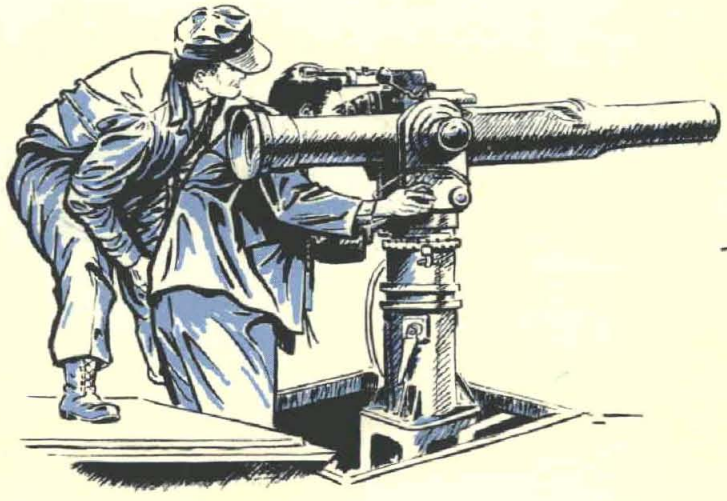
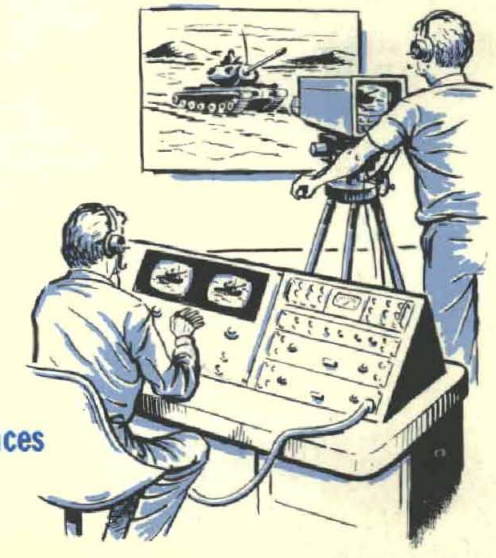
ARMY RESEARCH AND DEVELOPMENT

November–December 1974





Army Research Institute . . .

Developing Agency for the

Behavioral & Social Sciences

Page 16

SPEAKING ON . . .

Cost/Schedule Control Systems Criteria:

Practicable Army-Industry Approach to Acquisition Management

MG George Sammet Jr.

MG George Sammet Jr., Army Materiel Command Deputy Commander for Materiel Acquisition, in keynote addresses to recent Government/Industry seminars of the American Institute of Industrial Engineers and the Defense Systems Management School, shared his views and experiences regarding the Cost/Schedule Control Systems Criteria (C/SCSC).

The Cost/Schedule Control Systems Criteria do not represent a management system nor do they prescribe specific methods of organization or operation. The criteria are intended to serve as standards for measuring the adequacy of management control systems.

Contractors are free to organize in the manner best suited to their individual needs, environments and management philosophies; they may select the internal methods and procedures of their choice.

Methods and procedures selected, however, must result in a system which provides the data and capabilities specified in the criteria in order to be considered acceptable to the Department of Defense. The criteria apply to the contractor's procedures used for Work Authorization, Planning, Budgeting, Accounting, Analysis and Reporting.

The C/SCSC requires a formal discipline within the management system designed to emphasize objective reporting of the cost and schedule status of a contract, control of the cost baseline, and the disclosure of actual and anticipated problems.

The essence of General Sammet's remarks follows:

What is it that the Army really expects from C/SCSC? Primarily, we expect to gain confidence in a contractor's management system; to feel assured that we will not be under the impression that costs and schedule are going as planned—only to be surprised and jolted by the revelation of huge overruns.

More specifically, we look to C/SCSC to assure us and our contractors that the work to be accomplished is being properly planned and controlled in sufficient detail; that accomplishment is based on an objectively determined earned value; that the system has disciplines which achieve proper baseline control; and that there is consistently accurate and objective reporting of progress data and estimates-to-complete.

The Army looks for the C/SCSC compliant management system to provide the contractor and the government not only with valid data but also with adequate analysis of the data. This includes the cost impact of known problems; the identification of other problems not previously disclosed in the normal day-to-day contracts; the tracing of significant problems to their source; analysis of their impact on the contract and the program; and the plan for solving the problems.

A basic and most important expectation is that the management system which meets C/SCSC is the one which is in fact used to manage the contract rather than an "eye wash" system imposed simply to meet a contractual requirement. In fact, an "eye wash" system cannot meet the requirement which says that "the contractor shall establish, maintain and *use* . . . systems meeting the criteria."

In the past, we in the Military Departments, along with our counterparts in industry, have been guilty of a number of sins, many of which can be grouped into the category of poor cost and schedule control. We were so caught up in pushing the frontiers of technology and the state-of-the-art, and in obtaining the last drop of added technical performance, that we neglected to focus adequately on the cost and schedule objectives and constraints.

You have all heard the horror stories about suddenly discovered overruns that surfaced too late to allow any alternatives beyond pouring in more funds. When we had to face reality, there was only one other alternative—cancel the program. That is what happened to the Cheyenne Helicopter and Main Battle Tank Programs.

What led us down the wrong path? In addition to our technological myopia, many of our contractors were using rubber baselines, i.e., adjusting their plans to correspond more nearly with the actuals; working out today's problems with funds budgeted for future work; making subjective estimates of accomplishment; equating rate of expenditure with accomplishment; and using systems with lax reporting and no methodical variance analysis.

It became apparent that program managers who have a handle on where their programs are in terms of cost and schedule, who know the value of the work accomplished for the dollars spent, are able to manage their programs better—because they are aware sooner of cost problems and their impact.

The problem at the AMC level was to get all project managers into a position where they all have and use good, timely information, with emphasis on *use*.

When it was shown that C/SCSC and the associated Cost Performance Report (CPR) would have given us an objective status of projects at all times—that we would have had warning of pending cost and schedule difficulties and their magnitude, and that costs for C/SCSC and the related CPR are relatively low—it was decided to accelerate implementation of C/SCSC and to emphasize it with the project managers. Action was taken to:

- Develop a reporting system which would quickly provide HQ AMC with objective cost and schedule data based on C/SCSC, and with the Cost Performance Reports (CPRs) as the primary ingredients of the reporting system.
- Conduct a complete study of the numerous reports being submitted to HQ AMC to determine their utility—who uses them and what decisions are made based on them.
- Establish a control room in which all major programs are charted on viewgraphs each month. There are six basic charts displayed for each program.

A typical cost and schedule variance chart is shown at Figure 1. On this chart we have cost variance in dollars and schedule variance in both dollars and time. This is a simple chart—and it is no easy matter to keep it that way. C/SCSC proponents seem to want to show you everything on one chart; then it gets so busy it becomes part of the problem instead of a part of the solu-

(Continued on page 14)

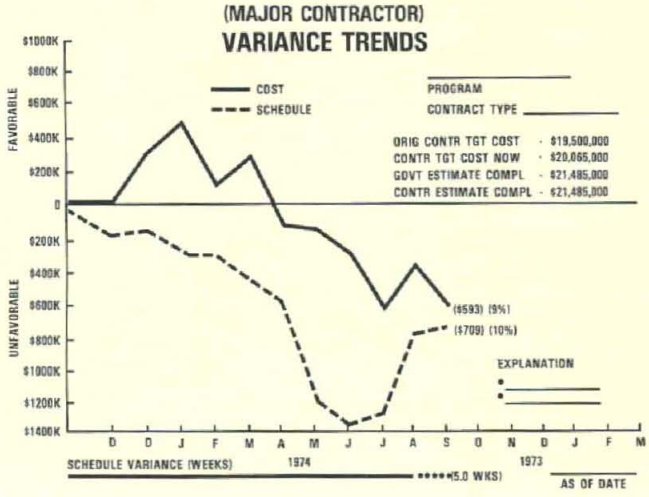
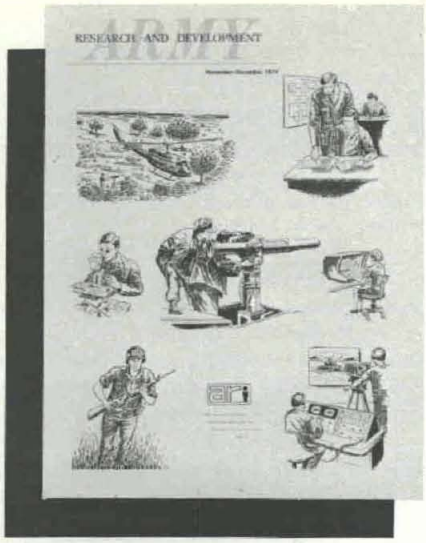


Figure 1



ABOUT THE COVER:

Pictures depict some of the U.S. Army Institute for Behavioral and Social Sciences' many areas of research and training activities. Starting at the top left and proceeding clockwise, the pictures show: Pilot training for NOE (nap of the earth) flying at the Army Aviation Training Center, Fort Rucker, AL; class in FLIT (functional literacy training); WAC at console for Computer-aided Instruction (CAI); remote sensor operation; soldier in REALTRAIN; technician engaged in image interpretation training; and (center) tank during REALTRAIN maneuver training in Germany.

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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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FEATURES

DEPARTMENTS

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Selective Scanner . . .

Callaway Proposes Continuation of HLH Testing

Secretary of Defense James R. Schlesinger was considering a recommendation of Secretary of the Army Howard H. Callaway, at the time this Newsmagazine went to press, that the Army be authorized to continue to completion the development and flight testing of an austere HLH prototype.

The recommendation is based upon findings of a special Army Systems Acquisition Review Council, chaired by Chief of Staff GEN Frederick C. Weyand, appointed to evaluate the HLH program.

The recommended course of actions, Secretary Callaway said, is consistent with the program presented to Congress for FY 1975 and represents a continuation of the original concept.

Demonstration of HLH technology and validation of advances in the state-of-the-art are part of the current program, including fly-by-wire, composite rotor blades, and fail-safe components.

As originally structured, the HLH program permitted completion of all initial objectives, without any necessary follow-on commitment to either HLH engineering development or production.

The ASARC studies included concept formulation, development status, cost estimates, and cost-effectiveness analyses. The council recommended, and the Secretary of the Army proposed to Secretary of Defense, that there be no follow-on Army commitment for either engineering development or production of the HLH because of the high cost involved in comparison with the Army's other priority needs.

DoD Implements Incentive Pay for Physicians

Variable annual incentive pay bonuses for military physicians approved recently by President Ford range from $9,000 to $13,000, as authorized by Public Law 93–374 and implemented by a Department of Defense directive.

The bonuses are designed to attract and retain military physicians and ultimately ease a shortage of doctors in the military services. Participation in the program requires that a physician be in pay grade 0–3 through 0–6, be designated in a critical specialty, and be selected by a board of medical officers. Intern and initial active duty personnel are not eligible.

If the initial service duty obligation is one of extended duration, only four years of creditable service will be required for eligibility. Officers selected must enter into a contract of one, two, three or four years military obligation.

TILO Transferred to Army Materiel Command

Industrial liaison services, which have been provided by the Department of the Army through its Technical and Industrial Liaison Office (TILO), Office of the Chief of Research, Development and Acquisition, were transferred to the Army Materiel Command (AMC), effective Oct. 21.

The new point of contact for DA industrial liaison services is: Commanding General, U.S. Army Materiel Command, ATTN: AMCRD-PS-TILO, 5001 Eisenhower Avenue, Room 8N-23, AMC Building, Alexandria, VA 22333, Tel: (202) 274–9816–9819.

Project engineers and scientists associated with DA industrial liaison should notify representatives of the transfer of functions.

Speaker's Bureau Offers Wide Range of Topics

Speaker's Bureau services offered by the Aberdeen (MD) Proving Ground Information Office, as a part of a comprehensive community relations program, are making available nearly 100 prominent scientific, engineering and professional employes qualified to discuss about 500 subjects.

The bureau provides speakers for civic, fraternal, service and nonprofit organizations, schools, church groups and other organizations on a no-fee basis. The Aberdeen Information Office believes the program is one of the largest being conducted at any Army installation, and that others may want to follow suit.

Some of the subject area specialties of the speakers are: The Impact of Science on Society; The Energy Crisis; Pollution Problems; Snake and Bee Venoms; Genetic Health Hazards Posed by Drugs; Use and Care of Experimental Animals; Patterns in Modern Education; The Use of the Computer in Today's Army; The Chemistry of Alcohol—Good and Bad; Operations Research for Solving Problems in Business and Other Fields.

Improved Pershing Results Termed 'Excellent'

Operational improvements for the Pershing missile system, through addition of an Automatic Reference System (ARS) and a Sequential Launch Adapter (SLA), are expected to reduce reaction time and troop training requirements.

During recent nonfiring tests of the ARS and SLA at Fort Sill, OK, James Conner, chief of the Pershing Product Assurance and Test Division, HQ U.S. Army Missile Command (MICOM), Redstone Arsenal, AL, termed results thus far "excellent." Operational tests will follow at White Sands Missile Range (WSMR), NM.

The ARS takes the man out of the Pershing azimuth laying operation and does it faster and more accurately, Conner said. The SLA is basically a switch box that allows a firing crew to cable one programer test station to three missiles. Instead of decabling after each firing and moving the programer to another missile, the SLA ". . . allows us to ready another missile by throwing switches," he added.

The 400-mile-range Pershing has been operational for almost 12 years with battalions in the United States and Europe, including the Federal Republic of Germany Air Force, and is a major part of the NATO Nuclear Shield. COL Samuel C. Skemp Jr. is the project manager for the Pershing missile system.

AMC Students Excell in CAD-E Graduate Course

Army Materiel Command who are in residence, or who have taken training recently, in the 12-month graduate-level education program in Computer-Aided Design and Engineering (CAD-E) at the University of Michigan have received an accolade.

Prof. Milton Chace, University of Michigan manager for the program, reported recently that the AMC students are "achieving significantly better grades than the average University of Michigan graduate students."

Qualified Army Materiel Command personnel designing to enroll in next year's program have to submit applications for the course, beginning in July, not later than Dec. 1. Applications must be submitted to AMC HQ, ATTN: AMCPT-CM and must include, in the following order, (a) DA Form 1256, (b) the commander's letter of indorsement, and (c) the application in the required format. Applicants selected will be announced in February. (For more details regarding the CAD-E training program, see September-October edition, *Army Research and Development Newsmagazine*.)

Mine Neutralizer May Aid Combat Operations

Development of a helicopter-mounted mine neutralizer, considered as a possible replacement for costly, time-consuming conventional mine-clearing methods, has been announced by the U.S. Army Mobility Equipment R&D Center, Fort Belvoir, VA.

Identified as the Fuel Air Explosive System, Helicopter Delivered (FAESHED), the unit features a U.S. Navy weapon, consisting of an 8-foot cylindrical dispenser containing three fuel air explosive bombs attached to each side of an Army Huey helicopter. A cockpit fire control box permits releasing either the right or left weapon, or both simultaneously.

Following release of the dispensers, the bombs are extracted and upon ground impact each bomb disperses a cloud of ethylene oxide fuel 50 feet in diameter and 9 feet thick. After an appropriate delay, the cloud is detonated, which results in the actuation of buried and surface laid mines within the cloud radius with almost 100 percent effectiveness.

During tests, each 3-bomb cluster, has demonstrated sufficient accuracy to clear a 10-meter path, 30 meters long. FAESHED success in clearing both U.S. and foreign manufactured mines has led to its type classification as Limited Production, Logistic Control Code Test, and to preparation of a draft technical manual. Army standard type classification is expected during FY 76.

HumRRO Studying Driver Education Curriculum

How effective is a model driver-education curriculum in assuring safe vehicle operation by beginning drivers? That is the question researchers at the Human Resources Research Organization (HumRRO) are trying to answer in a new project identified as DOT-MC.

The project grew out of a series of studies performed or sponsored by a number of organizations, including the Highway Research Board, the Highway Users Federation for Safety and Mobility, and the National Highway Traffic Safety Administration.

The study is based largely on a previous HumRRO Project DOT-DE, "Development of Driver Education Objectives: A Driving Task Analysis," and Project DOT-IG, "Course Guidelines for Teacher and Instructor in Driver Education."

EPA Inventories U.S. Waterways Pollution Areas

The Environmental Protection Agency's (EPA) 1974 Water Quality Inventory report, considered the first systematic analysis of the quantitative impact on water pollution on a national scale, has been submitted to Congress and is now available from the EPA Office of Water Programs.

Intensive studies of the 22 largest and most populated waterways in the U.S. show that the two water pollutants receiving the most widespread controls—coliform bacteria and oxygen-demanding organic materials—showed general improvement during the past 10 years. The report notes that levels of nitrogen and phosphorous, the two nutrients most often associated with eutrophication (premature aging of lakes), are rising.

The EPA report focuses on 5,000 major point sources of pollution, and provides State assessments of major problem areas in 56 States and territories. It also reflects their start of new activities in 1973 to collect the stream quality and effluent data necessary to implement the 1972 Water Act.

Copies of the National Water Quality Inventory report may be obtained from the EPA Office of Water Programs, Monitoring and Data Support Division (WH-453), Waterside Mall, Washington, DC 20460.

HDL Unveils New High Performance Antennas

A new approach to the design of conformal antennas for use in microelectronic systems has been successfully demonstrated at the U.S. Army's Harry Diamond Laboratories, Washington, DC.

These high performance antenna designs are capable of eliminating many mechanical and electrical problems, while enhancing the over-all system performance. The HDL concept provides for antennas to be constructed as an integral part of a body, at any position along its length and flush with the surface.

Developed by Dr. Howard S. Jones Jr., these compact thin-wall antennas are developed from copper-plated dielectric-loaded waveguides, cavities or surface wave structures. The plating provides a smooth radiating surface and a strong adherence to the dielectric substrate.

Dielectric materials used are low-loss (organic or inorganic), with a particular dielectric constant depending on its application. The effect of the dielectrics used for loading changes the antenna impedance, its wavelength, and minimizes the space required for design. Present applications in the UHF and microwave frequency range include sensor guidance and telemetry systems.

GOER Vehicles Issued to Tank, Artillery Units

Release and distribution of the GOER "family" of military vehicles to all active Army tank and 155-millimeter howitzer artillery units was announced recently by the Department of the Army.

Developed in response to Army requirements for a series of floatable, tactical wheeled vehicles for field armies, GOERs underwent intensive tests at Aberdeen (MD) Proving Ground between September 1972 and January 1974. GOER vehicles combine features of cross-country mobility approaching that of fully tracked vehicles, and effective logistical support to combat arms field units.

High mobility is achieved by incorporation of extra-large-diameter tires (18.00 × 33, 10-ply), exoskeletal construction with floating capability, high-ground clearance, articulated wagon steer, and a high payload-to-weight ratio. Components and design principles in use on commercial units have been adapted to GOER vehicles.

GOERs are designed specifically for transport operations over all types of roads, trails and adverse terrain, including the swimming of inland waterways. The vehicles are comprised of a forward or power unit and a rear trailing unit which is equipped with a cargo, tanker or wrecker body.

Testing of GOER vehicles dates back to 1956 and 19 of the vehicles were used to support 4th Division operations in the Pleiku area during the Vietnam conflict.

New Contract Extends Safeguard R&D Efforts

Completion of research and development on the Safeguard BMD System and continuation of the BMD test program will be accomplished under a $29 million contract extension announced by the Ballistic Missile Defense Systems Command.

Western Electric Co., prime contractor, will complete the R&D program from Nov. 1, 1974 through June 30, 1975, and continue the test program from Sept. 1, 1974, through Aug. 31, 1975.

The contract will provide work for Bell Telephone Laboratories, Whippany, NJ; Western Electric Co., Burlington, NC; Calspan Corp., Buffalo, NY; IBM, Morris Plains, NJ; Raytheon Co., Sudbury, MA; and many other subcontractors located throughout the United States.

MERDC Awards $119,000 for Test Forklifts

Contracts totaling more than $119,028 to provide forklifts were announced recently by the U.S. Army Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, VA.

Three companies will each provide one 15,000-pound capacity forklift from its normal commercial production inventory for testing by MERDC's Mechanical Technology Department and the U.S. Army Test and Evaluation Command.

Test results will be used to develop specifications for future quantity competitive procurement of the forklifts and determination of what, if any, modifications would be required for military use.

The companies are Hyster Co., Portland, OR; Towmotor Corp., subsidiary of Caterpillar Tractor Co., Peoria, IL; and Clark Equipment Co., Battle Creek, MI.

Army Activates 2d Battalion at Fort Lewis

The 2d Battalion (Ranger), 75th Infantry, was activated Oct. 21 at Fort Lewis, WA, as the second of three elite Infantry units composed of highly skilled Airborne Ranger personnel who can be rapidly deployed to maneuver in any terrain or climate.

The 1st Battalion (Ranger), 75th Infantry, was activated Feb. 8, 1974, at Fort Stewart, GA, and the stationing of the 3d Ranger Battalion is currently under study by the Army Staff.

MASSTER Evaluating Dragon Missile System

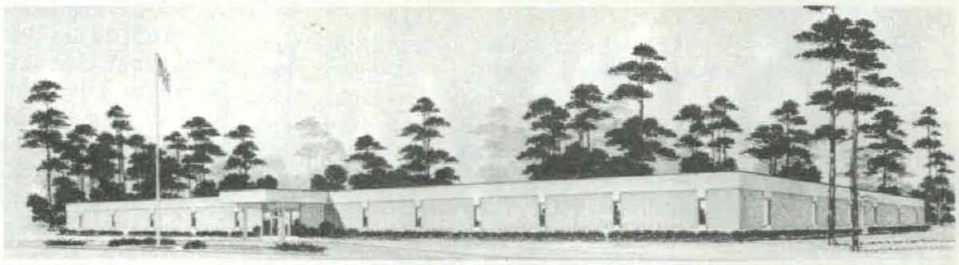
The Army is evaluating results of rigorous field testing of the Dragon antitank guided missile system in an operational environment at MASSTER (Modern Army Selected Systems Test, Evaluation and Review), Fort Hood, TX.

Powerful enough to destroy armored vehicles, the shoulder-fired Dragon's major components are an expendable round and a reusable tracker. Weighing 32 pounds loaded, it uses an automatic command-to-line-of-sight wire guidance system that allows the gunner to aim through a sight and hold the cross hair on target until missile impact.

The Dragon is designed to complement the heavier TOW weapon system. Currently, the infantryman's basic hand-carried antitank weapon is the 90mm recoilless rifle, a bazooka-like weapon that fires antitank rounds.

R&D News . . .

Army Research Office Plans Relocation in Spring



Relocation of the Army Research Office from the campus of Duke University in Durham, NC, to a newly constructed building in the 6,200-acre Research Triangle Park, about 12 miles away, is scheduled for the first quarter of CY 1975.

Ground was broken for construction of the 22,500-square-foot (usable space) building on Sept. 3 by Saieed Construction Systems, Inc., Raleigh, NC. Situated at the corner of Highway 54 and T. W. Alexandria Drive, the building will be formed with precast concrete components.

The Army Research Office is responsible for programing and monitoring basic research relevant to Army programs in mathematics and the physical, engineering, environmental and life sciences.

The mission is accomplished through contracts and grants (currently funded at about $13.8 million annually) with educational institutions (universities and colleges), nonprofit research institutes, industrial laboratories and other federal government agencies in the Western Hemisphere.

Army Research Office responsibilities include the Military Themes program of basic research in special high-priority areas of effort keyed to requirements for advanced knowledge in major Army programs.

Planning, arranging and conducting scientific conferences and symposia is another area of ARO responsibility. The Army Junior Science and Humanities Program was initiated in 1958 and has grown to activities in 37 regions throughout the United States, and one in Europe for the U.S. dependent school system, involving annually some 7,000 high school science students. The Twelfth National JSHS was held in 1974 at MIT in Boston.

The Army Operations Research Symposium also was initiated with the Army Research Office serving as host for the Office of the Chief of Research and Development (OCRD). ARO continued to serve as host through 1972, when the sponsorship was transferred from OCRD to the Assistant Chief of Staff for Force Development. ACSFOR was disestablished in May 1974.

The 1974 Army Science Conference also was planned and sponsored by the Army Research Office for the Office of the Chief of Research and Development.

Commanded by COL Lothrop Mittenthal since October 1972, aided by LTC Edward J. Downing, executive officer, and Dr. Hermann Robl, chief scientist, the Army Research Office has an authorized staff of 98 professional and support personnel. Seven professionals are assigned to the Lawrence Livermore Laboratories in California and five are serving with the Army at the Los Alamos, NM, laboratories.

The origin of the Army Research Office dates to 1951 when the Office of Ordnance Research was established by the Chief of Ordnance in a leased building on the Duke University campus. Effective Jan. 16, 1961, the OOR was redesignated as the Army Research Office-Durham (ARO-D), a Class II Activity of the Office of the Chief of Research and Development, Department of the Army.

With the disestablishment in 1973 of the Army Research Office in Washington (ARO-W), actually located in the Highland Building in Arlington, VA, some of the professional staff members were reassigned to ARO-D and the "D" was dropped in the current redesignation.

Army Unveils Nonlethal RAG Projectiles

Army interest in an unorthodox concept for launching grenades in 1970 has resulted in development of Soft RAG (XM742) and Sting RAG (XM743) projectiles, providing a nonlethal control capability the developers believe is currently unmatched by any other method.

Designed and developed specifically to meet requirements stated in an approved Army Required Operational Capability (ROC), the Soft/Sting RAG is scheduled for type classification in FY 1977.

The doughnut-shaped projectiles "fly" through the air on a near-straight path rather than on an arcing ballistic trajectory. Both projectiles are fabricated of a soft rubber-like material in the form of a ring with a streamlined airfoil cross-section (see Fig. 1). The shape of the projectile gives it aerodynamic rather than ballistic characteristics.

The Ring Airfoil Grenade concept was originated by Abraham Flatau, chief of the Aerodynamics Research Group at Edgewood (MD) Arsenal. This concept was initially intended for grenade applications only and was given the acronym RAG for Ring Airfoil Grenade. However, realizing the possibility of lower muzzle velocities, other applications were envisioned.

Fig. 1. Ring Airfoil Grenade

A U.S. Army Military Police requirement for an effective, nonlethal riot- or civil-disturbance control system turned a team of Edgewood engineers and technicians toward demonstrating the feasibility of the RAG projectile.

Flatau, now chief of the Weapons Systems Concepts Office, Development and Engineering Directorate at Edgewood, joined with aerospace engineers Miles Miller and Donald Olson to redesign the RAG projectile as a deterrent in civil disturbances.

Results of this effort were Sting RAG (XM743), a kinetic energy device that imparts a painful blow upon impact, and Soft RAG (XM742), which breaks open and disseminates a 3-foot-diameter cloud of CS powder with a tear gas effect.

Launched from an adapter (XM234) attached to the end of the M16A1 rifle (Fig. 2), the projectiles can be used interchangeably as the tactical situation may require. A blank cartridge (XM755) launches the projectiles at an initial velocity of about 200 ft/sec and 5000 rev/min—high enough to prevent dodging by individual targets.

Fig. 2. XM234 Adapter Attached to M16A1

The aerodynamic lift and low-drag characteristics of the ring airfoil configuration result in an almost flat trajectory. High accuracy is achieved against an individual target at ranges beyond human capability to throw rocks or other missiles, thereby enabling control forces to avoid direct confrontation with rioters and to select the ringleaders as targets. Projectile velocity is sufficient to prevent dodging.

Biophysics testing has established that normally neither the Soft nor the Sting RAG will produce lethal or hazardous injury at any operational range, including point blank. Developers believe these characteristics cannot be equaled by any civil disturbance control systems available today from either industry or government.

Armed Services Considering 'Aerocrane' Transport Concept

Feasibility of applications of the "Aerocrane," a new concept of ultra-heavy vertical lift and transport, in the potential range of 100 tons or more, for military containerized cargo and other heavy equipment, is being considered by the United States Army, Navy, Air Force and Marine Corps.

Interest in advanced aerial concepts for very heavy-lift VTOL (Vertical Take-off and Landing) is the result of the projected payload limitations of helicopter technology—when compared to very large conventional aircraft, such as the C-5A, and the recent success of balloons in logging operations.

In the search for cost-effective vertical lift cargo transport systems, quad-service representatives recently viewed a demonstration of an Aerocrane model.

The Advanced Concepts Division of the Naval Air Systems Command (NAVAIR) last April awarded a $65,000 contract to the All American Engineering Co. (a subsidiary of All American Industries, Inc.), Wilmington, DE, to delineate a conceptual study effort on the Aerocrane. The contract with the inventors of the Aerocrane also calls for definition of a wind tunnel test program for the Aerocrane configuration and a preliminary design sensitivity study.

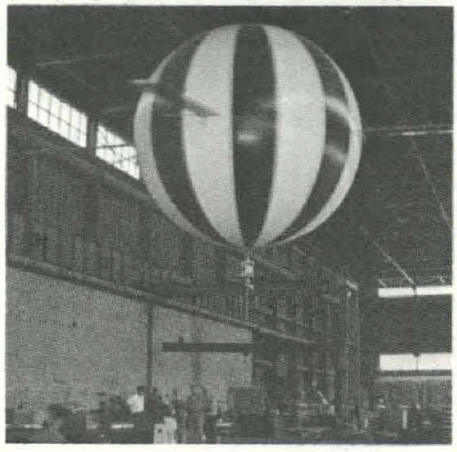
NAVAIR is reviewing a proposal for tethered flight tests of an instrumented 34-foot-diameter model Aerocrane in hover and transitional flight. Combining the most prominent features of a balloon and a helicopter, the Aerocrane gives the appearance of a skewered giant beach ball. Rigidity is provided by a network of spars and braces that form a central cabane structure to support aerodynamic and payload forces.

Figure 1 shows a hypothetical aerocrane with a centerbody and four 100-foot-long by 20.5-foot-wide blades. An estimated 1500 hp turboprop powerplant on each of the blades would provide the power necessary to lift a 50-ton slingload and translate at a maximum speed of 40 knots.

The helium-containing envelope consists of a single compartment without partitions. A ballonet system to provide internal pressure adjustments for ambient changes is located in the lower portion of the centerbody. An emergency helium valve is also provided to assure against critical overpressure and allow free balloon control, if necessary.

QUAD-SERVICE REPRESENTATIVES view demonstration of Aerocrane prototype. From left are Donald Doolittle, All American Engineering (AAE) Co; COL J. J. Morris, USA, Department of Defense project manager for Surface Container-Supported Distribution Systems Development; CPT M. K. McAfee, U.S. Marine Corps, DoD Project Managers Office; A. G. Crimmins, AAE Co.; LCdr D. G. Kipping, U.S. Navy, DoD PMO; LTC Keith McElwain, U.S. Air Force, Department of Defense PMO.

The aerostatic lift is supplemented by aerodynamic lift generated by rotating the entire centerbody/wing assembly at a low speed of about 10 rpm. Aerostatic lift forces support about two-thirds of the takeoff weight, i.e., the structural weight and about 50 percent of the sling load. The remaining percentage of the sling load is supported by aerodynamic lift.



Designers say that the low wing loading resulting from the low relative wind velocities and the external wing cable supports may permit uncomplicated construction techniques —much different than high-speed fixed-wing or conventional rotary-wing aircraft.

Because of the aerostatic lift of the Aerocrane, structural weight is also less important relative to present heavier-than-air aircraft and may allow lower production costs and longer life components, one of the designers explained.

Varying lift requirements, and the necessity of vertical and horizontal directional and rate controls, will require that the wings have both cyclic and collective pitch control—either a mechanical or combination mechanical/aerodynamic control system.

AAE design concepts call for an operator's control cab or gondola directly below the vertical centerline of the spheroid. To provide positive orientation of the control cab and to prevent rotation with the spheroid, the cab is attached with a swiveling joint above the cab and driven by a retrograde drive system. The gondola will carry engine and operator controls, navigation equipment, radio equipment and life support systems.

Many military operational requirements for aerial heavy-lift transport have been established for conventional aircraft. A stated military requirement for very-heavy aerial lift remains to be established. However, Russel G. Perkins Jr., Naval Air Systems Command, foresees a significant role for the Aerocrane as a logistics support vehicle.

"If cost-effective aerial cranes were available in the 100-ton range, military effectiveness would improve in many areas, including transportation of special combat equipment, harbor preparation, construction of elevated causeways, road construction, ship repair and salvage, and submarine rescue operations.

"A principal application of the Aerocrane concept may be to support amphibious assaults and subsequent operations ashore. Aerocranes would be complementary to medium- and heavy-lift helicopter forces, providing the very heavy-lift capacity to offload containerships and complete a vertical envelopment in transporting heavy equipment during different phases of operation.

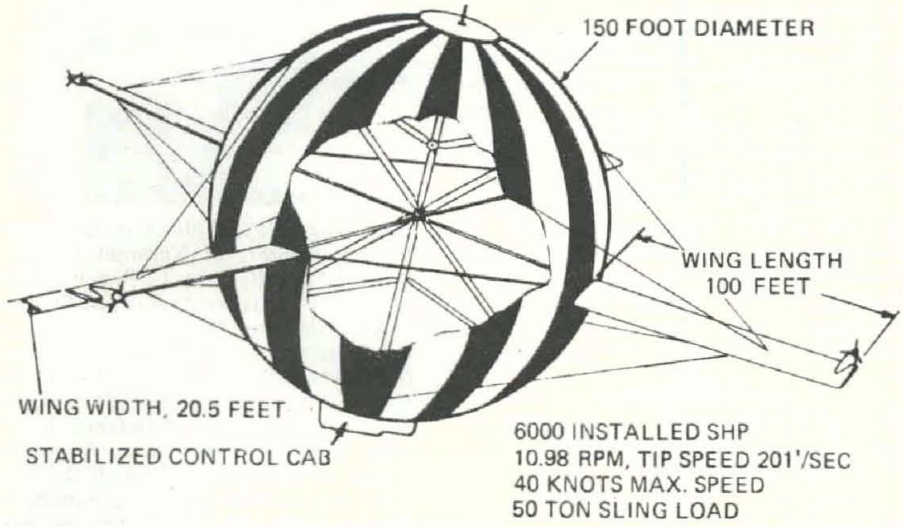


Figure 1. CONCEPTUAL 150-foot diameter Aerocrane.

Watervliet Duplication Technique . . .

May Have Potential Applications in Nondestructive Testing

A Watervliet Arsenal physical science technician has developed a duplication technique that increases the information which can be extracted from a radiograph.

Mrs. Catherine Grogan, employed in the arsenal's Product Assurance Directorate, describes the technique in "Enhancement of Duplicate Radiographs," a paper she presented at the recent 23d Defense Conference on Nondestructive Testing at San Francisco.

The paper describes the procedure she devised for radiographic examinations which, by duplicating a negative from a negative, decreases the required original radiation exposure. The technique is viewed as having potential for numerous applications in nondestructive testing of materials and in medical fields.

Duplicating films for radiographs are fairly new to nondestructive testing. These films were introduced to provide "extra copies" of X-ray negatives whenever an exact duplicate was required. While working with these duplicating films, Mrs. Grogan found another important possibility that had previously gone unrecognized.

In addition to being able to make exact duplicates, she was able to accentuate features not visible in the original radiograph. By varying the exposure condition during the duplicating process, she enhanced areas of the "duplicate" that had been difficult or impossible to read.

Radiographs often have these hard-to-read areas because of thickness and density variations. An X-ray exposure is calculated for a single area and density; other areas are either under-exposed or over-exposed. These too-light or too-dark areas may be impossible to interpret directly, but they do contain latent images which can be brought out in the duplication process. Thus, a single radiograph may be copied many times, using a variety of exposure conditions to make each copy ideal for a given area of the original.

The accepted way to compensate for too-light or too-dark areas has been to X-ray again under slightly different conditions. For industrial X-rays, this can be expensive in terms of utilization and wear on the X-ray machine. For medical X-rays, repeated exposures can be harmful to the health of the patient.

The duplicating film process developed by Mrs. Grogan uses visible light and and a contact printer. When commercially available printers proved unsatisfactory, she designed and built one suited to her purpose. It features a controlled variable light intensity, timers to control exposure, and contact between original and duplicating film.

The printer was built in the arsenal's Benet Weapons Laboratory by modifying a conventional X-ray viewer with a film cassette hinged to the front. Effects of varying light intensity and time were evaluated visually and by densitometer on over 1,500 radiographs and a technical report of the results was published.

The enhancement process demonstrated by Mrs. Grogan is believed to offer "termendous potential" for savings and process improvements, since it reduces or eliminates the need for re-shooting many X-rays, with the attendant costs, and substitutes a simple, inexpensive photographic process.

The technique permits full exploitation of rare radiographs which are impossible or too expensive to duplicate. Finally, it produces good readable radiographs from X-ray expsoures that are limited by mechanical arrangement, high velocity of the subject, hazard of damage to the X-ray equipment, etc.

Several AMC agencies have evinced interest in the duplication technique. Frankford (PA) Arsenal has taken advantage of it by submitting several flash X-ray radiographs to Watervliet for duplication and enhancement. Among these are internal and external ballistics radiographs of a single flechette and an exterior ballistics radiograph of a projectile in aluminum armor (simulated).

Mrs. Catherine Grogan

Frankford has reported these improvements: damage to the flechette tip is now visible, accurate measurement of flechette balloting is feasible, flechette velocity can be calculated more precisely, and accurate measurement of projectile position in aluminum armor is now possible.

Frankford has cited substantial savings achievable through use of the duplication technique: purchase of several new higher powered X-ray tubes could be deferred; Repeat of an expensive firing program could be eliminated; and danger of firing damage to X-ray equipment could be lessened.

Mrs. Grogan has also received inquiries about the technique from Picatinny Arsenal at Dover, NJ, Aberdeen (MD) Proving Ground, the U.S. Army Materials and Mechanics Research Center at Watertown, MA, and the Dahlgren (VA) U.S. Naval Weapons Laboratory.

R & D NEWS

Aviation Test Board Evaluating Air Traffic Control Center

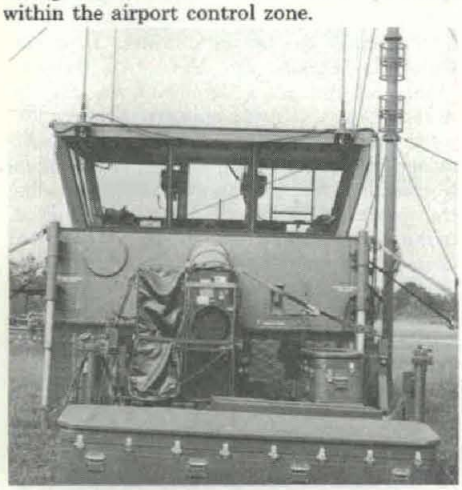
The U.S. Army Aviation Test Board (AATB) is evaluating the AN/TSW-7A Air Traffic Control (ATC) Center for technical and functional performance, under simulated field conditions, at Fort Rucker, AL.

Communications between ground controllers and aviators are conducted through the Standard VHF and UHF SLAE family AN/ARC-114, -115, and -116 radios.

A sectionalized antenna, shown at right of photo, is used for VHF-AM/UHF communications. Separate shelter-mounted whip antennas are used for VHF-FM communications. The high-frequency, single-sideband radio system utilizes a separate guyed 32-foot whip antenna.

When fully operational, the air-conditioned ATC Center's full range of capabilities will include landline communications provided by a telephone group compatible with 2-wire (manual and dial) and 4-wire field telephone systems.

Skid-mounted diesel-powered, 50/60-Hz, 15-kw generators will furnish primary power to the ATC Center, adding mobility in providing traffic control to aircraft operating within the airport control zone.



AN/TSW-7A ATC Center

Receiving $110,000 check from Joseph H. Berney (center) of National Presto Industries are MG John C. Raaen Jr., commander, U.S. Army Armament Command (ARMCOM) and Marvin C. Jothen, procurement contracting officer for ARMCOM (since retired). The Eau Claire, WI, firm manufactures 105mm HE M1 projectiles for the Department of Defense, and has now returned more than $140,000 in excess profits gained through the sale of scrap metal produced during manufacture. Berney said the full return of excess profits on this contract may total $250,000.

USAFO Coordinates Data Exchange Between AMC, Air Systems Command

An important function of maintaining an effective interface between the U.S. Air Force Systems Command and the U.S. Army Materiel Command, involving initiation of joint service programs and coordination of management procedures, is assigned to the U.S. Army Field Office (USAFO).

Located at Andrews AFB in Maryland near Washington, DC, USAFO is a Class II Activity of the Army Materiel Command with full staff status in the Air Force Systems Command. This arrangement enables USAFO to keep informed of all AFSC actions of potential interest or concern to the Army Materiel Command, and to facilitate exchange of technical information.

Subject areas of concern to USAFO range from technical to general, i.e., space programs, electronic warfare, aeronautics, RPVs (Remotely Piloted Vehicles), lasers, photogrametrics, target acquisition, life cycle costing and design-to-cost, reliability and maintainability of materiel, testing, contracting, project management, and intelligence.

USAFO may coordinate requirements with any Air Force Systems Command agency involving Army Materiel Command interests, but is often called upon by various Department of the Army and other service agencies for assistance.

Many actions of which USAFO becomes aware do not warrant widespread dissemination of information. In those cases the individual Army agencies are contacted directly for evaluation comments.

Procedures established to integrate efforts of the Air Force, Army Materiel Command and other Army agencies have often materialized in joint development and testing projects credited with substantial dollar savings. USAFO also has presented proven Air Force policies that have been accepted for Army implementation. Similarly, the office has been able to assist Air Force agencies in resolution of problems in areas of Army responsibility.

Conversely, USAFO in coordination with Army agencies has been able to provide management policies or guidance acceptable to the AFSC staff. Frequently these areas of interest require coordination with the Army Materiel Command, Forces Command, Training and Doctrine Command and the Army staff.

MG R. T. Marsh, DCS/Systems, HQ Air Force Systems Command, LTC (Ret.) James H. Proctor, chief, USAFO, and MAJ Charles Fleming, R&D coordinator, discuss the Air Force program to develop the Continental Operations Range.

USAFO Chief James H. Proctor, a retired Army officer, has served in this capacity since 1958. He serves as an Army representative on various inter-service panels and committees including: JTCG on Aircraft Survivability; Aircrew Station Standardization Panel; and Air Standardization Coordinating Committee Working Party on Aircraft Instruments and Aircrew Stations.

The *Technical Digest,* published monthly by USAFO, is the primary media for dissemination of a summary of selected Air Force research and development procurement actions of interest to the Army.

Distributed to Army Materiel Command activities and 31 other activities, including other services, the publication prompts more than 50 requests monthly for specific information. Requests may receive responses from overseas as well as CONUS-based commands.

Proctor, whose staff consists of R&D coordinator MAJ Charles A. Fleming and a secretary, said that USAFO aims to aid any and all persons in the Department of Defense agencies—"If you need USAFO's services, we are involved from A to Z. We will welcome your call."

Chaparral/FAAR Product Office Proposed for MICOM

Acceleration of activity and interest in the Chaparral missile has led to a proposal for establishment of a Chaparral/FAAR Product Office at HQ U.S. Army Missile Command. FAAR denotes Forward Area Alerting Radar.

A Chaparral management office was established at Redstone Arsenal in the mid-1960s and the heat-seeking missile that defends against low-flying aircraft was deployed in 1969. It is now deployed worldwide with the Vulcan antiaircraft gun.

Currently, Chaparral is undergoing a product improvement program including a new seeker, fuze and warhead, an IFF capability and a smokeless motor to extend its life cycle "well into the future."

The improvement program, plans for new production and interest by foreign countries wanting to buy Chaparral has resulted in establishment of a management office pending authorization for the proposed Chaparral/FAAR Product Office. Currently, the Chaparral/FAAR Management Office is staffed with 18 military and civilian personnel and is scheduled for expansion.

MASSTER Evaluating Tires With Flat-Run Capabilities

Folding sidewall tires that conform closely to conventional military tires, but have run-flat capabilities when punctured, are being evaluated at MASSTER (Modern Army Selected Systems Test, Evaluation and Review), Fort Hood, TX.

In recent tests, run-flat tires mounted on jeeps and Gama Goat vehicles were driven over a 10-mile course over paved and unpaved roads, steep hills, sharp turns, water crossings and open countryside. When a tire is punctured, the sidewalls fold inward, making the tire smaller but still able to support the vehicle.

Tests have included determination of how well a driver can control his vehicle with one or more of his tires flat, and comparison of characteristics and capabilities of the inflated run-flat tire with conventional tires when driven over the same type of terrain.

Drivers and data collectors participating in the tests are attached to the 48th Medical Battalion, 502d Supply and Transportation Battalion, 12th Maintenance Battalion and 142d Signal Battalion of the 2d Armored Division.

LARGEST COMPUTER CENTER. Opening of what is termed the "largest and most modern such facility within the U.S. Army Materiel Command" was officially marked at a ribbon-cutting ceremony presided over by MG Hugh F. Foster Jr., commander of the U.S. Army Electronics Command (ECOM) and Fort Monmouth, NJ. Flanking GEN Foster are (from left) BG Robert Cheney, BG Henry Hill, Richard Homan, day-shift supervisor in the computer room, and Joseph Bergman, whose Directorate of Management Information Systems was responsible for the new center. A large-scale, multiprograming IBM 360-65 computer has been set up in the one-half acre site in the basement of the ECOM Office building. A second identical computer is scheduled for installation by the end of this year. The center also houses operational personnel.

Communications-Electronics Materiel . . .

Electronics Command Maintains Rapid Pace in Advancing Technology

Established in 1962 during the Army-wide reorganization that created the Army Materiel Command from five of the seven Technical Services, the Army Electronics Command (ECOM) has a background of research and development achievements of its famed laboratories dating back more than half a century.

ECOM is one of the major commodity commands in the Army Materiel Command, and, as such, has full life cycle responsibility for the Army's essential communications-electronics materiel. This "womb to tomb" authority includes R&D, production engineering, procurement, distribution, maintenance and eventual retirement of C-E materiel.

ECOM's seven laboratories are: Atmospheric Sciences, Combat Surveillance and Target Acquisition, Electronics Technology and Devices, Electronic Warfare, Night Vision, Avionics, and Communications-Automatic Data Processing.

All of ECOM's current laboratories have their roots in work by scientists and engineers in the Army's former seven Technical Services setup. Predominantly, they are carrying on the R&D mission and basic communications-electronics responsibilities originally assigned to the Signal Corps and, to a lesser degree, the Corps of Engineers and Ordnance.

"Galloping technologies" in electronics and other fields today, however, might amaze many of the top R&D people in the old Signal Corps laboratories, or even in the early days of ECOM. Scientific and engineering work now requires constant schooling to keep up with the pace of technological progress.

For example, electronic circuits that would have packed the proverbial bread box 10 years ago are lost in a thimble today. Infrared sniperscopes that gave us our first capability of seeing in the dark were detectable because of the rays emitted; they have been replaced by light-intensification or passive infrared devices emitting nothing revealing to the enemy.

The tremendous range of work done by the laboratories—on their own projects and for such customers as AMC project managers and the other military services—might be illustrated by a size comparison.

ECOM scientists, engineers and technicians are working on tasks from pinhead-sized integrated circuits to complete extensive field systems such as TACFIRE, a tactical data system for effective automated fire control of field artillery. TACFIRE would be impossible without widespread use of microelectronics exemplified by almost incredibly tiny integrated circuits (ICs).

ECOM produced no highly publicized or sensational developments in FY 1974. However, the laboratories' steady progress prompted Dr. Robert S. Wiseman, director of Laboratories and Research, Development and Engineering, to comment:

"ECOM and its predecessor organizations have been in the forefront of military communications-electronics research and development for over half a century. Our many accomplishments are known the world over. We have continued in FY 74-75 our efforts toward providing U.S. troops in the field with the finest, most modern C-E equipment ever furnished any military force.

BIG CROW, Airborne EW Laboratory

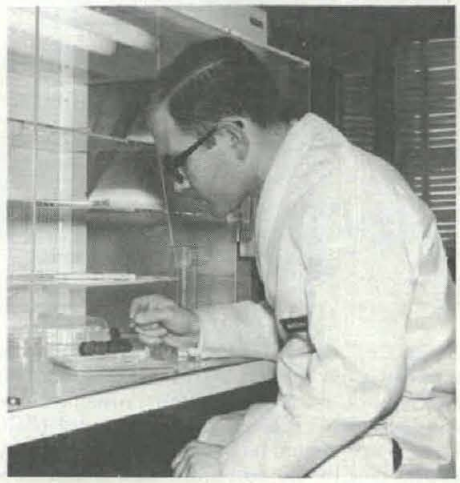
"I view our achievements proudly. New products for augmenting the Army's combat effectiveness, and the advancements of the technology base, provide the groundwork upon which we will build the succeeding generations of Army equipment and systems."

Dr. Wiseman selected five "most noteworthy technical achievements" during this period, specifically:

• LASER MINI-RANGEFINDER—ECOM established the feasibility and completed the design of a new family of mini-rangefinders for use with small arms direct firing weapons. Based upon a small, lightweight (one pound or less) laser rangefinder, the weapons are capable of providing accurate ranging information to a distance of one kilometer (five-eighths of a mile).

Further miniaturization is being pursued internally and under a contract for a highly reliable laser cartridge. This low-cost throwaway device will utilize a Q-switched laser cartridge, constructed by coating a laser crystal with a Q-switched dye film overcoated with a high reflectivity mirror.

• LASER CROSSWIND SYSTEM (LCS)—A Laser Crosswind System that measures winds transverse to a path has been evaluated. This type of system has a laser, detector (optics), and processor. Intensity fluctuations in the light are analyzed as they are carried past the detector by the wind.



RESEARCH SCIENTIST loads a quartz "boat" with silicon wafer crystals during the complex steps of fabricating advanced integrated circuitry in Components Lab.

The LCS can be operated in the bistatic mode or monostatic mode using specular reflection. A miniaturized LCS design was completed, and operational models for use at the Army and Air Force high-energy laser ranges were procured.

• BIG CROW, AIRBORNE EW LAB. The "Big Crow" aircraft, a flying electronic laboratory, successfully completed flight tests and was checked out on mission profiles required for the heavy schedule of missile vulnerability tests beginning in FY 75. This modified KC-135 is designed to provide the Army an airborne platform with the capability of creating EW environments for the susceptibility/vulnerability analysis of missile and support systems.

The laboratory is heavily instrumented with active and passive EW equipment, including data acquisition and recording systems, capable of generating barrage noise, spot noise, cross-polarized pulse and CW, deception signals, and the dispensing of chaff.

Transmitters and receivers cover the frequency bands of the electromagnetic spectrum used by many operational and developmental radars. Major Army missile systems, such as SAM-D, Improved Hawk, Pershing and Lance, can use this capability for ECM/ECCM (Electronic Counter Measures, and Electronic Counter Counter Measures) experiments or testing of missile subsystems.

• MILLIMETER WAVE IC RECEIVER. An all-solid-state, compact 60 GHz receiver using dielectric waveguide transmission lines has been developed for experimental use in Army secure communication and EW systems.

The laboratory receiver represents the culmination of prior efforts in development of the unique millimeter family of silicon devices—oscillators, modulators, detectors and dielectric guides. Aside from the compact design and unique performance capability, the receiver eliminates the need for the very costly precision-machined metal waveguides conventionally used at millimeter frequencies.

• TRAVELING WAVE TUBE. A novel TWT design using printed microwave circuits within the tube envelope has been developed for S-Band operation. The new 2-kilowatt (peak) tube features a simple electron gun design, deposited circuitry and a minimum of piece parts. It is expected to cost less than $100 in production, in contrast to over $1,000 for the conventional TWT in wide use today in Army communications, surveillance and EW systems.

The laboratories have selected five major thrust areas for work in the current and

coming fiscal years. They are:

• WEAPONS DETECTION AND LOCATION. The objective is to develop and field equipments to detect and locate enemy artillery, rocket and mortar weapons with sufficient accuracy to permit effective counterfire. The ultimate objective is to locate the weapons before they have fired.

Two competitive contracts for advanced development models of an Artillery Locating Radar Set, AN/TPQ-37, are being continued with the program on schedule. A contract was awarded for engineering development of a new Mortar Locating Radar Set, AN/TPQ-36. ECOM has continued development of Radio Data Link AN/GRA-114 for use with Sound Ranging Set GR-8, and has completed an experimental prototype of an Acoustic Artillery Locating System using the distributed array concept.

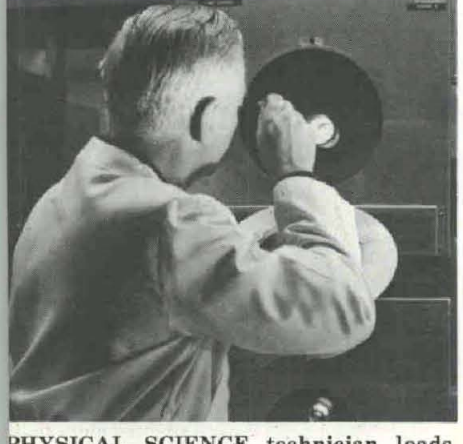
A feasibility test at Fort Sill, OK, showed that this system has excellent potential for significant improvements in performance areas such as accuracy, target capacity and response time. In addition, this system greatly reduces dependence on accurate meteorology and survey data, which was necessary for previous sound ranging systems.

ECOM is continuing technology programs intended to find alternate approaches for locating firing weapons which might be less expensive than the Radars AN/TPQ-36 and 37.

A computer simulation of a multisensor mortar locator combining acoustic and radar techniques has demonstrated that the system can provide acceptable accuracy with simple, low-cost components. A scanning type detector array was developed for an airborne infrared gun flash detecting system. An investigation was initiated to determine feasibility of using lasers to locate weapons by detecting effluents produced by firing of the weapon.

• NIGHT VISION. The objective of this "major thrust" program is to design and develop techniques and equipment required to assure the Army-85 operational concept for 24-hour tactical operations. Efforts are being expended in Far Infrared (Thermal Imaging) and Image Intensification, and lower-level effort is continuing in optical radiation.

Thermal imaging technology has been characterized historically by outstanding performance and military potential and very high cost. Numerous system designs to satisfy



PHYSICAL SCIENCE technician loads an oxidation furnace with wafer-shaped pieces of silicon, which are subjected to temperatures of nearly 2,000°F., in the fabrication of tiny integrated circuits.

MG Hugh F. Foster Jr.
Commander
ECOM & Fort Monmouth, NJ

Dr. Robert S. Wiseman
Director
ECOM RD&E Laboratories

requisite performance goals and be inherently low in cost have been investigated without success.

Results have shown that significant cost reductions could be achieved only by a single design concept (common module) for a variety of requirements and applications (aircraft, ground weapons, vehicles, etc.). Only by virtue of the accrued volume could economies sufficient to achieve significant reductions in the cost of acquiring and owning thermal imaging systems be realized.

The Night Vision Laboratory, an ECOM activity at Fort Belvoir, VA, has made significant progress in its program to develop, harden and standardize modular components for thermal imaging systems; to apply these components to a broad spectrum of military IR sensor requirements; and to achieve thereby significant reduction in life-cycle costs.

The NV program has been extensively coordinated with the other military services, under charter of the Joint Logistics Commanders, resulting in DoD-wide impact on infrared imaging system development.

In image intensification development, second-generation systems were essentially completed in FY 74. Night Vision Goggles, AN/PVS-5, have been Type Classified "Standard" and low-rate initial production has begun. The major thrust is therefore focused on efforts to develop high sensitivity photocathode materials with spectral response extended to .9 microns and subsequently to 1.9 microns.

The objective is to capitalize more effectively on the ambient radiation available at night, and to be compatible with laser sources operating at 1.06 microns.

Encouraging progress has been made in the areas of sensitivity and uniformity, stability in the tube environment, compatibility with substrate materials, and control of economically practical deposition techniques.

• AIRCRAFT NIGHT OPERATIONS. Major thrust goals encompass all forms of nocturnal aircraft operations with final objectives to provide nighttime capabilities with, or near, daylight efficiencies.

One of the barriers to deployment of Army airmobility in a mid-intensity battlefield is the requirement to operate at night at low level to provide the required survivability and tactical surprise. To define alternative avionic/visionic systems for the airmobile fleet, a study program was initiated in FY 72.

Emphasis in FY 73 was on developing a broad data base (experimental/flight test) measured on a standardized terrain to insure correlation of flight test and experimental data. Emphasis in FY 74 was placed on data analysis and preliminary system synthesis of alternative avionic/visionic systems.

• SECURE TACTICAL COMMUNICATIONS. This major thrust program is directed to the development of techniques and equipment needed to provide new secure communications capability to fulfill present and future Army requirements. Efforts are continuing on:

The Tactical Radio Communication System (TRCS) program, which is aimed at fielding a new generation of tactical net radios in the post-1980 time frame. Considerable time and effort in FY 74–75 have been devoted to support of the Single Channel Tactical Radio Communications (SINCTRAC) Working Group. Appointed by the Department of the Army, the group is working to define the single channel communications needs of the Army and to document the Required Operational Capability (ROC).

The effort is now essentially complete, with its most important output being a draft ROC for the VHF-FM portion of a Single Channel Ground/Airborne Radio System (SINCGARS). Significant progress has been made in the VHF-FM subsystem, and competitive advanced development models of the AN/URC-78 are nearing completion. Results of the analysis of radios will be used to define requirements of the VHF portion of SINCGARS. Exploratory development efforts have commenced for various components and techniques that will be used in future efforts.

• ELECTRONIC WARFARE. The objectives of this major thrust program are to improve the capability of the Army to intercept, identify and locate the source of enemy emissions; to permit Army operation in a hostile EW environment; and minimize the enemy's effective use of the electromagnetic spectrum.

Major ongoing efforts have been directed toward the EW protection of Army aircraft and the susceptibility/vulnerability assessment, including ECCM recommendations for U.S. Army missile systems. Two versions of infrared protection of fixed- and rotary-wing aircraft are in Development II and Test I, respectively.

Advanced development models of an advanced radar jammer, missile detectors, and chaff countermeasures have been delivered and are undergoing evaluation tests. SAM-D and terminal-homing weapons systems vulnerability investigations received considerable attention during FY 74. The Big Crow flying electronic warfare laboratory was delivered and accepted.

New initiatives by the Army Materiel Command to improve the Army's EW posture include establishment of a Quarterly Command Review of the AMC program in support of the Army EW Master Plan; the issuance of an AMC Policy Letter on EW; and designation of the Electronic Warfare Laboratory as the AMC Lead Laboratory for EW Technology.

(Continued on page 10)

Communications-Electronics Materiel . . .

(Continued from page 9)

Accelerated by new intelligence derived from the recent Mid-East conflict, these actions have resulted in the preparation of plans to augment the EW Laboratory resources in the areas of EW Vulnerability/ECCM for C-E Systems and Land Combat ECM.

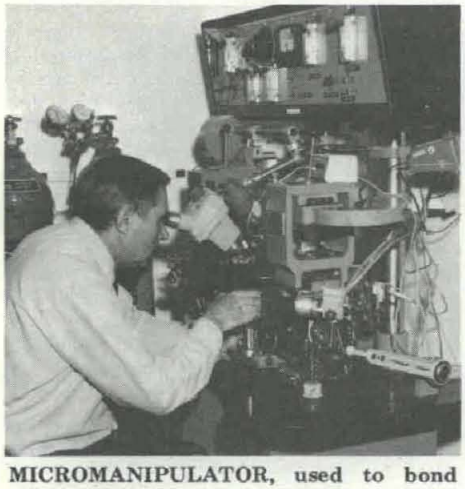
CIVILIAN SPINOFF BENEFITS. ECOM laboratory achievements, resulting from programs to serve military requirements, often have proven of great value to the civilian sector. Some of the major nonmilitary applications in the past year include:

The MOHAWK OV-1D aircraft configured with the ECOM-developed APS-94-D side-looking radar (SLAR), and using an ECOM-developed air-to-ground image transmission system, has been and will continue to be used for a number of civil applications. These include: ice mapping of the Great Lakes waterways, flood assessment of the Mississippi and Missouri Rivers, geological surveys, and environmental protection.

A spinoff from the Night Vision Goggle Program, was used in two new significant nonmilitary applications. Scientists at the University of California at Santa Barbara used the Pocketscope to study the bioluminescent organisms in the marine sonic layer. ECOM's Night Vision Laboratory modified a Pocketscope used by NASA in the Solar Telescope aboard Skylab II to aid astronauts in aiming the telescope rapidly and accurately.

The Small Starlight Scope has been used by a number of scientists throughout the world for studying the behavior of various types of wildlife active at night. For example in FY 74:

- The University of North Carolina, which previously used the scope to study insects attacking corn and tobacco crops, is now using it to study the habits of the Ghost Crab.
- University of Minnesota scientists are using this device to gain first-hand knowledge of creatures such as the American Bald Eagle, Woodcock, and White Tail Deer.
- Stanford University researchers are using a Starlight Scope to study the sociological and anthropological habits of the chimpanzee, and the National Geographic Society's Dr. Jane Goodall is using it to study the wild chimpanzee in Tanzania. Miss Dian Fossey is studying the mountain gorilla in Central Africa.



MICROMANIPULATOR, used to bond wires to microsize integrated circuits, gives the operator the capability to place the wires with an accuracy of a ten-thousandth of an inch. Features of the equipment include gear trains, sliding surfaces, a 100-power microscope, a control lever, and the needle-shaped vacuum pickups that serve as fingers.

A Night Observation Device, the AN/TVS-4, is being used by the Ohio Department of Natural Resources in a law-enforcement role to search for illegal commercial fishing in the Great Lakes.

The Handheld Thermal Viewer (HHTV) has found numerous nonmilitary applications. The Philadelphia Fire Training College, for example, is testing a viewer provided by the NVL to determine its effectiveness in locating persons in smoke-filled buildings. The Pennsylvania State Forestry Department is using the HHTV to locate forest and grass fires in their early stages.

Similar units were delivered to the U.S. Department of Interior, Bureau of Mines, for use in mine safety work. These were modified, however, to be safe for use in an explosive environment.

The system is used to detect cave-in hazards by sensing the small temperature differentials that exist when rock and earth become loosened from the main walls and ceilings in a mine. Additionally, the device has proven helpful in finding areas of spontaneous ignition in slag piles before an open fire emerges.

Night Vision Goggles have also been demonstrated in California as part of the California Four Cities Program to determine their "usability" for police and firemen in a variety of roles.

Civilian adaptations of the C-6533/ARC Intercom and the AN/ARN-89 Automatic Direction Finder are presently available to the commercial aviation market.

A target search and location system, featuring low-power, microcircuit transponder units and associated receive/decoding circuitry, was developed internally in support of requirements from the U.S. Department of Transportation.

The system was designed for application in the location of hijacked civilian vehicles. It also provides a potential low-cost means of tagging and locating air-dropped military materials/equipment in a tactical environment without compromising their location to the enemy. This technique is applicable to many military and civilian security surveillance problem areas.

Chemical vapor-deposited isotropic boron nitride, developed under the sponsorship of the Electronics Technology and Devices Laboratory, is being used in a classified reactor project by General Electric Co. at Orlando, FL, for the Atomic Energy Commission. No other known material can meet this special requirement.

The nickel-coated particle cathode powder facility established as an ECOM project is supplying the cathode material to several tube manufacturers for nonmilitary use. A market survey indicates the principal commercial use is in color cathode-ray tubes for longer life and superior performance.

Hydrogen thyratrons 1802/7322, developed for radar applications, were used as the switching device in modulators for commercial systems involving TEA lasers, nitrogen lasers, CO_2 lasers, flash lamp pulsing, and precipitation. These systems are finding applications in a variety of cutting, welding and optical pumping purposes in industries, as diverse as automotive manufacturing, fabric manufacturing, and fusion research laboratories.

ELECTRONIC 'CANNER' is used to encase integrated circuit chips in small containers. To create a special environment in the cabinet, air is evacuated and dry nitrogen, with a moisture content of 25 parts per million, is pumped in. To preserve this super-dryness, access is gained by rubber gloves fitted to cabinet.

Hexagonal ferrites have been under intense research scrutiny and development at ECOM for about five years. Rockwell International and Collins Radio Corp. are using the hexagonal ferrites in development of high-frequency microwave components, and are applying ECOM's technology base.

ECOM development of a 20-watt, 2 GHz broadband transistor provided the basis for recently announced commercial microwave power transistor product lines for international, common carrier, and industrial microwave radio relay and telemetry applications.

Modular hermetic microwave integrated circuit packages were developed under an ECOM program. Microwave Associates Inc. is using this technology in a variety of commercial as well as domestic and foreign military applications to reduce costs and improve reliability.

ECOM development of micropower integrated circuits for use in battery-operated portable military equipments has led to the design and development of a variety of medical electronic applications, e.g., blood flow monitors.

Development of microwave power transistor chip carriers as an ECOM effort for radar transmitter applications has resulted in widespread use in commercial microwave communications and cable TV systems.

These recent spinoffs, when added to the former civilian benefits from Fort Monmouth's laboratories, make a rather impressive list of double dividends in ECOM's use of the taxpayer's dollar.

Night vision goggles were adapted more than a year ago for use by sufferers of retinitis pigmentosa, an eye malady that makes vision in poor light conditions impossible. With the goggles, victims of the disease can see safely in twilight and other reduced light conditions.

An area directly affecting the consumer is the automated assembly of printed circuits, widely used in electronic equipment of all kinds, including commercial radios and television. The basic patent for assembly automation as applied to these circuits was granted to two ECOM laboratory engineers.

Commercial and military aviation owe much to the ECOM predecessor labs, where the magnetron tube, basic to the construction of ground control approach (GCA) systems for poor visibility aircraft landings, was largely developed.

GCA is based on radar, and Fort Monmouth's scientists were deeply involved in the early development of radar. The first and basic U.S. patent on pulse radar was granted to a colonel in the laboratories. An offshoot of early radar work was weather radar. All weather radar in use today can be traced to the pioneering models developed for military meteorological use.

Early radar work in the ECOM labs proved the feasibility of space communications when the now famous Project Diana succeeded in bouncing a signal off the moon and receiving a return pulse.

All of these radar achievements would have been impossible without the development of the original transmitting and receiving vacuum tube in the Signal Corps labs at Fort Monmouth. Early radar experiments required two immense antennas because the transmitter and receivers were separate. Invention of the TR tube made possible the use of one set and one antenna.

Another tube development at Fort Monmouth was the one that put radar into the higher frequencies, the microwave area. In microwave transmission—now perhaps the most widely used means of long-distance voice and digital communications—the ECOM predecessor laboratories also played a pioneering role. The first long-distance microwave radio relay systems were developed and set up to improve military communications economically through the use of unattended relay stations.

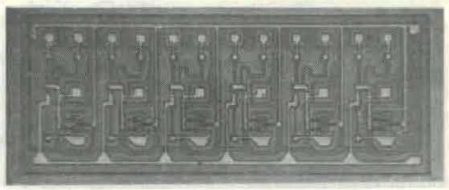
Except for some R&D conducted for the Satellite Communications Agency, ECOM's laboratories are just about out of the space business. But the labs were already working on the Vanguard satellite when the entire western world was stunned by the successful Soviet launch of Sputnik I on Oct. 4, 1957.

Nowhere in the United States was reaction faster than in the Fort Monmouth laboratories. Within hours an efficient and accurate monitoring system was set up to record signals and position of the Russian satellite on every orbit.

NASA was at that time still in its infancy, without the resources that were quickly assembled to monitor and track all satellites. But for Sputnik I and Sputnik II, the monitoring station at Fort Monmouth was the prime source of information on signals, orbits and positions.

The station remained in operation, constantly expanding, for several years, until it was phased out by more sophisticated stations set up by NASA and the Air Force.

The pre-ECOM laboratories also were responsible for many of the early successes of the U.S. satellite program. The solar cells that kept Vanguard I, the first successful American satellite beeping long after it had outlived its purpose, were proposed, developed and assembled into power units here.



INTEGRATED CIRCUIT CHIP, one twenty-fifth of an inch wide and one-tenth of an inch long, contains 6 transistors and 18 resistors. The circuity is one example of the work in microelectronics at the Army Electronics Command.

The communications package of SCORE, the nation's first store and forward and "real-time" satellite, was a Fort Monmouth product, as were Courier I, the first high capacity communications satellite, and the first successful weather bird, TIROS I.

PERSONNEL. The ECOM Laboratories have a total personnel strength, including Production Engineering and the R&D Technical Support activity, of 566 military and 3,277 civilians. About 380 of the military personnel are with the Atmospheric Sciences Laboratory, headquartered at White Sands, NM.

Engineers and scientists make up 52 percent of the lab strength. Of these, 8.3 are PhDs, 36.7 masters and 49.7 bachelors.

With this dedicated scientific and technical team, and the long tradition of pioneering excellence, the ECOM labs can logically be expected to continue to excel in their mission of providing the U.S. military with the newest and finest communications-electronics.

Scientists From 8 Nations . . . Participate in HDL Fluidics Symposium

Scientists from eight nations attended a 5-day Fluidics State-of-the-Art Symposium sponsored by the Harry Diamond Laboratories of the U.S. Army Materiel Command and hosted by the Naval Surface Weapons Center, White Oak, MD.

Among more than 200 participants were representatives from numerous Department of Defense and other U.S. federal agencies, industrial and academic research organizations, West Germany, Japan, Australia, Sweden, the United Kingdom, Canada and Israel.

The purpose of the symposium was to exchange information comprehensively reflecting the current status of fluidics technology—invented by HDL scientists and announced at a press conference in 1960. In recent years the Army Materiel Command has assigned to HDL "lead laboratory" responsibilities for the fluidics R&D Program.

FLUIDICS SYMPOSIUM attendees included (from left) Dr. William Carter, HDL associate technical director; COL David W. Einsel Jr., HDL commander; Dr. Alexander Slafkosky, U.S. Marine Corps scientific advisor; Richard Gottron, HDL, chief, Fluidics Development Branch; CPT Donald L. Jarrell, officer-in-charge and assistant commander, Naval Surface Weapons Center, White Oak, MD; Billy M. Horton, HDL technical director.

AMC Deputy for Laboratories Dr. Robert B. Dillaway presented the introductory address following an introduction by Joseph M. Kirshner, chief of the HDL Fluidics Research Branch and general chairman of the conference. Welcoming remarks were shared by CPT Robert Williamson II, commander of the Naval Ordnance Laboratory, and COL David W. Einsel Jr., HDL commander.

Dr. Dillaway reviewed the recent history in the application of fluidic devices to systems, military and commercial, and their relationship to the advancement in the technology base. The main point of concern today is the very difficult process of convincing new development programers to accept fluidic systems in addition to or in place of electronic subsystems, even though they have demonstrated reliability and environmental advantages, because of lack of familiarity and the established track record of fluidic systems.

Dr. Dillaway stressed that it is incumbent upon, and indeed the responsibility of, practitioners of this technology to take every opportunity to demonstrate availability and desirability of including fluidic subsystems in new system developments wherever appropriate. He also emphasized that DoD should try to get at least one new fluidic system into each new development so that "we can experience an orderly growth in the application of fluidic technology."

Eight technical sessions included presentations and discussion of about 80 technical papers—published in five volumes of symposium proceedings. Industrial presentations showed that fluidics is now a reliable operating technology with many promising applications.

Presentations by foreign representatives and U.S. military and academic scientists provided further substantial evidence that fluidics is a "viable technology" that is proving invaluable to designers and engineers in reducing systems specifications into hardware needs.

AMC Spends $55 Million for Unsolicited Proposals

Unsolicited proposals from industry during FY 72 through FY 74 accounted for diversion of $55 million from U.S. Army Materiel Command (AMC) planned programs.

During this period, AMC Research and Development (R&D) installations received 4,391 unsolicited proposals. More than 880 of these (19.6 percent of the total) were supported by AMC R&D funds.

Army Corps of Engineers Studies . . .
Land Treatment of Wastewaters

By Sherwood C. Reed & Timothy D. Buzzell

Implementation of stringent water quality and pollution control standards has placed major demands upon the resources of military and civilian communities, many of which have some form of primary treatment or a marginally functional secondary system.

Consistent achievement of high-level secondary treatment is difficult and expensive. Attainment of tertiary-level quality with advanced waste treatment (AWT) concepts imposes a severe economic burden on the community—not only for capital improvements but also in meeting operation and maintenance costs.

A fresh approach with an ancient technique appears to offer a method for meeting high-quality standards at an acceptable cost. Utilization of the land for the treatment of wastewaters is a familiar but, until recently, a largely ignored possibility.

The U.S. Army Corps of Engineers has initiated a research program to provide practical data and criteria for the planning, design, construction and operation of on-the-land treatment systems.

CONCEPTS AND CONSTRAINTS. Three basic concepts are available for the land-treatment of wastewaters, namely: slow infiltration, overland flow, and rapid infiltration (see Figure 1). In the physical sense, they differ as to the volume and the flow path of the applied liquid.

Slow Infiltration is the controlled flooding or spraying of liquid onto the land, at a rate measured in inches of liquid per week, with the flow path being infiltration and percolation within the boundaries of the receiving site (see Figure 2).

Overland Flow is the controlled discharge, by spraying or other means, of liquid onto the land, at a rate measured in inches per week, with the flow path being downslope sheet flow.

Rapid Infiltration is the controlled discharge, by spreading or other means, of liquid onto the land at a rate measured in feet per week, with the flow path being high-rate infiltration and percolation.

These methods are proposed as renovative systems and not as convenience disposal or convenience irrigation. Design, construction and operational management retain wastewater renovation as the functional intent of all system components, and optimization of renovation as the functional goal.

Probably the single most important constraint on attainment of this objective for the present and near future is public acceptance. The American public has become conditioned to expect an almost magical "black box" solution to all problems:

"If men can be sent to the moon, a neat container to fit in a closet could certainly be developed to take care of pollution." Millions will say: "Sanitary landfill for solid wastes may be the best approach, but don't put it in my backyard."

Both aspects may be overcome with the proper approach and presentation. Although the magic "black box" may be technically possible, the commitment in energy and other costs may be prohibitive. Moreover, operation of a landtreatment site is entirely different from a sanitary landfill. A landfill is never totally restored until the end of the design operational life, while a land treatment site does not necessarily impose any significant aesthetic change on the receiving location.

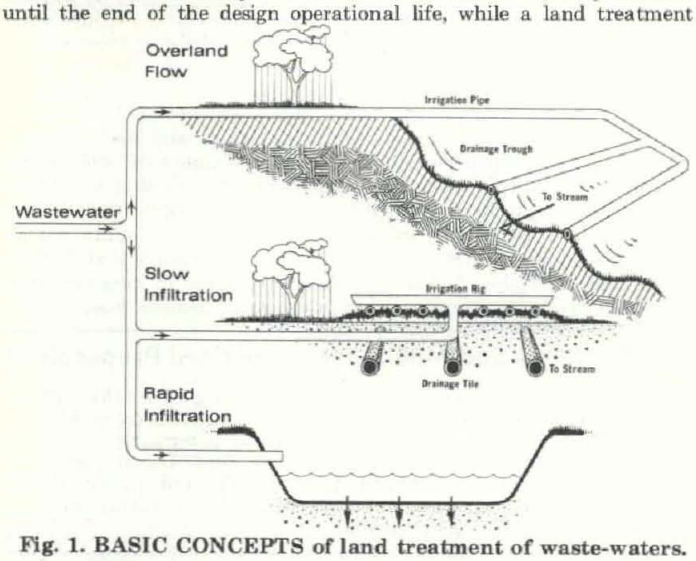


Fig. 1. BASIC CONCEPTS of land treatment of waste-waters.

The major concerns of the Corps of Engineers research program are with the environmental responses to wastewater constituents for both the long and short term. These constituents are: simple and complex organics, metals, nutrients, salts and the water.

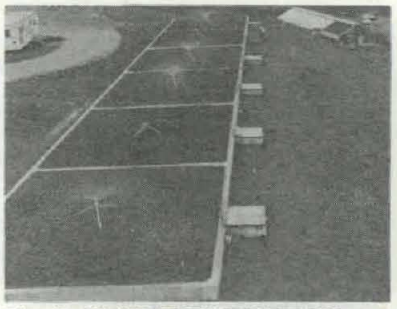


Fig. 2. SLOW INFILTRATION test facility at the U.S. Army Cold Regions Research and Engineering Laboratory. Six spray test cells (28 × 28 × 5 feet) allow flexibility in studying soil types, application rates, effluent types, and other system variations. A field laboratory greenhouse (top, center) provides facilities for the analytical tests.

At the application rates proposed, there is no question regarding the assimilation of simple organic compounds by a land treatment site. It has been estimated that a well-drained sandy soil could assimilate up to 30 tons of organic carbon per acre per year.[2] This would require over 200 million gallons of secondary effluent per acre per year, which far exceeds any loading rate proposed for any of the land-treatment concepts.

The concentration of metals and complex organics can be significant in highly industrialized urban centers. In such cases, the current trend is toward in-plant treatment of such wastes to reduce the load on municipal systems.

In the concentrations normally expected in effluents, it is believed that metals or complex organics will not impose an intolerable load on the land-treatment site. It is expected that these materials will be safely adsorbed in the surficial topsoil layer.

Further studies are under way on the long-term effects and build-up. Such pioneering operations as at Melbourne, Australia, show no deleterious effects from metals after 80 years of activity. Recently started sludge utilization activities in the United States show no harmful effects. The concentrations of metals and other materials in these sludges can easily be 10 times that expected for wastewater effluents.

Dissolved salts may be a problem, particularly in arid climates where the evaporation rates are high. Excessive salts inhibit plant growth and, by changing the soil structure, may alter the hydraulic capacity of the receiving site.

In humid climates with adequate rainfall, such effects are not expected. Generally the character of these dissolved solids may change as the liquid passes through the soil column, but the total concentration will not.

The nutrient materials, nitrogen and phosphorus, may be the major factors limiting operation and useful life of a land-treatment site. Depending on the product quality goals established, the nitrogen content may limit applications in a given season. Uptake by the vegetative cover on the site is the major recognized flow path for the nitrogen applied.

Adsorption can play a role for certain forms of nitrogen, and denitrification is known to occur. Work is under way to further define and optimize these mechanisms; until management techniques are developed, the plants remain the most significant component for nitrogen removal.

Application rates and schedules must therefore recognize the variable plant requirements for nitrogen during the growing season, since the root systems are in place and are active earlier in the spring. Experiments with multiple crops are under way to extend the application season and to improve nitrogen removal.

Over the long term, phosphorus contained in wastewater is likely to be the limiting factor on the useful life of a land treatment site. The plant cover does extract some phosphorus, but the major pathway is immobilization by the receiving soils. There is a finite upper limit to this capacity; when it is reached, the applied phosphorus will move through the soil column.

In addition to the short-term adsorption, other mechanisms prevail in the soil which, in time, convert the phosphorus into sparingly soluble forms. Long-term laboratory experiments and analysis of

soils from older land-treatment operations are required for a better definition of actual capacity.

The amount of water to be applied must be considered, primarily in the context of effect on the vegetative cover. In some California operations, for example, certain tree species were killed because of excessive water in the root zone.

A very significant body of data and expertise exists within the agricultural sciences concerned with irrigation requirements to optimize crop production (see Figure 3). However, a very critical point is that much of this work was aimed at identifying the minimum and optimum amounts of water required for irrigation. For land treatment, the question is the maximum amount of water which can be applied without impairing crop growth. Little or no quantitative information of this type is available.

DESIGN CRITERIA. Design of any waste-treatment system is a complex undertaking, far removed from the relatively simple hydraulic calculations and tank sizing of former years. Design of an advanced waste-treatment facility requires an understanding of microbiology, physical and organic chemistry, adsorption, ion exchange, precipitation and filtration mechanisms.

Design of a land-treatment system requires the same level of understanding of exactly these same factors. Land treatment seeks to take advantage, through proper management, of these naturally occurring phenomena in the receiving ecosystem, while AWT contrives to produce similar reactions in an artificial environment at a higher unit rate.

The proper design of a land-treatment system will include a plan for management of all components, from the new sewage pumps to the vegetative cover and the subsoils on the receiving site. The procedure must start with a simultaneous and converging assessment of product quality goals, intended flow paths, and capacity of potential receiving sites.

More than 500 operational systems in the United States incorporate a land area for the reception of wastewaters.[3] Extrapolation from these experiences to design criteria for land treatment is not always possible. Many of these were convenience disposal activities; others were convenience irrigation of crops.

LAND REQUIREMENTS. The total land required is directly dependent on both the application mode selected and the annual operational period. It is essential in planning the application system to design for maximum possible coverage efficiency within the constraints imposed by site topography.

With the spray methods, a buffer zone is required to prevent off-site transmission of bacteria, viruses and other materials affecting health and hygiene. The need for such protection is the subject of research concerned with aerosol transmission and viral survival.

Essential data will define requirements for buffer zones. Qualitative data obtained during a recent American Public Works Association survey of existing systems provided no evidence of any health problems associated with land-treatment concepts.[4]

Rapid infiltration basins can function on a year-round basis even in northern climates. Because no aerosols are present, they require no buffer zones, thereby reducing acreage needs.

Identification of suitable land areas should not be difficult in rural areas. In some cases, a combination of communities or transmission to a remote site may be necessary or economically desirable.

While there appear to be no technical barriers to the utilization of land treatment for any community size, very large cities may require significant transmission distances to suitable land. The constraints in this case are still social, institutional, economic and not technical.

If operation of a new land-treatment system will result in depletion of water resources at the former disposal or discharge point, it may be necessary to consider recovery and return of the water.

The area selected as a land-treatment site must be committed for the life of the system and must be properly managed. This does not necessarily mean that the land must be owned by the wastewater authority, nor does such a commitment exclude other beneficial uses during or after the system's operational life.

Management for agricultural crops or for forest products will provide an economic return while retaining the rural integrity of the site. Parks, greenbelts, and other recreational uses may be planned for spray irrigation or overland-flow systems. Either type of system will impose minimal changes on existing landscape features, and will tend to preserve rather than destroy the aesthetic character of rural land.

COST COMPARISONS. A cost analysis is an essential element in any planning or design operation. Under the most recent water quality legislation, it will be necessary to identify the most cost-effective treatment approach, considering both capital and operation and maintenance (O&M) costs. Where land costs are not excessive, the capital costs for land treatment should be less than AWT.

A recent feasibility study comparing land treatment via slow infiltration versus AWT, for Fort Meade, MD, indicated approximately a 30 percent savings in costs for the land approach, based on very conservative technical criteria. Current research is directed at optimization of these criteria to produce further cost savings.

Fig. 3. SELF-POWERED spray rig at treatment facility with corn crop.

The O&M costs for land treatment concepts are less than half those required for AWT. Major factors are the very significant energy and chemical requirements for AWT.

Land treatment concepts appear to offer not only cost effectiveness, but an environmentally compatible approach to waste management. Further research and development is necessary to expand the base of technical confidence, and to optimize criteria for design, construction and operation of such systems.

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TIMOTHY D. BUZZELL, a graduate of Norwich University (BSCE) and Clarkson College (MSSE), was a research sanitary engineer at CRREL (1970–74) when he conducted numerous field studies on wastewater treatment facilities in Alaska. He is currently a sanitary engineer with Dames and Moore, Alaska.

Timothy Buzzell

Sherwood Reed

SHERWOOD C. REED, manager of the CE research program on land treatment of wastewater, is active in research on waste treatment and disposal, and water supply treatment and distribution in cold regions. He earned a bachelor's degree in civil engineering from Maryland University and a master's in environmental health engineering from the University of Alaska.

Army Wastewaters Treatment Program

The Army's research on land disposal of wastewater, centered at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, NH, is an interdisciplinary program involving a number of federal agencies and universities.

Studies utilizing the slow infiltration concept are conducted at a test facility at CRREL. The overland flow mode is being investigated by the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS, and the rapid infiltration system is being studied by the Corps' New England Division at an operational site at Fort Devens, MA. WES and the Corps' Mobile District also are monitoring a facility at Tallahassee, FL.

Other active participants are the San Francisco District, Corps of Engineers; U.S. Army Medical Research and Development Command; U.S. Geological Survey; U.S. Department of Agriculture; University of Florida; University of Washington.

Close coordination and research interface is maintained with the U.S. Environmental Protection Agency.

SPEAKING ON . . .

(Continued from inside front cover)

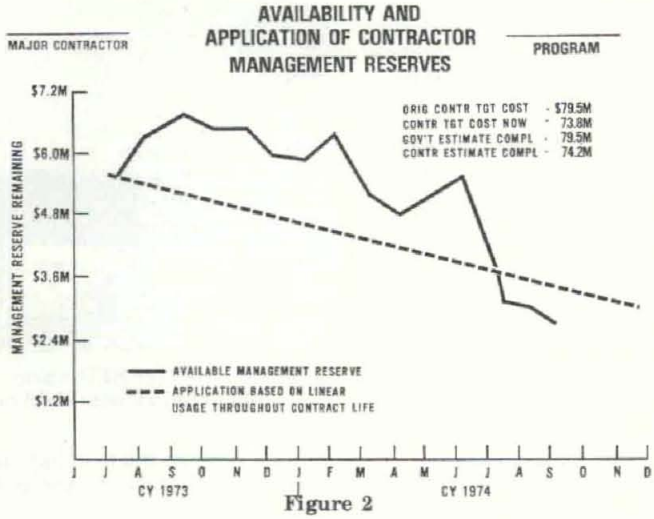


Figure 2

tion. The point is, it is necessary to guard against a tendency to get too detailed in the display of data to management.

The chart (Figure 1) shows cost and schedule variance from a controlled baseline. That's important. Rubber baselines are not permitted. On the bottom it shows the C/SCSC schedule variance as a function of time—and it shows the variance in terms of percent of the total contract.

The next chart (Figure 2) shows the availability and application of contractor management reserve. It follows that if we are going to track cost and schedule variance, we need to know the status of the management reserve. We recognize that a straight line application of reserve over the length of the contract is not realistic. It does give us a point of reference and that is all it does.

The comparison of these two charts, (cost and schedule variance, plus a track of management reserve) gives a good, quick picture of the dollar status of the contract.

That, however, is inadequate because it does not give us the whole story. Simply put, it does us no good to monitor cost and schedule in a vacuum. We must also track technical performance. What good is a piece of equipment brought in on schedule and within cost if it does not function properly.

Two charts are used to track technical performance. These differ with each program but a typical chart for a combat vehicle is shown at Figure 3. We merely list the bands of performance in the contract. In this case they are weight, speed, acceleration, and range. Performance below the horizontal line in each instance is unfavorable and is shown in red.

The other technical chart we watch is one on Reliability (Figure

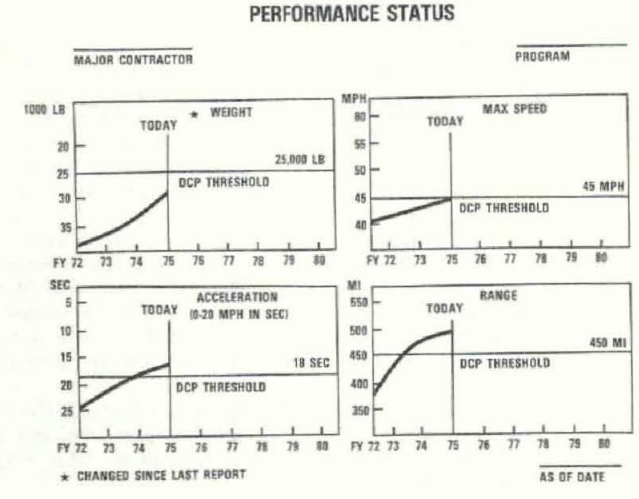


Figure 3

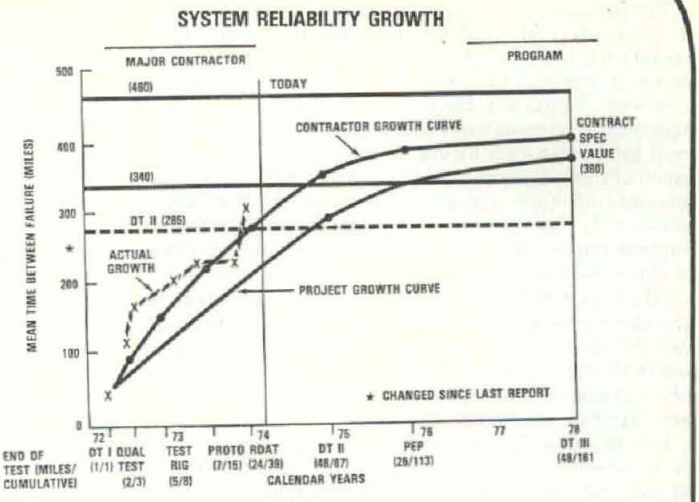


Figure 4

4). This chart has some weaknesses but as of this moment we have not figured out a way to do it better.

We also track manpower loading because it can be an important indicator. Engineering Manpower is shown in Figure 5. We have a baseline (the original plan for manpower utilization), the manpower actually used, and a projected utilization. When we see a negative variance in engineer manpower, it is a clue to an existing or pending technical problem. If the projected line is still negative, it tells us we are not yet near a solution.

Another chart (Figure 6) on manpower is very similar. It reflects total manpower. We use it the same way and any variances in these are checked out closely—because variances not in Engineering could mean a problem in one of the other areas of direct labor, or else an overhead problem. Further, this type chart assures us that the manpower loading reflects peaks or valleys in activity —like testing or phasing down near the end of the contract.

This high-level reporting system based on C/SCSC has solved one major problem—how to keep on top of many programs on a continuing basis. When negative variance red lines appear on the charts, emphasis is placed very quickly on those problem programs.

This approach has enabled us to bring to bear the old management principle—"that which the boss checks is also checked by everybody else." We now have a situation where the project managers check cost and schedule variances each month. In fact, it is really surprising how many similar systems based on the CPR have sprouted up in the project management offices.

In addition, this system provides us with enough data to enable us to eliminate many reports and reduce the number of formal program reviews.

Some lessons learned in establishing this system were:

- The charts must be simple. You must remember that as you

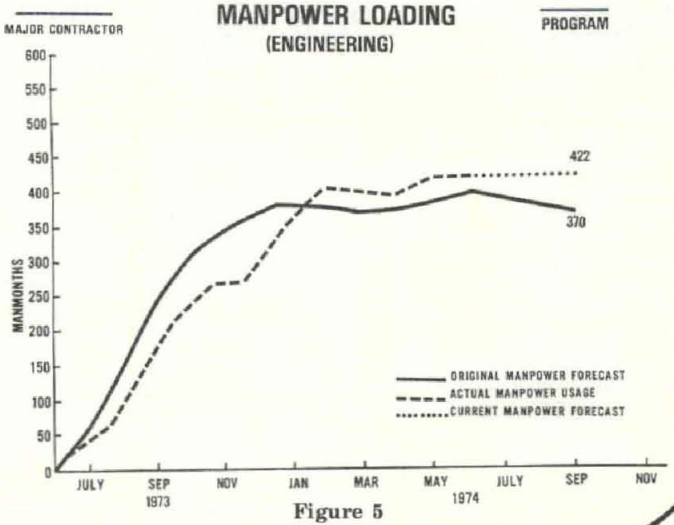


Figure 5

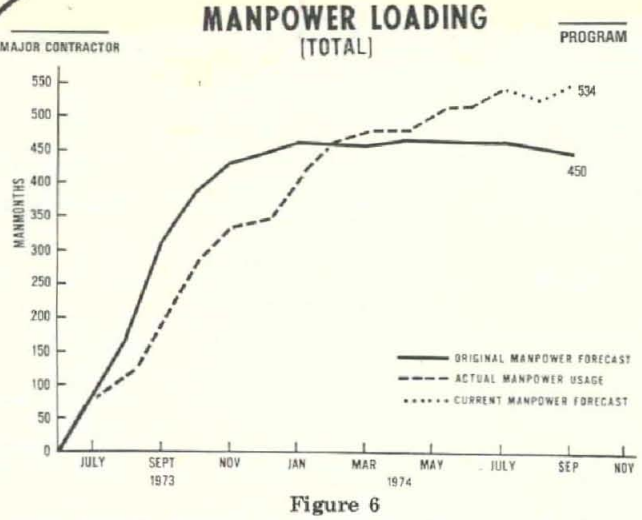


Figure 6

progress up the ladder of management, the manager's time becomes more important, almost critical, because of the greater scope of responsibility. No matter how good your management system is, no matter how good your analysis is, if you cannot get your message across quickly and clearly, your efforts are not productive. A graphic display is a simple, quick way of doing it.

- The CPRs must be analyzed and the data reduced quickly to graphic form to keep the information current. If this is not done, the information loses its impact because it is old, and it does not permit the manager to get a feel for the cost and schedule impact of technical problems which almost always surface before the CPR data is produced.
- The right people in the organization have to do the job. Analyzing CPR data, displaying it graphically, and having it briefed by people who understand it, is a job for experts. The people who do your analyzing must be trained in the theory and discipline of C/SCSC.

In the Army implementation of C/SCSC, we have more than 50 accepted applications plus about 30 more in process. Pioneering efforts at our in-house Army development activities and government-owned contractor-operated ammunition plants have been successful. Currently, we list nine accepted C/SCSC applications. They are the Radford and Volunteer Army Ammunition Plants, Rodman Labs at Rock Island Arsenal, Benet Weapons Lab at Watervliet Arsenal, the Tank-Automotive Command R&D Activity, and four development programs at Picatinny Arsenal.

We expect to see a broadened application of the CPR type of reporting to cover the need for effective cost and schedule control of smaller contracts. The Cost/Schedule Status Report (C/SSR) (Figure 7) has been specifically designed to meet this need. It should provide a practical tool for tracking cost and schedule performance on those contracts above $2 million and over one year in duration, on which application of the CPR is not appropriate.

COST/SCHEDULE STATUS REPORT

Contractor	Contract		Program		Report Period		
CONTRACT DATA							
Orig. Target Cost	Contract Changes ($)		Current Target Cost		Auth. Unpriced Work	Contr. Budg. Baseline	
PERFORMANCE DATA							
WORK BREAKDOWN STRUCTURE	CUMULATIVE TO DATE					AT COMPLETION	
	BUDGETED COST		ACTUAL COST	VARIANCE			
	WORK SCHED	WORK PERF		COST	SCHED	BUDGETED	LATEST ESTIMATE	VARIANCE
GEN & ADMIN								
UNDISTRIB. BUDG.								
MGMT. RESERVE								
TOTAL								

Figure 7

In other words, on most of our large contracts we will require C/SCSC and the CPR. There may be some where the CPR will be required, even though for some reason C/SCSC is not a requirement. The smaller ones will be candidates for the C/SSR.

Up to now we have expected our AMC managers to consider any contract over $10 million for possible C/SCSC application, especially if it is a cost-reimbursable type of contract, and on this type over $25 million is a sure thing.

What's new about C/SSR? It fills a gap, provides a "tailoring-down" of the CPR so that enough data can be obtained to manage a small contract without the "overkill" that would result from a CPR. In essence, it is simply the abbreviated first page of the CPR showing cost and schedule performance-to-date for summarized Work Breakdown Structure elements and the latest estimated-cost-at-completion compared to the budgeted cost-at-completion.

The data will be sufficient to allow the same tracking of cost and schedule variances that we now have using the CPR. However, the use of the C/SSR does not require that the contractor meet the C/SCSC requirements or use C/SCSC disciplines.

This obviates the need for the comprehensive C/SCSC reviews. But if C/SSR is to serve its purpose, there is a responsibility on the part of contractors to report conscientiously and candidly.

We are already in process of applying C/SSR to a project where it is badly needed. This project has a large number of rather small contracts—too small to make C/SCSC and CPR reasonable. We are expecting the C/SSR to give them a handle on cost and schedule status that up to now has been sadly lacking.

Although we are making progress, it seems appropriate to identify some of the areas requiring additional thought.

First, there is the question of overhead. We know that an awful lot of the dollars go into overhead. Is it controlled? Is it controlled well? Can it be measured? How? Getting a better handle on overhead can be a most profitable endeavor.

Second, design-to-cost is now to be reckoned with. Previously, the objective was to control development cost. The purpose of C/SCSC is to help keep development cost down but, with design-to-cost ceilings, it may be desirable to increase the development cost. Is C/SCSC then incompatible with design-to-cost? Can they coexist? Of what use is C/SCSC in the design-to-cost environment?

Third, OK, you have implemented C/SCSC. You are getting a lot of good valid data. You know the value of the work that is being accomplished, and how it compares with the actual cost. Now what? Are you getting full benefit from the data? How is it analyzed? What techniques do you use to forecast what is ahead. Do you derive useful information for better decision-making?

Fourth, can your management control system be improved? It may meet all the C/SCSC requirements, but this does not mean it cannot be improved. Have you overreacted to requirements? Are you doing more paperwork than necessary? Is there a better way?

Fifth, as a spin-off of this, are you able to show the "man who bends the iron," the bench engineer, how this discipline can help him? If you can convince this working engineer, our job will be considerably easier.

Sixth, we still struggle with the validity of the EAC (Estimated Cost at Completion). Is what we are getting valid? Are our contractors doing the type and caliber of planning that facilitates development of good EACs? Are our tools for analyzing costs and projecting the EAC adequate?

The question, "Why is C/SCSC of benefit to the Army?" may be answered in summary as follows:

- It forces detailed forward planning—the breakdown of the work, the scheduling, and the establishment of time-phased budgets.
- It gives an accurate and objective status of where we stand on the contract performance. This is important. It does not produce a subjective estimate. Rather, it compares the actual cost of the work performed to what it should have cost to accomplish the amount of work; it compares the value of the work accomplished to the value of the work that should have been accomplished.
- It permits us to get a cost impact of known problems and their cumulative effect in cost and time.
- It provides a means of tracing problems to their source—to the lower level hardware elements and organizational elements.

These are not all the benefits of C/SCSC, but they are considered to be the most important to me.

U.S. Army Research Institute . . .

Developing Agency for the Behavioral and Social Sciences

ARI, the Army's developing agency for the behavioral and social sciences, has recently reorganized and transferred as an operating field activity from the Office of the Chief of Research, Development and Acquisition to the Office of the Deputy Chief of Staff for Personnel, under the command of LTG B. T. Rogers.

ARI's laboratories, technical areas and field units are responsible for a yearly program of unusual scope and heterogeneity. Among its current responsibilities is the conduct of assessments of quantitative and qualitative manpower requirements and resources for personnel accessions and distribution.

ARI additional responsibilities include development of new systems for the training of the individual soldier, as well as realistic training at the unit level, and also conducts research projects in the universal aspects of Army life—motivation, morale, leadership—the values and quality of life of the American soldier. The program is rounded out with research on human factors, addressing the man-weapon problems of several Army systems.

The over-all ARI research program relates to current Army needs for a flexible combat capability and readiness, with additional emphasis upon the Army's future output capabilities. Lessons learned in the past are recognized as indeed important, but behavioral and social scientists realize that what has worked in the past may, or may not, work in the future.

ARI has a lively interest in the volunteer Army's ability to operate successfully in the current global military environment. Towards this end, ARI is dedicated to aiding the Army in becoming a force in readiness, with more than adequate combat capability, regardless of the contingency. This means that future requirements must be considered as a baseline, which with possible alternatives will ensure a much-needed flexibility within the constraints of the Army budget.

The research organizational structure of ARI under the leadership of COL Richard A. Rooth, commander and Dr. J. E. Uhlaner, technical director and chief psychologist of the Army, now includes two laboratories, six technical areas, and eight currently operational Field Units. A Fort Leavenworth (KS) Field Unit will be added Nov. 1, 1974, and a Fort Lee Field Unit is still in the planning stages.

The mission of all ARI field units is to execute assigned portions of the ARI work program in support of the over-all U.S. Army R&D program in the Behavioral and Social Sciences—stressing solutions to operational problems.

A recent Field Unit conference at ARI highlighted the new role expectations for field units. In addition to providing products for Army-wide implementation, new emphasis is to be placed on responsiveness to requirements in the field environment.

ARI Technical Advisory Services (TAS) are being extended to field commanders. TAS requirements of other Army organizations and posts may also be accommodated as the field units become fully manned. Additionally, the field units may be able to provide TAS to the requestor on his site.

Typical functions of the present ARI field units are listed below:

Fort Ord, CA	*—Research on performance-oriented training*
	—Literacy training
	—Training of low-ability personnel
	—Operator performance on night observation equipment
	—Support to the TRADOC Combat Development Experimentation Command (CDEC)
Fort Benning, GA	*—Support of US Army Infantry School Assessment center (research on leadership assessment, development, selection, and training)*
Korea	*—Liaison between ARI and Army Commands in Korea with Army's staff of social scientists in Korea.*
USAREUR	*—Assists all 6 ARI Technical Areas in identification of problems and the conduct of field research*
	—Training requirements, job satisfaction, morale, human factors
Fort Hood, TX	*—Human Factors field tests*
	—Support to Modern Army Selected System Test Evaluation and Review (MASSTER) group
	—Communications research
	—Target acquisition research
Fort Bliss, TX	*—Management skills*
	—Leadership at SGM Academy
	—Electronic Maintenance Simulation Research
Fort Knox, KY	*—Positive discipline coaching*
	—Performance Oriented Training in ATC
	—Performance Tests for Armor Crewman
Fort Rucker, AL	*—Aircrew performance and training*

ARI's two laboratories are: Individual Training and Performance Research (ITPRL), and Organizations and Systems Research (OSRL).

ITPRL addresses human resource needs and research problems of the individual soldier: the soldier's Army career; individual development through education and training; social indicators and processes of the Army as a social organization.

ITPRL's specific projects, conducted through three Technical Areas and its assigned field units, include research on entry screening instruments to determine individual abilities, aptitudes, and degree of motivation, as well as to predict potential discipline problems.

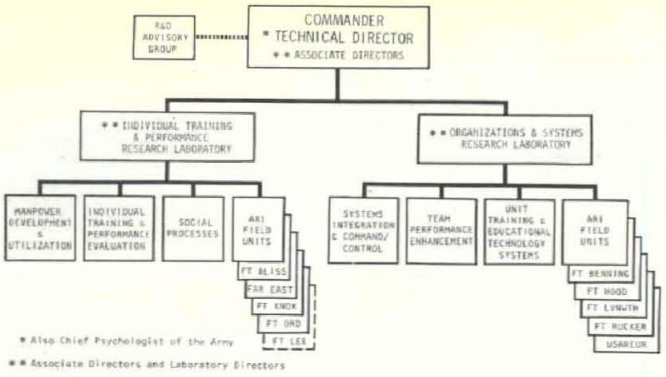
Active research in the area of assessment and training of the Army

DR. J. E. UHLANER, ARI technical director, has had a 27-year association with Army behavioral and social science R&D, including service as director of the Behavioral and Social Science Research Laboratory (forerunner of ARI). He is a former president of the Division of Military Psychology of the American Psychological Association.

COL RICHARD A. ROOTH, formerly director of MANRRDC, is assigned over-all management responsibilities for ARI. He has a master's degree in anthropology from the University of Minnesota and has 25 years of military experience including assignments as a battery commander and battalion commander.

DR. E. RALPH DUSEK, an ARI associate director, also heads the Individual Training and Performance Research Laboratory. He joined ARI in 1971 after serving more than 18 years with the Army Research Institute of Environmental Medicine and the U.S. Army Natick (MA) Laboratories.

DR. JOSEPH ZEIDNER, an associate director at ARI, is also director of the Organizations and Systems Research Laboratory. He has previously served in the Behavioral and Social Science Research Laboratory as director for Manned Systems Research and as chief of the Support Systems Research Division.



recruiter is of concern to ITPRL. Other prime interest areas include selection for appropriate training; effective placement; determination of motivational variables; effective job design; leadership training and performance; career progression, morale, and quality of life; drug abuse education; effects of social change on the soldier; and effective race relations programs.

OSRL also covers three broad areas, with the emphasis upon increased team effectiveness—research problems in the context of the soldier in the Army unit: increasing the unit's skills; maintenance and enhancement of unit proficiency in the field; integration of systems concepts—man/machine interface.

OSRL's specific projects—also conducted through three Technical Areas and field units—encompass the development of models for systems of unit training; surveillance systems; intelligence systems; command systems; measures of performance and standards; educational technology; organizational climate; and aircrew performance.

ARI Research and the Volunteer Army. Maintenance and operation of an effective combat-ready volunteer Army demands viable solutions to unique problems in a rapidly changing environment—over and above but including those formerly regarded as classical Army problems such as recruiting, selection, training and leadership.

Today's volunteer Army must face and resolve a broad spectrum of complex social problems, such as the proper employment of positive discipline, and appropriate utilization of a complicated mix of personnel at all levels.

The ARI research program is designed and continually updated to treat each aspect of that program as an integral part of the total Army personnel system. Morale, motivation, and job satisfaction, for example, are inexorably involved with selection, training technology, leadership, and the results of human factors evaluations.

ARI provides a clearly defined over-all behavioral and social science program that is sensitive and responsive to current Army requirements.

Research is involved from the time of the individual soldier's initial selection and entry into the Army, through training and education of various sorts, to job placement and evaluation, over-all assessment of quality of life, career development, human factors involved in employment and maintenance of equipment, and final input from individuals leaving the Army through retirement or end of enlistment.

Research in initial selection and classification of the volunteer soldier, with special regard to optimal placement, is under way at ARI. New forms of the Armed Forces Vocational Aptitude Battery (ASVAB), which the Army pioneered, are administered in high schools, and are a useful instrument for Army recruiters as well as civilian counselors.

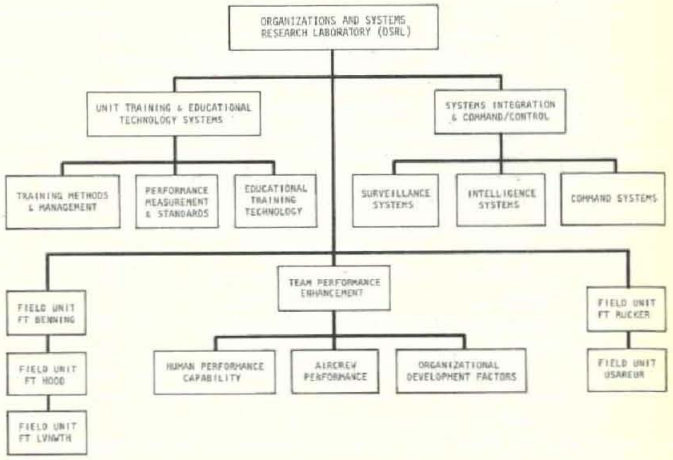
One technique now being developed maximizes career utilization of the individual through situational job classification, individual job training, on-the-job activities, and advanced training.

The total package includes the ARI-developed Army Classification Battery and the Aptitude Area system that provide measures of expected performance in job training. The over-all system helps to determine qualifications for enlistment and assignment to jobs, and provides indices of interest and motivation.

The new classification system has been shown to be equally effective as a measure of job potential for all ethnic groups, i.e., individuals with the same test score have the same expected level of job performance.

ARI research also realizes benefits in the utilization and retention of qualified women, and particularly in their qualification as greater numbers of them enter the volunteer Army. Instruments for evaluating male and female officers and ROTC members for assessing career development, and biographical inventories are being developed and tested.

ARI expertise has concentrated recently upon development of social indicators as a first step in detection, identification, and resolution of social problems related to morale, discipline, racial disharmony, social change, career planning, socialization and adjustment in the Army, prevention of drug abuse, and the soldier-family-community relationships.



One example (Figure 1) breaks down the social structural components of discipline.

Discipline is one of the many components of the general organizational health and welfare of concern to the Army. Trends in the components of discipline must be carefully studied to understand what is really taking place. This issue, among others, is directly related to the social indicator.

Measurement and improvement of the quality of life in the volunteer Army has become a vital issue. Methods of determination, and of progress in quality of life indices, involve surveys of organizational climate, Army-civilian relations, drug abuse and education programs, race relations education, and peer evaluations of opinions, attitudes and values.

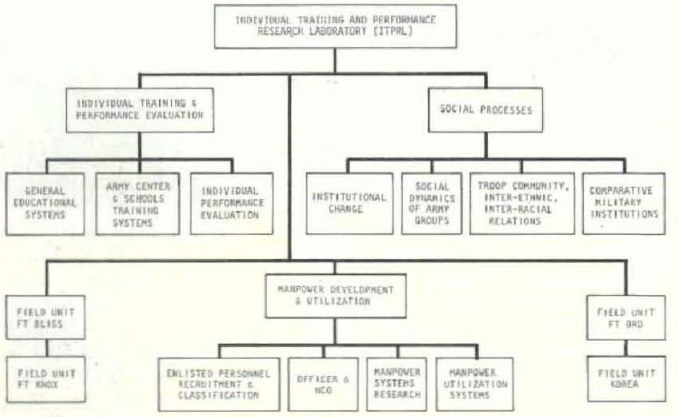
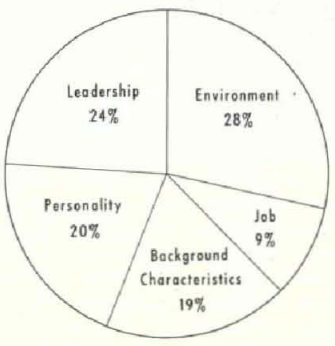


Figure 1
Social Structural Components of Discipline



(Continued on page 18)

U.S. Army Research Institute . . .

(Continued from page 17)

These techniques aid in setting realistic goals for evaluation of progress, and the presentation of clear options for policy-making in the volunteer Army.

ARI Research in Training. In keeping with the flexible readiness concept, ARI is researching and developing improved situational models to provide realistic, interesting and productive training.

One aspect of the training is called REALTRAIN I, which is a simple, inexpensive method for small-unit training in the maneuver arms (see *Army R&D Newsmagazine*, May–June 74). REALTRAIN II provides tactical training for tank crewmen.

In June 1974 a combined arms demonstration in Germany with USAREUR using REALTRAIN I & II was a resounding success—an example of the application of a number of principles of behavioral science. The soldiers plainly see that they are learning tactical skills; there are built-in elements of competition and credibility; one side wins and the other side loses.

The winning or losing is not based on luck or on the subjective judgment of an umpire, but upon the skill of the participating soldier. Telescopes mounted on rifles, tank weapons and antitank weapons are used to achieve and verify "hits," through identification of numbers on vehicles and on infantrymen's helmets.

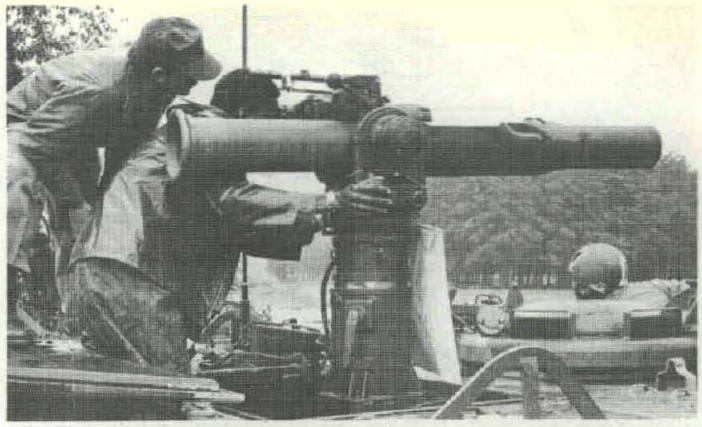
Behavioral science research application will also have a vital role in the future of Army aviation. One of the best countermeasures for coping with sophisticated antiaircraft offensive measures is nap-of-earth (NOE) flight using ground cover and concealment, much as battle-wise infantrymen do.

NOE flying demands complex training, new procedures, equipment, maps and other displays, along with all the support behavioral science research can provide. To help develop NOE capability for Army helicopters, a number of Army pilots have been tested in a series of simulated combat missions while flying at NOE.

The research program is focused upon NOE to define and improve instructional content, procedures and devices. The special skills needed in NOE flight warrant the new studies of student/pilot selection procedures and high-fidelity visual simulation techniques for training.

ARI Systems Research. Operating agencies in the Army are becoming increasingly aware of contributions, and potential contributions, of the behavioral and social sciences to Army operations levels and to Army policy at the higher levels.

Behavioral and social science ongoing research projects of ARI include computerized training systems, methods to increase the effectiveness of the Army command and control systems, enhancement of human sensory capabilities, and military intelligence gathering techniques, improved work environments, and better voice communications. All these efforts are involved in enhancement of the Army's flexibility and readiness. Army leaders are increasingly aware of these contributions, and they are placing research requirements for behavioral science in ever-expanding areas of application.



VERIFYING target hit by antitank weapon

ARI Publications. ARI scientists publish the final results of their work in two series of formal ARI publications—the Research Report, and the Technical Report. These are in addition to informal problem reviews, memorandums, and TAS reports designed to respond immediately to specific Army problems under ARI's purview.

The Research Reports describe comprehensive research studies or programs. Written in management language, they emphasize the operational problem and the research results as they offer some solution to the management problem, with a technical supplement that details the process used.

The Technical Reports present technical or research methodology or contributions to a body of knowledge resulting from the work program; they are an important tool for the trained research scientist, and are available through the Defense Documentation Center.

The following unclassified reports are representative of recent ARI products:

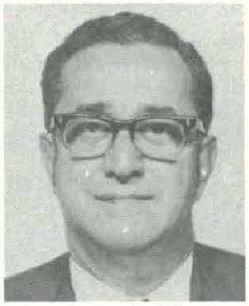
ARI Research Reports: *SIMPO-I general entity simulator (GES)*, by K. W. Haynam and S. A. Sachs (ARI) and A. Colker and J. S. Leib (CONSAD Research Corp. No. 1170; 1973. AD 767 249. Describes a computer model that simulates various Army manpower systems. *DISTRO II–Distribution rotation model*, by J. M. Witt. No. 1176; 1973. AD 760 485. Describes a model to simulate Army personnel distribution. *Development of a psychophysical photo quality measure*, by F. R. Clarke and R. I. Welch (Stanford Research Institute) and T. E. Jeffrey (ARI). No. 1178; 1974. AD 776 369. Identifies the most important factors affecting the interpretability of photo imagery. *Effectiveness of selection and classification testing*, by M. H. Maier and E. F. Fuchs. No. 1179; 1973. AD 768 168. Evaluates testing programs in terms of effective utilization of manpower. *Job requirements of G2 Air and image interpretation personnel*, by E. W. Youngling and R. A. Vecchiotti (McDonnell Douglas) and E. W. Bedarf and R. T. Root (ARI). No. 1181; 1974. AD 780 815.

NAP-OF-EARTH (NOE) flight, using ground cover for concealment, demands complex training, new procedures, equipment, maps and other displays, along with all the support behavioral science research can provide. A number of Army pilots have been tested in a series of simulated combat missions to help develop this capability for Army helicopters.

ARI laboratory leaders and field unit chiefs attending a recent Field Unit Conference include: Seated (from left) COL Ullrich Hermann, Fort Ord, CA; Dr. J. E. Uhlaner, ARI technical director; COL Richard A. Rooth, ARI commander; LTC Charles Moore, Far East, Korea. Standing (from left) Robert S. Andrews, ARI project director for Intelligence Systems; George Gividen, Fort Hood, TX; MAJ Peter Hixson, USAREUR R&D coordinator; Jack J. Sternberg, Fort Ord, CA; Dr. Douglas Holmes, USAREUR; Donald Kristiansen, senior research coordinator, Fort Knox, KY; Dr. Kay Smith, field technical chief, Fort Benning, GA; LTC W. G. Pratt, Fort Knox; LTC F. D. Lawler, Fort Bliss; LTC Robert Matheson, Fort Benning; LTC D. F. Youngpeter, Fort Rucker.

Environmental Quality Conference . . .

Reviews DoD Mission Requirements, R&D Programs



Dr. A. Louis Medin

Assistant Director for Environmental and Life Sciences Dr. A. Louis Medin, in the Office of the Director of Defense Research and Engineering, discussed "The Management of DoD Environmental Quality R&D Programs" at the recent DoD Interservice Environmental Quality Conference in Annapolis, MD. The major portion of his address follows:

The Department of Defense had been addressing the environmental field in many different R&D projects, but the real impetus came with the issuance of Public Law 91-190, the National Environmental Policy Act and Presidential Executive Orders 11507 and 11514 issued in early 1970.

In essence, the President's orders stated the need for federal agencies to comply with environmental legislation either in effect or forthcoming from Congress. This has been implemented by appropriate DoD and Military Department directives.

Directive 5100.50, recently revised, "the Protection and Enhancement of Environmental Quality," established the responsibilities within DoD as follows: The Assistant Secretary of Defense (Health and Environment) has the principal staff responsibility for administration. He in effect develops policy. The Assistant Secretary of Defense (Installations and Logistics) is responsible for planning, design, review, maintenance, and operation of facilities for the prevention and correction of environmental pollution.

The Director of Defense Research and Engineering, whom I represent, is responsible for identification, coordination, and direction of the research required to support the environmental quality program. The Secretaries of the Military Departments and the Director of the Defense Supply Agency are responsible for actual implementation programs, identification, development of corrective measures, and programing and budgeting to meet the identified needs.

This is probably enough time to spend on policy matters but it should indicate to you that DoD is, in fact, responsive to not only our military requirements and needs, but has developed policies around the national needs and goals in regard to environmental quality.

The DoD has quite a stake in maintenance of environmental quality since it is one of the largest landholders; we maintain about 800 military installations or bases worldwide.

The objective of our R&D programs is to provide the basic technology to enable DoD to assess the environmental impact of its operations and facilities, and to develop equipment that can meet both environmental quality criteria and military requirements.

The Office of the Director of Defense Research and Engineering has broad responsibilities. We must insure that the necessary R&D programs are developed and carried out to provide weapons systems necessary to preserve our national security posture. Our ancillary R&D programs must insure that these systems do not impact on the environment, during the test and evaluation, operations, or the ultimate disposal of an obsolete item or system.

Additionally, those R&D programs necessary to insure that our day-to-day operations and base activities do not cause environmental problems must be developed. In the latter area, we depend largely on civilian or other agencies for assistance.

In the DoD, we handle some materials and perform some operations and activities which are of little concern to the civilian community, such as explosives and propellants and large-scale film processing and electroplating. We do then have some problems unique to DoD which we must address and which will be covered during this meeting.

Within DoD, we have established general priorities to address the R&D problems. The prime priorities are aimed at developing solutions to either unique DoD environmental problems or to major facility or equipment problems for which there are no available commercial solutions. This is most important since the shutting down or curtailment of essential activities necessary to maintain our national defense posture can have serious consequences.

Other priorities include the development of data pertinent to DoD operations, to serve as a basis for standards or criteria where none exist—or where, based on inadequate data, the development of R&D programs is necessary to make present pollution abatement technology more timely and cost effective. We must also engage in R&D efforts in which DoD has a unique expertise or equipment to evaluate and extend the technology base.

I'm sure you are all interested in the magnitude of the DoD R&D program in environmental quality. This has been a rapidly emerging effort. We have performed many of these same efforts in the past. However, we associated them with a specific weapon system or installation as a part of the cost-effectiveness, public relations, public health, or military requirements programs.

Unfortunately, the DoD Environmental Quality R&D efforts in the past have been rather fragmented; they had low visibility, and were often generated in response to crisis situations. In terms of R&D programs or projects specifically termed environmental quality, in FY 71 only about $9 million could be identified. However, as implementation of the Public Laws and Executive Orders were undertaken, this rose to about $20 million in FY 72 and $26 million for FY 73.

Proposed expenditures for FY 74 and planned for FY 75 are $30.5 and $31.7 million, respectively. This does not include medically oriented; i.e., public health program areas; these are carried in the medical sciences budget. Comparably, some areas of environmental sciences, such as oceanographic or atmospheric efforts, are not included here.

To facilitate the management and coordination of this diverse effort, it was decided to use a management tool which has shown considerable value in the weapon system development area—the Area Coordinating Paper (ACP). This was begun just about two years ago here at the Naval Academy in a similar conference.

ACP No. 42, Environmental Quality, has now been completed and distributed to all DoD components. We in ODDR&E feel this is a significant accomplishment and has been one of the principal reasons this area of environmental quality has advanced in such an outstanding . . . manner.

The format of the ACP departs somewhat from the usual presentation of environmental material since our programs in DoD are generally mission-oriented. Therefore, we have chosen to address the environmental quality program in a selected group of six technology areas. These are: Aircraft, Vessels, Vehicles, Weapons, Facilities, and Special Programs. Within each of these are the necessary subsections to cover adequately the problem area.

Within each technology area the particular media concerned is addressed, such as air quality, water quality, land quality or noise effects. Each of these areas is related to the particular applicable standards, an evaluation of the present technology is made, and an investment strategy developed. These are then compared against the current R&D programs, and a supplemental R&D program is developed to meet the investment strategy, if this is required.

A major objective in DoD's research and development program is to eliminate unnecessary duplicative efforts and we have gone a long way. Long-range plans coordinated with the users to meet expected new standards are still required in all areas. This will allow the development of a stable program and a sound technology base to meet our rapidly changing military requirements as well as national goals and standards.

. . . Within the DoD, we constantly face a dilemma of competing with high-priority items. . . . The environmental researcher naturally insists that his programs are important and need additional funds to accomplish his objectives; yet, in all fairness, when attempting to prioritize the missions within the DoD, dollars invested in the environmental program often do little to improve weapon system capabilities. . . .

. . . It is for this obvious reason that we will continually stress cooperation between the Services, among Government agencies, soliciting the support of industry and universities and all those who can make any contribution to the environmental programs needed to meet the DoD requirements. . . .

. . . It is the job of every researcher within the DoD organization to be aware and to recognize the spin-off benefits that can occur from the many military environmental R&D programs. It is the job of the researcher to make known to other Government agencies, to the scientific community, and whoever he thinks will take this information and utilize it for the benefit of the nation and the world.

In return, it is a job of the military researcher to research the literature, to keep in close communications with the other Government agencies, the scientific body, to obtain information on work that they have done, or are doing, and capitalize on this work in meeting our military mission requirements. . . .

ASA (R&D) Initiates Awards Program . . .
Concept Requires Annual Evaluation of Army In-House Labs

Assistant Secretary of the Army (R&D) Norman R. Augustine has initiated a program of annual evaluation of all Army in-house laboratories, climaxed by presentation of two high honors—Army Laboratory of the Year Award (ALYA), and Army Special Award for Accomplishment (ASAA).

Nominations submitted by the U.S. Army Materiel Command, the Office of the Surgeon General, the Office of the Chief of Engineers, and the Office of the Deputy Chief of Staff for Personnel are being considered by an ASA (R&D) committee. Announcement of Army-wide winners is expected late in November.

The performance of each Army R&D Laboratory is judged on contributions within mission assignments to the Army's capability and readiness during the previous year.

The criteria for evaluation of the "best" laboratory is the degree to which each laboratory realizes its full potential impact in enhancing the capability of our operational forces, based on work accomplished under cognizance of the laboratory in the prior year.

The ASAA will go to the laboratory recognized for the "greatest improvement during the previous year."

The U.S. Army Night Vision Laboratories (NVL) at Fort Belvoir, VA, a major activity of the U.S. Army Electronics Command (ECOM) headquartered at Fort Monmouth, NJ, is the Army Materiel Command's nominee for the ALYA.

The Army Air Mobility R&D Laboratory (AAMRDL), AMC's primary source of expertise on aircraft aeronautics, and the principal Department of Defense agency for small gas-turbine technology, was nominated for the ASAA.

The NVL was selected from among 21 AMC laboratories "by virtue of having developed from earliest inception the technologies basic to observation and enhancement of restricted or infrared background light."

The citation further credits the NVL for having achieved international acclaim and recognition as the leader in the field; and for successfully delivering to the Army, on a timely basis, prototype and production elements for systems requiring operation under limited visibility conditions. The justification adds:

"This nomination is based on this laboratory's outstanding performance in meeting Army needs as well as recognition by the entire Department of Defense, industrial community and the technical community of the world as one of the leaders, if not the leader, as a technical center of excellence for research and engineering of night vision technology and devices.

"This laboratory has done an outstanding job during the year as the Army's lead laboratory in its area. It has been recognized for such acts by the Joint Logistics Commanders (JLC) giving it the lead in developing a joint position for the JLC on the Department of Defense program for FLEERS. In recent months it has been nominated by the Joint Directors of Laboratories as the lead coordinating laboratory for the three services in night vision technology.

"Throughout the year this laboratory has successfully carried out its assignments in a timely manner in providing prototypes and preproduction devices to meet Army urgent requirements existing for night vision equipment. This includes DRAGON and TOW. It also carried out in a workmanlike manner the responsibility to come up with a common IR module for all night vision devices. At the same time it has maintained a strong program on new technologies and has been alert to changing its position on a timely basis to incorporate new breakthrough or technological developments into the recommendations for future programs. . . .

The laboratory has done a creditable job on engineering development assignments, while at the same time continuing to maintain a strong program for developing next generation light amplifiers and IR imagery systems with high reliability and reduced cost of future night vision equipment. . . ."

The AAMRDL was cited for gaining international recognition as an outstanding organization during the past year, with "unquestionable expertise in the areas of helicopter technology and operations." The laboratory also was instrumental in the successful implementation of the development of three new Army helicopter programs.

Headquartered at the NASA-Ames Research Center, Moffett Field, CA, where its nucleus was formed in 1965, leading to the present organization's creation late in 1970, the USAAMRDL consists of the Ames Directorate, the Eustis Directorate at Fort Eustis, VA, the Langley Directorate at Langley Research Center, Hampton, VA, and the Lewis Research Center, Cleveland, OH, and the Ames Directorate, Ames Research Center. Each of the latter three directorates is collocated with a NASA Research Center and programs are conducted jointly in a unique arrangement.

The AMC nominations were made by an ad-hoc Laboratory Awards Selection Committee (LASC) comprised of AMC Deputy for Laboratories Dr. Robert B. Dillaway, chairman; BG Harry A. Griffith, RD&E director; William S. Charin, deputy director, Personnel Training and Force Development; and Sally Clements, assistant chief, Office of Project Management.

ASA (R&D) Augustine stated a threefold purpose for initiating the new awards:

- To create a means of routinely critiquing and ranking each of our R&D laboratories.
- To provide a consecutive atmosphere in which the assessment can be accomplished so that a beneficial effect can be realized in terms of continually upgrading the Army's scientific and technical capability.
- To recognize quality performance.

Augustine will present the Army Laboratory of the Year Award and the Army Special Award for Accomplishment to each laboratory so recognized. In addition to the two new awards, the top "one-fifth of the laboratories in each command" (AMC, OCE, TSG, DCSPER) will receive an Award for Excellence presented by their commanders.

The AMC Plan detailing 15 criteria for selection of the winners in the various categories was prepared by an ad hoc committee headed by Joseph Lindwarm, AMC Offiice of Deputy for Laboratories. Members were Dr. Hamed M. El-Bisi, chief, Research Division; Robert VanBriggle, chief, Command Management Review and Analysis Branch, Comptroller; and LTC Orbun F. Qualls, Office of Project Management.

OTSG Nominations. The Office of the Surgeon General's nomination for the Army Laboratory of the Year is the U.S. Army Institute of Surgical Research (USAISR), Fort Sam Houston, TX, and its choice for the Army Special Award for Accomplishment is the U.S. Army Aeromedical Research Laboratory (USAARL), Fort Rucker, AL.

The justification for nomination of the USAISR states, in part, that it is "the foremost clinical research and treatment facility for burns in the United States. As such, it is commonly referred to as the 'Army Burn Center.'"

During CY 1973, the institute admitted 261 patients. Previously developed therapeutic modalities developed at the institute over the past several years were maintained. In addition, newer modalities were instituted and evaluated, i.e., fiberoptic endoscopy to evaluate gastrointestinal pathology of the early post-burn patient; fiberoptic bronchoscopy to better define the spectrum of acute inhalation injury; improved function measurement procedures; and improved evaluation procedures on the metabolic responses of the post-burn patient.

The institute, as in previous years, was involved in education and training of many military and civilian personnel, not only at the institute but also in the national and international medical communities. This effort was carried out by multiple presentations, publications and participation at professional meetings, as well as in-house training of house officers, staff and foreign physicians, and paramedical personnel by the staff of the USAISR.

The depth and scope of the research and development activities of the USAISR was attested by 166 technical presentations during the past year to a broad spectrum of the medical community, including classes for paramedical personnel and international meetings of clinical research relating to treatment of burn wounds.

A few indicative random selections are: *Pruit, B. A. Jr.,* Resuscitation and Hemodynamic Changes Following Burn Injury, Sixth Annual Symposium of Plastic Surgery, Jan. 17-19, Washington, DC; *Agee, R. N.,* The Treatment of Burns, Officer Basic Course, Academy of the Health Sciences, Brooke Army Medical Center, Fort Sam Houston, TX, Jan. 31; *Lang, J. M. III,* Techniques of Parenteral Hyperalimentation, Annual Meeting of Brooklyn Surgical Society, St. Albans Naval Hospital, NY, Feb. 1; *Hood, B. A. Jr.,* (1) Use of Physiologic Dressing; (2) Electrical Burns, Management of the Burn Patient Course, Department of Surgery, Washington University, and Hartford Burn Unit, Barnes Hospital, St. Louis, MO, Feb. 16–17.

Other criteria used for nominating the USAISR for the Army Laboratory of the Year Award included 48 publications in pro-

fessional society periodicals and journals; also, the presentation of a film titled Management of Upper Extremity Burns. The film was shown at the American College of Surgeons Annual Meeting in Chicago, Oct. 15–19, and at the American Society of Plastic and Reconstructive Surgeons Meeting, Hollywood, CA, Oct. 21–26.

Corps of Engineers. In the justification for nomination of the U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH, for the Army Laboratory of the Year Award, the Corps of Engineers explained: (1) CRREL is not a materiel development agency and this criterion (used for evaluating AMC laboratories is not applicable; (2) that the Corps also has laboratories which could not be considered since they are concerned primarily with R&D for the billion dollar (annual approximation) Civil Works Program.

Much of the justification of CRREL was devoted to the application of new technical knowledge to requirements for construction in Alaska and other cold regions. Thirteen inputs were made to specifications and manuals for design of permanent Army facilities.

Specifications also were prepared for sewage outfall facilities, roads and streets, foundations for structures, protective membrane roofs, and design of maintenance hangars and various utility systems. All of this technology contributed to improvements in construction methods in areas subject to detrimental effects of cold temperatures.

Input also was provided to the National Research Council for a Permafrost Engineering Manual, and for a field manual on mountain operations, prepared for the commander of the U.S. Army, Alaska.

CRREL scientists and engineers authored and presented 30 technical papers dealing with a broad spectrum of subjects at meetings of national and international professional societies. Two randomly selected subjects, dealing with both the basic and applied research aspects of the laboratory program, are: Water-Ice Phase Composition, Clay-Water Systems, presented at the Soil Science Society of America conference; Controlled Release of Avalanches by Explosives, presented at the Symposium on Advances in North American Avalanche Technology.

CRREL's professional staff had 45 articles published in professional journals and periodicals during the period covered for the Army Laboratory of the Year Award consideration.

Three of the papers, selected at random by an *Army R&D Newsmagazine* writer as representative of the variety of the CRREL research program, are: Capillary Effects on Water Percolation on Homogenous Flow, published in the Journal of Glaciology; Stability of Floating Ice Blocks, published in the Journal of the Hydraulic Division, American Society of Civil Engineers; Air-Cushioned Vehicles: Key to the Alaskan Transportation System? Journal of High-Speed Transportation.

Under the award criteria heading of Training Programs in Support of Technology Transfer, CRREL conducted two notably successful sessions. About 350 professional personnel participated in training on remote sensing at Houston, TX, and a Waste Water Management Work Shop was held at CRREL.

CERL NOMINATION. The Construction Engineering Research Laboratory at Champaign, IL, established five years ago, is the Corps of Engineers' nominee for the Army Special Award for Accomplishment.

Featured in a front cover picture and centerspread article in the May-June 1973 edition of the *Army Research and Development Newsmagazine*, CERL has a mission of developing what is termed a "total systems approach" to strengthen the Corps' over-all military and civil works construction program.

CERL is not a materiel (weaponry) development agency but is very deeply involved in R&D to advance the technology of new materials and design for construction.

During the period considered for the ASAA, the laboratory made seven "important inputs" to specifications and manuals for design and construction of permanent Army facilities. Included were specifications for alternate materials for waterproofing, foundation walls, ultrasonic inspection of weldments, and road design parameters.

CERL also developed 15 computer programs in support of construction design and management, such as: generating progress reports in the field; evaluation of architectural requirements of new military facilities; automated equipment maintenance schedules for facilities engineers; evaluating alternatives for electrical power generation systems; environmental impact assessments and statements for all Army programs.

Thirteen technical papers authored and presented by CERL personnel at national and international scientific and engineering professional societies addressed problems in management and construction technology. One of these, Numerical Solution of Three-Dimensional Elasticity, was given at the 1974 biennial Army Science Conference at the U.S. Military Academy.

CERL also conducted seven technical training programs, including a building procurement work shop, environmental work shops in Champaign and in Germany, and two corrosion mitigation courses at CERL.

Deputy Chief of Staff, Personnel. Until May, 20, 1974, the Office of the Deputy Chief of Staff for Personnel had no laboratories. On that date, the Army Research Institute for the Behavioral and Social Sciences was transferred from the Office of the Chief of Research and Development (which simultaneously added *Acquisition* to its name) to the ODCSPER.

Established Oct. 1, 1972, from the nucleus of what was formerly the Behavioral and Social Research Laboratory (BESRL), the ARI is now a fast-moving and growing organization concerned with volunteer Army problems.

ARI is the ODCSPER nomination for the Army Laboratory of the Year Award, and also for the Army Special Award for Accomplishment. The citation accompanying the justification for these awards states:

The U.S. Army Research Institute for Behavioral and Social Sciences (ARI) is cited for EXCELLENCE for FY 1974. During that period, ARI engaged in research and development in support of the Army's manpower procurement program, personnel management program, training and education program, and human factors program for systems and organization.

In each of these vital areas, successes were attained which materially advanced the manpower and operational readiness goals of the Army. A new Army Classification Battery was developed which permits more accurate classification and assignment of newly enlisted personnel. A Racial Perceptions Inventory was validated which will permit, for the first time, measurement of the racial climate at installation level.

SCOPES, a new training technique, was developed for the Training and Doctrine Command (TRADOC). This imparts a realism to small unit infantry and armor tactical field exercises never before realized, and permits evaluating objectively the performance of those units. A Five-Year Plan was developed which totally delineates and coordinates the requirements among all agencies for behavioral research to enhance Army aviation operations.

The cited accomplishments are representative, but not at all inclusive, of the many advances and achievements of ARI . . ..

Reader's Guide . . .

Combat Arms MOSs Detailed in HumRRO Publication

Task inventories and job data for eight key combat arms Military Occupational Specialties (MOSs) are detailed in a recent publication issued by the Human Resources Research Organization (HumRRO).

Technical Report 74-12, *Systems Engineering of Training for Eight Combat Arms MOSs*, is an attempt to identify common and noncommon features among combat skill levels as a basis for improving Army training.

Research for this report was obtained through a joint effort between the U.S. Army Infantry School, U.S. Army Armor School, U.S. Army Field Artillery School, U.S. Army Air Defense School, Combat Arms Training Board and HumRRO Work Unit CATB.

DA Publishes 9 of 23 Scheduled 'Vietnam Studies'

Nine of 23 scheduled "Vietnam Studies" monographs have been published by the Department of the Army for distribution to Active Duty and Reserve troop units through battalion level.

The monographs are interim historical accounts by senior officers who served in a variety of Vietnam assignments. Titles are *Airmobility, 1961-71; Base Development in South Vietnam, 1965-70; Command and Control, 1950-69; Logistical Support in Vietnam; Medical Support, 1965-70; Riverine Operations, 1966-69; U.S. Army Engineers, 1965-70; U.S. Army Special Forces, 1961-71;* and *Communications-Electronics, 1962-70.*

During the next few months additional monographs will be published on artillery, financial management, Judge Advocate General activities, and Operations CEDAR FALLS and JUNCTION CITY. Other announced publications will include: *Intelligence; Defeat of the Tet Offensive;* and *The U.S. Army's Role in Pacification.*

All monographs published to date may be purchased from the U.S. Government Printing Office, Washington, DC.

Conferences & Symposia . . .

Army Sponsors Technical Information Analysis Centers Review

Functions, ongoing or projected programs, problem areas, achievements and operational procedures of Department of Defense, Army-operated Technical Information Analysis Centers—in support of research and development—were reviewed at a recent Army-sponsored TIAC annual meeting.

The Army Engineer Waterways Experiment Station, Vicksburg, MS, was host to the 3-day meeting of about 40 representatives of Department of Defense and other federal agencies, including directors and key personnel of the TIACs for which the Army is responsible. The Army operates eight and monitors four contractor-operated centers out of the DoD total of 20.

Army TIAC project officer Walter Galson, representing the Technical Data and Standardization Management Branch, Engineering Division, RD&E Directorate, HQ U.S. Army Materiel Command, opened the conference. He said the purpose was to review TIAC activities and achievements and to discuss major problems associated with center operations and services.

Despite the impact of manpower and funding shortages, Galson expressed optimism regarding the TIAC concept, saying:

"TIACs are probably the best and most efficient institutional mechanisms for helping the scientist and engineer locate the information relevant to their needs. The timely availability of packaged, *evaluated* information is the most important benefit that can be gained from a viable and well-managed Information Analysis Center."

Galson explained that TIACs "select, accumulate, organize and evaluate data in special subject areas and pass them on rapidly and effectively, in concentrated form, to the Defense R&D community and its contractors. TIACs attempt to provide solutions to RDT&E problems rather than simply furnish scientific and technical information on specific subjects, as do the libraries and conventional information centers and systems."

The Army TIAC project, he noted, was established in 1968 under the monitorship of the Chief of Research and Development but has since been transferred to the Army Materiel Command (early in 1973).

The project objective is to: "Support and strengthen the information services of existing DoD TIACs operated by the DA and to provide 'seed money' for the establishment of new centers in critical defense areas of specialization."

Galson said that there are about 115 federally sponsored information analysis centers in the U.S., specializing in technical and nontechnical fields.

Approval is pending for the formal establishment of an Army-operated TIAC on explosives at Picatinny Arsenal, Dover, NJ. Consideration also is being given to establishing a TIAC dealing with Environmental Effects on Materiel at the U.S. Army Engineer Topographic Laboratories, Fort Belvoir, VA.

"Information activities of the TIAC project," Galson said, "are closely associated and coordinated with the Information Technology Development (ITD) and Improved Data Effectiveness and Availability (IDEA) projects. All are designed to provide continued improvement of scientific, technical and management activities required for general support of the Army RDT&E Program."

PARTICIPANTS IN TIACs ANNUAL REVIEW meeting included (front row, l. to r.) LTC R. K. Hughes, deputy director, Army Engineer Waterways Experiment Station (WES); Sam Valencia, Army Mechanics and Material Research Center (AMMRC); C. B. Vickery, Defense Nuclear Agency; Hubert E. Sauter, Defense Documentation Center (DDC); Margrett Zenich, Office, Chief of Engineers; Spence Marks, Office, Chief of Research, Development and Acquisition; Paul Taccarino, WES; Walter Galson, Army Materiel Command (AMC); Ed Hargis, AMC; Charles P. Merhib, AMMRC. Back row: Samuel Helf, Picatinny Arsenal; Joe Blue, Defense Supply Agency; Bryant Mather, director, Concrete Technology Analysis Center, WES; Marie Spivey, WES; Randall Bergmann, Army Foreign Science and Technology Center; William Thompson, DDC; Charles DeVore, Naval Materiel Command; George Darcy, AMMRC; Seymour M. Kaye, Picatinny Arsenal; Fred Brown, technical director, WES; William C. Robison, Army Engineer Topographic Laboratories; and Dr. C. G. Gardner, Non-Destructive Testing Data Support Center.

Galson remarked that the tightening of the Defense budget has impacted on the centers operating budgets and has made it increasingly difficult for commands who sponsor such centers to fully fund their services. . . .

Referring to the application of service charges to TIAC users, Galson doubted that in many cases they would be sufficient to support appreciably the activities of the TIACs. He said that only a portion of the cost of maintaining a center can be passed on to the retail customer, adding:

"It is unrealistic to assume that the Army's TIACs can continue to exist unless positive steps are taken to find for them—at least for the next few years—considerable sustaining operational support. Funding remains the most pressing and probably the most complex problem associated with the TIACs."

Quoting Dr. Henry Pusey, director of the Navy's Shock and Vibration Analysis Center, Galson said: "In view of the impending reduction of R&D dollars, it becomes increasingly important to use the fruits of research in the most efficient possible way, by seeking the broadest application of newly developed materials and techniques. As I see it, TIACs play an important part in attaining this goal."

Posture reports summarizing responsibilities and achievements of the eight Army-operated TIACs were presented the remainder of the first day's session. These included:

• *Coastal Engineering Information Analysis Center (CEIAC), Coastal Engineering Research Center (CERC), Fort Belvoir, VA.* Directed by Barry R. Sims, the CEIAC is assigned responsibilities for collection, analysis and dissemination of information on coastal engineering research and technology. Services include publication of annotated bibliographies, reports and library and consultation services.

Sims reported that during FY74 the CEIAC continued cataloging the CERC photographic slide file, gathered input to the CERC Coastal Imagery Data Bank and initiated a contract for publication of a "Thesaurus of Coastal Engineering Terms." Primary obstacles were personnel and funding limitations.

• *Cold Regions Science and Technology Information Analysis Center, U.S. Army Cold Regions Research Engineering Laboratory (CRREL), Hanover, NH.* The primary efforts of this TIAC are to collect and distribute all available data pertaining to cold regions science and technology.

Wesley Pietkiewicz, director of the center, reported that 2,000 inquiries for information and data were processed during FY74. Volume 28 of the CRREL bibliography and a computer index of the previous five years of technical literature also were published.

• *Concrete Technology Information Analysis Center (CTIAC), U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS.* Directed by Bryant Mather, this center's objective is to collect and analyze all data relating to concrete materials, properties, construction methods and concrete composition.

Mather announced that 11 CTIAC reports were completed during FY74. Reports on Georgia highway bridge cores and a new method of analysis of hardened concrete are now under preparation.

• *Hydraulic Engineering Information Analysis Center (HEIAC), WES, Vicksburg, MS.* Directed by Ellis B. Pickett, the HEIAC is assigned responsibilities for all information pertaining to river, harbor and tidal hydraulics, flood control, water waves, under water shock effects and related topics.

HEIAC representative Dr. Frank Neilson described the interplay between the center and the hydraulic engineering community during FY74. He also outlined projected programs for FY75.

• *Nondestructive Testing Information Analysis Center (NTIAC), U.S. Army Materials and Mechanics Research Center, Watertown, MA.* NTIAC is designed to collect, store, maintain, retrieve and disseminate information in the field of nondestructive testing of materials and structures. Services and prod-

ucts of the center are being augmented by a contract with Southwest Research Institute, which operates the Nondestructive Testing Data Support Center in San Antonio, TX.

Charles P. Merhib, director of the NTIAC, reported that more than 270 inquiries for technical assistance were received from government agencies, corporations and institutes during FY74. A contract is also under way to consolidate the NDT data base of the Navy into the NTIAC.

• *Pavements and Soil Trafficability Information Analysis Center (PSTIAC), WES, Vicksburg, MS.* Efforts of this center are related to information on soil mechanics, expedient surfacing, flexible and rigid pavements, surface vehicle mobility research, ground flotation and terrain evaluation research.

Marvin P. Meyer, PSTIAC director, emphasized in his briefing that the development of a PSTIAC microthesaurus is one of the high-priority items of the center. It is now in final draft format and will hopefully be published and distributed during the coming fiscal year. Other key projects during FY74 were the establishment of an automated data bank and a computer program for data storage and retrieval.

• *Plastics Technical Evaluation Center (PLASTEC), Picatinny Arsenal, Dover, NJ.* PLASTEC is tasked with collecting, developing and evaluating technical data on plastics, adhesives and organic-matrix composites.

Fred Anzalone, acting chief of PLASTEC, reported that the income for FY74 was approximately $600,000, of which $450,000 went directly into PLASTEC operations and contracts for information services. Most of this income came from Army funding although some was from the Navy and the Air Force.

Anzalone also said that the Standardization Program attracted wider interest at the DoD level and that plans for the coming year will provide the PLASTEC staff with its greatest challenge to date.

• *Soil Mechanics Information Analysis Center (SMIAC), WES, Vicksburg, MS.* Directed by R. W. Cunny, SMIAC has an assigned mission of processing information regarding soil mechanics, soil physics, engineering geology, earthquake engineering, and embankment and foundation engineering. Achievements have included publication of a *Microthesaurus of Soil Mechanics Terms.*

Samuel Helf reported on the proposed Explosive Information and Analysis Center (EXIAC), scheduled for establishment early in 1975 at the Feltman Research Laboratory, Picatinny Arsenal, Dover, NJ.

EXIAC's scope of activities will encompass publication of the *Encyclopedia of Explosives and Related Items;* publish state-of-the-art reviews and analyses and organize conferences on specific subjects of current critical interest in the field of energetic materials technology; publish and update handbooks and manuals on explosives.

Planned also is coordination with other DoD laboratories active in energetic materials R&D, and establishment of a DoD-based editorial advisory board.

During the second day of the TIAC, review discussion focused on specific steps to support the TIAC operation, including user charges and cost recovery; utility of the computerized interactive DoD on-line system; establishment of guidelines to measure cost effectiveness; better advertising and marketing techniques; and the role of National Technical Information Service (NTIS).

Hugh Sauter, DDC administrator, discussed the need for greater interface between the DDC and the TIACs. He emphasized the need for increased networking with other non-DoD data banks and for better exploitation of the TIAC data bases. He also reviewed DDC's long-range plans, including the acquisition of other automated data bases and improved techniques for inputting and dispersing of data.

Fred Anzalone, acting chief of PLASTEC, recommended that small ad hoc groups be established as a means of dealing with specific problem areas related to TIAC operations. TIAC review participants supported this suggestion and agreed that formal project reviews would then be required only at 12- to 18-month intervals.

Technical Papers Requested For 1975 Frequency Symposium

A call for papers proposed for presentation at the 29th Annual Frequency Control Symposium, May 28–30, 1975, at Atlantic City, NJ, has been issued by the U.S. Army Electronics Command.

Recognized as the only international meeting devoted to frequency control and precision timekeeping, the symposium is attended by more than 600 representatives from industry, universities, and government laboratories from all parts of the Free World.

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

Filters, quartz crystal oscillators and frequency control circuitry, atomic and molecular frequency standards, laser frequency standards, frequency and time coordination and distribution, radio and systems applications of frequency control devices, specifications and measurements.

Deadline for submission of summaries is Jan. 15, 1975. Twenty (20) copies of a summary in sufficient detail for evaluation (at least 500 words) together with the author's name, address and telephone number should be sent to the Commander, U.S. Army Electronics Command, ATTN: AMSEL-TL-MF, Fort Monmouth, NJ 07703.

Authors will be notified of acceptance of papers by Feb. 28, 1975. Accepted papers will be published in the Proceedings of the 29th Annual Frequency Control Symposium. Photo-ready manuscripts are required by 5/30/75.

NLABS Contribute to Food Encyclopedia Publication

Encyclopedia of Food Technology, a comprehensive single volume expected off the press for sale late in November, will contain chapters authored by 10 food experts on the staff of the U.S. Army Natick (MA) Laboratories.

The NLABS have management responsibility for the Department of Defense Food Research, Development, Test and Evaluation Program. The encyclopedia is being issued by AVI Publishing Co., Inc., Westport, CT.

Dr. F. P. Mehrlich, director of the Food Engineering Laboratory, reports on extensive studies undertaken to determine what servicemen really like and dislike on daily menus. His findings indicate that milk, orange juice and grilled steak are the most demanded food items on the military menu; pickled beet/onion salad, parsnips, and zucchini squash are lowest on the totem pole of food dislikes.

Dr. Edward E. Anderson, special assistant to the NLABS commander, for the DoD Food Program, provides a detailed account of the latest developments and extended areas of food research.

Dr. Edward S. Josephson, deputy technical director, Food Service Systems Program, covers the history, accomplishments and current status of the food radiation program at Natick. He reports on worldwide approvals given for the processing and consumption of radiated foods at designated test sites.

Freeze-drying and microwave processing, of great importance for military food logistics, are described by Dr. Maxwell Brockmann and Dr. Robert V. Decareau, who have contributed to development of both processes.

Fabrication of foods from agricultural sources, such as meatlike foods from soybeans, is described by Dr. Abdul R. Rahman who oversees much of the NLABS research in this area.

Two chapters of the encyclopedia are devoted to research and development of space foods for astronauts. John Swift, who designed the NLABS "Clean Room," describes a virtually sterile environment for processing foods—minimizing the effect of airborne contamination on special purpose foods. Ms. Mary Klicka describes the science and technology required to develop the advanced space foods.

Dr. J. Walter Giffee, chief, Physical Sciences Division, Food Sciences Laboratory, contributes an article on ion exchange, the most widely used technique for separating amine acids in protein hydrolysates and for freeing water from special minerals. Ms. Miriam Thomas reports on the latest research on vitamins.

Editors of the *Encyclopedia of Food Technology* are Arnold H. Johnson and Martin S. Peterson.

CENTO Delegates Consider Military Medical Programs

Doctors from the Armed Forces of Iran, Pakistan, Turkey, United Kingdom and the United States recently met to discuss health care programs and treatment procedures at Central Treaty Organization's (CENTO) 13th Military Medical Conference at the Academy of Health Sciences, Fort Sam Houston, TX.

Medical papers were presented on such subjects as cardiovascular disease in the Armed Forces, current treatment of extensive thermal injury, decompression sickness, military progress in hoof and mouth disease, science and the physicians art, and the prevention of peridontal disease and dental caries.

MG Spurgeon Neel, commander of the U.S. Army Health Services Command, was host delegate to individual delegations headed by MG Mohammed Guran of Iran, MG Malik Shaukat Hasan of Pakistan, MG Saim Bostancioglu of Turkey, and LTG Sir James Baird of the United Kingdom. Other official delegates included observers from NATO.

NLABS, R&D Associates Discuss Food Research

Representatives of the military, industrial and academic scientific community considered "Streamlining Food, Packaging and Equipment Systems" at an Oct. 16–17 conference at the U.S. Army Natick (MA) Laboratories.

About 250 participants listened to presentations by outstanding authorities in food preparation, preservation and packaging technology, with emphasis on recent advances in the state-of-the-art. Cosponsors of the meeting were the R&D Associates for Military Food and Packaging, Inc., a nonprofit organization, and NLABS.

Management of the Department of Defense Food Research, Development, Test and Engineering Program has been an assigned responsibility of NLABS since Oct. 24, 1969.

Assistant Secretary of Defense for Installations and Logistics Arthur I. Mendolia, the keynoter, spoke on "Streamlining Military Food Service Systems," following opening remarks by COL Rufus E. Lester Jr., NLABS commander.

Dr. Dale H. Sieling, NLABS technical director, moderated one of the major discussion sessions, "Military Research Requirements." Session two, moderated by R. J. Campbell NLABS, was devoted to a review of "Advancements in Food Service Equipment."

Other session topics and moderators included: "Energy Conservation Measures," Dr. Edward E. Anderson, special assistant for the DoD Food Program, NLABS; "What is New at U.S. Army Natick Laboratories," Dr. Edward S. Josephson, deputy technical director, Food Service Programs, NLABS; and "Food Packaging," Dr. Edward A. Nebesky, chief, Food Packaging Division, Food Engineering Lab, NLABS.

Introduction of dignitaries included Charles A. Hinman, an executive of Quaker Oats Co., and Bruce A. Lister of Nestle Co., chairman and vice chairman respectively of R&DA. Closing remarks were made by V. K. Babayan, Stokely-Van Camp, Inc., R&DA president.

Among prominent speakers from other than military or industrial organizations were Dr. Sylvan H. Wittwer, director, Michigan Agricultural Experiment Station, Michigan State University, "Impact of Energy Restrictions on Agricultural Production," and Dale L. Anderson, Agricultural Research Service, U.S. Department of Agriculture, "Effect of Energy Supplies on Transport and Distribution of Agricultural Products."

Industrial speakers included: Robert W. Hockenbury, Campbell Soup Co., "Energy Conservation by Food Processors"; Dr. George G. Maltenfort, technical director, Container Corp. of America, "Recent Development of Voluntary Standards and Recommended Practices in Corrugated Shipping Containers"; S. A. Mencacci, FMC Corp., "Equipment Systems for Sterilizable Pouches" U.S. Army, Europe and Japan."

W. Page Andrews, director, Packaging Research Laboratory, Reynolds Metals Co., spoke on "The Successful Story of Flexpack Worldwide Use."

U.S. Army, Air Force, Navy and Marine Corps staff members for the Department of Defense Food Research, Development, Test and Engineering Program discussed special needs of these services.

QWG/CD Members to Review Operational Concepts

MG H. E. Hallgren

MG R. G. Gard Jr.

Members of the Quadripartite Working Group on Combat Development (QWG/CD), representative of the American, British, Canadian and Australian Armies, will convene for their 16th meeting at Fort Ord, CA, Nov. 21–28.

Sponsored by the U.S. Army Concepts Analysis Agency commanded by MG H. E. Hallgren, and hosted by the U.S. Army Training Center at Fort Ord, commanded by MG R. G. Gard Jr., the meeting will be chaired by COL Claire J. Reeder, U.S. Army Materiel Command. MG Hallgren will present the keynote address.

Primary objectives of the QWG/CD are to develop, produce and review the ABCA Armies' long-range operational concepts (15–20 years) as directed by the WSO; develop Quadripartite Objectives (QOs) arising from the Concepts; and to consider and make recommendations on related matters of WSO concern.

The projected ABCA Operational Concept covers the 1986–95 time frame and is scheduled for completion by Jan. 1, 1976. The ABCA Operational Concept 1986–95 consists of an introduction and three sections. The first section chapters include the Strategic Appraisal, Science and Technology, Threat Assessment and Factors Shaping the Concept.

The second section incorporates operational concept chapters covering High, Mid, and Low Intensity Conflict (Type A, Insurgency and Type B, Peacekeeping).

The third section focuses on priority QOs derived from the Concept.

The agenda will include the review and discussion of the U.S.-sponsored final draft chapter on high intensity conflict, the QOs, as well as the development methodology for the follow-on ABCA Armies' Operational Concept 1991–2000.

Inquiries pertaining to the meeting should be submitted to: Commander, U.S. Army Concepts Analysis Agency, ATTN: MOCA-JFL/MAJ A. Biegel, 8120 Woodmont Ave., Bethesda, MD 20014.

Conferences & symposia

Mechanics Symposium Focuses on Structural Joints

Dr. A. E. Gorum

Ways of making solid mechanics research efforts more responsive to requirements in the design of structural joints for advanced military systems were examined at a recent U.S. Army Symposium on Solid Mechanics.

More than 100 representatives of the Army, Navy, Air Force, several U.S. Government agencies, nine universities or research institutes, 17 industries and four foreign countries, exchanged information and viewpoints at the 3-day meeting in Cape Cod, MA.

Sessions were sponsored by the Technical Working Group (TWG) for Mechanics of Materials, one of nine TWGs of the U.S. Army Materiel Command Materials Advisory Group, with Dr. Alvin E. Gorum presiding as chairman. Dr. Gorum is director of the Army Materials and Mechanics Research Center (AMMRC), Watertown, MA.

Dr. Gorum stressed, in welcoming remarks, the essentiality of coordination and communication among in-house and contract researchers and designers having common military theme interests. Three earlier biennial symposia—all sponsored by the Mechanics of Materials TWG and coordinated by AMMRC—were themed on Solid Mechanics; Lightweight Structures; and Ballistic Problems.

Keynoter Dr. Richard S. Hartenberg, Technological Institute, Northwestern University, spoke on "Jointing Through the Ages," going back to the Stone Age when the first common structural joint for weapons and tools was devised by *lashing* a stone to a stick.

Four sessions were devoted to presentation of 17 technical papers on bonded joints, fasteners and design applications. In addition, a work-in-progress session was conducted, comprised of 17 brief presentations and discussions of current (but not necessarily complete) research relating to structural joints.

Procurement Symposium Attracts Armed Forces Representatives

More than 175 representatives of the Armed Forces participated in the recent 1974 DoD Procurement Research Symposium at the Army Logistics Management Center (ALMC), Fort Lee, VA.

MG C. M. McKeen Jr., director of Requirements and Procurement for the Army Materiel Command (AMC), stated in the opening address that the symposium presented a great chance for interchange of ideas for current research projects of the Army, Navy and Air Force.

Hugh Witt, deputy associate director and assistant to the director for Procurement Policy, Office of Management and Budget, delivered the keynote address. He summarized functions of the new Office of Federal Procurement Policy.

Assistant Secretary of Defense (Installations and Logistics) Arthur I. Mendolia, banquet speaker, stressed the need for more research within the Department of Defense and the stimulation of industrial research and development oriented toward military requirements.

200 Years of Service . . .

20th Annual AUSA Meeting Toasts Army's Past, Considers Current Issues

Contemporary issues affecting the total force Army as it enters its 200th year of service to the nation accented the 20th annual meeting of the Association of the United States Army (AUSA), Oct. 14-16, in Washington, DC.

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

Ambassador-at-Large Ellsworth Bunker was presented with the George Catlett Marshall Medal, highest AUSA award, at the climactic memorial dinner. The annual award is made to an individual for "selfless and outstanding service to the United States of America."

One of America's chief diplomates for over two decades, Dr. Bunker is currently serving as chief U.S. negotiator for a new Panama Canal treaty and is the U.S. representative to the Middle East Peace Conference in Geneva.

Previous recipients of the award include last year's winner, Secretary of State Henry A. Kissinger, entertainer Bob Hope, former Presidents Truman and Eisenhower, former General of the Army Omar N. Bradley, former Secretary of the Army Cyrus R. Vance, and former Secretary of State Dean Rusk.

Secretary of the Army Howard H. Callaway emphasized in his keynote address that the Army's goal during the coming years should focus on providing the President with the greatest possible range of alternatives should circumstances dictate the need for military action.

He noted that top priority should be given to the maintenance of the most capable and most credible force the Army can muster from available resources. The Army must provide the needed security in the most economical way possible, and maintain a deep and sincere concern for people, he said.

Commenting on over-all Army effectiveness, Secretary Callaway stated, "we are on the path to what is becoming known as the 16 and 8 division force—16 Active Army divisions and 8 Reserve component divisions, an increase of three Active divisions.

"This increase won't give us any surplus forces. In fact, a 16 and 8 division force merely will reduce the risks inherent in our present posture to a more moderate level. There is no room for slippage or error in our present structure. Three added divisions will significantly improve our credibility as an effective force for peace."

Secretary Callaway maintained that, to achieve a more effective and efficient Army, we must have continuing support of the American people and their congressional representatives.

He termed 1973 as a year of transition and 1974 as a year of challenge. "During this year," he said, "we'll have to enlist about 25,000 more soldiers than last year. So we're not home free."

In passing tribute to the late Army Chief of Staff GEN Creighton W. Abrams, Secretary Callaway announced that the Army will name one of its future main battle tanks in his honor.

Army Chief of Staff GEN Fred C. Weyand, AUSA luncheon speaker, said that opportunities are now at hand for building a better Army. He emphasized that the people who serve in the Army should be provided with a feeling of self respect and must understand the importance of their mission.

GEN Weyand noted that "the Army's most urgent need is that of stability." He said that stability will permit not only more effective use of our Active resources but also an opportunity to make fuller use of our ready National Guard and the Army Reserve, to a degree never achieved before.

Other featured speakers included Secretary of Defense James R. Schlesinger, who spoke at the memorial dinner; Under Secretary of the Army Herman R. Staudt; GEN Walter T. Kerwin Jr., commander, U.S. Army Forces Command; and J. W. Woodruff, AUSA president.

Assistant Secretary of the Army (R&D) Norman R. Augustine gave an address that was well applauded. A copy of the speech was received by the *Army R&D Newsmagazine* after press deadline and it will be featured in its entirety in the January-February edition.

Key topics addressed in AUSA panel discussions included "Current People Issues," moderated by MG Robert F. Cocklin, USAR, AUSA director of Public Affairs, and "Reserve Components—The Challenge for FORSCOM's Second Year," moderated by GEN Walter T. Kerwin Jr., commander, FORSCOM.

Approximately 50,000 square feet of floor space provided a showcase for the numerous Army and industrial exhibits. Featured attractions included TACFIRE, an automated artillery fire direction system which is currently undergoing extensive tests by the Army; a new militarized optical character reader for use in remote communications; and the Army TOW missile launcher.

James R. Schlesinger
Secretary of Defense

Gen Fred C. Weyand
Army Chief of Staff

Howard H. Callaway
Secretary of the Army

Hon. Ellsworth Bunker
Ambassador at Large

GEN Walter T. Kerwin Jr.
FORSCOM Commander

J. W. Woodruff Jr.
AUSA President

AMC Producibility Symposium Emphasizes Improved Visibility, Design, Production

The U.S. Army Materiel Command (AMC) hosted a symposium at AMC headquarters, Oct. 22-23, to provide AMC personnel with a philosophical stimulus toward producibility and all that it means in terms of unit production cost and competitive procurements of Army hardware.

In consonance with the expressions of AMC Commander GEN Henry A. Miley Jr., towards producibility, the symposium was geared toward top-level management involved in materiel development.

More than 35 key personnel from AMC major subordinate commands and selected project offices participated in the meeting, which was sponsored by the AMC Research, Development and Engineering Directorate and conducted by the Army Management Engineering Training Agency (AMETA), Rock Island, IL.

Following opening remarks by John Blanchard, AMC assistant deputy for Materiel Acquisition, the opening day was devoted to discussions of the basic concepts and considerations of producibility, some common deficiencies of hardware designs, the selection of materials and processes, and methods of enhancing, planning and managing producibility.

The second day was devoted to a round-table discussion on how the subject of producibility could best be given improved visibility and implemented effectively into the design, development and production processes. Following the discussions, it was decided that consideration will be given to conducting a series of one-day seminars on producibility at each of the major subordinate commands and laboratories. The seminars will be directed at the working level personnel and will emphasize case histories and include guest speakers from industry.

The Army Logistics Management Center (ALMC), Fort Lee, VA, and AMETA are being requested to incorporate the subject of producibility into their courses and to investigate the possibility of establishing courses on the subject.

In addition, AMCP 706-100, Engineering Design Handbook-Design Guidance for Producibility, will be updated to reflect the most modern thinking and state-of-the-art. The consensus was that the meeting succeeded in getting everyone thinking producibility.

Personnel Actions . . .

3 Key OASD Personnel Changes Announced

Three key personnel changes within the Office of the Assistant Secretary of Defense for Installations and Logistics, and the Office of the Comptroller, were announced recently by Secretary of Defense James R. Schlesinger.

Dale R. Babione has succeeded John M. Malloy as ASD for Procurement, OASD (I&L). Babione is assigned responsibilities for policies, programs, systems and procedures pertaining to procurement and small business in the military departments and the Defense Supply Agency (DSA).

Dale R. Babione

A veteran of 22 years of federal service, Babione has served since 1972 as director of Procurement and Production, DSA. Graduated with a bachelor's degree in business administration from the University of Dayton, he has received the Decoration for Exceptional Civilian Service and the Decoration for Meritorious Civilian Service.

Perry J. Fliakas

Perry J. Fliakas was named Deputy Assistant Secretary of Defense for Installations and Housing, OASD (I&L), following service since July in an acting capacity. He succeeds Edward J. Sheridan.

Fliakas has a bachelor's degree in business and public administration from Georgetown University. Employed since 1950 with the Department of the Army and the Office of the Secretary of Defense. He has served in various areas of supply management, budget and programing, including Director for Construction, OASD (Comptroller) and Deputy Military Assistant Comptroller, OASD (Internal Security Affairs).

Joseph P. Welsch

His new responsibilities include formulation of Defense-wide policies, plans and programs for military construction, installations and bases, management of the DoD housing program and formulation of legislative programs.

Joseph P. Welsch is the new Deputy Assistant Secretary of Defense for Management Systems, OASD (Comptroller), succeeding Melvin H. Baker. Welsch had served as the first Deputy Assistant Secretary of Defense for Audit. His responsibilities included development and implementation of DoD policies and procedures for contract and internal audit activities, monitoring and evaluating General Accounting Office reports and planning and executing audits of Defense-wide programs and agencies.

Welsch has a bachelor's degree in business administration from Pace College and is a member of the Federal Governments Accountants Association and the National Association for Accountants. He has been employed by the U.S. Air Force Auditor General and has served in supervisory positions in Europe, Colorado, New York and Washington.

CSC Approves Taylor for PL-313 Appointment

U.S. Civil Service Commission approval of the appointment of William B. Taylor as assistant to the Chief of Engineers for Research and Development and chief of the Corps of Engineers R&D Office was announced Oct. 14. Taylor's selection for the prestigious PL-313 position climaxes a 29-year association with research and development programs, all of it with the U.S. Army except for 1962–67 service with the NASA Office of Manned Space Flight (Apollo and Apollo Applications).

Graduated from the U.S. Military Academy with a BS degree in engineering in 1945, Taylor served as an officer until August 1954 with the Combat Engineers in Europe, the Special Weapons Operation at Sandia Base, NM, and Eniwetok Island, Special Weapons Test Planning in the Pentagon, and the Nuclear Reactions Studies, Washington, DC. He retired on physical disability.

William B. Taylor

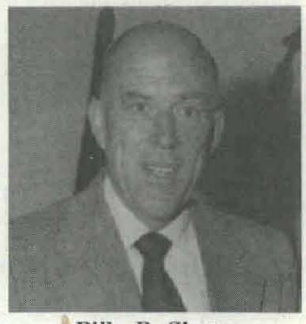
Appointed to a U.S. Civil Service position in January 1955, he served five years with Army-AEC Nuclear Power Reactor Development (Construction Operation and Training), Washington, DC. Two years with the Army R&D of Mapping and Geodetic Space Applications at Fort Belvoir, VA, preceded his transfer to NASA.

Upon his return to the Army in May 1967, he was scientific adviser for Missiles and Space, Office of the Chief of R&D, Department of the Army, serving in that capacity until January 1969. For the next four and a half years he was the technical director, U.S. Army Mobility Equipment R&D Center, Fort Belvoir. He has been a private consulting engineer since May 1973, including service with the Army Corps of Engineers.

His educational qualifications include training in radiological engineering at the U.S. Navy PG School in Annapolis, MD, a master's degree in Radiological Engineering in 1951 from Johns Hopkins University, a course in systems engineering at Mathematica, Inc., Princeton, NJ, and completion of the Federal Executive's Institute curriculum at Charlottsville, VA.

Sisson Named to APG Materiel Test Directorate

Thirty-one years of Federal Civil Service reached a high point for Billy D. Sisson when he was promoted recently to associate director of the Materiel Test Directorate, Aberdeen (MD) Proving Ground, a GS-16 position that makes him one of APG's highest ranking employes.



Billy D. Sisson

Sisson had served for 12 years as a GS-15 technical director in the Armor Directorate, U.S. Army Test and Evaluation Command at the APG, supervising testing of tanks, armor, transporters, tank weapons and other materiel.

Duties of his new position will involve primarily the maintenance of Army standards of quality of materiel through all phases of design, testing and the production cycle, including initiation of test programs.

Sisson served as an officer with the Ordnance Overseas Modification and Maintenance team in Detroit and at Aberdeen Proving Ground during World War II, and was instrumental in development of the light tank.

In 1962 he received the Maryland Civil Servant of the Year Award and was honored with the Decoration for Meritorious Civilian Service in 1964 and 1968. He was a BS degree in mechanical engineering from Texas A&M.

Yaggy Closes Out 31 Years of Federal Service

Paul F. Yaggy, director of the U.S. Army Air Mobility Research and Development Laboratory (AMRDL) since its establishment in 1970 at NASA Ames Research Center (NARC), Moffett Field, CA, retired recently after more than 31 years of federal Civil Service.

In 1965 he was initially named technical director and later director of the newly organized Army Aeronautical Research Laboratory, NARC. Establishment of this center provided for Army participation in an expanded program of aeronautical research in low-speed and VTOL (vertical take-off and landing) aircraft.

Yaggy attained national recognition in the development of V/STOL aircraft and served as a consultant to industry, the Armed Forces, and NASA centers.

COL Norman L. Robinson, deputy director of AMRDL, will serve as acting director of AMRDL pending selection of a successor to the prestigious PL-313 position.

Lester Assumes NLABS Commander Duties

COL Rufus E. Lester Jr., former executive officer, Office, Deputy Chief of Staff for Logistics (DCSLOG), assumed new duties as commander, U.S. Army Natick (MA) Laboratories, upon the recent retirement of COL Harry Corkill.

A graduate of the Army Command and General Staff College and the Army War College, COL Lester has a bachelor's degree in biology and economics from Mercer College and a master's degree in food technology from Massachusetts Institute of Technology.

During 1970–71 he served in Vietnam as commander, 4th Supply and Transportation Battalion, 4th Infantry Division and later as executive officer, Office of the Deputy Chief of Staff for Logistics. He was chief of the Subsistence Division, DCSLOG, Washington, DC, in 1971.

COL Rufus E. Lester Jr.

Other key assignments have included commander, 308th Supply and Service Battalion, Giessen, Germany (1968–70); staff officer, Office of the Chief of Research and Development (1965–68); Quartermaster adviser, I Corps, Vietnam (1964–65); and instructor, U.S. Army Quartermaster School, Fort Lee, VA (1961–63).

COL Lester is a recipient of the Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star Medal with OLC, Meritorious Service Medal, Air Medal, and the Army Commendation Medal with OLC.

Shallcross Heads AMRDL Eustis Directorate

COL George W. Shallcross

COL George W. Shallcross was recently appointed to head the Eustis Directorate, Fort Eustis, VA, of the U.S. Army Air Mobility Research and Development Laboratory, headquartered at NASA-Ames Research Center, Moffett Field, CA.

Included among his previous tours are: Office of the Inspector General, DA; company commander, 7/1 Air Cavalry Squadron, Vietnam; armor mobility representative, U.S. Army Standardization Group, England; company commander, 54th Aviation Company, Vietnam; executive officer, 55th Aviation Company, Korea; and company commander, Company D, 66th Armor, Fort Campbell, KY.

COL Shallcross has served as a liaison pilot and is a qualified Army aviator. His academic credentials include a bachelor's degree in sociology from Franklin and Marshall College, a master's degree from Troy University, and graduation from the Army Command and General Staff College, Air War College, and the Basic and Advanced Armor School.

He is a recipient of the Silver Star, Legion of Merit, Distinguished Flying Cross with Oak Leaf Cluster (OLC), Bronze Star Medal, Meritorious Service Medal with OLC, Air Medal with 36 OLC and two "V" devices, Army Commendation Medal and the Purple Heart.

Lasher Takes Over ECOM ADP Laboratory

COL Donald R. Lasher is the new commander and director of the Communications/Automatic Data Processing Laboratory, U.S. Army Electronics Command, Fort Monmouth, NJ. He succeeds COL John D. Mitchell, now assigned to Army Communications Command.

COL Donald R. Lasher

COL Lasher had served since 1972 as chief of the Intelligence and Control Systems Division, Office, Deputy Chief of Staff for Combat Developments, HQ, Training and Doctrine Command, Fort Monroe, VA. In 1969–72 he was technical adviser, Management Information Systems Directorate, Office, Assistant Vice Chief of Staff, DA.

His service record shows assignments as commander, 41st Signal Battalion, Vietnam; commander, Data Processing Center, Radford (VA) Army Ammunition Plant; and project officer, MOBIDIC-7A. He is a recipient of the Legion of Merit with two Oak Leaf Clusters (OLC), Air Medal, and the Army Commendation Medal with OLC.

A 1952 graduate of the U.S. Military Academy, COL Lasher has a master's degree in industrial engineering (data processing) from Stanford University. He has attended the Army Command and General Staff College and the Army War College.

O'Malley Named to WSMR T&E Directorate

Deputy director, U.S. Army Missile Test and Evaluation Directorate, White Sands (NM) Missile Range, is the new title of COL John M. O'Malley, as successor to COL L. Lee.

COL John M. O'Malley

A veteran of 21 years of active military service, COL O'Malley entered the Army in 1953 after graduating with a bachelor's degree from Arizona State University. Initially, he served as an instructor in the Communications Department, Fort Sill, OK.

He has served as director of Plans, Army Air Defense Command, CO; adviser to the Republic of Vietnam Inspector General, Territorial Forces Inspection Teams; staff officer, Hawk Missile System, Washington, DC; and test officer with the Army and Air Force joint tests of the Maverick Missile System, Fort Riley, KS.

COL O'Malley has completed the Army Command and General Staff College and the Artillery and Air Defense Advance course. He is a recipient of the Bronze Star Medal, Meritorious Service Medal with OLC, Joint Service Commendation Medal and Army Commendation Medal with OLC.

Ramsden Directs Edgewood Technical Support

LTC James H. Ramsden

LTC James H. Ramsden, former chief of the Chemical-Biological-Radiological (CBR) Studies Branch, Army Ordnance Center and School, APG, MD, is newly assigned as director, Technical Support Directorate, Edgewood Arsenal, MD.

During 1971–73 he served as plans officer and executive officer, CBR Agency, Fort McClellan, AL. In 1969–70 he was assigned to the 1st Cavalry Division (Airmobile), Vietnam, after serving as an instructor and assistant professor in the Department of Chemistry, U.S. Military Academy.

Other key assignments have included a tour with the 82d Airborne Division, Fort Bragg, NC, and aide-de-camp to the Chief of the Military Assistance Advisory Group, Phnom Penh, Cambodia.

Graduated from the U.S. Military Academy, LTC Ramsden has a master's degree in chemistry from the Johns Hopkins University and has completed the Army Command and General Staff College course. His military honors include the Bronze Star Medal with OLC, Meritorious Service Medal, Air Medal, and the Army Commendation Medal with two OLC.

Hunter Selected as New York District Engineer

COL Thomas C. Hunter, former commander, 24th Engineer Group, U.S. Army Europe, has been named New York District engineer, U.S. Army Corps of Engineers. His key assignments include staff officer, Office, Deputy Chief of Staff for Personnel; and staff and faculty member, U.S. Military Academy.

COL Hunter has bachelor's and master's degrees in civil engineering and is a graduate of the Army Command and General Staff College and the National War College. Included among his military honors are the Legion of Merit, Bronze Star Medal and the Army Commendation Medal with three Oak Leaf Clusters.

Women in Army Science . . .

Birth of an Industry . . .

BRL Employe Recalls World's First Computer

Secrecy shrouded the project thicker than a London fog during World War II when the U.S. Army was confronted with a monumental problem of trying to accelerate development of more reliable firing data for weapons.

Known as "Project PX" at the University of Pennsylvania's Moore School for Electrical Engineering, where Lila Butler was a supervisory mathematician in a group of Army and academic scientists working on firing and bombing tables, the effort was the beginning of today's worldwide computer industry.

Lila is still a mathematician with the Systems Programing Branch of the U.S. Army Ballistic Research Laboratories' Computer Support Division. She has been a BRL or APG employe continuously since 1942, except for a 4-year absence following her marriage in 1947.

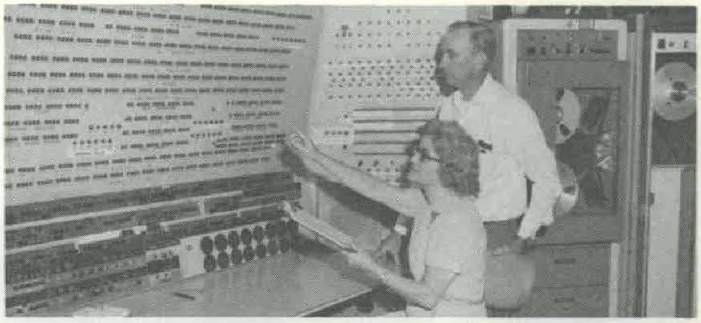
"Originally, I worked for the BRL Annex at the University of Pennsylvania. . . . I was supervisor of a section of mathematicians that made firing tables. I was associated with the people who invented ENIAC (the world's first computer) while I was at the Moore School . . . but, at the same time, we really didn't realize what the project was. It was a classified project. . . .

"We knew there were things going on down in the basement of the Moore School, but we weren't told what the projects were. We saw the people daily. . . . ENIAC (Electronic Numerical Integrator and Computer) wasn't completed until after the close of World War II. When the war was over, we came back to Aberdeen and the ENIAC was brought back. . . ."

Mrs. Butler's first indication of the nature of the ENIAC project was gained shortly before the end of the war when a group of mathematicians was organized to oversee the first programing for the computer. She was not a part of the original team because she was a supervisor of a team assigned projects of high priority.

When she returned to Aberdeen Proving Ground in 1951, she began programing the ENIAC and she has been programing BRL computers ever since. In 1951, she recalls, the full impact of the computer age was unclear "but it looked like it was going to be a booming field. . . .

"Quite a few industries were trying to get into the field at that time, and it looked like there was going to be a lot of different approaches to computing. But it really has gone beyond what you would have expected it to go beyond at that time. I think it has changed all of civilization."



SHE REMEMBERS ENIAC—Mrs. Lila Butler, who well remembers "Project PX" (development of ENIAC, the world's first computer) since she was employed at its birthplace, checks the programing of the U.S. Army Ballistic Research Laboratories Electronic Scientific Computer I, or BRLESC I (pronounced burlesk). Observing is J. H. Patrick, electronics technician.

Awards . . .

EXCEPTIONAL CIVILIAN SERVICE. *Norman L. Klein,* chief of Laboratory Operations and assistant deputy for Laboratories, HQ AMC, was a recent recipient of the Decoration for Exceptional Civilian Service.

He was recognized for 1966-73 contributions to the AMC Laboratory System and for efforts in allocation of RDT&E resources and establishment of managerial techniques.

A. A. Stewart, deputy director, Directorate for Materiel Management, U.S. Army Missile Command (MICOM), was awarded the DECS for personal contributions to the operational readiness of rockets and missiles used by the U.S. and Allied Forces. MG Vincent H. Ellis, commander, MICOM, made the presentation.

MERITORIOUS CIVILIAN SERVICE. *Dr. J. V. Richard Kaufman,* deputy director for Plans, RD&E Directorate, HQ AMC, received the Decoration for Meritorious Civilian Service (DMCS) for contributions to the review of FY75 RDT&E Program.

He was also cited for his services as chairman of the AMC Fuze Steering Group which coordinated a vast array of fuze programs within AMC and assembled an in-depth and widely communicated base of fuze technology.

Dr. Craig M. Crenshaw, recently retired chief scientist, AMC, was presented the DMCS at his recent retirement ceremonies. He was credited for improving the Army's posture in electronics equipment producibility, missile and warhead effectiveness, test instrumentation and safety, and materiel systems reliability and maintainability.

Joseph Lindwarm, physical science administrator, Office of the Deputy for Laboratories, HQ AMC, received the DMCS for contributions leading to an improved R&D program in the areas of life science, chemical and biological weapons, defense, subsistence, human factors engineering, and advances in in-house aeronautical research.

Beverly D. Briggs, physical scientist, U.S. Army Mobility Equipment Research and Development Center, was presented a DMCS for improvements in countermine and counter-intrusion equipment.

Decorations for Meritorious Civilian Service gave recognition recently to five HQ U.S. Army Missile Command employes.

Lawrence W. Howard of the Research, Development and Engineering Laboratory was cited for contributions toward development of a lightweight, man-portable weapon system for the combat soldier. *Bernie J. Cobb* of the same laboratory was recognized for his work as lead systems design engineer for technology of the short-range, man-portable SMAWT antitank weapon.

John W. Torzillo, recently retired from the Directorate for Maintenance, was cited for his performance from Feb. 1, 1973 to Sept. 1, 1974. He was credited with contributions toward development and advancement of logistics control of missile and ground equipment. *Frank C. Bunn,* also retired, was honored for his work as chief of the Flight Operations Division, Test and Evaluation Directorate from 1971 to August 1974.

Donald J. Ifshin, an RD&E Laboratory supervisory aerospace engineer, was commended for his efforts on the SMAWT.

Bedrosian Commended

Twenty years of duty as chief of the United States Scientific Office, Greater Boston Area, have gained Alvin D. Bedrosian numerous honorary awards, including a recent commendation presented by MG George Sammet Jr., AMC Deputy Commander for Materiel Acquisition.

Bedrosian has offices in the Massachusetts Institute of Technology with duties that encompass a broad variety of coordination responsibilities involving Army contracts and grants. The citation accompanying his recent award for outstanding and "totally dedicated" performance acclaimed his "tact, technical knowledge, and sensitivity to organizational policies . . . (making) "his presence in this position invaluable."

Standards Engineers Society Accepts McAdams as Fellow

Defense-related standardization achievements over a 35-year period by John P. McAdams were recognized recently when the Standards Engineers Society (SES) elected him a Fellow.

John P. McAdams

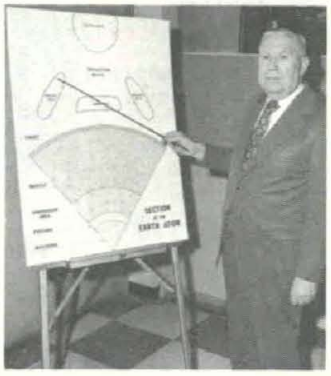
McAdams is an employe of the Research, Development and Engineering Directorate, U.S. Army Materiel Command, where he participates in staff supervision of 18 Army Standardization Offices in implementing the Defense Standardization Program.

McAdams was cited specifically for substantial contributions in the formulation of standardization policy and effective application of standards in DoD logistics. This was achieved while serving as representative of the U.S. Army Departmental Standardization Office on Technical Data and Standardization Policy Committee, Office, Secretary of Defense for Installations and Logistics.

An active member of SES since 1967, McAdams represents the Army on technical committees of the American Defense Preparedness Association and American National Standards Institute. He is a registered professional engineer in the District of Columbia.

People in Perspective

Picatinny Man Remains Undaunted . . .
During 30-Year Effort to Prove Electron Theory



Hollis Richardson

Would you, if you had tried aggressively and persistently for 30 years to prove the soundness of a concept you consider of potentially profound significance, termed the "macromatic theory of the universe," abandon your "salesmanship" as a futile venture?

Provided your answer is affirmative, you would fall within the probable 99.99 percent category of Earth dwellers, but Hollis Richardson of the U.S. Army Picatinny Arsenal, Dover, NJ, is cast in a different mold.

Employed as an electrical engineer with the Ammunition Development and Engineering Directorate, Hollis still is striving, undiscouraged by lack of essential support to date, to find a mathematician and others to enable him to develop two test proposals he believes may prove his theory.

Why? Well, he says, "the result would be a bonanza jackpot for science. The tremendous knowledge of the Earth and its surroundings would greatly benefit mankind, and by projection to heavenly bodies would give us a clear insight into some of the other secrets of the universe."

In a paper intended for publication in a professional journal, Richardson explains some of his thinking by saying that for more than 200 years it has been known that people on Earth walk on a carpet of free electrons, but nobody knows where they come from.

Richardson theorizes that the orphan electrons are squeezed out of atoms in the core of the Earth by gravitational pressure, leaving a central core of neutrons (uncharged elementary particles) and protons (elementary particles with a positive charge of electricity).

Like the poles of two magnets, he believes, the displaced electrons continually repel each other to the surface, with some reaching the top of the atmosphere to form the ionospheric layers which reflect radio waves across the oceans.

Hollis goes on to claim that the energy from occasional solar flares erupting from the sun's surface inject some of these electrons into orbit around the earth in the vacuum of space surrounding the atmosphere, where there is an electric as well as a magnetic field. He says this explains the belts of high-speed particles discovered by Dr. James Van Allen with our first satellite probes in 1958.

Richardson's paper shows how his view of the Earth as a giant atom helps to explain and correlate a number of phenomena that have puzzled scientists. These include the Earth's heat, magnetic field, earthquakes, volcanoes, electric charge, ionosphere, thunderstorm electricity, tornadoes, Van Allen belts, auroras, airglows (they're similar to auroras, but are visible only to scientific instruments), cosmic rays and magnetic storms. He says his theory takes all of the phenomena into account.

In one of the two tests he proposes to prove his theory—if he is on the right track—lightning would be produced between an ion layer in the atmosphere and the Earth, by using a conductive cable dangling from a balloon in a cloudless sky. According to other theories, a cloud is needed to generate the lightning.

The second test would prove that the Van Allen belt particles are in orbit around the Earth by measuring their direction with a gravity-stabilized satellite. Previous tests, Richardson says, were not effective because they used spin-stabilized satellites.

'Seemingly Impossible Dream'
Leads to Rewarding Career in Army Optometry

Adversity turns some people to the decisions that lead to fulfillment of the dreams of their youth. One of the panel moderators and judges at the 1974 12th National Junior Science and Humanities Symposium in Boston, MA, is an example of strong-willed determination.

Presently serving as chief of Optometry Service at Walter Reed Army Medical Center, Washington, DC, LTC Henry C. Turner can ascribe achievement of that position to the fact that when he was a 12-year-old boy in his native Mobile, AL, community he needed an eye examination—and trained optometrists were scarce.

That difficulty led to his career decision, at that time for a youth in a black family a seemingly "impossible dream." But it persisted through high school and led to graduation with a BS degree from Shaw University in 1946. Drafted into the Army as an enlisted man, he served in Japan as a medical laboratory technician and acting battalion medical noncommissioned officer.

LTC Henry C. Turner

Separated from the Army in 1947, he returned to Mobile only to be recalled to active duty again in 1949 and assigned at Fitzsimons General Hospital, Denver, CO. Following his release from the military, he remained at Fitzsimons in a civilian capacity as a supervisor in the Hematology Section.

LTC Turner received a U.S. Army Reserve commission in 1952. Shortly thereafter, he entered the Illinois College of Optometry and was graduated in 1955 with his doctorate.

While serving his internship in Birmingham under a private optometrist, he was recalled to active duty in 1958 as a fully licensed optometrist and assigned to the 130th Station Hospital, Heidelberg, Germany. He obtained a master's degree in teaching from Trenton State College in 1973. He is chairman of the American Optometric Association Committee on Clinical Standards, a Fellow of the American Academy of Optometry, and a member of the Executive Committee of the Armed Forces Optometric Society.

BMD Engineer's Frustration . . .
Leads to Design of Economical Electric Vehicle

Frustration in coping with the energy crisis last winter prompted Wiley Davis, an electrical engineer with the U.S. Army Ballistic Missile Defense Systems Command, Huntsville, AL, to design and build his answer to the low-cost transportation problem.

Davis had toyed for sometime with the idea of inventing an electrical car, but the fuel shortage spurred his decision. Following extensive research, he fashioned his "electrical gadget," which he drives 12 miles a day to and from work and on small errands around town —at a cost of eight cents a day.

Three 96-ampere-hour batteries power a commercial electric motor linked to a chain drive system. Davis recharges the batteries about every 50 miles by plugging them into a 36-volt charger at home. To minimize weight, he has equipped the "gadget" with 26-inch bicycle tires which have a low roll resistance on pavement.

Davis constructed a lightweight, low-wind-resistant frame from pieces of angle iron obtained from a local junk yard. Terming his creation a "feasibility model," he decided not to cover the body. However, he might exercise the option of covering it at a later date.

The vehicle cruises at 35 to 40 miles an hour, and can accelerate from a standstill to 35 miles an hour similarly to a gasoline-driven small import car. Davis flies bright orange flags from two rear antennas so other drivers can easily spot him in traffic.

Although he maintains a defensive outlook while driving, Davis says most people are quite courteous when they see him. One driver even raised his hands and applauded as he passed by.

Since there are no shock absorbers on the electrical gadget, the ride is a bit rough when crossing over railroad tracks. Davis really offers no complaints, noting that the project only cost about $500.

Air Environmental Monitoring . . .
An International Concern

By Richard L. Torian

Programs related to pollution abatement and environmental quality are of increasing concern within the U.S. Army. One of these has to do with developing and maintaining the latest and most effective detection and monitoring systems so that the Army will have the technical capabilities needed for measurement of air pollutants.

The U.S. Army Foreign Science and Technology Center, Charlottesville, VA, is assisting the Army's technical programs by keeping abreast of foreign science and technology in areas such as air monitoring systems.

Some of the systems that countries other than the United States are using for the determination of pollutant types and levels in the atmosphere will be discussed in this article, including mobile laboratories for collecting pollution data and stationary monitoring posts. Information will be presented on applications, capabilities, instrumentation, and some results obtained with these systems.

The Chemical Defense Establishment at Porton Down in the United Kingdom has fielded a mobile unit capable of identifying and monitoring gaseous atmospheric pollutants. Equipped with an infrared spectrophotometer, a quadrupole mass spectrometer, and a gas chromatograph, it provides a capability of measuring pollutant concentrations as low as one part in one hundred million (1 in 10^8).

Each spectrophotometer gas cell contains two sets of mirrors adjusted so that the beam is reflected between them several times before leaving the cell. An infrared beam, effectively 40 meters long, gives a high sensitivity for detecting unknown vapors. Typical minimum detection values are shown below in Table 1.

Compound	Minimum Detectable Concentration (parts per million)
Nitrogen Dioxide	0.01
Acrolein	0.02
Sulfur Dioxide	0.03
Ozone	0.05
Ethylene	0.10
Methane	0.3
Carbon Monoxide	0.8
Hydrochloric Acid	7.0
Hydrogen Sulfide	50.0

The quadrupole mass spectrometer provides a very sensitive method of identifying pollutants, capable of detecting one part per one hundred million concentration. The atmosphere is sampled through a thin diaphragm into the spectrometer low-pressure area.

The gas chromatograph can be used to separate the components of the atmospheric mixture and partially identify them by using a group of selective detectors. Components then can be further analyzed by the mobile unit's other instrumentation. Special detectors enable the gas chromatograph to analyze for organochlorine and organophosphorus compounds.

Use of the infrared spectrophotometer, the quadrupole mass spectrometer and the gas chromatograph provides a powerful analytical capability.

Examples of the use of the mobile lab are the analysis of air around airports and in aircraft cabins (using portable sampling techniques), in submarines, around and inside vehicles, and at selected spots in and around factories.

Sampling the atmosphere at a single site for an extended period makes it possible to monitor the variation of pollutant concentration with the time of year, time of day, and wind direction and speed.

Typical results from a rural England site show a considerable variation of carbon dioxide (CO_2) concentration at ground level with wind speed, time of day, and time of year. High winds apparently mix the low concentrations at higher altitudes with the high ground level concentrations to give a constant average.

During daylight hours it appears that CO_2 is used up by plants and concentration falls. The probable explanation for the sudden increase of CO_2 during the fall season is the relative inactivity of plants.

Two West German companies, Messerschmitt-Boelkow-Blohm, Ltd., and Messtechnik Fuer Umweltschutz, Ltd., have developed a mobile laboratory for detection of air pollutants. Capable of analyzing for sulfur dioxide (SO_2), nitrogen oxide (NO), nitrogen dioxide (NO_2), carbon dioxide, and hydrocarbon content, the lab is also equipped to collect meteorological data such as humidity, temperature, air pressure, wind velocity, and wind direction.

The vehicle carries a gas chromatograph, an ultraviolet spectrophotometer, and portable units designed to analyze for hydrocarbons, solvent vapors, acoustical levels, dusts, and various other aerosols at sites inaccessible to the mobile lab itself.

A minicomputer allows the data to be computed, queried by a time division multiple system, tape recorded, and, at the same time, transmitted via radio or telephone to an evaluation station. Values measured and the rate of query can be widely varied, and the minicomputer can be used to indicate when tolerance values are surpassed.

This mobile laboratory may also be used to determine optimum locations and to standardize equipment for an extensive system of stationary monitoring posts being planned for West Germany.

Detection devices such as those discussed here require the sample being tested to be at the site of the detecting instrumentation. Remote sensing is advantageous in some cases, such as the determination of pollutants emerging from smoke stacks.

One method of remote sensing currently receiving a great deal of attention is laser scattering. A beam of light produced by a laser is propagated to the desired site (such as smoke stack effluents) where it interacts with the pollutants.

Characteristic light is scattered back to the original source for detection. Although the theory is straightforward, the application presents complex problems. However, efforts are being made to utilize this method of sensing.

The Mitsubishi Electric Corp. of Japan has introduced a van-mounted with a laser

Japanese Laser-Mounted Van

remote-sensing apparatus. The system uses a Q-switched Nd, YAG (neodymium:yttrium aluminum garnet) laser, reportedly capable of producing 40 mJ output energy, as the generator of the light beam.

A photoelectron counting detector, reportedly capable of detecting single photons, is coupled with a Cassegrainian reflecting telescope of 50 cm diameter aperture. The detector's beam direction and gate setting are adjusted by using an oscilloscope.

The laser and detector are assembled on a bench which can be jacked up out of the van through an opening in the roof. This system will have a sensitivity of 400 ppm for SO_2 at a distance of 200 meters—less than desired distances of several kilometers.

Air pollutant data can also be collected at stationary on site monitoring posts. Since 1964 the Japanese have been building a permanent network of air monitoring stations for obtaining accurate data on the kinds and amounts of atmospheric pollutants. The stations are equipped with an automatic measuring and recording system for determining the concentration of sulfur oxides, nitrogen oxides, hydrocarbons, carbon monoxide, particulates and oxidants. They also contain meteorological measuring equipment and data processing devices.

The data collected at individual monitoring stations are transmitted to a central processing center for analysis. Air pollution conditions in certain sections of Japan are thus continuously monitored.

An example of an automatic monitoring station is a minicomputer system produced by the Nippon Electric Co. The interaction and interface between the sensoring devices, telemetric devices and minicomputer, as well as the software controlling the system, have been worked out.

Reportedly, the system is capable of converting the measured parameters, such as pollutant concentration or wind velocity, into analog voltage signals for telemetric transmission. The system can process the data immediately, providing output information on the measured values.

Results from the Japanese monitoring stations indicate that the yearly mean values of nitrogen oxides have increased appreciably —for example, from 0.034 ppm in 1964 to 0.129 ppm in 1970. Increases in the concentrations of sulfur oxides have also been noted in certain areas.

The amount of dust fall in Japan's major cities has generally been decreasing. In the industrial Tajima district around Kawasaki, the dust fall has decreased from 55.6 tons per km^2 per month for 1961 down to 29.7 tons per km^2 per month for 1969.

The decrease in dust fall is attributed to the nationwide energy switchover from coal to oil and the installation of dust-collecting equipment and corrective measures at factories and plants.

The Soviet Union is establishing networks of permanent monitoring stations for measuring air pollutants and meteorological conditions. Ukraine scientists have developed a system for monitoring air pollution in cities, capable of automatically measuring various harmful gases and dust as well as wind speed and direction, temperature, and humidity.

Data are transmitted via telephone lines to a computer-equipped central data collection and processing point. The Soviet Union also has mobile laboratories for collecting data, and appears to have generated a wide R&D program in support of air monitoring activities.

For example, in the area of detection the Soviets are investigating coulometry, an electrochemical technique based on the exact measurement of the quantity of electricity that passes through a solution during the occurrence of an oxidation-reduction reaction.

Apparently coulometry is considered one of the more promising detection methods under consideration for air monitoring duties. Advantages are the high sensitivity and small weight and size of the apparatus although nonspecificity still presents problems.

The United Nations recently proposed establishing a worldwide monitoring system which would utilize existing national monitoring networks and establish new ones where needed. Pollutant and meteorological data collected by this system would be extremely valuable to scientists studying the world's environment.

In summary, the U.S. Army needs to maintain a high degree of technical capability in analytical instrumentation. This capability is needed not only in the area of air pollution detection and monitoring discussed in this article, but also in an automatic alarm system for detecting chemical or biological warfare agents.

A large research and development program is needed to achieve this capability. A current awareness and evaluation of the latest advances in other countries could be beneficial to this program.

The information presented in this article is based on an open literature survey and technical reports received by the U.S. Army Foreign Science and Technology Center. More details about the systems discussed are available through the center.

AMC activities should first contact their local Foreign Intelligence Office. Other activities should route their queries through channels to HQDA (DAMI-FIR).

RICHARD L. TORIAN has been an analyst at the U.S. Army Foreign Science and Technology Center (FSTC), Charlottesville, VA, since 1973, where he is now preparing a study on foreign research and development in the waste disposal of materials.

Torian earned a BS degree in chemistry from Old Dominion University in Norfolk, VA (1965), and an MA degree in chemistry from Wake Forest University, Winston-Salem, NC (1968).

Assessing Soviet Progress in Small Arms Research and Development

By Harold E. Johnson

The Soviet Army was equipped mostly with outmoded small arms in the final year of World War II and through the remainder of the 1940s.

The Red Army had adopted a modern semiautomatic infantry rifle in 1938 and an improved version in 1940. These weapons failed the test of combat, however, and were replaced by the 5-shot, manually operated Model 1944 rifle.

Despite its date, the Model 1944 was merely a short version of the old Russian Model 1891 rifle. The infantry squad's machinegun was not quite as outdated since it was designed in 1926. Vast numbers of heavy, complex Model 1910 Maxim machineguns and a few excellent, but heavy, Model 1943 Goryunov machineguns were in use.

Even before World War II, the Soviets had realized that most of their small arms were obsolete and had started on a modernization program for infantry armament, but the conflict engulfed them prior to any real progress.

Among the military programs the Russians had obviously monitored were the Finnish, Swiss and German developments in short infantry cartridges. In 1942, when the Russians captured field test samples of the new German assault rifles, with their 7.9 × 33-mm short cartridge, they accelerated their development. The Soviets produced their own short cartridge, the 7.62 × 39-mm Model 1943 cartridge, early in 1943.

The cartridge is the heart of any weapon; the Model 1943 cartridge, with its relatively small diameter base, short over-all length, reduced recoil and minimal muzzle blast, permitted Soviet small arms engineers to design short, compact, lightweight weapons.

The first of these was the SKS, a short rifle or carbine used on the Belorussian front in the closing weeks of World War II. After minor changes dictated by combat lessons, it was type-classified as the standard Soviet infantry rifle.

SOVIET 7.62 GPMG PKB

To complement the SKS, several automatic weapons—an improved submachinegun (the AK-47) and a squad light machinegun (the RPD)—were developed to use the Model 1943 short cartridge. The old DPM light machinegun was redesigned as the RP-46 to use a belt feed and heavy barrel for use in a company supporting machinegun role.

Even the excellent SG-43 heavy machinegun was modernized as the SCM with an improved trigger mechanism and headspace adjustment. The Soviet Army by the end of the 1950s had been completely reequipped with a new generation of post-war weapons. The squad weapons fired the Model 1943 cartridge with its reduced recoil. Supporting weapons fired the old but effective 7.62 rimmed cartridge with its long-range heavy bullet.

On the negative side, the production technology used was right out of the 19th century. Component parts of these weapons were made from steel forgings laboriously machined into final form. Once they had rearmed with modern weapons, the Soviets were able to pause and consider modern techniques for improving their production base.

The major part of any weapon is the receiver. This component, which receives most of the other parts, is usually quite complex; if it can be simplified, considerable savings can be affected in both time and cost.

The Soviets redesigned their AK-47 assault rifle so that the receiver could be made of a stamped sheet steel shell, riveted to a simple machined barrel adaptor, with a few other stamped or easily machined parts spot welded or riveted to the receiver shell.

The Soviet designer of the AKM has given much thought to the design elements of its stamped receiver. The pin holes for the hammer and trigger, as an example, have small x-shaped indentations pressed over them. The pins work under heavy spring pressure and the indentation effectively spreads the working loads over a large area so the pins will not become grooved with extensive use.

The receiver also has an opposed pair

(Continued on page 32)

Assessing Soviet Progress in Small Arms R&D

(Continued from page 31)

of large dimples pressed into it. These serve to guide and center the magazine—a simple and novel technique. This stamped-receiver version of the AK-47, the AKM, entered service around 1960 and by the late 1960s had almost superseded the older AK-47 in the Soviet Army.

The SKS was phased out of infantry use in the late 1950s, not because of any inherent faults, but because a radical change in Soviet tactics rendered it obsolete. The Soviets shifted from a foot infantry to a mechanized infantry force, with their armored personnel carriers doubling as transports and mechanized infantry combat vehicles.

This type of fighting called for large volumes of automatic fire delivered primarily to suppress enemy fire while the APCs are moving. The AK-47/AKM could deliver this type of fire and also was short and compact for ease of handling within a buttoned-up carrier. These factors caused the AK-47/AKM to become the Soviet infantryman's basic arm. The SKS was rapidly relegated to missile, ceremonial and naval units.

The RPD squad light machinegun, unlike the SKS carbine, did display serious faults once it entered service. It had marginal operating power because the M1943 cartridge generated insufficient power to operate both the bolt mechanism and the feed mechanism under adverse conditions.

The RPD went through at least four major modification programs intended to increase operating power or to keep foreign debris out of its mechanism. None of these programs was really successful. The replacement for the RPD, phased out of service in the early 1960s, was a modification of the very successful AKM assault rifle, the RPK squad light machinegun.

The RPK represents an extremely low-risk approach by the Soviets to fulfill an urgent need. Since the AKM assault rifle had proven rugged and reliable, the Soviets modified it with a longer, heavier barrel, a light bipod and a special butt. A slight alteration at the front of the receiver also was made to accommodate the larger-diameter heavy barrel.

Other than these changes, the new machinegun had all its parts in common with the AKM assault rifle; this greatly eased logistical and training problems. The end result was an extremely reliable and lightweight (11.1 lbs. empty) weapon that provided effective fire to a range of 800 meters.

The RPK normally feeds from a 75-round capacity drum or 40-round capacity box magazine. If necessary, the 30-round capacity AKM assault rifle magazines can be used in the RPK, or vice versa. A special airborne version of the RPK, the RPKS, is produced with a folding butt stock.

The transition from the RPD to the RPK occurred very quickly, and is a prime example of the Soviet willingness to discard an unsatisfactory weapon. Their major consideration appears to be to insure that their soldiers have the most satisfactory weapons that they can produce, regardless of the cost. Second-best weapons appear to have no place in the Soviet Army.

By the mid-1960s, the Soviets had fielded the post World War II second generation of squad weapons, the AKM and RPK. About the same time, the second-generation PK General Purpose machinegun was produced to replace the company-use RP-46 and the SGM heavy machineguns.

When used as a company-level weapon, the PK was fired from its integral bipod; as a heavy gun, it was mounted upon a lightweight tripod which could be unfolded to elevate the gun for antiaircraft firing in a 360-degree arc.

The PK uses the same type gas-operated, rotary-bolt breech mechanism and receiver as the AKM and the RPK. The feed mechanism is closely modeled after that on the SGM and is operated directly by the breech mechanism operating slide.

In the early 1970s an improved version of the PK machinegun appeared. The new PKM used the operating parts of the PK; however, there was a greater use of stamped steel components and the weapon was reduced in weight by about two pounds. Weighing 17½ pounds, the PKM is one of the lightest machineguns in the world.

Currently, the Soviet Army is fully equipped with second- and third-generation small arms of excellent quality, extremely reliable and simple to produce in quantity. These weapons also represent the acme of Soviet small arms technology, which is directed primarily towards the production of reliable weapons in vast quantity.

While the Soviets use stampings to speed production, it must be borne in mind that one of their basic principles is that work must be provided for all persons. They are not adverse to using hand fitting to a degree that would be economically unacceptable anywhere in the Free World.

Analysis of a new plastic magazine for the AKM assault rifle, for example, indicates that the resin-impregnated fiberglass magazine shell is hand-laid over the mold block. This is prohibitively slow and expensive unless one has to provide work for people.

Soviet arsenals, however, also use precision gun castings molded in almost finished form, eliminating many hours of machining operations. The PKM front sight, gas cylinder, barrel adapter, feed tray, operating slide and rear sight leaf are examples of precision-cast parts.

The Soviets use hard chrome plating to increase wear life by protecting parts exposed to corrosive propellant gases, including the barrel bore, gas piston, interior of the gas cylinder, and exterior of the rear of the barrel. The stocks are made of durable resin-impregnated plywood.

Little use is made of plastics in small arms except for nonstressed components, such as magazines, pistol grips, carrying handles and hand guards, and there is no known use of lightweight alloys.

HAROLD E. JOHNSON, a native of Brooklyn, NY, is a small arms specialist for the U.S. Army Foreign Science and Technology Center at Charlottesville, VA, an element of the Army Materiel Command. Primarily responsible for the FSTC assessment of foreign small arms and automatic guns for almost 10 years, he has authored many official publications and reports, including the widely disseminated Small Arms Identification and Operation Guide, Free World and Communist World.

Advice to Readers: Submit DA Form 12-5!

Some Army Research and Development Newsmagazine readers—in fact, a disturbing large percentage of them—may be chagrined in the near future when they find they have been dropped from distribution due to negligence.

If their requirements have not been certified by submission of the new DA Form 12-5 (successor to DA Form 12-4) to the Adjutant General Center, in accordance with Army Regulation 310-2, those accustomed to receiving the Army Research and Development Newsmagazine are due for a disappointment.

A recent check with the Office of The Adjutant General in the Forrestal Building, Washington, DC, showed that the submitted requirements under the new "Pinpoint Formula Distribution Plan" totaled only about 56 percent of DA 12-4 requirements that are now obsolete for the Newsmagazine print order.

Moreover, the Department of the Army periodicals review and authorization process is screening out about 25 to 33 percent (for some periodicals) of the requirements submitted on the new DA Form 12-5.

The Newsmagazine is directed primarily to Army R&D scientists, engineers, technicians and supervisors at laboratory and bench level, and top management personnel. The basis for distribution is one copy for each officer (LTC and above) directly involved in R&D activities, one copy for each civilian (GS-13 and above) directly involved in R&D activities, and one copy for each six officers or civilians in the lower grades.

Doxey Named 'Man of the Year'

"Man of the Year" recognition was accorded W. L. Doxey, consultant to the commander of the Army Electronics Command, by the Institute of Electrical and Electronic Engineers during the IEEE Coast Aerospace and Electronic Systems Conference.

W. L. Doxey

Doxey has served as a consultant since he retired last June 30 after 34 years of military and civilian federal service. During 29 years with the Electronics Command and its predecessor organizations, he served in numerous management positions, including associate director for Development and Engineering, technical director and director of Research and Development.

New Technology for Radar Pulse Compression

By Archie Gold & Ernest Stern

• *To enable a missile-defense radar to pinpoint all the targets in its beam, even targets only 0.5 meter apart, and to measure the actual length of larger targets within 0.5 meter. . . .*

• *To shrink eight full-size relay racks of electronics to a single 10-inch panel —a 50-to-1 reduction in size—with a comparable reduction in cost. . . .*

These are among the remarkable results achieved by application of a new technology developed for the Army's Ballistic Missile Defense Advanced Technology Center (BMDATC) by the Lincoln Laboratory, Massachusetts Institute of Technology (MIT).

Using wide-bandwidth elastic waves on the surface of piezoelectric crystals, the dual Reflect Array Pulse Compressor (RAC-B) unit shown in Figure 1 supplants the equivalent of eight 7-foot relay racks of conventional electronics.

The RAC concept provides, for the first time, the ability to resolve and measure the length of relatively small, closely spaced radar targets at all ranges, with compact, low-power devices, at a reasonable price.

A pulse compressor is a vital element in a high-sensitivity, high-resolution missile-defense radar, since it enables the radar to satisfy two essential, apparently contradictory requirements.

For high *sensitivity*, the radar pulses must be of *long* duration, to carry enough energy to produce detectable echoes from small, distant targets. For high *resolution*, on the other hand, the radar pulses must be very *short*, to resolve individual, closely spaced targets.

Pulse compression enables the radar to use a long transmitted pulse and then to shrink the received echo pulse into a time interval several thousand times shorter than the transmitted pulse.

Pulse compression usually is accomplished by transmitting relatively long "chirp" pulses in which the frequency is swept upward, so that the lower frequencies precede the higher frequencies to and from the target.

Received (target echo) pulses are processed through a device that introduces a time-delay that decreases as the frequency increases. The trailing (high-frequency) end of each pulse catches up with the leading (low-frequency) end of the pulse, and the pulse is shortened or compressed in time.

At radar frequencies, this usually requires a length of coaxial cable equivalent to the length of the pulse, with frequency-selective taps along the cable at intervals corresponding to the desired time delays.

A system of this type is necessarily large, intricate and costly if it is designed for the wide bandwidths and large time-delays needed for a long-range, high-resolution missile-defense radar: a cable thousands of feet in length, plus a large number of high-performance filters and auxiliary amplifiers to compensate for transmission losses along the cable.

A. Gold is with the Ballistic Missile Defense Program Office (BMDPO). E. Stern is with the Massachusetts Institute of Technology (MIT) Lincoln Laboratory.

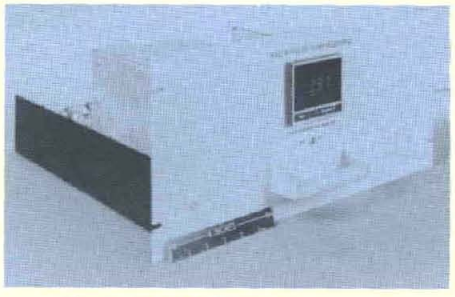
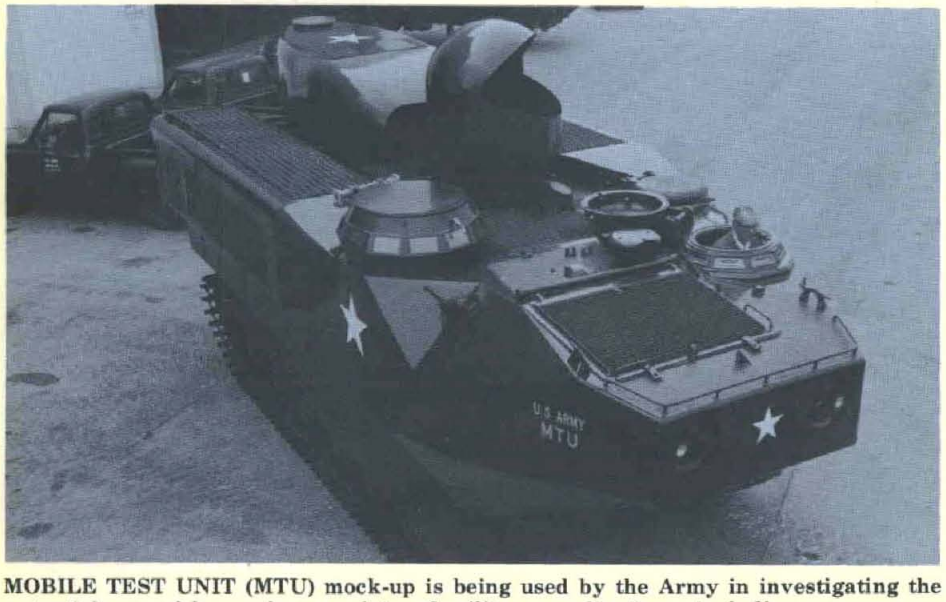


Fig. 1. RAC-B Pulse Compressor



MOBILE TEST UNIT (MTU) mock-up is being used by the Army in investigating the potential use of lasers in a variety of military applications, including weapons, as part of the Department of Defense laser research program. The Army's research effort is being directed by the Army High Energy Laser Programs Office, U.S. Army Missile Research, Development and Engineering Laboratory, U.S. Army Missile Command.

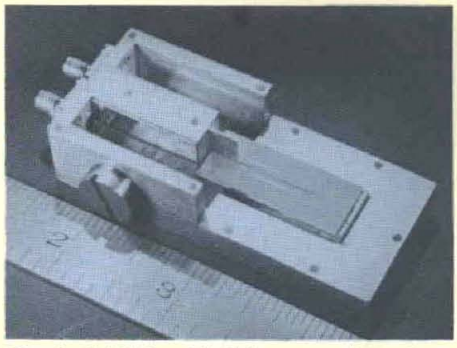


Fig. 2. RAC-B with lid removed to show electro-acoustic delay-line element.

The RAC-B converts radar signals into elastic waves that travel along the surface of a slab of crystal at a velocity 100,000 times slower than electromagnetic waves in a coaxial cable; thus, a slab of crystal a few inches long takes the place of thousands of feet of cable.

Reflective arrays of fine grooves etched into the surface of the crystal perform the function of frequency-selective filters. Booster amplifiers are unnecessary, since the loss-per-wavelength along the crystal is several hundred times less than along a coaxial cable.

Figure 2 shows the complete electro-acoustic delay-line element from a RAC compressor, including input and output transducers, the two reflective arrays of grooves (bright lines) and a variable-width metal film (dark line) for phase compensation.

The RAC-B unit shown in Figure 1 has two such elements, sealed and mounted in temperature-control ovens, and two solid-state amplifiers. It is installed in the high-resolution ALCOR (ARPA/Lincoln C-band Observable Radar) measurements radar system, which can resolve targets less than 0.5 meter apart.

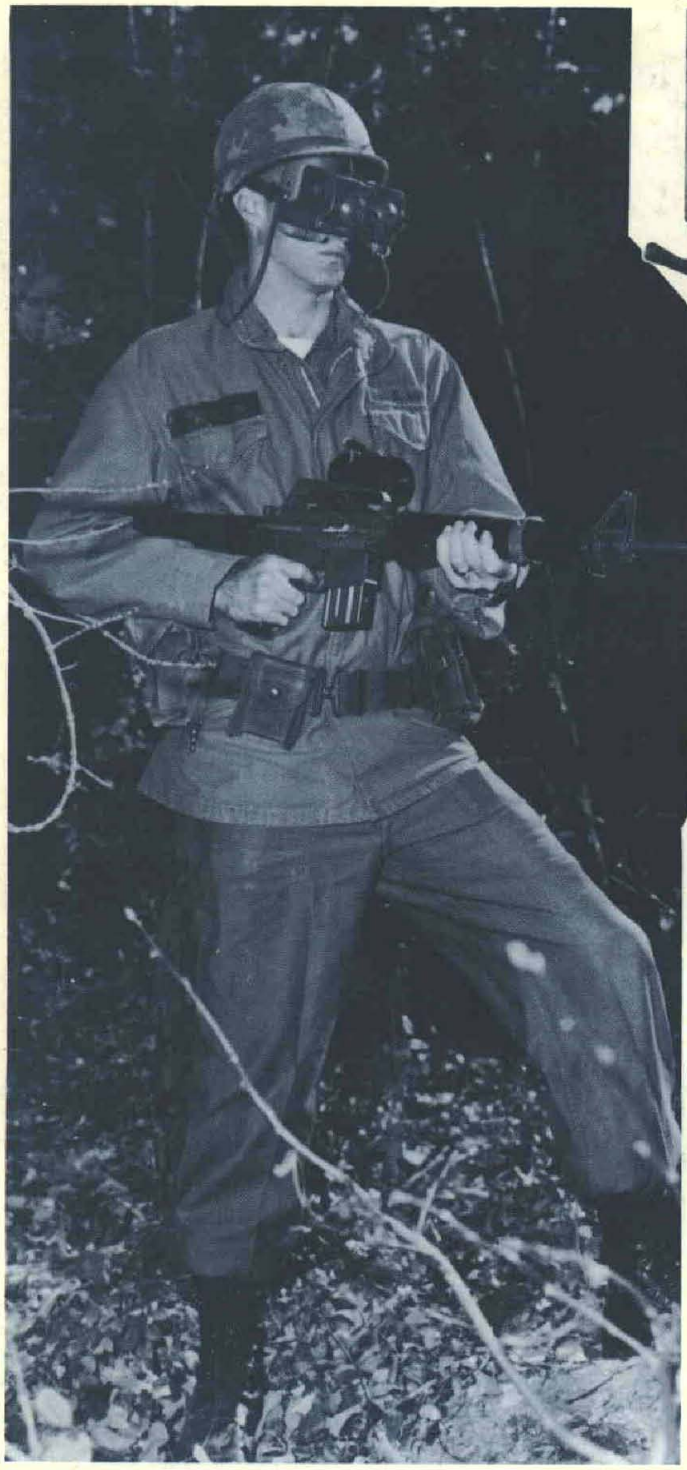
The ALCOR radar is located at the Kiernan Reentry Measurements Site on Kwajalein Missile Range. In this installation, one RAC element supplants four 7-foot relay racks of conventional electronics, with comparable performance characteristics:

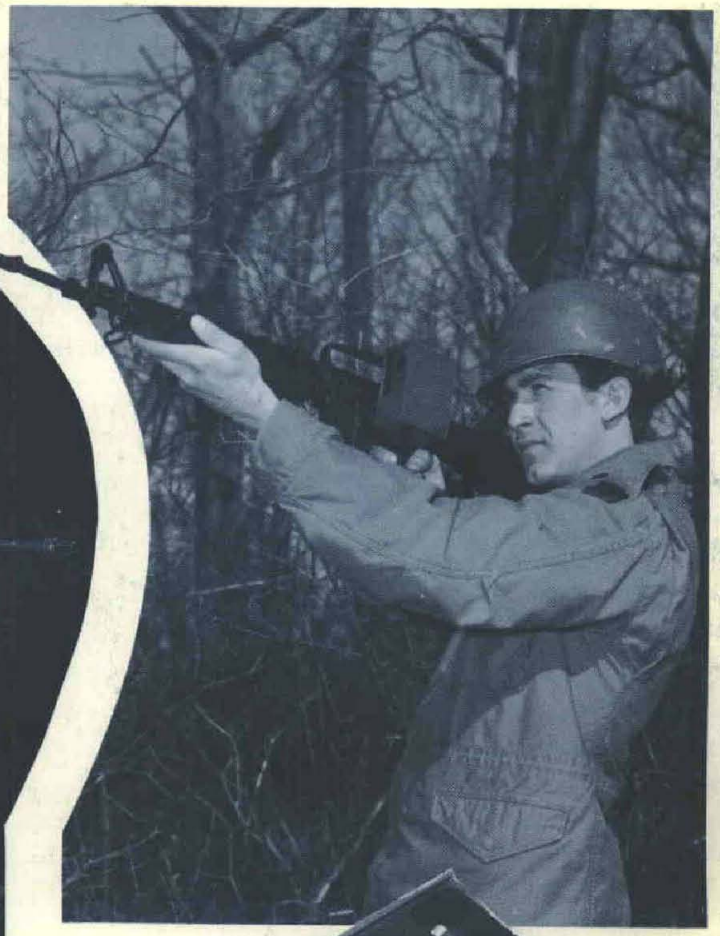
Compression:	10 microseconds to 2.6 nanoseconds
Bandwidth:	512 Megahertz
Sidelobes:	at least 28 db below signal
Phase error:	3 degrees (average)
Amplitude error:	0.5 db

The wide-bandwidth electro-acoustic technology developed at Lincoln Laboratory has also been used in other applications. Reflective-array gratings have been used to fabricate a compact, high-performance 16-element bandpass filter bank for a real-time radar-frequency spectrum analyzer in a missile-borne adaptive jammer.

Using a silicon slab mounted very close to the crystal surface, a newly developed adaptive analog signal-processing device generates the convolution of two input signals. This technique is being applied to the development of a memory correlator for processing many different radar waveforms.

Wide-bandwidth acoustic surface-wave technology has many other important potential uses, but probably none as significant or as dramatic as its contributions to advanced ABM radar systems.





ELECTRONICS-COMMUNICATIONS is recognized by Department of Defense and Department of the Army research and development leaders as one of the most critical areas for exploitation of advanced technology to produce superior equipment at the lowest practicable cost. The U.S. Army Electronics Command, headquartered at Fort Monmouth, NJ, has long been recognized as a pacesetter in advancing this technology. Shown here are two significant advances in materiel—night vision goggles using image intensification technology and (right) a Laser Mini-Rangefinder, cited by the ECOM director of Laboratories and Research, as one of the five "most noteworthy technical achievements" FY 74-75. The lower picture shows the miniaturization of the Mini-Rangefinder.

(Please turn to page 8 for a feature article on the Electronics Command.)