ARMY RESEARCH AND DEVELOPMENT

March-April 1976

CRREL

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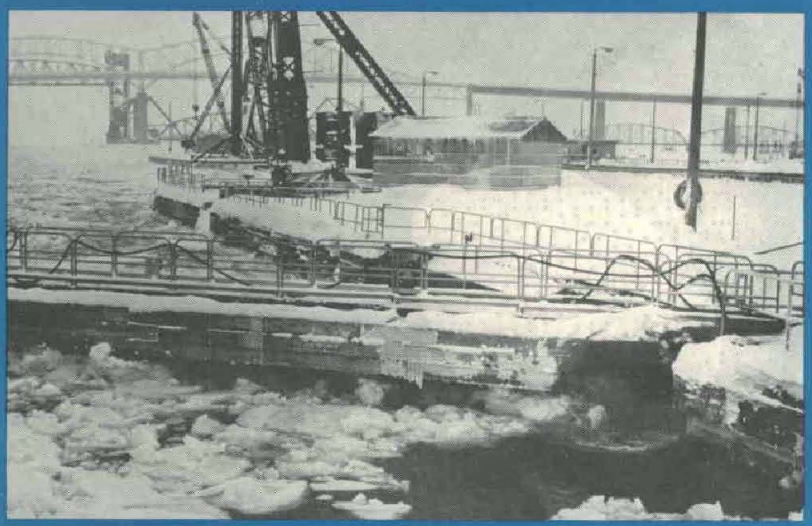
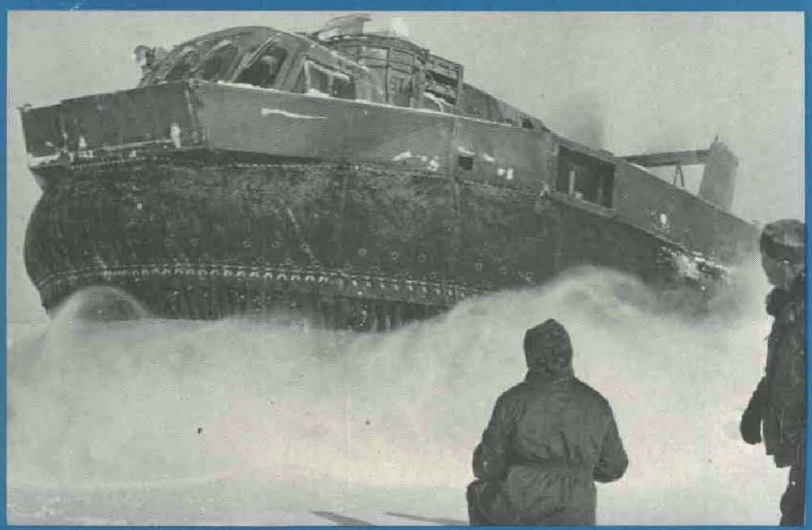
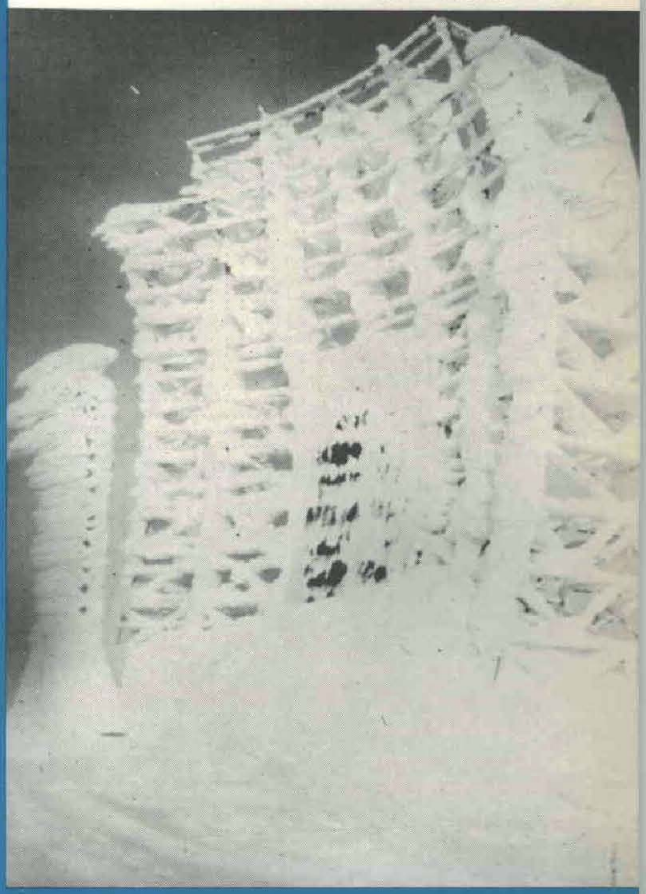
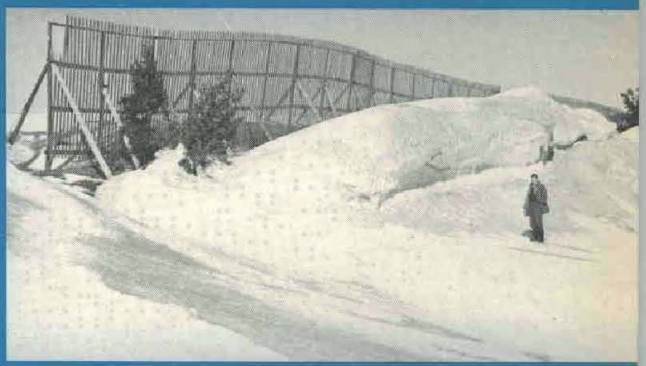








SPEAKING ON . . .

Army Readiness Posture: Requirements to Meet Foreseeable Threat

Chairman of the Joint Chiefs of Staff GEN George S. Brown, U.S. Air Force, sounded the general theme of Department of Defense leaders in their presentations to Congress, in justification of proposed budgetary increases for FY 1977, when he spoke Mar. 15 to the 1976 National Security Seminar at Pensacola, FL.

"The United States military establishment," he said, "has no life of its own. Its existence does not generate its needs. Quite the opposite. The needs of national security generate the requirements for a national defense establishment. The size, composition, equipage, deployment, and state of readiness of our military forces are dictated by three factors: One is the tasks to be performed; two is the threat to our national security; the last is the degree of risk judged acceptable."

Posture statements (summaries of current readiness and future requirements for adequate manpower and materiel to meet the threat of the potential enemy) in presentations to Congress comprise hundreds of pages of viewpoints, data and descriptions of foreseeable capabilities to cope with rapidly increasing strength of the USSR.

Director of Defense Research and Engineering Dr. Malcolm R. Currie's report, "Program of Research, Development, Test and Evaluation," is an inch-thick document, justifying in detail an FY 1977 budget proposal totaling $112.7 billions. Included in the research, development, test and engineering proposal, totaling $10,942.3 millions, is about $4,100 millions for 81 major weapons systems. The breakout is $7,846.9 millions for RDT&E performed by industry, $2,661.4 by DoD in-house laboratories, $221.7 by Federal Contract Research Centers, and $212.3 by universities.

SECRETARY OF THE ARMY Martin R. Hoffmann's presentation to the House Armed Services Committee, "The Posture of the Army," is a 66-page document. Under the heading of Establishing the Pattern for the Future, it has subheadings on Readiness; Balance; Stability; and Quality. Eleven following pages are devoted to The Army Today.

Secretary Hoffmann, in discussing equipment requirements of the modern United States Army vis-a-vis the growing strength of the Soviet Union, gives consideration to: Procurement; Research and Development; Standardization; and Industrial Base. That portion of the presentation to Congress considered of prime interest to the Army R&D community, follows:

The ability of the Army to fight and win on the modern battlefield depends to a great extent upon the numbers and capabilities of the troops and upon the excellence of the equipment provided to them. In past wars the United States' decisive edge has been achieved by quantitative equipment advantage after a period of mobilization.

This strategy has had to change since in virtually every category of major land forces equipment the U.S. Army today is substantially outnumbered by mobilized Soviet forces — tanks, armored personnel carriers, surface-to-air missiles, surface-to-surface missiles, and artillery. Only in the case of helicopters does the U.S. Army possess an advantage.

The current rates of production in the USSR appear virtually certain to guarantee a continuation of this situation. We should make no mistake in our calculations — numerical superiority on the battlefield is a significant factor in determining the outcome of combat.

The largest single increase in this year's U.S. Army budget request is in the procurement area. This increase represents a key initiative in enhancing the Army's capabilities in the coming year. It will permit the Army to begin to redress the current critical situation wherein only 51 percent of the materiel needed (in dollar value) to equip, modernize, and sustain current forces is on hand. The problem is particularly acute within the Reserve Components.

The problem is complicated by the growing lethality of the modern battlefield. This has been brought about principally by the advent of precision-guided weapons: what can be seen can be hit — what can be hit can be destroyed. The effects of these weapons were observed during the 18 days of the 1973 war in the Mideast when all combatants lost substantial portions of their stores of equipment.

The steps the Army is taking in materiel programs will be discussed against this background. The procurement program is intended to insure that adequate qualities of equipment are on hand when needed. The research and development program provides qualitative improvements to the force, both to meet the current threat and to anticipate future battlefields.

Procurement. The continuing and most important procurement objective is to achieve and maintain full materiel readiness for all 24 combat divisions. In addition to full combat equipment, replacement and support stocks must be constituted. This requires special emphasis on making product improvements to existing systems and taking advantage of allied initiatives. Funds to develop new weapons should be spent to fulfill requirements that cannot be met in any other way.

One promising technique for offsetting the growing cost of modernization is to use a high/low concept in procurement programs. Units which will meet the enemy first receive the newer items for equipment; units that will deploy later will keep the older models.

The determination of the mix depends on an assessment of the threat, priority of missions, and fiscal constraints. Thus, in the future, it is expected that the armor units in Germany will be equipped with the new XM-1 tank, while units in the United States will retain the older M48A5 and M60 series tanks.

Armor. The past year has seen a major effort to enhance the tank production capability of the United States. At the time of the 1973 war in the Mideast, the U.S. was producing about 30 tanks per month. Increasing this level required the creation of totally new production capacity, particularly in the area of large castings.

As a result of this program, which was fully supported by the Congress, the production rate was increased to 64 per month in mid-1975, is currently at a level of 72 per month, will reach over 100 per month in February 1977, and is expected to achieve a capability to produce 120 per month in January 1978.

This increase in tank production will assist in reducing the present 61 percent shortage in the Army's tank assets. The over-all objective for tanks (13,844) is a realistic assessment of the need to support Active and Reserve force requirements and to provide sufficient War Reserve Stocks to sustain forces in the early stages of combat.

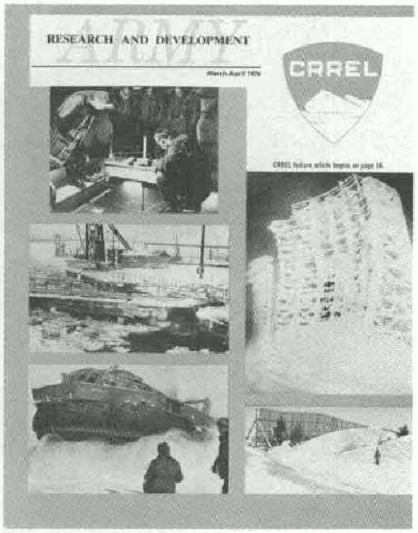
The increased production rate for M60 series tanks has been complemented by a program to upgrade M48 tanks and by the successful deployment of the M60A2 (Shillelagh missile) tank during the past year. Conversion of the M48 makes the M48A5 a prime tank equipped with the 105mm main gun and diesel engine. Commonality of support and tactical employment with the M60 series enhances force capability and reduces cost.

The M60A3 Product Improvement Program is designed to incorporate improvements into new production tanks on the assembly line and to modify existing tanks with product improvements during scheduled vehicle depot overhaul. There are 10 major product improvements in the current program, making the improved tank more cost-effective and yielding improved accuracy at long range. The M60A3 will have a striking improvement in night-fighting performance.

The M113A1, Armored Personnel Carrier, is the basic squad carrier for mechanized infantry and combat engineers. The U.S. Army and foreign customers are placing a high demand for this proven and reliable vehicle. Continued procurement is essential to satisfy the low side of the combined MICV/M113A1 high/low inventory objective.

Air Defense Missiles — Chaparral. With the congressionally approved procurement of Chaparral ground support equipment in FY 1976, the Army will be able to provide this essential support equipment in FY 1976, the Army will be able to provide this essential air-

(Continued on page 13)



ABOUT THE COVER . . .

CRREL (Cold Regions Research and Engineering Laboratory), Hanover, NH, scientists, engineers and specialists team their talents in an interdisciplinary approach to the planning and conduct of over-all Army research, development, test and evaluation programs focused on problems of military operations . . . "applicable to . . . those geographic areas of the world where cold presents a severe problem at least one year in 10. . . ."

Typical areas of concern include road and airfield pavement structures, foundations, building structures and utilities systems.

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

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ARMY RESEARCH AND DEVELOPMENT

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FEATURES

DEPARTMENTS

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Selective Scanner . . .

ERDA Agreement Expands Waste Conversion R&D

Conversion of waste paper and other cellulose wastes to glucose sugar and many short-supply chemicals — a process being developed for potential large-scale applications by the Natick Research and Development Command in a pilot plant program — is being continued under an Energy R&D Administration agreement.

ERDA is providing additional research and development funding through June 1978 under provisions that continue over-all control by NARADCOM of the experimental program. Funding by ERDA will be provided for specific assigned tasks.

NARADCOM announced the signing of the agreement in March, explaining that in general the research will include: expansion of mutants to develop more productive fungus strains; further investigation of all controlling variables and cellulosic wastes used as substrates and reactants; and study of the utilization of the resulting glucose syrup — particularly for direct or indirect conversion to energy forms.

"Since the worldwide production of cellulose is estimated at 100 billion tons annually," NARADCOM Commander COL Rufus E. Lester commented, "we cannot afford to overlook its importance as a future energy source. This agreement represents an important step...."

DARCOM Refurbishing West Coast TIL Office

Renovation and refurbishing of the West Coast Technical Industrial Liaison Office of the U.S. Army Materiel Development and Readiness Command, collocated with the U.S. Navy R&D Information Center, has been announced by HQ DARCOM.

Located at 1030 East Green Street, Pasadena, CA, the West Coast TILO is one of eight area TILOs reporting to the HQ DARCOM TILO (DRCDE-LO), 5001 Eisenhower Ave., Alexandria, VA 22333. The West Coast office telephone number is 213-792-7146 and the HQ TILO is 202-274-9816/9819. The West Coast TILO also serves current or potential defense contractors in Alaska and Hawaii.

To obtain information from one of the DARCOM TILOs a visitor must be a United States citizen and a member of an organization that has: (1) expressed a desire to participate in R&D efforts of the U.S. Army; (2) obtained the required industrial personnel and facility security clearance; and (3) an existing or potential R&D capability.

TILOs provide current and long-range technical information and have the capability of printing copies of most requested documents. Information includes R&D Planning Summaries (DD Form 1634) and (DA Form 3664); research, development, test and evaluation program and data sheets (AMC Form 1534); and DA Catalog of Approved Requirements Documents (CARDS).

Cruise Missile Completes First Powered Flight

Designed to play a large role in future national defense plans, the Air Launched Cruise Missile (ALCM), successfully completed its first powered flight of about 11 minutes in March at White Sands Missile Range, after being launched from a B-52 bomber at 10,000 feet altitude.

The Air Force prototype missile, designated the AGM-86, is in advanced development. Objectives of the first flight included safe launch with surface unfolding and engine flight, and to achieve and maintain level flight.

Six additional test flights are programed this year and decision on full-scale engineering development for the strategic missile is expected early in 1977. The ALCM program is directed by the Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, OH.

Engineered to be carried aboard and launched from either the B-52 bomber or the supersonic B-1 bomber, the latter now in flight tests at Edwards AFB, CA, the AGM-86 is planned to carry a nuclear warhead. It is intended to be used in large numbers to dilute enemy defenses to enable manned bombers to penetrate to targets.

Resembling a small airplane, the ALCM is 14 feet long, weighs about 1,900 pounds, flies at high subsonic speed at low altitude (making it difficult to detect), and has wings that snap open to span about 9½ feet when launched.

Contract Orders Initial Production of Chaparral

Initial production of the Improved Chaparral missile (MIM-72C) is called for in a $21,178,125 contract awarded to the Aeronutronic Ford Corp. by the U.S. Army Missile Command, Redstone Arsenal, AL.

Work will be done in the company's Aeronutronic Division, Newport Beach, CA, with final assembly programed for the Red River Army Depot at Texarkana, TX.

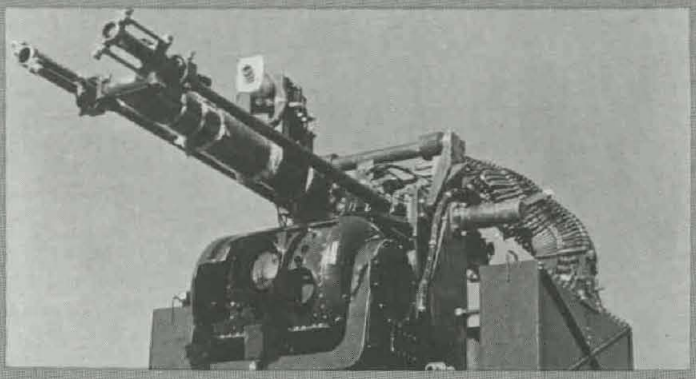
Fire Control System Proves GLAAD Feasibility

A new fire control system featuring fully integrated and stabilized optical infrared and laser sensors was used recently with a digital computer to prove the capability of a Gun Low Altitude Air Defense (GLAAD) system.

A modified Variable Speed Towed Target (VASTT) provided a challenging, high-speed highly maneuverable target during the field test phase of the GLAAD test bed.

Mounted on a tracked vehicle, the test bed consists of two 25mm automatic guns and uses an advanced digital fire control system with optical, infrared and laser sensors. A digital computer serves to fix gun positions and aid the gunner in tracking the target.

Sensors feed data into the computer for necessary lead



GLAAD Fire Control Test Bed

and elevation angles to hit the target at any point along its path. The U.S. Armament Command reported this was the first time the U.S. air defense gun has used a digital computer for fire control.

The GLAAD test bed was developed by ARMCOM and Rodman Laboratory at Rock Island, IL, and Frankford Arsenal, Philadelphia, PA. It was tested at Fort Bliss, TX.

DARCOM Establishes Special Features Award

Establishment of an annual Special Features Award, in recognition of publication of an article or acceptance for

publication, has been announced by the U.S. Army Materiel Development and Readiness Command.

Open to any civilian or military author now or previously assigned to a DARCOM element, the award will recognize a feature article deemed helpful in improving public understanding of Department of the Army or DARCOM missions and needs.

Each DARCOM subordinate command or activity may submit one nomination annually. Features may be submitted by the author, the author's supervisor or any individual knowledgeable of the manner in which the article meets the award criteria.

Each entry will be reviewed initially by the DARCOM Information Office, and prescreened by an Information Office Review Panel prior to consideration by the DARCOM Incentive Awards Review Board.

Since the *Army Research and Development Newsmagazine* is now a bimonthly publication, the official contest announcement was made too late (Feb. 10) for our January-February edition. The cutoff date for submission of entries was Apr. 1, shortly before presstime.

Army GLLD/USAF Laser Equipment Compatible

Compatibility of U.S. Army Ground Laser Locator Designators (GLLDs) and Air Force laser equipment was demonstrated recently when six live bombs impacted on target during two weeks of tests at Eglin AFB, FL.

Two GLLDs provided by the U.S. Army Missile Command, Redstone Arsenal, AL, were used to guide the bombs dropped by an Air Force F-111 jet at altitudes from 4,000 to 15,000 feet. The jet released the bombs over bunkers and concrete billboards which simulated bridge foundations. Speeds of up to 550 knots were recorded and targets designated at ranges exceeding 2,000 meters.

The tests were particularly important from a compatibility standpoint since the Missile Command has triservice responsibility for ground laser designator equipment. COL John Reeve is product manager for GLLDs.

Currently undergoing engineering development, the GLLDs consist of a laser, range finder, day sight, tracking unit and tripod ground mount. Hughes Aircraft Co. is prime contractor.

GLLD capabilities include identification of targets, determining day or night ranges, accommodating target handoff, and guiding any weapon fitted with a laser seeker whether it is a missile, bomb or an artillery shell.

CLGP Scores Scores Hits on Laser Designated Targets

Ability of a Cannon-Launched Guided Projectile (CLGP) to hit targets designated by ground lasers or lasers aboard manned and unmanned aircraft was demonstrated during recent tests, including a "kill" of a moving tank at night at White Sands (NM) Missile Range.

The gunner aboard a U.S. Army Cobra helicopter, the AH-1G, employed an airborne Target Acquisition and Fire Control System (ATAFCS) to acquire and track the tank and to guide the 155mm artillery homing round to the target. It was the eighth successful CLGP test out of nine since August 1974.

Six of the direct hits have been made while using the ground laser locator designator with a CLGP and a seventh successful firing against a moving tank used a laser mounted in a Remotely Piloted Vehicle (RPV). The next firings are scheduled to begin in February 1977 as part of CLGP engineering development contract awarded in July 1975 to Martin Marietta Aerospace.

COL Frank P. Ragano, HQ U.S. Armament Command, Rock Island, IL, is project manager for Cannon Artillery Weapons Systems. COL John Reeve is product manager for the helicopter visionics/laser designator system, ATAFCS, used in the latest test. Aeronutronic Ford Corp. developed ATAFCS, under contract to the U.S. Army Missile Command, Redstone Arsenal, AL.

ORACLE Determines Electronic Parts Reliability

Determination of electronic system reliability involving thousands of parts, in minutes rather than days, is possible by using the U.S. Army Electronics Command's new computer program, Optimized Reliability and Component Life Estimator (ORACLE).

Designed specifically for use with Military Handbook 217B, ORACLE provides the failure rate of an individual electronic part, including data such as operating temperature and screening level. Formulas to determine failure rates for integrated circuits, transistors, diodes, thyristors, capacitors, inductors, resistors, tubes, connectors, relays and switches are contained in algorithms.

Identification of a specific failure rate depends upon proper placement of part numbers into the ORACLE data base. Although 15,000 entries are listed currently, about 25,000 parts are represented because related items may be grouped under a single entry.

The effective data base actually contains about 200,000 additional parts. The output shows the failure rate for each part, as well as the failure rates summarized by module or any other equipment partitioning level desired.

Once a module failure rate and the mean time between failure have been determined, a trade-off analysis can be used to compare the reliability of various parts. Operational with a CDC 6600, ORACLE is also being prepared for use on the IBM 360/370 systems.

ASAP Meet Will Consider USMC RDT&E Program

Army Scientific Advisory Panel (ASAP) members and consultants will be briefed on the U.S. Marine Corps research, development, test and evaluation program at their spring meeting, May 17-18, at Camp Lejeune, Jacksonville, NC.

Camp Lejeune Commander MG Herman Poggemeyer Jr. will host the forum which is scheduled to include a joint services exercise of amphibious landing, airdrop assault and air strike capabilities.

One of the featured speakers is BG Paul X. Kelley, deputy for Development and director of the Development Center, U.S. Marine Corps Development and Education Command. He will present briefings on "Policy and Overview" and "Major Systems," relative to USMC RDT&E.

ASAP Ad Hoc Group reports and their chairmen will include: Smoke/Aersol Systems, Dr. Robert A. Beaudet, professor of chemistry, University of Southern California; and Biological and Toxin Samples, Dr. Herbert Ley, medical consultant.

Brief progress reports, including status on previous recommendations, are scheduled to include: Improving Dragon Hit Probability; Seismic Sensor Feasibility; Physical Security, Phases I and II; Environmental Quality Control; Energy R&D; Fire Support; LORAN Manpack Feasibility; IR Efforts for Fire and Forget Feasibility; and Improved Light Antitank/Assault Weapon.

R&D News...

DARCOM Office of Manufacturing Technology Created to Cut Costs

Cost-cutting design and fabrication of military materiel to meet standards for superior operational effectiveness, firepower, mobility, reliability and maintainability is the mission of a new Office of Manufacturing Technology (OMT) at HQ U.S. Army Materiel Development and Readiness Command (DARCOM).

Accountable directly to LTG George Sammet Jr., DARCOM Deputy CG for Materiel Development, the OMT is established as a highly professional group of scientists, engineers and analysts (GS-16 chief, three GS-15s, four GS-14s, GS-12 and two secretaries). COL Newell E. Vinson is designated as acting chief.

OMT goals are in line with objectives set forth by Assistant Secretary of Defense William P. Clements in directives and guidance documents issued in 1975.

Secretary Clements, in a keynote address last fall to a Missile Manufacturing Technology Conference at Hilton Head Island, SC, further stressed the criticality of an effective Army-industry partnership to achieve cost reduction by improved manufacturing techniques.

Clement's address was a rousing appeal to 178 representatives of some 60 industrial organizations and 78 attendees from 15 federal agencies. Sponsored by DARCOM (then the Army Materiel Command), the meeting was arranged and conducted by the Directorate of Research, Development and Engineering, working through the Army Missile Command and the Army Materials and Mechanics Research Center (AMMRC).

Against this backdrop of nationwide Army-industry organizational effort, the new DARCOM OMT assumes its rightful place of importance. It will function in close cooperation with another recently established HQ DARCOM element, the Product Improvement Office. (See **Army R&D Newsmagazine,** Sept.-Oct.)

OMT's mission may be defined generally, in part, as: To assure that new or improved manufacturing processes, techniques, materials and equipment are used for economical production of new or existing items in the Army materiel inventory.

Manufacturing technology encompasses part of the Production Base Support Program (Manufacturing Methods and Technology), Numerical Control/Computer-Aided Design Engineering (CAD-E), Production Engineering, Producibility Engineering, Value Engineering and Design to Cost. OMT personnel are charged with integrating these efforts into a coordinated approach to cost-reduction goals.

The OMT will function through DARCOM field installations and activities. Centralized fiscal planning and accountability will be exercised by the OMT but field elements will assess, formulate and execute technology programs.

One of the focal points will continue to be the Manufacturing Technology Division of the Production Equipment Agency (PEQUA), a tenant activity at Rock Island Arsenal. PEQUA has served in the Army manufacturing technology improvement activities for 12 years, and has a well-established capability.

The Materials and Mechanics Research Center, Watertown, MA, also will have a major role in the MT program, in recognition of long-established expertise (both in-house and with contract agencies) in materials design and testing.

Other DARCOM installations that will carry major responsibilities for the success of the over-all Manufacturing Technology Program include the Army Missile Command and the U.S. Army Aviation Systems Command.

DARCOM's Production Base Modernization and Expansion Program is directed at Picatinny Arsenal, Dover, NJ, by Project Manager MG Robert J. Malley. MG Malley controls more than half the funding currently directed to MM&T projects.

Numerous other DARCOM project managers for major materiel systems will have key roles in the MM&T Program. HQ DARCOM is considering the merit of setting up more formalized product producibility reviews as a part of the milestone decision process in transition from low-rate initial production to full-scale production of materiel.

An example of the anticipated payoff of the MM&T Program is the savings from only that portion of the over-all effort known as Value Engineering (VE), which accounted for "audited" Army Materiel Command savings of $95.4 million in 1974 and $104.6 million in FY 1975. The M&T Program is funded at about $60 million Army-wide for FY 1975 and will receive additional funding if anticipated ROI (Return on Investment) objectives are realized.

When fully activated, in line with guidance from DARCOM Assistant Deputy for Materiel Development John D. Blanchard, the Office of Manufacturing Technology will take the lead in representing the Army with the over-all technology community and provide the Army member of the Department of Defense Manufacturing Technology Advisory Group.

CH-47 Flight Simulator Tests Impress Dignitaries

U.S. Army Vice Chief of Staff GEN Walter T. Kerwin Jr. and GEN John R. Deane Jr., commander of the U.S. Army Materiel Development and Readiness Command, said they were pleased with the response and visual presentation of the CH-47 Flight Simulator after flight testing it Mar. 8.

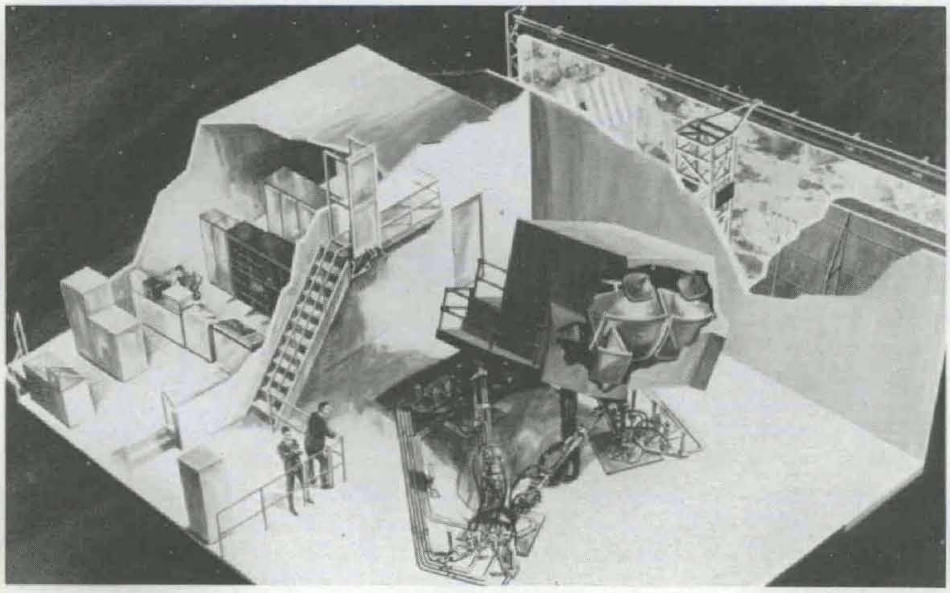
Under development by the Army Training Device Agency, Orlando, FL, the CH-47 simulator is the second element of the Synthetic Flight Training System, expected to achieve major savings in pilot training and fuel costs. A second system simulates the AH-1Q Cobra helicopter. Both include a computer complex, motion system, cockpits and visual systems.

High fidelity simulation of all CH-47 flight characteristics is built into the CH-47 training device, including a pilot-copilot compartment identical to that in the actual aircraft with respect to size, arrangement, instruments, seats and other components.

Scheduled for delivery in August 1976, when acceptance testing will begin, the new trainer has capabilities for automated instruction, automated performance measurement, record and playback student "flight," and hardcopy printout of training analysis and critique data.

The simulator permits training in all CH-47 flying skills. A high-resolution full-color visual display, the first of its kind in a U.S. Army flight trainer, derives its imagery from a closed-circuit television system whose camera moves about a 3-dimensional terrain model in response to the pilot's control of instrumentation.

Development of the Cobra simulator also is scheduled for delivery and acceptance testing in August. Both trainers are to be operational at the U.S. Army Aviation School, Fort Rucker, AL, by January 1977.



CH-47 Flight Simulator

Investigation Establishes TRIP Technical Feasibility

Technical feasibility of warm extrusion of TRIP (Transformation Induced Plasticity) high-strength austenitic steel, expected to find numerous applications in meeting military requirements, is now established after more than three years of investigation.

Two reports expected to be off the press in April will describe current state-of-the-art as developed by the U.S. Army Materials and Mechanics Research Center, Watertown, MA, in cooperation with other federal agencies, including research performed under contract.

The basic work started in 1967 with effort supported by the U.S. Atomic Energy Commission and conducted at the University of California (Berkeley).

Titles of the forthcoming AMMRC reports are "Warm Extrusion of TRIP Steel" and Austenite Stability and Tensile Properties of Warm Extruded TRIP Steel." They complement "Inhomogenous Deformation and Strain Rate Effects of High-Strength TRIP Steel," published in March 1973.

Responsible for the new reports is an AMMRC Material Development Laboratory team comprised of Dr. Morris Azrin, Dr. G. B. Olson and Roger A. Gagne. Dr. Olson works only one day a week at the AMMRC and is a research associate in metallurgy at Massachusetts Institute of Technology in Cambridge.

Dr. Azrin explained to an **Army Research and Development Newsmagazine** staff member that work on which the new reports are based was started through a cooperative research program with Battelle Memorial Institute, Columbus, OH, about three years ago. Thermomechanically processed TRIP steel warm extrusion technology was improved through this program.

Thick plates of medium-strength TRIP steel have been produced and strengthened by the new techniques and are being evaluated for their energy-absorbing capability under blast loading conditions, Dr. Azrin said. The goal is improved performance and reliability of critical components by "utilizing strength-toughness combinations not available in any other material than TRIP steel."

Currently, it was explained, TRIP steels are limited by the requirement for a thermomechanical treatment to achieve the high austenite strength level goal. Strong temperature dependence of the strain-induced transformation kinetics also can give rise to undesirable strain-rate sensitivity of the ductility and toughness under adiabatic heating.

'Cheese Cake' Comes in Many Forms...

Army Aids Air Force in Cutting Powerful Explosive Slices

"Cheese cake" in military barracks has been synonomous with lovely lady pin-ups to adorn the walls. But the term was applied recently to potentially powerful giant-size slices of propellant removed from an Air Force Titan IIIC ICBM in a joint Air Force-Army effort.

Army Materiel Test and Evaluation (ARMTE) Directorate technicians at White Sands (NM) Missile Range were brought into the act because of their long-established expertise in safe handling of missiles and equipment available to them. The task was painstakingly precise and it saved taxpayers' money - about $145,000, after deducting expenses involved.

When the Air Force needed fuel to use in burn tests of simulated nuclear fuel containers of the type used to power thermoelectric generators in satellites, some one came up with the idea of salvaging solid propellant from a surplus (obsolete) IIIC ICBM.

The propellant, about 79,000 pounds of it, valued at about $2.00 a pound, was delivered from the manufacturer in Sunnyvale, CA, to WSMR in its original Titan missile container, a 10 by 10-foot, three-eighths-inch steel-encased motor booster segment.

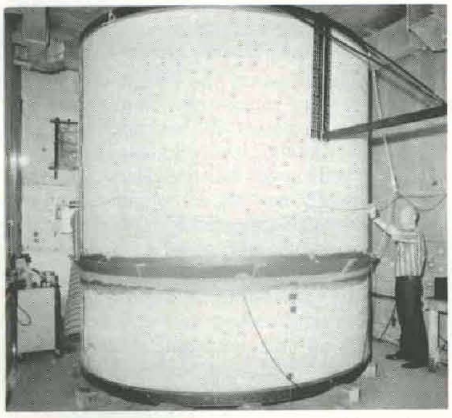
Working together, Air Force and ARMTE Directorate personnel decided on a chemical etching technique to cut the casing into three sections, each 10 feet in diameter and less than 3½ feet high. All other methods of cutting the casing or removing the propellant without cutting the casing were considered unsafe or impracticable.

When the casing was cut through, holes were drilled at selected intervals into the exposed solid propellant. Each of the 3½-foot sections of propellant then could be lifted and cut into slabs, using a technique much like cutting a giant cake of cheese. Precise considerations involved, however, were the size of the "cheese cake," the proper tools, wire strength required in the cutting process, temperature controls, and extreme care to avoid metal contact.

ARMTE personnel involved in the recovery operation included Ray Strom, project director; Steve Matson, project engineer; Richard Nichols, chief, Dynamics Branch; Oliver Hahn, leader of the 300K static test stand where the operation was conducted; and Lewis Cox and Ralph Avers, technicians at the 300K stand.

Air Force project people involved in the program, headed by Dr. Dermod Kelleher, included Ralph D. Robinson, project director; LT E. W. Holtzscheiter, project officer; MAJ R. L. Holton, project engineer; CPT J. A. Sholtis and 1LTs Marcia Clifton and C. M. Craft, engineering and logistics support officers.

J. Koury of Systems Command's Rocket Propulsion Laboratory, Edwards Air Force Base, CA, served as a technical consultant for the program.



Titan IIIC booster section, 10 x 10 feet, is cut into three segments by acid circulated through a trough mounted on the booster wall (left). At right, each segment is separated for final cutting into slabs. The grooves radiating from the 3-foot-diameter center are drill holes through which the wire was pulled in cutting operations to salvage solid propellant from an ICBM.

U.S. Sends Surplus Trackers To Argentina on Lease Basis

Five surplus photooptical tracking instrument systems, in storage for 18 months at White Sands (NM) Missile Range as the result of a modernization program, were airlifted recently to the Argentine government under a long-term lease program.

Flown aboard an Argentine Air Force C-130 aircraft from Holloman Air Force Base, NM, the 20 tons of equipment, valued at more than $500,000, will be placed in operation on a new rocket test range.

Operated at WSMR for more than 22 years, the equipment consisted of three Askania Cinetheodolites and two Intercept Ground Optical Recorder (IGOR) telescopes. The Askanias were used to obtain missile flight position data and the IGORs for altitude and event data. The Askanias were replaced with Swiss-built Contraves Cinetheodolites and the IGORs with Versatile Tracking Mount (VTM) telescope systems.

Arrangements for the lease agreement covering use of the equipment were made by the U.S. Army Materiel Development and Readiness Command's Foreign Military Sales Office. Argentina also obtained radar and telemetry equipment from other U.S. installations.

First of 2 Air Cushion Vehicles Programed for Fort Story Tests

Shipment of the first of two LACV-30s (Lighter, Amphibian Air-Cushion Vehicles, 30-ton payload), adapted for military use by the U.S. Army Mobility Equipment R&D Command (MERADCOM), is scheduled in March to begin a series of tests at Fort Story, VA.

The second test vehicle will be shipped later this spring for a development test program at Aberdeen Proving Ground, MD. Conducted by the Army Test and Evaluation Command, the tests will be monitored by MERADCOM.

Described as stretched and modified versions of the Voyageur ACV, the test vehicles are basically the fifth and sixth Voyageurs produced by Bell Aerospace Canada. Powered by UACL/Pratt & Whitney ST6T6-76 engines with a normal shaft horsepower rating of 1,400 and a maximum of 1,800, they will be capable of hauling MILVAN containers from ship to shore and inland at 50 miles an hour.

UTTAS Competitors Begin 9 Months of Testing Prototype Models

Sikorsky UTTAS

Boeing Vertol UTTAS

Nine months of UTTAS (Utility Tactical Transport Aircraft System) competitive prototype testing leading to award of a multimillion-dollar production contract in January 1977 was announced in mid-March by HQ U.S. Army Aviation Systems Command, St. Louis, MO.

Overseeing development of the new aircraft — one of the top priority Army "Big Five" materiel developments — is the UTTAS Project Manager's Office, U.S. Army Materiel Development and Readiness Command (DARCOM). MG Jerry B. Lauer, project manager, controls operations from HQ AVSCOM.

Acceptance of prototypes produced by Sikorsky Aircraft Co. and Boeing Vertol Co. was announced simultaneously with information regarding the test program schedule. The test program is scheduled to begin at the U.S. Army Aircraft Development Test Activity, Fort Rucker, AL, commanded by COL Robert S. Keller.

Two helicopters of each competitive design will be flown for three weeks of pilot training and nine weeks of testing (total of 295 flight hours) at Shell Army Heliport and in the vicinity of Fort Rucker.

One instrumented prototype from each contractor will undergo simultaneous engineering flight tests at Edwards Air Force Base, CA, conducted by the U.S. Army Aviation Engineering Flight Activity (AEFA), commanded by COL. Dennis M. Boyle.

Phase three of the program, operational tests, are scheduled at Fort Campbell, KY, beginning in June and conducted by the 101st Airmobile Division (Air Assault). Complexity of the overall test program will involve participation of numerous commands, schools, centers and agencies. This accounts for formation of a test task force at the Aircraft Development Test Activity at Fort Rucker.

ADTA has been augmented with additional pilots, test data collection teams from the 101st Airmobile Division, and maintenance teams. The integrated task force will evaluate flight test results with consideration of human factors, reliability, availability and maintainability (RAM) data, armaments, electronics, safety, air transportability, ground handling and mission compatibility characteristics.

Scheduled to replace or supplement the Army's aging UH-1 Iroquois (Huey), the UTTAS is the fruition of a concept formulated in the late 1960s when it was determined that a new aircraft would be needed to satisfy Army needs through the time frame of the 1980s.

Studies and research led to a decision that the UTTAS would be a twin-engine helicopter with wheeled landing gear, and transportable aboard C-130, C-141 and C-5A aircraft.

Development of specifications included requirements for a cruising speed of 145 to 175 knots an hour while carrying a crew of 3 plus 11 combat troops for 2.3 hours at 4,000-feet altitude at 95 degree F. conditions. Provision was included also to insure maximum aircraft survivability and crashworthiness in a hostile battlefield environment.

GSRS Competitive Study Contracts Total $855,000

Innovative manufacturing and materials approaches for a proposed new General Support Rocket System (GSRS) became a competitive responsibility of industry with the recent award of concept study contracts totaling $855,000.

The Army Missile Command announced the contracts with Boeing Aerospace Co., Emerson Electric Co., Martin-Marietta Corp., Northrop Corp., and Vought Corp. Each contractor will perform a 4-month study to outline technology approaches for developing a free-flight artillery rocket, including estimates on unit and life-cycle program costs.

Based upon results of the studies, the Army will determine the best technical approach for developing the GSRS.

GSRS is intended to be a simple, rugged, reliable free artillery rocket system which can be deployed rapidly and deliver a high volume of fire. Present Army concepts envision the weapon system as being a mobile launcher carrying rockets which can be fired in rapid ripples.

MICOM engineers say the design will probably accommodate conventional munitions and have a growth potential that might accommodate future guidance as technology evolves.

"We are looking for a nonnuclear, rapid and indirect fire system that will supplement cannon artillery during attacks when targets such as artillery, troops and armor appear rapidly and in great quantities," said COL Kenneth S. Heitzke, MICOM's new special assistant for GSRS. "We have nothing in the field like it." Heitzke said low-unit cost is emphasized.

MICOM has conducted extensive work in free-flight rockets in its research and engineering laboratories at Redstone Arsenal. Much of the early effort in establishing this new program was directed by MAJ William B. Ward, chief of the Artillery Systems Concept Team in MICOM's Advanced Systems Concept Office.

Kwajalein Installing New Earth Terminal as SCT-21 Replacement

Kwajalein Missile Range in the Pacific Ocean is getting a state-of-the-art earth terminal as a replacement for a smaller 21-foot nonstandard unit (SCT-21) in service since 1969 as the entry terminal for the Defense Satellite Communications System.

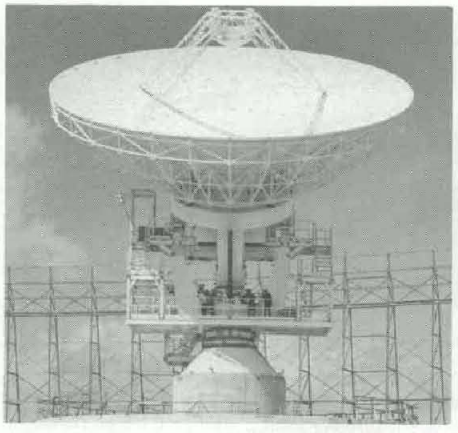
Being installed under contract with the Ballistic Missile Defense Systems Command, the antenna is expected to achieve "significant long-term cost savings."

Described as a "unique" KMR design, the system includes a 60-foot parabolic dish and 335,000-pound antenna structure, encased in a space frame radome about 100 feet in diameter for environmental protection. Operation and maintenance areas are within the radome. Installation is programed for completion in April.

The AN/FSC-78 terminal will be capable of serving three separate satellite links from different geographic locations within a 9,000-mile viewing range of the satellite transponder.

The links will have separate wideband capability for real-time data transmission in support of the most sophisticated KMR user requirements — reportedly at a small fraction of the satellite power currently needed to support the low-capacity operations of the SCT-21 terminal.

Twenty-three terminals for use by the Army, Air Force and Navy are being procured by the U.S. Army Satellite Communications Agency from Aeronutronic Ford Co. They are being installed around the world and the KMR is the first terminal delivered under the contract.



AN/FSC-78 Terminal

600 Words a Minute...

Army Upgrading Teletypewriter Capabilities

Would you suspect you were being spoofed a bit if someone told you that the U.S. Army Electronics Command is testing an improved standard teletypewriter that spews out 600 words a minute - as part of the development of the Army Tactical Communication System (ATACS)?

That amazing speed has been routine for more than 5,000 hours of a planned 8,400-hour test cycle in progress 24 hours a day, seven days a week, without a failure of any kind. Moreover, the improved Army standard teletypewriter, the AN/UGC-74, will be upgraded to give it "intelligence."

Representatives of the House Appropriations Committee are scheduled to check on the prototype development in mid-April and New Jersey Congressmen have been invited to join them in viewing a prototype machine.

All of the improvements have been or are being made by ECOM in-house scientists and engineers in support of a planned production procurement of the Intelligent Communications Terminal AN/UGC-74, as the project is known. The Congress has granted conditional approval contingent upon successful completion of tests and modifications.

Six of the modified machines are involved in the 2-phase "life" testing program of the componentry in the ECOM Communications/ADP Laboratory. COL John P. Dobbins is heading the program for ATACS, with Frederick J. Petschauer assigned as senior engineer in ATACS Record Traffic Communications. COL Donald R. Lasher, director of ECOM's Communications/ADP Laboratory, has a major role and James Coulopoulos is project engineer.

Phase II will involve a change in the AN/UGC-74 electronics to provide "intelligence" through incorporation of a microprocessor, read-only memory, and random-access memories. The microprocessor with its computer programing will enable a teletypewriter operator to compose a message, edit any errors, change a word, add a sentence or paragraph, and check the message before transmission.

The R&D team reports that other features possible with the new technology are operator prompting for message header information and storage of addresses. The "intelligent" terminal will thus be able to transmit and receive messages at different speeds with a constant printout.

ECOM and Fort Monmouth Commander MG Albert B. Crawford Jr. (second right) checks readout of 600 word-per-minute teletypewriter. With him are (from left) James Coulopoulos, project engineer; COL John P. Dobbins, PM; LTC A. B. Salisbury, C/ADP Lab.

Edgewood/EPA Unveil Portable Hazardous Materials Detection Kit

Prototype development of a man-portable field kit capable of detecting hazardous materials in inland waterways was announced recently by the U.S. Army's Edgewood Arsenal and the U.S. Environmental Protection Agency (EPA).

Completely self-contained, the kit is battery operated and contains a commercial spectrophotometer, pH meter, conductivity meter, a variety of specially designed equipment, and reagents.

Fully packed and complete with batteries it weighs 29 pounds and measures 8 by 10 by 24 inches. Shelf-available items were used in kit design wherever feasible.

Personnel from Edgewood's Detection and Alarms Branch, Development and Engineering Directorate fabricated the prototypes for EPA. They also provided EPA with manuals, engineering drawings and parts lists.

Sponsored by the Oil and Hazardous Materials Spills Branch of EPA's Industrial Research Laboratories, the 18-month development effort was geared toward requirements for a kit which is simple to use and quickly responsive.

EPA is specifically interested in waterways spillage control of about 370 contaminants (from a total of more than 3,000 spilled annually throughout the United States), many of which are released daily from plants, storage areas and barges. These particularly hazardous substances include alcohol, pesticides, phosphates, nitrates, sulfates and other industrial chemicals.

Following various surveys by the Edgewood R&D team, a concept was developed based on use of multiple non-specific detection systems. A representative list of 33 compounds was used to evaluate possible detection procedures.

After an initial screening, promising methods were further evaluated against samples of natural waters polluted in the laboratory with compounds from the representative list.

Edgewood concluded that about 15 test procedures might be adequate in detecting a significant portion of the contaminants. It was further estimated that 85 percent of these substances would respond to at least one of these test procedures.

Significant achievements of this effort will be presented at the 1976 National Conference on Hazardous Materials Spills in New Orleans. Edgewood's Achille Silvestri, project manager for the effort, will present "Detection of Hazardous Substances."

New AEHA Seater Device Assures Easier Earplug Insertion

Easier insertion and seating of two types of preformed Army earplugs is assured by using a new device invented by Dr. Doug Ohlin, an audiologist with the U.S. Army Environmental Hygiene Agency, Aberdeen Proving Ground.

The earplug seater can be used for inserting single or triple-flange earplugs. Introduced into the Army in 1945, single-flange plugs led to development of the improved triple-flange type.

Current triple-flange earplugs are much softer and more comfortable than their forerunners but Dr. Ohlin says they are "about as easy to insert and seat as a wet noodle."

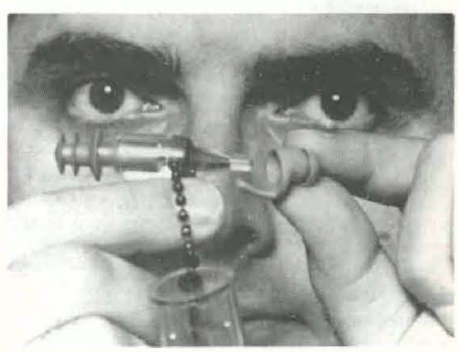
Chief of AEHA's Hearing Conservation Branch, Bio-Acoustics Division, Dr. Ohlin designed the earplug seater after noting that U.S. Air Force personnel were using retracted ballpoint pens to aid in inserting and seating their earplugs — a practice that could lead to accidental puncture of an ear drum.

The seater holds the plug steady during insertion and gently seats the plug at the proper place in the ear canal with a special retracting device. Dr. Ohlin advises that all earplugs should be initially fitted by medical personnel.

As a result of his invention, Dr. Ohlin recently received a $2,500 cash award, reportedly the largest suggestion award ever presented to an APG civilian employe. When mass produced, seaters will be issued with all Army earplugs.

A $1,000 award for suggesting color coding of different size earplugs was also presented to Dr. Ohlin and MAJ Roy Sedge, director of the Army Audiology and Speech Center, Walter Reed Army Medical Center.

Dr. Ohlin has indicated that hearing loss, which results largely from noises encountered during weapons training, is considered the Army's leading occupational health hazard. In Fiscal Year 1975 alone, he said, the Department of Defense paid out $61 million for hearing loss disabilities.



EARPLUG SEATER simplifies insertion of single or triple-flange earplugs.

Research Reports Throw New Light on Leprosy Source

Leprosy, a disease that currently affects more than 10 million people and was dreaded as one of the scourges of ancient days, may have its origin as a bacterium of the soil, study of captured wild armadillos indicates.

Researchers at the U.S. Armed Forces Institute of Pathology (AFIP), Washington, DC, and the Gulf South Research Institute (GSRI), New Iberia, LA, have been investigating the armadillo since 1971, when AFIP began work as a project of the Leprosy Registry, American Registry of Pathology.

Recent findings of pathologists in the Geographic Pathology and Microbiology Divisions of the AFIP are based on studies of 18 animals that have been infected naturally and 30 to 40 armadillos experimentally infected with the leprosy bacilli in 1971.

GSRI scientists reported (December 1975 issue of the Journal of the Reticuloentdothelial Society) that they had discovered a leprosy-like disease occurring naturally in seven wild armadillos brought in from southern Louisiana.

AFIP researchers released a report in mid-March 1976 stating they could not detect any difference in leprosy induced experimentally in armadillos in 1971 and the naturally occurring leprosy-like disease in the wild armadillos.

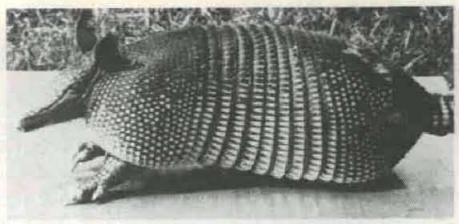
Tissue from experimentally infected animals indicated that the infection resembled leprosy bacilli taken from human patients but that the disease was much more extensive in that it infected many internal organs of the armadillos.

Several hundred grams of leprosy bacilli can be obtained from one infected armadillo. Thus, for the first time in the thousands of years history of leprosy, biochemists, immunologists and others collaborating with the World Health Organization (WHO) can study large quantities.

Human leprosy bacillus stains and looks like the bacillus that causes tuberculosis but has many distinguishing characteristics — principally that it selectively invades nerves, a peculiarity unknown for any other bacillus discovered to date in man or animals. The leprosy-like bacillus from armadillos regularly affects the nerves.

Investigators have long concurred generally that the ultimate identification of bacilli believed to cause leprosy depended on the skin reaction in man to suspensions of dead bacilli. Naturally infected armadillos gave the same type of skin reactions as known human leprosy bacilli; biochemical reactions of these two bacilli also were similar.

AFIP researchers say all these lines of evidence indicate that the disease found in the armadillos trapped recently in southern Louisiana is caused by a bacillus indistinguishable to date from the human leprosy bacillus.



Mini-banded Armadillo

Still awaiting an answer based on further investigation is the question: Since the armadillo spends much of its life in burrows, lives on insects in the soil, and is in constant contact with the soil, is it possible that the first human patients with leprosy were infected from a soil bacillus?

Dr. Salk, Dr. Sabin Address Edgewood Immunology Panel Discussion

World renowned scientists Dr. Jonas Salk and Dr. Albert Sabin, famed for development of poliomyelitis vaccines, formed a panel with three other distinguished researchers during a recent evaluation of the Edgewood Arsenal immunology research program.

The panel was invited to Edgewood Arsenal, an element of the U.S. Army Materiel Development and Readiness Command's Aberdeen (MD) Proving Ground, to appraise the future potential of the immunology research activities—primarily vaccines against chemical agents.

Serving on the panel were Dr. Paul Maurer, professor of biochemistry at Jefferson Medical College in Philadelphia, PA, Dr. Donald Reis, professor of neurology at Cornell University Medical College, and Dr. Earl Zimmerman, a neurologist with the College of Physicians and Surgery, Columbia University.

Assistant Surgeon General of the Army BG Kenneth R. Dirks represented the Office of the Surgeon General during the one-day conference.

Honored by President Eisenhower in 1955, and cited also by Congress for research that resulted in development of the prophylaxis vaccine against polio, Dr. Salk is the founding father and resident Fellow of the Salk Institute for Biological Studies at LaJolla, CA.

Dr. Sabin developed the oral vaccine against polio and has been honored by more than 25 nations for this and other contributions to medical science. Currently a research professor of biomedicine at the Medical University of South Carolina, he served in 1970-72 as president of the Weizman Institute of Science at Rehovot, Israel, and at the same time was a member of the board of governors at the Technion in Haifa and University of Tel Aviv.

POLIO VACCINE developers Dr. Albert Sabin (left) and Dr. Jonas Salk headed a 5-man panel of scientists to evaluate Edgewood Arsenal's immunology research program for chemical agent vaccines.

Large Sectionalized Model Eye Designated for Instruction

Construction of a human eye six times larger than normal - with all elements painstakingly scaled to size and put together much like a puzzle for rapid disassembly when used in instructional lectures - is being created at the Armed Forces Institute of Pathology (AFIP), Washington, DC.

Medical sculptor Norman Nusinov, employed in the AFIP Medical and Scientific Illustration Division, located on the grounds of Walter Reed Army Medical Center in Washington, DC, believes his model eye will be unique when completed.

CONSTRUCTING A GIANT EYE. A 3-dimensional eye is being created by Norman Nusinov, a medical sculptor for the Medical and Scientific Illustration Division of the Armed Forces Institute of Pathology. Each part of the model is six times normal size.

Each part of the exterior of the eye - eyeball, arteries, veins, nerves, muscles and glands - is fitted into the bony orbit in 3-dimensional form. Students will be able to put each component in place. Plans are being considered to make an eye atlas or orbital anatomy from the model.

The AFIP public medical museum is closed until construction of the facilities for The Uniformed Services University of the Health Sciences, Bethesda, MD, is completed in 1978. Some AFIP space is being used for the university and only the portion of the museum used for instructional purposes is open. When the public section is reopened, the model eye is expected to be an attraction.

Nusinov received instruction as a studio art major and pre-med student at the University of Maryland, graduating in 1972. He was one of two students selected from over 300 international applicants to attend the art-as-applied to medicine program at the University of Toronto, where he studied anatomy, radiology, surface anatomy, neuro-anatomy and human embryology.

Nusinov's initial goal as a sculptor is to make his service at AFIP widely known to medical students. He plans to make a series of good working aids in various medical fields.

Law May Affect Reservists Call-Up

Pending U.S. House of Representatives approval is a bill to authorize active duty call-up of 50,000 National Guard members and Reservists for up to 90 days without requiring a formal declaration of war.

The President is now required to declare a national emergency for such action, receive approval of state governors, or request volunteers to augment active duty forces. This legislation will increase reliance on Reserve components and allow more Presidential flexibility during emergency situations.

Consultant Donates Research Collection to WES

EXPRESSING APPRECIATION to Prof. Arthur Casagrande (third from left), professor emeritus of Harvard University and consultant to the Waterways Experiment Station (WES), for his contribution of a prized collection of technical books and papers to WES are (from left; LTC R. K. Hughes, WES deputy director; E. L. Dodson, chief, Geotechnical Branch, OCE; J. P. Sale, chief, Soils and Pavement; COL G. H. Hilt, WES director; S. J. Johnson, assistant.

Researchers in soil mechanics, foundation engineering, hydraulics and the technology of earth and rockfill dams can find a source of vast knowledge in a new Arthur Casagrande Room at the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS.

Prof. Casagrande, one of the world's most honored authorities in this field - after more than 40 years of continuing notable contributions to scientific advances at Harvard University and Massachusetts Institute of Technology - recently donated to WES a portion of his collection of books, files, technical papers, and soil and rock samples. He plans to add later to this collection.

Still a Gordon McKay Professor Emeritus of Harvard and a consultant to WES, Prof. Casagrande partially retired in 1969 but maintains a lifetime office at the university and continues a private consulting service.

During World War II, at the request of the U.S. Army Corps of Engineers, he trained about 400 officers on soil mechanics aspects of airfield construction in an intensive 4-week course.

After emigrating from his native Austria to the United States in 1926, he worked with Carnegie Steel Corp. until he sent a letter to MIT setting forth his qualifications. This gained him an interview which resulted in his selection as an assistant to Dr. Karl Terzaghi, a world authority in soil mechanics and foundation engineering. He later returned with Prof. Terzaghi to Austria to equip a soil mechanics laboratory in Vienna, and to tour all soil laboratories in Europe.

Following his return to the U.S., Casagrande built a triaxial cell for measuring soil strength, along with a direct-shear machine, and made the first consolidation tests in the U.S. on undisturbed soil samples.

Offered a half-time lectureship at Harvard to introduce a school of soil mechanics, he later initiated a course in foundation engineering, and in 1933 started a course in laboratory testing believed the world's first of its kind.

Prof. Casagrande began his long association with WES in the mid 1930s and in 1939 persuaded WES leaders to begin the Cooperative Triaxial Research Program that was conducted at Harvard and MIT during the early part of World War II. A summary report was published in 1944. He also is credited with introducing new ideas in frost action, highway and airfield design seepage, and foundation engineering design, as well as in earth and rockfill dams.

Much of his early education was in Germany and at the age of 17 he entered the Technical University in Vienna. Based substantially upon his scientific contributions and publications in the United States, he received a doctorate in engineering from TUV in 1933.

Edgewood Verifies Acid Resistance of Polyester Fiber

Emergency crews working in an acid environment should use lifesaving lines made of polyester fibers rather than natural hemp, researchers at Edgewood Arsenal, a part of Aberdeen Proving Ground, MD, have verified. The difference may be life or death to workers.

Investigation of the qualities of natural hemp in contrast to support lines made from various synthetic fibers was initiated at the request of the Army Technical Escort Center (TEC) when one of its teams responded to an emergency call.

Workers found that life-saving support lines made of hemp deteriorated rapidly after several hours at the disaster scene. The rescue squad was dealing with the problem of thousands of gallons of silicon tetrachloride leaked from a bulk storage tank. When mixed with water, the spill formed hydrogen chloride gas, hydrochloric acid solutions, and a deadly mist.

The disaster area was sealed off for nine days and residents evacuated while members of the Chicago Fire Department rescue squad and 19 members of the TEC emergency crew joined in controlling the spill and in clean-up operations.

Edgewood Arsenal scientists recommended polyester lines as a substitute for hemp lines when the request for assistance came in, but they did so only on the basis of published literature. Three months of intensive testing of various types of life-saving lines proved the soundness of the recommendation.

Polyester lines subjected to 72 hours exposure in a 1.5 percent solution of hydrochloric acid remained unchanged while hemp rope deteriorated rapidly. Even in a concentrated solution the polyester lines degraded only 15 percent during a 7-day exposure at room temperatures. Ropes given an acid-resistant finish did not show discernible benefits.

Tensile tests showed that polyester did not have acid resistance superiority over nylon. However, nylon was judged "very springy," to an unnerving degree for suspended workers.

'White Layer' Phenomenon Simulated at Watervliet

Simulation of the "white layer" erosion phenomenon in the firing of cannons, under scientific investigation for some 40 years, was achieved recently for the first time in a laboratory at Watervliet Arsenal, NY, the U.S. Army Armament Command design and development agency.

The research breakthrough is credited to Dr. Michael Kamdar, a research scientist, and associates in the arsenal's materials engineering division.

Investigations were under direction of Mrs Theresa Brassard, head of the Metallographic Laboratory, who conducted the metallographic analysis of the microstructure. Team members included Donald Winters, electronics engineer, and Harry Nazarian and John Zalinka, physical sciences technicians.

When a cannon is fired severe damage occurs to the metal on the bore surface of the gun tube, subsequently reducing the useful life of the cannon. This surface erosion, this gradual "eating" or wearing away of the metal, takes place during firing of the very first round and continues during subsequent firings until the inside bore surface has been damaged to a point where accuracy is seriously affected.

Scientists concluded long ago that this detrimental effect originates when the "white layer," microscopic in size, is formed in the bore surface metal. This thermally altered zone is composed of several smaller white layers associated with cracks and is formed across the inside surface of the cannon during firing.

Dr. Kamdar and associates achieved the simulation by employing a pulse heating technique which utilizes two high-voltage capacitors. A sample of gun steel is placed within a vacuum chamber, subjected to extremely high temperatures by electrical resistance, then quickly cooled in a selected atmosphere similar to that inside a cannon tube during firing.

Dr. Kamdar and his group now have the means of understanding how and why these thermally affected white layers begin to form. Eventually they hope to learn what can be done to eliminate or prevent their formation in order that the projected life-span of a cannon may be extended.

Watervliet Arsenal researchers (from left) Dr. Michael Kamdar, Donald Winters and Harry Nazarian remove a gun steel test specimen from a vacuum chamber where it has been pulse-heated to simulate damaging "white layer" altered zone of real firings.

Army Viper Nears Engineering Development Phase

Viper, the Army's new light antitank weapon developed from drawing board to complete prototype within laboratories of the U.S. Army Missile Command (redesignated Army Missile R&D Command, effective Oct. 1), will soon enter engineering development.

Viper Project Manager COL Hubert W. Lacquement heads an office established recently at Redstone Arsenal, AL, and authorized 34 civilians and three military personnel. Bernie Cobb, project engineer who directed Viper R&D, is civilian deputy. COL Lacquement formerly was at HQ Army Materiel Development and Readiness Command as executive officer, Research, Development and Engineering Directorate.

Viper is a direct fallout of an intensive Short-Range, Man-Portable, Antitank Weapon Technology Program conducted in-house throughout the Army Materiel Command in 1971-72 to establish an up-to-date Army technology base.

The MICOM Propulsion Directorate developed a carborane propellant for Viper that has a high burning rate, is insensitive to temperature, and permits firing high-performance rockets from lightweight launchers.

The Ground Equipment and Materials Directorate did detailed design work, material selection and fabrication. This directorate's advancements in composite fiberglass technology paved the way for lightweight launch tubes and future rocket motors.

The Aeroballistics Directorate conducted in-depth design tradeoffs and analysis. The Advanced Systems Concepts Office was responsible for program management and system engineering. The Test and Evaluation Directorate did everything from static testing to live firings and data reduction.

Other AMC (DARCOM) agencies in-house efforts were essential to the successful development of the initial prototype rocket. The warhead designs and composite fiberglass launch tubes were evaluated by the Ballistic Research Laboratories. A successful dual safety fuze was developed by the Harry Diamond Laboratories. The Human Engineering Laboratory evaluated the effects of varying weight and size on the carrying ability of the individual soldier under realistic training conditions to determine portability limits.

MICOM has sent proposals to more than 60 companies and is evaluating responses prior to awarding a contract for Viper engineering development. MICOM reports the weapon will weigh 6 to 7 pounds and is substantially more powerful, accurate and effective than the system it is designed to replace, the M-72 LAW.

Natick Claims Improvement To Clean Ammo Effluents

Development of a "cheaper, more practical" way to clean pollution effluents from waste waters at ammunition plants, prior to disposal in streams, was announced in March by the U.S. Army Natick R&D Command.

Based on "encouraging results" of pilot plant studies, full-scale operations are being considered for Army and Navy munitions plants, the NARADCOM announcement stated. Ecological and economic advantages of a new recyclable resin were demonstrated during experimental operations.

Waste waters were fed into columns containing polymeric resin formed from a copolymer of styrene and divinylbenzine or acrylic esters. When the resin became saturated with TNT wastes, the water was drained.

Acetone, a common organic solvent, was then introduced to "wash" the resin and safely remove explosive contaminants. The column of small, insoluble plastic filter beads was then ready for operation again.

The experimental process may present a more efficient solution for the "pink water" effluents problem involved in TNT and TNT-base munitions production. Currently, a carbon adsorption method is used. Because the filtered impurities are highly explosive, they cannot be safely burned off from the adsorbent beds. When saturated, they must be replaced.

Practicability of continuous regeneration of resin used in the filtering columns of the new process, without any loss in adsorption efficiency, was demonstrated in pilot plant tests, according to the Natick announcement.

8 Pershing Off-Range Firings Scheduled to Impact at WSMR

Scheduling of an 8-round series of Pershing missile off-range firings for impact against ground targets at White Sands Missile Range, NM, was announced Mar. 17.

Six rounds will be fired from McGregor Range, a Fort Bliss launch site north of El Paso, TX, two rounds each on May 4, 18 and June 2. Two rounds will be fired from Fort Wingate, NM, June 29.

The first four rounds from McGregor Range will be fired by units from the Federal Republic of Germany Air Force, followed by two rounds from Fort McGregor and two from Fort Wingate by the Seventh U.S. Army Europe. Support for all of the firings will be provided by the 9th Field Artillery, Fort Sill, OK.

Performance of the firing units will be evaluated by a multi-agency team of umpires led by the U.S. Army Field Artillery Missile Systems Evaluation Group, Fort Sill, complemented by representatives of U.S. and German commands from Europe.

Other participants and support elements will represent the U.S. Army Missile Command, Picatinny Arsenal, and WSMR elements, including the Army Materiel Test and Evaluation Directorate, and National Range Operations.

Army Science Conference Paper Reports on Infantry Helmet Development

Four technologists from the U.S. Army Natick Research and Development Command, Natick, MA, will present a paper on the development of a new infantry helmet at the 10th Army Science Conference, June 22-25, at the U.S. Military Academy, West Point, NY.

PROPOSED Infantry Helmet

Coauthored by Lawrence R. McManus, Philip E. Durand, Dr. William D. Claus Jr. and John H. Greendale, the paper will report on their work in producing the first completely engineered Army helmet through a joint effort by several Army laboratories.

The proposed helmet, a radical change in design from the standard M-1 Hadfield now in use, incorporates a one-piece construction with a low profile and low center of gravity.

If it passes design engineering and Phase II operational testing, it will provide the soldier with maximum head coverage and increased ballistic protection without weight increase.

Engineer design test results indicate that the new helmet, with its simplified cradle suspension and open cup chinstrap, fits better and is more comfortable than the model in service.

The biennial Army Science Conference provides an opportunity for Department of the Army civilian and military scientists and engineers to present the results of their research efforts to critical members of the scientific community. Medallions, honoraria and certificates will be awarded for the best papers.

Prototype Inverter Advances Lightweight Energy Plant Progress

Development of a family of silent, lightweight electric energy plants (SLEEP), a long-term project of the U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, advanced recently with successful testing of a prototype inverter for use with a 1.5 KW fuel cell power source.

MERADCOM's announcement of the inverter termed it "a major advance" as the first relatively low-cost, simple device capable of changing the normal variation of direct current voltage output of the fuel cell to the constant alternating current voltage generally desirable for operation of forward-area equipment.

Dietrich J. Roesler, project engineer, said the inverter means that 10,000 fielded 1.5 KW fuel cells can be employed in the ac voltage mode.

Significance of the inverter assumes added importance in view of the fact that as many as 20,000 fuel cells will be needed to provide single-phase ac output - 120 or 240-volt at 60 Hertz - to power surveillance and other forward-area equipment where silent operation to avoid detection is critical.

Reliability of the inverter is established by its record of more than 5,000 hours of experimental operation without a relevant failure or distortion of the sine wave output. It can accept a variable dc input ranging from 30 volts to 60 volts and application within this range is not limited to fuel cells.

MERADCOM reports the inverter can be used with other dc power sources, including solar cells, wind-power generators and batteries.

The prototype inverter is being redesigned to improve efficiency and operation, particularly in regard to electromagnetic interference (EMI). A follow-on development eliminating the transformer output stage is expected to produce an inverter of decreased cost and weight.

Army Science Conference Principal Speakers, Panel Members Programed

Dignitaries programed for principal roles in the tenth U.S. Army Science Conference, June 22-25, include Under Secretary of the Army Norman R. Augustine, Assistant Secretary of the Army (R&D) Edward A. Miller and Deputy Chief of Staff for Research, Development, and Acquisition LTG Howard H. Cooksey.

From 350 to 400 invitees representative of the Department of Defense, U.S. Army R&D leaders and in-house laboratories, and high officials from British, Canadian and Australian defense agencies are expected to gather at the U.S. Military Academy, West Point, NY, where all previous ASCs have been held.

Under Secretary of the Army Augustine, banquet speaker, has selected "The Bicentennial Army" as the subject of his address. Keynote speaker LTG Cooksey had not announced his topic at press time. ASA (R&D) Miller will present awards to authors and coauthors of the best papers selected by a distinguished panel of judges from 120 papers prepared for the conference.

"Technology Transfer and the Army" is the topic for a panel discussion that will be chaired by MG Charles D. Daniels Jr., special assistant to GEN John R. Deane Jr., commander, U.S. Army Materiel Development and Readiness Command (DARCOM). MG Philip R. Feir, assistant to LTG Cooksey and assistant DCSRDA for International Programs, is scheduled to be master of ceremonies at the banquet.

In addition to MG Charles D. Daniel Jr., the discussion panel will include: Dr. John L. Allen, Deputy Director (Research and Advanced Technology), Office of the Director of Defense Research and Engineering; COL Thomas W. Kelly, chief, Doctrine and Systems Integration Division, Requirements Directorate, Office of the Deputy Chief of Staff for Operations and Plans, HQ DA; Dr. John L. McDaniel, director, Research, Development and Engineering Laboratory, U.S. Army Missile Command, and Dr. Joseph Sternberg, Director, Advanced Systems, Martin Marietta Aero-space.

Dr. Marvin E. Lasser, Army Chief Scientist and Director of Army Research, also will serve as presiding chairman of the conference. Arrangements are being made by an advisory group headed by Dr. Ivan R. Hershner, assistant director for research programs on Dr. Lasser's staff. Other members are Dr. Gordon L. Bushey, physical scientist, U.S. Army Materiel Development and Readiness Command; Dr. Hermann R. Robl, scientific director, U.S. Army Research Office, Durham, NC; William B. Taylor, chief, R&D Office and assistant to the Army Chief of Engineers; and COL Phillip E. Winter, chief, Research Planning Office, Office of the Surgeon General, DA. Donald C. Rollins, ARO, is project officer and Anne G. Taylor is executive secretary.

Awards to be presented by ASA (R&D) Miller will include the Dr. Paul A. Siple Silver Medallion, bronze medallions bearing the Army Research Office crest, Certificates of Achievement and from $3,500 to $4,000 in cash honorariums, the latter provided by the Army Incentive Awards Program. Ninety-six technical papers are programed for presentation.

Dr. Lasser is chairman of the panel of judges that will select prize-winning papers. Members are Dr. Robert A. Beaudet, professor of chemistry, University of Southern California at Los Angeles; Dr. David L. Fried, optics science consultant; Howard Gates Jr., private consultant; Dr. Richard O. Hundley, program manager, Research and Development Associates; and Dr. Herbert L. Ley, former U.S. Food and Drug Commissioner, now a consultant.

HDL Demonstrates XM734/81mm Fuze Mortar Adaptability

Adaptability of the XM734 Multi-Option Fuze to the 81mm mortar was demonstrated recently by the U.S. Army Harry Diamond Laboratories, Adelphi, MD, with a reported 100 percent successful feasibility test. A proposal is being prepared for initiation of a research, development, test and evaluation program.

Currently in its final stage of development and acceptance testing for the new 60mm Lightweight Company Mortar System, the XM734 fuze has demonstrated better than 99 percent system reliability. No premature functions of the fuze have been experienced.

In the recent tests, an XM734 fuze was used with a standard T211 adapter to the 81mm mortar round. When used in this configuration, the multi-option fuze will be designated the XM741.

Representatives of the U.S. Army Training and Doctrine Command, U.S. Army Materiel Development and Readiness Command, the U.S. Marine Corps Development and Education Command witnessed the demonstration. The purpose was to prove the feasibility of using a single fuze 60mm and 81mm mortars.

The new fuze, as its name indicates, allows the mortarman to choose the warhead detonation-airburst or proximity, near-surface burst, impact detonation, or delay burst, as his target of opportunity is encountered.

Use of this fuze will allow the elimination of seven different fuzes from the Army inventory. Other advantages include reduced training time for mortarmen, increased safety and reliability.

Technological advances incorporated in the fuze include a fluidic sensor that provides an arming signature by integrating the projectile velocity for the desired time to give the minimum safe-arming distance while providing power to the electronic monitor assembly.

The safety and arming mechanism is driven by the fluidic turbine/alternator sensor. An independent setback sensor recognizes the proper sustained launch acceleration, thus meeting the latest dual-safety requirements.

Complementary Metal-Oxide Semiconductor (CMOS) electronic technology in the signal processor provides improved reliability without increasing production costs and space needs.

The XM734 is scheduled for type classification this summer.

Army Type Classifies M732 Proximity Fuze for Artillery Shells

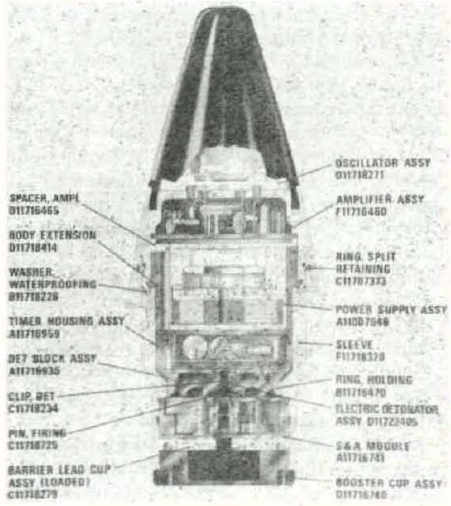
The U.S. Army has type classified the M732 proximity fuze for high-explosive field artillery shells, thus introducing the third generation of artillery proximity fuzes engineered by the Army Materiel Development and Readiness Command's Harry Diamond Laboratories.

Advantages of the M732 over the current M514A3 and M728 standard artillery proximity fuzes are basically threefold. First, the fuze intrusion into the shell has been reduced to the same length as point detonating and mechanical time fuzes. This reduces the need for deep-cavity shells and supplementary charges, thereby saving approximately 70 cents per round.

A secondary gain is that the new design eliminates the present restriction on firing the older proximity fuzes at charge 7 in the 105 millimeter howitzer.

Lastly, the new design incorporates a new electronic arming timer that will eliminate the need for precision mechanical clocks. This reduces the mobilization expense of maintaining a decreasing industrial base.

Additional features of this fuze are a compact mechanism that provides about 500 calibers of safe air travel, and a mechanical impact element that provides a back-up function to eliminate duds. In the latest series of tests, 830 rounds were fired and 828 functioned for a 99.76 percent score. No early initiations of the fuze were experienced.



M732 Fuze Configuration

Aerobee Sounding Rockets Collect Comet West Data

Spectroscopic studies of Comet West, the world's most recently discovered comet, are being made from data collected by three Aerobee research sounding rockets launched in March from White Sands Missile Range, NM.

Data was collected in the ultraviolet and far ultraviolet regions to identify minor elements present in the atmosphere of the new comet. The rockets carried instrument payloads ranging from 321 to nearly 430 pounds and traveled at nearly 70 miles a minute to altitudes ranging from 110 to 138 miles.

Sponsored by the National Aeronautics and Space Administration, the data-collection firings involved project scientists Dr. P. Feldman, Johns Hopkins University; Dr. C. Opal, Naval Research Laboratory; Dr. G. M. Lawrence and Dr. G. Rottman, University of Colorado Laboratory for Atmospheric and Space Physics; and Dr. A. M. Smith, Goddard Space Flight Center.

Bicentennial Science Exposition Scheduled for JFK Space Center

Cape Canaveral's John F. Kennedy Space Center will have a complementary "colossal" attraction, to help lure millions of Americans to Florida this summer, in the U.S. Bicentennial Exposition on Science and Technology.

Themed on "A Better Life in Third Century America," and open from May 30 through Labor Day in September, the exposition will celebrate the American state-of-the-art in science and technology and its prospects during the next 100 years. All federal agencies and major industries engaged significantly in research and development activities will participate.

Commenting on the exposition from The Cabinet Room in the White House, President Ford stated recently:

"... When we look at what can be done with science, whether it is in climate or energy, in food, in health, or in a wide variety of other areas, we should be emphasizing very dramatically to the people who will come and see it the prospects for a better way of life in 1976 and the next 100 years thereafter..."

Fifteen large geodesic domes will house the exposition, located in the shadow of the world's third largest building — the Vehicle Assembly Building. There the Saturn rockets were prepared which sent man to the moon and boosted America's first large space station into earth orbit. Visitors will witness the final minutes of countdown, liftoff and early phases of flight in the same way NASA's pioneering teams did.

The Department of Defense will display exhibits in one of the geodesic domes in the Federal Agency Pavilion designed to portray how the military services have contributed to science and technology through the years.

U.S. Army exhibits, for example, will show how military R&D activities are helping mankind in an unusual variety of ways. Wide-ranging in scope, the exhibits will feature:

- Food Research (Natick R&D Command) including methods of processing meats and vegetables to be stored on a shelf for years and then returned to their natural state in minutes.
- Advanced Communications (Satellite Communications Agency) including a back-pack device that will allow an individual to communicate with satellites.
- Fluid Controls Technology (fluidics). Arranged by the Harry Diamond Laboratories, this exhibit will show how advanced research permits common fluids to do uncommon things in control systems with numerous potential advantages to military, industry and in homes.

Each of the Military Departments will provide bands and aerial demonstrations on a rotating basis throughout the 100-day duration of the exposition. Aerial demonstrations currently being planned to demonstrate the latest in technological developments in design include the F-14, F-15, F-16 and AV-8A Harrier aircraft. The Navy's Blue Angels and Air Force Thunderbirds have been requested to perform.

Each of the domes will offer fascinating exhibits of the marvels of modern science. The Environmental Protection Agency (EPA) pavilion, for example, will show how Americans can correct environmental errors of the past and prevent them from occurring in the future. Both capabilities and limitations of science and technology will be displayed.

The Department of Health, Education and Welfare will show how better health and longer, more active lives are resulting from technological advances in medicine. Visitors will be able to take on-the-spot tests for hypertension and other health problems, administered by qualified medical personnel to those interested.

The National Science Foundation exhibit will focus on how scientists perceive familiar phenomena in considering ways that technological advances can improve the quality of human life. A multi-media approach will be used to show the ancient Greek concept of the universe as composed of four fundamental elements — Earth, fire, water and air.

The Department of Agriculture exhibit will portray the demand for agricultural knowledge, the problems farmers will have to face, and the progress in plant genetics, insect control, land management, multiple crop tillage, waste recycling and food inspection.

Other federal agencies will have similarly exciting displays to depict their contributions to scientific advances that offer the prospect for a better life in the future.

SAM-D Full-Scale Engineering Authorized by DSD Clements

Negotiations to complete full-scale engineering development of the SAM-D (Surface-to-Air Missile Development), based on authorization early in March from Deputy Secretary of Defense William P. Clements, were scheduled to begin as this edition of the *Army Research and Development Newsmagazine* went to press.

In a letter to Secretary of the Army Martin R. Hoffmann, the DSD said authorization to proceed with full-scale ED was based on SAM-D's highly successful proof-of-principle flight tests. SAM-D tests had achieved 21 "complete successes" and one partial success in 24 firings as of mid-March at White Sands Missile Range.

SAM-D Project Manager MG Charles F. Means said more advanced tests will be scheduled at WSMR this year, using the first tactical prototype of the fire control group. One of the goals now, he said, is to reduce production costs without sacrificing user requirements.

Testing of the TVM (track via missile) guidance results and studies, DSD Clements said in authorizing full-scale engineering development, indicate that SAM-D will be "the most cost-effective solution for our high and medium altitude air defense needs."

Army 2-Man Submarine Aids Kwajalein Test Operations in Debris Recovery

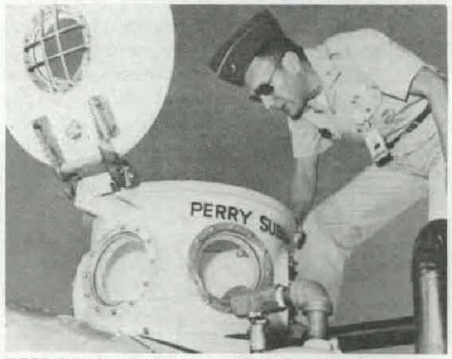
One of the first surprises experienced by BG John G. Jones when he took command of the U.S. Army Ballistic Missile Defense Systems Command, headquartered at Huntsville, AL, was to learn that his responsibilities included operation of a submarine at a missile range.

Assigned to the command's Kwajalein Missile Range in the Marshall Islands in the Pacific Ocean, the 2-man submarine has an important role in test operations. Designated a Department of Defense National Missile Range, Kwajalein is the only U.S. facility where scientific data on the terminal portions of flights of intercontinental ballistic missiles can be gathered by land-based instruments.

After a flight of nearly 4,000 miles, ICBMs fired from Vandenberg Air Force Base in California splash down in the Kwajalein lagoon. Contractor personnel use the submarine to locate debris for study by Army, Navy and Air Force scientists on effects of space, speed and heat on the nose cones.

Until the submarine was pressed into service, scuba divers used to locate the debris, but at depths of about 200 feet they could be effective for only about 10 minutes each day. Sometimes costly delays of several days were involved in recovery operations. The submarine can remain submerged for several hours. Recovery of debris is reduced to a matter of hours.

The first 2-man submarine used in recovery operations made about 500 dives before it was given a place of honor in the Alabama Space and Rocket Center. The new PC-14 thus became the second submarine used by the U.S. Army.



BMDSC Commander BG John G. Jones examines Army's 2-man submarine used to locate missile test debris on the floor of the Kwajalein lagoon in the Pacific Ocean.

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

Army Readiness Posture: Requirements to Meet Forseeable Threat

defense capability to all of its Active divisions. Over the next two years, the Army plans to procure sufficient Chaparral missiles to meet war reserve stock requirements. The missile to be procured is an improved version which provides a capability to engage incoming aircraft that the current missile does not have.

Looking to the future, the Army's plan is eventually to provide the Roland air-defense system to the Active divisions, with the Chaparral being transferred to the Reserve Components.

Antiarmor Missiles. In its eighth year of production, TOW is a heavy antitank weapon that can be employed on the ground, mounted on a variety of military vehicles, and fired from helicopters. Its maximum range is three times the 106mm recoilless rifle, yet it weighs only half as much. With the present program, the requirements of deployed U.S. forces for TOW will require continued procurement beyond FY 1977.

Dragon is a hand-carried antitank missile in the Army inventory which is capable of defeating enemy armor out to a range of 1,000 meters. The first tactical unit received Dragon in March 1975 and issue continues.

The first contracts for high-rate production were awarded in July and August of 1975. The fielding of Dragon will improve the Infantry platoon's ability to attack and defeat armor, providing a significant improvement in accuracy and lethality over its heavier predecessor weapon, the 90mm recoilless rifle.

Nonnuclear Lance. The Army needs the nonnuclear Lance (NNL). The capability exists today to locate targets beyond cannon range. Enemy command posts, assembly areas, supply depots, surface-to-air missile sites, and ammunition dumps are susceptible to strikes by nonnuclear Lance.

With its inherent accuracy, lethality and all-weather delivery capability, this missile can be delivered by the Lance battalions currently deployed in Europe. No further research and development effort is required, and initial procurement is included in the FY 1977 budget request.

Aircraft. The Army's aircraft program is designed to give units in the field a mobility advantage, and improved antiarmor and electronic warfare capabilities. Mobility advantage has been partially realized with the proven UH-1 series aircraft. However, the accelerated pace and violence anticipated on future battlefields require a higher performance capability.

The Utility Tactical Transport Aircraft (UTTAS) helicopter will give the Army, for the first time, the capability of lifting a full, combat-equipped squad under high-altitude and temperature conditions. The UTTAS will also be used in assault helicopter, air cavalry and aeromedical evacuation units.

The AH-1S, Cobra/TOW, helicopter will provide the airborne antitank capability required in the Army's tactical force pending introduction of the Army's Advanced Attack Helicopter (AAH). The procurement plan for the AH-1S will minimize the critical shortage in antitank helicopters until AAH procurement can be initiated in FY 80. These AH-1S aircraft will continue in service through the 1980s as the low side of the high/low mix for antitank attack helicopters.

Product improvements to modernize and improve the Army's current fleet of airplanes and helicopters are included in the aircraft program. The most essential improvements are in the areas of airborne electronic warfare and aircraft survivability (such as infrared signature suppressors and radar warning devices).

Ammunition. The Army's ammunition program provides for the procurement of ammunition to support training requirements on an annual basis and to build up the inventory of war reserve stocks. Research and development efforts over the past several years have been successful in developing new types of munitions which have greatly improved range, accuracy and lethality characteristics over existing conventional rounds. The ammunition procurement program has been designed to modernize the inventory with these new rounds over the next 5 to 10 years.

The FY 1976 procurement was the beginning of procurement of small quantities of these new rounds for the 155mm howitzer. Achievement of about 5 percent of modernization requirements with this year's request is planned, and 40 percent more is anticipated by the end of the 5-year program.

A substantial portion of the ammunition program is devoted to modernization and expansion of the production base. For the most part the production base is of World War II origin, and substantial resources are needed to assure that required modern production capacity is available, and that it meets environmental and safety standards. By the end of the current 5-year program, a little over half of the on-going 20-year effort will be completed in this area.

Chemical Warfare. The objectives of the U.S. chemical warfare policy and related Army programs are to deter the use of chemical weapons by other nations and to survive and retaliate should deterrence fail.

The Soviets have made substantial advances in the chemical warfare field. Their ability to operate in a toxic environment surpasses U.S. capabilities. An aggressive protection and warning program has therefore been implemented to correct weaknesses in the Army's defensive posture.

The Army's program objective in this regard is to equip individual soldiers and units with chemical protective equipment, and to replace items that are expended during increased chemical defensive training. The equipment to be purchased from the operation and maintenance appropriation, and the procurement appropriation, includes protective clothing, detection and alarm material, and decontamination items.

The Army continues to conduct investigations related to chemical accident and incident control, physical security, and movement of chemicals. There is a continuing need to upgrade storage site security. Although public laws severely restrict lethal chemical movement within the United States, there are possibilities for reducing operating costs by selective consolidation of storage locations.

Research and Development. With the growing Soviet emphasis on research and development in recent years, and the continuing erosion of the U.S. technological base caused by inflation, the Army is much harder pressed to maintain qualitative superiority than at any time since World War II.

Therefore, the Army's research and development program is being increasingly focused on a more selective number of high-payoff programs in an effort to provide the most combat-effective systems possible within resource limits.

For example, before embarking on a new research and development program, the Army first attempts to improve the products already fielded. Last year was a pivotal year in that the Congress undertook to reverse the downward trend of the Army's research and development effort when measured in real program dollars.

XM-1 Tank. The XM-1 tank is designed to provide a significant improvement to the Army's offensive ground combat capability with its improved ballistic protection, cross-country mobility and firepower. The XM-1 is in the development stages, however, and will not be fielded until the early 1980s, thus lagging deployment of the new Soviet T-72 by a number of years.

Total program costs, including inflation, are estimated to be $514 million for research and development and $3,931.6 million for procurement. Low-rate initial production is scheduled in FY 1979. The program to date has been very successful in meeting the original guidance of the Congress.

The prototype vehicles will be delivered to the Army in February 1976, and the competitive evaluation will be completed by 30 April. It appears that the winner of the competition could be ready to enter full-scale engineering development next August. The winning tank will enter a comparative evaluation with the German Leopard II (AV) tank in September 1976.

MICV (Mechanized Infantry Combat Vehicle). The MICV has been designed to provide significantly improved mobility, firepower, and armor protection. Operating with the Army's XM-1 tank, this vehicle will permit the infantry to fight while mounted and protected. Total program costs, including inflation, are estimated to be $93.1 million for research and development and $643.6 million for procurement.

A low-rate initial production contract is planned to be awarded in

(Continued on page 23)

Biological Studies of Electromagnetic Pulse

By Dr. Siegmund J. Baum
Chairman, Experimental Pathology Department
Armed Forces Radiobiology Research Institute
Defense Nuclear Agency, Bethesda, MD

Nuclear explosions generally produce a short, intense electromagnetic pulse (EMP) which, depending on the altitude, can radiate over many hundreds of miles. This pulse is produced by a flow of Compton electrons generated in the atmosphere as the front of gamma rays from the burst interacts with the air molecules.

Because of the very short rise time (~10 nanoseconds) and large amplitudes of the EMP, large voltages and currents can be induced in conductors exposed to the electromagnetic fields.

In the early phases of nuclear weapons testing, it was found that cables and electronic test equipment could be upset or damaged by the energy contained in the EMP; hence, EMP represents a threat to communication systems, missile guidance devices, computers, etc.

The understanding of EMP, its interaction with weapon systems and the prevention of damage, has, therefore, been a matter of great importance and concern in national defense.

This article reports on a study to relate the need for safety standards for workers in an EMP environment, as based on experiments with rodents.

Restrictions on atmospheric nuclear testing have made it necessary to construct simulators of an electromagnetic environment relatable to that produced by this type explosion for empirical investigation of military hardware — from small electronic components to large airplanes and ships.

EMP radiation may be described as a traveling wave consisting of transverse electric and magnetic oscillating fields. Amplitude of the oscillation is directly related to power density of the field. There could be an effective energy exchange from the electromagnetic field to the medium whenever these forces are sufficient to alter the kinetic or potential energy of the molecules in the medium.

A 3-cm microwave with a frequency of 10 GHz, however, has an energy of only 4×10^{-5} eV, which would preclude an effective energy exchange. A contributing effect of heat is not predicted because of the low average power of the EMP. Nevertheless, there have been a few reports attempting to show that illnesses suffered by some operators are associated with the testing of electronic equipment in EMP facilities.

Furthermore, some people in the field, assuming that a biological hazard existed, proposed safety standards to restrict healthy workers to field strengths of 50kV/m at one pulse per minute. The general public would be restricted to exposures of 200-300 V/m peak at a rate of no more than one pulse per minute.

To test the rationale of these safety standards, experiments were designed, based on the hypothesis that damage from exposure to EMP should be tested on biological systems, that could respond to rapid changes in electric and magnetic fields.

These could be systems with continuously high cellular turnover as seen in the embryo and in the adult bone marrow. The present experiment utilized the Armed Forces Radiobiology Research Institute EMP simulator which provided five pulses per second with a peak electric field intensity of 447 kV/m. The system specifications are as follows:

Transmission line:	parallel plates, 122 cm wide, 10 m long, 56 cm separation, 95 Ω impedance (with animal load and in shielded room)
Power supply:	two ± 150 kV dc supplies
Energy storage capacitors:	four 5-nF tubular capacitors, two series banks of two parallel capacitors; total capacitance in banks 5 nF
Spark gaps:	triggered, pressurized switch
Pulse shape:	double exponential
Rise time:	10 nsec
Fall time:	550 nsec (to 1/e of peak)
Peak field strength:	10-500 kV/m
Pulse repetition rate:	up to 7 pps or single shot
Energy per pulse:	160 joules maximum
Field power density:	66.3 kW/cm² peak (at 500 kV/m)
System line impedance:	95 Ω
Spectral content:	double exponential

This represents a condition in excess of that normally encountered by humans who operate EMP facilities.

The study report deals with rodents which were subjected continuously to EMP radiation for nearly all their adult life, receiving a total of 2.5×10^8 pulses. As may be seen from the table, none of the measured biomedical parameters indicated a significant difference between irradiated and nonirradiated rats.

EMP exposure caused no changes in the blood forming and reproductive organs. Female rats exposed throughout their gestation period to approximately 3.4×10^7 electromagnetic pulses gave birth to normal progeny.

Finally, exposure to electromagnetic radiation did not induce either earlier appearance or late increased numbers of tumors or any other cause of shortening life.

Results obtained in the present study clearly indicate that EMP radiation presented no biological hazard to rodents. Radiation exposure employed in the experiment represents a condition by factors of tens of millions in excess of that normally encountered by workers who operate EMP facilities.

If the negative effects observed in rodents hold true for larger mammals and man, they should have a great influence on future proposed safety standards. Based on the study results, the Occupational Safety and Health Administration determined that a proposed standard on exposure to electromagnetic pulses should not be issued at this time.

Summary of biological parameters after 2.5×10^8 pulses during 94 weeks of chronic EMP irradiation

Experiment	Animal species	Biological effects	
		Early*	Late+
Blood chemistry	Rats	None	—
Blood count	Rats	Variable	None
Bone marrow	Rats	None	None
Chromosomal aberrations	Rats	None	None
^{59}Fe uptake	Rats	None	—
Embryology	Rats	None	None
Fertility	Rats	—	None
Histology	Rats	None	None
Leukemia	Mice	None	—
Mammary tumors	Rats	None	None
Other late effects	Rats	—	None

* 10^8 pulses during 38 weeks of exposure
\+ 2.5×10^8 pulses during 94 weeks of exposure

Services Conferees Discuss Mutual Benefit Actions

Interservices use of development testing information, methods and facilities themed a recent meeting of U.S. Army, Navy, Air Force and Marine Corps high-ranking officers at HQ U.S. Army Test and Evaluation Command (TECOM).

TECOM Commander MG Patrick W. Powers said in welcoming remarks that the briefings and discussions were designed to explore mutual benefit actions for near- and long-range materiel cost cuts.

Topics included TECOM capabilities available to other services, the White Sands (NM) Missile Range hi-energy laser facility, computer technology for range support, use of lasers in range instrumentation and problems relative to budget restraints.

TECOM provided the conferees with a tour of its Electromagnetic Interference Shielded Enclosure. One of the nation's largest, it provides an interference-free environment for measuring electromagnetic effects.

Conference dignitaries included RAdm Claude P. Ekas Jr., deputy chief of Naval Materiel; BG Phillip N. Larsen, deputy chief of staff for Systems, U.S. Air Force Systems Command; BG Paul X. Kelley, director, Development Center, U.S. Marine Corps; BG Frank P. Clarke, TECOM deputy commander; and Dr. Richard H. Duncan, chief scientist and technical director, White Sands Missile Range.

CERL Gets ASA (R&D) Annual Award for Excellence

The U.S. Army Construction Engineering Research Laboratory (CERL), near the University of Illinois campus, is a recent recipient of one of the Assistant Secretary of the Army (R&D) special awards for over-all excellence. Deputy Chief of Army Engineers MG J. W. Morris made the award.

CERL was cited for preparation of 85 reports on its wide-ranging, inter-disciplinary, systems approach research, development, test and evaluation programs. The reports include 35 in project planning, 14 in engineering design and 11 in construction methodology.

CERL personnel also presented 205 technical papers and conducted 8 training seminars for Army and other federal agency personnel. An outstanding professional development program also was cited.

CERL accomplishments included preparation of 5 patent applications in the areas of foam-filled fibrous concrete on-grade slabs design; fireproofing polyurethane building structures; infrared radiation suppression; generation of domes by sector techniques; and composite concrete foam dome protective shelters.

CERL also was awarded the 1976 Champaign Chapter of the Illinois Society of Professional Engineers nomination for the U.S. Government Professional Development Award, sponsored by the National SPE.

ACCORD: A New Dimension in Information Storage and Retrieval

By William R. King
U.S. Army Electronics Command

Scientists and engineers have long needed a capability of determining quickly what computer-aided "tools" (in particular, software) are available to perform their R&D tasks.

The U.S. Army Materiel Development and Readiness Command (DARCOM) is addressing this problem with a new prototype information storage and retrieval system. Associated data bases contain abstracts of scientific and engineering software which is now available.

Designated as ACCORD (Army Computer Capabilities On-line Repository and Disseminator), the system was developed and implemented by personnel of the Scientific and Hybrid Control Systems and Programing Division, Directorate of Management Information Systems, U.S. Army Electronics Command (ECOM), Fort Monmouth, NJ.

William R. King was the project leader and the task was under auspices of the U.S. Army Materiel Development and Readiness Command's Computer-Aided Design and Engineering Council, which works to: "Promote the interchange of information on computer-aided design and engineering within DARCOM and with other military services, government agencies, industry and the academic community."

Programed and maintained on the ECOM Burroughs B-5500 computer, the information is readily accessible through any teletype compatible (video or hard copy) terminal at the user's site and over an IN-WATS telephone.

The task to establish an automated library of abstracts of available computer-aided scientific/engineering tools was proposed originally in response to R&D management's desire to eliminate needless overlapping or duplication of effort, or frustrating searching for information among scientists and engineers. Upon attempting or planning to use computer-aided technology, they often discovered that:

1. They must either develop special-purpose software for their own use (which is not only expensive and time-consuming, but usually not the most efficient due to the multidisciplinary aspects of a good scientific/engineering software program), or

2. They must manually search through mounds of literature and/or trade journals to locate an existing software package that may or may not perform the task at hand.

ACCORD and its existing data bases enable DARCOM scientists or engineers to dial into the ECOM B-5500 computer and perform any or all of the following functions:

- Make a keyword search of some 1,000 software abstracts currently in the system and have the selected abstracts printed out at their remote sites. From these abstracts, the user can determine which, if any, software package (routines) will serve his needs, contact the listed point-of-contact and make arrangements for its use.
- Enter abstracts on particular software packages or routines that he has developed or for which he is the point-of-contact.
- Communicate with other ACCORD users from various parts of the country through a "mailbox" feature, i.e., leaving a message in a secure mailbox for retrieval when desired.
- Enter and/or update personal subscriber data and "interest profiles."
- Enter the text for a newsletter of general interest for dissemination to all (or a selected subset of) ACCORD users.
- On-line perusal (headline search) of newsletters currently in the system.
- Extract rosters of various DARCOM select councils and committees.

ACCORD has been designed to be as user-oriented as is possible, and to take advantage of time-sharing capabilities of the B-5500 for a responsive multiple-user, real-time system.

Capabilities include simultaneous access, by up to 24 users, of virtual memory core storage and an extensive amount (374 million "bytes") of very fast (20 ms) on-line magnetic disk. Although this will allow for growth to a very large integrated data base system, every effort has been made to eliminate data redundancy in the inter-file relationships of the data base. This is done through the use of partially inverted files and inter-file indices.

Both the subscriber data base and the software data base are accessed via indices, with a user number providing entry into the subscriber file and keywords (including those relevant terms contained in the text of the abstract and other contextual terms that may not be in the text) into the software data base.

Theoretically, of course, it is possible to do a narrative search against the entire set of abstracts rather than the index file, but this becomes very inefficient with even a few abstracts. Thus, the index becomes a method for identifying abstracts most likely to contain the desired information.

This set of terms constitutes not only the index language but an important part of the retrieval language. Once the index terms have been assigned, they are used to represent the abstract and become the only vehicle for resolving inquiries.

Considerable research is being done by ACCORD project personnel to determine the "best" indexing technique for this particular application in order to "close-the-gap" in the man-machine interface.

This interface becomes even more complex with a system that is highly user-oriented, such as ACCORD, in that it bypasses, in most cases, the usage of an information specialist (research librarian). Usage is simplified to the extent that anyone with little or no prior instructions, can query data bases and retrieve abstracts indexed by the user's choice of keywords.

Research done by the University of Dayton Research Institute for the Air Force Materials Laboratory shows that an optimum arrangement for effective scientific and technical literature searching requires the requester and the information specialist to work together as a team.

The contents of the retrievals can suggest to the requester alternative keywords or they may suggest certain keywords which should be negated to prevent retrieving undesired items. The information specialist is then able to use his knowledge of search strategy formulation techniques as well as his technical expertise to achieve the desired search results for the requester.

With a system such as ACCORD, accessed by users from their own working environments throughout the nation, such an arrangement is not always possible. With this and Mooer's Law* in mind, the system has been tailored to the user with little or no prior knowledge of its use, and consequently is designed to be completely tutorial in nature.

Future plans call for the implementation of a thesaurus search capability and a "browsing" capability; also, incorporating into the system software existing at ECOM to provide the user with automatic notification of new items entered into the data base matching his predefined "interest-profile." Data bases containing abstracts on computer tools other than software, i.e., hardware, models, personnel expertise, etc., also are being considered.

***Mooer's Law (paraphrased): If it is more trouble to obtain information than not to have it, a person will proceed without it.**

3 Watervliet Arsenal Metallurgists Contribute to ASM Publication

Three Watervliet Arsenal metallurgists are contributors to the eighth edition of *Metals Progress* (Vol. 10, Failure Analysis and Prevention) published by the American Society for Metals.

Dr. Vito Colangelo and Peter Thornton coauthored the chapter dealing with failures of metal forgings, citing numerous case histories. The collaborative effort reports on contributions of arsenal metalworking programs toward an understanding of industry-wide problems in processing and fabrication.

Richard S. DeFries (recently retired) was a coauthor of the chapter on elevated temperature failures which was based on studies performed at Watervliet on industrial problems.

Dr. Colangelo collaborated with another arsenal metallurgist, Dr. Francis Heiser, on Analysis of Metallurgical Failures, a book published in 1964 by John Wiley and Sons in a series on *Science and Technology of Materials*.

AFIP Instruction Booklet Themes Modern Case Management Technology

Submission of Pathologic Material by Contributors, an instruction booklet prepared by the Armed Forces Institute of Pathology to accelerate "Modern Case Management Technology," is scheduled for distribution almost simultaneously with this edition of the *Army R&D Newsmagazine*.

The AFIP Receiving and Accessions Branch, Patient Records and Tissue Repository Division, announced with issuance of the new publication that it is preparing to insure all cases are delivered to a staff pathologist within 24 hours of receipt.

AFIP already has progressed a long way toward this goal by sharply reducing response time, in many cases giving immediate attention. Therefore, contributors no longer need to request a telephone response to be assured of a prompt report.

About 60 percent of all cases received are accessioned and in the hands of the pathologist within two days of receipt.

Nine-three percent are accessioned within five days of receipt. In emergency cases, where the patient's life is in danger, AFIP can provide a consultation within 2-4 hours.

CRREL Mission - Past, Present, Future...

Related to Far North Strategic Defense, Many Civil Programs

Strategic importance of the far north to national defense interests of the United States is strongly related to the mission of the U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH, although CRREL has been and is basically a civil engineering research organization.

CRREL scientists, engineers and specialists, in an interdisciplinary approach to the planning and conduct of over-all research, development, test and engineering programs, focus effort in cold regions type problems.

Quoting from the official mission statement, CRREL is concerned with problems "...applicable to U.S. Army needs in those geographic areas of the world where cold presents a severe problem at least one year in 10...."

Geographically, this includes the northern half of the United States and on to the north, as well as most of Eurasia where, throughout history, winter has been a major factor in military operations.

Technological areas of concern to CRREL primarily include road and airfield pavement structures, foundations, building structures and utilities systems for cold regions.

Applied research programs are supported by a strong basic research effort centered on fundamental properties and behavior of snow, ice and frozen ground under varied conditions. Long recognized quality of performance within this specialized area has earned CRREL's staff a highly valued international reputation.

CRREL was established at Hanover in 1961 through the merger of two U.S. Army Corps of Engineers research organizations. One was the Arctic Construction and Frost Effects Laboratory (ACFEL), formed at Waltham, MA, during World War II. The other laboratory was the Snow, Ice and Perma-frost Research Establishment (SIPRE) which was located at Wilmette, IL, in 1949.

ACFEL was created to conduct research for solving engineering and construction problems encountered by the Army Corps of Engineers in Alaska and Canada.

Formation of SIPRE was induced by the Cold War - the realization that the arctic region had assumed great strategic significance in the defense of North America from attack by aircraft or missiles following Great Circle routes.

CRREL is examining methods to control and prevent ice jams that result in flooding of rivers and damage to towns (shown above).

COL ROBERT L. CROSBY has been commander and director of the U.S. Army Cold Regions Research and Engineering Laboratory (USACRREL) since Aug. 1, 1973. Formerly Secretary, U.S. Army Engineer School, he is a 1953 graduate of the U.S. Military Academy, West Point. COL Crosby received a master of science degree in civil engineering from Iowa State University. He is a graduate of the U.S. Army Command and General Staff College and the Air War College.

COL Crosby's assignments have included service with the 503d Engineer Group in Korea; as company commander, 271st Engineer Battalion and 9th Engineer Battalion at Fort Lewis, WA; assistant professor, Military Science, Northeastern University, Boston; assistant resident engineer, U.S. Army Engineer District, Alaska; the Officer Personnel Directorate; Office of the Assistant Secretary of the Army (M&RA); commander, 92d Engineer Battalion, Vietnam; senior engineer adviser, IV Corps; executive director, U.S. Army Engineer Institute for Water Resources, Alexandria, VA. He has been awarded the Legion of Merit, (OLC) Bronze Star, Army Commendation Medal (3OLC).

APPLICATION of ice-phobic coatings, water jets, and large chain saws for cutting ice, are among methods being studied at CRREL to prevent ice buildup which restricts shipping seasonally in cold climates.

This realization led to the construction of the Distant Early Warning Line extending along the rim of the Arctic Basin from northwestern Alaska, through arctic Canada and Greenland. Research performed by ACFEL and SIPRE played a highly important role in making the DEW Line system a reality.

Continuing importance of the far north to the U.S. national defense interests became increasingly apparent during the 1950s, pointing to the need for sustained research in cold regions science and engineering.

The U.S. Army Corps of Engineers responded by developing a plan to consolidate ACFEL and SIPRE activities at a new site having a climate cold enough to permit local research in the field during the winter months. An extended site selection study considered numerous possible locations, including the Rocky Mountain area as well as Upstate New York and New England.

Dartmouth College eventually offered to provide a site in Hanover on a long-term lease basis. Dartmouth had an extensive library collection of original documents on polar exploration to support a proposal that there be close interaction between the college and the planned laboratory for mutual benefit.

In response, the Army accepted the site and a unique laboratory facility was designed and constructed during 1959-61. With few exceptions, the professional staffs of ACFEL and SIPRE relocated when the new CRREL building was ready for occupancy late in 1961.

The Army Corps of Engineers' first major return on investment on cold regions research was the early development of basic information on the physical and engineering properties of snow, ice and frozen soil. This knowledge permitted timely construction of the DEW Line system in the mid-1950s.

A field research station was established near Fairbanks, AK, when ACFEL was formed because of permafrost (permanently frozen ground) in that area. Research was conducted on various types of foundations in permafrost.

Results paid off the investment many times over in the design and construction of the White Alice Communications System and the Ballistic Missile Early Warning System at Thule, Greenland, and Clear, AK, along with the DEW Line.

The SIPRE investment in ice and snow research provided a capability to operate heavy-cargo aircraft from both sea and lake ice runways - a capability essential to expedited construction of the DEW Line. Two unique radar sites were also constructed on the interior of the Greenland ice sheet, which averages more than 3,000 meters in thickness.

Considerable additional snow and ice research

CRREL is developing snow-load criteria that will lead to more effective and economical snow-load protection for private homes and U.S. industrial areas.

was conducted on the Greenland Ice Sheet prior to the Camp Century operation in northwestern Greenland during the 1950s and early 1960s. Camp Century was an under-snow Army installation constructed in the ice sheet 240 kilometers from Thule. Valuable cold regions technology information was gained from research done at Camp Century and at Camp TUTO, located at the edge of the ice sheet in the vicinity of Thule.

An interesting turn of events for CRREL resulted from the Army-wide reorganization in 1962. When the Army Materiel Command was formed, two Corps of Engineers laboratories, CRREL and the Engineer Research and Development Laboratory (renamed MERDC), were transferred to AMC.

CRREL operations in Greenland were phased down and terminated. Concurrently, Army involvement in Vietnam was increasing rapidly. Part of the impact on CRREL was a de-emphasis on "polar" research and a shift was made to cold regions problems encountered at lower latitudes.

Requests for CRREL expertise and capabilities for application to Vietnam-related problems included innovative methods for mine and tunnel detection. The shift away from cold regions research emphasis continued during the late 1960s - culminating in the renaming of the laboratory, for a brief time, as the U.S. Army Terrestial Sciences Center.

Shortly following this period it became apparent at the Washington level that the capabilities and output of CRREL correlated more closely with the Corps of Engineers mission than that of AMC, and that there was a continuing need for cold regions research. The

CRREL researchers observe and assess construction and operation of the Trans-Alaska oil pipeline, in order to improve basic understanding of the interaction of man's activities with permafrost and cold regions.

laboratory was returned to the Corps control in August 1969. Corps laboratories reported to the Chief of Engineers at that time through staff directorates.

Under this arrangement, CRREL reported to the Director of Military Construction, as did the Construction Engineering Research Laboratory (CERL), Champaign, IL. The Engineer Topographic Laboratory, Fort Belvoir, VA, reported to the Military Engineering and Topography Directorate.

The Waterways Experiment Station (WES), Vicksburg, MS, and the Coastal Engineering Research Center (CERC), Fort Belvoir, VA, reported to the Civil Works Directorate.

CRREL's work thus tended to reorient on military engineering and construction problems in the cold regions, although the Army Materiel Command continued to support basic and applied research related to cold regions environmental constraints.

Subsequently, it became apparent that CRREL could and should conduct research related to the Civil Works mission of the Corps of Engineers, including responsibility to the Congress for development of the nation's harbors and navigable waterways.

The Corps of Engineers Civil Works mission was later expanded to include responsibilities for flood control and water resources development. Recent laws and court decisions have added authority over many proposed activities which could adversely impact on water quality and the wetlands environment.

Accordingly, with Civil Works as well as Military Construction support, CRREL initiated a major research program on the treatment of wastewater effluents by disposal on land. The Corps is required to have the engineering technology available to assure that Army and Air Force installations will meet future water-quality standards established by the Environmental Protection Agency.

Land treatment must be considered, along with other means, for the advanced treatment of wastewater which may be required to meet new water quality standards. The Corps is further required by law to be available as a consultant to state and local governments on land treatment technology.

Responsively, the Corps program has

(Continued on page 18)

CRREL Drilling Program...
Impacts on NSF Ice Sheet Projects

U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) investigators have played an important role in the National Science Foundation's Greenland Ice Sheet Program (GISP) and Ross Ice Shelf Project (RISP) for a number of years.

During research in technology for excavating snow, ice and frozen ground, they developed an electrically heated, cable-suspended thermal drill used in the initial penetration of the Greenland ice sheet in the 1960s.

A reconditioned cable-suspended electromechanical rotary drill modified in 1964 was used to penetrate to a depth of 1,390 meters (4,287 feet) to reach bedrock at Camp Century in northwest Greenland.

Analysis of this ice core has revealed the record of more than 120,000 years of climatic change, including the entire last ice age (Wisconsin) which was triggered some 75,000 years ago. It terminated abruptly about 10,000 years ago.

The CRREL thermal drill has been used to take several other Greenland ice cores of about 400 meters and to retrieve the upper portion of a 2,200-meter-deep core from Byrd Station in Antarctica.

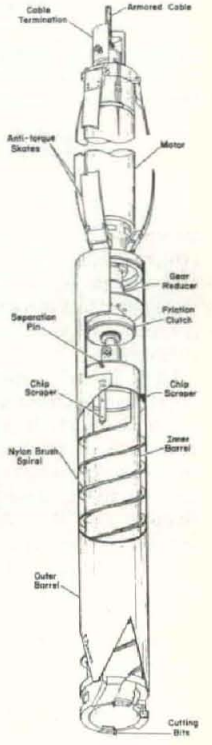
Recent efforts in the drilling program have been focused on developing a mechanical wire line drill which will be significantly faster than the thermal rig for deep drilling. CREEL's attention has been centered on the development of a lightweight mechanical shallow drill capable of 100-meter depths and movable in ski-equipped aircraft smaller than the C-130.

The shallow drill was first tested on the Greenland ice sheet and was proven in Antarctica during the 1974-75 austral summer. Recovery of a 101-meter core under the geodesic dome at the South Pole was one of the first scientific achievements completed at NSF's new Amundsen-Scott Station at the South Pole.

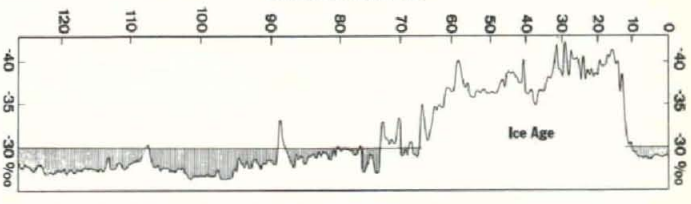
The shallow drill rig has potential for developing a medium-depth capability which could prove most valuable in the study of atmospheric pollution and climatic change during recent decades and centuries.

Strong scientific interest exists in the causes of climatic change. In a world with an exploding human population, there is a very real need to develop means for predicting climatic shifts and their international impacts.

CRREL continues to play an important role in this work, which was initially funded by the Army but is now sponsored by the National Science Foundation. Past and future efforts by CRREL are expected to provide powerful tools for unraveling the mysteries of climatic change.



CRREL lightweight mechanical shallow drill was first tested on the Greenland ice sheet and was proven in Antarctica during the 1974-75 austral summer R&D program.



TECOM Realignments Keyed to Progressive Return on Investment

Effects of organizational and functional realignments are widespread in the U.S. Army these days, in line with intensive innovative management concepts to gain a more productive return on investment of resources, and the Test and Evaluation Command is a good example of changes.

TECOM is the Materiel Development and Readiness Command's major subordinate command for checking on how materiel, including major weapon systems, satisfies design specifications. Despite recent changes, TECOM still supports the objective of acquiring the best materiel obtainable within cost limitations.

Established at Aberdeen Proving Ground, MD, the headquarters has remained there since TECOM was activated Aug. 1, 1962. Initially, part of the basic mission was to provide decision-makers with reliable, independent appraisals of Army materiel; also, to furnish test and evaluation support to DARCOM's commodity commands, project managers, and other authorized customers on request.

TECOM also was assigned responsibility for 44 installations and activities, most of them components of the Army's former seven Technical Services, and many of them eliminated in the ensuing development of a streamlined Test and Evaluation Command.

Five of TECOM's six service test boards were transferred to the newly formed Training and Doctrine Command (TRADOC), effective July 1, 1975. The Aviation Test Board remained with TECOM until TRADOC established an Aviation Test Board Feb. 17, 1976 at the U.S. Army Aviation Center, Fort Rucker, AL. Simultaneously the Army Materiel Command (renamed the Materiel Development and Readiness Command Feb. 23) established the Aircraft Development Test Activity (Provisional), under

MG Patrick W. Powers
TECOM Commander

control of TECOM, for aircraft and component testing at Fort Rucker.

Aberdeen Proving Ground and eight other proving grounds and test activities now report to TECOM Commander MG Patrick W. Powers. Manned by a workforce of about 12,000 military and civilian personnel, these installations and activities are located in the continental United States, Alaska and Panama.

TECOM's test mission and operational procedures have changed progressively since 1962 as more sophisticated Army test philosophies, policies and concepts have evolved. Currently, the mission is to check engineering quality of proposed Army materiel through a series of development tests, to assess test results, to provide some of the world's unique test facilities and services, and to command several major installations in support of its own mission as well as those of nearly 100 tenants.

New agencies, each with a major stake in the materiel acquisition process, have come into being during the past few years and now share the total test mission. The principal additions to the RDT&E community of immediate interest to TECOM include the Operational Test and Evaluation Agency (OTEA) and the Concepts Analysis Agency at DA level, TRADOC, and DARCOM's Army Materiel Systems Analysis Activity (AMSAA).

THE NEW PERSPECTIVE. Major changes in basic Army policies applicable to materiel acquisition and development were stated in November 1974 in AR 1000-1. They were further defined in March 1975 in AR 70-10, "Test and Evaluation During Development and Acquisition of Materiel." With emphasis shifting from "independent testing" to "independent evaluation," the impact on the RDT&E community has been profound.

Two basic test categories are recognized. Development testing (DT), forms the hard core of the present TECOM mission. Operational testing (OT) is now the responsibility of OTEA, TRADOC, and other user representatives.

DT is conducted to demonstrate that the engineering design and development process is complete; that design risks have been minimized; that the test item will meet specifications; and to estimate the system's military utility if introduced into the inventory. This type of testing is accomplished in factory, laboratory and proving ground environments.

OT is conducted to confirm and gauge prospective system's military utility, operational effectiveness and suitability, and the need for modifications, if any. OT also provides information on organization, personnel requirements, doctrine and tactics, as well as verification of associated operating instructions, publications

CRREL Mission — Past, Present, Future . . .

(Continued from page 17)

progressed to the stage of preparing, in a joint effort with the EPA, a manual for the planning and design of land treatment systems. This research effort obviously is of long-term benefit not only for the military community but for the entire nation.

The Corps' research and development management structure was revised in 1974 as a result of a study directed by the Chief of Engineers. A small Research and Development Office was created and authorized to report directly to the deputy chief and the Chief of Engineers LTG William C. Gribble Jr. Designated as Corps Laboratories, WES, CERC, ETL, CRREL and CERL were authorized to report to the Chief of the Research and Development Office William B. Taylor Jr.

A number of management actions were subsequently taken with the objective of forming a more cohesive Corps of Engineers R&D program having a clearly defined thrust relating to principal mission areas.

Concurrent with this reorganization was the establishment of the Facilities Engineering Directorate in the Office of the Chief of Engineers. Corresponding adjustments were made within the Corps R&D community to provide support appropriate to the higher priority given to facilities engineering.

What does the future hold for CRREL? Part of that answer relates to the fact that Western Europe is a primary area for military contingencies and that cold can present the U.S. Army with many serious problems in that environment.

CRREL's research program accordingly will continue to address the myriad of cold problems which could be encountered in Europe. An example of current interest is the phenomena of helicopter icing. CRREL is drawing on its store of knowledge of the fundamental properties of ice in search of new and perhaps greatly improved techniques to prevent or acceptably control helicopter icing.

Another area of increasing attention is termed "Ice Engineering." A study has shown that average annual damages due to ice in the nation's waterways total about $200,000,000. This problem relates primarily to the Civil Works function but should have important spinoffs of value to military engineering. The program is designed to find ways to reduce these costs.

An Ice Engineering Laboratory, a major addition at CRREL, will soon be under construction and will be dedicated to finding solutions to many types of anticipated problems.

Some major categories are: Extending the winter navigation season in the Great Lakes; ice damage to structures in winter waterways; inefficiencies in the operation of locks for ships and barges; flooding due to ice jamming in northern rivers; reduction of hydroelectric power production capacity or damage to hydro power facilities.

Another influence on CRREL's future will surely be development in Alaska, triggered by current petroleum discoveries and accelerated in the future by the development of known and yet-to-proven reserves.

Petroleum development will not occur in a vacuum. It will be accompanied by the development of transportation systems, of other natural resources, and general social and economic growth.

Alaska is in the process of assuming a new and different strategic significance to the nation that will impact on National Security Policy and on the Corps of Engineers responsibilities to provide means to support future military developments in Alaska.

Civil Works responsibilities of the Corps will also be affected. Water resources development, flood control, rivers and harbors work and offshore developments all have implications for research which should be performed by CRREL to meet the Corps' future needs in Alaska.

Furthermore, petroleum search and development activity is not by any means limited to Alaska; it includes the entire rim of the Arctic Basin. Thus it will become international in nature, involving not only the interests of the U.S. but also of Canada, Norway, Denmark and the Soviet Union.

This situation should trigger a revived national interest in arctic research and a parallel increase of international interest and support. CRREL, it is clear, will have an important role to play in these areas as the future unfolds.

BORESIGHTING the helmet sight system rails, mounted along the top of the helicopter cockpit canopy, was included in tests of the Improved Cobra Armament System by the U.S. Army Aviation Test Board.

and handbooks.

OT is accomplished by operational and support personnel of the type and qualifications of those expected to use and maintain the system when deployed. Tests are conducted in as realistic an operational environment as possible.

The Single Integrated Development Test Cycle (SIDTC), now being implemented by DARCOM, is an aggressive in-house effort to reduce time and costs by eliminating duplicatory testing (i.e., the performance of identical or similar tests by the contractor and the Army).

The SIDTC concept recognizes that valid test data can be generated by many sources (laboratories, arsenals, proving grounds, contractor plants); also, that all valid data, however developed, should be used in evaluating a test item or system.

Independent government testing will be conducted only to supplement valid contractor test results or to provide data which cannot be generated through normal contractor development.

While the contractor's share of the testing burden has been expanded, the resources placed at his disposal also have been increased. In effect, the Army's entire development test capability can be made available to him. Reimbursement is calculated on the basis of direct costs.

The contractor may, if he chooses, conduct his own tests at government sites with his own personnel, or government testers will perform the work for him on a customer basis. These options are expected to result in significant savings in time and resources.

AMSAA programs impose increased reliance on contractor efforts to reduce the scope of government testing. Analytical tools, such as mathematical models and simulations, also are expected to reduce test requirements for prototype materiel and thereby shorten test time.

AMSAA provides the expertise to assist developers of major, designated non-major, and other selected systems. The agency develops evaluation plans to support the decision-making process. Development test design plans also are prepared to define circumstances under which testing is to be conducted, the data required, and the means of analyzing test data.

TECOM, in its restructured role as a member of the development team, continues to plan, conduct and prepare the analysis of government validation tests. Together with AMSAA, TECOM provides a test design and independent evaluation service for the developer. All non-major or designated systems involve preparation of independent evaluation plans and test design plans for developers.

TECOM also offers test facilities and expertise to contractors and materiel developers to maximize use of its existing test investment. Contractor-conducted tests are monitored to insure the validity of data in support of the independent evaluation process.

ENVIRONMENTAL QUALITY. Compliance with statutory and regulatory provisions regarding environmental quality protection is demanding more and more tester's attention.

TECOM is charged with implementing the Army policy that achievement of environmental quality objectives is an integral part of the military mission. This means the environmental consequences of any proposed action will be evaluated along with the physical and economic factors of the decision-making process.

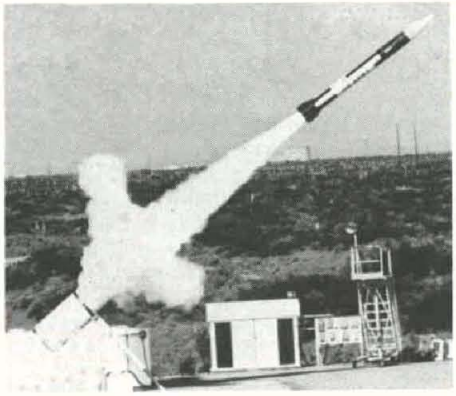
Preparation and processing of environmental impact assessments (EIAs) and statements (EISs) constitute a major chore for TECOM commanders. Resources the tester currently devotes to satisfying the basic requirements of the National Environmental Protection Act of 1969, and the subsequent guidelines issued by the President's Council on Environmental Quality, are substantial - and can only be expected to increase as the program matures.

A meaningful milestone in the TECOM Environmental Quality Control Program was reached in October 1975 with the initial drafting of EIAs covering all TECOM installations and activities. EIAs are detailed inventories, in effect, of existing environmental factors present at reporting installations.

Among other things, EIAs list all known pollutants and sources of contamination, describe activities and operations which contribute adversely to the environment, and take note of what is being done to enhance or preserve existing assets. Included are post conservation and wildlife programs, preservation of historical structures, and protection of archaeological deposits and artifacts.

Routine, repetitive testing must be examined for environmental impact and a formal EIS must be initiated whenever a proposed test is determined to have significant environmental implications or is likely to prove controversial.

MANAGEMENT of the TECOM mission is centered in the Test Operations and Policy Office and in the six materiel testing directorates of the headquarters. The directorates are Air Defense; Armor and Automotive; Aviation; Electronics; Field Artillery and Special Weapons; and Infantry and Troop Support Materiel Testing. Staff supervision is provided by the deputy to the commanding general for testing.



SAM-D, single-stage solid propellant missile, with latest technology in propulsion, guidance, electronics and armament, clears launching rig during test firing at WSMR.

Lanyard-fired, modified .22 cal. weapon is used to simulate terminal ballistics of 30mm AP rounds of ammunition at reduced distances at the Yuma Proving Ground, AZ.

Resources and Facilities. Facilities occupied by TECOM and its subordinate elements include several of the Army's largest reservations. Real estate holdings run into millions of acres of plains, uplands and coast. While most test stations are located in temperate regions, some have been established in areas where climatic extremes are the rule — in the arid deserts of the southwest, in the jungles and rain forests of the tropics, and Alaskan interior.

Within these complexes military hardware of every description can be tested and evaluated under precise laboratory conditions or pitted against the natural environments in which it is expected to operate:

Aberdeen Proving Ground, now one of the world's leading engineering test centers, occupies 79,293 acres on the upper reaches of Chesapeake Bay. About half this area on the western shore of the bay consists of wetlands, with a substantial portion under water. The APG supports more than 40 tenant units.

Dugway Proving Ground, about 75 miles southwest of Salt Lake City, was established in 1942 to test chemical munitions during World War II. More than 840,000 acres on the edge of the Great Salt Lake Desert in Utah were acquired for this purpose. The proving ground became a part of the TECOM complex in 1962.

The Army Electronic Proving Ground is a tenant activity at Fort Huachuca, AZ, where more than 100,000 acres are available for testing communications systems, components, and other items of electronic equipment. Located in the southeastern portion of the state, the post dates to 1877 and the Army's operations against the plains Indians.

Reactivated in 1954 as the Army Electronic Proving Ground, the installation was assigned to TECOM in the 1962 Army-wide reorganization. The principal test accommodations are an electromagnetic environmental test facility, used to study the compatability of Army communitions-electronics devices, and a fully instrumented systems test facility.

Jefferson Proving Ground was acquired as an Army test station during World War II. The 55,000-acre plant is about midway between Louisville and Cincinnati, north of Madison, IN. Its mission is devoted almost completely to testing production ammunition.

White Sands Missile Range, the country's largest military reservation, came into being in July 1945 as an Army rocket and missile proving ground. A week later, the first atomic explosion was triggered at Trinity Site in a remote area of the new post. WSMR is managed and operated by TECOM as a national missile range

(Continued on page 20)

Simulating Vehicle Operations at APG's Munson Test Site

By COL Alvin D. Ungerleider

Most of the terrain operational conditions military vehicles may encounter in performance of the U.S. Army's mission in many parts of the world - except for extreme climatic environments - can be simulated for safety, durability, reliability and maintainability testing at Aberdeen Proving Ground, MD.

Fuel economy and antipollution devices are among high-priority considerations in procurement of new ground and amphibious vehicles. Rugged reliability, maneuverability in all types of terrain and simplicity of maintenance continue to receive prime consideration in test and evaluation activities at the APG.

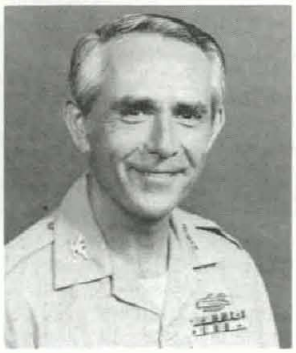
The internationally known 150-acre Munson Test Area contains 26 fixed obstacle and special courses for collecting data on characteristics of vehicles during field operational requirements. Each of the permanently constructed courses is engineered and maintained for precise measurements.

The Belgian Block Course is paved with unevenly laid granite blocks forming an undulating surface. Duplicating a rough cobblestone road of the type found in many parts of the world, the course serves as a standard for accelerated tests of wheeled vehicles and is generally included in cycles of courses used for vibration studies.

The Imbedded Rock Course consists of granite rocks of assorted sizes imbedded in concrete and protruding 2 to 4 inches above the surface. The rough, irregular surface is suitable for evaluating vehicle suspensions and is a severe test for pneumatic tires.

The 3-Inch Spaced Bump Course, also of concrete, gives a vehicle an irregular jolt by means of rounded sections three inches high that cross the road surface at varying angles. The spacing allows the vehicle suspension to "settle down" between jolts and can reveal any tendency toward wheel shimmy.

Washbord Courses, each consisting of sine waves - one of 6-inch amplitude, one of 2-inch amplitude, and another of amplitudes varying from 2 to 4 inches - are built into alternating curves. The courses are used in evaluating "wheel fight," front-wheel shimmy, and riding qualities.



COL ALVIN D. UNGERLEIDER has served as commander of Aberdeen (MD) Proving Ground since August 1974, following a tour as deputy director of the Strategic Studies Institute, U.S. Army War College (AWC), Carlisle Barracks, PA.

Graduated in 1974 with a master's degree in public administration from Pennsylvania State University, he has a BA degree in social science from George Washington University. He has completed career advancement courses at the Army Command and General Staff College and the Army War College.

Assignments in recent years have included executive officer, U.S. Army Combat Developments Command Institute of Special Studies, and deputy commander, I Corps Advisory Group, Republic of Vietnam. He wears the Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star Medal with "V" device and two OLC, Air Medal with OLC, Joint Service Commendation Medal, Army Commendation Medal and Purple Heart with OLC.

TECOM Realignments Keyed to Progressive ROI

(Continued from page 19)

for the benefit of all U.S. Military Departments, other government agencies, and authorized non-government users.

The range occupies some 4,000 square miles of desert in the Tularosa Basin in southern New Mexico. Another 2,000 square miles can be leased when required. Launching sites can be backed up as far as Blanding, Gilson Butte, and Green River in Utah — 450 miles and more from impact zones on the range.

WSMR is one of the most heavily instrumented, precisely surveyed test areas available to the scientific community. Each year, an average of 6,000 test operations, including the firing of more than 2,000 missiles, rockets, and space vehicles, are conducted.

Yuma Proving Ground fulfills TECOM requirements for testing materiel in extremely hot, dry environments. Located near Yuma, AZ, the post occupies almost a million acres of arid wasteland in the Sonoran Desert. The headquarters is about a mile from the Imperial Dam on the Colorado, the river which forms the western boundary of the reservation.

The post was activated in 1943 to test bridges, boats, vehicles, and well drilling equipment for the Corps of Engineers. As a TECOM proving ground, YPG specializes in testing aerial delivery techniques long-range tube artillery, in addition to its mission as an environmental test center.

The U.S. Army Aircraft Development Test Activity (Provisional) is a tenant activity at Fort Rucker, AL. This TECOM element has the responsibility to plan, conduct, evaluate and report on government test elements of the Single Integrated Development Test Cycle program for aircraft, components, and aircraft support equipment.

TEST CENTERS. Environmental testing, i.e., evaluation of materiel under extreme natural climatic conditions, is essential to confirm or supplement data obtained in studies conducted in environmental chambers or under simulated conditions. A report on climatic effects on the soldier and his equipment, and how to cope with them, is an important part of the total test package.

The *Arctic Test Center* at Fort Greely, AK, occupies more than 750,000 acres of typical arctic terrain less than 180 miles below the Arctic Circle, near Big Delta. The post is 105 miles southeast of Fairbanks at the junction of the Alaska and Richardson Highways, in the midst of one of the two coldest spots in the Northern Hemisphere, where the temperature may drop occasionally to 60 to 70 below zero Fahrenheit during the winter. The other spot, also in the subarctic, is in Siberia. ATC's winter test program usually is sandwiched between Oct. 1 and the end of March.

The command traces its origins to Task Force Williwaw and Task Force Frigid, which were sent to Alaska in 1946 and 1947 on a safari.

The *Tropic Test Center* is headquartered at Fort Clayton on the Pacific side of the Isthmus of Panama. Test sites located throughout the Canal Zone offer excellent opportunities for observing effects of the hot, humid environment on men and equipment. In addition to the materiel test mission, TTC researchers gather basic data to define the conditions with which U.S. Army troops and other sojourners in the tropics must contend.

The TTC started in 1962 as the U.S. Army Research and Development Office, Panama, a Class II activity of the Office of the Chief of Research and Development, HQ Department of the Army. Transferred to the Army Materiel Command and assigned to TECOM, it was redesignated in 1964.

Understandably a product of necessity and the result of changing technology, TECOM today stands astride the path of research and development, between the drawing board and combat materiel user-the American soldier.

Whenever you strike into uncharted areas, as TECOM often does, you can expect surprises. But that is the TECOM job - to minimize surprises in materiel performance in moderate and extreme environments, serviceability he expects from his weapons and equipment; that he can depend on it to work reliably and effectively. TECOM tests tomorrow's defense capabilities today.

M109A1B self-propelled 155mm howitzer, with inflated flotation kit, prepares to enter Chesapeake Bay waters for APG evaluation.

DEMOLITION personnel "plant" an antitank mine to be used along with modified tank, right, during JPG ammunition tests.

Imbedded Rock Course

Many of the Munson special obstacle courses can be used for vibration tests. However, these five courses, with nearly two miles of connecting gravel roads, comprise the standard *Load Vibration Course,* for vehicles carrying missile ground support or electronic equipment.

The LVC also is used for evaluating the portability of other special military loads, including those of the Navy and the Air Force. Smooth roads run parallel to the individual courses for the operation of instrument vehicles.

The Fuel Consumption Course is a loop of graded Munson roads, gravel and paved, totaling 8,003 feet, on which the vehicle is operated for specified distances in both clockwise and counterclockwise directions on each grade and surface. It includes graded slopes of 5, 15 and 30 percent. The course was designed to provide a test representative of field service conditions, yet with the reproducibility obtainable under controlled conditions.

The Improved Gravel Road is a 2-mile loop with numerous curves and a surface of compacted gravel maintained by grading. Besides its use as an element of the *Fuel Consumption Course,* it is one of several basic courses used for vehicle endurance testing.

The graded slopes serve other purposes, among which are the determination of optimum drive ratios and maximum attainable speeds on the slopes, brake-holding ability, and adequacy of angles of approach and departure. With the test vehicle in both ascending and descending attitudes, functions such as lubrication, fuel flow, and carburetion are investigated. Five asphalt slopes have grades varying from 5 to 20 percent. Four concrete slopes have 30, 40, 45 and 60 percent grades.

Munson also has side slopes ranging up to 40 percent that are standards for testing the stability and controllability of tactical vehicles. These slopes are used during measurements of steering ease and lateral loading effects, and are long enough to be included in endurance tests involving other types of operation.

The Wave Course, also known as the "Frame Twister," is designed so that wheels will be constantly at different levels to provide a severe test of differentials and universal joints as well as suspensions.

Distortion of vehicle bodies is checked by operating doors, dump bodies, engine hoods, etc., after stopping the vehicle with the suspension at extremes of vertical travel.

The Staggered Bump Course provides a means of inducing vehicle pitch and roll through cast concrete humps alternately spaced to exercise opposite suspension members. The humps vary in height from 5 to 12 inches.

Wall-climbing capability is a characteristic that is measured for all tactical vehicles. The Munson Vertical Walls, ranging in height from 18 to 42 inches, are equipped with replaceable timbers at the top so that the walls may be maintained in a standard condition following damage from test operations.

The Munson Standard Ditch, used to check the adequacy of the angles of approach and departure of tactical vehicles, has gradients of 36.5 percent and is 4 feet, 8 inches at maximum depth.

The bridging requirement for various types of tracked vehicles is usually given in the technical characteristics of military specifications. The Bridging Device provides an adjustable gap for measuring the maximum opening that the vehicle can cross unsupported.

The Simulated Loading Ramp is designed to insure that tactical vehicles intended for transportation by either aircraft or ramp-equipped landing craft are capable of entering and leaving the transporting vehicle by means of an inclined surface or ramp.

The ramp angle is 20 degrees in accordance with the present military standard and enables vehicles to be tested for adequacy of angles of approach and departure; also, for adequate ground clearance and absence of interference at the point of articulation between towing and towed vehicles.

The Fording Basin, or "Bathtub," was designed to provide still water at controlled depths up to six feet. Ramps at both ends permit gradual immersion, if desired. The principal uses for the basin are for determining the fording characteristics of nonfloating vehicles and for studying the effects of water on running gear components such as brakes, seals and universal joints.

Some vehicles can neutralize water obstacles by submerging. Vehicle effectiveness while submerged is tested in the *Underwater Fording Facility* in which water depths can be adjusted up to 20 feet. Performance and safety of operations are evaluated under water and on the 40 and 50 percent entrance and exit slopes.

The Sand Course provides a standard for evaluating drawbar pull of wheeled and track-laying vehicles under controlled sand conditions. The straight portion of the course has sufficient length to produce stabilized data for a given condition. The circular bed at the end of the course is useful for evaluating the ability of vehicles to steer in sand. Track-throwing tendencies and the effect of accumulations of sand in suspension systems also can be tested.

The Abrasive Mud Course, or "Hog Wallow," has an independent, piped water supply which provides the means for maintaining muddy conditions regardless of the season. The soil is sandy with some clay and silt, making it particularly useful for evaluating the effects of abrasion on brakes and other components as well as the effectiveness of wheel seals. The course can be tilled to depths up to two feet.

Fording Basin

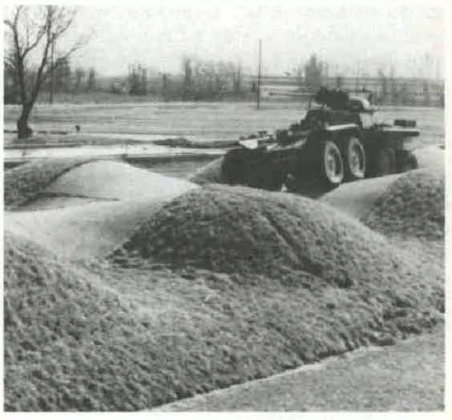
The Rolling Hill Course was designed to provide short, closely spaced grades. As a vehicle ascends and descends the grades, the engine and power train are subjected to rapid variations in loading. The surface of the course is of crushed stone compacted with stone-dust binder.

The Amphibian Ramp provides access to Chesapeake Bay through Spesutie Narrows which has a dredged channel 10 feet deep. Swimming and floating tests of amphibious vehicles are conducted in this channel and the deeper waters of the Bay. For water entrance and exit interface tests, earthen slopes are constructed by grading.

The Turning Circle is a concrete pad 250 feet in diameter used for measuring turning diameters on a hard surface. It is large enough to permit figure-eight turns by the largest vehicles and for plotting limits of vision. An overhead platform is available at the edge for making photographs from high angles. The circle is also used for other activities requiring a large and essentially flat concrete surface.

Portions of the Munson Test Area have been engineered to represent the world's worst terrains. A vehicle that has satisfactorily negotiated all or most of the 26 courses will be one on which the soldier user in the field can depend. It will be safe, rugged, reliable, and of the country's best in engineering design, proven by testing at one of the Army's oldest and most comprehensive test and evaluation facilities.

Staggered Bump Course



Wave Course

Automation in Ballistic Munition Testing

By Dr. Norman L. Wykoff*

In the field of ballistic testing and evaluating ammunition we have been, until very recently, in many respects, at the mule level of sophistication in our methods of operation. Like the mule, we have relied on brute force to get the work done.

Many advances have been made in ballistic testing instrumentation, but only very recently have they been brought together with an on-site minicomputer to automate completely the gathering, processing and reporting of test data for most of the parameters under consideration.

Now it is possible in many test programs for the engineer in charge to pick up the completed test record on his way from the testing site to his office.

This is a boon for us at Jefferson Proving Ground, Madison, IN, an installation of the U.S. Army Test and Evaluation Command (TECOM). Our mission is to test ammunition, both complete rounds and components. There are, of course, many different phases in the testing of ammunition components and complete rounds, depending on the items under test.

Only occasionally are we content merely to see if an item works. We need to know how well it will work under varying conditions of rough handling, humidity, extreme temperature and other hostile environmental conditions.

Many phases of testing of an item lead to a large amount of data being collected. Coupled with this are recent advances in electronic components and compatible transducers which make previously tedious measurement of many engineering parameters economical and accurate.

Realizing the tremendous potential of increasing the data base, the customer requires ever-increasing amounts of raw and processed data. Altogether, the increased ability and the increased requirements mean that we must collect and process enormous amounts of data.

The obvious answer is to use a modern, high-speed digital computer. How to make it all work together is not so obvious. Many of the problems we face are as unique as our mission. The digital computer is a very fast, efficient tool, but very finicky about what and how it is fed. Its diet consists of very carefully regulated electrical pulses that are directed through various circuits, according to the instructions given by the operator.

Many measurements can be made with equipment that provides an electrical output. Projectile velocities are measured by determining the time between two electrical pulses generated a known distance apart. Using the well-known formula, distance = rate x time, we can determine an average velocity over the known distance. However, this is not the muzzle velocity, which is a more desirable parameter, but it is related to it and will be discussed later.

Heat, or rather changes in heat output, can be measured by using infrared detectors with an electrical output. Infrared units are useful for determining such diverse phenomena as tracer burning time, and the explosion of the expelling charge that deploys the parachute for an illuminating round.

The measure of the pressure generated by the burning propellant is important for a variety of reasons. Excessive pressure can damage the weapon and endanger the lives of the weapon crew. Peak pressure and the time it occurs are the critical factors. The range of the projectile is dependent upon the burning rate of the propellant as well as the peak pressure. Using piezo-electric pressure transducers, we can determine pressure throughout the burning cycle in the weapon tube.

The artilleryman is primarily concerned with the point of impact of the projectile. Other measurements are only of academic interest to him; he wants to assure that the projectile impacts exactly where he wants it. We, too, want to know that the payload can hit the target.

Most of the techniques for measuring the point of ground impact rely on observers. However, we have digital theodolites that can feed information about horizontal and vertical angles directly to the computer, once the telescope is aligned with the point of impact.

We now are awaiting delivery of hardware that will enable us to score automatically the accuracy of projectiles at vertical targets at various distances from the weapon.

The processing unit that takes the various inputs of data, performs the required operations, and finally outputs the final record with all the data in proper form, the mathematical analysis performed, and the appropriate decisions recorded, is actually a rather modest unit.

The central processing unit (CPU) is a Datum 70 system with 24K memory. Auxillary equipment includes: a 256K drum storage, card reader, line printer and a teletype controller. Permanent storage of records is on magnetic tape, catalogued according to weapon type and type of ammunition items being tested.

Perhaps the greatest factor in enabling us to make this system operational is the recent completion of an instrumentation cable network. With the installation of the network, the computer can communicate with each firing position as effectively as if the computer were located at the site.

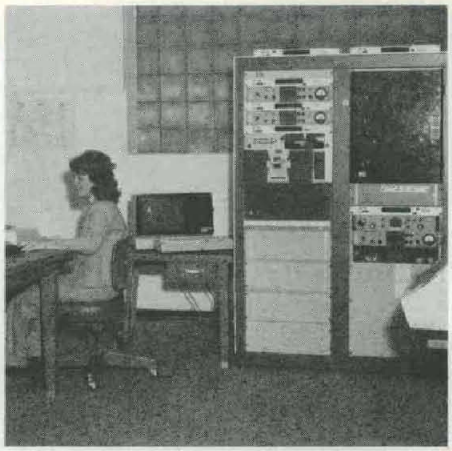
The CPU is located in a building one-half mile from the center of the main firing line. The main firing line consists of approximately 268 firing positions located on an East-West line three miles long.

In a typical firing program, several parameters (e.g. velocity, pressure, projectile spin, accuracy, tracer timing) may be taken. For the sake of illustration, we shall consider only the most common requirement, velocity.

The projectile is magnetized longitudinally by placing it in the electric field generated by an electrified coil placed around the projectile. The magnetized projectile is then fired through two passive coils of wire, located in front of the weapon at a known distance apart and a known distance from the muzzle of the weapon.

The magnetized projectile generates an electrical pulse as it passes through a coil. Using the first pulse as a starting signal and the second pulse as a stop, we can determine accurately the time taken to travel between the coils. Since we know the distance between the coils, we can determine the average velocity.

Because of the muzzle blast of artillery weapons, the coils must be placed far enough away to remain undamaged. But the velocity of the projectile decays due to air resistance, which is a function of the air density, the shape of the projectile and its velocity.



PROTOTYPE MINICOMPUTER is designed for one operator to control data collection from several firing sites at Jefferson PG.

Rather than work with the velocity at some specified distance from the muzzle, it is more convenient to correct the data back to muzzle velocity. This can be accomplished readily since the only variables in a firing program of one type round are the individual velocities and the air density.

Programing is neither unduly complicated nor excessively long, but is somewhat unusual. Currently, six velocity programs can be taken simultaneously; future hardware additions will increase our capabilities.

The engineer in charge at the firing site is in communication with the computer by means of a teletype keyboard and a cathode ray tube (CRT) display unit. This enables him to instruct the computer and gives him instant feedback via the CRT of the data collected as each round is fired.

One would be tempted to say that the engineer has the data before the smoke clears; but it is much faster than that. By the time he transfers his view from the blast to the CRT, the data is being printed before him.

With this immediate information regarding all the parameters being measured, the engineer can spot those occasional trends or erratic behavior and determine causes immediately.

By the time the test is concluded, the test report can be run on the line printer, all measurements made, all computations performed, all analyses done, all decisions made and the data placed into easily retrievable permanent storage. Before the firing position can be readied for the next test, the report can be ready for review by engineers and statisticians.

In the traditional situation, again say for velocity measurement, a technician must read the elapsed time between coils on a digital counter. Then, using a calculator, he computes the average velocity between the coils and makes the necessary correction back to muzzle velocity.

After all the data has been collected and processed, the summary and analysis steps follow. Finally, the report must be typed. None of these steps consumes too much time or is overly complicated but collectively the manual process involves many hours of effort.

Further, there is always the danger, despite all our precautions, that a human error, such as a transposition of two digits, might creep in

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***Dr. Norman L. Wykoff is a mathematical statistician at the U.S. Army Jefferson Proving Ground, Madison, IN. He received his PhD in mathematics (nonparametric statistics) from Indiana University.**

from the engineer, a technician, or the typist. This problem is nonexistent in the automatic data gathering, processing and reporting system. Thus, the reliability of the test report is enhanced.

Accuracy of the data in many tests is improved in the new system and, in most cases, is virtually limited only by the precision of the sensing equipment in the field. In no case is the accuracy lessened in the automatic system.

Once an adequate data base has been stored on magnetic tape, as an easily retrievable record of test trend, cyclical variation, and variation from series to series, control charts for any parameter will be extremely easy to construct.

JPG Commander COL James Bishop states that the computer is not a panacea; it cannot do all the work that comprises our mission. But in many vital areas it enables us to perform critical tasks more accurately, reliably, efficiently and quickly. This reduces costs and the work load - so vital during austerity pressures upon the modern Army.

We believe ballistic munition testing has taken a big step forward, but all we have done is to make bold use of today's tools to solve today's problems. We now can solve those problems with fewer personnel and less delay between event and analysis. Thanks to progressive, dedicated personnel in the Materiel Development and Readiness Command (DARCOM) and TECOM, capabilities that we only dreamed of yesterday will lead to solutions for tomorrow.

★ ★ ★

Speaking On . . . *(Continued from page 13)*

Army Readiness Posture: Requirements to Meet Forseeable Threat

October 1977, with the first delivery in January 1979. Developmental testing commenced in September 1975 and has been progressing satisfactorily except for technical difficulties with the transmission.

A backup transmission program has been initiated and, to insure the fielding of a vehicle meeting all of the requirements, additional time has been added to the test program. Total time lost in the program is estimated to be eight months.

AAH (Advanced Attack Helicopter). The AAH has been designed as a highly mobile aerial antitank weapon system capable of fighting and surviving in a mid-intensity environment and to provide, for the first time, a night and adverse weather capability. Thus far the two contractors' prototypes have accumulated over 100 flight-test hours.

Both aircraft have generally performed well; some technical problems have been encountered but are being resolved. The solutions of these problems and associated program adjustments have necessitated an Army reprograming request for $14.6 million in FY 1976.

With these funds, the prototypes can be brought to sufficient maturity for the conduct of the government competitive test later this year. Total program costs, including inflation, are estimated to be $550.5 million for research and development and $2,327.0 million for procurement.

UTTAS (Utility Tactical Transport Aircraft System). The UTTAS is being developed to replace the UH-1 as the Army's squad assault, air cavalry, and medium helicopter. The total program cost, including inflation, is estimated to be $459.4 million for research and development and $2,864.0 million for procurement.

SAM-D (Surface-to-Air Missile Development). SAM-D is being designed to counter the expected aircraft threat to the Army in the field for the 1980s and beyond, and to be effective in a severe electronic countermeasures environment. Successful development would permit replacement of nine different kinds of radar in the current Hercules and Hawk systems with a single type of multifunction radar.

SAM-D flight tests to date continue to be highly successful. All proof-of-principle objectives were met on the sixth firing. The total program cost, including inflation, is $1,728.8 million for research and development and $4,190.0 million for procurement. The Army's program resumes full-scale engineering development and initiates testing in an electronic countermeasures environment.

BMD (Ballistic Missile Defense). The focus of continuing BMD efforts is on an active research and development program designed to maintain technical pre-eminence in this field. Under the terms of the SALT agreements, active BMD deployments are limited.

The threat against which future deployment might be required is unknown, but the many uncertainties require maintenance of a national capability to respond to a wide variety of potential threats.

The Soviets are continuing an aggressive program for development and deployment of new strategic offensive weapons, and they are directing their efforts toward overcoming the U.S. technological lead in ballistic missile defense in spite of the ABM treaty.

The challenge to national security posed by continuing nuclear proliferation cannot be discounted. The Army's BMD program will concentrate on two interrelated research and development programs — Advanced Technology and Systems Technology.

Binary Munitions. As mentioned earlier, funds have been requested for procurement of protective chemical equipment. The Army's request also includes RDT&E funds to develop a binary chemical muntions for the stockpile.

A binary chemical consists of two relatively harmless chemical components which are mixed during the flight of an artillery projectile and on impact release the same lethal nerve agents found in our current stockpile.

The Army's program will continue to support engineering development of an 8-inch binary round, to include fabrication of test hardware and initiation of development testing.

Air Defense (Roland). The Army currently does not have an all-weather short-range air defense (SHORAD) capability. The French/German developed Roland missile system is designed to provide this capability for defense of bases and other rear area target complexes.

Due to delayed receipt of technical data, a poor initial cost estimate, and a need to insure missile interchangeability with the French/German system, the U.S. contractor will require an additional $40.7 million to complete the development effort.

Accordingly, the program is being restructured to meet these unexpected costs. Interchangeability of the Roland II missile between American and French/German Roland is an important step towards NATO standardization and is planned for accomplishment in the restructured program.

8-Inch Nuclear Projectile, XM753. The new 8-inch nuclear projectile, XM753, features advanced nuclear technology, improved accuracy and range to permit a 50-percent increase in capability to destroy enemy battlefield combat units while reducing by about 80 percent the undesired collateral damage area.

The XM753 design incorporates improvements in command control, safety, and security, so that it is more secure in stockpile storage and more responsive to control on the battlefield.

Testing to verify full electronic functioning and ballistic characteristics will continue. After completion of testing, long lead-time procurement will start to support low-range initial production of fuzes, training projectiles, and test equipment in FY 1978.

Cannon-Launched Guided Projectile. Based on a successful advanced development program, the Army's Cannon Launched Guided Projectile entered engineering development last July. The CLGP, a laser-directed round, is a precision-guided munition that can have great effect on future battlefields.

When deployed, it will provide the large number of existing 155mm artillery units with a capability of achieving greatly increased accuracy against point targets using indirect fire.

The winning prototype of the advanced development competition scored 7 direct hits out of 11 rounds fired against stationary and moving tank targets at ranges from 4 to 16 kilometers. One of these shots included target designation from an airborne remotely piloted vehicle.

Weapons Locating Radars. Two radar systems are under development to correct a long-standing weakness in target acquisition capabilities. The AN/TPQ-36, Mortar Locating Radar, which is in engineering development, will locate mortars out to their normal firing ranges with sufficient accuracy to effectively attack the target.

The AN/TPQ-37, Artillery Locating Radar, which is in advanced development, will provide the capability to locate enemy artillery and large-scale rockets at their normal firing ranges with a sufficient accuracy to effectively attack the target. Both systems are automatic with multiple target locating capabilities. Both radars

(Continued on page 25)

TACOM's Land Mobility Technology Base Development Program

By Z. J. Janosi

ZOLTAN J. JANOSI, chief of the Methodology Function, Engineering Science Division, U.S. Army Tank Automotive Command at Warren, MI, joined the Land Locomotion Lab. in 1957.

Known for his research in off-road locomotion, he has a 1951 degree in mechanical engineering from the Technical University of Budapest and a 1963 master's degree in engineering mechanics from the University of Michigan.

Janosi has presented papers at the First, Second and Fourth International Conferences of the International Society of Terrain Vehicle Systems. He was one of four Army engineers who received a Department of the Army R&D Achievement Award in 1973 for development of the Army Mobility Model.

The Office of the Director of Defense, Research and Engineering published the Land Mobility Technology Coordinating Paper in July 1974 to provide a concise summary and an analysis of LMT efforts.

Included in objectives were definition of areas of scientific endeavor and specific engineering advances needed to meet future military requirements and solve current problems.

The Land Mobility TCP also identifies programs which are under way or planned by each military service to fill these needs. Important gaps also were pointed out in the projected technology program. Finally, the TCP discussed ways in which the technology program can be strengthened.

Current U.S. Military Land Mobility Systems are categorized as follows: Tactical vehicles, combat vehicles, special purpose vehicles, engineering construction vehicles, materials handling and counter barrier equipment.

The Tank-Automotive Command exploratory development program is in strict compliance with the recommendations advocated in the TCP and concentrates on the first three systems. Additionally, the program deals with vehicle armor technology, automotive component development, track and suspension technology and advanced propulsion systems.

Recognized, however, is a compelling need for reliable methodological tools for analyzing the gamut of systems. This requirement derives from the day-to-day functioning of designers and decision-makers involved in system development and/or procurement.

A reliable methodology for the analysis of land mobility systems is being developed by TACOM with the help of the U.S. Army Corps of Engineers Waterways Experiment Station (WES), Vicksburg, MS, and the U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory, Hanover, NH.

The methodology consists of interfaced components: Analytical procedures for predicting and optimizing system behavior at many levels of complexity; experimental procedures to select hard data for trade-offs in technical decision-making, and to formulate, validate and apply analytical procedures.

The essence of current accomplishments of mobility evaluation methodology is embodied in a comprehensive set of models, collectively designated as the Army Mobility Model (AMM). A schematic representation of the AMM is shown in Figure 1.

The model examines terrain-vehicle relationships including the mechanics of vehicle-soft soil interaction, slope negotiation, obstacle climbing and movement in wooded areas.

Considered also are roughness of the terrain profile and the vehicle's dynamic response to excitations thus caused. If the terrain contains rivers or similar features portrayed by a line on a map, the model computes the time needed to cross them.

Depending on the purpose of the analysis, the output of computations can be presented in various forms. The final output can be a statistical evaluation covering a large geographic area, or it can be a single prediction of the time needed to go from "A" to "B".

Naturally, the predictions always include NO-GO or zero speed situations. The specific factors which limit off-road speed can be pinpointed. Examples are inadequate engine HP, ground clearance, and not enough wheel travel.

Use of the model study results helps the designer in making changes calculated to lead to the most significant improvement in the vehicle's off-road performance.

It is also possible to determine the amount of fuel consumed during a specific mission or to calculate the probability of staying within a given limit relative to the horizontal position of missile-carrying trailers.

These examples demonstrate that the AMM is an excellent tool for parametric design studies, comparison of concepts and war-gaming studies.

Utility of the AMM has been demonstrated convincingly by its profitable applications in the WHEELS Study, in the Department of the Army Special Analysis of High Mobility Vehicles (HIMO) Study, and in the support of vehicle development programs (ARSV, SAM-D, High Mobility Tactical Trucks, XM-1 and others).

One shortcoming of existing AMM methodology, however, is its limited scope. Lack of analytical procedures which take quantitative account of reliability and maintenance effects prevents definitive mobility/RAM-D trade-off studies—or the general interpretation of laboratory and field failure data in terms meaningful to designers or operational planners.

To meet immediately foreseeable needs for mobility evaluation methodology, TACOM's current 6.1 and 6.2 budgetary code programs include the development, validation and extension of the Army Mobility Model.

Further development and extension includes research to derive new engineering relationships in the area of mobility/agility, driver responses and RAM-D (Reliability and Maintainability Development). Important for TACOM needs is creation of viable interfaces with supporting experimental methodology and combat-effectiveness models.

The design optimization and concept evaluation methodology discussed here is strongly emphasized in TACOM's vehicle-systems-oriented exploratory development programs.

TACOM's high-mobility tactical vehicle systems development activities are concentrated on two concepts. To fill the high-mobility gap reported by the WHEELS Study Group, a 3/4-ton high-mobility truck concept development is under way.

Interfacing this effort with efforts of mobility methodology experts should assure that the most effective concept is pursued into the detailed design and fabrication phase. This will be followed by joint user-developer evaluation of the potential high-mobility tactical truck of the post-1980 timeframe.

The AMM is the primary tool used for optimizing cost as a function of mobility for analyzing design concepts varying in complexity. The measure of mobility is an index derived from the AMM which characterize the average maximum speed the vehicle can obtain while crossing different terrain elements of increasing difficulty in a large geographic area.

The index is weighted so that crossing difficult areas receives more emphasis than the ability to move across relatively easy areas. Table 1 contains the numerical values of the indices calculated for three areas for which we have detailed terrain information.

TABLE I

Cross-Country Mobility Indices

Vehicle	Germany	Yuma	Thailand
M151	23.51	21.95	1.68
M561	40.95	45.98	22.11
M35	26.80	36.29	21.31
M814	19.34	30.98	10.09
M656	27.58	37.02	22.01
M520	12.80	22.34	5.58
M60A1	40.52	36.05	19.84
M113	41.49	37.03	22.41
M114	40.36	33.87	15.90
M551	46.53	46.88	24.81
M548	37.57	35.14	21.30

A high-mobility gap also exists in the 2½ - 5-ton truck area, identified from analyses of the WHEELS Study. Therefore, concepting activity was initiated in the nominal 4-ton payload range. The planned approach for providing the Army a high mobility 4-ton truck in the post-1980 timeframe is essentially similar to that followed in the 3/4-ton truck program.

In the area of combat vehicle systems, TACOM is engaged in providing the user community with a High-Mobility Combat Test Rig for parameter evaluation purposes. This effort was initiated in direct response to the Land

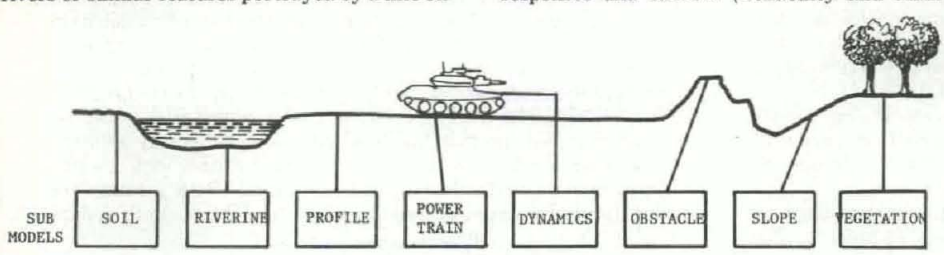

Fig. 1. Army Mobility Model

Mobility TCP which calls for a "high mobility/agility tank prototype."

Analytical tools for establishing the importance of high mobility and agility in various combat scenarios, from a survivability viewpoint, are not well developed. Current and projected developments in electronic technology, plus pressures to reduce the burden on and hazard to the individual soldier, suggest development of remotely controlled special-purpose vehicles.

Consequently, TACOM is updating an existing XR-311 remote-controlled vehicle providing additional capability of target acquisition and firing of the TOW antitank missile system.

Hardware and software are the bricks and mortar of the technology base. Only with the proper mixture of these two elements can we hope to produce cost-effective land mobility systems with the capability to defeat prospective threats in any specified operational environment. This is the main principle which guides TACOM's 6.1 basic research and 6.2 exploratory development effort under the over-all program outlined in the Land Mobility Technology Coordinating Paper.

'Preferred Alternatives' in DARCOM Realignments Announced

Secretary of the Army Martin R. Hoffmann announced Apr. 1 "preferred alternatives" for creation of four major commands as subordinate elements of the U.S. Army Materiel Development and Readiness Command (DARCOM).

Decisions involving consideration of Environmental Impact Statements (EIS), comments from interested parties over a 45-day waiting period for evaluation of EIS, and other alternatives, are expected in June and August." Stressed in the announcement is that the favored proposals leave other options open.

The proposals call for organization of an aviation development center involving an Aviation R&D Command along with a Troop Support and Aviation Materiel Readiness Command, and a U.S. Army Electronics Research and Development Command (USAERADCOM) along with a Communications and Electronics Materiel and Readiness Command.

USAERADCOM would be created from the Harry Diamond Development Center Study options, principally the Harry Diamond Laboratories, Adelphi, MD, along with the Electronic Warfare Laboratory, the electronics R&D functions now performed by the Army Security Agency, and other selected functions. Most would remain in place in existing facilities.

Communications and automatic data processing electronics research and development and logistical support for all Army electronics equipment would continue to be performed at Fort Monmouth, NJ, now the headquarters of the U.S. Army Electronics Command, in a new Communications Electronics Materiel Readiness Command. An Army message to all organizations concerned states:

"A major consideration in choosing to identify a preferred alternative was that doing so would provide a focal point for the comments developed by interested parties. The Army recognizes fully that information obtained through comments on the draft EIS may surface additional considerations which may affect the viability of some of the alternatives.

"Accordingly, each of the comments received will be evaluated in the process of developing the final EIS and reaching a decision as to which of the alternatives will be implemented."

Based on current estimates of the realignment of electronics functions in the preferred alternatives, about 530 jobs would be transferred and about 455 would be eliminated. About 500 jobs would be transferred from the Electronics Command at Fort Monmouth to installations in the greater metropolitan area of Washington, DC. About 275 of the estimated job losses would be at Fort Monmouth and the others in the Washington DC, area.

AVIATION DEVELOPMENT CENTER. As a preferred alternative, this center would result in designation of a U.S. Army Aviation Research and Development Command, and a U.S. Army Troop Support and Aviation Materiel Readiness Command. They would be staffed from R&D elements of the U.S. Army Aviation Systems Command (AVSCOM), St. Louis, MO. The Avionics Laboratory of the U.S. Army Electronics Command would remain at Fort Monmouth but be assigned to USA R&D Command. All AVSCOM lab elements would remain in place.

Alternatives addressed in arriving at the preferential option included:

- Establish the Development Center Headquarters in St. Louis, MO, at the Federal Center with other major subordinate elements essentially unchanged in present locations.
- Consolidate the Development Center at Langley AFB, VA.
- Consolidate the Development Center at Moffett Field, CA.
- Establish the Development Center Headquarters in St. Louis at the Federal Center with restructuring and some relocation of elements of the Air Mobility Research and Development Laboratory (AMRDL).

Currently AMRDL elements are at Langley AFB, Moffett Field, Fort Eustis, VA, and the NASA-Lewis Research Center, Cleveland, OH. The AMRDL reports to HQ U.S. Army Aviation Systems Command, St. Louis.

The proposed Troop Support and Aviation Command would be formed by merging elements of AVSCOM with the Troop Support Command at the Federal Center in St. Louis. Other alternatives are: 1) Retain all current functions and missions performed by TROSCOM and the logistical elements of AVSCOM; 2) Transfer selected functions and personnel to other DARCOM commands.

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Army Readiness Posture: Requirements To Meet Forseeable Threat

(Continued from page 23)

met design specifications in testing completed last year.

Standardization. The Army is participating in a variety of actions aimed at standardizing weapons within NATO. Examples include joint testing of an infantry rifle, comparative testing of a Belgian and U.S. machinegun, and joint testing among the United Kingdom, the United States, and the Federal Republic of Germany of a common main tank gun. The comparative evaluation of the XM-1 and the Leopard II (AV) tanks has been addressed earlier in this statement.

Savings from standardization can be calculated in terms of time and cost. For example, development costs for the Roland short-range air-defense system on a unilateral basis would be $450 million. The costs of adopting the allied product would be $240 million. Similarly, development time can be telescoped.

Savings are possible in other areas under exploration, such as command and control systems and logistics. Mutual support and operational flexibility are being increasingly enhanced in cooperation with allies in NATO. The standardization effort is a 2-way street, of course, promising benefits to all participants, but necessitating hard decisions on both sides. The program will continue, not only as a means of increasing NATO combat power, but as an initiative which promises substantial economies.

Industrial Base. The Army is increasingly concerned over the erosion of the country's vital military/industrial base. A detailed study completed last year substantiates the concerns about some of the inadequacies in industrial preparedness planning.

The Army is therefore taking positive steps in a number of areas to enhance the production base for certain key items. As stated earlier, a 4-fold increase in M60 tank production capacity is under way.

Emphasis is continuing on the modernization and expansion of ammunition production capabilities, both privately operated government plants and private producers. A new piece of production equipment, the rotary forge at Watervliet Arsenal, represents new production capability which will revolutionize and expedite the manufacture of large-size gun tubes.

Additionally, it should be noted that the level of foreign military sales orders, combined with our current requirements, allows the maintenance at a nominal cost of many production lines which otherwise would be going cold.

SECURITY ASSISTANCE. One of the Army's most important missions is support of the U.S. Security Assistance Program. The Army fully recognizes security assistance as a key element of U.S. foreign policy. Army Security Assistance Programs are in operation for nearly 80 nations and involve provisions of a vast array of materiel ranging from uniforms and trucks to electronics and missile systems.

Technical services, training, and construction cover the entire spectrum from small Quality Assurance Teams to extensive foreign student attendance at Army schools to multi-billion-dollar foreign military construction projects.

In FY 1975, the new orders for security assistance processed by the Army totalled $4.7 billion, while the undelivered Security Assistance Program was valued at $10.9 billion. . . .

Career Programs...





"School Without Walls" program provides high school students an opportunity to work alongside WRAIR researchers. From left, Jon Howard removes sample of degraded virus particles; Jennifer Howard uses computer to analyze data from steroid hormone assay; Veronica Genies checks amino acid analyzer chart; Karen Lucas sets up spectrophotometer for check on specimen in the simultaneous quantification of serum and copper; David Stone monitors heart rhythm of experimental animal.

School Without Walls...

WRAIR Opens Doors to High School Scientists

Practical experience in a scientific laboratory is being provided to six high school students at the Walter Reed Army Institute of Research as part of an experimental program of the Washington, DC, public schools.

Termed "School Without Walls," the program sets aside one day a week for each student to work alongside WRAIR researchers who are assigned as "mentors" on a one-to-one relationship. Students also will spend one day a week in a chemical class started last fall by the Organization of Black Scientists (OBS) and three days in regular school classes.

Assignments are determined primarily by individual student interest in a particular field. Participating in the program for the second year, WRAIR will provide training in the use of a scientific library and research report writing.

Initially, the students will be introduced to basic procedures such as weighing and solution making. They will then learn to use equipment such as pH meters, spectrophotometers and amino acid detectors.

Projects included on the student agenda will be studies of amino acid reactions to stress, heart-lung bypasses and cardiovascular surgery, and effects of hormones on metabolism.

All of the students are enrolled in a chemistry course sponsored by the DC Organization of Black Scientists. WRAIR employe Harold Williams, an OBS member, will serve as one of the mentors.

Williams emphasized that the OBS felt responsibility to expose young people to blacks who have achieved recognition in science. He indicated that the students have an expressed interest in chemistry and biology.

ALMC Establishing Awards for R&D Reservists

Responsibility for establishing an annual awards program for members of the Army Reserve Research and Development Officer Program has been assigned to the U.S. Army Logistics Management Center (ALMC) Reserve Affairs Office.

Approved conceptually by the Office, Deputy Chief of Staff for Research, Development, and Acquisition (DCSRDA) and the Office, Chief Army Reserve, the program will recognize professional and technical contributions of selected R&D Reservists.

Joint sponsorship of the awards will be assigned to DCSRDA, Office, Chief of Army Reserve and ALMC. ALMC is surveying various agencies to determine nomination and awards procedures, panel makeup and operating criteria.

More than 500 personnel are currently enrolled in the Army Reserve R&D Officer Career Program, serving as Reserve Mobilization Designees (MobDes) at Army schools and training centers, and R&D elements of numerous commands

The ALMC Reserve Affairs Office is responsible for conducting three Reserve Component programs: the Logistics Career Program, R&D Education Program and the Group Study Program.

A New Type of Professional...

Biomedical Engineer Expresses Concern

Many of the marvels of modern health care are becoming increasingly dependent upon services of a relatively new type of professional exemplified by Harry Thurman at Walter Reed Army Medical Center, Washington, DC.

Currently, Thurman is the only biomedical engineer at WRAMC, a vast institution internationally known for the quality of its medical services, modern equipment and over-all facilities. Plans call for an eventual group of four or five biomedical engineers.

What is a biomedical engineer and why is he an individual whose special capabilities are increasingly in demand? Thurman's response is:

"With medical science advancing so quickly, a need arises for someone to take the requirements of the doctor (for new diagnostic and treatment equipment) and translate them into engineering designs and specifications for devices that can be produced commercially."

One of his recent assignments, for example, was to devise an effective patient monitoring system for about 200 patients normally bedded in WRAMC's new hospital acute and intensive care facilities. The system is designed for highly sensitive response to alert a physician of potentially dangerous trends in a patient's condition.

Similar techniques are planned for use in WRAMC surgical intensive care units as well as in thoracic surgery and organ transplant facilities. Working with WRAMC's Hospital Project Office, Thurman views himself "an engineer member of the medical-surgical team."

Thurman often is called upon to review architect and U.S. Army Corps of Engineers planned systems for the new facility. One such review dealt with redesign of a high-purity water system.

The original design, he found, would have fallen short of providing enough water of sufficient purity to supply the laboratories and clinics. This determination resulted in design of a new system to provide more than 10,000 gallons of pathogen- and pyrogen-free water daily.

4 ARMCOM Employes Receive ME Certification

Mechanical engineering technician certificates were issued recently to four employes of the U.S. Army Armament Command's Thomas J. Rodman Laboratory when they became the first TRL staff members to qualify by passing a 6-hour examination after filing applications.

Qualifications of candidates are reviewed by the Institute for Certified Mechanical Engineering Technicians which issues certificates in three categories: Associate Engineering Technician (two years experience or schooling), Engineering Technician (seven years experience) and Senior Engineering Technician (15 years experience or schooling).

Engineering technician certificates were awarded to Ron Brown of the Armored Weapons Systems Directorate, Michael Munch of the Small Arms Weapons Directorate, and Larry Patrick of the Aircraft-Air Defense Systems Directorate.

Certified as an associate engineering technician is Rick Gossen of the Armored Weapons Systems Directorate. He has been employed at Rodman Laboratories for two years and has attended Iowa State University.

AAAS Elects Krevsky as Fellow for Achievements

Seymour Krevsky, assistant to the technical director of the Army Communications Systems Agency at Fort Monmouth, NJ, is a recently elected Fellow of the American Association for the Advancement of Science.

A member of AAAS since 1962, Krevsky was cited "for contributions to the electronics engineering field, in particular for advances in high-frequency ionospheric radio propagation theory and techniques."

He is a senior member of the Institute of Electrical and Electronics Engineers, and a vice president of the Fort Monmouth chapter, Armed Forces Communications and Electronics Association. Author or coauthor of more than 15 technical papers, he has BS and MS degrees in electrical engineering from the New Jersey Institute of Technology, formerly Newark College of Engineering.

Army Announces Selectees for 4 Top Senior Service Colleges

Department of the Army personnel selected to attend four top senior service colleges during 1976-77 were announced late in March.

Selectees were screened by the Department of the Army Executive and Professional Development Committee. Members included four Deputy Assistant Secretaries of the Army: Manpower and Reserve Affairs; Research and Development; Installations and Logistics; and Financial Management. The deputy director of Civilian Personnel and deputy director of Military Personnel Management completed the committee.

Schools and selectees follow.

NATIONAL WAR COLLEGE (NWC), Fort McNair, Washington, DC, is a graduate-level interservice school for senior military and civilian career officials and State Department personnel. It provides training for high policy command and staff functions and national strategy planning.

William S. Hayden is a supervisory electronic engineer serving as chief of the Communications/Electronics Warfare Division, Office, Deputy Chief of Staff, R&D, U.S. Army Security Agency. He is backed by 12 years of federal service and has a BS degree from Clemson University.

Current responsibilities include supervision of about 25 military and civilian engineers and management of an annual R&D budget of about $30 million. He also exercises financial and technical control over EW/Communications R&D programs.

Hayden has served as the Army member of the Tri-Service Receiver Panel and the Tri-Service Recorder Panel, and as product manager of the TACOM-Electronic Warfare System.

INDUSTRIAL COLLEGE OF THE ARMED FORCES (ICAF), Fort McNair, conducts graduate-level courses in national security with primary emphasis on management of national resources.

Thomas E. Daniels is currently detailed as acting deputy project manager for Navigation/Control Systems (NAVCON), Office of the Project Manager, Navigation/Control Systems, Fort Monmouth, NJ.

Daniels acts jointly with the project manager in the total life-cycle management of two complex, technically related systems. He also represents the U.S. as a navigation expert to the Army Armaments Group of the North Atlantic Treaty Organization.

He earned a BS in electrical engineering from the State University of Iowa in 1948, a master's degree in business administration from Monmouth College in 1975, and has 25 years of Federal Civil Service.

John Mitchell Russ, employed by the U.S. Government for seven years, is a cost analyst in the Office of the Assistant Secretary of the Army (Financial Management). His responsibilities include development, coordination and implementation of economic analyses.

A member of the American Society of Military Comptrollers and the Institute of Military Science, Russ holds a BS degree in engineering and a master's degree in economics, both from Michigan State University.

Dr. Roy L. Schooling, assigned to the Office of the Assistant Secretary of the Army (Installations and Logistics), serves as Army policy representative on the Armed Services Procurement Regulation Committee. He was director of the Army Procurement Research Office, 1969-73.

Federally employed for 22 years, Dr. Schooling holds BS, LLB and JD degrees from Oklahoma City University and an LLM from George Washington University. He graduated in the top 10 percent of all classes in which he was enrolled and has served various procurement assignments with the Department of the Air Force.

John R. Jury, a federal service employe for 15 years, is a senior procurement analyst, Procurement Management Review Division, Directorate of Requirements and Procurement, U.S. Army Materiel Development and Readiness Command.

Jury performs reviews of the Army's major procuring activities worldwide on a periodic basis. Responsible for planning, coordinating and directing surveys of post-award contract activities, he has a bachelor's degree in business administration from Gettysburg college.

ARMED FORCES STAFF COLLEGE (AFSC), Norfolk, VA, conducts studies in joint and combined organization, planning and operations. Included are aspects of national and international security designed to enhance preparation of selected military and civilian personnel for duty in all echelons of joint and combined commands.

John S. Bezner is an operations research analyst, Systems and Economic Analysis Division, Office of the Comptroller, U.S. Army Communications Command (ACC). He directs implementation of ACC's Decision Risk Analysis Program and serves as director of the Defense Satellite Communications System Working Group.

A 1975 recipient of a Secretary of the Army Award for Outstanding Achievement in Material Acquisition, Bezner served during 1971-74 in the School of Logistics Science, U.S. Army Logistics Management Center, and as course director of the Decision Risk Analysis Course.

Frank E. Tremain is a mechanical engineer assigned to the Special Projects Division of Laboratory 7000, U.S. Army Mobility Equipment Research and Development Command. He conducts research and analyses related to the fielding of new electromechanical systems.

Backed by 12 years of federal service, Tremain holds a bachelor's degree in mechanical engineering from the Newark College of Engineering. He is credited with assisting in the development of north-seeking gyroscopes and other inertial equipment for artillery surveying.

ARMY WAR COLLEGE (AWC), Carlisle Barracks, PA, offers a course to prepare graduates for senior command and staff positions within the Army and throughout the Department of Defense and promotes understanding of the art and science of land warfare.

L. Standlee Steenrod is an operations research analyst assigned to the Strategic Forces Group, Joint and Strategic Forces Directorate, U.S. Army Concepts Analysis Agency. He serves as team leader on projects dealing with strategic and general-purpose forces.

Formerly an adviser to the SHAPE Headquarters, NATO Committee on Command and Control, Steenrod has an associate's degree in mathematics from Joplin Junior College and a BA degree in mathematics and a master's degree in mathematics, both from the University of Missouri.

ARMY WAR COLLEGE (Nonresident Course). Initiated in 1975, this program provides an intensive correspondence course, including two 2-week summer seminars. Two Department of Army personnel are nominated annually.

Dr. Thomas J. Welch is chief of the Radiation Systems Branch, Combat Developments Directorate, U.S. Army Ordnance Center and School. Responsibilities include management of the Army's nuclear defense combat development mission and Training and Doctrine Command laser mission.

Dr. Welch received his BS degree in physics from St. Bonaventure University in 1960, his MS in physics from John Carroll University in 1963 and his PhD from Auburn University in 1974.

Helen Dunn Gouin, a Department of Army civilian alcohol and drug abuse program administrator, is directly responsible for development of all DA policies relative to the worldwide alcohol and drug abuse program for more than 400,000 employes.

Graduated with an MS degree in pharmacy and public health from the University of Oklahoma, she is a member of the Association of Military Surgeons of the United States, and the Food and Drug Administrations's Advisory Group for Review of Over the Counter Drugs.

Reader's Guide...

ARI Papers Report Intelligence/Tactical Systems

Combat intelligence information and tactical data systems are the subjects of technical papers published recently by the Systems Integration and Command/Control Technical Area, U.S. Army Research Institute for the Behavioral and Social Sciences.

Technical Paper 265, *Tactical Order of Battle: A State-of-the-Art Survey*, examines current "order of battle" (OB) procedures for processing OB intelligence information. Historical development, functions and opinions of OB are evaluated.

Technical Paper 267, *Application of Tactical Data Systems for Training: Devtos Feasibility Determination and Selection of an Instructional Operating System*, discusses the feasibility of using tactical data systems to support individual and unit training requirements.

Correspondence relative to distribution of these reports may be addressed to: U.S. Army Research Institute for the Behavorial and Social Sciences, ATTN: PERI-P, 1300 Wilson Boulevard, Arlington, VA 22209.

Waterways Station Announces New Publications

Two reports published recently by the U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, are available from the Department of Commerce, National Technical Information Service, Springfield, VA 22151.

Technical Report H-75-17, *Type 16 Flood Insurance Study: Tsunami Predictions for Monterey and San Francisco Bays and Puget Sound:* Final Report, examines runup resulting from seismic sea waves (tsunamis) of distant origin.

Miscellaneous Paper H-75-8, *Westport Small-Boat Basin Revision Study: Hydraulic Model Investigation*, Final Report, evaluates flushing characteristics of three proposed revision plans to the existing Westport Small-Boat Basin.

Printed copies are $3.00 and microfiche $0.95.

People in Perspective...

'Electrons From Cold Emitters' Coauthor...

'Forgets the Clock' to Advance Research Theory

Elusive answers to problems of proving theories in scientific research often cause investigators to "forget the clock" of the normal work week.

An example is Joe Shelton, a U.S. Army Missile R&D Command scientist at Redstone Arsenal, AL, who has devoted five years to research on "Electrons From Cold Emitters" — the title of an article coauthored with Ralph L. Norman and Jerry W. Hagood and published in the May-June 1975 edition of the *Army Research and Development Newsmagazine*.

Shelton believes that recent experimentation in his garage workshop at home on weekends and evenings may have produced practicable solutions to some of the problems of field emitter technology, an area in which his research has resulted in several patents.

The basic problem he tackled, by making an electrolytic tank in the garage, was that of determining why the current obtained from a cold emitter was too low in density for some military electronic applications.

Experimentation established, to his satisfaction, that the problem was caused by what he terms the "edge effect" of a theoretical model that had been used in earlier studies.

An electrolytic tank simulates an electronic tube by passing electrons from a cathode, such as the cold emitter, through a conducting medium to an anode (collector). Shelton selectively removed the electron-emitting fibers from the edges of the cold emitter and recorded the effect of each removal on the emitter-to-anode electron flow pattern.

Each removal, he observed, changed the "edge effect" — providing the knowledge he needed to redesign the anode to collect electrons given off from all fibers in the emitter.

This technological advance, Shelton hopes, may place cold emitters in the realm of feasibility for application to numerous military requirements in electronics, by overcoming the previous current density limitations. Civilian applications are envisioned.

Funded by the Department of Defense Advanced Research Projects Agency, the project on which Norman, Hagood and Shelton have been working has been conducted by the Department of Ceramic Engineering at Georgia Institute of Technology under direction of Dr. A. T. Chapman.

Joe Shelton

Federal Building Heat Loss Surveys...

Gain Plaudits for AMMRC Researcher

Paul Vogel

Thermal detection of critical flaws in nondestructive testing of gun tubes and thermographic determination of heat loss from federal buildings involved in national energy conservation may appear to be "horses of a different feather" — as a man prone to mixed metaphors stated.

Paul E. J. Vogel of the Army Materials and Mechanics Research Center, Watertown, MA, finds no incompatibility in wide variance of applications of thermal detection such as these. His thermographic heat loss survey program has burgeoned since October 1975 into a frequent 18-hour-a-day on-the-go job that has gained him widespread plaudits.

Indicative of the acclaim he is receiving are comments such as:

"It will result in substantial savings of energy and dollars for years to come." (Federal Executive Board, St. Louis, MO.) "He was able to show us areas where immediate improvements can be made." (MG Hugh R. Higgins, Defense Construction Supply Center, Columbus, OH.)

"His determination, tenacity and devotion to duty contributed significantly to the success of the survey." (COL John J. Fatum, commander, Headquarters Activity, Electronics Command, Fort Monmouth, NJ.)

During a 6-month period, Vogel conducted full-scale thermographic surveys of the exteriors of 12 federal installations. They ranged from the Coast Guard radio transmitter station on Cape Cod, MA, to Dugway Proving Ground, UT, and from New York's Seneca Army Depot to the Red River Depot in Texarkana, TX.

Following presentation of an invited paper on "Infrared for Energy Conservation" to a U.S. Army Materiel Development and Readiness Command (DARCOM) meeting in Alexandria, VA, Vogel was asked to perform as many infrared surveys of Army installations as possible during the heating season.

Heat losses appear as "hot spots" on his Polaroid thermograms. His typical day may begin at 3:00 a.m. when he inspects east and south sides of buildings until sunrise, the west side until noon, and the north in the early afternoon.

When the sun has been off the east side for five to six hours, he can continue surveying from that direction until after sundown. If he can manage free time before sundown, he returns to the scene of his nighttime work and makes conventional photos of the sites.

After the outdoor part of his work has ended, Vogel disassembles his radiometer and oscilloscope camera to polish mirrors, dry out camera parts, oil the pan gears, and do "first-echelon" maintenance on the motor generator set. On the way home he stops for a meal.

Then comes the day's end task, that of spreading the collection of thermograms and photographs to dry while he catches a few hours of sleep before starting out again in the wee hours of the morning. His workshop on-the-job is the back of a pick-up truck, which subjects him to a lot of bad weather along with the good.

During Vogel's only respite from the surveys this winter, came in January, when he planned and conducted his Third Symposium on Nondestructive Testing of Tires which was held in Dayton, OH.

Redstone Retiree a One-Man Band...

Entertains by Playing Six Instruments

It may not be the sweetest music this side of heaven but the melodious 6-instrument tones produced by Senior Citizen Fred Hatchett, a former facilities engineer for 17 years with the U.S. Army Redstone (AL) Arsenal, are unmistakably all his own!

Hatchett is a one-man band specializing in saw music. For years, he singly played the six instruments, the others being the banjo, guitar, piano, harmonica and violin. With the aid of multi-track records, he now plays them simultaneously.

Next to the saw, he contends, the violin is without a doubt the hardest instrument to play. However, he admits that this opinion reflects back to his boyhood memories when daily fiddle practice was less than enjoyable.

As far back as he can remember, the saw has always played a part in his life. The saw he now plays was used to build his present home.

Most of his musical entertaining is restricted to civic functions and charity performances but, using his home-made recordings, he has performed on various Redstone area television programs.

His strong interest in music has led him into writing much of his own material. His published songs range from those of a religious mood to the very lighthearted.

Hatchett views his musical performances and work with senior citizens groups as a means of remaining "fresh." "I see many former employes who stop doing and that is a bad approach to retirement," he explains.

Awards...

Academy of Sciences Honors ARI Technical Director

Dr. J. E. Uhlaner

Two scientific achievement "firsts" were recorded by a U.S. Army executive and researcher when Dr. J. E. Uhlaner was honored by the Washington Academy of Sciences at Mar. 18 ceremonies in the Cosmos Club, Washington, DC.

Deputy Assistant Secretary of the Army (R&D — Science and Technology) Dr. K. C. Emerson paid tribute to Dr. Uhlaner's long record of outstanding scientific achievements. In his presentation address, Dr. Emerson cited that it was the first time the academy had selected a psychologist, and the first time its annual achievement award had been presented in behavioral science.

Dr. Uhlaner is technical director of the U.S. Army Research Institute (ARI) for the Behavioral and Social Sciences, and the Army chief psychologist. Dr. Emerson said, "The award honors ARI as well as Dr. Uhlaner for achievement. . . He has insisted on the application of sound scientific methodology, rather than merely responding to pressure for action-oriented programs."

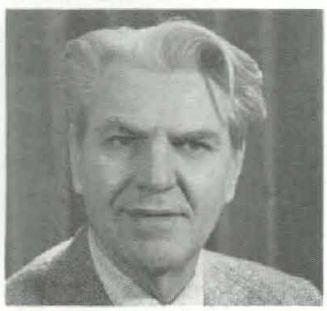
Crediting Dr. Uhlaner with introducing a systems-oriented approach to ARI human factors research, Dr. Emerson added:

"This era of changing social goals and individual ambitions in the civilian sector has also resulted in changes in the U.S. Armed Forces. Today, the Army is able to attract, train and insure more job satisfaction to the individual than it has ever done before in peace time. These are real accomplishments without a draft [as applied to ARI's role in building the Volunteer Army] and following so closely after the Vietnam episode.

"The Army's success can be attributed to assistance and advice of a group of competent scientists at the Army Research Institute working under the professional leadership of Dr. Uhlaner. . . . I am glad that the Academy, in honoring Dr. Uhlaner, recognizes his personal contributions in the behavioral sciences and his aggressive, creative leadership as the technical director of the Army Research Institute."

Among Dr. Uhlaner's Federal Civil Service awards is a 1969 U.S. Government Decoration for Exceptional Civilian Service.

Bush Wins Ballistic Lab's 1975 Zornig Award



Clarence C. Bush

Clarence C. Bush, supervisory aerospace engineer at the U.S. Army Ballistic Research Laboratories (BRL), Aberdeen (MD) Proving Ground, was presented with BRL's 1975 Zornig Award.

Assigned to BRL's Exterior Ballistics Laboratory, Bush is internationally recognized as an expert in the operation and instrumentation of wind tunnels. His award citation noted his efforts in making BRL's wind tunnel one of the best facilities of its kind.

BRL Director Dr. Robert J. Eichelberger presented the award, one of the two highest offered annually by the laboratories, along with a gold lapel pin and a plaque bearing the names of former recipients.

Established in 1959, the award honors COL H. H. Zornig, who was responsible for the organization of BRL in 1938 and was director until 1941. The award recognizes outstanding individual achievement in technical, administrative, mechanical and other related fields.

Employed in BRL's Wind Tunnel Branch since 1948, Bush has served as a mechanical engineer, an aerospace engineer and as chief of the Operations Section for 15 years. He is credited with eight invention disclosure awards and six patent awards.

Included among his inventions are a spring-type torque indicating lock washer, flexible cams, spring inserts or set screws, a device for measuring skin friction, a spring-o-matic transmission, and eye protectors for welders.

Natick R&D Command Recognizes Achievements

Research, engineering, administration and installation support achievements were recognized recently during annual awards ceremonies at the U.S. Army Natick Research and Development Command (NARADCOM), Natick, MA.

Gerald Schulz, Peter Burke, Tedio Ciavarini and *Joseph Szczeblowski* shared the Technical Director's Gold Pin for Engineering, in recognition of joint development of the flexible package for heat-processed foods.

Robert S. Smith received the TD's Silver Pin for Engineering, based on an experiment to consolidate company-level feeding kitchens for soldiers. The plan is believed capable of saving an estimated $70 million annually in food services for a 16 division Active Army.

Philip Brandler, an operations research analyst, was presented the TD's Gold Pin for Research. He was cited for outstanding contributions to the Uniform Ration Cost System. *Dr. Earl Steeves,* research engineer, was awarded the TD's Silver Pin for Research, based on studies of pressure-stabilized beams for the design of air-supported tents.

Dominic Luppino received the Commander's Gold Pin for Leadership in Administration. He developed and conducted a training program for engineering support in the Technical Documentation Office.

Richard Elwell, chief of the Technical Documentation Branch, won a CO's Silver pin for Leadership in Administration. He was praised for effective management of engineering support programs. *Dr. John Mulvihill,* chief counsel to the commander, also received a CO's Silver Pin for Leadership in Administration.

SP5 Jerald L. Tisinger was presented with the Commander's Annual Military Award for Research, Development, Test and Evaluation, in recognition of his contribution to animal research and the welfare of laboratory animals.

Williard Hall and *Dominic Caccavelli* won the CO's Gold Pin for Installation Support. The award was established this year to recognize achievements of one white-collar worker and one blue-collar worker. Hall was honored for his work as a glassblower and Caccavelli for carpentry work on audio visual displays.

Medical Technologist Wins Presidential Citation

Jerome A. Waliskewski, a nuclear medicine technologist at William Beaumont Army Medical Center, El Paso, TX, is one of 24 Army winners worldwide to receive a Presidential citation for contributions toward Army management effectiveness.

Secretary of the Army Martin A. Hoffmann presented the Management Improvement Certificate to Waliskewski — the only employe from more than 51,000 serving nationwide in the U.S. Army Health Services Command to receive the citation.

Assigned as chief technologist in William Beaumont's Nuclear Medicine Clinic, Waliskewski was cited specifically for:

- Enhancing morale and effectiveness of his technicians by permitting each to take full responsibility for scheduling and completing his own assignments. He also initiated weekly and monthly in-house work seminars.
- Improving equipment efficiency by staggering work hours and thus increasing the number of patient procedures performed on each machine without need of hiring additional personnel.
- Contributing to better patient care through a basic understanding of patient flow patterns. Improved scheduling also made special procedures available to more patients.
- Reducing operating costs by $183,000 in Fiscal Year 1975 by establishing five laboratory program changes, including more in-house tests, and use of bulk chemicals rather than prepackaged kits.

Patents Evidence TACOM Engineer's Ingenuity

Ervin F'Geppert, a mechanical engineer, is "laying claim to patent fame" at the U.S. Army Tank Automotive Command, Warren, MI.

Assigned to the Engineering Division, Research, Development and Engineering Directorate, F'Geppert was awarded four patents during a recent 2-month period, bringing his current total to five with five pending. He also has eight invention disclosures under patent consideration.

His most recent patented inventions include a temperature-responsive drive unit, a vehicle-level control mechanism, a constant-force belt tensioner, and an antifriction worm and wheel drive.

A native of Germany, F'Geppert earned a bachelor's degree in mechanical engineering from the University of Berlin in 1928, the same year he came to the United States, and became a federal Civil Service employe in 1949 with the former Army Tank-Automotive Command.

Personnel Actions . . .

Officer Promotion Boards Announce MG, BG Selections

Officer Promotion Board selections announced recently for major general and brigadier general rank serve to accent the importance placed on career development in specialty fields under the Officer Personnel Management System, known as OPMS.

Twenty-four of 53 BG selectees will fill specialty requirements at general officer level, including three project managers for major weapon systems and a former product manager for the Cobra helicopter.

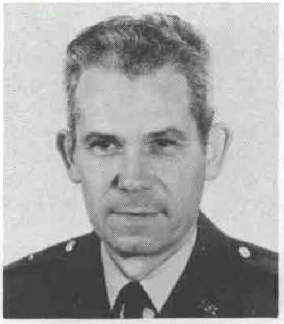
MG William E. Eicher

MG Harry A. Griffith

Deputy Commander BG William E. Eicher of the U.S. Armament Command, Rock Island, IL, is No. 1 on the 2-star list, followed by BG Harry A. Griffith, director of Development and Engineering, HQ U.S. Army Materiel Development and Readiness Command (DARCOM), Alexandria, VA. *(Promoted Mar.30-31.)*

Other 2-star rank designees, listed in the numerical order in which they will be promoted as vacancies develop, are: John N. Brandenberg, chief of staff, XVIII Airborne Corps, Fort Bragg, NC; Arthur J. Gregg, DCS/Logistics, U.S. Army Europe/Seventh Army; Richard E. Cavazos, assistant commander, 2d Armored Division, Fort Hood, TX; and

Raphael D. Tice, commander, U.S. Army Berlin Brigade, U.S. Army Europe (USAREUR); Oscar C. Decker, deputy commander, U.S. Army Tank-Automotive Command, Warren, MI, and former project manager for the Armored Reconnaissance Scout Vehicle; Hugh F. T. Hoffman Jr., assistant commander, 3d Infantry Division, USAREUR; Ennis C. Whitehead Jr., commander U.S. Army Garrison, Okinawa; Ernest D. Peixotto, director, Materiel Plans and Programs, Office Deputy Chief of Staff for Research, Development, and Acquisition, HQ DA; and



BG Oscar C. Decker

BG Ernest D. Peixotto

William B. Steele, deputy commander, U.S. Army Recruiting Command, Fort Sheridan, IL; John L. Osteen Jr., DCS/Intelligence, U.S. Army Forces Command, Fort McPherson, GA; Charles I. McGissis, division engineer, Southwestern Division, USA Corps of Engineers; William R. Todd, ACS/Operations, U.S. Army Forces Command; David E. Grange Jr., CofS, I Corps, ROK/US Group; Richard L. Prillaman, deputy commander, U.S. Army Training Center and Fort Jackson, SC.

Robert J. Lunn, assistant commandant, U.S. Army Air Defense School, Fort Bliss, TX; Jack L. Hancock, deputy commander, U.S. Army Computer Systems Command, Fort Belvoir, VA; Fred C. Sheffey Jr., director, Supply, HQ DARCOM; John K. Stoner Jr., commander, 2d Support Command, USAREUR; Alexander M. Weyand, deputy commander, U.S. Army Recruiting Command; Glenn K. Otis, deputy commander, U.S. Army Training Center, Fort Knox, KY; Richard G. Fazakerley, DCS/Comptroller, U.S. Army Forces Command; George L. McFadden Jr., deputy director, Field Management and Evaluation, National Security Agency, and deputy chief, Central Security Service, Fort Meade, MD.

BRIGADIER GENERAL SELECTEES. Promotion opportunities in the project manager system of the U.S. Army Materiel Development and Readiness Command are accented — as they were in the previous announcement of designees for BG and MG rank — by the choice of three for promotion to BG.

Included among designees are COL Frank P. Ragano, PM, Cannon Artillery Weapon System, HQ ARMCOM, Rock Island, IL; COL Frank J. Palermo Jr., PM, Hellfire, U.S. Army Missile Command, Redstone Arsenal, AL; Dan M. Williamson Jr., PM, M60 Tank Development, TACOM, Warren, MI.

Other brigadier general designees, listed in numerical order of promotion, are:

George E. Marine, chief, Regional Operations Division, Office, DCS/Operations and Plans, USA, Washington, DC; Donald W. Connelly, CofS/deputy commander, U.S. Army Administration Center, Fort Benjamin Harrison, IN; Louis C. Wagner Jr., commander, 1st Brigade, 3d Armored Division; Arthur J. Junot, assistant commandant, U.S. Army Transportation School, Fort Eustis, VA; and

David K. Doyle, deputy director of the Army Staff, Office, CofS, Washington, DC; Orlando E. Gonzales, commander, 7th Transportation Group, Fort Eustis, VA, and former product manager for the Scout helicopter; Joseph T. Palastra Jr., commander, 3d Brigade, 101st Airborne Division (Air Assault), Fort Campbell, KY; John S. Blair, deputy commandant for Combat Development, U.S. Army Signal School, Fort Gordon, GA; and

James H. Mapp, deputy for Training, U.S. Army Aviation School, Fort Rucker, AL; Charles T. Lynn Jr., deputy commander for Support, U.S. Army Finance and Accounting Center, Fort Benjamin Harrison, IN; Hugh J. Clausen, Staff Judge Advocate, III Corps, Fort Hood, TX; Howard F. Stone, CofS, 9th Infantry Division, Fort Lewis, WA; Maxie O. Redic Jr., chief, Depot Maintenance Division, Directorate of Maintenance, DARCOM; and

Thomas P. Lynch, commander, 7th U.S. Army Training Center, USAREUR; Ransom E. Barber, CofS, U.S. Army Military Personnel Center, Alexandria, VA; Norman G. Delbridge Jr., commander, Division Support Command, 3d Armored Division; Fred K. Mahaffey, commander, 2d Brigade, 101st Airborne Division (Air Assault), Fort Campbell, KY; Charles W. Dyke, commander, 1st Brigade, 101st Airborne Division (Air Assault); and

John P. Casey Jr., director, Plans and Exercise Group, III Corps, Fort Hood, TX; Robert S. McGarry, district engineer, USA Engineer Division, North Atlantic, Baltimore, MD; Robert W. Sennewald, chief, Firepower Division, Requirements Directorate, Office, DCS/Operations and Plans, Washington, DC; Drake Wilson, district engineer, USA Engineer Division, South Atlantic, Mobile, AL; and

James J. Lindsey, CofS, 82d Airborne Division, Fort Bragg, NC; William C. Moore, executive officer, Office, DCS/Operations and Plans; Charles W. Bagnal, commander, 101st Aviation Group, 101st Airborne Division (Air Assault); Charles E. Graves, director, Directorate of Combat Developments, U.S. Army Air Defense School, Fort Bliss, TX; Richard S. Sweet, deputy director, Accession and Retention, Office, ASD (M&RA), Washington, DC;

Robert H. Forman, director of Instruction, USA Field Artillery School, Fort Sill, OK; James H. Patterson, commander, 6th Air Combat Cavalry Brigade, III Corps, Fort Hood, TX; Paul F. Pearson, director, Department of Gunnery, USA Field Artillery School, Fort Sill, OK; William K. Hunzeker, commander, Sharpe Army Depot, Lathrop, CA; Joseph H. Kastner, chief, Aviation Division, Office, DCS/Operations and Plans, Washington, DC; and

Corey J. Wright, ADCS, Resource Mangement, U.S. Army Training and Doctrine Command, Fort Monroe, VA; Emmett Paige Jr., commander, 11th Signal Group, U.S. Army Communications Command, Fort Huachuca, AZ; Theodore S. Kanamine, provost marshal, USA Forces Command, Fort McPherson, GA; Michael N. Bakarich, CofS, 2d Infantry Division; Jeremiah J. Brophy, Assistant CofS, VII Corps, USAREUR; and

Richard M. Wells, commander, 4th Advanced Individual Training Brigade, Fort Leonard Wood, MO, James S. Welch, chief, Supply and Maintenance Policy Division, Office, DCS/Logistics, USAREUR; Benjamin E. Doty, chief, Majors Division, Officer Personnel Directorate, USA Military Personnel Center, Alexandria, VA; Archie S. Cannon Jr., CofS, USA Recruiting Command, Fort Sheridan, IL; and

David W. Einsel, chief, Chemical and Nuclear Office, Office, DCS/Operations and Plans, Washington, DC; Theodore G. Jenes Jr., commander, 3d Brigade, 2d Infantry Division; Richard X. Larkin, CofS, 4th Infantry Division (Mech), Fort Carson, CO; Tommie G. Smith, Manpower Survey Team Chief, USA Inspector General Agency, Washington, DC; Richard D. Boyle, Executive to the Secretary of the Army, Washington, DC; and

Allen M. Goodson, commander, USA Midwestern Regional Recruiting Command, Fort Sheridan, IL; Vaughn O. Lang, commander, 1st Signal Brigade; Robert L. Herriford Sr., chief, Procurement Division, ARMCOM, Rock Island, IL; Robert B. Solomon, information officer, USA Forces Command, Fort McPherson, GA.

COL F. P. Ragano

COL F. J. Palermo Jr.

COL D. M. Williamson Jr.

Civil Service Confirms PL-313 DSCRDA Appointments

Dr. Robert J. Heaston

Dr. Henry J. Smith

Confirmation of appointment of two PL-313 scientific advisers on the staff of the Deputy Chief of Staff for Research, Development, and Acquisition, Department of the Army, has been announced by the U.S. Civil Service Commission.

Dr. Robert J. Heaston, who recently graduated with distinction from the National War College at Fort McNair, Washington, DC, was promoted from a GS-15 position to PL-313 (GS-17 equivalent) as scientific adviser to the Director of Weapons Systems. He succeeds Dr. William C. McCorkle Jr., who returned to HQ Army Missile Command.

Dr. Henry J. Smith, a former executive with the National Aeronautics and Space Administration, is now scientific adviser to the Director of Combat Support Systems. He was detailed to that position in July 1975 after seven years with NASA as deputy associate administrator and chief scientist, Office of Space Sciences.

Among Dr. Heaston's U.S. Civil Service career appointments have been: chief, Technology Overview Team, Technology Division, Office, Chief of R&D (1972-75); chief, Chemistry and Energy Conversion Branches, Army Research Office (ARO), Europe (1966-70) and ARO, Washington, DC, (1964-66 and 1970-72).

He also served R&D assignments with the Advanced Research Projects Agency and for five years was a U.S. Air Force employe at Wright Patterson AFB, Dayton, OH.

Dr. Heaston has BS (Cum Laude, 1952) and MS (1954) degrees from the University of Arkansas and a PhD from Ohio State University (1964), all in chemical engineering. His major technical experience is in aircraft and missile technology and combustion and explosive phenomena.

Dr. Smith's former NASA responsibilities included supervision of basic and applied research in space sciences. He also managed space science flight experiments on lunar, planetary and earth orbital probe and satellite missions, and was deputy director of Physics and Astronomy and chief of Solar Physics.

Previously associated with the National Bureau of Standards' Control Radio Propagation Laboratory, and the U.S. Air Force Geophysics Research Directorate, Dr. Smith holds BS, MA and PhD degrees from Harvard University.

Dr. McClelland Succeeds Dr. Crawford at HumRRO

Dr. William A. McClelland

Dr. Meredith P. Crawford, president and director of the Human Resources Research Organization (HumRRO) since it was established in 1951 as a major U.S. Army contract agency, retired Apr. 1 and was succeeded by Dr. William A. McClelland, executive vice president since 1969.

Graduated (magna cum laude) with an AB degree from Brown University in 1941, Dr. McClelland holds MA and PhD degrees in psychology from the University of Minnesota. He is a certified psychologist in the District of Columbia and is licensed in Virginia.

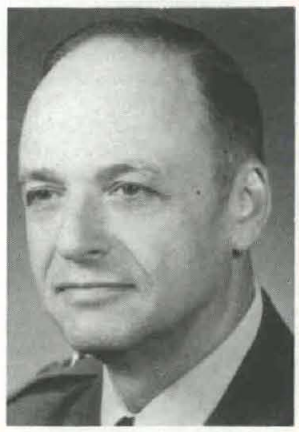
Dr. McClelland joined the Army Air Corps in 1942, serving in the enlisted ranks until commissioned as an officer. He was a supervisory experimental and physiological psychologist with the U.S. Air Force as a civilian from 1951 to 1955, when he joined HumRRO, then an element of George Washington University, as director of the Training and Methods Division.

During 1960-64 he served as deputy director for General Operations and Personnel. Selected as associate director in 1964, he retained that title until 1969 when HumRRO became an independent nonprofit corporation, headquartered in Alexandria, VA.

Dr. McClelland is chairman of the American Psychological Association's Committee on Structure and Functions of Council, and chairman of the NAS-NRC Committee on Personnel Requirements in the U.S. Maritime Industry.

Included among his honors are: Fellow, American Psychological Association (APA); Fellow, American Association for the Advancement of Science; former president, APA Division of Military Psychology. He is also a member of the Psychonomic Society.

Grombacher Taking Over as ACC Commander



MG Gerd S. Grombacher

MG Gerd S. Grombacher has been selected to command the U.S. Army Communications Command, Fort Huachuca, AZ, effective Apr. 30, when MG Jack A. Albright retires from that office after nearly 37 years of active military service.

MG Grombacher is currently commander of the Communications Systems Agency (CSA), headquartered at Fort Monmouth, NJ, and the Communications Electronics Engineering Installation Agency, headquartered at Fort Huachuca. He also is CSA project manager for the Defense Communications Systems (Army).

A veteran of the Vietnam War assigned to the Military Assistance Command (1967-68), MG Grombacher also served in Korea with the 25th Infantry Division Intelligence Staff (1952-54).

Listed among other key assignments are commander, Signal Service Group Four, ACC-Europe; executive officer, Office of the Assistant Chief of Staff (Communications-Electronics); and commander, Safeguard Communications Agency.

MG Grombacher is a recipient of the Silver Star, Legion of Merit with two Oak Leaf Clusters (OLC), Bronze Star Medal, Army Commendation Medal with two OLC and the Purple Heart.

Singley Named AMRDL Eustis Deputy Director

George T. Singley Jr.

George T. Singley Jr. recently became deputy director of the Eustis Directorate, U.S. Army Air Mobility Research and Development Laboratory (AMRDL), Fort Eustis, VA, filling a position vacated by retirement of Larry M. Hewin in August 1975.

Initially assigned to AMRDL as a major in 1961, Singley later joined the civilian AMRDL staff in March 1965 following his retirement as a lieutenant colonel from a 22-year military career.

During his AMRDL tenure he has served as chief, Applied Aeronautics Division; acting director, Systems, Office of the Technical Director; acting chief, Reliability and Maintainability Division; chief, Systems Support Division; technical adviser to the director; and chief, Military Operations Division.

A rated pilot in rotary and fixed-wing aircraft, Singley has a BS degree in mechanical engineering from the University of Delaware and is a graduate of the Command and General Staff College, Air Force Flight School and Officer Candidate School.

Listed in the 1946 edition of *Who's Who in American Colleges and Universities,* he has authored numerous aviation reports and technical presentations. He also has served as guest lecturer for several professional organizations.

Lawrence Gets TRADOC TRASANA Assignment

Deputy for Resource Management and commander of troops of the U.S. Army Training and Doctrine Command's Systems Analysis Activity, WSMR, NM, is the new title of COL William J. Lawrence.

Assigned until recently at Fort Monroe, VA, as chief of TRADOC's Analysis Office, Office, Deputy Chief of Staff for Combat Developments, COL Lawrence also has served as military assistant to the Deputy Under Secretary of the Army for Operations Research; and operations research analyst, Office, Assistant Vice Chief of Staff, Department of the Army.

Graduated from the University of California with a BS degree in mathematical statistics, he has also completed Army Command and General Staff College and Army War College courses. Military awards include the Legion of Merit (LOM) with Oak Leaf Cluster (OLC), Bronze Star Medal with OLC and the Meritorious Service Medal (MSM) with OLC.

Block Heads ECOM's Special Items Office

COL Theodore S. Block, former chief of the Procurement Division, Procurement and Production Directorate, HQ U.S. Army Electronics Command, is now chief of ECOM's Special Items Management Office.

COL Block was assigned to HQ ECOM in 1973 as head of the Production Engineering Division, Research, Development and Engineering Directorate, following a 3-year tour of duty in Belgium as commander, SHAPE Signal Support Group, and headquarters signal officer.

Other key assignments have included service in the Office of the Assistant Secretary of the Army (Installations and Logistics), Washington, DC (1967-70); Army Electronics Materiel Supply Agency (1954-57 and 1963-65); and Allied Forces Southern Europe (1958-61). He also served tours in Korea and in Vietnam.

COL Theodore S. Block

COL Block has master's and bachelor's degrees in business administration from Washington State University and is a graduate of the Army Command and General Staff College. He is a Certified Professional Contracts Manager. Military honors include the LOM w/OLC, Bronze Star Medal and ACM w/OLC.

Mojecki Succeeds Coe in APG D&E Directorate

COL John A. Mojecki was promoted to that rank and reassigned from 2½ years duty with the U.S. Army Ordnance Center and School at Aberdeen (MD) Proving Ground when he recently succeeded COL George B. Coe as director of APG's Development and Engineering Directorate.

Key assignments during his 23-year military career have included nuclear-chemical staff officer, Army European Command; chief of Plans Division, HQ 1st Logistics Command, Vietnam; chief, Radiological Branch, U.S. Army Chemical Center and School, Fort McClellan, AL; chief, N-B-C testing, Arctic Test Center, Fort Greely, AK; and technical operations officer, Dugway PG, UT.

Graduated from the University of Maryland in 1967, COL Mojecki has completed the Armed Forces Staff College, Army Command and General Staff College (non-resident course) and the nuclear weapons effects engineering course.

COL Mojecki has been awarded the LOM, MSM, and ACM with two OLC.

COL John A. Mojecki

Remson Chosen as Chicago District Engineer

COL Andrew C. Remson Jr., a graduate of the Army Command and General Staff College, was recently named to succeed COL James M. Miller as Chicago District engineer, U.S. Army Corps of Engineers.

COL Remson is currently assigned as deputy director of Strategy, Plans and Policy, Office of the Deputy Chief of Staff for Operations and Plans, Headquarters Department of the Army.

A former assistant professor at the U.S. Military Academy, West Point, NY, he has served tours of duty as military assistant to the Supreme Allied Commander, Europe, and commander, 19th Engineer Bn, Vietnam.

Army R&D — 15 Years Ago

The Army R&D Newsmagazine reported on...

Joint Effort Aimed at GEM Development

Development of a ground effect machine (GEM) capable of ship-to-shore, over-the-beach, and inland travel was spurred at a recent meeting in Washington, DC. Sponsored jointly by the Army Transportation Corps and the U.S. Marine Corps, the meeting was attended by representatives of 30 industrial concerns actively interested in the project.

Army-Navy Team Blazes Antarctic 'Highway'

Staked out through the treacherously dangerous crevasse fields of a previously untraveled area of Antarctica as an "historic achievement" is an 800-mile "safe highway" for tractor trains, stretching from Byrd Station to the U.S. Amundsen-Scott South Pole Station.

Headed by MAJ Antero Havola, U.S. Army Transportation Corps, an 11-man Army-Navy team completed the trailblazing feat on Jan. 11 — 35 days after they started the Byrd-Pole Traverse as part of Operation Deep Freeze 1961. Navy Seabees, Army and civilian scientists participated.

ARO Foreign Research Program Broadens Payoff Base

Impregnable logic — that the continued world crisis requires the united skills of the best scientific and technological authorities of the free nations for the building of an impregnable defense, militarily, economically and politically — explains the U.S. Army's foreign research program.

In explaining the Army's interest in expanding foreign research, Chief of R&D LTG Arthur G. Trudeau has stated: ". . . Our program, tailormade to provide us unique advantages and benefits, is capable of a sizable contribution to our international objectives since it is also tailormade to benefit the foreign scientists; that is, the research supported is always unclassified, publication of results in scientific journals is encouraged, and support permits research that might otherwise not have been done. . ."

CRD Directs 20-Year Technical Requirement Forecasts

Foresight for the timely development of the weapons systems and other military equipment of the future—a visionary, vital approach to the U.S. Army's constant objective of remaining superior to the potential enemy in all respects—is strongly reemphasized in a newly initiated program of technological forecasting.

Purpose of the forecasts is to aid the long-range Army planners in formulating new concepts and requirements, within a realistic time structure. Forecasting for the R&D program is to be on a sound basis of completely integrated information regarding the over-all capabilities of Army R&D in-house, contractual and grants activities.

Research Spurred on Masers, Lasers, Irasers

Masers, lasers and irasers, electronic devices which produce amplification by stimulated emission of radiation from atoms or molecules, are receiving intensive investigation from Army research organizations because of importance to military equipment.

Studies grew out of basic research started at Columbia University by Prof. C. H. Townes during World War II. The early research was supported by the Signal Corps and the Navy, which were later joined by the Air Force in the current joint contract with Columbia's Radiation Laboratory. Army activities have been concentrated within the Signal Corps, which, besides sponsoring a number of contracts, has developed a research capability at Fort Monmouth's R&D Laboratory.

The laboratory also has technical monitorship for the Army's participation in the Joint Service Electronics Program (JSEP) university contracts, which include Harvard University's Cruft Laboratory, Stanford University's Microwave and Electronics Laboratories, and the Polytechnic Institute of Brooklyn.

Nitrosa Rubber Interests Government Agencies

Top governmental agencies, including the National Aeronautics and Space Administration and the Atomic Energy Commission, are interested in possibilities of meeting many critical requirements with an experimental nitrosa rubber being developed under Army contract.

Tests substantiate claims that the new product is a dramatically significant breakthrough in the Army's search for a synthetic rubber that is nonflammable, flexibly usable at temperatures as low as 40 degrees below zero F., and resistant to deterioration by hydrocarbon fuels and strong oxidizers. The product was synthesized by the Minnesota Mining and Manufacturing Co., under contract with Quartermaster R&E Command.

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Research Philosophy at BRL

By F. E. Niles and R. J. Eichelberger

Effective and efficient research can be conducted economically by exercising a clearly defined research philosophy. In this article we shall describe the research philosophy currently being employed at the U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, MD.

BRL's research philosophy centers around the development of phenomenological models in the form of computer codes. It does not eliminate serendipity or data-gathering experiments, but it does provide a clearly defined repository for information, efficient transmittal of information, and a method by which relevant research can be identified so that which is marginal can be eliminated.

The connection between phenomenological models and other aspects of R&D is illustrated in Figures 1 and 2. Life cycle management is divided into the research and early development level (Figure 1) and the hardware and operations level. Information flows between activities and levels.

Phenomenological models are those which describe observable events in terms of physics and chemistry. They may be empirical in that the models make interpolations or extrapolations on the basis of previously gathered data or experiences, or they may be mathematical. Empirical models may be formulated in computer language and are an excellent way of assimilating masses of data into useful form.

In the better phenomenological models, physics and chemistry occurring during observable events are described in mathematical terms and in various degrees of complexity and detail. Physics and chemistry may be considered on a microscopic basis, employing a minimum of approximations in descriptions or method of solving mathematical equations.

A second class of mathematical models is those having parts of the physics or chemistry lumped together into a single mathematical description; pertinent coefficients are known as lumped parameters.

A third class of mathematical models is a hybrid of the preceding two. Physics and chemistry parts are solved in detail and in a lumped fashion, or techniques to solve equations incorporate some approximations.

Examples of the three classes of mathematical models can be drawn from those currently employed to describe atmospheric effects produced by nuclear bursts. The AIRCHEM computer code used in the detailed class gives a timed history of the chemistry of deionization.

The code simultaneously solves, in its present form, the time-rate-of-change equations for 64 atmospheric species (15 negative-ion species, the electron, 27 positive-ion species, and 21 neutral species). These species are interrelated by 496 reactions.

Codes of this type require fast computers with large memories and accurate integrating routines which are now available to provide quantitative contributions of each chemical species or physical processes to the entirety of the phenomenon being modeled.

Results from detailed codes become the data base for lumped-parameter computer codes. Chemical or physical processes requiring additional investigations, as well as those which are adequately known, are identified.

Examples of the lumped mathematical model class are the nuclear weapon phenomenology (WEPH) codes developed by General Electric/TEMPO. For most of these codes, one positive ion is representative of all positive ions. The chemistry description assumes that one negative ion is representative of all negative ions; electrons, and neutral concentrations are unchanged by changes in concentrations of charged species.

Conservation of change is normally assumed so that the codes solve only two time-rate-of-change equations - one for positive ions and one for electrons. These assumptions allow the computer code to have more of its resources devoted to other facets of the phenomenon which is being modeled; however, the results may not be sufficiently accurate. Conditions under which results are sufficiently accurate are investigated.

Inherent difficulties of lumped mathematical models of the atmosphere include a need for rapid solution of time-rate-of-change equations. Mitro and Rowe[1] have developed a hybrid mathematical model to solve the rate equations for four positive ions (one of which lumps a series of ions), two negative ions (one of which lumps many ions together), and electrons.

This hybrid method should allow a better description of the time evolution of atmospheric deionization than the lumped mathematical model without requiring a large amount of computer time.

Now let's look at how phenomenological models interact with the aspects of R&D shown in Figure 2, involving laboratory measurements and theoretical investigations.

Physical and chemical properties data obtained in these areas become a necessary part of the input data. Laboratory measurements and theoretical investigations provide information on known needs. Often they reveal weaknesses in the description of the physics and chemistry incorporated in the model.

Many laboratory measurements are made to answer questions raised during the testing or operation of hardware. Models can be utilized to aid in designing an experiment with the best potential for obtaining dependable answers as laboratory results are compared with predicted results.

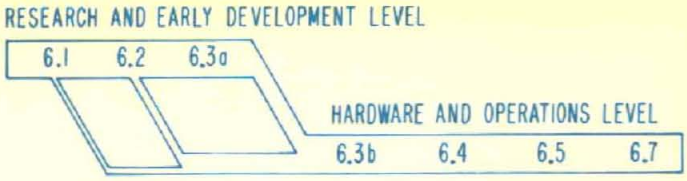

Figure 1

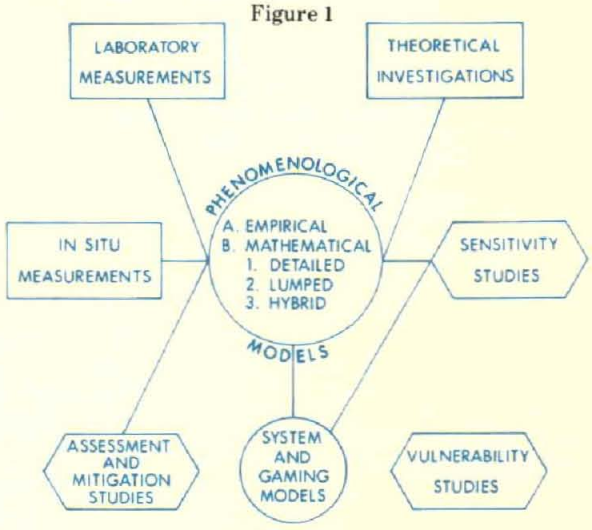

Figure 2

Next let's look at *in situ* measurements which also provide input data for the models. More importantly, they serve to validate the model's description of the physics and chemistry interaction. The models give guidance on measurements necessary to keep them honest.

Most of the information exchange should be filtered through a phenomenological model - even if the model exists only in the minds of the persons exchanging the information. Research data gathered without phenomenological models tend to become only a collection process.

Appropriate models, when properly joined, serve to make a complete system model describing the operation of a system in terms of physics and chemistry. Many approximations are required, at this stage, to simplify descriptions and allow completion of computations within a reasonable amount of computer time. An example of a system model is the Hardsite Engagement Effectiveness Model (HEEM), assembled by Teledyne-Brown Engineering Co.

Determining how a system will function under a given set of conditions, involving more than just the one system, may require assembly of gaming models from system models and investigation of specified scenarios. Again, many approximations of phenomena must be made to perform calculations in reasonable computer time.

Studies to help in determining the accuracies of the predictions of the various models and other investigations are carried out in activities denoted by the hexagons in the flow diagram. These studies help to establish confidence in predictions of the models.

Assessment, sensitivity and mitigation studies are made with well-defined systems and scenarios to determine how a system will perform when a prescribed phenomenon is present. Methods to obtain real-time assessment of the impact of the phenomenon are investigated - hopefully leading to techniques to circumvent or mitigate deleterious effects.

Vulnerability studies deal primarily with the threat to hardware or personnel in hostile action. Components, entire systems, and groups of systems are studied.

Not all the functions shown in Figure 2 are carried out within the Ballistic Research Laboratories for the investigation of atmospheric effects produced by nuclear bursts; however, they are performed within the total Department of Defense community.

Activities in the R&D level must be aware of and in touch with the requirements of activities in the hardware and operations level at all stages. Figure 1 shows this coupling is greatest for functional area 6.3a.

Research philosophy at the BRL can be applied to nearly all R&D activities. This philosophy centers around the development of mathematical models of phenomenon as a principal means for planning and directing research in an effective and efficient manner.

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[1]A. P. Mitra and J. N. Rowe, *J. Atmos. & Terrest. Phys. 34, 795 (1972).*

Missile Command Dedicates $40 Million Advanced Simulation Center

Marvelous is a much overworked word in the publicist's lexicon but when applied to the U.S. Army Missile Command's newest $40 million R&D facility, the Advanced Simulation Center at Redstone Arsenal, AL, visitors agree that it falls short as an adequate descriptor.

Dedicated Mar. 10 with Under Secretary of the Army Norman R. Augustine in the role of keynote speaker, at ceremonies attended by three former MICOM commanders — MG John G. Zierdt, LTG Charles W. Eifler and MG Edwin I. Donley — the ASC is expected to yield a huge ROI (Return on Investment) in savings on testing of all types of missiles. MICOM Commander MG George E. Turnmeyer gave the welcoming address.

Augustine termed the simulation facility the most advanced of its kind in the Free World. Due to continually accelerating inflated costs of missile testing, he said, the ASC meets a critical need for a capability of simulating tests "for the spectrum of our missile development system."

One of the "driver" cost considerations of missile testing, he said, is that every time a missile is field tested it is lost. Aggravating the problem is the hard fact that the target destroyed in a successful test frequently costs more than the missile.

Referring to the role of the Advanced Simulation Center in radically reducing the risk of fielding new missile systems when field testing is limited by austerity funding, he said:

"We must know what a system will do before it leaves the ground. We can't afford to have failures . . . I can assure you that if the first five rounds are failures, further field test money will be hard to come by," due to Congress.

Among the favorable factors cited by Augustine is that the center may serve to shorten normal lead time of about eight years in developing a new missile system, by compressing the test cycle in the over-all program.

MICOM's newest facility, under direction of Dr. Kelly Grider, is capable of simulation testing, in precisely controlled experimentation, any known or foreseeable missile system, including components under engineering or advanced development programs.

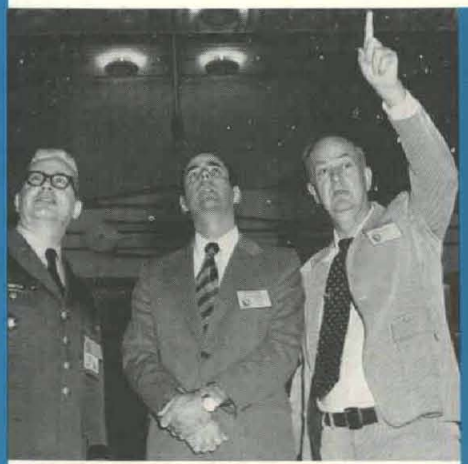
Dr. John L. McDaniel, director of MICOM's Research, Development and Engineering Laboratory, and master of ceremonies for the dedication, said the ASC is available to all of the U.S. Armed Forces and Defense contractors.

The ASC is a 3-story, 75,000-square-foot building attached to the McMorrow Laboratories. Three test chambers are linked to third- and fourth-generation computers for control of simulation of most of the environmental factors that affect missiles during flight. Test sensors in the visual and infrared bands include those for terminal homing, close air support and antitank missiles.

The electro-optical cell, a 1,024-square-foot moving terrain model, is covered with miniature deserts, mountains, rivers, dams, towns and military targets. Missiles can be tested for ability to acquire, track and destroy enemy targets under day or night conditions. Natural illumination can be simulated from sunlight to starlight.

The anechoic chamber (RF cell) will be used to test ability of radar guidance systems to acquire and hit targets in a simulated battlefield environment including electronic countermeasures. Each of the three test chambers is linked to and can "talk" to the computers.

Control console for terrain model at Missile Command Advanced Simulation Center.



Under Secretary **of the Army Norman R. Augustine is flanked by MICOM Commander MG George E. Turnmeyer and Dr. John L. McDaniel, director of MICOM's RD&E Laboratory, as he observes lighting system that can simulate any natural light.**

Third- and fourth-generation computers control simulation of most environmental factors that affect missiles during flight. Each of the three test chambers is linked to and can "talk" to Advanced Simulation Center computers during experimentation.

MISSILES can be tested for ability to acquire, track and destroy enemy targets under day or night conditions at the electro-optical cell, a 1,024-square-foot moving terrain model covered with miniature deserts, mountains, rivers, dams, towns and military targets.