineers, Washington, DC; chief of Installations and Services, HQ Eighth U.S. Army, Korea; and commander, 4th Engineer Combat Battalion and division engineer, 4th Infantry Division, Fort Lewis, WA.

Graduated with a bachelor's degree in civil engineering from Cornell University, Ithaca, NY, he is also a graduate of the Army C&GSC and the Industrial College of the Armed Forces (ICAF).

Military awards and decorations include the Distinguished Service Medal (DSM), LM w/OLC BSM with "V" device and two OLC, AM (three awards), Commendation Medal (ARCOM) with OLC, and Purple Heart.

MG Young Becomes Defense Mapping Agency DD

MG James A. Young, U.S. Air Force (USAF) has been named deputy director of the Defense Mapping Agency, following reassignment of MG Hilding L. Jacobson, USAF, who had held that title since 1974.

MG Young was reassigned from duty as commander, 25th North American Air Defense Command/Continental Air Defense Command Region, McChord AFB, WA, and commander, Aerospace Defense Command's 25th Air Division. After his second Southeast Asia assignment (commander, 8th Tactical Fighter Wing, Thailand, with 105 combat flights), he served as deputy assistant chief of staff, Operations, HQ Pacific Command, HI.

Other key assignments have included operations officer and later commander, 333d Tactical Fighter Squadron, McConnell AFB, KS; and vice commander, 8th Tactical Fighter Wing, Ubon Royal AFB, Thailand.

MG James A. Young

MG Young flew 100 combat missions over North Vietnam, led the first raid on the Thai Nguyen railroad yards, and participated in the first strike against the Hanoi petroleum, oil and lubricant complexes. In Korea as a P-51 pilot in 1950, he flew 34 combat missions, and during 1957-61 was an F-100 pilot in France and England.

Graduated from the Air War College in 1969, he wears the SS w OLC, LM, DFC w OLC, Meritorious Service Medal (MSM), AM with 15 OLC and the Distinguished Unit Citation Emblem.

Jones Manages Army Ballistic Missile Program

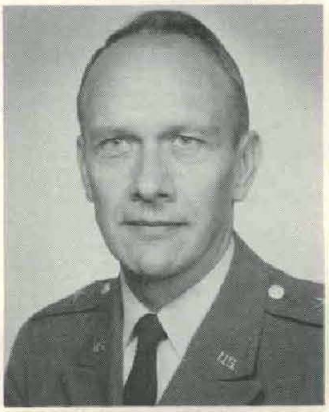
Commander of the U.S. Army Ballistic Missile Defense Systems Command BG John G. Jones has assumed additional duties as program manager for the Army's Ballistic Missile Defense Program, following reassignment of MG Robert C. Marshall.

BG Jones will also be responsible for command of the U.S. Army Ballistic Missile Defense Organization, including the BMD Advanced Technology Center, Huntsville, AL, the Stanley R. Mickelsen Safeguard Complex, in North Dakota, and Kwajalein Missile Range, Marshall Islands.

He is a graduate of the U.S. Military Academy, has a master's degree in mechanical engineering from the University of Southern California, a master's degree in business administration from George Washington University, and attended the ICAF.

Key assignments have included military assistant, Office, Deputy Secretary of Defense; assistant for Combat Material, Office, Assistant Secretary of the Army (R&D); and chief, Programs, Plans and Operations, MBT Project.

BG Jones is a recipient of the LM, BSM, MSM, Joint Service Commendation Medal (JSCM), and the ARCOM.



BG John G. Jones

McGarry Chosen as USACSC Deputy Commander

BG Robert S. McGarry, former Baltimore District engineer, U.S. Army Corps of Engineers, is the new deputy commander of the U.S. Army Computer Systems Command, Fort Belvoir, VA.

A 1952 graduate of the USMA, BG McGarry has a master's degree in civil engineering from the University of Illinois. He is also a graduate from the Army C&GSC and AWC.

Key assignments have included 378th Engineer Battalion, Korea; assistant professor, USMA; adviser, IV Corps Combat Engineering Group, U.S. Military Assistance Command, Vietnam; commander, 169th Engineering Battalion; and later, chief, Operations, 20th Engineering Brigade, U.S. Army Pacific.

A registered professional engineer in New York and Maryland, BG McGarry has received the LM w/OLC, BSM w/3 OLC, MSM, AM (two awards), and ARCOM.

BG Robert S. McGarry

Hughes Assigned as MERADCOM Commander

COL Bernard C. Hughes

COL Bernard C. Hughes, former Buffalo (NY) District engineer, U.S. Army Corps of Engineers, has assumed command of the U.S. Army Mobility Equipment R&D Command (MERADCOM), succeeding COL Tenho R. Hukkala.

COL Hukkala departed MERADCOM in August for an assignment as Logistics Systems director, Directorate of Battlefield Systems Integration, HQ U.S. Army Materiel Development and Readiness Command, Alexandria, VA.

Selected as the first black officer to command a Corps of Engineers' district office, and also the first black MERADCOM commander, COL Hughes is a graduate of the USMA, where his son is in his sophomore year. He has an MS degree in civil engineering from the University of Illinois, and is a graduate of the Army C&GSC and AWC.

His key assignments include chief, Plans Division, HQ Defense Mapping Agency; Operations Directorate, Joint Chiefs of Staff; battalion commander, 538th Engineer Battalion (Construction), Thailand; U.S. Military Assistance Command, Vietnam; and director, U.S. Army Nuclear Cratering Group, Livermore, CA.

Among his military honors are the LM w/OLC, BSM, MSM w/2 OLC, ARCOM, and Air Force Commendation Medal.

Brooke Succeeds Stahl as Edgewood Commander

COL Stafford R. Brooke Jr., assistant commandant of the Army Ordnance Center and School, Aberdeen (MD) Proving Ground since December 1975, has succeeded COL Kenneth L. Stahl as commander of Edgewood Arsenal, MD. Prior to joining APG, COL Brooke served as deputy commander and chief of staff at Fort McClellan, AL, following an assignment as commandant, Army Chemical Center and School.

COL Stafford R. Brooke

Other key assignments have included chief, Nuclear Policy Branch, Office, Chief of Staff for Operations, Department of the Army; chief, Chemical Branch, Office of Personnel Operations, DA; and a 3-year tour in Baumholder, Germany.

COL Brooke has a BS degree in physics from North Georgia College and a master's degree from Tulane University. He is a graduate of the AWC, AFSC, and the Infantry Officer Advanced Course.

Military honors include the LM w/OLC, BSM, and Vietnam Service Medal and Campaign Medal.

Reeder Assumes Command of Foreign S&T Center

Command of the U.S. Army Foreign Science and Technology Center, Charlottesville, VA, was assumed recently by COL Claire J. Reeder, former chief, Foreign Science and Technology Division, HQ Army Materiel Development and Readiness Command, Alexandria, VA.

COL Reeder has served tours of duty as commander of mechanized infantry and special forces battalions, and head of long-range study groups at Combat Developments Command and the Concepts Analysis Agency.

COL Reeder also served assignments with U.S. Army, Europe as chief, Scientific and Technology Section, Interrogation Center, executive officer, S&T Section, G-2, and as USAREUR technical intelligence coordinator.

Awards and decorations include the LM w/2 OLC, BSM, AM w/OLC, ARCOM, Combat Infantry Badge with Star and Meritorious Unit Medal.

COL Claire J. Reeder

Cousins Directs Coastal Engineering Center

COL John H. Cousins, former deputy division engineer, Ohio River Division, is the new director of the Army Coastal Engineering Research Center, Fort Belvoir, VA, succeeding COL James L. Trayers.

Recent duty tours have included assistant chief of Operations, Directorate of Civil Works, Office, Chief of Engineers, Washington, DC; engineer adviser, U.S. Military Assistance Command, Vietnam; and commander, 249th Engineer Battalion, Europe.

COL John H. Cousins

He has also served as chief, Installations Branch, Engineer Office, HQ, U.S. Army Europe; deputy district engineer, Norfolk, VA; executive officer, 802d Engineer Battalion (Construction, Korea); professor and instructor, USMA.

A 1951 graduate of the USMA, COL Cousins has an MS degree in civil engineering from the University of Illionois. Military honors include the LM w/OLC, BSM, and MSM.

Browne Takes Control as AAH Project Manager

COL Edward M. Browne, former project manager for the Advanced Scout Helicopter, has assumed new duties as project manager for the Advanced Attack Helicopter, one of the Army's "Big Five" materiel developments.

Graduated from Officer Candidate School in 1952, COL Browne has a BS degree in business administration (summa cum laude) from St. Benedict's College, an MS degree in public administration from Auburn University and an MS degree in procurement management from Florida Institute of technology.

COL Edward M. Browne

He earned an MS degree in systems management upon graduation from the AWC in 1972, and has completed the C&GSC and the Transportation Corps career course.

COL Browne's previous assignments have included project manager, LOHS and Quiet Aircraft Systems; aviation logistics officer, Office, Deputy Chief of Staff for Logistics, DA; First Field Forces, Vietnam; and Seventh Army Aviation Group. Listed among military honors are the BSM, AM w/4 OLC, and the ARCOM.

Petersen Commands/Directs ECOM Avionics Lab

COL Darwin A. Petersen recently succeeded COL Lee M. Hand as commander/director of the Avionics Laboratory, U.S. Army Electronics Command, Fort Monmouth, NJ.

Assigned for the past 10 months to the Air War College, Maxwell Air Force Base, Montgomery, AL, COL Petersen has a bachelor's degree from the University of South Dakota and a master's degree in public administration from the University of Northern Colorado. He has completed the Army Command and General Staff College Course.

A master Army aviator, he was commissioned through ROTC in 1954 and later served as an avionics projects officer at Fort Huachuca, AZ. During 1963-66 he was assigned to the Army Aviation Detachment, Heidelberg, Germany.

COL Darwin A. Petersen

Other key assignments have included Research and Development Directorate, HQ U.S. Army Materiel Development and Readiness Command; J-6 officer, Navigation and Control, Office, Joint Chiefs of Staff; and Office, Assistant Chief of Staff for Intelligence, Pentagon.

COL Petersen is a recipient of the SS, FDC, BSM w/"V" device and OLC, MSM w/2 OLC, AM w/10 OLC, ARCOM wOLC, Purple Heart (OLC).

Hearn Takes Over as Natick Deputy Commander

COL Jerry L. Hearn

Deputy commander, U.S. Army Natick (MA) Research and Development Command, is the new title of COL Jerry L. Hearn, following an assignment as director of the Hale Koa Hotel, Waikiki Beach, HI, the first Hawaiian hotel for sole use by military personnel and their guests.

Commissioned in the Quartermaster Corps through the ROTC program at The Citadel, Charleston, SC, COL Hearn served three years in Hanau, Germany, with the 6th Quartermaster Group and also as commander, Group Headquarters Company. He also served two tours in Vietnam and as chief of Plans, Deputy Chief of Staff, Logistics, HQ U.S. Army Pacific.

His academic credentials include a master's degree in industrial management from Babson Institute and graduation from the Army Command and General Staff College, and the Army War College.

He holds the Legion of Merit, Bronze Star Medal with Oak Leaf Cluster (OLC), Air Medal, Meritorious Service Medal, Army Commendation Medal with OLC, the Vietnam Cross of Gallantry with Palm, and the Vietnam Honor Medal (1st Class/with OLC).

Natick Picks Weitzler as AME Lab Director

Assignment of Irving M. Weitzler as director of the U.S. Army Natick (MA) R&D Command's Aero-Mechanical Engineering Laboratory (AMEL) was announced in August. AMEL is responsible for developing and improving parachute and field support equipment.

A mechanical engineer employed at NARADCOM since 1955, Weitzler has served in posts involving supervision of research and development programs in mechanical, aeronautical and electrical equipment and in packaging technology.

Irving M. Weitzler

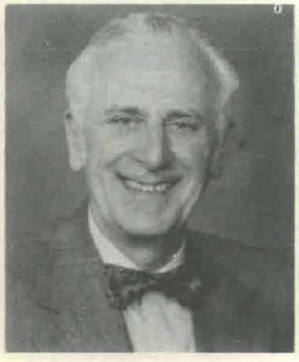
He is a member of the American Society of Mechanical Engineers, American Institute of Aeronautics and Astronautics, Armed Forces Management Association, and has served as contributing editor to various technical periodicals.

Recipient of numerous technical achievement awards, Weitzler has represented the Department of the Army at national and international conferences and is a member of International Platform Association.

Neuman Directs Defense Contract Audit Agency

Frederick Neuman, deputy director of the Defense Contract Audit Agency (DCAA) since 1972, was promoted to director when Bernard B. Lynn resigned to accept a position in private industry.

Neuman was appointed in 1965 to a special task force to establish the DCAA. Later he served as chief, Operations Division, and assistant deputy.



Frederick Neuman

A 1933 graduate of the College of the City of New York, he is a certified public accountant in New York State. Formerly a charter member of the Association of Government Accountants (AGA), he is a member of Prince Georges and Montgomery County (MD) AGA chapters.

Neuman has served as chairman of various AGA national committees, is serving a second 3-year term as chairman of AGA's Federal Financial Management Standards Board, and in 1970 was awarded the Distinguished Civilian Service Gold Medal for outstanding performance with the Defense Contract Audit Agency.

Army R&D — 15 Years Ago

The Army R&D Newsmagazine reported on ...

DDR&E Forms Advisory Group on Electron Devices

Director of Defense Research and Engineering Dr. Harold Brown approved, in a DoD instruction, establishment of an Advisory Group on Electron Devices. AGED will provide technical advice to the DDR&E and the Military Departments in planning and directing adequate and economical R&D programs in the area of electronic devices.

AGED, in its review and evaluation of the electronic device program, will "give special attention to projects and programs of particular significance: for example, those in new areas or those requiring large expenditures of effort...and will maintain on a continuing basis a detailed long-range supporting research program for electron devices."

Six working groups are contemplated at the outset of operations, involving microwave devices, low-power devices, high-power devices, special devices, conventional devices, and planning and requirements.

Army Dedicates First 'Pulse' Atomic Reactor

Dedication of the Army's first "pulse" type atomic reactor, capable of emitting bursts of radiation simulating those of an atomic explosion, was conducted at Walter Reed General Hospital Forest Glen Annex, MD.

The reactor, distinct from a power type, has been designed to build up to a high level of radiation for a pulse, or burst, approximating in energy output an atomic blast lasting 10 milliseconds. It will permit study of transcient radiation effects on electronic devices and systems, to learn how they would stand up under atomic attack. A foolproof system of automatic turnoff or shutdown is built into the core, making impossible the runaway generation of atomic power.

The reactor will be manned and operated by personnel of the Diamond Ordnance Fuze Laboratories (DOFL). Walter Reed Army Medical Center will provide health physicists and will share its use.

RAC Takes Over Part of Army Operations Research

Operations research, an area of mounting importance to Army R&D, is now a prime responsibility of the Research Analysis Corp., a newly established nonprofit research organization headed by Frank A. Parker Jr., formerly Assistant Director of Defense (R&E), Office of the Secretary of Defense.

Under the terms of an Army contract signed by Dr. Finn J. Larsen, Assistant Secretary of the Army for R&D, RAC will assume a major portion of Army operations research, providing a "greatly increased potential for scientific inputs for . . . planning."

Top-ranking Army planners assisted in the organization of RAC which, Parker said, offers the flexibility and growth potential necessary to meet the complete range of Army operations research requirements.

CRD, DCSLOG Emphasize Value Analysis Program

Techniques of Value Analysis are scheduled to come into sharp focus in all Army R&D activities during coming months by direction of Chief of R&D LTG Arthur G. Trudeau, as part of a cost-cutting campaign.

Determined that Army R&D management officials shall take a long hard look at every possibility of offsetting rising production costs of weapon systems and material, General Trudeau is working closely with the Deputy Chief of Staff for Logistics to advance the VE concept.

About 300 Army and industry representatives were invited to an introductory seminar and an Army Reg will implement the program.

Theme of Month Author Stresses 'Reduce Lead Time'

Director of Army Research MG William J. Ely recently stated: "It is of prime importance that Army R&D establish guideposts into the future for the orienting and directing of its program. Reduce lead time is the R&D mandate, because of the political urgency of our times and because science and technology, with associated changes, are increasingly the basis of military power and national survival. This means proceeding under forced draft with the R&D program, telescoping a time-consuming and complex process.

"Such action can deal with all sorts of lost motion in conflicting and wasteful efforts - marginal projects carried far beyond the proper point of abandonment; duplicate projects; projects yielding only obsolescent or obsolete end products; projects not started until the end product need is glaringly evident - unless Army R&D managers, scientists and administrators perfect procedures for a better analysis of what the Army of the future needs, and how and where Army R&D should act now to satisfy these needs.

Ballistic Research Laboratories Simulate Nuclear Burst Thermal Layer

By. Dr. Edmund J. Gion

Political and environmental considerations led to 1962 cessation of atmospheric testing of nuclear weapons. Extreme temperatures and energies liberated in such blasts lead to many diverse and complex "non-ideal" phenomena, many details of which are not fully understood despite extensive simulation testing.

Comprehensive understanding is necessary, however, for defensive planning, including important information on missile detection and radar communications blackout, structural damage, personnel protection, and countermeasures, to name a few areas.

Under terms of the imposed constraints on real nuclear testing, scientists and engineers have had to devise reasonably suitable simulations of nuclear explosions and the effects which they wished to study. Some of these have required a considerable logistic effort.

U.S. Army Ballistic Research Laboratories investigators recently simulated, on a modest laboratory scale, the "thermal layer" previously observed in a number of air nuclear bursts over terrain. Then we have studied its interaction with a "nominal" nuclear blast wave corresponding to ground ranges of 600 meters.

The thermal layer is a heated area of air, dust, smoke and other foreign materials overlying the ground surface slightly after bomb detonation. Such a layer may be formed by the nearly immediate irradiation of the earth's surface by the nuclear burst, accompanied by evaporation of the surface and transfer of heat into the adjoining air layer - all before the arrival of the main air blast.

The thermal layer has a higher sound speed than the air above it, with the important result that a pressure wave incident on and in the layer travels faster in it and thus runs ahead of that portion of the incident wave traveling in the colder region above. Precisely this interaction of the nuclear air blast with the thermal layer gives rise to the so-called "precursor shock" observed in the field tests.

Presence of the precursor shock in the nuclear blast has some important consequences for Army weapons. The dynamic pressure, for example, is increased and its phase lengthened.

This phenomenon increases the chances for defeat of structures strengthened against static pressure forces but still vulnerable to drag forces. The damage radius may be increased as much as 50 percent, thereby influencing weapon yield selection, particularly where damage must be minimized outside the target area.

Some problems concerning the thermal layer

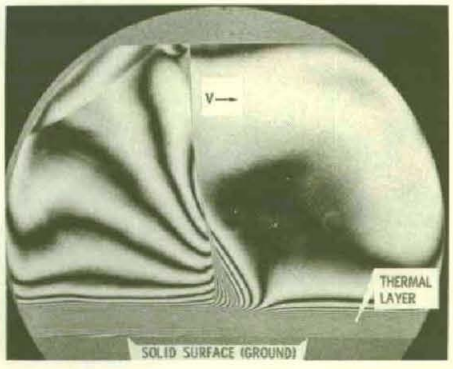


Fig. 1. Interferogram of Plane Shock Interacting With Thermal Layer

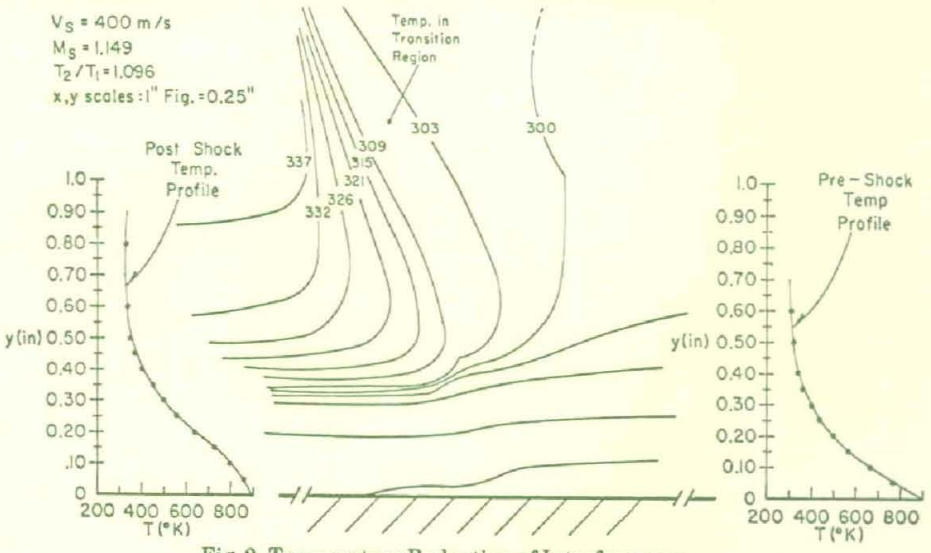


Fig. 2. Temperature Reduction of Interferogram.

are: (a) because of dust and foreign materials the properties of the thermal layer are not well known and can vary according to the terrain; and (b) the details are lacking of the blast-thermal layer interaction. Thus the prediction of forces and impulse applied to targets is not very accurate when thermal layers are present.

Our simulation of the thermal layer involved simply the heating of the air over a heated plate, a technique used many years ago at much lower temperatures by Prof. W.C. Griffith.[1] The test plate is held in an inverted position to minimize convection currents in the test section of our Expansion Tube/Shock Tube Facility. This results in a model *clean-air* thermal layer. We then observe thermal interactions with plane shocks passed over the plate by using Mach-Zehnder interferometer instrumentation developed by BRL.

The interferometer provides interferograms of the flow over the plate at the time of the snapshot, an example of which is shown in Figure 1. The fringes - the dark lines, say - represent the interfering effects of the flow on the special lighting used to expose the film. The shock is the vertical curving line near mid-picture and is moving to the right.

This example is so-called "infinite-fringe" interferogram, which has a special property: the fringes represent lines of constant density - i.e., density "contours." The few fringes in the upper portions to right and left of the shock represent the more-or-less uniform pre- and post-shock regions of the flow.

The numerous and closely spaced fringes above the "ground" surface characterize the thermal layer. Particularly interesting is the transition region reaching down from the main shock into the thermal layer.

One observes, in effect, a set of constant density "waves" into which the main shock has degenerated in its encounter with the thermal layer. Similar wave structures were also observed in the field, although at the time their origins were unclear.

Apparently, the thermal layer affects the shock well above itself. The waves leading the main shock must be associated with the precursor shock. By measuring the fringe displacement on the interferogram with respect to known conditions, and using our model of the thermal layer, its interactions, and transition zone, we are able to extract densities and temperatures in the interaction zone adjacent to the thermal layer.

These phenomena are seen in the enlarged view of the interaction zone shown in Figure 2 for the interferogram of Figure 1, together with the flow conditions for the test. We note the temperature increase through the transition region and the steep fall-off of temperature with increasing height in the thermal layer.

Temperatures are an important property of a thermal layer since they affect the local sound speeds which were not well known in the field tests. Our experiments produced a fair amount of temperature data, particularly in the transition region for which no data had existed.

In principle, the techniques used here are easily extendable to cover a realistic set of shock over-pressures, simulating different ground ranges, and thermal layer temperatures. These experiments would yield a substantial amount of temperature data and would be available for comparison with computer models of the nuclear blast/thermal layer interaction.

In the investigations here described, experiment and theory interact to provide weapons experts improved understanding of complex phenomena of nuclear blast interactions.

[1] W.C. Griffith, "Interaction of a Shock Wave with a Thermal Boundary Layer," J.Aero. Sci., 23, 16-23 (1956).

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Army Research Office Sponsors Bicentennial of American Science

Sponsored by the U.S. Army Research Office with support from the United Nations Educational Scientific and Cultural Organization (UNESCO), the Bicentennial of American Science 2-week program for 115 representatives of 15 nations was lauded as a unique, stimulating, unforgettable experience. All of the participants - 80 from foreign lands and 35 from the United States - joined in enthusiastic comments, the most common being: "Will it be possible to arrange a similar program for science students again?"

Donald C. Rollins
Organizer of Tour

That query was "rewarding music" to Donald C. Rollins, chief of the Conferences and Symposium Office, U.S. Army Research Office, Research Triangle Park, NC. He developed the concept while thinking about a distinctive contribution USARO might make to America's Bicentennial Celebration - and started to work on the idea about two years ago.

Rollins also serves as project officer for the biannual Army Science Conference, a duty he assumed for the 1976 ASC, as well as the National Junior Science and Humanities Symposia Program for high school science students, and numerous other scientific gatherings in which USARO plays a lead role. USARO is an element of the U.S. Army Materiel Development and Readiness Command.

Many words of gratitude also were expressed by group members for the hospitality of their hosts - Georgetown University during the first week (Aug. 13-20) in the Greater Metropolitan Area of Washington, DC, and Fairleigh Dickinson University during the New York City area visit.

Some of the comments from participants, ranging in age from 18 to 30 years and in experience from high school students to professionals with PhD degrees in science, will go down in the record books of USARO as making the Bicentennial of American Science satisfying such as:

"When the people in Sweden say trashy things about the United States when I get back, I am going to tell them that this is a beautiful country." — Artur Tenenbaum.

"Your Army does much more than fight. I never knew your Army was involved in so many different things." — Jacques Severs, Belgium.

"Everything here is connected by computers. What takes you minutes to do takes us many hours." — Richard O'Kennedy, Dublin, Ireland.

"There are more PhDs working at Bell Laboratories (one of more than a score of major laboratory complexes visited by the group) than we have in all of Mexico." — Jose Luis Haen, Mexico.

"Dr. Hofstadter's lecture on Quantum Theory and Electrodynamics was the most impressive of all the great lectures." — Masaki Okawa, Japan. (Dr. Robert Hofstadter, Stanford University, is a Nobel Prize Laureate.)

"Your science in America is excellent, very sophisticated, but your beer is not good." — Wolfgang Meyer, Bonn, Germany.

Approved by the Department of the Army with the blessing of the U.S. State Department, the Bicentennial of American Science was funded partially by the Army through grants to Georgetown University and Fairleigh Dickinson University, but the foreign participants each paid $150 expenses plus their transportation costs.

Arrangements for foreign participation were worked out in conjunction with the UNESCO International Coordinating Committee for Out of School Science Activities, and the Council for International Contact, London, England. Aiding Don Rollins as coordinator of U.S. participation was Mrs. Barbara Osborne, Duke University staff, who coordinates National Junior Science and Humanities Symposia Program.

United Kingdom chaperone Harry Stevenson (left, rear), Alan Waby, Susan Turner, Dinah Parums (rear), and Stephen Pickering, all from the United Kingdom, and Carol Thomas, Scotland, view display of British munitions at Picatinny Arsenal Museum.

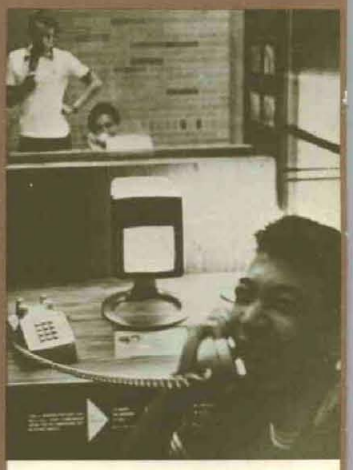
PROGRAM OF EVENTS. USARO Commander COL Lothrop Mittenthal presided at the Sept. 14 opening session at Georgetown University. Associate Dean of the College of Arts and Sciences Dr. Richard Sullivan gave the welcoming address.

Dr. Chalmer G. Kirkbride, scientific adviser to the chief administrator of the U.S. Energy Research and Development Administration, was the principal speaker. His topic was "The Future Availability of Energy - Its Impact on the Development of Civilization As We Know It."

Guided bus tours of Washington on Saturday afternoon were followed by a much-appreciated concert featuring The Army Blues Band.

(Continued on page 23)

Thomas A. Edison's chemistry laboratory in East Orange, NJ, drew attention. Marie Bock, Luxembourg, examines equipment used by Edison in search for synthetic rubber.



Bell Laboratories picture telephone is enjoyed by Amnueyporn Kanchanawongse (foreground), Thailand, and Jean Pierre Bal, Belgium, and Suthep, Fraumnuaytol, Thailand.

PROJECT ENGINEER Paul Chiodo (right) escorts Bicentennial of American Science group (from left) Carol Thomas, Scotland, Pierre DeVries, Republic of South Africa, Garry Griffin, United Kingdom, and Alicia Koch, U.S., through Picatinny Arsenal Ammunition Museum.

Georgetown University Professor Dr. Digmund Norr observes as Bicentennial of American Science participant views whole embryo culture through electron microscope while touring the university's labs.

Viewing modern weapons as well as early munitions at the arsenal museum are (from left) Jean Pierre Bal, Belgium, Danny Gigo, Belgium, Rosalind Rafanelli, Florida, U.S., and Rado Genorijo, Yugoslavia.