ARMY
RESEARCH AND DEVELOPMENT

October-November 1977

Walter Reed Army Medical Center Dedication

Climaxes Decade of Intense Effort to Attain Maximum in Advances

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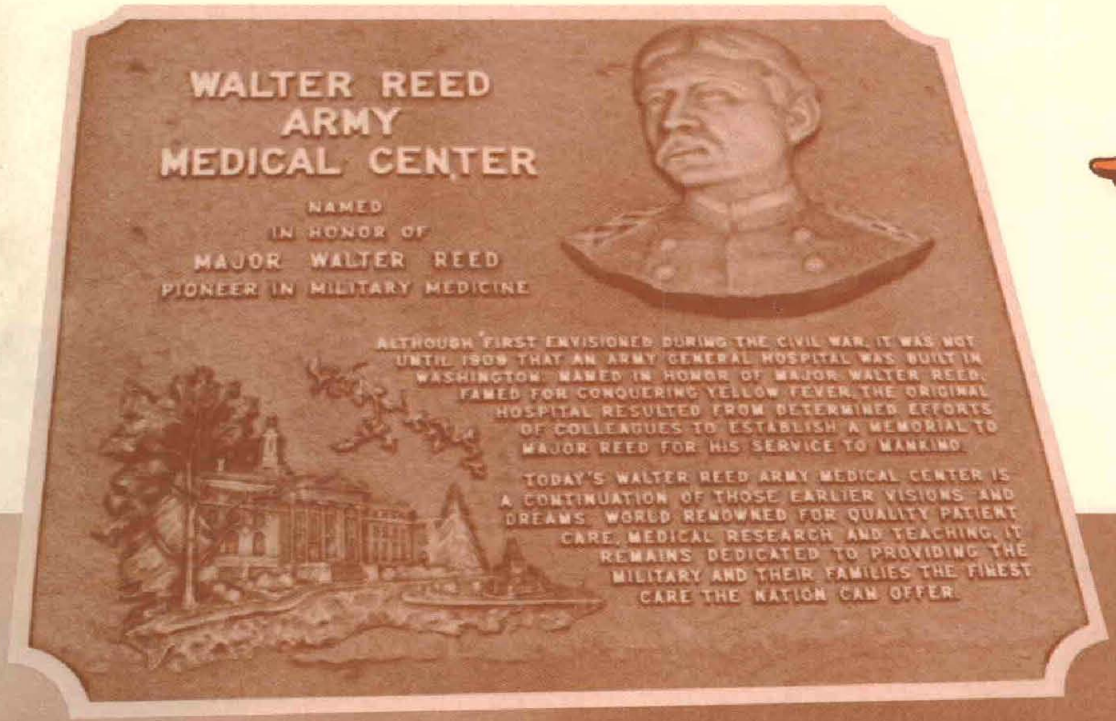

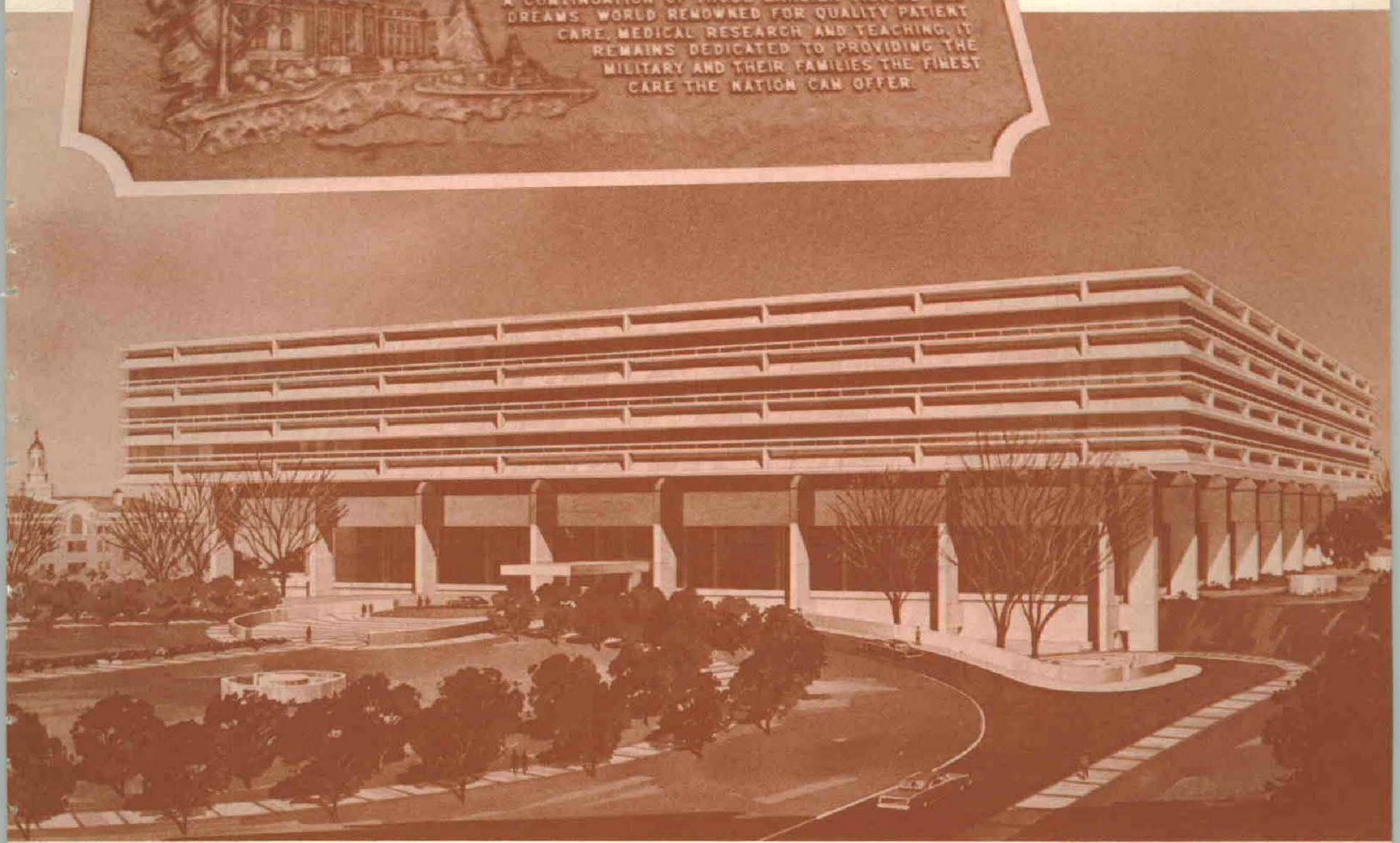

SPEAKING ON . . .

Changing Army Operations Research

By Dr. Seth Bonder

This article is a condensation of Dr. Bonder's keynote address at the recent 16th annual U.S. Army Operations Research Symposium at Fort Lee, VA. It presents some critically challenging views regarding the changes that must be made to restore credibility and acceptability of OR by decision-makers. Dr. Bonder is regarded as a "giant" in the OR profession and is founder and president of Vector Research Incorporated.

Dr. Bonder obtained his BS degree in mechanical engineering in 1960 from the University of Maryland. His doctorate in industrial engineering (operations research) came in 1965 from Ohio State University, where he was a principal investigator with the Systems Research Group.

While serving on the University of Michigan faculty, starting in 1965, he founded and directed the Systems Research Laboratory, and is currently an adjunct professor. He also has been a lecturer for the National Science Foundation, a committee member for the National Academy of Sciences, and has built his reputation as an expert by authoring numerous technical publications.

Since attending my first AORS in 1963 (second AORS), I have participated in many and have fond memories of them. It was reassuring to review the list of attendees at the 2d AORS and observe that some of the captains are now generals. Many of the participants, who were not young then, are still alive and some are actively practicing in military and other operations research areas.

When I was invited to present this keynote address, it was suggested that I discuss useful directions for Army OR over the next decade or so. After some thought, I was convinced that there are, in fact, some changes in direction required—if OR is to exist as a professional activity in the Army. I have the impression that the Army OR community suffers a credibility gap in the eyes of its military leaders, and that the work we do is accepted for legislated reasons, but is not particularly respected or deemed necessary for the good of the Army.

Deputy Under Secretary of the Army for Operations Research Dave Hardison suggested, in last year's keynote address, we had problems with many senior military and defense managers. Following his own advice, he presented a simplified description of the problem and its solution. I am sure that complex approaches contribute to the problem and that simpler presentations and models would help. Nevertheless that prescription only serves to suppress the disease symptom without addressing its cause.

Rather, I believe the problem is that we do too much systems analysis or, more precisely, system evaluations not wanted by military managers, and not believable to them. The analysis may have no demonstrable validity. Most importantly, the analysis provides none of the necessary feedback or substantiation to us, or them, of its military contribution.

I want to devote a few moments to providing some historical perspective to focus this point. Then I will spend the remainder of the address presenting a number of example topics which I believe should be pursued over the next 10 to 15 years by the Army OR community.

HISTORICAL PERSPECTIVE. *Operations research* in World War II was primarily analyses of existing military systems to improve their operating effectiveness and/or efficiency. The availability of operating systems and ongoing military activities facilitated the gathering of data on systems' capabilities and effectiveness, enemy characteristics and tactics, and environmental factors for use in studies.

The success of these activities is recorded in history. It was a period of glamorous contributions to the military via analysis of the use of gun-laying radars, bombing tactics, convoy structures, and target search procedures, to mention but a few. The work was performed by innovative scientists whose contributions were needed and respected.

After the war and during most of the 1950s, emphasis was on military-requirements studies as the individual services redefined and negotiated their roles and missions in the defense establishment. In the late 1950s and 1960s, there was a shift to problems of broader scope and complexity, such as the development of weapon systems, force compositions, and, in general, planning for future programs and the next generation systems.

The term "systems analysis" was coined by Rand (Corp.) economists to describe the cost-effectiveness study activities associated with this long-range planning. The move toward more centralized management and defense decision-making in 1961 required the military services to learn and use systems analysis as a means of quantitatively justifying their share of the defense budget.

In contrast to the operations research of World War II, which was a data-based scientific activity, the extended decision horizons of 5, 10 and 20 years associated with long-range planning preclude data-related efforts in many military areas, and cause systems analysis to be an intellectual activity rather than a scientific one. It is an intellectual art used in making necessary and, at times, useful predictions in problem areas where measurements, data collections, experiments, and verification are difficult and at times impossible.

Because of the emphasis on prediction, and the need to justify requests for resources quantitatively in the 1960s, the Army developed many war games and models to generate cost-effectiveness numbers to support development proposals. In conflicts with OSD-SA (Office of the Secretary of Defense-Systems Analysis), the services usually lost, because, in the absence of data, the OSD analysts made up the analysis rules (i.e., assumptions, threat levels, input data) but usually after the fact. Thus, the Army OR analyst did not perform analyses to determine what was needed but, rather, conducted numerical evaluations as the Army's vehicle to advocate what was wanted.

If the 1960s instigated this tyranny of numbers, the 1970s have formalized it. The weapon system acquisition process was institutionalized into a long, complex management system. The adversary process has been legislated throughout the Defense Department via DoD Directive 5000.1.

The Army has met this challenge by legislating (via AR 1000-1 and TRADOC Regulation 11-8) that COEAs (Cost Effectiveness Evaluations) be conducted for most materiel development programs at various points in the development process. The studies have become increasingly complex to prove, by the sheer weight of numbers, that system A is better than system B.

A significant amount of resources at Army OR organizations such as TRASANA (TRADOC Systems Analysis Activity), CAA (Concepts Analysis Agency), and the TRADOC (Training and Doctrine Command) schools are devoted to production, job-shop-like COEA activities. Approximately 15 major program COEAs or updates and about 30 subsystem ones are conducted each year. I concur with Dave Hardison's contention last year that they belabor needless detail and overlook key questions, and with General DePuy (former TRADOC commander) that they needlessly prolong and complicate the development process.

More importantly, they do not contribute any knowledge about military activities (I cannot remember when last I saw a bright experimental hypothesis emerge from such studies) and have the effect of encouraging analysts not to think. I am of the impression that senior military officers view much of the OR community, perhaps with justification, as a necessary modeling/COEA activity, and not a valuable analysis asset that can identify important problems, solve them, and contribute to the inventory of military knowledge.

FUTURE DIRECTIONS. I strongly believe that if emphasis continues on these job-shop-like activities, OR/SA will cease to exist as a meaningful activity within the Army. I think the time is right to shift the emphasis of OR activity from the long-range planning issue of "what is needed for the future" to address the more operational one of "how to use what we have." That is, we should focus our efforts on research on operations rather than systems analysis. The recommendation is based on these considerations.

- Serious questions are being raised, both in the defense community and elsewhere, regarding the ability to do meaningful, precise, quantitative, cost-effectiveness or cost-benefit analyses on development programs whose products will not be realized for 5, 10, or 15 years, especially the ability to characterize the uncertainties associated with them.
- There will continue to be a growing need for, and concomitant payoff from, the analysis and solution of a large number of current and future operational problems. Stimulated by advances in science and technology, and hopefully in part rationalized by Department of Defense planning, the Army is in the process of modernizing its operational forces. Between now and 1985, the Army will field (or have available in prototype) a broad spectrum of new materiel systems including:
- Combat Systems: XM1 (tank), IFV (Infantry Fighting Vehicle), armored and mobile TOW, Stinger, Dragon, ILAW, Patriot, Copperhead, (all missile systems), GSRS (rocket), AAH (Advanced Attack Helicopter), Black Hawk helicopter, and possibly enhanced radiation warheads.
- Intelligence/EW (Electronic Warfare) Systems: SOTAS, ALR, TACELIS, AGTELIS, QUICK FIX, MULTEWS, TACJAM, LEFOX GREY, EWIOCS, and CACS.
- Command, Control, Communication Systems: TOS, TACFIRE, Missile Minder, INTACS.

These systems reflect major advances in technology which, when com-

(Continued on page 24)

ARMY RESEARCH AND DEVELOPMENT

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ABOUT THE COVER . . .

State-of-the-Art medical technological advancements in sophisticated facilities, including numerous automated or semi-automated processes and systems, are incorporated in the new $134.7 million Walter Reed Army Medical Center in Washington, DC. The huge structure has about 27.5 acres of floor space, 5,500 rooms, can accommodate 1,280 in-patients and several thousand out-patients daily, and is termed an "enduring symbol of medical progress." More than a decade of intensive planning and construction effort preceded recent dedicatory ceremonies.

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Selective Scanner

ODDR&E Redesignated as Under Secretary for R&E

Redesignation of the Office of Director of Defense Research and Engineering as Under Secretary of Defense for Research and Engineering has been announced following recent Presidential approval of an amendment to Title 10 of the U.S. Code.

Dr. William J. Perry, current DDR&E, has been selected to fill the new position, which will include responsibilities for research, engineering, communications, command and control, intelligence resources, warning and reconnaissance activities, and weapons system acquisition.

Established also is an unprecedented position of Under Secretary of Defense for Policy, relative to matters of international political-military affairs, arms limitation talks, intelligence, and over-all national security objectives.

Additionally, the Reorganization Act provides for a reduction in the number of Department of Defense Executive Level II positions from five to four by eliminating an existing Deputy Secretary of Defense position.

These actions are in accord with President Carter's announced intention to reorganize and improve management at all levels of U.S. Government. Secretary of Defense Harold Brown stated, in part: "I believe this change ultimately will make possible both significant savings to the taxpayer and improved utilization of the nation's resources which are committed to our defense."

Copperhead Scores Direct Hit on Tank Target

Copperhead, a 155mm laser-guided projectile, made a direct hit on a tank target, despite a deliberate cannon aiming error of several hundred meters, in a recent test at White Sands Missile Range (WSMR), NM.

The modified artillery projectile is equipped with a laser seeker and control fins that guide the projectile to a target designated by a laser-equipped forward observer. The designator can be hand-held and also mounted on a helicopter or remotely piloted vehicle.

Viewed by developers as a significant advance in defense technology, Copperhead is fired from existing 155mm artillery. It is expected to provide a high single-shot kill probability against moving and hardened targets.

The projectile is being developed by the U.S. Army Armament R&D Command (ARRADCOM) Joint Army/Navy Semi-active Laser Guided Projectile Office, and a production decision is scheduled for September 1978.

Heat Exchange Method Aids Laser Rod Fabrication

Laser rods fabricated from neodymium-doped yttrium aluminum garnet (Nd YAG) single crystals grown by the Heat Exchanger Method (HEM) have been announced at the U.S. Army Materials and Mechanics Research Center.

The AMMRC, Watertown, MA, developed the HEM process several years ago for the growth of large ingots of sapphire for use in transparent armor.

The U.S. Army Missile Research and Development Command (MIRADCOM) is sponsoring an MM&T (Manufacturing Methods and Technology) program for development of the new laser rods. The effort is in support of various Army weapons systems using laser range-finders (AN/GVS-5), and guidance for the Copperhead missile.

Involved in the R&D effort is the difficult problem of high-purity meltstock preparation along with definition and implementation of process parameters, i.e., nucleation temperature, temperature gradient and growth rate.

Facet-free crystals are being grown and laser rods 3mm by 30mm with optically flat and parallel ends were diamond ground from crystal slabs free of scattering centers. Tests by the U.S. Army Electronics R&D Command showed lasing properties adequate for intended applications.

Data regarding the development program are available from Dr. Dennis J. Viechnicki, supervisory engineer, and/or Dr. Jaroslav Caslavsky, research scientist, in the AMMRC Ceramics Research Division. Results to date are considered a step toward eventual mass production with a potential for time and cost savings.

Contract Calls for Hellfire Laser Engineering

Engineering development of a laser seeker for the Army's Hellfire missile system is being conducted under a $10 million 3-year contract awarded by the U.S. Army Missile R&D Command (MIRADCOM), Redstone Arsenal, AL.

Martin Marietta Aerospace, Orlando, FL, will develop a "low-cost" laser seeker with potential applications to several systems, in addition to Hellfire, the Army's first weapon designed especially for helicopter launch.

Hellfire is a modular missile system that will provide the Army with a family of terminal-homing seeker modules and a common airframe to engage tanks and other hard-point targets. The initial configuration will utilize semiactive laser guidance, but the modular design will enable future terminal-homing seekers to be accommodated without complete system redesign as technology matures. COL Robert J. Feist is Hellfire project manager.

Device Aids Helicopter Transmission Gear Tests

Evaluation of two case-hardened steels, AISI 9310 and VASCO X-2, for possible use in manufacturing gears for helicopter transmissions is being accomplished with a "four square" gear dynamometer at the U.S. Army Materials and Mechanics Research Center, Watertown, MA.

Designed to simulate the operating torque and speeds generally encountered in helicopter transmissions, the device is driven by an electric motor capable of supplying a constant torque to the drive gears, up to 150 foot-pounds. The torque range and speed allow investigation of various types of failure mechanisms.

The dynamometer is equipped with two independent oil lubricating systems, permitting investigation of gear wear and scuffing due to oil contaminants and temperature.

Equipped with a hydraulic pulse loading component, the dynamometer can superimpose a force on the steady state torque by means of a programed signal to simulate shock loading of helicopter transmission gears.

Major Improvements Extend M151A2 Life Span

Extended service life and easier maintenance of the M151A2 quarter-ton truck (jeep) are reported as the result of developmental work at the U.S. Army Tank-Automotive Materiel Readiness Command, Warren, MI.

Among major improvements leading to increasing the vehicle's life span from 8 years to 12 years are a solid-state electronic ignition with no breaker points or condenser, and body rustproofing.

The most noticeable improvement, from the driver's standpoint, is addition of a factory-installed heater. This is required for all enclosed-cab Army trucks and will satisfy a Department of Transportation requirement for windshield defrosters on all highway vehicles.

Other improvements include bonded rather than riveted brake linings, stronger materials for the clutch disc and turn signal control, and improved design for better lubrication of universal joints and other areas.

Thomas Finlinson, head of TARCOM's Quarter-ton Truck Branch, stated that all M151A2 vehicles procured in 1978 will incorporate the improvements, and that many of the jeeps currently in the field are being similarly equipped.

The electronic ignition is produced as a kit and is completely interchangeable with older jeep ignitions. Other components are available as repair parts.

Other improvements undergoing testing include new engines such as commercial diesels.

DLA Unveils Automated Container Marking System

Faster and more accurate labeling of packaged materials is claimed for a new shipping container automated marking system (CAMS), announced recently by the Defense Logistics Agency Depot, Ogden, UT.

Developed by DLA engineers, the system incorporates a high-powered, pulsed laser beam controlled by a microcomputer to burn labels directly on the containers.

The CAMS unit is interfaced to the depot's main computer system which automatically gathers weight and cubic data, and assigns the package to a shipment sorter.

Estimated purchase cost for the new system is $95,000; anticipated annual savings, based on 650 marked packages, are $39,761.

Army Announces 6th Signal Command Elimination

Elimination of HQ 6th Signal Command, resulting in a reduction of six military and 65 civilian positions at Fort Shafter, HI, and estimated annual savings of $2.0 million, is announced by Army Secretary Clifford Alexander.

The move, which is expected to also result in a one-time cost of $406,000, is prompted by a decline in recent years of Army communications missions in the Pacific area. A small activity will remain for essential residual functions.

Elimination of the U.S. Army Communications- Electronics Engineering Installation Agency-Pacific, also located at Fort Shafter, was also considered by the same study affecting HQ 6th Signal Command. However, no decision has as yet been made on USACEEIA-PAC.

Army Updates Radar Approach Control Facility

Consolidation of new surveillance radars with existing systems has been completed to form the first updated Army Radar Approach Control (ARAC) facility at the Henry Post Army Airfield, Fort Sill, OK.

Managing the modernization of aircraft radar surveillance control facilities at selected Army airfields is a responsibility of the U.S. Army Communications Systems Agency/Project Manager Defense Communications Systems (Army) Communications Systems, located at Fort Monmouth, NJ.

ARAC includes airport surveillance radars, precision approach radars, and an Air Traffic Control (ATC) beacon interrogator that automatically requests information from aircraft without verbal communication with crewmen.

The facility also includes a video mapper, an ATC communications control system, a Brite radar indicator, flight-data entry/printout equipment, and an operations console. To complete the Fort Sill update, an Automated Radar Terminal System (ARTS-II) will be installed at the facility by July 1979. Meanwhile, two Air Force planned-position radar scopes are being used.

The Federal Aviation Administration (FAA) engineered, furnished and installed most of the major equipment involved in the update, with the U.S. Army Communications-Electronics Engineering Installation Agency (CEEIA) at Fort Huachuca, AZ, responsible for test and evaluation.

A similar modernization effort is being conducted at the Robert Gray Army Airfield, Fort Hood, TX, with operational capabilities scheduled for November 1978.

CH-54 Serves as Paradrop Training Platform

The CH-54 Skycrane helicopter can serve as a stable platform for paradrop training without danger to jumpers or equipment, according to results of recent tests conducted by the Army's Airborne and Communications- Electronics Board (ACEBD) at Fort Bragg, NC.

ACEBD conducted the tests at the request of the Alabama National Guard, using a CH-54A helicopter and crew from the Alabama Guard's 307th Aviation Company, Birmingham, AL, to verify the aircraft's capabilities under various deployment conditions.

More than 300 static line jumps were made by troopers from units of the XVIII Airborne Corps. Military free-fall jumps, bundle drops, and night jumps also were made.

While the Skycrane is not being considered for tactical applications, the ACEBD considers the aircraft exceptionally stable for paradrop training purposes. Results of the tests were forwarded to the Infantry School and the Institute for Military Assistance for certification and publication in training manuals.

Contract Expands Simulation Center Operations

Operation and expansion of the Radio Frequency Simulation System, part of the Advanced Simulation Center of the U.S. Army Missile Research and Development Command, Huntsville, AL, are programed through September 1980 under a recent $7.3 million contract.

Boeing Aerospace Co. will establish a variety of electronically simulated operational and combat conditions to assist MIRADCOM in conducting tests of surface-to-air and air-to-surface tactical missiles.

Used to test both developmental and operational missiles, the Radio Frequency Simulation System is among the MIRADCOM Advanced Simulation Center facilities including electro-optical and infrared simulators.

Dedicated in March 1976, the $40 million center enables the Army to test a missile against electronic countermeasures and jamming. The facility thus reduces the number of flights required to evaluate sensors and guidance gear.

CRTC Examines Improved Ski Mountain Boot

An improved ski mountain boot is being evaluated by the Army's Cold Regions Test Center, Fort Greely, AK.

Made of leather with vibram soles, the boot is designed to have better insulation and more support than the boot currently in service. CRTC tested the new style of boot during the summer and fall of 1976 and found that the original model could not meet all test standards.

The Cold Regions Test Center is an activity of the U.S. Army Test and Evaluation Command.

R&D News...

Molecular Sieve Oxygen Generator Undergoes Tests

An Army Molecular Sieve Oxygen Generator (AMSOG) is undergoing applied research tests at altitudes up to 23,000 feet, to check its potential for serving aircrews under the limitations of weight, space and power of Army aircraft.

An operational AMSOG system, under development by the Aviation Medicine Research Division, U.S. Army Aeromedical Research Laboratory (USAARL), Fort Rucker, AL, has been installed in a U-21 aircraft for evaluation during flight.

AMSOG uses a molecular sieve material which absorbs nitrogen from the air (essentially about 80 percent nitrogen and 20 percent oxygen). Engine-bleed air under pressure provides a flow of air across the molecular sieve, which removes the nitrogen and provides about 95 percent oxygen for breathing at high altitudes.

LTC (Dr.) Frank S. Pettyjohn, director of the Aviation Medicine Research Division, considers AMSOG technology a major breakthrough. He notes a wide range of applications in support of missions ranging from combat aviation and aeromedical evacuation to medical oxygen supply of hospitals and frontline medical units.

Dr. Pettyjohn also looks to the Black Hawk as the future U.S. Army aeromedical evacuation helicopter. With addition of AMSOG to its specialized medical care equipment, he believes the Black Hawk will provide the most advanced aeromedical care available to the combat soldier, from point of injury to the definitive medical treatment facility.

The USARL is continuing applied research on the AMSOG for use, other than its medical application, on other existing and future aircraft.

USAARL Aviation Medicine Research Division Director LTC (Dr.) Frank S. Pettyjohn (left) briefs BG (P) Benjamin Harrison, former deputy commander of Fort Rucker, AL, on Army Molecular Sieve Oxygen Generator designed to supply life support breathing oxygen from aircraft engine bleed air at altitudes up to 23,000 feet.

Integrated Mockup Review Reports on AAH Status

"On schedule, within cost estimates, and meeting all technical objectives" are the latest words on the U.S. Army Advanced Attack Helicopter (AAH) program.

COL (P) Edward M. Browne, program manager, made this comment following a 3-day, Phase 2 Integrated Mockup Review.

The mockup represents the configuration for three additional engineering prototype aircraft to be manufactured and delivered to the Army for further development flight testing prior to the production decision.

Taking part in the review were key Hughes Helicopter personnel and a military team comprising a cross-section of the Army's expertise in program management from HQ DA and all major interested commands.

Areas of interest for the Army review team ranged from the ability to fly the aircraft in its required mission, reliability, availability and maintainability, transportability, and deployability.

Primary items reviewed included the cockpit displays and controls arrangements for both pilot and gunner; armament subsystems integration, including the Hellfire missile system; the Target Acquisition and Designation System and the Pilot Night Vision System (TADS/PNVS).

"The mockup review provided the Army user the first opportunity," commented Thomas K. Stuelpnagel, Hughes Helicopter chief executive, "to evaluate the production configuration of the AAH with all systems installed." He noted further, that the results of the review provided Hughes Helicopter with a firm baseline for completing the design.

Thermal Target Tests Termed 'Overwhelmingly Successful'

Adverse weather, with rain and heavy fog predominating, did not prevent the Thermal Target Experiment conducted recently from being "overwhelmingly successful," in the judgment of the president of the United States Armor and Engineer Board.

The experiment at Fort Knox, KY, involved thermal signatures generated by carbon impregnation of paper and paint heated by battery and generator power sources. The signature of the heat patterns corresponded to the heat patterns of an actual vehicle, according to the test report.

Results were reported by the president of the Armor and Engineer Board to COL Joseph J. Leszczynski, Army project manager for Training Devices at the Naval Training Equipment Center, Orlando, FL, under whose direction the experiment was conducted over a one-week period.

MG Stewart C. Meyer directed initiation of the research and development effort for the experiment while he was commander, Combined Arms Test Activity, Training and Doctrine Command, in January 1977.

Weather conditions reportedly would have prevented use of conventional targets but the thermal targets "held up very well in this environment." They demonstrated a capability of taking a large number of hits before needing repair, which was accomplished under field conditions.

The U.S. Army Operational Test and Evaluation Agency, TRADOC, plans to use thermal signature targets for OT/DT II (Operational and Development Testing) of the thermal sight of the XM1 tank.

Current plans also provide for the U.S. Armor and Engineer Board to construct a number of thermal signature targets for training gunners in the use of thermal sights.

M60A1 Tanks Use British Smoke Protection System

U.S. Army M60A1 tanks in Europe are now being equipped with a new fast-reacting smoke protection system. Approved recently by the Department of the Army, the system consists of British-developed grenades (L8A1) and launchers (M239).

The U.S. Army Project Manager for Smoke-Obscurants at Aberdeen Proving Ground, MD, in cooperation with PM for M-60 tanks, and other development commands and contractors, designed and developed an interface kit to adapt the British-developed components to the American tank. The system was then successfully tested at Aberdeen, in the Arizona desert, and in Alaska.

Following a recent "very successful" demonstration of the system at Grafenwoehr, Germany, during which there was rain and a 30-knot wind, a young sergeant tank commander commented: "I will now feel a lot better in crossing those open areas, knowing we can screen ourselves if we get in trouble!"

Protection for tanks is provided by a dense red phosphorus smoke screen that enshrouds the vehicle in two seconds after firing, and lasts up to three minutes, depending on weather conditions.

The protection is activated by the tank commander or the gunner and electrically fires 12 grenades from the two launchers on the tank turret. The grenades fly in an arc pattern in front of the tank and burst about 10 meters in the air.

The system will also be mounted on the new XM1 tank and other combat vehicles.

Adoption of this British-developed system, with its considerably faster reaction (projecting a much denser screen than comparable U.S. systems) is termed another example of the U.S. determination to "take advantage of allied weapons development and to achieve standardization and interoperability with our NATO allies."

British-developed smoke protection system and standard M176 system are compared, one and three-fourths seconds after simultaneous firings from vehicles 700 meters away. The demonstration led to a decision to equip U.S. armored vehicles with the M239/L8A1 system.

ARRADCOM Continues SADARM Exploratory Development

SADARM, a "fire and forget" sensor-delivered submunition artillery system designed to destroy three tanks almost simultaneously—by bursting three projectiles from a single shell to hit the turret areas—is being continued in exploratory development.

Responsibility for this effort is assigned to the Large Caliber Weapon Systems Laboratory of the U.S. Army Armament Research and Development Command (ARRADCOM), Dover, NJ.

SADARM denotes Sense and Destroy Armor and the missile can be fired by weapons now in standard use. Termed a "low-cost" system, SADARM is packaged, stored, handled and loaded like standard artillery rounds.

In outlining the sequence of operations for a SADARM round, project engineer Theodore J. Malgeri points out that illumination of the target, as well as external guidance and control of the projectile, is not required. Each submunition (3) is equipped with a vortex ring parachute, a sensor, a processor, a warhead, a power supply and a safe-and-arm (S&A) mechanism.

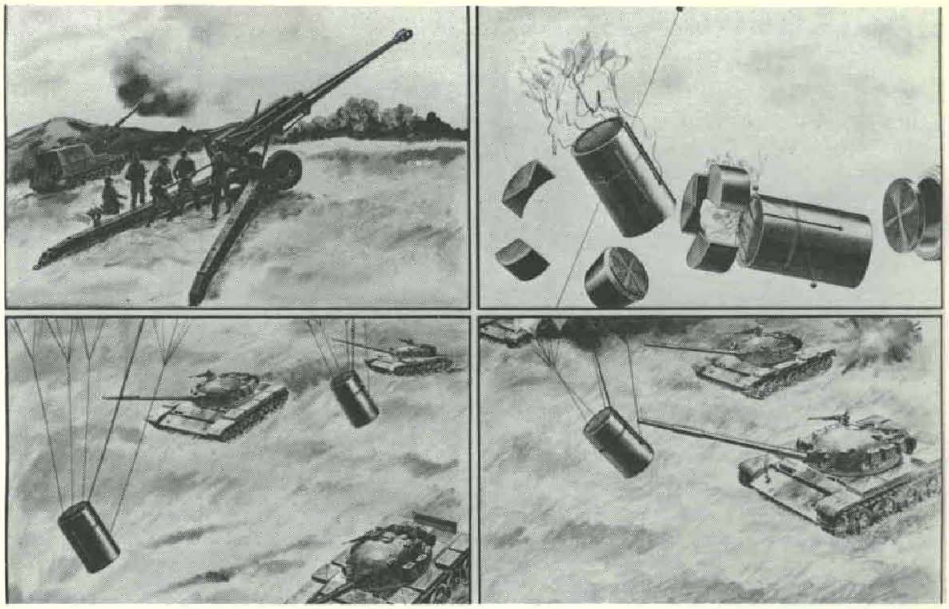
After azimuth and range to target are determined, the primary fuze is set and the correct amount of propellant charge is loaded into the gun to deliver the round to an area above the target (photo 1).

Launch setback activates the S&A device in the round. As the projectile speeds on its ballistic path, a preset primary fuze triggers a pusher charge to eject the submunitions (photo 2).

A de-spin mechanism slows the speed of each submunition to allow deployment by the vortex ring parachute. This initiates the power turn-on and stabilizes the submunition to a steady drop velocity of 30 feet per second and a rotation of about four revolutions per second (photo 3).

Parachute shroud lines are attached to the submunition canister in such a way that the canister maintains a 30-degree angle (to vertical) as it descends. This gives the sensor greater scanning coverage and the submunition the desired ground coverage for use against multiple targets. When the sensor detects a target, it fires the armor-penetrating warhead (photo 4).

The new system is considered unique because it uses a passive millimeter-wave radiometric sensor in a high-spin mode at low altitude for the first time in a munition; uses a vortex ring parachute that maintains a constant-spin rate and drop velocity, and is exceptionally stable; and delivers a fragment warhead with armor-penetrating capabilities.



SADARM components have been successfully tested during the exploratory development phase. The complete system is expected to be available for fielding by the late 1980s.

CRTC Examines Solar Panels For Cold Weather Endurance

Solar panels are undergoing cold weather endurance tests to determine their capabilities over a 10-year period at the U.S. Army Cold Regions Test Center (CRTC), Fort Greely, AK.

Manufactured by four separate industrial firms, the 16 combined panels can generate 400 watts of electricity - enough to power a small television receiver. However, this continuous electrical output will not be used while the panels are under surveillance.

Endurance and electrical generating capabilities of the panels will be compared through monthly inspections by the National Aeronautics and Space Administration (NASA), Lewis Research Center, Cleveland, OH.

CRTC is the first of several locations throughout the Continental United States and the Panama Canal Zone to install panels for long-term endurance and of environment testing.

General Support Rocket Contracts Total $64 Million

Development of the Army's new General Support Rocket System (GSRS), is the basis for competitive contracts totaling $64 million awarded recently by the Army Missile Research and Development Command (MIRADCOM).

Boeing Co. will receive approximately $34 million and Vought Corp. about $30 million to design, build, test and demonstrate free flight artillery rocket systems of their own design. Following a competitive 29-month program of fabrication and testing, the Army will select one contractor for final qualifications and initial production.

GSRS Project Manager COL Barrie P. Masters, Redstone Arsenal, said the contract awards ". . . are the culmination of 2½ years of program planning, proving system feasibility, and teamwork. People in industry and the U.S. Government have done an outstanding job."

The Army solicited bids from approximately 31 sources. Boeing and Vought were selected by a team which included MIRADCOM, the Missile Materiel Readiness Command (MIRCOM), Armament Research and Development Command, Ballistic Research Laboratory, Harry Diamond Laboratories of the Electronics R&D Command. Training and Doctrine Command, Tank Automotive Research and Development Command, and other Army agencies concerned with GSRS development.

Boeing and the Huntsville Division of Thiokol Corp. will design and develop a solid-propellant propulsion system. Teledyne Systems Co. is responsible for the Boeing system fire control.

Vought is teamed with Atlantic Research Corp., Gainsville, VA, which is developing the solid-propellant rocket system. Bendix Corp. is responsible for Vought's fire control unit.

Contracts were awarded earlier to FMC of San Jose, CA, for development of a self-propelled carrier vehicle, and to Harry Diamond Laboratories for the warhead fuzing system.

GSRS will be a "low-cost, rugged, reliable artillery rocket system that can be emplaced quickly and deliver a high volume of fire." The system will be mounted on a highly mobile, full-tracked vehicle that will carry 12 rockets which can be fired singly or in rapid ripples.

The self-propelled weapons carrier is a modification of the Army's new Infantry Fighting Vehicle which will give GSRS cross-country speed comparable with the Army's new XM1 tank, enabling GSRS to be an integral part of the combined arms team.

"This weapon will provide a non-nuclear, rapid, indirect fire capability to supplement cannon artillery when targets such as artillery, troops and light material appear on the battlefield rapidly and in great quantities," COL Masters said. "It will have growth potential for development of an indirect fire, heavy-armor defeating capability. We have nothing like it."

Range of the rocket will be more than 30 kilometers (18 miles). GSRS advantages are its mobility, manpower savings and massive firepower. One GSRS launcher, with a 3-man crew, can provide firepower equivalent to 27 8-inch howitzers against certain targets.

General Support Rocket System

Patton Tanks Revamped for Copperhead Target Duty

EXCESS and UNSERVICEABLE M-47s await rejuvenation at WSMR.

"Excess and unserviceable" is the way M-47s are reported in the Defense Property Disposal books, but the old Patton tanks are being pressed into service again as mobile targets for the U.S. Army's highly lethal Copperhead missiles at White Sands Missile Range, NM.

Out of production since the late 1940s, the M-47s are being rejuvenated by soldier mechanics for use in about 210 inert and 60 live Copperhead developmental test firings during an 18-month period.

A cannon-launched guided projectile (CLGP), Copperhead is a 155mm, high-velocity, highly accurate, 137-pound round, which is bigger and faster than the Dragon, Maverick, Shillelagh and TOW tested at WSMR since the mid-60s.

Because of the light weight of these missiles (approximately 40 pounds) and the use of inert warheads, the former fleet of nine M-47 tanks at WSMR stood up well under repeated use.

With the advent of the Copperhead, which boasts a one-round, one-kill capability, Dick Dysart, project engineer for the mobile ground-targets function at WSMR, knew that a lot more tanks would be needed in a hurry. He found them in the Defense Property Disposal Region for Europe.

"The U.S. gave our allies several M-47s," he said. "One of the stipulations of the arms aid was that the tanks had to be returned to us when the ally was through using them." The only cost of the tanks is for transporting them to WSMR. Dysart cannot accurately predict how many Copperhead test shots an M-47 may take but he hopes for six inert tests from each.

WSMR enlisted the aid of 25 soldiers schooled in track and wheel mechanics in a program of controlled canabilization for repair parts to recondition the tanks. SSG Francis Stork, one of the first project mechanics recruited, said.

"If we have a requirement for a stationary target, we strip the tank down to nothing but its hull, and stockpile all its working parts. If an engine blows, we take out all the good parts before turning it in. We fix everything we can."

SSG Stork said repairmen receive good support from mechanical repair shops at Fort Bliss, TX, which have been rebuilding carburetors, generators, starters, magnetos and batteries for the M-47s. Mechanics face problems other than lack of new replacement parts for the vintage M-47s. Since the need for the mobile target function is short term, money is also limited.

TANK REPAIR mechanics SGT Dean Edwards and PFC Violetmary Wilson recondition one of the M-47 6,000-pound engines.

TONE IMPULSE device is operated by SGT Marvin Duhr for remote guidance on an M-47 used for target tests at WSMR.

Still the soldier mechanics have managed to get running and keep running most of the 22 tanks received so far. An additional 22 M-47s are awaiting shipment at Red River Army Depot and a bid is in for 20 more to fill requirements for Copperhead tests at WSMR.

WSMR project officer for Copperhead testing Jack Dage says more than half of the 270 scheduled firings will require tank targets. Inert tests will measure accuracy of Copperhead against a maneuvering target; live warhead tests will verify effectiveness against armor.

TARADCOM Develops Gun Loader Trainer Device

Development of a training device designed to permit loading of a tank's main gun while the vehicle is in motion has been announced by the U.S. Army Tank-Automotive Research and Development Command, Warren, MI.

Installed in an M60A1 tank, the feasibility model is removable and consists primarily of a hydraulic power supply that pumps oil into the tank gun mount at a pressure of 1,500 pounds per square inch each time the gun is fired.

Recent tests with an inert 105mm round were reported successful, marking the first firing of such a weapon at HQ TARADCOM.

Hydraulic pressure forces the gun into a recoil position with roughly the same intensity produced by firing a live round. This allows the gunner to operate the weapon under conditions similar to those encountered on the battlefield. Spent shell casings are ejected when the breech is opened by actuated cams. The entire procedure, from the moment of firing, consumes less than two seconds.

John DeWald, project engineer in the Tank Automotive Systems Laboratory, said requirements for the new trainer resulted from the advent in recent years of gun stabilization systems to permit tank firings while in motion.

However, he added that ammunition-loading personnel must learn to adapt themselves to the roll, pitch and yaw of a tank traveling cross-country while handling a 56-pound shell.

"To become skillful," he noted, "requires considerable repetitious training, which is difficult and expensive. It is difficult because live ammunition requires large, safe firing ranges, and expensive because of ammunition costs."

Developed at the request of the XM1 Tank Project Manager Office, the device is believed the first attempt to build a trainer that provides experience of loading a primary weapon in a moving vehicle environment.

Full-scale development of the device is dependent upon results of additional demonstration tests for personnel of the U.S. Army Training and Doctrine Command, Fort Monroe, VA, and Fort Knox, KY.

Patriot Componentry Intercepts Full-Sized 'Drone' Jet Aircraft

Despite a heavy countermeasures environment, a full-sized "drone" jet aircraft was intercepted by mobile tactical equipment of the Patriot Air Defense System in a Nov. 4 first test of new componentry at White Sands (NM) Missile Range. Initial review of results indicated all objectives were accomplished.

FP-2 (Firing Platoon No. 2) elements - radar, engagement control station and launcher - were tested in the intercept of the PQM-102 jet while it was flying at medium range and altitude. The mobile equipment had gone through extensive integration and electronic testing.

MG Oliver D. Street, Patriot project manager stationed in Huntsville (AL) Research Park, reported on success of the test mission. Patriot is currently in a $425 million, 49-month program that began in August 1976 to complete the engineering development. Raytheon Co. is designing, building and testing four sets of tactical equipment to support the initial production.

Patriot radar and launching stations are operated remotely from the Engagement Control Station, employing a high-speed digital computer and communications equipment. Patriot is being developed as the cornerstone of the field Army air defense against medium to high-altitude targets for the land warfare environment envisioned for the 1980s.

Bioengineering R&D Laboratory Mission . . .

Covers Multi-Disciplined Tri-Service Range of Activities

Multi-disciplined research and development is a mission of the Army Medical Bioengineering Research and Development Laboratory, an element of the Army Medical Research and Development Command and winner of an ASA (RDA) Award for Excellence.

Located at Fort Detrick, MD, the AMBRDL also was a runner-up for the Most Improved Laboratory of the Year Award, won by the Army Engineer Topographic Laboratories, Fort Belvoir, VA. The Assistant Secretary of the Army (Research, Development, and Acquisition) awards were initiated in 1974. AMBRDL's mission statement includes:

Conducts engineering research and development of military medical equipment on a continuing basis for the Army and on an "as required" basis for the Navy and Air Force; responsible for construction of developmental prototypes, test models, and the production of limited quantities of medical materiel to support urgent military requirements; conducts The Surgeon General's research, development, test and engineering program in integrated pest management systems to include pesticide dispersal and entomological equipment.

Environmental health research in support of The Surgeon General's responsibilities in air, land, water pollution control, and chemically related occupational exposures is part of AMBRDL's responsibility; also, hazardous waste and pesticide disposal to include management of the intramural and extramural portions of the USAMRDC Environmental Quality Protection Program.

To accomplish these missions, the laboratory is authorized 112 military and civilian positions. The break-out is 14 officers, 1 warrant officer, 15 enlisted personnel, 72 general schedule civilians and 10 wage grade civilians.

Temporary positions are authorized from time to time to support specific programs. In addition, the personnel complement is enhanced by outstanding students, many of whom advance to permanent staff members, through cooperative training programs with universities, colleges and other government agencies.

Professional disciplines represented in AMBRDL include: Aquatic biology, biomedical engineering, chemical engineering, chemistry, computer sciences, electrical engineering, electronic engineering, engineering crafts and drafting, epidemiology, general engineering, graphic and photographic arts, mechanical engineering, operations research, parasitology, physiology, sanitary engineering, statistics, toxicology, and veterinary medicine.

The laboratory consists of a headquarters element and five unstructured divisions designed to carry out or support mission requirements.

The Engineering Division is engaged primarily in the research, development, test and evaluation of combat materiel in three main categories: exploratory development, advanced development, and engineering development.

Typical medical equipment being developed or evaluated in the current program includes: Improved field ambulance, improved aid bags, chemical casualty decontamination kit, cold injury rapid rewarm system, field blood chemistry unit, improved field splint set, improved field sterilizer and modern dental assembly.

The Operations and Applied Research Division is conducting in-house R&D efforts on pest management dispersal and survey equipment urgently needed by preventive medicine teams.

COL CHARLES R. ANGEL assumed command of the U.S. Army Medical Bioengineering Research and Development Laboratory in July 1975, following duty as assistant chief, Medical Service Corps, for Allied Sciences, Office of the Surgeon General, HQ DA.

Born in 1922 in Williamsport, PA, he studied at the University of Maine, receiving a BS degree in 1947 and MS in 1949, both in biochemistry. In 1960, he received a PhD in radiation biology from the University of Rochester. He was awarded the A prefix in biochemistry in 1969. COL Angel served as an enlisted man during World War II and began his commissioned service as a biochemist at the Fort Detrick Biological Laboratories in 1949.

Considerable effort also is being expended to support the Department of Defense and Department of the Army installation pest management programs; also, developmental testing and evaluation of medical materiel. The division also is responsible for the laboratory's operations function. Ongoing projects include: controlled release pesticide formulations, aerial spray pesticide dispersal system, improved mosquito light trap, ULV pesticide dispersal units, backpack insecticide sprayers, and stored products insect detector.

The Environmental Protection Research Division conducts in-house and also monitors contracted research. Jointly supported research efforts with the Environmental Protection Agency, the National Aeronautics and Space Administration, the Department of Health, Education and Welfare, and elements within the Department of Defense are being utilized to the maximum extent.

Research programs are reviewed for "scientific credibility" and approved by the Committee for Military Environmental Research of the National Research Council. Current efforts involve programs in munitions standards, installation restoration standards, land application of wastewater, water/wastewater treatment, wastewater reuse, analytical methods, pesticide and hazardous waste disposal, occupational health, and technical information systems.

Conceptually, the laboratory functions in the unstructured mode, permitting maximum responsiveness and flexibility. Each division has responsibility for specific mission elements, but must apply the principles of teamwork.

Administrative and Logistics Support Divisions play an active role in research programs as well as in support services. Logistical Support, for example, is responsible for fabrication of medical materiel designed by the research and development divisions.

Administrative Support is tasked with the statistical and computer sciences services; also, graphic and photographic arts particularly important to the materiel development mission. This integrated philosophy of operations results in a close relationship between researchers and support personnel.

With an eye toward advanced managerial techniques, demanded by the ever-increasing complexities of mission requirements and the extremely interdisciplinary nature of the laboratory, the unit is in the early stages of implementing an automated management information system. Workload data has been automated to provide valuable, readily available manpower information to division chiefs.

In addition, the "life flow" of laboratory documents is being surveyed for possible automation. The objective is to provide timely information to research managers to aid the decision-making processes.

The efforts are being conducted jointly by the laboratory's various divisions, again reflecting the team spirit and flexibility of the AMBRDL.

LTC LeRoy H. Reuter is deputy commander and chief, Environmental Protection Research Division. MAJ Bernard A. Schiefer is chief, Operations and Applied Research Division and executive officer. MAJ Heath F. Reinhardt directs the Logistical Support Division. Aaron Ismach heads the Engineering Division and MAJ G. A. Kirschbaum Jr. is administrative officer.

Natick Modifies Helmet for Firefighters' Improved Protection

Military firefighters will be provided with significantly improved impact protection and fire safety by a helmet modified from a commercial version by scientists at the U.S. Army Natick Research and Development Command.

The new model features a polycarbonate face shield and flame-resistant Nomex ear flaps, along with an energy-absorbing foam-lining that covers the circumference of the head to provide side and tangential impact protection.

Weighing less than 40 ounces, the helmet satisfies safety helmet and impact protection requirements established by the American National Standards Institute (ANSI). The former military firefighters' helmet lacked the face shield and protective ear flaps. Type-classified in April, the Army helmet is expected to be in the field by the first of next year.

The redesigned helmet, improved from an earlier commercial model, also is programed for commercial marketing.

AMSAA Goal: Materiel Worthiness Through Quality Evaluation

Generation of guidelines for the management and acquisition of nearly every type of Army materiel is a responsibility of the Army Materiel Systems Analysis Activity (AMSAA), involved with operations extending throughout the entire Army structure.

Headquartered at Aberdeen Proving Ground, MD, as one of 40 tenant activities, AMSAA supports all commodity commands of the U.S. Army Materiel Development and Readiness Command (DARCOM) with systems analyses.

DARCOM defines materiel systems analysis as the "orderly study of a management system or an operating system using the techniques of management analysis, operations research, industrial engineering, or other methods to evaluate the effectiveness with which missions are accomplished, and to recommend alternatives or improvements."

Simply stated, AMSAA specialists ask and seek answers for top-level decision-makers, such as: "How does something or someone perform under a given set of circumstances, and is it worth the cost?" The question entails detailed analysis of the various stages of a commodity's life cycle.

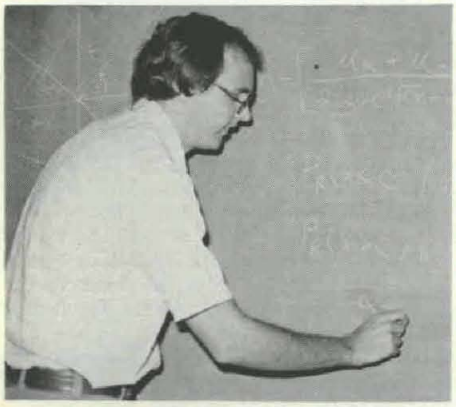
Studies and evaluations deal with weapons systems, electronic and communications systems, vehicles or mobility systems, as well as the combat soldier's equipment. All studies are oriented towards the discovery of systems characteristics and worth; the product is a technical report.

One-half of AMSAA's mission is fulfilled when the technical report is complete. The next step is to convey the information - the ideas and recommendations - to decision-makers, the commodity commands, project managers, designers and other military departments.

"We have to get the reports out rapidly - into the system - in order to accomplish our objective," an AMSAA spokesman said. "The analysis must be understandable. Combat data is often matched against our estimates. We are usually correct, but when we are wrong, we adjust our estimates to the data.

"We quantify how well a system will do in combat," he added, "and seek to assure that new systems are better than the ones they replace. It takes two to four years to modify an old system, opposed to 8 to 12 years to field a new system, so we look carefully before we opt for a new system over one we can modify and update."

AMSAA does not stop with analyses and checks with combat data and performance. A



Ground-Emplaced Mine Scattering System (GEMSS) problem is worked out by Jeff Landis, a mathematician at the AMSAA.

AMSAA conducts research and analysis to evaluate effectiveness of materiel items such as the multilayered ballistic nylon blanket, impact-resistant goggles, redesigned helmet and protective combat vest.

continuing program of direct interface with the soldier at the working level is maintained through field liaison visits. These visits are timed after major exercises and provide information on equipment-related problems. AMSAA works closely with the DARCOM commodity commands to develop solutions to today's problems, with today's equipment, today.

Modern systems analysis evolved slowly during the early 1900s. One of the Army's early applications of analysis occurred in the 1920s, when the Ordnance and Medical Corps fired various caliber bullets at pigs and goats. Data from the early tests were used for comparison with data from much more exhaustive tests, begun more than 30 years later.

Systems analysis in 1938-39 by APG's Ballistic Research Laboratories dealt with the vulnerability of aircraft. Results included improvements to the rationale for selecting antiaircraft weapons, ammunition fuzing, and accuracy of range finders.

These studies led to extensive tests, at the end of World War II, to determine the vulnerability of aircraft to a larger variety of weapons. The test series culminated in a recommendation for the development of a family of antiaircraft weapons in 1949.

One of the first products of systems analysis from APG was a technical manual, TM-9-1907, Ballistic Data Performance of Ammunition, which appeared during World War II. It resulted from studies involving assessment of the destructiveness of various bombs, based upon fragment zones of damage (rather than customary calculations based on bomb blast).

The BRL demonstrated that fragmentation causes the primary damage, and that the blast effects are secondary considerations.

During the 1940s and 50s, the BRL Weapons Systems Laboratory was the center of the systems analysis activity with the Ordnance Corps and, later, the Army Materiel Command (now DARCOM). Atomic weapons versus ground and aerial targets, tank battlefield effectiveness, air-defense cost effectiveness, and missile evaluation were some of the systems under study.

Aircraft and missile vulnerability, surveillance and quality evaluation of ammunition stocks, and the effectiveness of artillery shells were the main projects during the later 1950s. Results led to the development of the military Services Joint Munitions Effectiveness Manuals in the 1960s.

Introduced to the forces of the North Atlantic Treaty Organization (NATO), and still in use, the manuals deal with effectiveness of air-to-surface weapons, air-to-air and surface-to-surface weapons, air defense, target vulnerability, weapons characteristics, and delivery accuracy.

War games and system studies were used in 1963 to predict combat ammunition expenditures. Target complexes, vulnerability, acquisition and tracking errors were studied intensively, and artillery forces' effectiveness in intense combat were analyzed.

The need for a separate Army Materiel Command agency for systems analysis services became increasingly apparent. AMSAA was established on Jan. 1, 1968 at the Aberdeen Research and Development Center.

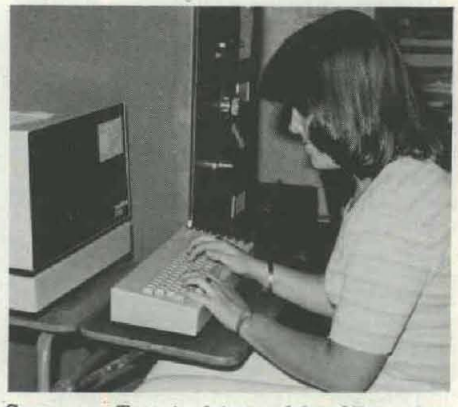
AMSAA now consists of five operating (line) divisions, four staff offices, the Office of the Director, and a Management Services Division to serve technical, line and staff elements.

The Systems Methodology Office assists in planning, reviewing, and conducting research programs in improved systems analysis, analytical research, and economic and resource allocation; it also conducts selected technical studies related to production processes, and mobilization base adequacy. The Special Activities Office plans, directs, coordinates and reviews for the director joint activities pertaining to munitions effectiveness and survivability.

AMSAA's five line divisions are Air Warfare, Ground Warfare, Combat Support, and Field Equipment and Technology, Reliability, Availability and Maintainability. They are involved with systems analysis and research for aircraft, missiles, and air defense; design and evaluation of ground warfare systems; mobility and systems engineering; and studies in system reliability, maintainability, and operational availability involving the entire spectrum of Army weapons systems.

More than 400 people work for AMSAA, with over half of the professional staff trained and experienced in operations research techniques; the remainder are divided between basic science and engineering fields.

AMSAA has generated numerous analyses, studies and reports that have been acclaimed



Computer Terminal is used by OR analyst Debra Meredith for the AMSAA project.

for improving and streamlining Army systems and materiel. Particularly notable was a 1969 systems analysis of helicopters that compared nine "off-the-shelf" helicopter candidates for the Special Forces transport helicopter. Five candidates were eliminated early in the study due to deficiencies in evaluation criteria and the remaining four were studied in detail.

After preliminary modifications, each candidate was evaluated in terms of range, payload, cruise speed, maneuverability and agility, amphibious capability, detectability, size, vulnerability, unit cost, and 10-year program costs. AMSAA was thus able to recommend the most cost-effective candidate.

Another AMSAA project involved missile life-cycle reliability studies of Honest John, Pershing, Sergeant, Shillelagh, Nike Hercules and the M22 to provide a continuing evaluation of safety and reliability of deployed systems, and the total stockpile. Considered also were safety and ballistic performance factors.

The objective was to enable decision-makers to maintain required inventory levels by corrective action or replacement. Extension of the life cycle of the missiles far beyond the manufacturer's recommendation avoided "millions of dollars in cost that would have been required for premature replacements."

AMSAA programs cover the entire inventory of military systems and materiel. Investigators are generally free to pursue projects as far as analysis and research may lead, for example, to ferret out reliable answers to such complex questions as:

How fast is an air-defense system? Does the effectiveness of a weapon change with a change in combat environment? How many weapons must be procured, and how should they be distributed to assure proper operating number? Are current techniques for analyzing systems efficient? How can we predict the cost of a weapon in the concept stage?

"Because we do not have many of the usual organizational constraints," AMSAA reports, "we can look at a system to determine what it can do against anything, in any situation. For example, we may ask, 'Why can't an antitank system work as an antiaircraft system?' We look at things from all angles. Within the Army's scheme of things, we believe AMSAA is unique."

Army Authorizes Production of 56 More Black Hawk Helicopters

Production of 56 additional UH-60A Black Hawk helicopters, renamed from the UTTAS (Utility Tactical Transport Aircraft System) at ceremonies Sept. 7 at Fort Myer, VA, has been authorized by the Army under an option in a contract award in December 1976.

Assembly of the additional aircraft at a cost of $129.4 million is programed to begin in March 1978, with the first delivery scheduled in early 1979. The initial purchase of 15 aircraft was under a basic contract totaling $83.4 million. The Army has a stated requirement for 1,107 UH-60A models, designed to carry a fully-equipped combat force of 11 plus crew of 3.

GEN John R. Guthrie, commander of the U.S. Army Materiel Development and Readiness Command, said during renaming ceremonies:

"It is a great day for DARCOM, its subordinate commands, and its combined efforts with industry to provide the best possible equipment to our soldiers at reasonable cost." He added that it is "visible proof of a highly successful industry-Army effort - proof which you can touch, feel and sit in, that our acquisition process is doing its job well . . . ."

GEN Guthrie explained that the Black Hawk has been designed to survive in today's and tomorrow's combat environment, with critical systems that are redundant - including engines, flight controls, electrical system and hydraulics.

Other passive countermeasures he cited include reduced noise levels, low reflective paint, reduced radar cross section and high ballistic tolerance. Crew seats are armored and the propulsion system gear boxes can operate for 30 minutes without oil - long enough to get the aircraft home.

While emphasizing that the Black Hawk is more crashworthy than any U.S. aircraft, GEN Guthrie told about a prototype that crashed into a stand of 4-inch diameter pines while flying at night. Fourteen soldiers and the operating crew walked away unharmed. After the trees were cut down and new rotor blades installed, the aircraft was flown out under its own power.

Other qualities he mentioned are economy of operation and greatly reduced maintenance requirements, which translate into a need for fewer aircraft to perform the mission of the present Huey company. The Black Hawk will replace the Huey in all Active Army air assault, air cavalry and medical evacuation units.

GEN Guthrie paid tribute to Sikorsky Aircraft Division of United Technologies Inc. and to General Electric Co. for meeting development and production requirements for what is

UH-60A Black Hawk

termed the "most advanced and superior helicopter in the world."

Sikorsky developed the aircraft and General Electric developed the T700, 1,600-shaft- horsepower engine (two will power the Black Hawk) which has proved its reliability qualities in more than 35,000 test hours.

Gerald J. Tobias, Sikorsky president, shared the speaker's podium with GEN Guthrie. He described the government competitive development and test program as the "most demanding and stimulating challenge" the company had ever experienced. He expressed pride that "We are on schedule, within target costs and bettering our guaranteed performance."

When the Black Hawk production schedule is completed, the Army expects to have a mix of about 1,100 of the UH-60s and 2,500 Hueys in service.

The Black Hawk is named in honor of the Sauk and Fox Indian Chief Black Hawk (1767-1838), who won respect in defense of his homeland. One of his direct descendents was the legendary Jim Thorpe, of football and Olympic Games fame, whose son, LTC Carl Thorpe, attended the Black Hawk renaming ceremonies.

Balloon Probes Collect Ozone, Stratosphere Data

Valuable information on the ozone layer and chemical content of the stratosphere - related to problem area concerns of numerous major U.S. Government agencies including the Department of Defense - is being collected by using giant balloons instrumented as data platforms.

Technology developed during almost a decade of U.S. Army experimentation at White Sands Missile Range, NM, is serving objectives of ongoing tests. The eighth balloon experiment was conducted recently, involving balloons with 11 and 22 million cubic feet of helium.

STRATCOM (STRATospheric COMposition) Program Director Dr. Harold Ballard, Army Atmospheric Sciences Laboratory at WSMR, rated the two balloon probes "90 percent successful." Tests included parachute drops of instrumentation, and participation of a NASA U-2 aircraft that carried sensors complementary to those aboard the balloons.

The first flight carried a 3-instrument 1,000-pound payload to a 23-mile altitude. The second lifted 30 scientific instruments weighing 1,100 pounds 25 miles into the stratosphere.

Data from the balloon flights, parachute drops, the U-2 flights, five associated rocket flights, and ground tests, are being compared to check the ability of a photochemical model to predict accurately the profiles of atmospheric composition, such as the aerosol, carbon dioxide, ozone, water vapor, nitric oxide and chlorine content.

Federal agencies supporting the STRATCOM program or specific experiments include the Department of Defense, Energy Research and Development Administration, the National Science Foundation, and the Ames, Goddard and Langley divisions of the National Aeronautics and Space Administration.

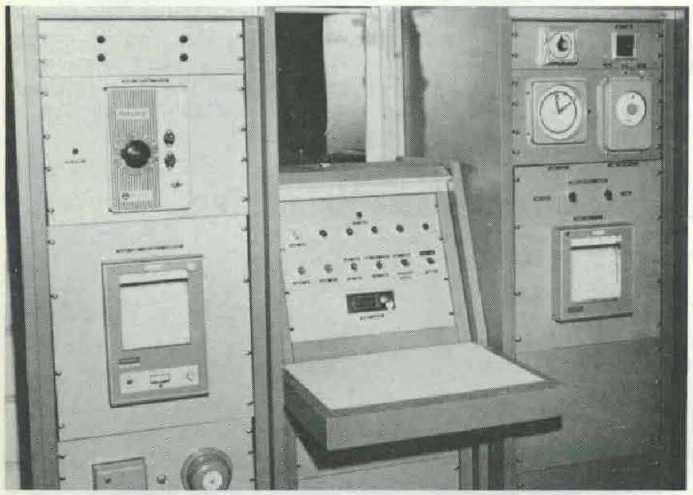
Also participating in the program are laboratories of the National Center for Atmospheric Research, Atmospheric Physics and Chemistry Laboratory, Sandia Laboratories, Panametrics Inc., SenTran Co., and Colorado, Utah and Pennsylvania State Universities.

Cost Effectiveness Cited . . .

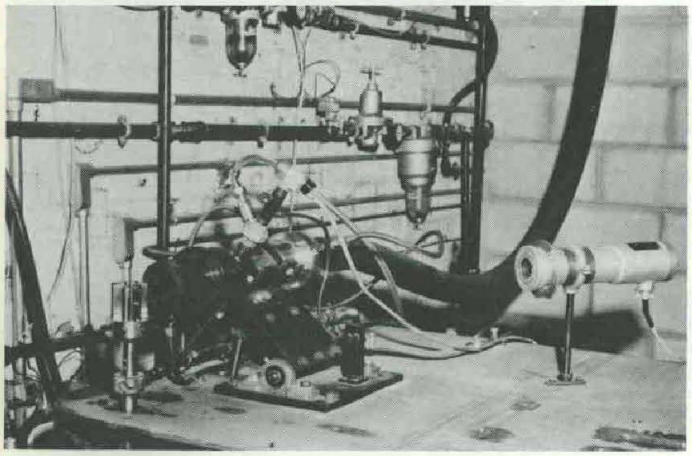
AMMRC Installs Hot-Corrosion Test Rig

Cost effectiveness is intrinsic to the dynamic hot-corrosion burner test rig installed at the U.S. Army Materials and Mechanics Research Center, Watertown, MA, for "less than $25,000," as reported by Milton Levy, leader of the Corrosion Research Group. The rig is believed the first of its kind located at an Army research center.

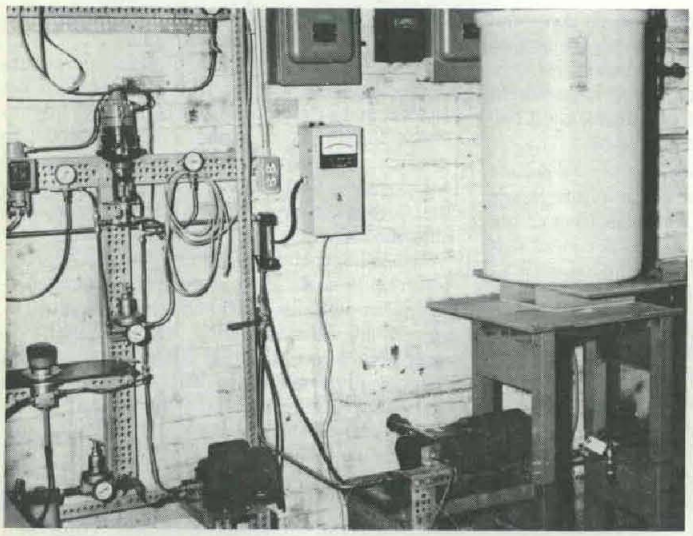
Levy describes the test rig as a source of combusted fuels into which a sea-salt corrodent is introduced, thereby impinging on the surface of test specimens. Combustion conditions are maintained on the oxidizing side of stoichiometry and the specimen may, or may not, be cycled thermally out of the flowing gas stream.



Hot Corrosion Test Facility Control Console



Burner Rig Assembly



Sodium Chloride Feed Assembly

The rig is actually an AMMRC-modified Pratt & Whitney unit with auxiliary controls. Effects of combined hot oxidation and sulfidation (hot corrosion) on experimental material systems can be realistically evaluated after exposure to dynamic test conditions.

Understanding of the contributions of these phenomena to materials deterioration is, Levy states, "germane to the rational selection of optimum gas turbine materials which are exposed to increasingly severe operating conditions; and in response to the need for improved performance along with upgraded reliability and maintainability of Army aircraft."

Choice of specimen geometry is open ended for the test rig. Variations may be selected that will simulate gas turbine engine components. Magnitude of hot corrosion is evaluated by metallographic examination (change in cross section) and weight loss measurement (weight after cathodic descaling).

Current effort with the test rig is concerned with developing techniques for refractory alloys to resist hot corrosion; also, elucidating mechanisms controlling these phenomena.

Levy is the principal investigator of the project involving hot corrosion studies. Special credit is due, he said, to J. J. Falco and J. L. Morossi for assembling the test rig and making it operational.

AAMRDL Renamed R&T Laboratories

U.S. Army Research and Technology Laboratories (AVRADCOM) is the new name for the former U.S. Army Air Mobility Research and Development Laboratory at Moffett Field, CA, as announced recently by Dr. Richard M. Carlson, who continues as director of the USARTL.

AVRADCOM denotes the parent U.S. Army Aviation R&D Command, St. Louis, MO, commanded by MG Story C. Stevens. Four subordinate directorates of the former USAMRDL also were redesignated.

What was the Ames Directorate is now the *Aeromechanics Laboratory,* Moffett Field, CA. The *Propulsion Laboratory* is the new name for the former Lewis Directorate, NASA Lewis Research Center, Cleveland, OH. The *Applied Technology Laboratory,* Fort Eustis, VA, is the new name of the former Eustis Directorate. Similarly, the *Structures Laboratory,* NASA Langley Research Center, Hampton, VA, evolved from the Langley Directorate.

Despite the name changes, missions of the new laboratories are relatively unaffected, including major projects. The Research and Technology Laboratories' over-all responsibility is: To plan, develop, manage and execute for AVRADCOM the research and exploratory development programs, and advanced development programs, through demonstration of technology to provide a firm technical base for development of superior airmobile systems.

Special emphasis is to be placed on improved aircraft engine and rotor performance; reduced structural weight, cost and complexity; improved maneuverability, survivability, safety, reliability and maintainability, and lower life cycle cost. Major projects include the XV-15 Tilt Rotor Research Aircraft; the XH-59A Advanced Balde Concept; Rotor Systems Research Aircraft (RSRA); and the 800-Shaft Horsepower Advanced Technology Demonstrator Engine Program.

Ceramic Cracks Laid to Electron Tube Failure

Interdisciplinary team effort has solved a problem of occasional failure and shortening of the shelf life of the A2 ceramic-to-metal sealed electron tube in the M1140 fuze of the Lance missile, the U.S. Army Materials and Mechanics Research Center has announced.

Cooperating in the R&D effort were specialists from the AMMRC, the Harry Diamond Laboratories at Adelphi, MD, Army Electronics Command, Picatinny Arsenal at Dover, NJ, Naval Research Laboratories, National Bureau of Standards, and Arthur D. Little, Inc.

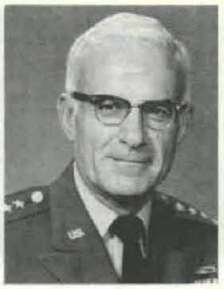
The root cause of failure was determined as cracks in the ceramic parts of the tube slowly propagating under stresses produced by the thermal expansion mismatch between the copper and alumina components. When the cracks intercepted gas-filled pores produced during processing, the gas was released into the interior of the tube causing arcing and resultant failure when the power was turned on.

The failure analysis team recommended changes in the method of fabrication of the tube. Fabrication with ceramic previously metallized with a layer of molybdenum/manganese alloy eliminated the failure mode by reducing the chemical attack.

AMMRC supervisory research ceramic engineer Dr. Dennis J. Viechnicki termed the result of the interdisciplinary team effort "important in increasing the reliability of our main new weapons systems."

Secretary of Energy
James R. Schlesinger

Secretary of Army
Clifford L. Alexander



Army Chief of Staff
GEN Bernard W. Rogers

DARCOM Commander
GEN John R. Guthrie

23d Annual AUSA Meeting . . .

Focuses on 'Total Army' Readiness Requirements

Current and projected manpower and materiel issues relative to "Total Army" readiness accented major speeches and panel discussions at the 23d annual meeting of the Association of the United States Army (AUSA), Oct. 17-19, in Washington, DC.

More than 6,000 military personnel, industrial representatives and guests gathered to hear presentations by top military leaders and to view exhibits of equipment and capabilities designed to meet U.S. defense requirements.

Secretary of Energy and former Secretary of Defense (1973-75) James R. Schlesinger was honored with presentation of the George Catlett Marshall Medal, the highest AUSA award, at the climactic memorial dinner. Cited for "selfless service to the United States of America, as an educator, strategist, and superb public servant," Schlesinger entered public service in 1969 as assistant director of the Bureau of the Budget.

Previous recipients of the award include former Presidents Truman and Eisenhower, Secretary of State Cyrus R. Vance and former Secretaries of State Henry A. Kissinger and Dean Rusk, Ambassador Ellsworth Bunker, and former Secretary of the Army Frank Pace Jr., last year's winner.

Secretary of the Army Clifford L. Alexander emphasized in his keynote address that the quality of the people who comprise the Total Army and the Readiness of the Army are virtually inseparable, and that dedication and talents of the active soldier must be combined with those of the citizen soldier.

Emphasis on a quality Army must begin with recruiting, he said, adding that efforts in this area by the Recruiting Command during the past 12 months have been encouraging despite diminishing resources.

Commenting on the Army's readiness, Secretary Alexander stated: "We have traditionally defined readiness in terms of *unit* readiness in people, training and equipment. This may not fully correspond with our capability to go to war should the need arise.

"Unit readiness does not tell us much about responsiveness of the entire Army. Force readiness does. It includes unit readiness in the traditional way - but also the factors of rapid mobilization, deployment, operations, and ultimate sustainability of a force once overseas."

Secretary Alexander concluded his remarks with a brief discussion of the Panama Canal. He stressed that ratification of the Canal treaties will send a clear signal to developing nations that the U.S. acts in accord with what it says.

Army Chief of Staff GEN Bernard W. Rogers, AUSA luncheon speaker, amplified on the importance of strategic and force structure issues in Europe. He said that needs of NATO present a great challenge to the Army, adding:

"Efforts to improve effectiveness of the forward defense in Europe currently include introduction of more attack helicopters, additional artillery units, and increasing ammunition storage levels."

Major efforts are designed to permit NATO to deal with an attack occurring with little warning, he said, adding: "Current emphasis is to increase, to the highest level, force readiness of forces already deployed or to be deployed during the first 30 days of war."

Six Total Army goals outlined by GEN Rogers are: increased readiness; improved soldier quality and family life; developing, fielding and maintaining a balanced fighting capability; improved deployment ability; improved technology and equipment; and better personnel and materiel resources management.

Commander of the U.S. Army Materiel Development and Readiness Command GEN John R. Guthrie was the featured speaker at the sustaining members luncheon. He spoke on mission changes within DARCOM as the result of organizational realignments, the relationship with industry, and its Total Army readiness role.

GEN Guthrie stressed that DARCOM's reorganization is far from complete and that realignments and personnel actions are actually the easiest part of the reorganization process, explaining that "The hard part is making the new organization work."

Commenting on DARCOM's changing mission, he stated, "it has grown from that of a wholesale logistics manager, limited to the continental U.S., into providing support *directly* to 570 Army units and installations worldwide.

"DARCOM now fulfills responsibilities as the single manager for conventional ammunition for all the military services, and executes a foreign military sales program with $15 billion worth of open cases. We also operate maintenance plants in Germany, and airlift repair parts directly to 89 key support units in USAREUR (U.S. Army Europe)."

Addressing the issue of DARCOM/industry relations, GEN Guthrie said that we must strive to become more aware of each other's problems and objectives through improved communication. Special Army/industry seminars, initiated in 1974, are a positive step in this direction, he said, adding:

"The nature of the Soviet threat demands that we modernize our forces and it is in this area that industry can make its greatest contribution. We are continuing to increase the proportion of industry effort and reduce in-house contributions to the Army acquisition efforts.

"A similar trend is visible in engineering development and the technology base. Our ED funds, which support most of our R&D PMs (project/program managers), have moved steadily toward more contract and less in-house effort. Roughly 75 percent of our ED dollars go to industry.

"In the technology base area, we are working toward a rough 50-50 ratio. The ratio in 1975 was about 57 percent in-house and 43 percent contractor. Today it is 55 percent in-house and 45 percent contractor."

GEN Guthrie voiced strong concern that one of the greatest challenges facing the Army is NATO standardization/interoperability. He said that DARCOM is deeply engaged in a major effort to study implications of standardization.

"These issues," he stated, "range across a wide spectrum, from training support requirements of foreign systems to legal ramifications of dealing directly with foreign manufacturers."

Basic methods of international materiel acquisition cited by GEN Guthrie are: Cooperative research and development in basic military research between two or more countries; coproduction of a weapons system by one or more prime contractors in two or more nations; licensed production where developers of military hardware provide data, patent rights, and technical assistance necessary to permit production in another country.

Another method is direct procurement of foreign systems by straightforward contracting, in accordance with the Armed Services Procurement Regulation. Direct procurement with a foreign government rather than a foreign firm can be effected through a contract or international agreement.

Other subjects of concern presented by GEN Guthrie included small business participation in the federal procurement process; minority business programs; and use of letter contracts as preliminary tools to commence industry work.

Letter contracts, he cautioned, should be used only when absolutely necessary, such as when dictated by urgency of program requirements or when production lead time is insufficient.

GEN Guthrie concluded with an appeal to reduce costs in buying and maintaining Army weapons systems, explaining that the current federal funding environment demands that the Army eliminates program funding turbulence.

Other featured AUSA speakers included Under Secretary of the Army Walter B. La Berge, who addressed the corporate members luncheon; LTG DeWitt C. Smith Jr., Army Deputy Chief of Staff for Personnel; Sergeant Major of the Army William C. Bainbridge; and George M. Houston, new AUSA president.

Topics discussed in two panel seminars were "Ability to Man the Total Army," moderated by Dr. Curtis Tarr, former director of the Selective Service System, and "A Bill of Rights for Those Who Serve," moderated by MG Robert F. Cocklin, USAR, AUSA executive vice president.

Included among numerous Army and industrial exhibit attractions were progress reports on the Patriot surface-to-air missile system; the Black Hawk helicopter; and a mobile, solar-powered telephone communications system.

Army Modernization Affordability

By MG Ernest D. Peixotto

How to pay for its modernization program, concurrent with increasing the Army's immediate readiness posture, has been the subject of recent briefings by general officers of the Office of the Deputy Chief of Staff for Research, Development, and Acquisition. ODCSRDA Director of Materiel Plans and Programs MG Ernest D. Peixotto spoke on this subject at the U.S. Army Operations Research Symposium. A condensation follows:

How many times has each of us heard the comment in our own household: "We can't afford it!" You feel your 1972 car should be replaced; your wife presents good arguments to replace the 20-year-old refrigerator that has served her well but is now wearing out. However, the family assets simply do not allow both things to be done, certainly not simultaneously. But they will both be needed, sooner or later. Which comes first, and when? It is the problem we term affordability.

This is a greatly simplified analogy of the major challenge that now faces, and will continue to face, the Army's materiel acquisition community in planning future budget requests. The magnitude of this affordability problem evolved during the mid-seventies as the Army increased the emphasis on modernization.

It became evident that there is a serious shortfall between the total funding required for the modernization program and the active funding that the Army is likely to receive from the Congress over the next decade.

The modernization program is the largest in our history. We are making up for lost time caused by the Vietnam War and technology opportunities are greater than ever. At the same time the Soviet threat is ominous.

Our program probably exceeds in magnitude our build-up for World War II; it certainly exceeds it in cost and it is a 2-fold effort. On the one hand we are undertaking a major upgrading, a product improvement effort if you want to call it that, for a large number of systems. We are improving our tank fleet from M60A1s to M60A3s, AH-1G helicopters are being upgraded to TOW-firing AH1-S antitank systems. The CH-47 helicopter is being improved, and M113 armored personnel carriers are being converted from gas to diesel—to cite only a few examples.

On the other hand, we are completing development of many totally new systems with significantly increased combat capabilities. We are in the process of fielding a new family of modern weapons and equipment. The XM1 tank, the Black Hawk utility and YAH-64 attack helicopters, the Patriot air defense system, a new family of conventional munitions, and new antitank mines are a few examples.

The issue facing the Army is to obtain funding support for this program. Our budget must be increased over the next few years or we must delay the fielding of certain equipment. Given the current Army missions, a solution of some sort must be found that permits us to come as close to achieving the desired goal as available resources permit.

To understand the affordability issue, and how we are attempting to analyze it, we have divided the problem into four parts. The first is what I call *total program affordability,* which covers a 15-year period in the future. The second is to answer the "What if . . . ?" type questions. In this case, we evaluate the impacts of major changes in the allocation of funds over the 5-15 year time period.

The third analysis evaluates the affordability of our specific system in connection with an ASARC (Army Systems Acquisition Review Council) decision to trade off for systems already included in the program. The last and toughest part of the problem is that of life cycle affordability. Our analyses have dealt with the first three of these. I will limit my remarks to the first type of analysis—total program affordability.

Each year, during the formulation of the Army's materiel acquisition program, this challenge is faced and resolved, based on the resources allocated. In these deliberations, the research, development, test and evaluation dollar requirements are worked out by fiscal year. This is added to cost estimates required to procure these modernization items—the new capabilities.

In addition, the cost of the many other projected buys for already adopted items needed to sustain the Army must be included. Together, these make up the total procurement requirement, defined in terms of both dollars and quantities by fiscal year.

This total procurement requirement (TPR) is, in reality, based on a complex series of decisions as to how the Army will accomplish its mission. The primary factor is the nature of the threat and the scenario for responsive action as shown in Figure 1.

Probable scenarios are established to size the logistics base required to fight the war. Guidance comes to us from the Secretary of Defense and from the Army Chief of Staff. This guidance is passed along to the materiel acquisition community as *goals and objectives*.

MG ERNEST PEIXOTTO has been director of Materiel Plans and Programs in the Office of the Deputy Chief of Staff for Research, Development, and Acquisition (ODCSRDA) since September 1975, after serving for 15 months as deputy. Effective Nov. 15, he was reassigned as director, Army Budget, Office of the Comptroller.

A 1951 graduate of the U.S. Military Academy, he has an MS degree from Massachusetts Institute of Technology. He has completed requirements at the Army Command and General Staff College and the National War College. He served as assistant commandant, U.S. Army Engineer School, Fort Belvoir, VA, during 1973-74, following a 3-year tour of duty as commander/director of the U.S. Army Waterways Experiment Station, Vicksburg, MS.

Other key assignments have included commander, 86th Combat Engineer Battalion (in support of the U.S. Army 9th Infantry Division), Mekong Delta, Vietnam; and special assistant for Plans and Policy, Office, Chief of Engineers, Washington, DC. He is a recipient of the Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star Medal with OLC, Army Commendation Medal with OLC, and the Air Medal (OLC).

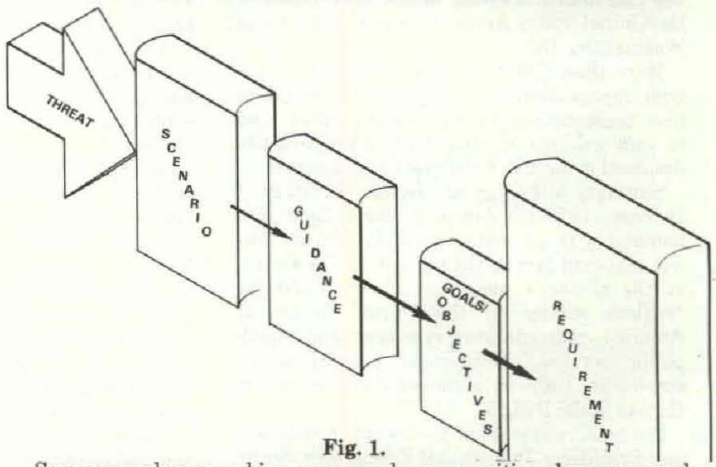


Fig. 1.

Some examples are: achieve so many days prepositioned war reserve by a certain date; establish a number of division force equivalent prepositioned stocks overseas; achieve a certain Initial Operational Capability by a specified date for a specific weapon system. These goals and objectives, which have a 2-part interplay, serve as the basis for TPR calculations.

General goals and objectives are those such as, for example, determining an appropriate balance between R&D and procurement or, to put it another way, between force modernization and filling shortages in current standard items to achieve and maintain Force readiness.

Other goals and objectives deal with providing sustainability for our forces. Here I refer to the need to procure equipment to replace combat losses and ammunition. An example might be support of a D-Day force of X number of divisions for a fixed number of months of sustained combat.

Keyed to the requirement, then, is a planning factor we call the Army Acquisition Objective (AAO). This is calculated for every major system in the Army, some 900 in all. Simply stated, the AAO is calculated by determining the quantities authorized for TO&E and TDA units, maintenance floats, combat consumption rate and any special stocks.

In order to insure the allocation of program dollars to the highest priority requirements, we are using a concept we call a force planning package (FPP). FPP 1 reflects the needs of the in-place and early deploying forces. Successive packages are keyed to deployment schedules of augmentation and build-up forces. Priority of equipment, especially in terms of modernization, must go to the early deployed forces. Our foreseen resources simply do not allow a rapid materiel fill-out for all of our units.

But the total AAO does not remain constant. On the contrary, the Army's increasing requirements result in significant increases to the AAOs. There are four major causes for these increased requirements. Until recently, our ammunition expenditure rates were based on World War II and Korean experience.

During the past few years the Army has developed new ammunition rates, based on our projected needs on tomorrow's battlefield. These projections are based on detailed war games performed by the Army's Concepts Analysis Agency.

Second, our wartime replacement factors for equipment have been sub-

jected to significant change due to more accurate projection of the increased lethality anticipated, and evolutionary improvement in combat support systems on the modern battlefield. These new rates are also based on computerized war game simulations.

Third, force structure changes have been made and more are being planned. For example, some divisions may be converted from light Infantry to mechanized Infantry, thereby increasing requirements for tanks, armored personnel carriers, etc. The proposed division restructuring tests could result in increased demands for materiel.

The fourth cause for a large increase in materiel requirement costs is the need to modernize the Army's conventional warfare capability. During the late 1960s and early 1970s, while we were concentrating most of our dollar resources on Vietnam, the Soviets were hard at work on a major revitalization of their conventional war ground forces. Now we are in a critical program to assure a qualitative superiority over any enemy.

A significant increase in the Army's budget is essential to meet these growing requirements. Over the past few years, the Department of Defense has received 25 percent of the total federal budget. The Army has been receiving only a quarter of that 25 percent.

We also find that noninvestment costs consume 67 percent, leaving only 33 percent for materiel acquisition, including research, development, testing and evaluation.

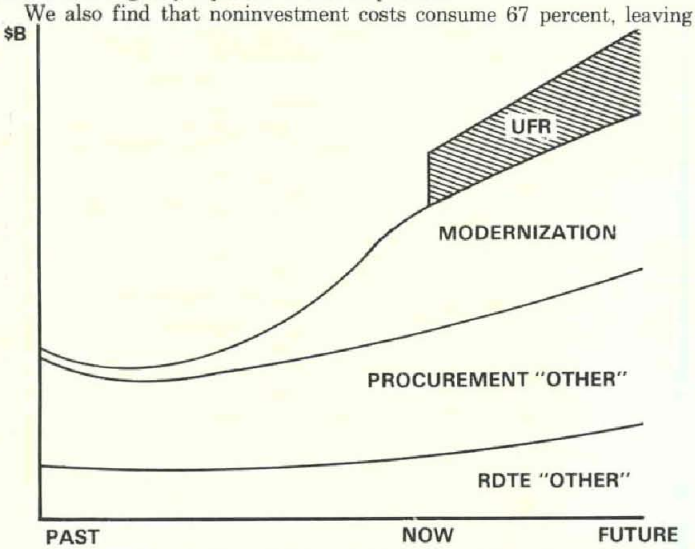


Fig. 2. Materiel Acquisition "Bow Wave"

Clearly, the Army needs to attain a greater share of the defense dollar if we are to accomplish our modernization and readiness goals. A challenge to all of us is to bring these facts to the forefront.

After determining all of the items required by the Army and programing their production, the increasing demand for funds becomes evident. When this is plotted graphically, as shown in Figure 2, there is a sharply rising total cost curve. Usually referred to as the procurement "bow wave," this term derives from the wave that precedes the bow of a ship.

The Army RDTE program, as shown in Figure 2, reflects a modest annual increase; however, in constant dollars this does not restore our level of effort to pre-Vietnam equivalent. But the procurement curve projection increases dramatically. We have virtually tripled the procurement budget over the past four years. A major reason for this increase is the need to procure the new systems resulting from the R&D process—the critically needed modernization items.

There are always additional numbers of other things that are believed needed. Because of their lower priority, they fall into a category in Zero-Based Budgeting terms called the "enhanced case."

The projection of this out-year money allows the Army to continue to program for needed systems. If we are not funded at the levels programed, the time of procurement must be delayed. During preparation of the FY 78 budget, about $1.6 billion was removed from our procurement account before the request went to Congress.

This process usually results in reductions in the budget year with additional funds added in the outer years of the FYDP (5-year Defense Plan). Budget year dollars are almost real while the out-year planning money is more like Monopoly money.

So what solutions exist? The most obvious is for the Army to obtain more money, a greater share of the defense dollar. There is clear justification that the Army should receive more than the current 25 percent, but this is difficult in view of the needs of the other Military Services.

Moreover, the cost of our equipment is increasing. For years the Army's weapons and equipment have cost less than those of the Air Force and Navy. Now the Army's weapons and equipment are costing in the hundreds of thousands, even millions, and Army procurement patterns are difficult to change.

A second course of action is to slow down the modernization program by delaying the start of new systems acquisition. The objection to this course is that these weapons are needed at the earliest opportunity to counter the growing threat in Europe.

This is a difficult and controversial course of action, because all of the modernization systems have strong proponents, some in the Office of the Secretary of Defense and the Congress. I am pleased to report that we have not significantly delayed any major weapon system because of a lack of funding support.

Whenever budget cuts are required, we must take the "salami" method where it is necessary to cut a portion of a large number of lower-priority programs. Combat service and combat service support type items, such as generators, bridging, trucks, communications and mess equipment, are typical items that are reduced; procurement is delayed from year to year.

The third course of action is to acquire all systems "less" optimally. This has led to attempts to develop a procurement strategy. One approach is to place priority on near-term readiness and sustainability items. A second option is to place priority on the procurement of modernization items. Another is to develop a procurement program that balances modernization with readiness and sustainability.

The course of action or strategy to follow is also dependent to a large extent on planning uncertainties. If one accepts a high probability of war in a certain time period, then he can adopt a procurement strategy to fit.

If, for example, one would conclude that a war could occur in the near term, then we might defer much of our modernization procurement and increase the purchase of readiness items. We would concentrate on filling requirements for M113 armored personnel carriers and M60A1/A3s tanks, TOW missiles fired from Cobra aircraft, and a number of others.

At the other extreme of the planning and procurement process, you would guess that war would not occur for 10 to 15 years. We could then concentrate on the modernization program, with minimum funding for the current standard items. We would plan to fill out our forces with XM1 tanks, YAH-64 helicopters, Infantry Fighting Vehicles, etc.

Will it be a long war, a short war, nuclear or nonnuclear? We not only have these extremes but we have a variety of options in between. We cannot run the risk of putting all of our eggs in any one of these possibilities. Then we must ensure a program that is carefully balanced to meet the total spectrum of contingencies.

We must insure an adequate readiness posture for the immediate future. For that reason, we have increased the procurement of many items, for example, M60A3 tanks. We plan to continue the M60A3 buy until we begin to achieve full production of XM1s. The same applies to other areas.

On the other hand, we recognize we must continue to modernize, or face an enemy that is not only numerically superior but, in many areas, qualitatively superior. What are the tools available to us to assist in making these affordability determinations? First, we need help at what I call the macro level—not the micro level. We all know the XM1 tank is better than the M60, etc.

We need analytical models that provide the answer to the question of *total system effectiveness and minimum cost*. What has helped us considerably to date are three management tools: first, a categorization of weapons and equipment in functional areas called CAPCATS, a priority system, and the use of computer graphics.

Currently, there are 11 capability categories, most of which deal with some aspect of Army operations. For example, there are categories of close combat, fire support, and air defense; also, general combat support systems, administrative and research. In each category, we have attempted to provide a picture of the total capability and our needs.

In the case of Close Combat, we include tank/antitank, guided missiles, combat aviation, mechanized combat equipment and light weapons, including all support equipment and ammunition. We have attempted to take into account every aspect of that capability as it cuts across every one of the Army's five procurement, as well as the RDTE appropriations.

A second extremely useful tool has been a system of priorities developed by the Training and Doctrine Command. Establishment of this priority system has greatly facilitated our job.

Finally, use of computer graphics permits a virtually instantaneous graphical display of the impact of a materiel acquisition decision. It has aided us in obtaining fast answers to questions that otherwise required the use of voluminous computer printouts at a later time.

In summary, the Army's affordability problem is here now, and it will be with us for a while. It is a many-faceted problem. The solution is not easy. If the Army is to attain its goals and objectives, as I emphasized earlier, we must, obtain a greater share of the dollar resources.

Army Project Managers Conference. . .

Top Army Leaders Accent Important Role of PMs in Defense Requirements

Controversial, challenging, stimulating, crammed with action, and highlighted by U.S. Army leaders as speakers and discussion panelists, are properly descriptive when applied to the eighth annual U.S. Army Project Managers Conference.

Stated concisely, the Oct. 26-28 meeting in Orlando, FL, was an intense "cram" course to update project managers on views of their leaders; the interface problems with Congress; relations with industrial contract executives; changes in program/project progress or the planning phase; and policy or procedural problems (some of which provoked vigorous viewpoints).

Participating dignitaries included: Under Secretary of the Army Walter B. LaBerge; former incumbent of that office, Norman R. Augustine; Assistant Secretary of the Army for Research, Development, and Acquisition Dr. Percy A. Pierre; Army Vice Chief of Staff GEN Walter T. Kerwin Jr.; and GEN John R. Guthrie, Commander of the U.S. Army Materiel Development and Readiness Command.

DARCOM leaders who presented addresses included Deputy CG for Materiel Development LTG Robert J. Baer, Deputy CG for Materiel Readiness LTG Eugene J. D'Ambrosio and his assistant James F. Maclin, assistant deputy for Materiel Development John Blanchard, assistant deputy for Science and Technology Norman L. Klein, and director for Battlefield Systems Integration MG Ira A. Hunt Jr.

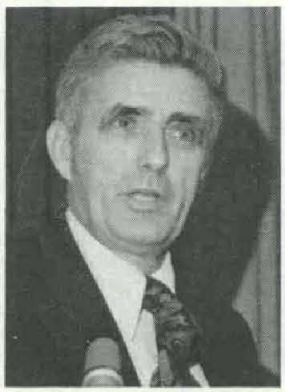
Chief of the DARCOM Project Managers Office COL Lauris M. Eek Jr. was presiding chairman for all general sessions. In his opening comment, he defined the conference goal by saying, "We are here to improve the PM system . . . . Numerous high executives and managers of the Army are here to see what they and their institutions can do to help you . . . ."

Project Manager of Year Award. ASA for RDA Dr. Pierre presented the second annual Project Manager of the Year Award to BG Frank P. Ragano, PM for Roland at the Army Missile Research and Development Command. Roland is one of the first European designed weapon systems selected for production in the U.S. for deployment with the U.S. Army. The TSQ-58 shares that distinction.

Prior to assuming responsibility for U.S. production of Roland, a French-German development that will be used as the U.S. Army all-weather, short-range, air-defense system, BG Ragano was PM for the 2.75-inch Rocket System and later the Cannon Artillery Weapons Systems, including the CLGP (Copperhead).

Selected under provisions of Army Regulation 672-13, Nov. 7, 1975, pertaining to PMs in DARCOM, the Office of the Surgeon General, Corps of Engineers and the Army Security Agency, BG Ragano was cited for outstanding performance "during the critical period July 1976 through June 1977.

"Through his initiative, technical competence, excellent judgment and astute managerial ability, General Ragano restructured the U.S. Roland Project to place greater emphasis on NATO Standardization, and to increase international confidence in this unique technology transfer project - an achievement of great distinction at a time of strict personnel and fiscal austerity. General Ragano's performance reflects great credit upon himself, the U.S. Roland Project and the United States Army."



Walter B. LaBerge

Under Secretary of the Army LaBerge spoke on objectives of the high-priority current emphasis on North Atlantic Treaty Organization activities for standardization and interoperability of weapon systems as a "clear and present challenge." His presentation was emphasized with vugraphs, one of which showed the United States has a $56 billion investment in Europe.

As outlined by President Carter in a May 1977 meeting in Europe, Under Secretary LaBerge stated, NATO is the heart of U.S. foreign policy; the U.S. supports flexible response and forward defense; Allies must combine, coordinate, and concert national programs more effectively; and the United States is prepared to join in major effort to improve collective deterrent strength of NATO.

The speaker discussed additional details of President Carter's statement of objectives, including:

- NATO must eliminate waste and duplication (in acquisition of materiel).
- NATO Allies each should have opportunity to develop, produce, and sell competitive defense equipment.
- Alliance must maintain technological excellence in combat forces.
- U.S. must be willing to promote a genuinely 2-way trans-Atlantic trade in defense equipment.
- Europe and North America must explore ways to improve cooperation in development, production and procurement—to fight as an effective Allied fighting team, which means greater interoperability if not standardization, and to place forces in a high state of readiness.

Army Vice Chief of Staff GEN Kerwin, the formal dinner speaker, was at times unusually candid in expressing his viewpoints regarding problem areas in the materiel acquisition process with which top Army management as well as program/project managers must deal.

Many of the problems are monumentally complex and difficult to resolve, he said, particularly those that involve continual changes during the developmental process. He stressed that "getting the user (principally elements of the Training and Doctrine Command) in on the ground floor" should greatly alleviate some major problems.

"People—you—I—the user—your bosses—the Department of the Army organization—are part of the problem and its solution," GEN Kerwin stated, adding:

"Project managers, you are great Army officers. You are success-oriented. You have that 'Can Do' attitude that has helped to preserve this nation for two centuries. You work under terrific pressure from your bosses, the users, the testing community. It is really hard for you to say you cannot meet your schedules or your budgets.

"I charge you to get the user in from the beginning. And I want your bosses to see that you get user cooperation. Don't think it is a personal failure if you cannot meet the schedule for legitimate reasons. In my experience, haste only ends up costing millions of dollars.

"Be willing to use your authority as a PM. You must stop changes at some point. And your bosses have to avoid constraining you. That erodes your authority and may even take it away. Stand up and be counted . . . . Dig your heels in if someone, the Department of the Army, whoever, is hurting your program . . . ."

ASA for RDA Dr. Pierre was introduced by GEN Guthrie as the opening-day luncheon speaker. Dr. Pierre, whose professional qualifications include 3½ years with Rand Corp. as a research engineer, complimented the gathering of DARCOM commanders and project managers as being representative of the "cream" of the structure of Army research and development.

One of his early observations in his new position, Dr. Pierre said, is that the "bottom line" at the Pentagon staff level is to produce, to get results as efficiently and expeditiously as possible.

Army project managers are similarly charged with responsibility for results on programs and projects involving an annual expenditure of more than $3 billion annually, he said, to achieve development of materiel systems that will meet defense requirements.

"Your success is critical to the mission and image of the Army. The quality of the total Army program is dependent largely on the quality of the project managers and materiel acquisition managers . . . . The future of the PM program depends on the caliber of the officers selected and the management principles built into the selection process . . . ."

Dr. Pierre said that all PMs are "presumed to be totally competent" and that in his review of programs and projects to date he has not been

disappointed. "We want to fund all the major materiel acquisition programs properly within budget priorities. Let us know if your program is in difficulty. I do not relish trying to defend a losing program to Congress . . . ."

GEN John R. Guthrie

DARCOM Commander GEN Guthrie meeting with his project managers for the first time since he assumed command of DARCOM, delivered the keynote address. He enunciated clearly his approach to PMs' problems and their responsibilities to the Army and their commanders.

"It was most significant to me that when GEN Rogers (Army Chief of Staff) opened the recent Army Commanders Conference, he told the group that he wanted them to be frank and forthright in their discussions, else the conference would have little value. I underline and endorse that approach in the strongest terms I can.

"GEN Rogers also said, 'No one here has a right to wear his heart on his sleeve.' I also underline that, because I think one of the greatest benefits to us, and to the Army, is to conduct meetings of this nature with a full sense of self-criticism. In-house critique can help us shape our thinking and our activities to the best benefits to the Army.

"The Chief of Staff also established his priorities as near-term modernization and mid-term modernization, in that order. Generally speaking, near-term readiness covers roughly the span from D-Day to D+34 days for NATO forces. Mid-term modernization comes thereafter. I see these priorities as a primary influence on how we shape our activities . . . ."

After discussing briefly his philosophy of the function of DARCOM HQ in respect to its major commands, GEN Guthrie said: "Being a project manager, as you know better than I, is one of the toughest jobs in the Army. I am sure that there are times when you may feel like a Dodgers' pitcher in Yankee Stadium with Reggie Jackson at bat in the sixth game of the 1977 World Series.

"Your job is an important and without a doubt a rewarding one. All of DARCOM is proud of what you have collectively accomplished in your missions. At the same time, we must also be our own severest critics. Tell it like it is, not only here but in all your activities . . . ."

GEN Guthrie then turned to a discussion of DARCOM's expanding mission with diminishing resources by way of civilian and military manpower and funding constraints. Today DARCOM has responsibility for direct support of some 570 Army units worldwide, plus management of foreign military sales, and serving as single manager for Armed Forces conventional ammunition.

Over-all Army civilian strength (less AMC/DARCOM) from 1962, when the Army Materiel Command was established as a consolidation of Technical Services R&D and logistics functions, increased 8.9 percent to the end of FY 1977. DARCOM now has 37.5 percent fewer civilians than AMC had in 1962 and its military strength declined over 50 percent during the same period, he said.

After citing personnel strength and funding increases, as well as the growth of project manager offices (4,171 people in 58 PM offices managing about 42 percent—$3.6 billions—of the total research, development, test and evaluation budget), GEN Guthrie said, "We must make certain that we utilize our resources as effectively as possible . . . .

"What I am trying to say, is that we have to take a position of enlightened self-interest. There are areas in this command where the quality of people we would like to commit to project management, and the people who have been trained in project management, can have a very great impact if they are assigned to functional areas.

"By the same token, finding those kinds of quality people is, as you know better than anyone, an increasingly difficult task. Therefore, I want to be sure that no one says that I am against project management. That is not true. But I am concerned that we do not commit more resources to this expensive form of management than we can afford.

"In those instances, however, where we obviously need project management, you can be assured of my full support, and you can be assured of full support of your projects. Within these constraints, the projects management system, including the special selection and training process that we have so laboriously achieved over the past few years, will continue to be emphasized.

"Perhaps one source of this growth is the demonstrated success which project management has realized in the past few years. The philosophy of project management has taken hold so well that assignment of PMs to a command has become almost a status symbol.

"The high visibility and publicity given to the program, to the caliber of people it has attracted, and to the relatively high level of general officer promotions from PM ranks, have combined to create a demand for admittance to the PM program and for establishment of PM offices.

"Let me assure you, both commanders and project managers, that I do not consider PMs as status symbols; I do not believe every command needs an abundance of them. We simply need to determine requirements for PMs based on merits of the projects and purposes they are intended to accomplish. . . ."

GEN Guthrie, at this point, launched into a discussion of integrated logistic support, and NATO standardization and interoperability, citing policy guidance from the White House and Office of the Secretary of Defense.

"Project managers," he said, "will play a pivotal role in the standardization effort. All of you are already aware of the requirement for you and other developers to present a thorough analysis of competing foreign systems at Army and Defense System Acquisition Review Committees meetings.

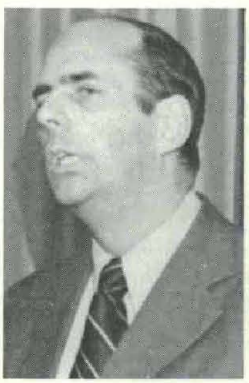
"This will require that you become an expert on those foreign developments in your area of responsibilities . . . . We will be developing a data bank on foreign systems that will provide much of the information you need. TECOM (Test and Evaluation Command) has begun to test foreign systems. Results of the tests should guide your recommendations . . . ."

The Army Materiel Systems Analysis Activity (AMSAA), he said, is considering an alternative methodology for presentation of data on standardization and interoperability at meetings of Army and Defense Systems Acquisition Review Committees—including the issue of quantification of interoperability.

"For example," GEN Guthrie explained, "when do you say two systems are interoperable? When they use the same fuel, or the same ammunition, or the same engine, or must all the parts be interchangeable? Much of the basic work remains to be done . . . ."

GEN Guthrie concluded with a discussion of some of the difficult problems of concern to DARCOM commanders and PMs. He included cost control and cost reduction; proper forethought and administrative planning; his concern about letter contracts, and particularly undefinitized letter contracts; small business participation in the materiel acquisition process; equal employment opportunity in PM offices; test procedures, and integrated logistics support.

One of his strongest points was the need to avoid an adversary relationship with industry and with the Army Training and Doctrine Command (TRADOC). For DARCOM to be able to fulfill its mission, he said, "it is essential that we eliminate, not ameliorate, adversary relationships . . . ."



Norman R. Augustine

Norman R. Augustine, known to the Army R&D community as a speaker who invariably

LTG Robert J. Baer

(Continued on page 21)

Walter Reed Army Medical Center Dedication . . .

Climaxes Decade of Intense Effort to Attain Maximum in Advances

Medical technological advances accelerated almost incredibly during more than a decade of planning and construction are represented to the maximum in the recently dedicated $134.7 million, massively impressive, 5,500-room Walter Reed Army Medical Center.

Facilities in the 125-foot-high (equivalent to about 10 stories) structure cover about 27.5 acres of floor space. The new WRAMC was termed an "enduring symbol of progress" during dedication ceremonies in which numerous dignitaries and an estimated 2,500 people participated.

Every possible effort was made to incorporate in the new medical treatment facility—near the Maryland-District of Columbia boundary and easily accessible from Beltway 495—capabilities representative of the current state-of-the-art in medical advances.

Equipment and techniques throughout the world were in a "constant state of review" during more than five years of construction, scheduled to continue well into 1978.

Final decisions to include the newest devices and systems were made at "the last possible moment," as directed by length of time required to purchase and install the equipment in accord with the construction status.

Moreover, design of the building includes provisions for progressive additions in capabilities to maintain the most modern service.

MG Robert Bernstein, WRAMC commander, explained that the policy of constant updating of capabilities during the construction period generally permitted the purchase of equipment "two to three years more recent in development" than that in early design concepts.

More than 3,000 out-patients daily are expected to benefit by the current "ultimate in facilities." Accommodations can handle 1,280 in-patients, and can be expanded substantially and rapidly for a national emergency.

HONORED GUESTS at the dedication ceremonies included Mrs. Charles Royce, granddaughter of MAJ Walter Reed, in whose memory the first WRAMC was dedicated in 1909, along with former First Lady Mamie Eisenhower. Also, Senator John Stennis (D-MS), Secretary of the Army Clifford Alexander, and Army Chief of Staff GEN Bernard W. Rogers.

TOMOGRAPHY UNIT is used for taking a picture of only one layer of a patient's body, and is especially useful for determining the exact location and depth of body tumors.

MG ROBERT BERNSTEIN, MC, was appointed acting commander of Walter Reed Army Medical Center (WRAMC) in June 1973 and designated as commander a month later.

Assignments as commander, U.S. Army Medical R&D Command in March 1973 and a month later as assistant surgeon general for R&D followed duty as deputy commander for WRAMC and command surgeon general, U.S. Military Assistance Command, Vietnam.

He served as director, Plans, Supply and Operations, Office of the Surgeon General (OTSG) and special assistant for Field Medical Activities, OTSG; from August 1968 to August 1970.

Commissioned in the Army Medical Corps in 1947, MG Bernstein holds a BA degree from Vanderbilt University (1942) and an MD from the University of Louisville School of Medicine (1946). He also is a graduate of the U.S. Army War College (1964) and the Command and General Staff College (1960).

Other key assignments have included command surgeon, U.S. Southern Command, and chief surgeon, U.S. Army Forces, Southern Command, CZ (1965-68); chief, Plans and Operations, Office of the Surgeon, USCONARC (1964-65); and nuclear medical officer, WRAIR (1958-59).

Included among his military honors are the Distinguished Service Medal, Legion of Merit with two Oak Leaf Clusters (OLC), Bronze Star Medal with "V" Device and OLC, Meritorious Service Medal, Joint Service Commendation Medal, Army Commendation Medal and Purple Heart.

Other dignitaries present were LTG John Morris, Army Chief of Engineers; LTG Richard Taylor, Army Surgeon General; MG Spurgeon Neel, commander of the Army Health Services Command; MG Charles Pixley, who took over Oct. 1 as The Surgeon General; Norman F. Patterson, president, Stone, Marracini and Patterson, architects; Milton T. Pflueger, the principal designer; and Morton A. Bender, president, Blake Construction Co., the prime contractor.

Secretary of the Army Alexander, dedicatory speaker, stated in part:

"In order for us to keep our promises to our soldiers, there are some things that we must do. We must find a way to alleviate the physician shortages in the Army. We need to obtain the necessary incentives that will attract doctors into our Army and keep them there.

"Because of the physician shortage, more retirees and dependents must seek civilian care. They are having difficulty in finding doctors and hospitals to participate in CHAMPUS—the Civilian Health and Medical Program of the Uniformed Services. To help solve this problem, we need approval to return CHAMPUS to its previous level of payment for medical services rendered by civilian doctors and hospitals.

"If we can achieve these and related programs, we will be able to convince our soldiers that we care for their needs.

"As Secretary of the Army, as a resident of the Washington Metropolitan Area, and as an American citizen, I am proud of what the dedicated people who serve at Walter Reed have accomplished during the construction period. . . .

"Walter Reed is a national resource. It is famed as a teaching hospital, and for the specialties which provide a wide spectrum of treatment for our soldiers around the world. Now the physical plant, equal to the best in the state-of-the-art anywhere, will add lustre to that fame and permit it to increase."

Most Out-patient Clinics were expected to be operational late in November or early December, and some started to care for patients Nov. 7. One of the first to become operational is the Department of Dentistry with a 52-chair clinic. Until all parts of the new WRAMC are operational, the existing hospital buildings will provide a full range of services.

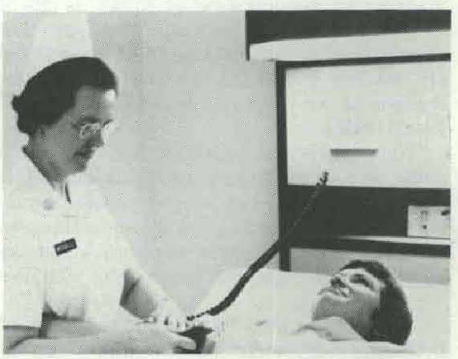
Still under construction are the upper four floors of the 7-story building, actually equivalent to a 10-story facility because of the "interstitial" 6'9" high spaces between each floor. They carry air conditioning, life support systems, wiring, plumbing, and a monorail system for transporting food carts, linens and other essentials to various parts of the hospital. This easily accessible space provides for rapid repairs or additions of equipment.

An inspection tour of the building for the press prior to the dedication provided an insight into the meticulous planning that began long before construction started in 1972.

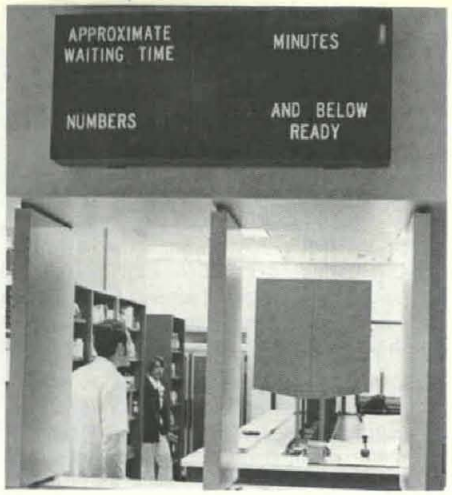
An explanation adequate for reasonable comprehension of the many "marvels" of the new facility would require much more space than is available; rather, it could be told by devoting a complete edition of this publication to the subject. Automation is a key word.

Automated systems handle food service to an almost incredible degree, as they do for pharmacy and laboratory materials. Computerized systems also handle sterilization and distribution of supplies and linens. An integrated communications network adds to efficiency.

With a minimum of the sweat that normally goes into the process of preparing food in hot kitchens, the semi-automated system can serve 3.5 million meals a year (10,000 daily) - with processing and deliveries accomplished mainly by push button controls.



WALL UNITS, located behind the patient's bed, contain oxygen, compressed air and suction units, electrical outlets, a telephone jack, the nurse call system and other equipment necessary to meet the patient's needs.



Out-patient Pharmacy

Some of the advanced technology developed by the U.S. Army Natick Research and Development Command laboratories—along with that developed by the giants of the mass food preparation industry to serve chain restaurants, airlines and other large-scale operations—is incorporated in WRAMC facilities.

When the Natick Laboratories were assigned responsibility for the Department of Defense Food Program management in a 5-year management plan, the Army Surgeon General was designated the Executive Agent for Nutrition, under provisions of a 1971 Joint Service Regulation. Since then the program has resulted in many major improvements in food processing and serving.

A considerable part of the WRAMC sophisticated food preparation equipment and automated controls was manufactured in West Germany. The constant review of food processing technology during construction of the new WRAMC extended also to other countries. Several trade publications have termed the over-all result "a miniature semi-automated food factory."

The totally air-conditioned system is the first of its kind in the U.S. Army. Mass production methods of preparing meals in advance (as long as two to three weeks) permit most WRAMC food production employes to work a regular Monday through Friday schedule.

Food items drawn from storage areas (dry, refrigerated, frozen) are sent to the ingredient preparation room for cleaning, peeling, chopping, slicing and weighing or measuring—in much the manner currently used.

Cooking is semi-automated and controlled by push buttons in the food production manager's office where the cooking cycle, speed of conveyors and temperature settings are ever under his watchful eye.

For example, pumps collect natural juices from the bottoms of ovens to baste the meats. More than 380 pounds of roasts can be cooked in each of two rotating ovens. Conveyorized grills can turn out more than 2,000 portions of chops, hamburgers or sausages an hour.

Speedy preparation also is accomplished by three double-jacketed steam kettles featuring self-contained mashers, pureers and stirrers. They can produce, in about half the normal time for current methods, more than 1,100 pounds of mashed potatoes, about 900 pounds of vegetables or rice, or 45 gallons of pudding or soups. Audio-visual signals inform the production control manager that a predetermined process is being followed.

Patients who can eat in the dining hall make entree selections from about 25 items on two revolving carousels. Patients who eat in their rooms and are on predetermined diets are served by an amazing semi-automated process involving a conveyor system.

Trays are placed automatically on the conveyor and as they travel along the individual portions (drawn by employes from dry, cold or refrigerated storage in advance) are placed on the trays. Each tray is checked at the end of the conveyor to make certain that the prescribed diet is followed.

A "trayveyor" takes the tray for each patient to another floor where it is loaded by employes into a food cart of the monorail system serving all patient floors. Employes take carts destined for each nursing unit and place them into a refrigerated area until they are dispatched by the monorail to food pantries for each nursing unit.

One of the amazing processes is that which starts half an hour before meal time. The cart automatically heats certain items on the tray (meat, chicken, potatoes, vegetables, gravy, rolls) to the desired temperature. The salad and milk remain chilled and butter is warmed only to make it spreadable. The same tray does it all without aid of human hands.

Many of the automated systems in the dining hall also are sophisticated, to the degree that extensive training is scheduled for employes. The food cart is a first in the food service industry and was originated by MAJ Ben Davis while assigned to the WRAMC Food Service Division in the late 1960s and early 1970s.

MAJ Davis commented: "We are marshalling our ingenuity for one of the most innovative, cost-effective food services known to man of this decade and the future." That objective is now achieved.

PATIENT SERVICES facilities and personnel resources are organized to provide optimal modern care and comfort. The Walter Reed medical treatment facility can accommodate 1,280 in-patients, and can be expanded rapidly in the event of a national emergency. Out-patient facilities have a capability for treating thousands of patients daily, providing continually up-dated techniques and equipment.

Computerized systems control sterilization procedures, distribution of medical supplies and linens, laundry procedures, and numerous other aspects of hospital operations. An integrated communications network contributes to efficient management of over-all operations.

Medications are compounded in the hospital's central manufacturing pharmacy; every dose is separately prepared, packaged and labeled. Satellite pharmacies—one for each floor—complement the central facility in meeting requirements of upper-floor in-patients.

In-patient rooms surround a fully landscaped courtyard where convalescents may relax during favorable weather or walk for exercise. Nursing units are just outside the courtyard boundaries and are organized to serve private, semiprivate and multibed patient rooms.

Pri-Team Nursing is a concept that calls for a team made up of a registered nurse and paraprofessionals to care for 6 to 12 patients, giving them individualized attention from date of admission to their release.

One of the Pri-Team requirements is an adequate administrative staff for each ward. Recent studies showed that nursing staff members on many wards spend as much as 40 percent of their time with administrative work—writing reports, making appointments, ordering meals, getting supplies, etc.

These functions, as well as personnel and housekeeping responsibilities, will be handled by the ward manager, clerks and logistics technicians. This permits the nursing staff to give individualized treatment to patients without increasing the nurse to patient ratio.

All the high technology capabilities at the new hospital are designed to complement each other with maximum efficiency for patient care, meticulously programed with consideration of "the human element."

In addition to providing the most up-to-date diagnostic and treatment accommodations, the medical treatment facility offers numerous special services to make the patients' stay agreeable. The third floor houses an inter-faith chapel, library, recreation room, snack bar, barber shop and beauty salon. *Clinical Environment* is the result of many years of planning with assiduous attention to detail for maximal effectiveness in serving patient needs.

WRAMC main clinical laboratories are rated among the three busiest of their kind in the nation. Records for 1976 show that 5.2 million tests were performed, not only for Walter Reed but for patients around the world. The clinics' workload growth is about nine percent annually, and it is believed that rate may be exceeded in the new hospital.

Six satellite out-patient clinics in the Washington metropolitan area combine in service to about 1.5 million out-patients annually. Sixty-four specialty clinics in the WRAMC complex, including the Forest Glen annex, last year handled nearly 900,000 out-patients.

The Medical Clinic, on the first floor, serves out-patients screened in advance to provide the attending physician with essential information on medical history and all aspects related to proper treatment.

Acute minor illnesses and injuries are handled on a 24-hour basis—meaning that patients are admitted and released the same day. Emergency room facilities and personnel handle *only* emergency cases.

Intensive Care capabilities are on the fourth floor and include accommodations for 200 patients. Capabilities include surgical, medical and nursing units, along with cardiology, metabolic, thoracic and urology clinics. Each of the intensive care units incorporates the latest patient monitoring techniques (substantially automated) along with innovative methodology.

(Continued on page 18)

LANDSCAPED COURTYARDS, located on each of the upper floors, can be enjoyed by the patients without ever leaving the hospital. Nursing units abut the courtyard.

Walter Reed Army Medical Center Dedication

(Continued from page 17)

The Surgi-Center also is located on the fourth floor. Minor surgery is performed on an outpatient basis—admission and release the same day. Sixteen operatories, clustered into self-contained units of four suites each, form the center core of the fourth floor.

Each suite is equipped for special procedures. One suite features a viewing amphitheater for 300 persons with color TV placed in the operating lights. Others contain instrumentation for opthalmology, neurosurgery, and heart or lung cancer operations. A special elevator delivers a custom surgical case cart for each operation. Following surgery the cart is returned by separate elevator to central material services.

The Dental Clinic also is considerably involved in surgery and is one of the largest serving the U.S. Army, with 52 treatment rooms as compared to 23 in the old hospital. From 400 to 500 patients can be treated daily.

What is described as a new system employing "auxiliaries" increases the number of cases each dentist can handle. The auxiliaries perform various aspects of treatment formerly reserved for the dentist. The dentist, dental therapy assistant (DTA) and dental assistant work together as a team, in a cluster of operatories.

The dentist initiates patient treatment, accomplishing all "nonreversible" tasks. The DTA performs all reversible procedures, that is, any treatment repeatable with no harm to the patient. This includes placement of fillings, taking impressions, cleaning teeth, X-rays, removing sutures, discussions with the patient, and patient education lectures.

The Department of Dentistry also will be able to support more effectively the treatment of patients suffering from head or neck cancer, heart disease and other diseases that have a dental impact.

Capabilities will be expanded significantly in the *Maxillofacial Prothesis Laboratory.* Dental surgeons specially trained for such operations will replace with plastic materials—for patients disfigured by cancer operations or accident—facial features such as ears, noses and eyes.

The MPL also will have an extensive role in advaneed technology training of dentists, including an expansion in number of those serving residencies, and in their areas of specialties. The most modern teaching methods will be used, such as closed-circuit TV and video-tape.

WRAMC Pathology Laboratories are rated among the busiest in the world. Workload records for the past year show roughly 30 million weighted procedures of the College of American Pathologists were performed.

Moreover, the new facility workload is expected to increase 30 to 40 percent. Involved are tests for Uniformed Services hospitals worldwide, and, when facilities permit, the Veterans' Administration and U.S. Public Health Service.

A 3-fold mission is assigned to the Pathology Laboratories—testing; the training and residency programs including summer courses for medical students and the Armed Forces Blood Bank Fellowship; and clinical research.

New systems in the department will include a SMAC (Sequential Multiple Analyzer, Computerized), representative of the state-of-the-art for large-volume chemical analyses. It will be capable of 10 to 12,000 tests daily.

To assure the most modern working environment for clinicians, systems will control noise, dust and air-flow.

Department of Radiology facilities will feature "amazing developments" during recent years to enhance capabilities of diagnostic, nuclear medicine and radiation therapy areas. Virtually all equipment will be new (relatively little moved from the old hospital) and 34 diagnostic X-ray rooms will have "some of the most modern and sophisticated equipment in the entire U.S."

Much of the radiology equipment will be fully automated and computerized for "fast, efficient accomplishment of both routine and difficult X-ray examinations with a minimum chance for error in techniques .... Radiologists will be able to give instantaneous typed reports for display on TV monitors on the wards any time of the day or night."

Diagnostic radiology also will feature an advanced tomography unit. Tomography is described as a process for taking a picture of only one layer of a patient's body—the remainder does not show. The technique is especially useful for taking pictures of the inner ear, for example, or exact location and depth of tumors.

A computerized axial tomography unit, said to be "in great demand," particularly for brain scanning "with excellent detail," is another feature in the new equipment category. It permits scanning areas of increased or decreased density in brain tissue where cancer or other problems may exist, and "just about does away with the former painful pneumoencephalography exams."

The CT scanner also is used to take detailed pictures of the liver, pancreas, kidneys and other abdominal organs "with great accuracy."

Another "marvelous" new machine for diagnosis without using radiation is an ultrasound whole body scanner. Density variations in the body are shown by the reflection of sound waves. Currently, the machine is finding about 60 percent of its application in examination of obstetric patients.

"We have had cases where this unit could detect a pregnancy as early as eight weeks," explained a WRAMC radiologist. "This is faster than any of the commonly used tests to determine if a woman is pregnant or not."

In the latter stages of pregnancy, the ultrasound scanner is described as being capable of detecting twins, triplets, abnormalities, a position where delivery of the baby would be difficult and, in one proved instance to date, the sex.

Computers at the new hospital have advanced the art of nuclear medicine dynamic studies by using injections of radioactive material followed by X-rays as it passes through the body. Isotopes are being used also to study heart function and detect coronary artery disease, bone scans and other organs. Cancers show up many months earlier than in regular X-rays.

The thyroid scanner, developed at Walter Reed Army Institute of Research (WRAIR), may eliminate the need for injection of radioactive material in patients who should receive as little radiation as possible, such as pregnant women and small children. A beam of gamma rays on the thyroid gland excites the iodine atoms in the thyroid, causing them to give off detectable X-rays and thereby determining the size and level of the iodine.

EDUCATION AND RESEARCH facilities in the new hospital are being provided to improve its long-standing reputation as one of the finest medical teaching institutions in the U.S.

The training program serves needs of young physicians as well as experienced practitioners intent on continually upgrading qualifications. The second floor houses numerous classrooms, a 300-seat auditorium, medical library and equipment for advanced training.

The Research Program at the WRAMC, as mentioned earlier, makes use of broadly diversified opportunities in the numerous clinics and laboratories. State-of-the-art sophisticated instrumentation for measuring test results and for analyses enhances the over-all facilities and equipment to provide for a full range of medical investigation in scientific disciplines.

WRAMC Commander MG Bernstein, speaking at the hospital dedication, stated in part:

"Buildings are built or remodeled but great institutions are not buildings. Great institutions are people. One common bond that makes an institution great is the concern of its people. In that regard, we are extremely fortunate."

2 Firms Chosen for Air-Defense Gun Engineering

Selection of two contractors for competitive full-scale engineering development of two prototypes each of the new division air-defense gun was announced Nov. 29 by Secretary of the Army Clifford L. Alexander.

Pomona Division of General Dynamics and Aeronutronic Division of Ford Aerospace and Communications Corp. were selected from five firms that submitted proposals. The Army Source Selection Evaluation Board considered cost, system performance, NATO standardization, management, tactical suitability and supportability of all proposals.

Secretary Alexander said the Army plans to complete negotiations soon for contracts that will provide for accelerated development over a 29-month period and competitive testing phase. One contractor then will be selected for completion of development and initial production.

Upon completion of negotiations, the Army will issue letters of intent authorizing limited expenditures for completing detailed contract execution plans. Revalidation of the DIVAD gun requirement by the Department of Defense will precede award of contracts.

Intended to replace the current Vulcan gun, the DIVAD will be an all-weather, radar-directed gun system, employing either 35mm or 40mm cannons in an armored turret mounted on a modified M48A5 tank chassis.

Total procurement is currently foreseen at about 600 systems. Should a decision be made to buy the German Gepard system for a near term option to meet an operational need for our European stationed forces, then the total procurement quantity of the DIVAD will be reduced accordingly.

Firm cost figures will not be available until negotiations are complete, but $17.1 million has been budgeted in FY78 to initiate development. Competition for procurement will come later with costs being an evaluation factor. COL Len Marella, U.S. Army Armament Research and Development Command, Dover, NJ, is the DIVAD project manager.

16th Annual Army Operations Research Symposium. . .

Directs Attention to Challenge of Change to Serve Decision Makers

Changes of major significance in operations research goals and methodology, to be more realistically responsive to factual needs of Army decision-makers on programs involving billions of dollars annually, are essential if OR is to retain recognition as a meaningful U.S. Army profession.

Keynote speaker Dr. Seth Bonder, respected internationally as one of the most eminent leaders in the OR field, carried this message to about 275 AORS XVI attendees, Oct. 12-14, at Fort Lee, VA.

Themed on Operations Research Support of the Army of the 1980s — Looking Ahead, the 3-day symposium was under the auspices of the U.S. Army Operational Test and Evaluation Agency (OTEA), Falls Church, VA, commanded by MG Julius W. Becton.

Cohosts were the Army Logistics Center, commanded by MG Homer D. Smith Jr.; Army Quartermaster Center and Fort Lee, commanded by MG Fred C. Sheffey; and Army Logistics Management Center, headed by COL Don A. Wilkinson.

Dr. Bonder's address carried the authority of one of the pioneers in the OR profession — a leader who has participated as a principal in most Army Operations Research Symposiums since he attended his first in 1963. This year, he concentrated his remarks on what he views as an urgent need for change, after tracing briefly the role of OR in World War II and up to date.

"I think the time is right," he said, "to shift the emphasis of OR activity from the long-range planning issue of What Is Needed for the Future to address the more operational issue of How to Use What We Have. That is, we should focus our efforts on operations rather than on systems analysis. . . . "

(A substantial portion of Dr. Bonder's address is the subject of our regular feature, SPEAKING ON. . .beginning on the inside front cover.)

Symposium Chairman Walter W. Hollis, scientific adviser of OTEA, called the assembly to order and introduced MG Sheffey for opening remarks.

Following Dr. Bonder's keynote address, N. G. Asbed and L. S. Steenrod teamed in an invited paper titled Static Analysis — An Answer to the Complexity Crisis. Both are with the U.S. Concepts Analysis Agency, Bethesda, MD, and their paper was a report on simplification of a war-gaming analysis procedure.

Dr. Marion Bryson, who has participated in all 16 of the Army Operations Research Symposia, and was for many years chairman of arrangements when the symposia were sponsored by the Army Research Office (then at Durham, NC, and now at Research Triangle Park, NC) presented a technical report on TEMAWS (Tactical Effectiveness of Minefields in an Anti-Armor Weapons System).

Dr. Bryson has been technical director of the Army Combat Developments Experimentation Command at Fort Ord, CA, since 1972. His presentation described in detail the parameters for a war-gaming experiment conducted by CDEC to determine measures of effectiveness under varying war gaming model structures.

Results of altering the study factors, he said, demonstrated that the field trials variation of factors is "limited only by the imagination."

COL Donald S. Pihl of the U.S. Army Training and Doctrine Command and a member of the TRADOC Division Restructuring Study Group, described the study and analysis. The objective is to prepare armored and mechanized divisions for envisioned conditions of combat in the 1980-85 time frame. COL Pihl served three years as a military assistant to the Secretary of the Army.

Army Chief of Staff GEN Bernard W. Rogers approved the division restructuring concept with some caveats in December 1976. Smaller divisions, COL Pihl explained, and the change of weapons mix in concept will achieve goals of greatly increased firepower (up to 1,630 pounds a minute) and accelerated mobility.

Development testing of restructured divisions at Fort Hood, TX, will provide the basis for evaluation and analysis. A decision on proposed restructuring is planned for October 1978.

Army Vice Chief of Staff GEN Walter T. Kerwin Jr. was introduced by MG Becton as the featured speaker on the second day of the conference, following COL Pihl's presentation. GEN Kerwin opened with a "look back" at the U.S. Army as a basis for a "practicable look at the future." He first traced some highlights of 43 years of progress.

GEN Kerwin then turned to a discussion of the Army of today as it is being reorganized and re-equipped to meet requirements for greatly increased firepower and mobility on the modern battlefield — in consideration of a potential enemy force that is known to have numerical superiority in manpower and in most of the traditional materiel resources.

After paying tribute to the quality of U.S. Army leadership all the way down the organizational structure to platoon and squad leaders, GEN Kerwin talked about strengthening some of the resources required to modernize the Army to meet the foreseeable threat.

Affordability, in view of continually escalating manpower and materiel costs, is focusing primary consideration on "what we really need to have," he said, as related to all that may be considered desirable in the rebuilding process.

"We must find better ways to do more with less, to get more payoff from new weapons systems that are coming into service," GEN Kerwin explained. He added that improved training methods must be developed to maintain the highest achievable quality standards in manpower resources.

Other considerations discussed by the Army Vice Chief of Staff included problems of standardization and interoperability of weapon systems of U.S. and Allied forces, and the trade-offs in the negotiation process to achieve these goals.

GEN Kerwin also discussed total Army readiness problems, the Volunteer Army, the expanding role of women in the Army, the Reserve and the National Guard, and the "whole back-up structure" with respect to maintaining maximal professionalism.

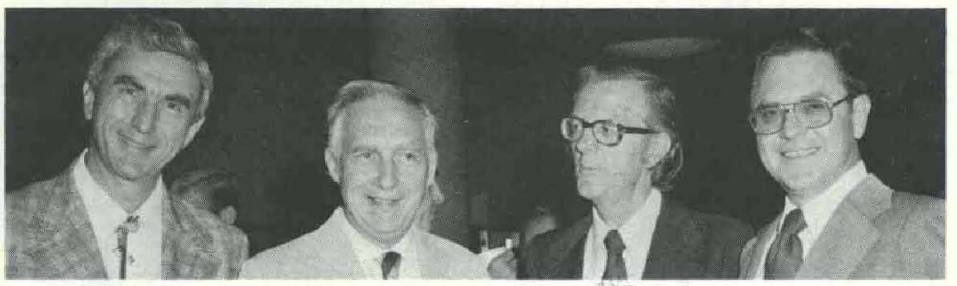
MG Ernest D. Peixotto gave an in-depth presentation of the problems of affordability in

(Continued on page 20)

ARMY VICE CHIEF OF STAFF GEN Walter T. Kerwin Jr. (center), a principal speaker at AORS XVI, poses with symposium cohosts MG Julius W. Becton Jr., commander, OTEA, and MG Fred C. Sheffey, commander of the Quartermaster Center and Fort Lee.

SYMPOSIUM Chairman Dr. Walter W. Hollis, OTEA, is flanked by Dr. Marvin E. Lasser (left) and Dr. Marion Bryson.

COL Donald S. Pihl



PICTURED DURING COFFEE BREAK are Saul Penn, Concepts Analysis Agency, CAA Technical Director and Deputy Commander Jack Newman, Roger Willis, TRASANA professional staff, and Leon Gude, deputy director, TRASANA.

Challenge of Change Stressed at AORS XVI

(Continued from page 19)

the Army materiel acquisition process. Most of his address is carried on page 14 as a separate feature.

He called upon professionals in the Army OR community for aid in analyzing complicated decision factors on affordability considerations for weapon systems and other materiel requirements extending over a 15-year time frame.

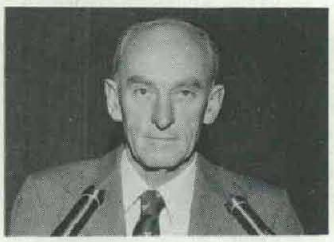
MG Peixotto was director of Materiel Plans and Programs in the Office of the Deputy Chief of Staff for Research, Development, and Acquisition at the time of the address. Effective Nov. 15, he was reassigned to director, Army Budget, Office of the Comptroller.

Dr. Roland V. Tiede

Dr. Roland V. Tiede, widely known for his contributions to a large number of high-level study groups, including war gaming and the effectiveness and utilization of data information systems, reported on Our Contractual Review of the Qualitative and Quantitative Value of Tactical Mobility.

Currently on the staff of Science Applications Inc., Dr. Tiede served on a number of Department of Defense study groups, including one on Surveillance of the Land Battlefield, and another on Integrated Tactical Information. Several of his major efforts have been made as director of weapons systems studies for the U.S. Army Training and Doctrine Command; also for the Defense Nuclear Agency, involving consideration of NATO capabilities.

Dr. Tiede's AORS XVI presentation was a sophisticated report, illustrated with numerous vugraphs of highly detailed charts showing the complexity of analysis methodology. He gave a summary of results of studies on his subject as prepared by three working groups.



Dr. Daniel F. McDonald

Banquet speaker Dr. Daniel F. McDonald, vice president for Technical Programs, BDM Corp., lightened with considerable humor his discussion of serious aspects of the changing challenge to the Army OR community.

Army decision-makers, he said, generally recognize and pay tribute to the importance of operations research technology, but are frequently prone to question the validity (credibility) of the end product. OR practitioners face the issue of presenting critical data in simplistic usable form—and at the same time weighing highly sophisticated factors.

Closing Session Speakers. Dr. David A. Schrady, dean of Academic Planning, Naval Postgraduate School, Monterey, CA, gave a presentation on the Operations Research Engineering Program for officers doing postgraduate studies. Dr. Schrady discussed the progress being made in educating officers to become professionally qualified as experts in operations research and analysis methodology. Thirty-eight universities and major colleges are offering OR courses, and Dr. Jerome B. Wiesner, president of Massachusetts Institute of Technology, has endorsed the program.

Dr. Marvin E. Lasser, director, Army Research in the Office of the Deputy Chief of Staff for Research, Development, and Acquisition, HQ DA, was the closing invited guest speaker. His presentation dealt with the dynamics of change in Army R&D, evolving philosophy in management principles, single element funding and Zero-Based Budgeting.

CONCURRENT WORKING GROUPS.

Session Chairmen were: Frank B. May, U.S. Army Logistics Center, Fort Lee, VA; Wilson S. Ford, Operations Test and Evaluation Agency, Falls Church, VA; Thomas L. Paris, Roger F. Willis and LTC John L. Hesse, all with TRASANA (TRADOC Systems Analysis Activity), White Sands Missile Range, NM; Ms. Diane M. Brown, Army Combat Developments Experimentation Command, Fort Ord, CA; Alvan J. Hoffman, Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD; LTC Charles J. Petronis, Ben Robbins, and COL Leigh Ogden, Army Concepts Analysis Agency, Bethesda, MD; CPT Richard Grube, HQ TRADOC, Fort Monroe, VA.

Session A: Logistics

An Analysis of Special Purpose Tank Car Requirements for the Defense Freight Railway Interchange Fleet, Dr. Joe W. Knickmeyer, Military Traffic Management Command; Analysis of the Provisioning System as Applied at HQ, ARRCOM, CPT Larry W. Krueger, Armament Materiel Readiness Command (ARRCOM); Army Forward Strategic Basing Requirements, Dean E. Considine, Office, Chief of Engineers (OCE);

Frank B. May III

A Factor of Significance in Theater Army Force Structuring, LTC Gerald R. Wetzel, Concepts Analysis Agency (CAA); An OR/SA Logistic Support Challenge, LTC Vincent R. Aceto and Charles A. McCarthy, Joint Tactical Communications Office; Computer-Aided Battlefield Operations Management System, V. Berger, Aviation Systems Command (AVSCOM).

Session B: Reliability, Availability, and Maintainability

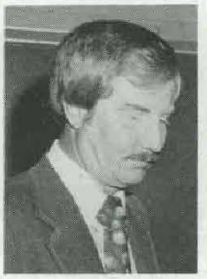
Economic Analysis of Reliability Improvement Warranties for Army Aviation Systems, A. Kassos, AVSCOM; AVSCOM Bayesian Techniques for Reduced Reliability Assurance Testing, Allan W. Gillespie and Michael P. West, AVSCOM; Benefits to Helicopter Users Which Result from Reductions of Weight, Power Consumption and Failure Rate, Gene R. Marner, AVSCOM;

Wilson Ford

A Simple Interactive Stochastic Algorithm for a Reliability Availability and Maintainability (RAM) Policy Guideline of an Air Mobile Combat System, Dr. Harold Y. H. Law and Timothy Evans, AVSCOM; Reliability Growth Tracking and Control Procedures, Dr. Larry H. Crow, Materiel Systems Analysis Activity (MSAA); Contracting for Reliability Growth, James R. Kniss, MSAA; Modeling Reliability Conditioned on Usage in an Operational Test Environment, Les Lancaster, Operational Test and Evaluation Agency (OTEA).

Session C: Resource Analysis

Cost and Schedule Risk Analysis Modeling for Weapon System Acquisition Programs, Truman W. Howard II, Missile R&D Command (MIRADCOM); Estimation of the Maximum Potential Savings Implied in NATO Standardization, Earl Williamson Jr., CAA; Applicability of Zero Base Budgeting to Army R&D, E. H. Holt and Bernard F. Engebos, Electronics Command (ECOM);



Thomas L. Paris

M240 Machine Gun Warranty Estimated Cost of Repair Parts, Norman H. Trier and CPT Larry W. Krueger, ARRCOM; The Family of Systems Study and Its Role in Army Systems, Floyd Rivera, TRADOC Systems Analysis Activity (TSAA); Army Dollar Resource Allocation Model— ADRA II, Daniel Shedlowski, CAA.

Session D: Combat Analysis

Evaluating the Combat Utility of Aerially Delivered Scatterable Mines, James B. Campbell and Joe R. Capps, General Research Corp.; An Austere Field Artillery Concepts Effectiveness Model, Alan R. Downs, Ballistic Research Laboratory (BRL); The AMSAA/RARDE Combat Simulation, Stewart J. Kempster, Royal Armament Research and Development Establishment, England;

Simulating Combat Under Degraded Visibility Conditions (Night and Smoke), Kent Pickett, Combined Arms Combat Developments Activity (CACDA), Fred Campbell, MSAA, Tom Cassidy, ECOM; A Smoke Effectiveness Model, George Stiles, MSAA;

Ben Robbins

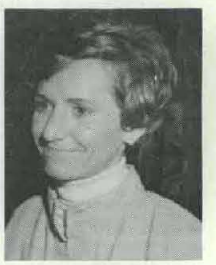
A Smoke Effectiveness Model, George Stiles, MSAA; The Impact of Smoke and Battlefield Obscurants on Tactical Weapons Systems, Bruce W. Fowler and Donald R. Peterson, MIRADCOM, O. Fred Kezer, Mobility Equipment R&D Command (MERADCOM); Battlefield Electrooptical Systems Effectiveness, Ralph Zirkind and R. E. Forrester, General Research Corp.;

DUEL 3, A Quick and Easy Simulation of Armor or Infantry Duels, Fred Bunn, BRL; Investigations Into Air-to-Air Combat Between Helicopters, James H. Young, Wyoming B. Paris, TSAA; High Leverage Nuclear Target Engagement, Donald F. Davis, BDM Corp.;

A Time Step Model for Replaying Simulated Battles, Dr. Marion R. Bryson, Combat Developments Experimentation Command (CDEC); Combat Engineering and Combat Engineering Analysis—Prospects, Promises, and Progress, Gerald E. Cooper and MAJ Terry W. Curl, OCE.

Session E: Testing and Experimentation

Test Program for the Proposed Restructured Heavy Division, Virgil A. Henson Jr., TRADOC Combined Arms Test Activity (TCATA); Tanks Versus Infantry in a Smoke Environment Experiment, Ms. Susan J. Wright, TCATA; Environment and Radar Operation Simulator, Stephen N. Cole, Robert C. Michelson, Reinhard Olesch, Otto Rittenbach and Eric S. Sjobert, ECOM;



Diane Brown

Delay Fuze Requirements and Evaluation for 20-30mm Ammunition, J. McCarthy, MSAA; Analysis of Laser Designator Tracking Errors, Julian A. Chernick and John F. Sheldon, MSAA; Looking Ahead in Instrumentation, MAJ Robert Douglas, CDEC;

Reducing Vulnerability: The Role of Tank Camouflage Measures, MAJ William Emerson and MAJ Walter Zaremba, MERADCOM, David Bitters, CACDA; The Effect of Target Vehicle Agility on Tank Gunners, Dr. Samuel H. Parry, Naval Postgraduate School, William D. Hahn, Army Armor and Engineer Board, William D. West, AVRADCOM;

A Cost Optimal Approach to Selecting a Factorial Design, CPT William Friese Jr. and Douglas Montgomery, Georgia Institute of Technology; Experimentation at CDEC: Case Studies in Operations Research, Dr. W. S. Mallios, BDM Services Co.; Baselines Where No Baseline Exists, CPT S. Williams and D. Spurway, OTEA;

Firing Port Weapon Effectiveness Analysis, Edward T. Walker, MSAA; Use of Prime Numbers in a Querying Simulation, Michael E. Neyer, Tank-Automotive Materiel Readiness Command (TARCOM); Scatterable Mines: Evaluation, Deployment, and Detection, CPT Manfred Benkel and Dr. Samuel H. Parry, Naval Postgraduate School.

Session F: Lethality and Vulnerability

A Survivability Methodology for the Analysis of Theater Nuclear-Capable Units, LTC John L. Hesse, TSAA; Expected Number of Attempts to Achieve a Binary Objective, Lawrence D. Johnson, BRL; Implementation of Survivability Program for Weapon Systems, Walter Dzingala, Armament Research and Development Command (ARRADCOM);

Alvan J. Hoffman

Parametric Tank Vulnerability Model, Ceslovas Masaitis, BRL; Nuclear Damage Assessment of Nuclear Capable Howitzer Batteries,

155mm and 8 inch, Self-Propelled, C. Spyropoulos, Harry Diamond Laboratories (HDL).

Session G: Intelligence, Communications, Command and Control

LTC Charles Petronis

Battalion Command and Control in Combat, David Prichard and MAJ William Milliron, CAA; How to Cook a Bayes, Dr. Douglas E. Hunter, Defense Intelligence School; A Software Cost Estimating Technique for Communications Systems, Stan Dunn, Army Communications Command (ACC);

Risk Analysis and Communications Costing: A Practical Application, John Bezner, ACC; A Decision Making Game to Establish the Value of Various Types of Battlefield Data, David Daniel, Ministry of Defence, England.

Session H: Training Analysis

CPT Richard Grube

The Selection and Analysis of Training Measures of Effectiveness, Ms Diane Brown, CDEC; Formative Utilization of a Model for the Prediction of the Effectiveness of Training Devices, Dr. Marshall A. Narva, Army Research Institute for the Behavioral and Social Sciences (ARI); Definition of Cost Effective Training Program—A Summary of Current Research Efforts With Application Predicting Future Training Requirement, Dr. John R. Chiorini, Melvin H. Rosen, Dr. Robert W. Swezey, Litton Mellonics;

New Directions in Rifle Marksmanship: The Development of a Total Training System, MAJ John H. Callaway, Army Infantry School, Dr. Thomas J. Tierney Jr. and Dr. John A. Cartner, Army Research Institute Field Unit; Operations Research at the Corps Level: An Analysis of V Corps Major Training Area Operations, Dr. Samuel H. Parry, CPT Michael J. Moore and CPT Thomas J. Teesdale, Naval Postgraduate School.

The Role of RAM, Testing In Acquiring Training Devices

(Continued from inside back cover)

Systems.

Due to the engineering development costs of these complex devices, and requirements for a dedicated facility, only one prototype is procured during this phase. When initially accepted by the government, this prototype was installed at Fort Rucker for final acceptance and operational testing. LTC Sexton and his support elements are using the same philosophy of development testing.

This type of interaction is not restricted to the TECOM Infantry Test Directorate. Similar support has been obtained from LTC Dave Sexton of the Aviation Test Directorate for the development testing of the Synthetic flight training systems support elements are using the same philosophy of development testing.

TECOM has just completed DT (Development Test) II for the CH47 Helicopter Flight Simulator. This was accomplished by monitoring contractor's in-plant/on-site acceptance testing and the conduct of OT (Operational Test) II at Fort Rucker. All additional testing needed for DT II analyses has been accomplished during OT II and in the 3-week period immediately following completion of OT II.

This same philosophy will be used on the AH1 Helicopter Flight and Weapons Simulator, scheduled to begin OT II in February 1978, and for all future simulator systems.

It is a challenge to expedite the acquisition and fielding of training devices. It is a greater challenge to do this while maintaining confidence that the device meets technical and logistic requirements. PM-TRADE, with the support of TECOM, is meeting these challenges.

Session I: New OR/SA Techniques

Roger Willis

CHOOSE, Gerald L. Moeller, ARRCOM; U.S. Army Remotely Piloted Vehicle (RPV) Uncertainty Analysis, Victor Liuzza, AVSCOM; The Theory and Practice of Using Confidence Regions to Test the Equality of More Than Two Means, Dr. Lewis S. Fichter, ARRADCOM;

Applications of Functional Analysis to Diophantine Optimization—Theory, MAJ Albert A. Mullin, TCATA; Rank Ordering of Laboratory Projects Under Elastic Constraints: A Fuzzy Subsets Approach, Dr. Harold Y. H. Law, AVSCOM; Multivariate Hypothesis Testing, MAJ William J. Owen and Jimmie C. Deloach, Army Infantry Board;

Battlefield Visualization Graphics Analysis Techniques, Dr. L. G. Pfortmiller and R. A. Favison, CACDA; A Cost Optimal Approach to Selection of Experimental Designs for Operational Testing Under Conditions of Constrained Sample Sizes, MAJ Sam W. Russ and Douglas C. Montgomery, Army Communications, Electronics Engineering and Installations Agency, Harrison M. Wadsworth, Georgia Institute of Technology.

Session J: Other OR/SA Applications

New Management Tracking Tool, P. Shapiro and A. Arconati, AVSCOM; A Mathematical Programing Model for Scheduling Engineering Change Proposal (ECP) Installation, Frank Fox, AVSCOM; Target Oriented Gun Analysis for Feasibility Studies, Ralph E. Shear and Bertram B. Grollman, BRL; Developing ARRADCOM's Systems Analysis Data Base, Joseph H. Mydosh, ARRADCOM;

Data Estimates and Subjective Probability: A Review, Michael J. Dorsett, MIRADCOM; Management of Change, Frank A. Distasio Jr., MAJ Mitchell E. Bonnett Jr., CPT(P) Frederick E. Hartman, CAA; A Method for Validating Missile System Simulation Models, Thomas P. Tytula, MIRADCOM; Operations Research in Operational Testing, Dr. James W. Dees, Army Aviation Board;

LTC John L. Hesse

The Use of Discriminant Analysis and Classification Procedures to Risk Assessment in Operational Testing, CPT Edward D. Simms Jr., TRADOC, and Douglas C. Montgomery, Georgia Institute of Technology; An Analysis Technique for Helicopter Aim Error Measurements, Dr. Robert S. Bennett and William T. Pibil, Falcon R&D Co.

Session K: Force Structure Analysis

COL Leigh Ogden

Weapons Slices—An Incremental Approach to Force Design, Robert C. Spiker, CAA; The Use of Goal Programing in the Theater Level Design of Forces, LTC Edward E. Hildreth Jr., CAA; Alternative Concepts for Evaluating Division Force Structures, Dr. Philip H. Lowry and Henry J. Schroeder Jr., General Research Corp.; Uncertainties and Assumptions in Theater Level Combat Analysis, MAJ Brian R. McEnany, Office, Joint Chiefs of Staff, Studies, Analysis and Gaming Agency; A Proposed Probabilistic Monte Carlo Analogue Concept, Herbert Cohen, CAA.

Operations Research Symposium Participants

OR VETERANS, totaling over century of experience, are (l. to r.), Ray Attarian, Dr. L. C. Callahan, Dr. Frank Grubbs, Harrison Wackworth, A. C. Christman Jr.

AUSTRALIAN attendees (l. to r.) are LTC John Chipman and Dr. R. G. Gillis, Embassy Defense staff, Washington, DC; LTC Richard Hall, HQ U.S. Army Logistics Management Center, Fort Lee, VA; and LTC J. C. Snell, Washington, DC.

Army Project Managers Conference

(Continued from page 15)

conveys a stimulating, challenging, highly informative and thought-provoking message - during his regime as Assistant Secretary of the Army (R&D) and, later, Under Secretary of the Army - put himself in the role of a witty luncheon speaker. Since his resignation in January 1977, he has been vice president for technical operations, Martin Marietta Corp.

Featured by liberal use of vugraphs, many of a cartoon nature, his address provoked numerous chuckles. But his humorous treatment was spiced with cogent observations relative to differences between Army in-house and industrial laboratories, Army total readiness for combat, NATO goals and initiatives, Army relations with Congress, materiel programs life expectancy, and enlightened personnel management to achieve productivity objectives.

OTHER SPEAKERS. DARCOM Deputy CG for Materiel Development LTG Robert J. Baer was the opening speaker. He mentioned that he was a "veteran of six of the eight PM conferences . . . . When we look back, I think that we realize the Army PM program is still a relatively young business. Much progress has been made since it started about 15 years ago."

Commenting that it "is extremely important that we have the DARCOM commanders here to

(Continued on page 22)

Army Project Managers Conference

(Continued from page 21)

LEADING PARTICIPANTS at 8th PM Conference, Army Vice Chief of Staff GEN Walter T. Kerwin Jr., ASA for RDA Dr. Percy A. Pierre, and DARCOM Commander GEN John R. Guthrie. All gave addresses.

exchange views with the project managers," he said, "PMs could look with pride upon some very important results but that a changing set of rules and resources are being applied to the PM program . . . . A whole new ball game confronts us . . . ."

(LTG Baer is well known to the Army PM community as a long-time R&D officer and as PM for the XM1 tank development program. He was honored at the 1976 PM conference when he was the first recipient of the PM of the Year Award.)

John D. Blanchard, DARCOM assistant deputy for Materiel Development, reported on a new study on international standardization and a new "Green Book" for PMs and industrial contractors titled the "Materiel Acquisition Management Guide." The guide is the result of a 6-month effort by a sizeable staff and is available for purchase by industry. The plan is to update the document twice annually.

Norman L. Klein, DARCOM assistant deputy, Science and Technology, **LTC Leslie C. Oakes** and **LTC Merrit P. Walls,** DARCOM PM Office, teamed in a presentation on "Project Management Organization Steering Committee Report." Klein stressed that this is an in-depth study and that "what we have is a progress report."

LTG E. J. D'Ambrosio, DARCOM deputy commander for Materiel Readiness, and **Willard F. Stratton,** DARCOM assistant for Data Application, spoke on Integrated Logistics Support (ILS) Management and Control. LTG D'Ambrosio presented an introduction to the program and Stratton followed with an overview discussion.

A large wall chart, prepared by the U.S. Army Maintenance Management Center, depicted in great detail the procedures involved in the Logistics Support Analysis Record for Integrated Logistics Support. It showed the total Life Cycle of the program: Concept Phase; Demonstration and Validation Phase; Full-Scale Engineering Development Phase; Production and Deployment Phase, Operation and Support Phase; and Disposal Phase.

Dr. Ronald P. Uhlig, head of the DARCOM Materiel Acquisition Systems Division of the Director for Management Information Systems, discussed the ELITE (Executive Level Interactive Terminal) System. One of the features of the conference was a display and demonstration of hardware for the system.

BG Samuel G. Cockerham, chief of the Rationalization, Standardization and Interoperability Office, Deputy Chief of Staff for Operations, HQ DA, presented "NATO Standardization and Interoperability."

COL Lloyd A. Gimple, chief of the DARCOM Product Improvement and Modifications Programs Office, reported on the purpose and scope of this effort. DARCOM Surgeon **COL Robert T. Cutting** spoke on "Health Hazards in RDT&E."

COL Joseph A. Barry, security officer for HQ DARCOM, received a hearty round of applause at the conclusion of his presentation on maintaining maximum security in PM procedures. COL Barry used a humorous approach, opening with a vugraph of a Trojan horse, showing "Project Pegasus as one of the first examples of PM effort," in which the "Troy Forces' janitor served as intelligence officer."

Berdell Spencer of the Army Test and Evaluation Command gave a presentation on "Initiatives—Testing of Logistic Supportability."

Michael D. Jones, TRADOC Logistics Center, discussed "Initiatives—Efforts to Promote Testing of Logistic Supportability." **William C. Dates,** U.S. Army Maintenance Management Center, spoke on "LSAR Initiatives and Enhancements."

PM Presentations. BG John S. Egbert, PM for Munitions Production Base Modernization and Expansion, discussed "Integration of Development and Production." **COL John T. Top,** PM for Special Electronic Mission Aircraft, spoke on "Lessons Learned: Fielding/Handoff—OVID (Mohawk)." **COL Larry H. Hunt** reported on his activities in "Life/Cycle Costing" as PM for the Pershing II missile.

Panel Discussion. MG Hunt moderated a panel discussion on "Integrated Technical Discussion and Training." Members were COL Franklin A. Hart, director, Training Devices Institute, Fort Eustis, VA; William Kracov, Directorate for Development and Engineering, DARCOM HQ; and Arthur J. Rulon, Maintenance Management Center (renamed the Materiel Readiness Support Activity), Lexington, KY.

Conference Arrangements were headed by Robert L. Michellon, DARCOM PM Office, as over-all coordinator. Assistants credited with "outstanding support" included MAJ Anthony J. Buetti, Ralph Nelson, Mrs. Bette Steen, Mrs. Karen Walker, Ms. Kathy Brooks, Ms. Martha Brooks, Wendell Vance and E-3 Jacky Ewing.

COL Lauris M. Eek Jr.
Presiding Chairman

A Versatile Facility for Studying Fluid Flow

By Dr. Fritz H. Oertel Jr.

Investigation of a variety of gas dynamic problems of U.S. Army interest has been accomplished during the past decade at the Ballistic Research Laboratory, Aberdeen Proving Ground, MD, by exploiting a modest facility which has proved adaptability as a simulator.

Originally this device was conceived as an "expansion tube" for reproducing high-enthalpy flows encountered in ballistic missile reentry.

When research priorities changed, it was possible to adapt the device for application to the shock/thermal layer interactions typical of above-ground nuclear explosions. Finally, it was converted to a muzzle-blast simulator for addressing transitional ballistic problems of guns.

Technical results achieved with this facility are detailed in a variety of Ballistic Research Laboratories reports and professional journals. This article offers a concise history of its evolution, including the technical motivations and managerial perspectives which fostered them.

Expansion Tube. Commitment to Antiballistic Missile Defense stimulated Army interest in this area. The requirement was to gain a fundamental understanding of the processes occurring when a gas passes through the shock wave ahead of a reentry vehicle (RV) and when it subsequently relaxes toward an equilibrium state in the shock layer—processes like radiation, vibration, dissociation and ionization, and their coupling with the gas dynamics of the flow field. Because the flow energy required to excite these processes is extremely high, such simulators necessarily operate intermittently.

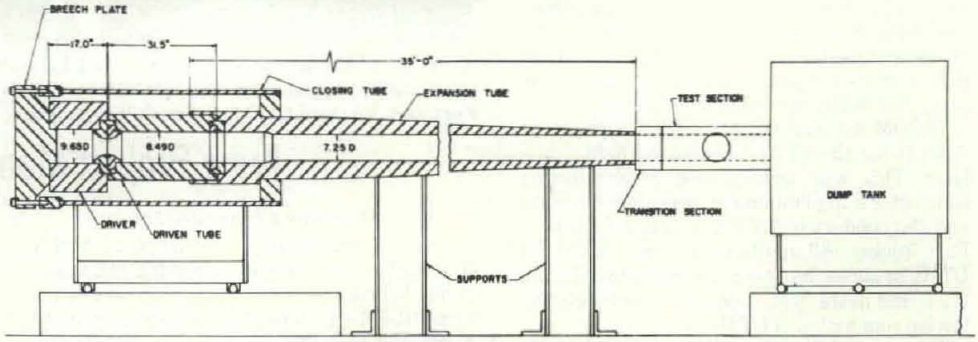


Fig. 1. BRL Expansion Tube Facility

The expansion tube simulator was conceived and built in 1963-64 at modest cost by Dr. Joseph H. Spurk, using In-House Laboratory Independent Research (ILIR) funds. Completion of this facility in the short time required was assisted by employing existing equipment, instrumentation, and expertise previously developed at BRL for a controlled temperature and pres-

sure ballistic range, and a hydrogen-oxygen propulsion system for light gas guns.

Several facilities can partially simulate the flow near the body of a vehicle traveling at hypersonic velocity, but none had the same simulation capabilities as the expansion tube. For example, the shock tube can be used to simulate the high enthalpy encountered near an RV, but the Mach number of the supersonic flow behind a shock wave is very low and has a limit (~1.89 for ideal air).

Duplication of the free stream Mach number is important for many flow conditions of interest. Therefore, shock tubes have been modified to generate hypersonic, high-enthalpy flows. In the modification most widely used, higher Mach numbers are achieved by steady expansion in a divergent nozzle attached to the shock tube.

In a second modification, the expansion tube, a slug of test gas, which is initially isolated between two diaphragms in the driven tube (Figure 1) is accelerated from rest to a hypersonic velocity by unsteady (or wave) expansion in a long constant-area tube. For the same reservoir conditions, the highest velocity attainable in the unsteady expansion is (for ideal air) $\sqrt{5}$ greater than that attainable in the steady expansion of the shock tunnel.

Consequently, to generate the same velocity in each facility, extreme reservoir conditions and a high degree of expansion are necessary in the shock tunnel - leading to low free-stream temperature and density, and high free-stream dissociation. The shock tunnel is a Reynolds number-Mach number simulator suited for some aerodynamic studies. The expansion tube duplicates the free-stream density and velocity needed for physical gas dynamics studies, and free-stream dissociation is appreciably lower.

Other agencies in this country and abroad were also interested in exploiting the unique simulation capabilities of the expansion tube, as elucidated in an original theoretical feasibility study by R. L. Trimpi of the National Aeronautics and Space Administration in 1962.

Other agencies built prototypes for much larger facilities and tested them to see if the potential of the device could, in fact, be realized. In the unique BRL design (Figure 1), a 175mm gun tube was used which, in retrospect, offered advantages that some of the other designs apparently did not offer.

The result was that "spikes" in stagnation pressure, which appeared in several other facilities, were not recorded in the BRL expansion tube. From the outset, the quality and duration (~100μs) of the test flow was acceptable for studies of hypersonic reacting flows at flow velocities of ~3050-6100 m/s.

Consequently, the more modest BRL program - more modest, because no larger facility was planned - was in full swing in little over a year from its inception. During the first five years of its operation, several BRL experimental studies in fundamentals of nonequilibrium processes coupled with gas dynamics were completed.

Among these studies were electronic excitation and dissociation of diatomic oxygen in the shock layer of cone-cylinder models, and ionization or argon gas. The quality of the test flow in the original design was verified to check the accuracy of these experiments. Moreover, a modification to the original expansion tube improved the quality and repeatability of the flow.

Because test times are inherently short in such an intermittent flow facility, u ique instrumentation and diagnostic methods were adapted to the expansion tube. A full complement of pressure gauges, and other special-purpose gauges (heat transfer, ion, etc.) with rapid response times, were adapted to measure velocity, pressure, heat flux, etc.

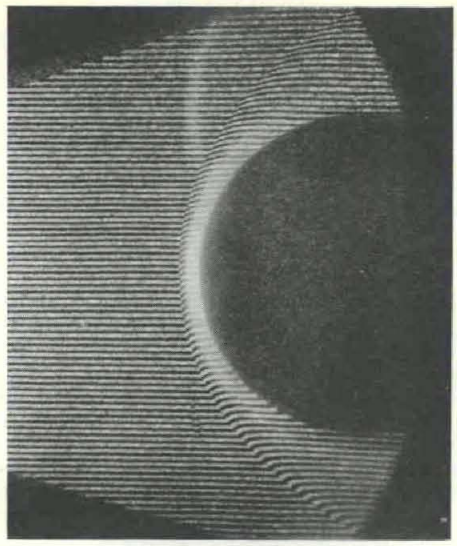


Fig. 2. INTERFEROGRAM of the instantaneous fringe pattern as argon gas flows over a sphere. Properties of the argon were essentially constant for ~ 100 μs.

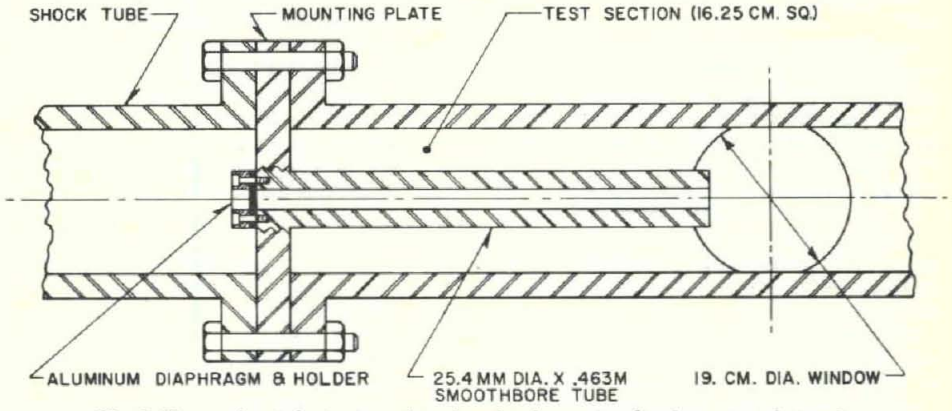


Fig. 3. Expansion tube test section showing how gun simulator was formed.

Use of optical techniques - schlieren, shadow, and interference - was stressed. Heavy use was made of the interference technique, because it can serve to obtain quantitative data in the form of density contours in 2-dimensional and axisymmetric flows; the entire flow field can be probed instantly without disturbing the flow.

Interferometry was used initially to measure simultaneously the density history of the undisturbed or free-stream flow (streak interferometry) and the density behind a model's bow shock (frame interferometry).

An example of a frame interferogram is shown in Figure 2. This photograph was made using the second harmonic wavelength of a giant pulse ruby laser light source (λ = 3471Å, laser pulse duration ~30ns) while a slug of argon test gas was flowing at hypersonic velocity over a 50.8mm diameter sphere. The straight, parallel fringes indicate a spatially uniform density in the free stream; this condition lasted for ~100μs. The upward shift of the fringes near the model is due to a density increase through the bow shock. Radiation from the shock layer is prominent for this flow.

This photograph was used in conjunction with a second photograph made simultaneously at the ruby laser's fundamental wavelength, λ = 6943Å, to map the concentration of electrons in the shock layer. Two photographs, made with light at different wavelengths, can be used to map the concentration of electrons in the flow, since the index of refraction of the electrons - or, simplistically speaking for an axially symmetric flow, the *fringeshift* due to the electrons - is strongly dependent on wavelength; that of the atoms and ions is not.

Shock/Thermal Layer Simulator. The expansion tube has also been used to gain insight into other areas of Army interest in fluid flows. Dr. E. J. Gion recently operated the facility as a low performance shock tube (high performance operation is also possible) to simulate a ground effect of a nuclear blast at altitude, called the thermal layer.

The thermal layer is formed when the ground is heated by radiation. Because the local sound speed of the heated gas in the thermal layer is higher than in the cooler air above it, the shock

(Continued on page 24)

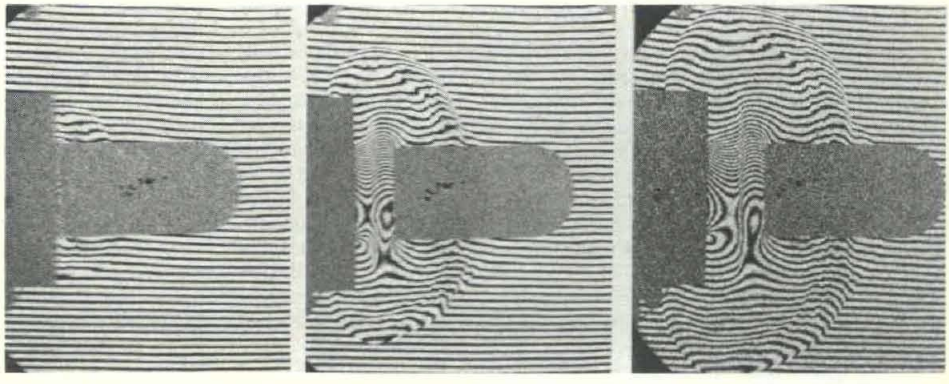


Fig. 4. Multiple-pulse laser interferograms of a projectile being launched for a single run.

A Versatile Facility For Fluid Flow Studies

(Continued from page 23)

wave from the blast travels faster in it (precursor wave), resulting in a significant increase in the dynamic pressure. Failure to take this effect into account could result in a serious underestimate of the damage radius due to blast effects.

This flow situation, which cannot be simulated in field tests using explosive charges due to lack of radiation, was simulated in two dimensions by passing a shock wave through the test section (Figure 1) to pass over a heated plate attached in an inverted position near the roof of the test section. Interferometry again was used.

The test provided (a) photographic evidence of the existence of a precursor wave in the thermal layer, and (b) temperature and density data throughout the flow field. Results are chronicled more fully in *Army R/D Newsmagazine*, September-October 1976.

Muzzle Blast Simulator. A final example of an area of recent application of this flow facility is in the gas dynamics of blast near the muzzle of guns. The Army has a long-standing interest in far-field blast effects for troop protection and safety.

More recently, interest has grown in learning more about the highly transient flow field near the muzzle which engulfs the projectile after it uncorks the muzzle. This attention is stimulated by Army interest in muzzle devices, shell stability at launch, and sabot separation.

Making measurements near the muzzle of guns is difficult, because of flash, high-speed unburned powder particles, and opacity of the test gas. Optical probing has been limited to the quasi-steady flow several diameters ahead of the muzzle where the gases are more transparent. A simulator using clean propelling gases is very desirable to observe early development of the flow field and to make measurements for comparison with mathematical models.

Such a simulator (again using BRL ILIR funds) was constructed from the expansion tube by bolting a mounting plate - into which a 25.4mm diameter smoothbore tube was screwed - between the transition and test sections (see Figure 3). The result was a "gun" with an essentially infinite chamber length.

Operating the simulator in its "shock tube" mode created a high-pressure reservoir of clean propelling gas by shock reflection from the breech plate. An aluminum diaphragm was used to seal the breech end of the tube.

When the sealing diaphragm opened under action of the high-pressure gases, a projectile placed downstream of the diaphragm was pushed down the tube to be photographed through the windows as it emerged from the muzzle.

Photographs were obtained which show the flow development for a variety of launch conditions. For many of the tests, the pressures and temperatures at the muzzle are comparable to those encountered in real guns.

Interferometry again proved useful for this application in obtaining quantitative data. Figure 4 shows a set of interferograms made for a single run in this simulator. Such photographs are being analyzed to provide a test case for evaluating competing hydrocodes used to compute the muzzle blast flow field.

Photographs in Figure 4 were also made with the laser light source used earlier to photograph Figure 2; however, here output of the laser was modulated by a dye shutter so that several pulses were generated for a single laser pumping cycle instead of one. A unique gas turbine, whose driving gases also serve as a fluid bearing, was employed to drive a rotating mirror which swept the images of the laser-illuminated event onto a fixed film drum.

A long exposure time could not be tolerated for these photographs. Here, the flow properties change rapidly in time as the shock wave and the projectile move away from the muzzle. The short-duration pulse of the laser (~30ns) was essential to prevent blurring of the flow details at the high shock velocity and the very fast film writing speed.

The mirror sweeps across 17mm of film every microsecond. This writing speed translates to an equivalent framing rate of 100,000 frames/second for the nearly 1:1 image size (~163mm across the test section). If a smaller film, say 25mm, were used, the framing rate at the same mirror rotating speed would be on the order of one million frames/second. These images would be too small for useful interferometry.

The photographs made above could be made more simply for separate runs. But the complexities associated with performing the experiment as here outlined are justified by noting that the most meaningful and accurate *quantitative* data are obtained for these highly transient flows when initial conditions are not subject to run-to-run variations.

The experiments here described briefly show the flexibility and versatility of this facility; the quality of the optical data speaks for itself. Clearly, with imagination, the facility can be used with profit in the future to study a variety of other problems of Army interest associated with classical and physical gas dynamics.

DR. FRITZ H. OERTEL JR., Office of the Director, Ballistic Research Laboratory, Aberdeen Proving (APG), MD, has been engaged in physical gasdynamic and aerodynamic research, specializing in the use of novel optical methods for measurement and flow visualization, since 1967. He served in the U.S. Army as a test director at the Materiel Test Directorate, APG, and received his PhD degree in 1970 from North Carolina State University.

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Speaking On . . . *(Continued from inside front cover)*

pared to systems currently in the hands of the troops, I believe will come as a cultural shock to the operating units. This is especially true in the intelligence, EW, and C^3 (command and control data system) areas. I am convinced that the Army does not now understand how to employ most of these systems effectively, much less how to operate during their multi-year transition period.

•Defense budget constraints coupled with current modernization will preclude the Army from procuring any significant number of new systems for 20 to 25 years. There will exist shortly a near-parallel situation in the field to that which prevailed in World War II for the operations researchers. There will be a rapid introduction of new, complex military technology into the hands of forces lacking any experience in its use.

•The *raison d'etre* of the World War II operations analyst was as a principal translator of technology into effective operational employment. Although a war does not now exist to provide actual combat experience, the many real exercises in Europe (such as REFORGER) and the United States, coupled with the use of computerized combat modeling technology, can provide an environment for simulated but very credible large unit operational experiences.

•Instrumented facilities such as CDEC (Combat Developments Experimentation Command) can provide valuable data on the dynamics within small unit actions. Thus, I believe there exists an opportunity for military operations researchers, like their progenitors in World War II, to develop a detailed, data-based understanding and knowledge of the dynamics of military processes, leading to more effective employment of military systems. It will provide an environment in which analytically derived solutions can be tested to provide relatively quick feedback on their efficacy.

Maneuver Unit Tactics. Tactics is the principal means by which the Army will win the next land battle. This will be increasingly true over the next decade or two because the Army is engaged in a large modernization with sophisticated weaponry . . . . Both sides will be employing technology more similar than different, and rewards will go to those who learn to use the technology to advantage.

Although some thought and progress has been made in TRADOC and by operational commanders in Europe, I contend there is more art than science, and that more understanding and knowledge regarding battlefield dynamics are needed . . . .

(Dr. Bonder, at this point, went into a lengthy discussion of tactics during which he posed numerous questions on potential technical situations, offered some answers, and presented war gaming analyses using numerous charts and data from study situations (scenarios). He then presented a large number of other operational issues in different military areas, including intelligence-electronic warfare, fire support, and nuclear doctrine. His address will be published complete in AORS XVI proceedings.)

Women in Army Science...

CSL Nominates Chemist for Federal Award

Nomination for the 1977 Federal Woman's Award is for Marguerite E. Brooks, an employe of the U.S. Army Chemical Systems Laboratory (CSL), in the Edgewood area of Aberdeen Proving Ground, MD, the apex of a 23-year career in chemistry.

Assigned currently to the CSL Research Division in the Analytical Branch, she started her federal career in 1967 at Edgewood Arsenal. Graduated from Penn State University in 1949 with a BS degree, she continued her education in organic chemistry spectroscopy and spectrometry.

Marguerite E. Brooks

She worked with W. R. Grace and Co. in Baltimore for six years (1954-60) and continued until 1964 as a part-time consultant. Then she taught chemistry in the Baltimore County School System, before joining the Lord Baltimore Press as a chemist.

During her first Edgewood assignment, a study of the application of polarography to the structure of chemicals, she distinguished herself by publishing several comprehensive reports. Based on this demonstrated capability for independent research, she was assigned as the principal investigator in thermoanalytical techniques.

Again she proved her mastery of the fundamentals relating to the breakdown of compounds through the use of heat, along with parallel chemical efforts for this purpose. This led to appointment as principal investigator for laboratory studies in the demilitarization of nonlethal military chemicals.

Application of this technology, as reported in her media publications, has been made to the design of pilot plant processes by United States engineers and contractors. Mrs. Brooks has been awarded seven U.S. patents as well as a British patent assigned to W. R. Grace and Co.

Elected to the Scientific Research Society of North America, based on her noteworthy achievements as an original investigator in a field of pure or applied science, she is a Fellow of the American Association for Advancement of Science, and the American Institute of Chemists.

Diligent activities in scouting have earned her selection as assistant district commissioner, to the District Award of Merit and to her present nomination for the Silver Beaver Award. Her 2 sons are Eagle Scouts.

Mrs. Brooks also has served as a Sunday school teacher for the past 25 years, working on numerous church committees, and is a deacon of the Divinity Lutheran Church in Towson, MD.

Awards . . .

4 Employes Win 20th Annual Commander's Honors

MERADCOM Commander's Award winners (front row, l. to r.) are Dr. David C. Heberlein, David E. Sheese, John F. Sargent and Dr. Richard K. Young. In background are DARCOM Deputy Commander for Materiel Development LTG Robert J. Baer and MERADCOM Commander COL Bernard C. Hughes.

Outstanding achievements in science, technology, leadership and technical or administrative support were recognized when DARCOM Deputy CG for Materiel Development LTG Robert J. Baer presented the 20th annual Commander's Awards at the U.S. Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA.

Each of the winners, selected from a total of 25 nominees, received a certificate, a plaque-mounted medal and a $50 cash honorarium. All nominees received Certificates of Achievement and individual cash awards of $50 through the Army Incentive Awards Program, with MERADCOM Commander COL Bernard C. Hughes making the presentations.

SCIENTIFIC ACHIEVEMENT. Dr. David C. Heberlein, a research physicist in the Mine Neutralization Division of the Countermine Lab, is the winner of this award, in recognition of his technology advances related to hardening of combat vehicles against mine blasts, countermeasures against magnetic influence mines, and improved fuel air explosives.

The nomination justification states that these accomplishments strengthened the technical data base for countermine equipment developments and added significantly to the repository of fundamental knowledge for the scientific community. He also was a nominee in 1975.

Dr. Heberlein has a BS degree in physics from the University of Virginia and a PhD in physics from the University of Florida. A member of the American Physical Society, the American Society of Testing and Materials, and Scientific Research Society of North America, he has worked at MERADCOM since 1971.

TECHNOLOGICAL AWARD. Dr. Richard K. Young, a research physicist in the Sensors and Barriers Division of the Counter Intrusion Lab and a MERADCOM employe since 1971, was cited for "highly significant contributions" to improved Army capabilities for detecting and locating underground anomalies such as tunnels, and other man-made cavities.

Under Project Night Fishing, he successfully combined original design concepts with existing automatic data processing technology to produce and field a new Automatic Resistivity Data Collection System and a new Geoanomaly Interactive Data Analysis System.

Dr. Young received a BS in physics in 1964 and a PhD in solid state physics in 1968 from Brigham Young University.

LEADERSHIP. John F. Sargent, a mechanical engineer in the Marine Division of the Marine and Bridge Lab, was honored for his leadership in providing technical and managerial guidance and support to the development of the 30-ton lighter air-cushion vehicle (LACV-30).

The award citation attests to his "untiring leadership, initiative and extra effort," which enabled the Army to develop, test and evaluate a highly advanced means of transporting containerized cargo from offshore ships to inland points under a tight time schedule and cost limitations.

Sargent is a graduate of a 5-year piping and machinery design apprenticeship program with the Newport News Shipbuilding and Dry Dock Co. He has completed mechanical engineering courses at Virginia Polytechnic Institute, the University of Virginia and George Washington University. Employed at MERADCOM and its predecessor organizations since 1964, he is a member of the Canadian Aeronautical and Space Institute and the National Research Council.

GELINI MEDAL. Presented in recognition of technical or administrative support, this award went to David E. Sheese. He is a management specialist in the Integrated Logistics Support Division, Engineering and Logistics Management Directorate. The award recognizes his work in developing computer programs for Logistics Support Analysis Record.

These achievements improved command capabilities in integrated logistics support of development projects, and are considered contributory to MERADCOM's progressive research and development performance.

Sheese has a BS degree in industrial technology (specialization in electronics) from California State University at Fresno. He has worked at MERADCOM since 1976 and is a Society of Logistics Engineers member.

Eisenhart Receives 1977 Wilks Memorial Award

Internationally recognized statistician Dr. Churchill Eisenhart, whose rise to renown spans a 40-year period of service in government and academia, is the 1977 Samuel S. Wilks Memorial Award recipient.

The award is the highest honor bestowed by the American Statistical Association (ASA) in recognition of contributions to scientific or technical knowledge in statistics benefiting the U.S. Government, Department of Defense, or the U.S. Army.

Initiated jointly in 1964 by the ASA and the U.S. Army, the award is

Dr. Churchill Eisenhart

a tribute to the Princeton professor who achieved international acclaim as the "Statesman of Statistics." It is comprised of a gold medal, a citation, and a cash honorarium.

Dr. Eisenhart received the award at the 23d annual Conference on the Design of Experiments in Army Research, Development and Testing, sponsored by the U.S. Army Mathematics Steering Committee on behalf of the Army Materiel Development and Readiness Command.

This year's conference was hosted by the U.S. Army Combat Developments Experimentation Command and held at the U.S. Naval Post Graduate School, Monterey, CA.

Dr. Eisenhart's award citation credits his "significant contributions in development of statistical methods for problems in agriculture, national defense, science and engineering, and for statistical applications in metrology."

A former president and vice president of the ASA, Dr. Eisenhart joined the staff of the National Bureau of Standards in 1946, and since 1963 has served as an NBS senior research Fellow.

He earned bachelor's and master's degrees in mathematics from Princeton University and was the first statistics graduate student of Prof. Samuel Wilks. His PhD in physics was received from the University of London.

Early in his professional career, Dr. Eisenhart was an associate professor of mathematics and head of the Biometry and Physics Sections of the University of Wisconsin's Agricultural Experiment Station.

During World War II, he investigated the mathematical theory of combat as a research associate at Tufts College. He later directed studies on aerial gunnery and worked on mathematical phases of the U.S. rocket program at Columbia University.

Dr. Eisenhart spent a year (1958-59) at the Research Techniques Unit of the London School of Economics and Political Science as a recipient of a Rockefeller Public Service Award.

Credited for leadership in integrating modern statistical development with experimental research in physical and biological sciences, he has authored more than a 100 technical papers and lectured on numerous statistical subjects.

Realistic Evaluation of Precision and Accuracy of Instrument Calibration Systems, one of the publications which has enhanced Dr. Eisenhart's reputation, is considered one of the most comprehensive documents in its field.

Dr. Eisenhart is a Fellow of the American Association for the Advancement of Science, ASA, Institute of Mathematical Statistics (VP 1948), and a member of the Biometric Society, International Statistical Institute, Royal Statistical Society, and the Washington Academy of Sciences.

Included among his earlier honors are a U.S. Naval Ordnance Award for work on U.S. rocket programs, and a U.S. Department of Commerce Exceptional Civilian Service Award.

Prestigious Achievements Cited . . .

12 Personnel Get Exceptional Service Decorations

Twelve Decorations for Exceptional Civilian Service (DECS), the Department of the Army's highest award for civilian employes, are among recent honors presented for prestigious achievements.

Dr. Mary H. Mandels, research microbiologist, U.S. Army Natick (MA) R&D Command, was awarded the DECS for contributions to fungal growth science relative to development of an enzymatic process for conversion of cellulosic wastes into useful products.

She was also credited with stimulating other international researchers to study enzymatic processes for production of foods, chemicals, plastics, pharmaceuticals, and energy-rich storage materials from disposable waste (cellulose products), using regenerable enzymatic resources.

Charles C. Crawford Jr., chief, Systems Development and Qualification Division, U.S. Army Aviation R&D Command, was cited for his supervision of airworthiness qualification tests of the Advanced Attack Helicopter (AAH), Black Hawk helicopter, and the AH-1 improved main rotor blade programs.

Marlyn K. Buffington, deputy project manager, Office of the Cobra Project Manager, U.S. Army Troop Support and Aviation Materiel Readiness Command, was recognized for contributions in cost reduction, program scheduling and tactical aspects related to development and production of the AH-1S Cobra/TOW attack helicopter.

Robert Q. Taylor, deputy project manager, TOW Project Office, U.S. Army Missile Materiel Readiness Command, was honored for "professionalism, exceptional ability and selfless devotion to duty . . . in resolution of problems during development, production, deployment and logistical support of the TOW weapon system."

Robert V. Johnson, supervisory aerospace engineer, Black Hawk Project Manager's Office, U.S. Army Troop Support and Aviation Materiel Readiness Command, received the DECS for outstanding leadership (1975-76) in organizing and coordinating functions of the Black Hawk Source Selection Evaluation Board.

Daniel J. Shearin, deputy director, Plans and Analysis Directorate, HQ U.S. Army Materiel Development and Readiness Command, was presented the DECS for exceptional contributions in weapons systems evaluation, along with mission and organizational planning.

His award justification states in part: "His innovative ideas for decentralized management and management by objectives resulted in large personnel space savings while providing for a more efficient, effective and responsive DARCOM operation."

Victor H. Carreira, technical director, U.S. Army Computer Systems Command Support Group (Pacific), Fort Shafter, HI, was recognized for design of automated logistics support systems which benefited worldwide Army data processing operations.

Julian Davidson, deputy program manager, U.S. Army Ballistic Missile


Dr. Mary Mandels


Charles Crawford


Marlyn Buffington


Robert Taylor

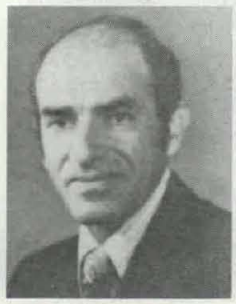

Robert Johnson


Daniel Shearin


Victor Carreira


Julian Davidson


Kisuk Cheung


Manfred Gale


Yi, Sin-kyo


Marvin Zukerman

Defense Program Office, Alexandria, VA, was awarded the DECS for contributions to all phases of Army ballistic missile development, despite a rapidly changing national strategy environment.

Kisuk Cheung, chief, Engineering Division, U.S. Army Engineer Division, Pacific Ocean, HI, was cited for leadership in developing managerial personnel and engineering services for water resources programs.

Manfred Gale, adviser for research, development and acquisition analyses in the Office of the Army Deputy Chief of Staff for Research, Development, and Acquisition, received the DECS for work involved with realignment of Army development and logistic centers.

Yi, Sin-kyo, traffic management specialist, 25th Transportation Center (Movement Control), Eighth U.S. Army, Seoul, Korea, was honored for exceptional performance in formulating and negotiating policies which improved efficiency and reduced costs.

Marvin Zukerman, visual information specialist, HQ U.S. Army Training and Doctrine Command, Fort Monroe, VA, received the DECS for improving the process for producing field manuals and training circulars.

Outstanding Suggestion Award. *Earl L. Smaltz*, electronic technician, U.S. Army Missile Materiel Readiness Command, Redstone Arsenal, AL, is the 1977 civilian recipient of the Department of the Army's Outstanding Suggestion Award.

He was cited specifically for his suggestion to purchase an off-the-shelf target tracking and control system which resulted in first-year validated savings of $3,663,500.

MAJ Howard Miller, former R&D coordinator, U.S. Army Missile Materiel Readiness Command, Redstone Arsenal, AL, is the 1977 military outstanding suggestion awardee. His suggestion for use of surplus helicopters as missile test targets achieved savings of about $470,000.

Benjamin F. Willis, supervisory mechanical engineer, Harry Diamond Laboratories, Adelphi, MD, was presented the Department of the Army Equal Employment Opportunity Program annual award for increasing employment of minority group workers and women in professional jobs.

COL Alvin Ungerleider, special assistant for Armor, Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, MD, received the military EEOP award for promoting the Army's community image and achievements as an EEO employer.

Army Handicapped Employe of the Year . . .
Earns Esteem for 'Unyielding Devotion to Others'

John A. Chappell receives Outstanding Handicapped Federal Employe of the Year Award from First Lady Mrs. Rosalyn Carter.

"Perserverance, fortitude and unyielding devotion to the service of others" are cited as attributes of John A. Chappell Jr., the Department of the Army's 1977 Handicapped Employe of the Year and also one of 10 Federal Handicapped Employes of the Year.

Assigned to the Applied Technology Laboratory, Fort Eustis, VA, one of the four major elements of U.S. Army Research and Technology Laboratories, headquartered at NASA-Ames, Moffett Field, CA, Chappell also was presented the Decoration for Meritorious Civilian Service during ceremonies at the Pentagon, HQ Department of the Army.

America's First Lady, Mrs. Rosalyn Carter, joined in acclaiming Chappell's outstanding achievements during a U.S. Civil Service Commission ceremony at the U.S. Department of Commerce. All of the federal handicapped honorees and their families were escorted on a special "VIP" White House tour.

A GS-12 electronics engineer, Chappell has been confined to a wheelchair since age nine, 24 years ago, as the result of an adverse reaction to a series of rabies innoculations following a dog bite.

Although permanently paralyzed from the waist down, he has been described by one Hampton (VA) newspaper, because of the whirlwind pace of his life-style, as "a four-wheeled phenomenon in perpetual motion."

He has been actively involved in the design of various measurement systems, including the OH-58 transmission durability test, a new ballistic test range control system, and numerous software developments for data analyses.

Independent work resulted in design of a complex electronic control panel which operates an automatic safety system for a ballistic test chamber. The system performed without flaw during initial operation and has since proved highly successful.

Chappell's efforts on behalf of the physically handicapped have resulted in extensive improvements to public facilities in the Newport News, VA, area, including construction of easy-access ramps and wider parking spaces.

Additional biographical information and achievements of Chappell are reported in the January-February 1977 edition of the *Army R&D Newsmagazine* (People in Perspective, page 25).

Other 1977 Federal HEOY honorees are Herbert W. Hoffman, meteorological technician, U.S. Department of Commerce; Christopher S. Branigan, computer programer, U.S. Department of Defense; Charles Branch, contract representative, U.S. Department of Health, Education and Welfare; Robert L. Adams, acting assistant director, Minerals Data Forecasting Analysis, Office of Minerals Policy and Research Analysis, U.S. Department of the Interior; and

Sharon H. Wilkin, employment opportunity specialist, U.S. Department of Labor; Donna Pastore, mathematics braille specialist, Library of Congress; Dennis W. Meyers, mail clerk, Securities and Exchange Commission; Steve Key, draftsman, Tennessee Valley Authority; and Dennis C. Walker, veterans benefits counselor, Veterans Administration.

Grinding Process Wins Acclaim From IR Magazine

AVRADCOM Product Assurance Director Edward Hollman (left) and coworkers Stewart Chen and John Conroy receive plaque for completing a 3-year program to requalify scrapped roller bearings.

Development of a grinding process for restoring scrapped ball and roller bearings, achieved through joint effort of the U.S. Army Aviation R&D Command and the NASA-Lewis Research Center, has resulted in a "significant new technical product."

Acclaim for the new process was announced by *Industrial Research Magazine* during award ceremonies at the Museum of Science and Industry, Chicago, IL, honoring scientists and engineers for research leading to the "100 most significant new products of 1977."

Estimated to achieve annual government savings of more than $1 million, the new process involves grinding of stressed and damaged material from bearing raceway surfaces and reassembly of the bearings with oversized rolling elements.

Three types of bearings from the Army's UH-1 Huey helicopter were used in the 3-year prototype program. Final tests of the helicopter's engine and transmission, using restored bearings, were conducted at Corpus Christi Army Depot, TX.

Previous bearing refurbishment methods were considered "highly unsatisfactory" for use in high performance machinery. However, the new process reportedly "can provide 90 percent yield of usable reconstituted bearings."

Credited with the Army's portion of the program are John Conroy, Dallas Fleming and Steward Chen, all with the Directorate for Product Assurance, Quality Engineering Division, HQ AVRADCOM, St. Louis, MO, and Hugh Bull of Corpus Christie Depot.

Career Programs . . .

USCSC Announces Management Intern Program

A new Presidential Management Intern Program designed to attract highly motivated personnel into federal career management positions has been established by Executive Order 12008.

The program provides for 250 2-year internships to be granted annually to graduates with degrees in public management. Successful interns will receive competitive Civil Service status for completion of the program.

The U.S. Civil Service Commission's Bureau of Intergovernmental Personnel Programs is developing and implementing processes for nominating, screening and selecting participants. Initial selectees will be from 1978 college graduates.

Civil Service Commission Chairman Alan K. (Scotty) Campbell stressed that heavy reliance will be placed on recommendations of deans and faculty of graduate schools. Federal agencies will make final choices.

Opinions of other recognized public management experts will be used to ensure that the program attracts the most able students and that interns are involved in meaningful tasks.

All interns will be employed at the GS-9 pay scale and will serve under "Schedule A" of the excepted service category. Assignment offices will be located throughout the United States, including Washington, DC.

Upon successful completion of their internship, participants will be eligible for conversion to competitive Civil Service status. Continuation in the program is dependent on performance during the 2-year period.

Described by CSC Chairman Campbell as a "small but significant step" in the general reorganization of the federal personnel management system, the program is designed to provide new avenues to top managerial jobs for women and minority group members.

Other programs to be recommended by the CSC will include broader based executive development efforts, part-time work programs for graduate students, and a new executive managerial system.

"All of the proposals," says Campbell, "constitute the beginning of an over-all program for increased professionalism of the public service.

Stuempfle Picked for Exec. Development Training

Arthur K. Stuempfle, a research physicist at the U.S. Army Chemical Systems Laboratory, Aberdeen (MD) Proving Ground, was selected recently for six months of training under the CSL technical director's executive development program.

Arthur K. Stuempfle

Employed initially at Edgewood Arsenal (CSL's predecessor) in a co-op student program in 1958, Stuempfle earned a BS degree from Drexel University in 1962 and a master's degree in 1971 from Johns Hopkins University, both in physics.

Stuempfle served two years of active military service at the U.S. Army Chemical Center and School, Fort McClellan, AL, preceding commencement of his Civil Service career.

Author or coauthor of more than 20 technical publications, he has received three Department of the Army Suggestion Awards. He also has been recognized for achievement by the Chesapeake (MD) Chapter of Sigma Xi Scientific Research Society of North America.

Stuempfle is the 24th recipient of CSL's executive training program initiated in 1970. Following three months of varied assignments at CSL, he will receive three months of managerial training at HQ U.S. Army Materiel Development and Readiness Command, Alexandria, VA.

Gieske Begins Executive Interchange Assignment

Under a Presidential Executive Interchange Program, Dr. Harry Gieske, U.S. Army Harry Diamond Laboratories, has been selected for a year-long assignment with the Xerox Corp. as assistant to the vice president for Research and Development.

Administered by the President's Commission on Personnel Interchange, the program is designed to provide mutually beneficial learning experiences between government, educational and industrial middle management executives and their organizations.

A supervisory physical scientist, Dr. Gieske is one of more than 60 persons chosen for this year's program. About 400 executives have participated in the program since it was established by former President Lyndon B. Johnson.

Dr. Gieske has a BS degree (Magna Cum Laude) from Xavier University and MS and PhD degrees from the University of Maryland, all in physics. He has authored a variety of technical papers and is a member of the American Physical Society.

All program participants are selected on the basis of demonstrated leadership, initiative and management ability, significant on-the-job achievements, and potential for senior executive assignments with their sponsoring agency.

Program Executive Director Jay F. Morris states that "participants are able to witness on a first-hand basis the operation and decision-making process of the opposite sector, while applying their particular talents to a new set of objectives."

Employing agencies are presumably able to identify more immediate benefits from the program as the result of applications of new management techniques and the fresh perspective of their visiting executives.

Pathology Institute Schedules 18th Annual Lectures

Advances in anatomic pathology and clinical pathologic methods will be considered during the 18th Annual Lectures of the Armed Forces Institute of Pathology, June 5-9, at Silver Spring, MD.

Course content will include common diagnosis pitfalls; unusual cases and statistics; advances in histochemical, bacteriological, biochemical, immunological and toxicological methods; and AFIP published articles.

The lectures will give practicing pathologists combined periods of instruction and review of pathologic anatomy concepts as interpreted by AFIP staff members.

Attendance is limited to members of the Armed Forces Medical Corps or federal civilians who are board eligible or certified in pathology. Other than federal employes will be considered on a space-available basis.

Reservation requests should be received on or before May 8 and addressed to: Director, Armed Forces Institute of Pathology, ATTN: AFIP-EDE, Washington, DC 20306.

Requests should include name, address (country, if foreign), federal or civilian organization, position held, professional board status (certified or eligible), degree in specialty and military rank.

Reader's Guide

ARI Reports on Low-Altitude Aircraft Navigation

Effectiveness of low-altitude aircraft navigation training is the subject of a research report and a technical paper published recently by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

Research Report 1190, *Aircrew Training Requirements for Nap-of-the-Earth Flight*, identifies NOE training criteria (at entry and unit levels) which might be improved for course content at the Army Aviation School, Fort Rucker, AL.

Suggestions for improving NOE pilot proficiency call for more practice in reorientation and use of maps showing only natural features, and choosing flight paths over a wider variety of terrain.

Visual surveillance also appeared to be a unitary skill best developed during flight, requiring "head up" scanning for navigation and threat detection, "head down" scanning to monitor displays and read maps.

Technical Paper 277, *Specialized Training Versus Experience in Helicopter Navigation at Extremely Low Altitudes*, reports results of an experiment to determine if general navigation skills of normal rotary-wing flight are transferable to NOE flight.

Twenty-one Army helicopter pilots individually navigated at NOE altitude on prescribed routes about 15 miles long. A second helicopter at normal altitude recorded the path being flown. Each pilot flew six routes.

Results indicate that either NOE navigation is a specific skill, to which normal flight experience does not transfer, or else the transfer of experienced pilots' skill could be equaled by 15 hours of NOE training.

Publications Report on Powder Metallurgy Meets

Powder Metallurgy in Defense Technology is the title of a new publication containing proceedings of two seminars held at the U.S. Army's Frankford and Picatinny Arsenals during 1975 and 1976.

The 206-page, soft-cover book is the third volume in a continuing series on powder metallurgy in ordnance seminars dating back to 1971. Chapter authors are recognized experts from government and industry.

Topics included in the new 15-chapter document include aluminum and titanium PM in military applications; status and potential of PM forging; optimal use of PM components in ordnance; and Soviet powder metallurgy technology.

Volume I, titled *P/M in Ordnance*, is 172 pages and contains proceedings of the first tutorial seminar. Proceedings of the second tutorial seminar are featured in Volume II, *P/M in Government Products*.

Information relative to any of these publications may be obtained from the Metal Powder Industries Federation, P.O. Box 2054, Princeton, NJ 08540, or commercial telephone (609) 799-3300.

Conferences & Symposia . . .

Chronic Pain Causes, Treatment Probed at WRAMC

". . . Body achin' and racked with pain," one of the laments in the classic song, Old Man River, is an expression of a problem recognized by the medical profession as one of the most perplexing with which it deals.

What to do about chronic pain was a topic of discussion among some of the nation's leading neurosurgeons, anesthesiologists and psychiatrists in a symposium at Walter Reed Army Medical Center, Washington, DC.

Themed on Current Concepts in the Treatment of Pain, and sponsored by the host WRAMC Department of Psychiatry and Neurology, the symposium directed considerable attention to the merit of hypnotic therapy.

Chronic pain may be soundly based in physiological causes, some of the speakers explained, and still be responsive to hypnotic therapy - since tensions deriving from emotional as well as physical problems frequently are a fundamental factor in generating pain.

Some of the perplexing aspects of chronic pain were discussed by Dr. (COL) Darrel Buchanan, chief of the Department of Psychiatry and Neurology at the WRAMC. Because of the complexity of the problem, he explained, some physicians may be inclined to suspect the pain is often self induced - that is, "put on" by hypochonriacs.

Consequently, the patient may be "bounced" from one specialist to another, simply as a method of getting rid of a persistant "sufferer" whose problem the physician is unable to relieve, it was explained.

Because patients may feel their doctor or associates are accusing them of using medicines they do not need, which makes them feel badly about their treatment, the problem can be additionally complicated.

Dr. Buchanan said this may lead to a situation where the patient, by the time he/she arrives at a chronic pain clinic, has extreme sensitivity about the treatment.

Clinical experience at the WRAMC has established that surgery may be helpful to only a minority of chronic pain patients, whereas some of those with an obvious physiological cause of pain responded well to hypnotic therapy. "Many, many of our patients have been helped by the hypnotic mode," Dr. Buchanan said.

Dr. Harold Wain, of the WRAMC Psychiatry Liaison and Consultation Service, said there are many misconceptions about hypnosis, that it is "nothing mysterious," and that it is being studied scientifically for medical applications. Although it has proved effective for many patients, he cautioned that hypnosis is not a chronic pain panacea. Pain is increasingly more acceptable as a chief complaint, he said, and thus hypnotic treatment merits scientific study.

Among factors under consideration are the patient's response to hypnosis, which may vary widely in susceptibility, that is, responsive motivation. Effectiveness of hypnotic therapists, their ability to develop empathy in the patient along with treatment strategy, also varies widely.

Dr. Wain explained that psychological reaction to pain may be independent of its organic origin, and that anxiety is often a major factor. Consequently, whatever eases anxiety "reduces perception of pain."

Dr. Wain thus believes that when hypnotic therapy is successful in relieving pain, the patient's responsiveness may be an important factor.

AFCEA Conferees Review Military Communications

Progress and potential problems in tactical and strategic military communications were considered by conferees at the Art of Communications Interfaces Seminar, sponsored recently by the Armed Forces Communications and Electronics Association.

About 500 Department of Defense and industrial representatives attended the one-day meeting in the Fort Monmouth, NJ, Officer's Club. Fort Monmouth AFCEA Chapter President Seymour Krevsky, an employe of Army Communications Systems Agency, was general chairman.

Major topics included digital tropospheric communications systems, telecommunications, command and control applications, and fiber-optic switching systems.

"Strategic/Tactical Communications Interoperability" was the title of a luncheon address by Director of the Defense Communications Agency LTG Lee M. Paschall, following introductory remarks by MG John E. Hoover, director of the Joint Tactical Communications Office (TRI-TAC).

Commander of the Communications Systems Agency (CSA) BG Emmett Paige Jr. chaired a session on strategic issues, and Commander of the Communications Research and Development Command BG William J. Hilsman chaired a session on tactical systems interfaces. Systems Engineering for the Defense Communication System was discussed by Gilbert E. LaVean of the Defense Communications Engineering Center (DCEC). Leo Wagner, CSA, reported on Access Area Switching Systems.

Other presentations included New Interfaces for Upgrading Autodin II Services, W. Scott McClary, Computer Science Corp.; Digital Tropo Modems, Walter Cybrowski, CORADCOM; The Combined U.S./NATO Digital Tropo Test Program, John Osterholz, DCEC; The Use of Graphics in a Tactical Environment, Leon Bloom, Litton Data Systems; New Technology for Programable Interface Subsystem for ARTADS Automatic Test, David Priestly, RCA.

Command and Control System Applications for TRI-TAC Using Demand Assigned Multiple Access Techniques was presented by D. W. Horner, Motorola Inc., and Architectural Impact of Fiber Optics on Future Military Switching Systems, Edmund A. Harrington, GTE-Sylvania.

ECOM Calls for Frequency Control Meet Tech Papers

A call for papers proposed for presentation at the 32d Annual Frequency Control Symposium, May 31-June 2, 1978, at Atlantic City, NJ, has been issued by the U.S. Army Electronics Command.

The symposium is unclassified and normally attracts more than 600 representatives from government, industry and universities.

Authors are invited to submit papers dealing with recent progress in research, development and applications in fundamental properties of natural and synthetic piezoelectric crystals, resonator processing techniques, and theory and design of piezoelectric resonators.

Other topics may include R&D reports on filters, surface wave devices, quartz crystal oscillators and frequency control circuitry, atomic and molecular frequency standards, laser frequency standards, frequency and time coordination and distribution, radio and systems applications of frequency control devices, and specifications and measurements.

Deadline for submission of summaries is Jan. 20, 1978. Four copies of each summary in sufficient detail for evaluation of the proposed paper (at least 500 words), together with the author's name, address and phone number should be sent to Commander, U.S. Army Electronics Command, ATTN: DRSEL-TL-MF (Dr. J. R. Vig), Fort Monmouth, NJ 07703.

CDEC Hosts U.S./FRG Military Interoperability Meet

Concepts, tactical doctrine and hardware interoperability between the U.S. Army and Federal Republic of Germany military units were discussed at a recent meeting hosted by the U.S. Army Combat Developments Experimentation Command, Fort Ord, CA.

During a tour of CDEC's Fort Hunter Liggett field laboratory, conferees observed the Joint Attack Weapons Systems (JAWS) field experiment involving Army attack helicopters and U.S. Air Force A-10 jet aircraft.

Commander of the U.S. Army Training and Doctrine Command GEN Donn Starry headed the U.S. delegation and LTG H. Reichenberger, FRG Army chief of staff, was senior foreign delegate. CDEC Commander BG Donald F. Packard was host to the conferees.

Personnel Actions . .

Keith Wearing 3-Star Rank as Acting DCSRDA

LTG Donald R. Keith

Acting Army Chief of Staff for Research, Development, and Acquisition LTG Donald R. Keith received the insignia of 3-star rank Nov. 4. He will hold acting status pending retirement of LTG Howard H. Cooksey Dec. 31 after more than 34 years active military service. The U.S. Senate has approved his retirement as LTG.

LTG Keith had served since October 1976 as commander of the U.S. Army Field Artillery Center and commandant, Army Field Artillery School, Fort Sill, OK. Graduated from the U.S. Military Academy with a BS degree in military science, he later received an MA degree in science from Columbia University.

During 1974-76 he was director of Weapons Systems, ODCSRDA, Washington, DC, following service (1972-74) as director of Developments, Office, Chief of Research and Development (OCRD, later designated ODCSRDA).

Other assignments have included director, Research and Analysis Directorate, Civil Operations and Revolutionary Development Support, U.S. Military Assistance Command, Vietnam; executive officer, OCRD; and commander, 36th Artillery Group, U.S. Army Europe.

LTG Keith has completed course requirements at the Command and General Staff College, Armed Forces Staff College, Industrial College of the Armed Forces, Artillery School (basic and advanced), and the Ground General School (basic).

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

Pixley Takes Over as Army Surgeon General

LTG Charles C. Pixley

LTG Charles C. Pixley was promoted to that rank Oct. 1 when he became Surgeon General of the Army, following retirement of LTG Richard R. Taylor.

LTG Pixley was superintendent of the Academy of Health Sciences when Secretary of Defense Harold Brown announced his selection as Army Surgeon General. During 1975-77 he commanded William Beaumont Army Medical Center, El Paso, TX, after serving briefly as director, Health Care Operations in the Office of the Surgeon General (OTSG).

Earlier assignments included director, Plans, Supply and Operations, OTSG; surgeon of the First U.S. Army, Fort Meade, MD; commander, U.S. Army Medical Training Center, Fort Sam Houston, TX; and chief of Professional Services and commander, Kenner Army Hospital, Fort Lee, VA.

Certified by the American Board of Surgery in 1954, LTG Pixley received BA and M.D. degrees from the University of Oregon. He served his internship at Robert Packer Hospital, Sayre, PA, and Brooke General Hospital, Fort Sam Houston, TX.

Military training has included the Command and General Staff College, Air War College, the Army Medical Department Advanced Course at the Medical Field Service School, and Air Force School of Aviation Medicine.

LTG Pixley is a Fellow of the American College of Surgeons, a member of the American Medical Association and American Hospital Association, and Diplomate of the American Board of Surgery.

MIRCOM Installs Rachmeler as Commander

MG Louis Rachmeler

MG Louis Rachmeler, new commander of the U.S. Army Missile Materiel Readiness Command, Redstone Arsenal, AL, moved into that duty after serving 13 months as coordinator for Army Security Assistance, Office of the Chief of Staff, Department of the Army.

A 1947 graduate of the U.S. Military Academy, MG Rachmeler has an MS degree in electrical engineering from Stanford University and has completed requirements at the Command and General Staff College, Army War College, Ordnance School (advanced) and Armor School.

During 1974-76 he served as deputy for Materiel Acquisition, Office, Assistant Secretary of the Army (Installations and Logistics), following service (1973-74) as director, Industrial Preparedness and Munitions Production, Office, Assistant Secretary of Defense (I&L).

Other key assignments have included deputy commander, U.S. Army Missile Command; executive to the ASA (I&L); and chief, Force Planning Division, Plans Directorate, Office, Deputy Chief of Staff for Logistics, DA, Washington, DC.

Honors include the Legion of Merit with three Oak Leaf Clusters (OLC), Air Medal, and the Commendation Medal w/2 OLC.

Vinson Directs ODCSRDA Weapons Systems

MG Wilbur H. Vinson Jr.

MG Wilbur H. Vinson Jr. is the new director of Weapons Systems in the Office of the Army Deputy Chief of Staff for Research, Development, and Acquisition, following MG Jerry B. Lauer (Ret.).

MG Vinson had served since 1975 as deputy chief of staff, Combat Development, U.S. Army Training and Doctrine Command, Fort Monroe, VA. He commanded the U.S. Army Southern European Task Force and Support Group in Italy from 1973-75.

During 1971-73 he served in the Office, Chief of Research and Development as deputy chief of R&D (International Programs); director, Plans and Programs; and director of Missiles and Space. OCRD was disestablished in 1974 coincident with establishment of the Office of the Deputy Chief of Staff for Research, Development, and Acquisition.

Earlier assignments included commander, I Corps (Group) Artillery, Eighth U.S. Army, U.S. Army Pacific-Korea; assistant division commander, 2d Armored Division, Fort Hood, TX; and chief, Nike-X and Space Division, OCRD.

MG Vinson is a 1945 graduate of the U.S. Military Academy, and has an MS degree in mechanical engineering from the University of Southern California. He has completed requirements at the Command and General Staff College, National War College, and the Artillery School.

He wears the Silver Star, Legion of Merit with four Oak Leaf Clusters, Bronze Star Medal with OLC, Meritorious Service Medal, Air Medal, Army Commendation Medal, and Parachutist Badge.

Shea Assigned as ODCSRDA Weapons Deputy

BG John M. Shea

BG John M. Shea's assignment as deputy director, Weapons Systems in the Office of the Deputy Chief of Staff for Research, Development, and Acquisition, Department of the Army, follows recent conclusion of a tour of duty as 4th ROTC Region commander.

Commissioned as an ROTC graduate, BG Shea is a veteran of more than 26 years active military service. He commanded the 3d Cavalry Regiment, Fort Bliss, TX, in 1975 after serving as Dragon missile project manager at Redstone (AL) Arsenal, and an assignment with the Office of the Assistant Chief of Staff, Plans, HQ Pacific Command, Hawaii.

Other assignments have included special assistant to the Chief, Weapons Division, Materiel Directorate, U.S. Army Combat Developments Command, Fort Belvoir, VA; and commander, 3d Squadron, 4th Cavalry, 25th Infantry Division, U.S. Army, Vietnam.

BG Shea has a BS degree in history from Boston College and an MS degree in business administration from George Washington University. He has completed requirements of the Command and General Staff College, Industrial College of the Armed Forces, and Armor School.

He wears the Silver Star, Legion of Merit with Oak Leaf Cluster (OLC), Meritorious Service Medal, Air Medal, Joint Service Commendation Medal, Army Commendation Medal with OLC, and Parachutist Badge.

Roddy Chosen as MIRCOM Deputy Commander

BG Patrick M. Roddy

BG Patrick M. Roddy, former project manager for the Hawk missile system, is the new deputy commander of the U.S. Army Missile Materiel Readiness Command (MIRCOM), Redstone Arsenal, AL.

A veteran of more than 22 years of military service, he graduated from Seattle University with a BA degree in history/philosophy and from Syracuse University with an MBA degree in industrial management. He has completed course requirements at the Command and General Staff College, Industrial College of the Armed Forces, Ordnance Center and School, and the Armor School.

BG Roddy served during 1974-76 with the U.S. Army Europe as assistant chief of Staff, Supply and Maintenance. Then he commanded the U.S. Army Combat Equipment Group, USAREUR, and concurrently was installation coordinator at Funari Barracks.

Other assignments have included chief, Program Development Team, Planning and Programing Analysis Directorate, Office, Army Chief of Staff, DA; and commander, 79th Maintenance Battalion, U.S. Army Support Command, Saigon, Vietnam.

Listed among his military awards and decorations are the Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star Medal, Meritorious Service Medal with three OLC and the Army Commendation Medal w/2 OLC.

Knapp Commands Aeromedical Research Laboratory

COL Stanley C. Knapp, commander of the U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL, recently assumed that duty following retirement of COL Robert W. Bailey, head of USAARL for 12 years.

Assigned since 1973 as director of USAARL's Life Support Equipment Division, COL Knapp has a master's degree in public health from the University of California (Los Angeles) and is a "distinguished graduate" of the Armed Forces Staff College.

· Earlier assignments included battle group surgeon, 82d Airborne Division, Fort Bragg, NC; battalion surgeon, 508th Infantry, Fort Kobbe, CZ; and clinical investigator and instructor, School of Aerospace Medicine, Brooks Air Force Base, TX.

COL Stanley C. Knapp

A Diplomate of the American Board of Preventive Medicine (aerospace medicine) and a Fellow of the Aerospace Medical Association, he is a Senior Parachutist, Naval Flight Surgeon and a Master Army Flight Surgeon.

COL Knapp wears the Meritorious Service Medal, Army Commendation Medal and is a recipient of the Association of Military Surgeons' MAJ Gary P. Wratten Award for contributions to military medicine.

Koos Assumes Aberdeen Proving Ground Command

Commander, U.S. Army Aberdeen (MD) Proving Ground, is the new title of COL Frank S. Koos, after serving as chief of Concepts and Studies, director of Mobility Training, and Director of Course Development, U.S. Army Ordnance and Chemical Center and School.

COL Frank S. Koos

Commissioned through the Reserve Officers' Training Corps at Rutgers University in 1952, COL Koos has a bachelor's degree in business from the University of Nebraska. He is a graduate of the Army Command and General Staff College.

Included among his earlier assignments are commander, 2d Maintenance Battalion, Vietnam; commander, 1st Maintenance Battalion, Germany; logistics inspector, Office, Army Chief of Staff, Washington DC; operations officer, HQ U.S. Army Vietnam; and plans officer, Ordnance Section, Seventh U.S. Army.

COL Koos is a recipient of the Legion of Merit, Meritorious Service Medal with Oak Leaf Cluster (OLC), and the Army Commendation Medal with three OLC.

Pellegrini Named Ground Laser Designator PM

COL Benjamin J. Pellegrini has succeeded COL John Reeve as project manager for Ground Laser Designators, U.S. Army Missile R&D Command, Redstone Arsenal, AL.

COL B. J. Pellegrini

Graduated from the U.S. Military Academy in 1958, COL Pellegrini has master's and PhD degrees in nuclear physics from Tulane University and has completed course requirements at the National War College.

Listed among his key assignments are military assistant to the Secretary of the Army; commander, 2d Infantry Division's Chaparral-Vulcan Battalion, Korea; and system coordinator for High Energy Lasers, Office, Deputy Chief of Staff for Research, Development, and Acquisition, Department of the Army.

COL Pellegrini is a recipient of the Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star Medal, Air Medal with three OLC, and the Army Commendation Medal with OLC.

Knight Directs Applied Technology Laboratory

COL Emmett F. Knight is the director of the U.S. Army Research and Technology Laboratories' Applied Technology Laboratory, Fort Eustis, VA, following reassignment of COL George W. Shallcross as project manager, Advanced Scout Helicopter Program.

COL Knight served formerly as chief, Technical Advisory Field Team, Iranian Helicopter Logistics, Program/Depot, Iran. During 1973-75 he served with the Office, Deputy Chief of Staff, Logistics, and Office, Deputy Chief of Staff, Research, Development, and Acquisition, HQDA.

Other key assignments have included commander, Aviation Maintenance Battalion, 1st Aircraft Maintenance Brigade, Hunter Army Air Field and Fort Stewart, GA; and chief, Logistics Plans, Eighth U.S. Army, Korea.

COL Emmett F. Knight

COL Knight has a BA degree from the University of Washington and a master's degree from Georgia Southern College, both in business administration. He is an honor graduate of the Transportation Officer Advanced Course and a master aviator.

His military decorations include the Distinguished Flying Cross with Oak Leaf Cluster (OLC), Bronze Star Medal with OLC, Meritorious Service Medal with two OLC, Air Medal with 20 OLC, and the Joint Services Commendation Medal.

Albright Selected as MSCS Project Manager

COL Anthony F. Albright is the new project manager for Multi-Service Communications Systems (MSCS) at Fort Monmouth, NJ, succeeding COL (P) Donald R. Lasher, now project manager for Army Tactical Data Systems (ARTADS).

COL Anthony F. Albright

COL Albright graduated from the U.S. Military Academy in 1957. He has an MS degree in systems engineering from the University of Arizona and an MBA from Shippensburg (PA) State College. He also is a graduate of the Signal School (basic and advanced courses), the Command and General Staff College, and the Army War College.

Following 1975 duty as director of the Telecommunications Center Directorate, U.S. Army Communications-Electronics Engineering Installation Agency, he commanded the 11th Signal Group at Fort Huachuca, AZ, for 16 months. Other major assignments were served in the Pentagon, Germany and Vietnam.

Among his military honors are the Legion of Merit, Bronze Star Medal, Meritorious Service Medal with Oak Leaf Cluster (OLC), Army Commendation Medal with OLC, Joint Service Commendation Medal, Joint Chief of Staff Identification Badge, Ranger Tab, Parachutist Badge.

Penney Follows Lester as NARADCOM Commander

COL Hubert F. Penney, former director of Combat Developments, U.S. Army Quartermaster School (USAQMS), Fort Lee, VA, has succeeded COL Rufus E. Lester as commander of the U.S. Army Natick (MA) Research and Development Command.

COL Hubert F. Penney

COL Penney joined the USAQMS in 1974 as chief, Concepts and Studies Division, Combat and Training Developments, after serving during 1972-73 in the Officer Personnel Directorate, U.S. Army Personnel Center, Pentagon, Washington, DC.

Earlier assignments included commander, 215th Combat Support Battalion, 1st Cavalry Division, Vietnam; staff officer, Program Manage-

ment Division, Office of Special Mission Operations, Washington, DC; and Directorate of Installations and Services, HQ U.S. Army Materiel Command (now DARCOM).

COL Penney has a BS degree in marketing and advertising from the University of Rhode Island and an MBA degree from the University of Illinois. He has completed requirements at the Army War College, Naval War College, and the Quartermaster Officer Advanced Course.

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

Conti Takes Over as Reserve Board Chairman

Louis Conti, a U.S. Marine Corps Reserve major general, has been selected by Secretary of Defense Harold Brown to succeed John Slezak as chairman of the Reserve Forces Policy Board.

Senior vice president and director of GATX Corp. of Chicago, IL, Conti recently completed a 3-year term on the RFPB as one of 12 non-active-duty members. He chaired several board committees on policy issues.

Conti enlisted in the U.S. Naval Reserve in 1941 following graduation from Cornell University and was commissioned a second lieutenant in the Marine Corps in 1942. He was a combat officer during World War II and engaged in 102 combat missions during the Korean War.

Acting through the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics), the RFPB is a principal policy adviser to the Secretary of Defense on matters relating to Reserve components.

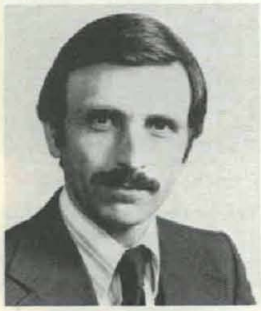
The board is composed of 21 members, a majority of whom are officers of general or flag rank from Armed Forces Reserve components. The part-time chairman is assisted by MG Stanford Smith, USAR, a full-time military executive of the board.

Dunetz Becomes DARCOM IR&D Assistant Deputy

Bryant R. Dunetz, assistant director, U.S. Army Ballistics Research Laboratory, Aberdeen (MD) Proving Ground since 1976, is the new assistant deputy for International Research and Development, HQ U.S. Army Materiel Development and Readiness Command.

Dunetz began his Civil Service career at BRL in 1960 and in 1970 was awarded one of the annual Department of the Army R&D Achievement Awards. He has served as chief, Target Analysis Group, operations research analyst, and as an aeronautical engineer.

Earlier active Army duty was also served at BRL following employment with North American Aviation Corp.



Bryant R. Dunetz

Graduated with a BS degree in engineering from Davis and Elkins College, Elkins, WV, Dunetz has authored numerous technical reports. In 1970, he received Department of the Army Special Act or Service Award for effective management of a Department of Defense weapons-related project.

He is a member of the National Research Council, American Institute of Physics, Operations Research Society of America, American Society for Engineering Education and the American Defense Preparedness Association.

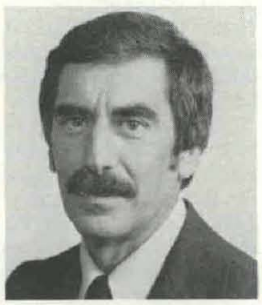
Scranton Fills CSL Development Support Post

Robert C. Scranton is the new deputy director of the Development Support Division, Army Chemical Systems Laboratory (formerly Edgewood Arsenal), Aberdeen (MD) Proving Ground.

A federal career employe since 1964, he served until recently in CSL's Munitions Division as chief of the Special Products Section, Production Engineering Branch. That duty followed a 5-year assignment as chief of the Ammunitions Branch in Edgewood's Manufacturing Technology Directorate.

Graduated from the University of Maryland in 1958 with a BS degree in mechanical engineering, Scranton was the first of 24 Edgewood CSL civilian employes to complete training under the technical director's executive development program initiated in 1970.

He served in the U.S. Army as a disposal specialist in Korea during 1953, and has completed numerous executive training courses in management, communications, logistics and economics



Robert C. Scranton

Army R&D — 15 Years Ago

The Army R&D Newsmagazine reported on . . .

Army Sets Policy to Strengthen In-House Research

Policies prescribing an In-House Laboratory Independent Research (ILIR) Program, funded initially (for FY 1963) at about $10 million annually, are detailed in a new Army Regulation 705-55 titled: R&D of Materiel, Management of U.S. Army R&D Laboratories or Activities.

The objective is "to promote a vigorous internal research program of the highest technical caliber." This is to be accomplished by encouraging Army scientists to investigate new frontiers of science in areas of effort of particular interest to them but having potential military application if breakthrough knowledge is the payoff.

Funds allocated to the ILIR Program cannot be used to compensate for deficiencies in regular funded program or to support outside work. Within established capabilities, in-house laboratory resources are to be directed to "new and challenging" research tasks.

Group Attacks Problem of Improving Technical Info

Dissemination of scientific and technical information on a timely, comprehensive basis to meet urgent R&D needs is being studied by 23 Army-designated task groups, created as an outgrowth of an orientation conference for the Army Ad Hoc Group on Scientific and Technical Information.

Senator Hubert Humphrey, whose recent activities have sparked intensive high-level effort to solve scientific information problems, conveyed his message to the conference in a taped recording, stating in part:

"I like the idea of this conference and the planning which has gone into it. What you are doing is precisely what we have been striving for on Capitol Hill. We want modern information systems so as to help strengthen our nation's research and development program. And that is what you want and are prepared to do."

Army Announces Incentive-Type R&D Contracts

Multiple benefits in development and production of military materiel are envisioned through an Army-wide changeover to incentive-type contracts. Objectives: Reduction in lead time and costs; improvement in performance.

As explained by COL Wilford D. Gower, OCRD, charged with over-all responsibility for implementation of the program, the incentive-type contract puts the emphasis on the best possible management practices. Army research, development and procurement personnel are directed to insure that the U.S. Government gets the maximum return for the taxpayer's dollar. Industry is encouraged to insure that only a "fair" profit is realized in production of military materiel that best serves the nation.

Mobile Plant Produces Nuclear-Generated Power

Mobile nuclear electrical power, an important U.S. Army objective for military field operations, recently advanced in development when the ML-1 plant generated electricity on an experimental basis.

The Army has pioneered ML-1 development with the support of the Atomic Energy Commission. Designed to produce 300 or more kilowatts of 60-cycle power, it operates at 1200°F., a higher temperature than any other reactor system of its type.

Termed "the world's first direct, closed-cycle, gas-cooled nuclear power system," the ML-1 is regarded as an effective answer to high-speed mobility requirements of today's military operations. It can begin production within 12 hours after arrival at an operating site, and is capable of relocation within 24 hours after it is shut down.

Report Shows Increased Research on Fuel Cells

Research on fuel cells as a power generation source of great potential increased substantially in Federal Government agencies and in industry during 1961, the Army's "Third Status Report on Fuel Cells" indicates.

Estimates place the value of industrial fuel cells research at about $15 million annually, with governmental agencies funding an additional $7.3 million in 1961. The previous status report on fuel cells (December 1960) showed U.S. Government spending an estimated $4.5 million annually.

All known fuel cell research in the United States which is neither classified nor proprietary is described in the recently published report. Joint authors are Herbert H. Hunger, Fritz R. Franke and John J. Murphy of the U.S. Army Signal R&D Laboratory, Fort Monmouth, NJ. Earlier reports were authored by Dr. Bernard Stein and Ernst M. Cohn, as U.S. Army Research Office publications.

The report attributes the growth in fuel cell research to increased interest in liquid hydrocarbon fuel cells, new space projects, and "a far broader basic approach to certain fuel cell problems than previously."

The Role of RAM and Testing in Training Device Acquisition

By COL Joseph J. Leszczynski and Edwin A. Trier

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Acquisition and fielding of U.S. Army training devices—varying in complexity from blank firing adapters to computer-driven flight simulators, and from system to non-system applications—is the responsibility of the Office of the Project Manager for Training Devices.

Located at the Naval Training Equipment Center, Orlando, FL, the OPM-TRADE is applying RAM (Reliability, Availability and Maintainability) criteria, along with development testing, to meet materiel users' needs. Expeditious fielding of training devices is a constant objective.

Unrealistic or unattainable RAM or fielding time requirements will significantly reduce the probability of successful acquisition. Even though *attainable,* the requirement will increase the amount of testing to demonstrate compliance, thus detrimentally impacting on expeditious fielding of the end item. Life-cycle costs frequently outweigh their benefits.

Unattainable RAM requirements are even more deadly since they make it impossible to honor the contract we have with the user through the requirements document, possible materiel within affordability constraints.

All materiel developers must, therefore, work closely with the user in the specification of RAM requirements to include establishment of the mission and failure definition. An unrealistically long mission may drive costs of required reliability to the point of impracticability. The failure definition states just what is, and is not, a reliability failure.

The XM1 tank training devices serve as an excellent example to convey the method used by PM-TRADE in generating RAM requirements for 12 training devices, ranging in complexity from moderate to high. The user initially presented a mission of 80 hours consisting of five, 16-hour (two shifts), training days.

Additionally, the user required a high probability of completing that mission without a failure. PM-TRADE was concurrently performing predictions to determine what levels of reliability were attainable, based upon the failure definition and proposed configurations, considering complexity, cost and time constraints of the program.

When values by the PM-TRADE were compared to user reliability specifications, only nine of the devices could meet acceptable standards. PM-TRADE then analyzed the proposed mission; it was evaluated as unrealistically long and not indicative of actual usage.

The 80-hour mission, coupled with the user's required probability of successful completion, had driven the minimum acceptable reliability to nearly 500 hours mean-time between failure. An alternative mission was proposed, based upon the 16-hour training day.

The user agreed that this was, in fact, the mission and modified his minimum acceptable value for reliability. Realistic and attainable RAM requirements thus were incorporated early into the requirements document.

The culmination of a reliability program is the demonstration, which may require an extremely long duration of testing. All PMs must look continually for ways to reduce test duration and expedite fielding, without compromising user confidence in the equipment.

An example is the plan used by PM-TRADE for acquisition of the Reactive Electronic Equipment Simulator (REES).

REES is a multiple-position, multiple-purpose, non-system training device. It duplicates the physical configuration and simulates the logic functions in "real time" for the installation, operation, organizational maintenance (troubleshooting) and tactical communication control of the Army Tactical Communication System (ATACS) transmission equipment.

The normal testing method requires a preliminary government inspection, followed by a completely separate reliability demonstration (RD). During the PGI, performance requirements, other than RAM, are demonstrated to assure compliance with the contract.

After review of the methodology used in this inspection, we determined that a fair amount of the test data could be used to satisfy part of the reliability demonstration without biasing the test result.

Forty-six percent of the RD time was thus eliminated, resulting in test time and acquisition cost reductions. A different approach was taken on the Firefinder Training Devices.

PM-TRADE is developing the AN/TPQ 36 and AN/TPQ 37 Radar Operator and Maintenance Trainers for PM-Firefinder. These highly complex, multiple-station TDs are needed urgently to support fielding of the radar systems. Every effort is made to reduce the acquisition time.

A significant saving in reliability test time was made possible by a review of the maintenance philosophy. These devices will be contractor maintained for one year after delivery to Fort Sill, OK. Consequently, PM-TRADE removed the contract requirement for a reliability demonstration, replacing it with assessments during the year of contractor maintenance.

Assessed reliability at the end of the year must meet or exceed the specification value or the contractor must make the necessary equipment modifications to attain the required value. This approach eliminated 460 hours of testing.

Since the contractor is still required to establish and maintain a reliability program, to include reliability growth, during the acquisition cycle, elimination of the demonstration is, in our estimation, a low risk.

TESTING. Early in 1975, DARCOM issued guidance on integrated development testing, including elimination of duplication. PM-TRADE took this guidance seriously because it would serve to expedite fielding of training devices. Discussions with representatives of the Army Test and Evaluation Command showed that TECOM could make use of contractor testing when it was structured to yield required data.

PM-TRADE then established a policy which required complete interaction with TECOM, beginning with the preparation of the Request for Proposal, followed by TECOM review of contractor-submitted test plans, and concluded by TECOM monitoring of contractor testing.

A key element in successful execution of the technique is to keep TECOM completely informed of program changes.

Accordingly, a complete set of project status reports is provided on a monthly basis. TECOM is advised of scheduled program reviews and other meetings for discussion of testing.

Information resulting from these reviews and meetings is provided to assist in test planning. Some of the PM-TRADE Infantry-related developments will be identified to show the efficiency of this policy.

The Multiple Integrated Laser Engagement System (MILES) is a multicomponent training system which allows real-time unit engagement with nonsubjective casualty assessment—a critical training need.

MILES includes eye-safe laser transmitters for the M16 rifle, machineguns (M60, M2, M85 or coaxially- mounted versions); also, tank guns, antitank weapons, eye-safe laser transmitters, personnel and vehicle laser detectors. Other elements are combat vehicle hit/kill indicators (noise/smoke), tank and antitank weapons signature simulators and controller transmitters.

The Infantry Remote Target System (IRETS) development will provide the Army's infantry range training requirements for the future. The system consists of static and portable target mechanisms, a computerized static range-control console, a portable range-control device, a moving target carrier, a hostile fire simulator, and a night fire simulator.

The Marksmanship Gunnery Laser Device (MAGLAD) will be used in conjunction with IRETS to allow use of low-cost laser energy in lieu of ball ammunition in marksmanship training. MAGLAD consists of M16 eye-safe laser transmitters, erect and prone silhouette target laser detectors, and a scaled indoor range.

Independent TECOM testing would have required considerable expenditures for test samples and for test execution. Equally important is the test time that would have been required.

PM-TRADE was fortunate in that the TECOM Infantry Test Directorate Project Officer for Training Devices, LTC John Dissek, was very receptive to integrated testing. TECOM supporting elements became involved in every aspect of the test programs. Test Integrated Working Groups (TIWGs) were established for each program, which provided a mechanism to involve the operational tester.

The culmination of these efforts was the complete elimination of independent TECOM testing for these devices. TECOM will make maximum use of contractor testing and additional data will be obtained from monitoring the operational testing.

This type of interaction is not restricted to the TECOM Infantry Test Directorate. Similar support has been obtained from LTC Dave Sexton of the Aviation Test Directorate for development testing of the Synthetic Flight Training

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Laser Hazards: A Vital Army Research Program

By LTC Edwin S. Beatrice

Rapid development of laser systems for military environments has, by necessity, made the U.S. Army a principal supporter not only of laser hardware development but, through the Medical Research and Development Command, the lead service in biomedical hazards of lasers.

Since 1968, the laser community, both civilian and military, has depended upon the Army's laser research effort. Biomedical hazards of lasers are the principal concern, at the present time, of the Division of Non-Ionizing Radiation, Letterman Army Institute of Research (LAIR) in San Francisco.

The division research team is comprised of scientists who have worked together as an interdisciplinary research unit for eight years. Their investigations involve ophthalmology, pathology, physics, comparative sensory psychology, physiological optics and neurophysiology.

Efforts of this team have produced the principal portion of the data base which currently supports national and international laser safety standards; also, to broadening our current understanding of the actual biological mechanisms underlying changes induced by laser radiation.

THE MAJOR THRUST of the Research Program involves interdisciplinary effort within the division, other departments within LAIR (comparative medicine, surgery, nutrition, and information sciences), systems developers and users, and the safety community, military and civilian.

Collaboration of physical and biological scientists evolves into practical applications through the specific expertise of the military ophthalmologist, the individual most responsible for diagnosis, detection and treatment of laser eye injury.

Observable changes in biological systems must be coupled with exact knowledge of how much laser energy is required to produce such changes. The earliest investigations in this area employed the ophthalmological criteria of opacity or observable "burn." However, this criterion is by far the least sensitive when vision and loss of visual function are considered.

To answer such questions, the pathology of the retina at electron microscopic levels is being studied. Measurements of the visual process itself - visual acuity, color vision, movement perception - are being investigated with respect to levels of laser radiation that might permanently alter vision.

The LAIR research program is comprehensive. Interaction is established at an early stage with the Army's system developers and contractors as a major portion of the research program.

PHOTORECEPTOR alterations following Q-switched Ruby laser radiation are pointed out. Such changes have been found in the absence of a "burn" and may be implicated in low-level changes in the visual process.

PRINCIPAL INVESTIGATORS of Division of Non-Ionizing Radiation, LAIR, (l. to r.) David I. Randolph, physiological optics; Bruce Stuck, biophysics; Harry Zwick, visual processes; Jack Lund, physics; Edwin S. Beatrice, ophthalmic pathology.

This assists the developer and the user, providing them with the most current biological information available on laser hazards for development of the safest and most cost-effective laser systems. Data are frequently derived from non-human subject exposures to the Army developers' laser prototype devices.

Research Accomplishments. Because of the interdisciplinary nature of this group and its interaction with Army laser systems developers, it can list numerous outstanding accomplishments. It was the first group to show retinal photo-receptor changes at the previously defined "safe" level for Q-switched ruby laser radiation; also, the first to show that long-term changes in visual acuity and color vision can be induced at levels well below those defined as "safe" by burn criteria.

Additionally, it is the only group that has been able to demonstrate significant differences in biological effects of lasers as compared to ordinary incoherent sources; also, the first group to establish threshold data from which safety criteria for Gallium Arsenide laser diodes have been derived.

In their most recent effort, the team has found that very low doses of laser radiation, at levels considered well below maximal permissable levels, have been found to be additive. Thus, under certain laser viewing conditions normally considered "safe," repetitive exposure could lead to loss of visual function.

Similarly, within the last year, this team has contributed substantially to the over-all requirement of the Army to use the most effective, and up to now the most extensive, laser training systems in field exercises.

Through a coordinated effort, involving the research expertise of the LAIR group, the system developer and the contractor, biological data to implement existing safety standards were obtained and employed to design the safest laser training system available.

The system developer and the contractor were provided the necessary informational background in biophysical aspects of present standards - meeting present and anticipated future needs in which eye safety considerations will again impact on the development cycle. Within the last six months, two formal modifications to present laser safety standards have been submitted, based on LAIR research.

Present and future research of this team will be concerned with effects of laser radiation on the processes of vision. Findings will be used to establish the most realistic data base for safety standards; also, to enlarge greatly our current knowledge of ocular damage processes associated with laser radiation.

Development of ophthalmic detection techniques and treatment modalities for laser injury is currently receiving in-depth evaluations by the Division of Non-Ionizing Radiation and the ophthalmic research group in the LAIR Department of Surgery.

Current and projected use of lasers and the ever-increasing concern for environmental hazards will continue to make the research and consultation services of this group vital to developers within the Army laser community.

ALIGNMENT of Gallium Arsenide laser for exposure of rhessus monkey retina. This is a prototype of one being considered for use.

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After graduating from the Albany (NY) Medical College of Union University in 1962, COL Beatrice trained in biomedical engineering at Case Western University, Cleveland, OH, and Drexel Institute of Technology at Philadelphia. He received additional residency training in pathology and opthalmology at Stanford University School of Medicine, Stanford, CA, prior to duty in 1968 with the Joint AMC-AMRDC Laser Safety Team at Frankford Arsenal, PA.

The colonel is active in the DARCOM system developer and user community, and is frequently consulted for his opinion on the safety of laser devices in the civilian community. He has lectured on lasers and laser safety education at many government and academic institutions.