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 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 radar 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 summa 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 AntiaBallistic 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-
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 Leopard 2—along with other combat vehicles.

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OTHER GOVERNMENT AGENCIES' requirements should be submitted directly to DRDCE/LN, 5001 Eisenhower Ave., Alexandria, VA 22333.


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ARMY RESEARCH AND DEVELOPMENT NEWS MAGAZINE 1
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, and an infrared tracker system and an interfaced programmed 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 Determining 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

Implementation 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 programmed 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 on 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 post, Dr. Eichelberger, his director, has been involved with ARRDCOM on a daily basis.

Graduated from the United States Military Academy in 1959, 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). In addition to a variety of construction engine assignments 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 for six 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 ARRDoom. 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.

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

The Office of the Chief, Defense Research, Development, and Acquisition (ODCSRDA) worked with DARCOM in sponsoring the 2-week seminar conducted by members of the 195th and 160th MOBDES Detachments, Fort Belvoir, VA.

The 2-week program and discussion sessions updated the attendees on current developments, progress and objectives in advanced and engineering development, efforts, prototype and new initiatives, basic research, and "real-world" budgetary constraints as related to international and political considerations.

Welcoming addresses were presented by summarizing co-directors COL Herbert L. Levy Jr., commander, 160th MOBDES Det., and COL R. L. Pendleton, commander, 156th 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 those involving freeze-dried foods, flexible food packaging, night vision devices for treatment of Retinitis Pigmentosa eye disease, 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. Hersher, assistant director of Army Research (Technology), ODCRDA, spoke on "The Army Research Program." E.J. Sheehan, director of the U.S. Army Night Vision Laboratory, "Night Vision R&D - An Update."


TARCOM Awards $43.9 Million for 596 Heavy Equipment Tractors

Award of a $43,897,980 contract for 596 Heavy Equipment Tractors (HET) tractors, with a first-year obligation of $13,748,830, was announced by the U.S. Army Tank-Automotive Command at press time for this edition of the Army R&D News magazine.

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 successfully 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 tanks, along with a non-driving axle which will reduce axle loadings to prevent road and highway damage.

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 MICTOM'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 Conventional 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 procurements, 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 will encompass wholesale and retail stocks, that is, stocks between point of production and point of receipt at the first intermediate CONUS activity, and (retail) 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

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 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 internationally 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 News magazine went to press.

CDEQ Tests TOW Capability Against Attack Helicopters

Feasibility of using the TOW (Tube-launched, 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, CDEQ’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 pro-

file, 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-1) is ordered in a 48-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.

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, technical director and assistant for R&D to the Chief of Engineers, and COL Ralph J. Garver, deputy engineer, New England Division. Former Senate 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 - 10° 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 photographic 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 economic 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.

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 bubbles-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. Natarajan, Institute of Technology, India, Ballistics of Vaporizing Liquid Droplets; 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 Npyrr; A. Mitchell, 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 Gasous 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 workflow channels built into its entire surface.

Since earlier water-cooled garments developed for the NASA space program used rigid 1/8-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 testing by the Army's LARC-V and LARC-15 amphibious resupply crafts.

A modified version of the Voyager 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 Voyager is at Aberdeen Proving Ground (APG), MD, for development testing to determine conformity to mobility, performance, transportability, and safety requirements.

The prototype LACV is 76% 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 equipment.

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, MLRS, 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 print-out 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.

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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 man-handling 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 may be 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 Arsenal, 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 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.

CONCEALMENT for M60A1 Tank

Army Research and Development News Magazine 7
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 Leopard2.

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.

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 Leopard 2.

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 trademark for an aramid fiber) which proved to be most effective against fragmenting munitions. These fabrics are built up in layers and resinated within a mold. The large size weighs 53 ounces, 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 paratroopers, 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.

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.

Collection 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. Zarow, project engineer in Edgewood Arsenal's Development & Engineering Directorate.

The system has radio and telephone connections to control overall 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 Material 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 barrell 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 mater 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 tests.”

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.

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 employees 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-crossing press equipment; also, an additional station to clean the burster and fuse cavity.

Six to eight employees 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.

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.

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 engine, 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 dieting 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 99 research tasks listed in main categories: food science analytical chemistry, food chemistry, human factors, field studies, food habits and methodology, taste, olfaction, appetite, and food acceptance.


Food Preference and Consumption, J.R. Siebold and D.L. Maas. A Method for the Re-


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


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.

In addition to the CAWS PMO, the latter organization will be responsible for all missions and structures will be altered. 1964. He is also project manager for Cannon Artillery Systems Concepts Team, Advanced Systems Concepts Office.

COl L. K. S. Heitzke, who has served six months as GSRS technical assistant, 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 of staff in 4 at present to 18.

MlCOM 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 FortMonmouth, 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 experience includes the Legion of Merit with 2d Oak Leaf Cluster (OLC), Distinguished Flying Cross, Bronze Star (2d OLC), Korean War Ring with Gold Star, Republic of Vietnam Gallantry Cross with Palm, and Republic of Vietnam Honor Medal.

MI, as director of Research, Development and Engineering, U.S. Army Mobility Systems Laboratories. During 1971-72 he served in the Combat Material 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 (1988) 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 at 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, Army Medal w/3 OLC and Army Commendation Medal w/2 OLC.
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 swimable” 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: 280 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 consensus 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 (Waste-

WARHEAD ASSEMBLIES For Roland short-range air-defense missiles are inspected at Boeing Aircraft's Long Beach Aircraft Research Laboratories. 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.

water) Treatment (CAPDET), calling for the laboratory to serve as principal agent.

CAPDET was initiated 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. Francignoues of EEL conceived 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, quantum treatment of EEL, and users from field offices.

USAIDR Bone Loss Replacement Research Continues

Directed toward the 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 a proposal for a U.S. Army Institute of Dental Research, Walter Reed Army Medical Center.

USAIDR research is now in its third year, using tricalcium phosphate /Ca(PO4)2/ initially proved as a highly satisfactory substitute in bone grafting experiments. 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.

Osteoporosis treatment 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 study presented at the 10th U.S. Army Science Conference, June 22-25, by USAIDR Commander COL Duane E. Cutsright (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 Tran, Memphis District, participated.

WES Technical Director Frederick R. Brown welcomed conferencees and was followed at the community growth patterns, and restriction when developing designs and costs for upgrading sewage plant capabilities.

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.

Osteoporosis treatment 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 study presented at the 10th U.S. Army Science Conference, June 22-25, by USAIDR Commander COL Duane E. Cutsright (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.

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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 foxhole 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 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 sensors 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.

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. At 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 Air Mobility and Air Defense (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 Aircraft Engine Group will develop, under a $424,000 award, manufacturing methods and technology and design layout of an advanced technology experimental helicopter ground mobility system. A $49,710 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. RACOIL 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). A $14,500 award to Teledyne Ryan Aircraft, El Segundo, CA, will be used to evaluate its application to inspection systems.

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 (MERADCOM), a $69,000 award to United Technology Research Center to determine dynamic structural response with a goal of reducing damage and personnel injury.

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

Army helicopters will be developed by Panametrics, Inc., under an $85,961 contract. fiberglass, $82,549 for a concept formulation, selection corrosion resistance.

Coast Guard Adopts Army's EOD Protective Clothing

Coast Guard has been working with Army's Environmental Protection Agency on an EOD protective clothing system. The system has been only slightly modified for Coast Guard use.

Coast Guard Adopts Army's EOD Protective Clothing

Coast Guard has been working with Army's Environmental Protection Agency on an EOD protective clothing system. The system has been only slightly modified for Coast Guard use.

Chemical protection is provided without hindering body movement. An airtight butyl rubber helmet is sealed at the boots, gloves, helmet and front zipper closure to guard against any gas leakage or direct liquid splash. A non-tinted, durable over-glove serves for the hand, body, and head. Airtight butyl rubber boots are sealed at the boots, gloves, helmet and front zipper closure to guard against any gas leakage or direct liquid splash. The suit is now being developed for use by personnel of the Environmental Protection Agency.

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.

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.

ARMY RESEARCH AND DEVELOPMENT NEWS MAGAZINE 13

SEPTEMBER-OCTOBER 1976
AMMRC Expands Fracture Mechanics Technology Applications

Increased use 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 Tracey of the Mechanics Research Lab, AMMRC, and by 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 sorted in the survey include industrial organizations, U.S. Government agencies, universities, and material developers, for applications such as engines, pressure vessels, aerospace structures and ship structures.

Table 1 - Number of......

<table>
<thead>
<tr>
<th>TYPE OF DESIGN</th>
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<tbody>
<tr>
<td>1. Adhesive Joints</td>
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<tr>
<td>2. Aerospace Vehicles</td>
<td>52</td>
</tr>
<tr>
<td>3. Aircraft Engines</td>
<td>15</td>
</tr>
<tr>
<td>4. Aircraft Structures/Frame</td>
<td>77</td>
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<tr>
<td>5. Analytical Methods/Mechanics</td>
<td>89</td>
</tr>
<tr>
<td>6. Bridges and Buildings</td>
<td>13</td>
</tr>
<tr>
<td>7. Cargo-Land Vehicles</td>
<td>2</td>
</tr>
<tr>
<td>8. Cargo-Ships Vessels/Seas</td>
<td>3</td>
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<td>9. Dental Structures</td>
<td>4</td>
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<tr>
<td>10. Electronics Equipment</td>
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<tr>
<td>11. Fracture Control Planning</td>
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<tr>
<td>12. General Structures</td>
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</tr>
<tr>
<td>13. Geologic Applications</td>
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<tr>
<td>14. Helicopter Structures</td>
<td>17</td>
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<tr>
<td>15. High Temperature Applications</td>
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</tr>
<tr>
<td>16. Internal Combustion Engines</td>
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<tr>
<td>17. Materials Development</td>
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</tr>
<tr>
<td>18. Materials Fracture Characterization</td>
<td>119</td>
</tr>
<tr>
<td>19. Mechanical Testing/Evaluation</td>
<td>122</td>
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</tbody>
</table>

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.

Table 2 - Fracture Stress Activities

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Growth of Activity</td>
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<td>4</td>
</tr>
<tr>
<td>Research</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Testing</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<td>4</td>
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</tr>
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<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Use</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 3 - Usage of Toughness Tests in Selection of Material Applications

<table>
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<th>3</th>
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<tbody>
<tr>
<td>Crystallography</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>Thermal Analysis</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Fatigue Testing</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Fracture Testing</td>
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<td>6</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Hardness</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Cost Schedule Control System Accepted for Use at Edgewood

The Cost Schedule Performance Control System (CSPCS), developed as an improved management system to provide a tangible baseline for operating R&D programs and determining budgetary requirements, has been tested 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 System 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. Forkorn, 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 analysis 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 material.

The primary purpose of this laboratory equipment is to develop counter-surveillance techniques to reduce probability of detection of tactical material 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) uncontrollable 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 L-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 processed 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.

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 scatterers 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 microwave 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 scatterers 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.

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

Fig. 2. Microwave Imagery

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.

SEPTEMBER-OCTOBER 1976

ARMY RESEARCH AND DEVELOPMENT NEWS MAGAZINE 15
Implementing DARCOM 'New Way of Doing Business'...

TACOM Realignment Separates R&D From Logistics Functions

Transitional changes phased into the U.S. Army Material 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 overall 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 Material 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 duties at that time as acting deputy commander of the provisional organization.

Shortly afterward, TACOM’s R&D&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 Central 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 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 R&D&E Directorate, separated from the provision 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 logistic 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 886 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, 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
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. Adis 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)
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 civil-military personnel office, and legal, small business, public affairs, and historical services.

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 1 1/4-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 Frederick 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 program managers for the Mechanized Infantry Combat Vehicle (MICV), BG Stan R. Sheridan, and XM-1 Tank Systems, GM Robert J. Baer.


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 maintenance, and equipment. Similar services are provided to friendly 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 materiel, in development. 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 responsibility associated with 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, M562 cargo and M533 wrecker trucks), the M561 Gama Goat rough terrain vehicle, M68/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 12,260 (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 program and 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 Detroit city center. 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 burdened by 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 di-
rector of Advanced Systems with Martin Marietta Aerospace.

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 his-
torically, and wittingly, enjoyed good tech-
ology transfer. That is nothing to get complacent about, however,
since it is also widely agreed that the U.S. dominance in high tech-
ology 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 technology transfer audit 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, as a 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 understand-
ing 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 tech-
nology transfer effectiveness.

Furthermore, things will continue to degrade unless we under-
stand 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, de-
ponds in no small way on the productivity of DoD technology, I wel-
come this opportunity to share views of this situation with you.

The subject of this session is technology transfer, or 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 tech-
nology 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, tech-
nology 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 un-
comfortable 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 com-
plex technology - our much touted "high technology" - is greatly facilitat-
ed 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, especia-
Uy 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. The "suggestions" that show up in propos-
als 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, how-
ever, the ultimate burden of proposing and executing the tech-
nological 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 that it is a prereq-
Uite 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 tech-
nological 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 cutset. 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 tech-
nology transfer effectiveness it is necessary to get a high tech-
hology capability.

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. I remain convinced of the need for:
(1) Sources of new ideas, (2) filters of ideas for useful applicability, (3)
formulators and executors of both the in-house and contract of Tech-
nology Base programs, (4) direct contributors to systems de-
velopments, and (5) advocates and promoters of quality technology
throughout DoD.

(Continued on page 20)
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 are: 1) technological edge in new military competition; 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 approaches have been summarized as: 1) emphasize future system studies; 2) focus R&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 the 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 R&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 to research, 45 percent to 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, the criteria are for only about 23 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 heavy 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.
My remarks on Technology Transfer, from the viewpoint of the developer, will highlight the mechanisms employed by the Army for the development of new technology. As we understand the Army's purpose, the Army is concerned with all aspects of technology development, from the initial research and development (IR&D) to the application of technology to operational systems. The Army's primary concern is the effective transfer of technology to the user community.

In the past, the transfer of technology has been a slow process, often hampered by the lack of coordination between the developer and the user. This has resulted in a situation where the technology developed by the Army is not effectively utilized by the user community. The Army has recognized this problem and has taken steps to improve the transfer of technology.

The Army has established a series of Technology Transfer Offices (TTOs) at its major research and development laboratories. These TTOs are responsible for the coordination of technology transfer activities within the Army. They work closely with the user community to ensure that the technology is effectively utilized.

The TTOs are responsible for maintaining close liaison with the user community and the Army to coordinate the technology transfer process. They maintain a close relationship with the user community to understand the needs of the user and to ensure that the technology is effectively utilized.

The TTOs also work closely with the Army's laboratories to ensure that the technology is effectively utilized. They coordinate with the laboratories to ensure that the technology is effectively transferred to the user community.

In conclusion, the Army is committed to the effective transfer of technology to the user community. The Army has established a series of Technology Transfer Offices to coordinate the technology transfer process. These TTOs work closely with the user community and the Army to ensure that the technology is effectively utilized.

The chart on page 22 illustrates the Army's technology transfer process, from the initial research and development to the application of technology to operational systems. The chart highlights the various stages of the technology transfer process, from the initial research and development to the application of technology to operational systems. The chart also highlights the various stakeholders involved in the technology transfer process, including the developer, the user community, and the Army.

The Army's technology transfer process is designed to ensure that the technology is effectively utilized by the user community. The Army is committed to the effective transfer of technology to the user community, and the chart on page 22 provides a clear illustration of the Army's technology transfer process.
million in research, development and production costs for Army, Navy, and Air Force systems over a 10-year period.

The MDCOM data bank is being kept coincident with full implementation of a Defense Documentation Center data bank.

A rather lengthy list might be used to show examples of technology transfer from the MDCOM 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 MDCOM. Through the use of informal tri-service working groups, the technology needed to build laser-guided “smart” bombs was transferred to other Department of Defense agencies - resulting in a new era of tactical warfare.

### TABLE 2 - MDCOM Laboratory Technology Used by Other Agencies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Source</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propulsion</td>
<td>Falcon</td>
<td>Improved Hawk</td>
</tr>
<tr>
<td>First castable composite</td>
<td>Polaris, Poseidon</td>
<td>Air</td>
</tr>
<tr>
<td>Manufacturing process</td>
<td>Polaris, Terrier, Posidon</td>
<td>A1l-configuration (missiles)</td>
</tr>
<tr>
<td>large solid rocket motors</td>
<td>Sparrow, Terrier, Possidon, Scout</td>
<td>Aircraft, tactical</td>
</tr>
<tr>
<td>Polyurethane propellant</td>
<td>Polaris</td>
<td>Long-Range Missile</td>
</tr>
<tr>
<td>Polyanhydride chloride propellant</td>
<td>Aluminum fuel</td>
<td>Long-Range Missile</td>
</tr>
<tr>
<td>Polybutadiene propellant</td>
<td>Polybutadiene</td>
<td>Long-Range Missile</td>
</tr>
<tr>
<td>Polyepoxy propellant</td>
<td>Polybutadiene</td>
<td>Long-Range Missile</td>
</tr>
<tr>
<td>Polyurethane propellant</td>
<td>Carbonyl-terminated polyurethane</td>
<td>Pharmaceutical Industry</td>
</tr>
<tr>
<td>Stabilizing cast double-base composite propellant</td>
<td>Nitroglycerin analysis</td>
<td>Pharmaceutical Industry</td>
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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 last item 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 pharmaceutical 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 adoption of technology generated by other services, NASA, and industry. As you can see, technology invented elsewhere has found its way into Air Force systems and system concepts - Hellfire, small rockets, long-range missiles, Lance, lasers and radar. (See Table 3.)

<table>
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<tr>
<th>Technology</th>
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<td>Navy</td>
<td>Hellfire</td>
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<td>2.75-Inch Rocket</td>
<td>Navy</td>
<td>2.75-Inch Rocket System</td>
</tr>
<tr>
<td>Lancer Grade Nitrocellulose</td>
<td>Navy</td>
<td>IMP Chaparral Propellant</td>
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<tr>
<td>Hornet Missile</td>
<td>Navy</td>
<td>Helicopter Test Bed</td>
</tr>
<tr>
<td>Directional Measurement Gear</td>
<td>Air Force</td>
<td>Long-Range Missile</td>
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<tr>
<td>Pulse Code Modulation</td>
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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:

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 over-all 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, 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, 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 innovation to 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. That resource con­
strain requires us to prioritize our needs, and to make decisions that
will provide us with the greatest battlefield payoff.

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

Yet we really need to do is continue research to build our tech­
ology 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. 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. The user must be patient.

As the user, we feel it is our responsibility to evaluate
our system. Today, scientists are challenged to
develop weapons systems that are not only complex, but are not
possibly complex. We must understand that
sophisticated enough to operate, cheap. reliable, and built for rugged use.

ARO Sponsors Bicentennial of American Science
(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 Wash­
ington, 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
popular poling 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 Uni­
versity. 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, NASA's Jet Propulsion Laboratory, the National Institute of Dental
Research, National Institute of General Medical Sciences, National Institute of Neurological
and Communicative Disorders and Stroke, National Eye Institute, National Institute of
Mental Health (Alcohol, Drug Abuse, and Mental Health Administration), the Goddard
Space Flight Center, and National Aeronautics and Space Administration.

Wednesday morning, Aug. 18, offered an insight into Georgetown Uni­
versity'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 "Pendulous" by Richard N. Cottron, U.S. Army Harry Diamond Laboratories.

The Aug. 16 program included a tour of the National 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 Corps Center.

Buses departed from Washington Friday, Aug. 20, making a visit to
Independence Hall in Philadelphia, PA, en route to Fairleigh Dickinson
University, Madison, N.J. Dr. John S. Rines, professor of biological sciences, served as
president of 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, following a tour of the city 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 H. Hetherington, director, Station Systems Division 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 Fool." 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 Avey, professor of chemistry emeritus at Berkeley and President of the University, and Dr. Robert Hofstadter.

Known as one of the best lecturers in the world on chemistry, Dr. Avey
held the group spellbound for an hour and 50 minutes with his presen­
tation and demonstration on "Lucky Accidents, Great Discoveries and
the "Great 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 Institute 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 represent 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 "ionospheric 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.

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 a marked 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 observe 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 Arkhangelsk's 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 terminate 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) Project at Kerguelen and Sogra) Project, consisted of launching two French ER-5 rocket 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 1968 U.S. experiment demonstrated the feasibility of using a rocket-launched electron accelerator to generate small artificial auroras.

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, which lasted several minutes, caused interactions 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 study 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 electronic 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 PSTD assessment of foreign research in geophysics, 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 adaptation 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. Reyes, 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.**

**SEPTEmBER-OCTOBER 1976**
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 employee 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

OL Alvin D. Ungerleider

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 about 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 Recreation, 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 went on 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 Employees 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 employees 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 FRG 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 80’s” program, attended the Engineer School in Holziminden, and was assigned to the Procurement Center for the Ministry of Defense.

Dr. Henning Wilke, 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 Engineers, Army Corps of Engineers, nine Picatinny Arsenal employees will receive four years of training leading to journey- man-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 Zeeck, William Mack and Peter Waterman (WG-10 electricians); Richard Boessen 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 employees chosen to attend one of eight universities under the U.S. Civil Service Commission's Education for Public Management Program.

The program is designed as 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 of 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.

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) employees 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.

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.

'Best of Both Worlds'...

Enlisted Psychophysiological Is Also An Officer

SSG Michael "Scott" Cameron, a psychophysiological 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 a specialist. He was recently commissioned a Reserve second lieutenant through 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.

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 1975 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 employees by 1969-75 "exceptional 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.

A federal employee 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

Therence 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 employees.

Employed at MERADCOM since 1964, Kirkland was cited for his major role in engineering 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, employees 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.

Employed at BRL since 1968, Dr. Dehn has worked on analyses of radio-active 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 employee since 1957. His special expertise is in transient high-pressure phenomena that occur during impact or detonation.

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 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 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, a 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) B&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. Selected as a Fulbright Fellow, Ohio State University post-doctoral Fellow, and a recipient of a 1965 Army Research and Study (SABRS) 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 creativity 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 Employee Wins Special Features Award

Nancy Minnick, 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 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 employees in telling the DARCOM mission to internal and external audiences, the DARCOM Special Features Program details are outlined in DARCOM Swenson etc. Application 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.

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. Gelovatch, 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. Fath, Army Aviation Systems Command; Quick Way to Contain Oil Spills, Henry F. Faulkner, APG; The White Sands Missile Range Laser Ranging and Tracking System, John A. Reth, 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 microbial activity of chemicals in the vapor phase.

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 F. Pabst, 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, 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.

ADPA 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. Loom, deputy director, Defense Advanced Research Projects Agency, Department of Defense.

Conferences 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 conferences.

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.

Inadvertently 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.

Coposponsors 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, 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.

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, 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 include 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), Command 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, 33d Tactical Fighter Squadron, McConnell AFB, KS; and vice commander, 5th Tactical Fighter Wing, Ubon Royal AFB, Thailand.

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


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 Communication Medal (JSCM), and the ARCOM.

McGarry Chosen as USACSC Deputy Commander


A 1982 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/OLC, MSM, AM (two awards), and ARCOM.
Hughes Assigned as MERADCOM Commander

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 B. Hukkala.

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 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 Crane 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.

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, APSC, 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.

Cousins 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 1962, 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.

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.

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 w/OLC, Purple Heart (OLC).

SEPTEMBER-OCTOBER 1976
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.

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 the 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.

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 News magazine 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 transient radiation effects on electronic devices and systems, to learn how the could 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 guidelines for 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 obsolete 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 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. 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 wave 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 overpressures, 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.
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?"

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 Symposium 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 Tenbaum.

"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 a computer hours." - Richard O'Keeney, 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 Huen, Mexico.

"Dr. Hofstadter's lecture on Quantum Theory and Electrodynamics was the most impressive of all the great lectures." - Masaki Ohara, 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.

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 Rafaelini, Florida, U.S., and Rado Genorijo, Yugoslavia.

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 Miltenthal 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)