H D L Marks 20 Years of R&D Defense Achievements

Relocation Begins this Fall
To New $42.8 Million Complex
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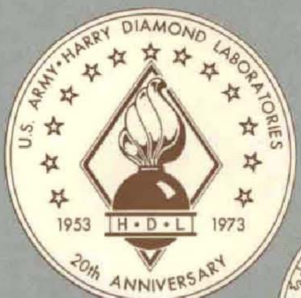
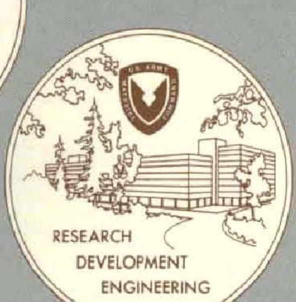




ARMY RESEARCH AND DEVELOPMENT

September–October 1973

SPEAKING ON . . .

Design to Cost: Department of Defense Concepts


LTG Robert E. Coffin

Design to a Cost is a Department of Defense mandate as applied to new materiel systems these days—meaning to produce the most effective systems possible within funding resources that can be provided. In a recent major address to the National Contract Management Association, LTG Robert E. Coffin, Deputy Director of Defense Research and Engineering (Acquisition Management), discussed Department of Defense concepts related to this topic.

★ ★ ★

. . . Just a year ago the Director of Defense Research and Engineering, Dr. John Foster, brought you an urgent message at your eleventh annual symposium. He said: "We must change the way we do business—in the Government and in Defense industry—or the things that you sell and we want to buy will grow to be too expensive to provide an adequate national defense under limited funding."

In a memorandum dated June 18, 1973, Deputy Secretary of Defense Clements told the Services: "It is the intent that in the future *all* new major programs will have established Design to a Cost goals."

The dollars spent for U.S. national defense this fiscal year will have the lowest buying power since 1951; manpower in the national defense will be at its lowest level since 1950. But the threat we face has not lessened. Our need for new and better defense systems is greater now than ever before.

We will have to reverse the upward trend of unit costs, or we will be faced with the undesirable choice of asking for substantial funding increases or further cutting force levels. I believe that significant Defense funding increases, beyond inflation adjustments, are unlikely. The alternative of reducing force levels will be against the long-term interests of the United States.

We need to change our way of doing business. We intend to make cost a full partner of performance and schedule. We will look at changing the forecasting techniques used within Defense in an effort to improve our own understanding of the probable future penalties of excessive systems costs. We will also improve our cost data system to increase visibility of the direct and indirect costs of owning and operating our large weapons systems. We will look at improving further our own independent costing techniques, and of encouraging industry to become more cost conscious, especially within their engineering design staffs.

We intend to develop methods for increasing the realism of our "requirements" levied on new systems. We will look at where increased R&D funding can lead to lower cost alternatives at both the system and subsystem level. We will look at means of increasing competition throughout development and procurement. We will look at means of reducing the costs of spares and provisioning. We will take another serious look to see if we can find areas in which we can cut back on Defense demands which lead to unnecessary overhead burdens with the contractors.

The policies in DoD Directive 5000.1 are moving us closer to commercial practice, but we must not lose sight of the need to perform in military environments. In Design to a Cost, we are making cost a major design criterion with performance, but not at the sacrifice of reliability.

We believe that low production costs and reliability are designed into a system, not achieved later. As you know, early operational failures are largely attributable to manufacturing errors. Those which occur later, and are subject to warranties, are likely to be the result of design shortcomings. Designing in reliability is done all the time in the commercial sector, especially by companies that service their own equipment—so, why can't it be done in military equipment?

In order to get a more complete perspective on the subject of Design-to-Cost, Dr. Foster last August chartered a Defense Science Board Task Force, under the chairmanship of Mr. J. Fred Bucy, executive vice president of Texas Instruments, to report to the Secretary of Defense as follows: first, an analysis of "Design to a Cost" as it is generally practiced in the commercial sector; second, a cross-comparison with the acquisition practices that now exist in the defense sector; and third, recommended actions that could better utilize commercial Design to a Cost principles and practices in defense systems acquisition.

The Defense Science Board Report of Task Force on Reducing Costs of Defense Systems Acquisition, "Design-to-Cost, Commercial Practice vs. Department of Defense Practice," dated Mar. 15, 1973, was the result. The report was printed by the Government Printing Office after being reviewed and released by the Deputy Secretary, Mr. Clements, on May 14. He found the report "particularly stimulating and worthwhile." The report is available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, under Order Number D1.2: C82/2, for 85 cents postpaid. I will briefly describe its contents.

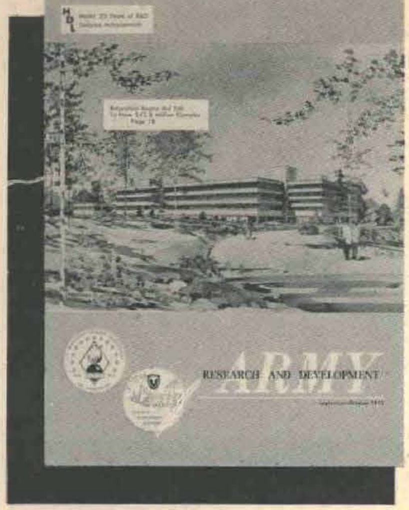
There were 13 members of the Task Force. All are prominent men who represent a cross-section of commercial industry—aerospace, electronics, transportation, and construction. The members also contributed widely varied personal backgrounds, including engineering, finance, operations, and management. Before entering into the discussion of the committee's findings and recommendations, let's examine the scope of the Design to a Cost problem the Task Force was considering. DoD Directive 5000.1 which has been widely discussed, has perhaps the best outline of what is meant by the expression "Design to a Cost" in the realm of military systems. The key thoughts from 5000.1 are:

- The costs of the system shall be broadly defined to include the cost of ownership and use, not merely original acquisition cost.
- Before a system goes into development, cost is to be established as a design objective which becomes one of the principal focuses of the requirement definition process.
- 5000.1 implies that it shall be the policy of the DoD to place emphasis on altering or modifying performance requirements and schedule requirements when necessary to adhere to the design cost objective. This statement tends to focus attention on the requirements definition and the design in a technical sense.

It is important to note, however, that, in the work of the Task Force, it was not their view that the technical aspects of arriving at an appropriate cost objective or its consonant design was the principal problem obstructing cost-effective weapon systems. Rather, the Task Force directed most of its attention and recommendations to a larger problem; that of structuring the management philosophy and practices of DoD in a manner which permits and encourages effective use of the technical tools which do exist, however imperfect these tools may be. They suggest that the relationship between DoD and industry must be restructured to motivate contractors to *reduce* costs rather than *justify* them.

The current wave of interest in the idea of Design to a Cost is both encouraging and alarming to commercial industry people. To some, the emphasis is centered on design of the product to its performance requirements, such as speed, range, payload and so on. This is a very narrow focus. Product costs are a function of *all* elements of a program and significant leverage on costs can

(Continued on page 26)



ABOUT THE COVER:

Scheduled for full occupancy in December 1975, with the first increment of about 500 employes scheduled this November, the new R&D environment of about 1,400 Harry Diamond Laboratories scientists, engineers and support personnell will be one of the most modern R&D complexes in the nation. Located on the grounds of the Naval Ordnance Laboratory, the complex will facilitate a close working relationship between the major R&D laboratories.

Editor . . . . **Clarence T. Smith**
Associate Editor . **George J. Makuta**
Editorial Assistant . .**Harvey Bleicher**

Published bimonthly by the Plans and Programs Division of the Research, Development and Engineering Directorate, HQ U.S. Army Materiel Command, Alexandria, VA, in coordination with the Technical and Industrial Liaison Team, Office of the Chief of Research and Development, HQ Department of the Army, to serve all elements of the U.S. Army R&D community.

Grateful acknowledgement is made for the valuable assistance of Information Offices within the Army Materiel Command, Office of the Surgeon General, Office of the Chief of Engineers, Army Training and Doctrine Command, Army Forces Command, Office of the Assistant Chief of Staff for Force Development, Office of the Assistant Chief of Staff for Communications-Electronics, Computer Systems Command, and miscellaneous related activities. Use of funds for printing of this publication has been approved by the Department of the Army, Jan. 1, 1972.

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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Submission of Material: All articles submitted for publication must be channeled through the technical liaison or public information officer at installation or command level.

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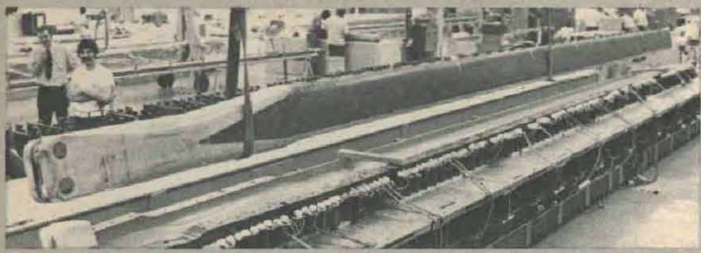
Selective Scanner...

Largest Known Rotor Blade Targeted for HLH



LARGEST helicopter rotor-blade spar is removed from die.

Designed for the U.S. Army Heavy Lift Helicopter Advanced Technology Component (HLH-ATC) program, the largest known composite helicopter rotor blade, a 41.5-foot spar weighing 570 pounds, has been assembled and cured.

The titanium nose cap is termed the "largest creep-formed titanium component known to the aircraft industry." Used in the spar is a fiberglass and graphite fiber closed "D" construction in conjunction with a 4-lug all-fiberglass root-end that is reported by Boeing Vertol Co. to have "surpassed all fatigue and static testing goals established to date."

The closed "D" spar configuration was used because it has the highest torsional stiffness per pound and results in a complete, fully inspectable assembly. The spar is capable of housing a pneumatic failure-detection system.

Originally designed as a tool-proving specimen, this first spar is reported by Boeing-Vertol to be of such high quality as to permit its use, after the trailing edge assembly is added, as a fatigue specimen. This will save the cost of another spar for fatigue test purposes when the blades are placed in a whirltest.

Boeing Vertol was selected to design, build and demonstrate advanced technology components for a multiservice HLH for the U.S. military services in 1971. Early this year, a contract modification authorized the design, development and flight evaluation of a HLH prototype. The first flight is set for August 1975.

$3 Million Awarded for Camouflage Research

Improved camouflage and countersurveillance technology, materials, and techniques for ground forces are the objectives of a recent $3 million research contract awarded by the U.S. Army Mobility Equipment R&D Center (MERDC), Fort Belvoir, VA.

Scientists will collect, analyze and catalog information relating to the tactics and strategies that establish the needs and logical utilization of such materials, equipment and techniques.

MERDC officials said the Army program will advance the United States capability to achieve acceptable levels of force survival by developing near- and long-term means of minimizing enemy identification and location of U.S. ground forces.

Results are expected to provide a means to establish an active countersurveillance technology center for RDT&E support.

MICOM Assumes 2.75-Inch Rocket Management

Responsibilities for project management of the 2.75-inch rocket system were transferred effective Sept. 1 from Picatinny Arsenal, Dover, NJ, to HQ U.S. Army Missile Command, Redstone Arsenal, AL.

MICOM has assumed research, development, procurement and life-cycle activities for the Army, with responsibility for procurement, production and delivery of all 2.75-inch rocket components for the Navy, Air Force and Marine Corps.

The 2.75-inch rocket system has been adapted to both fixed- and rotary-wing aircraft and was used extensively in Vietnam in air-to-ground operations. More than 30,000,000 have been produced since the program was initiated in 1965.

Several exploratory development programs are currently under to extend its effectiveness well into the 1980s.

HDL Unveils New Mortar Alignment Sensor

Demonstration of a breadboard model of a new mortar alignment sensor, as reported recently by the U.S. Army Materiel Command Harry Diamond Laboratories, permits rapid and accurate reaiming following baseplate movement.

The sensor uses a light source located about five feet in front of the mortar which is directed onto a mirror attached to the barrel. The mirror reflects the light back onto a viewing screen perpendicular to and surrounding the light source.

Initially, the system is set up so that the crossline image of the source is superimposed with the crossline marking on the viewing screen. Any subsequent displacement of the crossline due to mortar movement is corrected by the azimuth and elevation controls of the mortar.

The system eliminates the telescopic sight and distant aiming stakes used in present mortar firing methods and replaces them with a close-in setup for rapid and accurate mortar firings.

Corps of Engineers Issues Recreational Guides

Six regional recreation folders containing color maps and guides to 400 recreational areas were published recently by the U.S. Army Corps of Engineers.

The "Lakeside Recreation" folders provide directions to the Corps-operated areas, list available facilities and designate major cities, interstate highways and national parks and forests.

The regional areas are New England, the Northeast, the Southeast, the Northwest, the Southwest, and the West. Copies may be obtained free from all Army Corps of Engineers Divisions, Districts and the Public Affairs Office, Chief of Engineers, Washington, DC 20314.

STRATCOM Manages Air Traffic Facilities

Responsibilities for operation and maintenance of air traffic control tower facilities and navigational aids at Army airfields and heliports have been assigned to the U.S. Army Strategic Communication Command (STRATCOM), Fort Huachuca, AZ.

Designed to provide centralized management for the Army's air traffic control mission, the move is effecting subordinate elements in CONUS, Alaska and Panama (41 in all), Europe (32) and the Pacific (10).

A key function in the realignment is the development and implementation of an over-all systems approach. The change makes STRATCOM Commander MG Jack Albright the designated combat developer and user of ground air traffic control navigational aids, facilities and systems. COL Lloyd J. Petty is chief of the new ATC staff element.

Transferred to STRATCOM are the U.S. Army Aeronautical Services Office (USAASO), formerly an activitiy of the Office of the Assistant Chief of Staff for Force Development, HQ DA, three Army air traffic central companies, and air traffic control personnel and facilities at all Army installations.

EPA Redesignates Research, Monitoring Office

Enhanced responsiveness to over-all needs is the stated purpose of the reorganization of the U.S. Environmental Protection Agency's Office of Research and Monitoring.

Renamed the Office of Research and Development, the new organization remains under the direction of EPA assistant administrator Stanley M. Greenfield and consists of four main units.

Research and engineering strategies are assigned to the Office of Program Integration, headed by Dr. Leland D. Attaway, while the research, development and demonstration pollution control program is managed by the Office of Environmental Engineering, directed by Albert C. Trakowski.

The Office of Environmental Sciences, directed by Dr. Herbert L. Wiser, will develop criteria for environmental control quality standards and identify problems in need of control actions. Measurement and monitoring equipment, techniques and systems are assigned to the Office of Monitoring Systems, headed by William B. Foster.

EPA Expanding Water Pollution Control Efforts

Army-wide efforts to control and abate water pollution are expanding rapidly in scope and in cost, but the nation's over-all program directed to this objective is reflected by $3.1 billion in FY 1973 grants by the U.S. Environmental Protection Agency.

The EPA announcement late in July stated that this huge investment in achieving future clean water goals is financing the building or modernization of some 3,500 water treatment plants by cities and states. Since the EPA was established in December 1970, it has obligated about $4.4 billion for sewage disposal construction projects.

About one-half of the $3.1 billion awarded in FY 1973 was obligated in accordance with provisions of the Federal Water Pollution Control Act as amended Oct. 18, 1972. Changes were the most extensive and far-reaching since the first permanent water pollution control program was enacted by Congress in 1956. The other half of the $3.1 billion was awarded under the law prior to amendment.

Rapid expansion of the national effort is indicated by the EPA statistic that in FY 1972 only $990 million in grants was awarded for water and air pollution control, solid waste planning, and consolidated air, water and solid-waste programs.

Included in FY 1973 grants were 555 research and demonstration awards totaling more than $50 million, and 374 manpower development and training grants—about $12 million.

CSC Updates Guidelines for Logistics Employes

A new series definition and qualification standard published recently by the U.S. Civil Service Commission may affect a number of U.S. Army logistics field classifications.

Logistics Management Series, GS-346, includes work involved in planning, coordinating or evaluating logistical actions required to support a specified mission, weapons system or other designated program. It benefits Army employes by providing policy guidelines for complex logistics duties not adequately covered by existing standards.

Additionally, the Logistics Management Series incorporates into the career program system some high-level logistics positions not formally covered, notably in the GS-301 series.

At present there are no Army plans to establish a separate career program for the Logistics Management Series. Employes classified in the GS-346 series will remain in the career programs in which they are currently enrolled.

WES Completes $3 Million Computer System

What is believed the largest computer system dedicated solely to civil engineering operations, installed at a total cost of about $3 million, was completed recently to serve the U.S. Army Waterways Experiment Station (WES), Vicksburg, MS.

Installation of a $1.9 million Honeywell G-635 computer system culminated about six years of planning effort and continuing development, spanning the tours of three WES directors. The latest addition contains twin processing units with 192,000 bits of main memory and 170 million characters of random access.

Capable of performing 1,000,000 operations and utilized 401 hours during its first full month, the new system can process 15 different jobs simultaneously and return the data to the user over direct telephone lines.

Additionally, the unit constantly analyzes itself and types messages on the local operators console if a component is malfunctioning. Remote capabilities permit engineers at WES or any serviced office to achieve immediate access to computer data.

WES computers are servicing 27 Corps of Engineers offices and 231 engineers and scientists at WES and other units.

Device Monitors Cannon Tube Temperatures

A compact thermal device capable of measuring cannon tube temperatures, while providing a visual reading that alerts gun crew operators of excess heat, is a recent achievement of two Watervliet (NY) Arsenal employes.

Developed by mechanical engineer Richard B. Hasenbein and designer Louis B. Rigaud, the device utilizes a mercury-filled primary sensor, requires no external power source and is mounted directly on the weapon.

Designed for extremely rugged environments of vibration and shock-loading, as well as adverse weather conditions, the unit is intended primarily to ensure the safety of gun crews. Improved weapon capabilities are also expected with use of the device.

Initially developed for the 155mm howitzer, the new warning system is also applicable to numerous other weapons.

Ballistics Experts Discuss Ammo Interchange

TALKING IT OVER at Second Quadrilateral 155mm Ballistics Meeting are (from left) COL Heinrich Siebler, MG John R. Guthrie, COL John Stephenson, Robert Schwab, Dr. Robert J. Eichelberger and COL Sterling T. Post.

Ammunition interchangeability for new 155mm artillery weapon systems under development by member nations was the objective of the recent Second Quadrilateral 155mm Balllistics Meeting at Aberdeen (MD) Proving Ground.

The U.S. Army Ballistics Research Laboratory was the host and BRL Director Dr. Robert J. Eichelberger welcomed the participants. Representatives of the United Kingdom, Italy and Germany reported on the FH70 155mm system, a joint developmental effort. The U.S. gave a briefing on its XM198 system, a demonstration of which concluded the sessions.

The U.S. dignitaries included MG John R. Guthrie, U.S. Army Materiel Command deputy commander for Materiel Acquisition, Dr. Eichelberger and COL Sterling T. Post Jr., project manager, Cannon Artillery Weapon Systems, Army Armaments Command.

COL Heinrich Siebler, accompanied by Robert Schwab, headed the German delegation, with COL John Stephenson in the same role for the United Kingdom. COL Franco Chiesa was the leader of the Italian representatives.

Environmental Impact Curbs CE Projects

Since the enactment of the 1969 National Environmental Policy Act (NEPA), environmental reasons have necessitated changes in one out of every three recommendations in major U.S. Army Corps of Engineers studies.

MG John W. Morris, director of the Corps' national Civil Works Program, stated that environmental assessments were made for 500 projects in the construction and design stages, 200 studies and over 100 completed programs.

Actions were taken to minimize the environmental impact. NEPA has accelerated progress toward reorienting staff attitudes for a better balance between economic, environmental, social and other important considerations included in the public interest, MG Morris said, adding:

"The Corps' goal in our Civil Works mission is to get the public more involved in the decision-making process. I feel we have come a long way in the last three years and we are gratified with the assistance we are receiving from a number of governmental agencies and environmenral groups and individuals. We must continually strive to get all segments of the public involved in the planning process of our projects . . . where there will be a free exchange of ideas of the pro's and con's, and can iron out the differences during the planning process."

Army R&D Achievement Awards . . .

40 Team Members, 10 Individuals Recognized For In-House Advanced Technology Contributions

U.S. Army Research and Development Achievement Awards for 1973, the most prestigious recognition the Army bestows annually upon in-house laboratory personnel for significant contributions to advanced technology, will honor 40 members of 9 teams and 10 individuals.

New Chief of Research and Development (CRD) LTG John R. Deane Jr., who succeeded LTG William C. Gribble Jr. in August, will join with Deputy CRD MG George Sammet Jr. and Army Chief Scientist Dr. Marvin E. Lasser in presenting the awards during the next few months at Army installations where the winners are employed.

Following the criteria established in 1961, the 13th annual Army R&D Achievement Awards will be presented on the basis of accomplishments that provide for subsequent technical improvements of military importance; materially improve the Army's technical capability; and/or contribute materially to the national welfare.

Ten researchers will receive the award for developing the technology for night-vision goggles. The Awards Board felt that the contribution of each of the coworkers was of significant value and that the award to such a large group (the previous high was seven) was warranted.

Other team effort awards went to seven men for research on cartridge cases in high-performance, small-caliber ammunition; six investigators for work on antitank projectiles; and five men for design of a dual-purpose 40mm projectile.

Other awards went to teams for development of mathematical analytical models; structural uranium alloy systems; gyros for Army missile systems; full-scale simulation systems; and new techniques for locating tactical positions.

Individual accomplishments ranged over many scientific disciplinary areas, such as medical research on techniques for measuring antibodies against meningococcal polysaccharides, to advancing the state-of-the-art in color photography.

The Army R&D Achievement Award consists of a distinctive wall plaque and a heavy cast-bronze medallion desk decoration that in 1972 replaced the lapel pin that had been awarded since 1961.

Nominations for 1973 awards were made by laboratory chiefs and approved by the commander of The Chief of Engineers, the Surgeon General, and the director of the Army Land Warfare Laboratory in their respective areas of responsibility.

Dr. Lasser chaired the panel of judges that selected the award winners. Other members included Dr. I. R. Hershner, scientific director of Army Research; Dr. Richard L. Haley and Dr. Vitalij Garber, scientific advisers to the Director of Developments, OCRD; COL Garrison Rapmund, chief, Life Sciences Office, and Dr. Valentine E. Zadnik, Environmental Sciences Office, Army Research Directorate; and LTC Hubert W. Lacquement, Combat Materiel Division, Developments Directorate.

The winners, a brief description of their achievements, and excerpts from their nomination citations follow:

ARMY MATERIEL COMMAND

U.S. Army Electronics Command (ECOM), Fort Monmouth, NJ. A 10-man team from the ECOM *Night Vision Laboratory*, Fort Belvoir, VA, was selected for development of the Night-Vision Goggles, AN/PVS-5. They provide the user with hands-free night vision for vehicle driving, helicopter NOE (Nap-of-Earth) flight, patrol, surveillance, map or instrument reading, and other cover-of darkness tasks.

The team that originated the concept and carried out the development of components and systems includes *Jasper C. Lupo, David K. Anderson, William Dincher, Robert L. Stone, Charles F. Freeman, Dr. Herbert Pollehn, Sen-Te Chow, Mack R. Farr, Nicholas Diakides* and *John Johnson.*

The device provides the user with an intensified visual image by incorporating state-of-the-art advances in microchannel technology. The 1.85-pound goggles do not require active infrared illumination for operation and thereby enhance the Army's ability to operate at night without detection. The goggles also are expected to have widespread civilian applications.

Dr. Pete H. Hudson, an engineer with the Electronics Technology and Devices Laboratory at ECOM HQ, was recognized for "two years of intensive research," in collaboration with MAJ Leo Rubin, cardiologist at Patterson Army Hospital, that resulted in development of an automatic "combined transvenous defibrillator and demand pacemaker."

The all-electronic prototype device consists of a transvenous catheter implanted within the heart, a microelectronic system for recognizing arrhythmias (irregular heartbeat patterns) an electric shock defibrillator system, and a conventional demand pacemaker.

The bedside unit monitors the heart's electrical activity and takes corrective action as needed to restore the heart beat to a "near normal condition with minimum trauma and medical surveillance . . ."

Army medics anticipate that, with subsequent system refinements, the widespread use of such a device in Army hospitals will reduce the need for highly specialized medical personnel required for surveillance and treatment of patients.

Louis J. Jasper Jr., physicist, Electronics Technology and Devices Laboratory, ECOM HQ, will receive an R&D Achievement Award for his invention of the "radial-beam amplifier." This is a new type of microwave tube that utilizes the interaction between an RF-wave guided by a spiral circuit and a radially propagating electron beam.

The multioctave instantaneous bandwidths made possible by this new amplifier, as well as corollary advantages such as simplicity, high reliability, and low cost, "will add significantly to the Army's technical capability."

Marilyn Levy, research chemist, Command Surveillance and Target Acquisition Laboratory, ECOM HQ, was recognized for completing two research programs "that advanced the state-of-the-art in color photography."

One method involves a unique formulation for processing color photographic material that reduces processing time from 53 minutes and 9 steps to only 11 minutes and 3 steps. The second development is a "very elegant and simple" procedure for producing color prints by eliminating the need for making test prints.

These technological advances enable employment of personnel with a minimum of training and experience; they also provide the Army with the capability of color photographs in military operations at a "considerable savings" to the government.

ARMAMENT COMMAND (ARMCOM), Rock Island, IL. *Dr. Edward J. Haug Jr.*, R&D Directorate, ARMCOM HQ, was selected for an Army R&D Achievement Award in recognition of design and demonstration of a constant recoil mount for heavy machineguns and his subsequent management of programs for its exploitation.

His automatic weapon mounting technique permits mounting of heavy machineguns on comparatively light rotary-wing aircraft. The constant recoil feature avoids vibration in the airframe and permits increased system effectiveness that was not possible with previous machinegun systems.

Allen E. Stern, James G. McCrory, Norman Regber, John W. Grogan, Donald Mesler and *Arnold S. Klein* of the Antitank Mine Section of the Ammunition Development and Engineering Directorate (ADED), *Picatinny Arsenal*, Dover, NJ, were selected for a team engineering achievement. They completed advanced development and proved the feasibility of the XM718 Artillery-Delivery Projectile/XM70 Antitank Mine.

Developers expect the XM718 to be the world's first antitank mine system of its type with "a new dimension" for Army tactical operations. With the XM718, tank-killer mines can be emplaced in minutes, as opposed to hours or days required for conventional mines. The mine has demonstrated it can detect and destroy any known armored vehicle, without direct contact, and can perforate the heaviest known armor protection.

Picatinny Arsenal's prestigious reputation for design and development of munitions and propellants was further enhanced by a 5-man team effort, all members of the ADED, that

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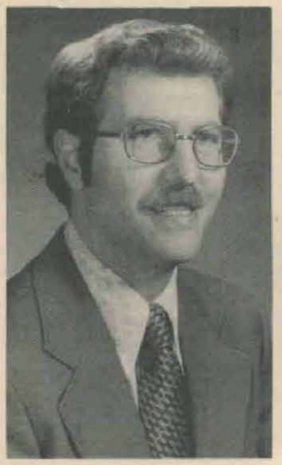
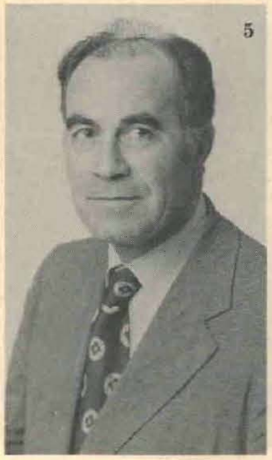
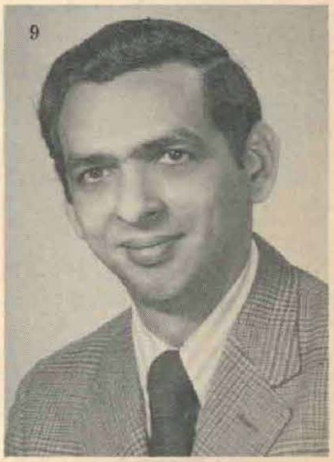
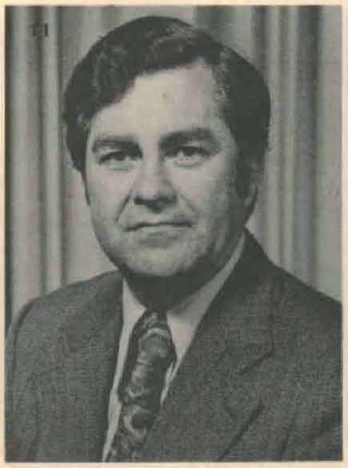




R&D Achievement Award Winners

AMC, ECOM, Fort Monmouth, NJ—Night Vision Laboratory, Fort Belvoir, VA. **(1) From left, Sen-Te Chow, Mack R. Farr, John Johnson, Dr. Herbert Pollehn, Charles F. Freeman, Robert L. Stone, Jasper C. Lupo, William Dincher, Nicholas Diakides, David K. Anderson. (2) Louis J. Jasper Jr. (3) Dr. Pete H. Hudson (4) Marilyn Levy.** *AMMRC, Watertown, MA.* **(5) Fortunato J. Rizzitano (6) Jacob Greenspan (7) Dr. David A. Colling.** *CE, WES, Vicksburg, MS.* **(8) Ellis K. Krinitzky (9) Dr. Jimmy P. Balsara.** *AMC, Frankford Arsenal, PA.* **(10) Top, from left, James R. Harris, Leonard W. Skochko, Marvin Rosenbaum, Thomas J. Hennessy. Below, from left, Henry P. George, Reed E. Donnard. Walter H. Squire is not shown.** *AMC, MICOM, Redstone Arsenal, AL.* **(11) Aubrey Rodgers (12) Rayburn K. Widner.**





Army Research & Development Achievement Awards

(Continued from page 4)

produced a small-caliber projectile that increases the firepower of infantrymen. Sharing the Army R&D Achievement Award for this feat are *Robert C. Smith, Wallace J. Harvey, Louis DeCaprio, William Kuhn* and *John Webb.*

The new dual-purpose 40mm projectile enables a soldier with an M79 or M203 grenade launcher to destroy lightly armored vehicles or enemy troops protected by hastily erected fortifications. These targets also can be attacked by a helicopter firing the new round from an automatic weapon.

The new projectile is designated the M433 cartridge when used with the shoulder-fired grenade launcher, and the M430 cartridge when used in the helicopter armament system. These rounds will replace earlier versions that had only antipersonnel capability.

Frankford (PA) Arsenal nominated a 7-man team that earned an R&D Achievement Award for demonstrating the feasibility of using aluminum cartridge cases in high-performance, small-caliber ammunition.

The team consists of *Reed E. Donnard, Leonard W. Skochko, Thomas J. Hennessy, Walter H. Squire, Marvin Rosenbaum, James R. Harris,* all with the Munitions Development and Engineering Directorate, and *Henry P. George* of the Pitman Dunn Laboratory.

Because of the team's work, the benefits of aluminum cartridge cases—an important ammunition weight reduction and a lessening of dependence on copper—can now be used in small-caliber ammunition applications.

Edgewood (MD) Arsenal selectees for R&D Achievement Awards are *Dr. Robert I. Ellin,* employed in the Biomedical Laboratory, and *Michael A. Parker,* Directorate of Development and Engineering.

Dr. Ellin was selected for his "persistency, dedication and attention to great detail required to perfect the analytical procedures of precise identification of minute yet active amounts of chemical agents."

His work is credited with determining that the rate of absorption and excretion of "Belladonna"-like compounds in animals and man "not only contributes to the knowledge of drug effects on the mind, but guarantees against misdiagnosis and confusion in treatment of persons exposed to this type of compound."

Parker was selected for his "significant technical contributions to the development of the 155mm binary projectile and similar items." The citation also states that his "achievements in new and imaginative application of theory to projectile design . . . are directly responsible for success of the projectile development. His creative thinking has provided practical solutions to the most difficult of the technical problems and laid the necessary groundwork for future design."

U.S. ARMY MISSILE COMMAND (MICOM). Aubrey Rodgers and *Rayburn K. Widner,* employed at the Missile RD&E Laboratory, Redstone Arsenal, AL, were honored for establishing a design basis for technical improvement of gyros for Army missile systems. Recognizing that a completely new approach was needed in design and fabrication techniques, they abandoned conventional concepts and analyzed the basics of gyro technology. The resulting gyro is credited with meeting the requirements of the most accurate directional control missile, and is producible at a "cost reduction of an order of magnitude" from previous designs.

U.S. ARMY TANK-*AUTOMOTIVE COMMAND (TACOM),* Warren, MI. *Howard J. Dugoff, Zoltan J. Janosi, Clifford J. Nuttall Jr.* and *Adam A. Rula* were selected to receive R&D Achievement Awards for their part in the development and application of an analytical model for predicting the off-road performance of military models.

The citation states "they have contributed to the successful completion of the WHEELS Study that led to the restructuring of the Army wheeled-vehicle fleet, with projected savings of $4.5 billion in procurement costs over the next 12 years."

Dugoff and Janosi are supervisory research mechanical engineers at TACOM. Nuttall and Rula are supervisory research civil engineers at the U.S. Army Corps of Engineers Waterways Experiment Station (WES), Vicksburg, MS.

SEPARATE AMC INSTALLATIONS. Harry Diamond Laboratories (HDL), Washington, DC. *George W. Walsh* and *Joseph V. Cuneo* were cited for their outstanding technical and managerial contribution to the national defense effort—in particular, the analysis of a threat air defense system and the development of a full-scale simulation of the Control, Tracking and Display Center for this system.

U.S. ARMY MATERIALS AND MECHANICS RESEARCH CENTER (AMMRC), Watertown, MA. *Fortunato J. Rizzitano, Jacob Greenspan* and *David A. Colling* will receive Army R&D Achievement Awards for work on structural uranium alloy systems, including small-caliber armor penetrators and the center body of the XM673 8-inch nuclear round.

This work, an outgrowth of progress at AMMRC in disciplines of metallurgical engineering, physical metallurgy, process development and scale-up, was cited as providing the Army with a basis for improved armor-piercing projectiles, and a basis for improved design for the XM673 nuclear projectile case.

OFFICE OF THE CHIEF OF ENGINEERS

U.S. Army Waterways Experiment Station, Vicksburg, MS. Two employes of WES were adjudged deserving of R&D Achievement Awards. *Dr. Jimmy P. Balsara* was selected primarily for verifying modeling relationships for buried structures subjected to dynamic overpressures, and applying such techniques in assessing the response of strategic structures associated with the Minuteman, Safeguard and other strategic missile systems.

Dr. Balsara devised modeling methods for testing small structures used in predicting the structural response and defining the interior shock environment of prototype structures. The citation states that this work "extends appreciably the state-of-the-art for modeling buried structures and represents a significant engineering achievement."

Ellis L. Krinitzky was selected for his work in using X-radiographic techniques in soils mechanics and earth sciences research, especially in "developing, establishing and promoting a highly valuable investigative technique concerned with the internal structure of clays and clay shales."

The technique is cited as permitting "the definition and delineation of internal stratification and structure entirely unsuspected by visual scanning or normal laboratory techniques."

Krinitsky's recent book on X-radiography

ABMDA Holds Laser Radar Applications Meet

Laser radar applications to ballistic missile defense were considered by more than 200 engineers and scientists at a 3-day symposium conducted by the U.S. Army Advanced Ballistic Missile Defense Agency (ABMDA) in the Westgate Research Park, McLean, VA.

Representatives of the Department of Defense, Department of the Army, Federal Contract Research Centers and industry attended the technical briefings and panel discussions devoted to systems applications, signatures and discrimination, and laser-radar technology. The symposium was conducted in the General Research Corp. facilities.

Martin Zlotnick of ABMDA stated in his introductory remarks:

"The symposium brings workers on laser-radar applications for BMD (Ballistic Missile Defense) into contact with specialists in the development of laser-radar technology—so that BMD workers can see more clearly what laser-radar technology is becoming available and . . . can appreciate better the requirements imposed by the BMD systems."

ABMDA has determined that with technology potentially available on a laboratory "brassboard" in 1976, a laser radar can make major qualitative improvements to BMD. This finding is the result of more than a year of intensive effort during which nearly $1,000,000 was expended on Army in-house laboratory and contractor research programs.

Executives and researchers in the ABMDA effort are anticipating that the application of laser radars can make "revolutionary improvements" in BMD if, as expected, the technological growth can be "extrapolated" to the post 1980 period. For the present, the main thrust of the FY 74 ABMDA program on laser-radar applications is in measuring signature data of threat components on the range and in the laboratory.

One goal of the FY 74 program is to demonstrate measurement of signature parameters for discrimination by using a wave-form consisting of a coherent train of very short pulses. A laboratory demonstration that a laser radar can maintain adequate signal-to-noise in a very intense gamma flux is also expected during FY 74.

The third day of the symposium was devoted to assessing the status of the program and recommendations for further work. The open sessions and panel discussions covering systems applications, signatures and discrimination, and laser-radar technology were led, respectively, by R. D. Williams of TRW Inc., Dr. R. S. Ruffine of ABMDA and Dr. R. Kingston, Lincoln Laboratory, MIT.

and its application to the earth sciences and soil mechanics is termed "an accepted reference on a new and rapidly developing research technology."

U.S. Army Engineer Topographic Laboratories (USAETL), Fort Belvoir, VA. *Joseph F. Hannigan* and *Mary Louise Powers* were selected for establishing the scientific basis for a new technique of locating tactical positions—such as artillery forward observers, artillery batteries, command posts, patrols and even automated remote sensors on the battlefield.

This capability, according to the award nomination, "can permit the location of any number of tactical positions in less than five minutes under all-weather conditions, is of significant military importance, and has potential peaceful applications" because it can be used to locate any number of observers with respect to any coordinate system.

OFFICE OF THE SURGEON GENERAL

Walter Reed Army Institute of Research (WRAIR), Walter Reed Army Medical Center (WRAMC), Washington, DC. *Brenda Lee Brandt* is credited with developing a "highly specific, exquisitely sensitive test for measuring antibodies in man and animals against meningococcal polysaccharides."

Called a radioactive antigen binding assay, the test is performed by adding measured amounts of purified radioactive polysaccharide antigen to small amounts of an individual's serum and then measuring the amount of radioactivity.

The radioactive binding assay, the citation states, has become the most important test for potency of group C meningococcal vaccines that have had a significant impact in eliminating group C meningitis in basic trainees in all the U.S. Armed Services.

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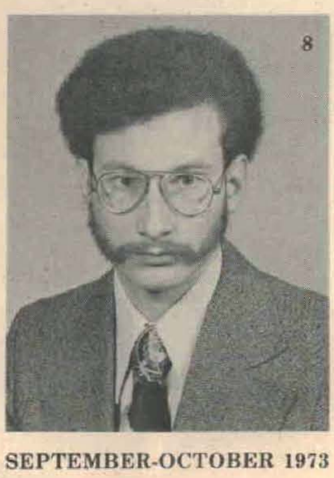

R&D Achievement Award Winners

AMC, Picatinny Arsenal, Dover, NJ.—(1) Top, from left, John W. Grogan, James G. McCrory, Norman Regber, Arnold Klein; below, Donald Mesler and Allen E. Stern. (2) Top, from left, Louis DeCaprio, Wallace J. Harvey, John H. Webb; below, Robert C. Smith, William J. Kuhn Jr. _ARMCOM, Rock Island, IL._—(3) Dr. Edward J. Haug Jr. _OTSG, WRAMC, Washington, DC._—(4) Brenda Lee Brandt. _CE, USAETL, Fort Belvoir, VA._—(5) Joseph F. Hannigan. _HDL, Washington, DC._—(6) Joseph V. Cuneo and George W. Walsh. _TACOM, Warren, MI._—(7) Howard J. Dugoff. _AMC, Edgewood Arsenal, MD._—(8) Michael A. Parker—(9) Dr. Robert I. Ellin.

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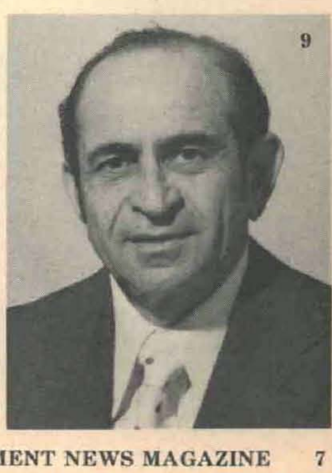


R&D News . . .

WES Applying Hydraulic Modeling for Landslide Impact Predictions

Ability to predict the nature and behavior of waves created when a large mass of earth and rock slides rapidly downward into a lake or reservoir has been advanced substantially by research using hydraulic modeling at the U.S. Army Waterways Experiment Station.

The Corps of Engineers facility at Vicksburg, MS, announced that the investigation, termed the first of its kind in the United States, was fully successful in respect to objectives. Results add to the WES use of hydraulic modeling to establish effects of tsunamis, hurricane tides, floods and earthquakes in its laboratory complex.

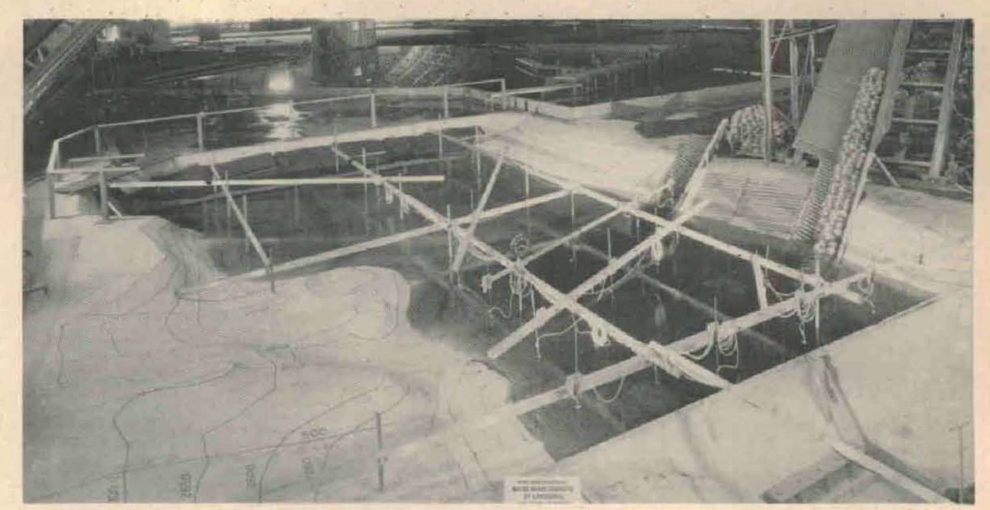
Information gained in the experimentation finds application in the consideration by architects and engineers of the importance of site selection, feasibility of construction, costs, maintenance of structure, and safety.

Information on wave characteristics was requested by the Seattle District of the Corps of Engineers because of concern for possible landslide areas at the Libby Dam reservoir under construction in northwestern Montana. Increased knowledge of this hydraulic phenomena was needed with respect to careful planning and watchful maintenance for safe operation of the dam and the surrounding public recreation areas.

A 3-dimensional model duplicated Libby Dam and portions of both Lake Koocanusa and the Kootenai River to scale of one foot on the model representing 120 feet in nature.

The entire model area, 2,300 square feet, recreated in miniature the dam and the reservoir topography for about one mile upstream and 1,200 feet downstream of the dam. The overbank of the model was reproduced to an elevation of 2,700 feet mean sea level. A mechanical slide mechanism provided support for higher landslide areas.

Slides from four possible landslide locations upstream of the dam were reproduced in the model by sliding scaled landslide masses, made up of small bags of iron ore and lead, into the model at various speeds. A few tests were also conducted for gravel and concrete cubes to represent a debris slide. The largest possible landslide reproduced on the model represented 4¾ million cubic yards in nature.



IRON ORE sliding down roller mechanism (top, r.) simulates Libby Reservoir landslide.

Wave data were measured at various locations over the reservoir to determine the magnitude of wave heights, runup, overtopping, and wave pressures on the powerhouse if overtopping of the dam occurred for the expected landslides.

Model tests pointed out the wave heights and runup to be expected at various reservoir pool elevations. Remedial plans proposed by the Seattle District for reducing possible landslide volumes and velocities were checked on the model to see if corrective measures would lower the wave heights as desired.

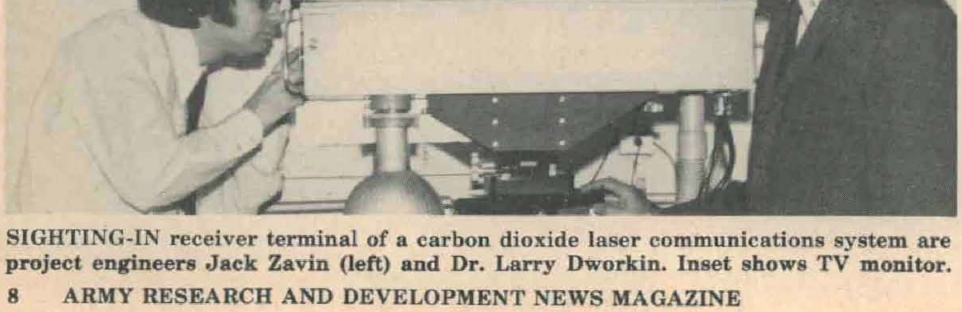
The tests consisted of the use of tendons to secure possible landslide material to the slopes; excavation of the material from the slopes, buttressing of the toe of the possible landslide areas to prevent sliding; and installation of a wave trap at the right abutment of the dam in conjunction with buttressing of the toe to prevent excessive wave runup on the west banks, thus preventing water from running around the west end of the dam.

The model has also contributed to general knowledge on landslides by showing that resulting wave heights are critically dependent on the speed of the slide and less sensitive to the alignment and dispersion of the slide.

ECOM Develops Laser Communications Field Unit

Development of what is termed "the first carbon dioxide laser communications system capable of field use" has been announced by the U.S. Army Electronics Command, Fort Monmouth, NJ.

Testing of the system to date has established that it is capable of sending up to 100 separate telephone channels simultaneously over a 5-mile path through all but the most severe weather conditions. Additional research and development effort is needed to make the system operational.



SIGHTING-IN receiver terminal of a carbon dioxide laser communications system are project engineers Jack Zavin (left) and Dr. Larry Dworkin. Inset shows TV monitor.

The transmitter terminal uses a metal-ceramic CO_2 laser carried beam. An FM intercavity cadmium-telluride modulator crystal puts the electronic incoming information on the carrier beam for operation in the far-infrared. Another laser amplifies the signal in the receiver and a liquid nitrogen-cooled mercury-cadmium-telluride detector converts the infrared light back to an electronic signal.

The two terminals are initially aligned by powerful telescopes on each unit for line-of-sight operation. Final adjustment to maximize signal strength is made by moving a beam-steering mirror.

The developers report that the system uses little power, is compatible with present operational digital communications systems, and offers advantages of lighter weight, smaller size and reduced cost compared to present microwave systems.

Laser communications systems achieve a much greater flow of information without adding to the frequency congestion problem incident to microwave systems, the developers pointed out. Further, the narrow laser beam-width makes detection and interception "extremely difficult."

The contract developers, Hughes Laboratories, anticipate that future laser devices may be able to handle up to 20 times as much data as the present model.

AEHA Combating Pollution Hazards Through Environmental Engineering

Pollution abatement and control activities are much in the national focus these days as environmentalists strive to achieve clean air, water and other conditions viable with public health interests and enjoyment. The U.S. Army Environmental Hygiene Agency, however, has been concerned with these problems for about 30 years.

Located at Edgewood Arsenal, a part of Aberdeen (MD) Proving Ground, the USAEHA has long worked to insure that over-all conditions at U.S. Army installations and their impact on adjacent civilian communities—particularly as related to disposal of waste from manufacture of munitions—establish high standards.

The USAEHA professional staff is concerned with a broader range of mission responsibilities than clean air, clean navigable and recreation waters, and clean living conditions generally. They are involved in problems of occupational medicine, solid-waste management, and radiation sciences, including laser and microwave hazards.

One of the USAEHA's four directorates provides laboratory services. This support embraces industrial, radiological and biological chemistry, toxicology, pesticide control and other scientific work.

The USAEHA Air Pollution Engineering Division of the Environmental Quality Directorate is currently one of the Amy's busiest activities. Its troubleshooting teams working on control measures survey air quality at U.S. Army installations worldwide.

ENVIRONMENTAL ENGINEERING. "We're probably more experienced in air pollution technology than most other groups by virtue of having been in it so long," states MAJ Robert J. Murphy, a PhD environmental engineer with the Air Pollution Engineering Division.

The AEHA had been studying air pollution for about a quarter of a century when the division was created in 1966. Most of its work involves (1) advising installation commanders on how to meet air quality standards and (2) studying unusual munitions plant emissions.

SMOKESTACKS. Any military or civilian community with incinerators or boiler plants has potential air-pollution problems in that emissions cannot exceed Federal Clean Air Act levels. The U.S. Army policy, MAJ Murphy said, is to meet the most stringent standards, federal, state or local.

TESTING to determine if operations at Fort Detrick, MD, are degrading air quality, LT Art Payne, an air pollution engineer with the U.S. Army Environmental Hygiene Agency, regulates a flow-control box on a scaffold built around a smokestack. Wired to sensors in the stack, the control box tells when the effluent sample being analyzed is flowing at same rate as discharge from the stack.

Suppose, for example, that the AEHA sets out to monitor the effluent from a smokestack at Aberdeen Proving Ground. This, like most of their air quality work, would be done from a mobile laboratory manned typically by a meteorologist, a statistician, a chemical or sanitary engineer, a chemist and an engineering technician.

"Our role is surveillance and assessment," MAJ Murphy said, "and is carried out in emission and atmospheric tests. Emission tests have two parts, visual and instrumented."

A visual test determines opacity of a smokestack's plume. Smoke generators are used to train men for this.) If sunlight passing through the plume is obscured by more than 20 percent, a problem is evident that need not be substantiated by an instrumented test, which follows otherwise.

For the comprehensive instrumented sampling and analysis, technicians install monitoring instruments in the stack at a designated point. The instruments quantify emission levels of particulate pollutants and sulphur and nitrogen oxides.

Environmental Protection Agency (EPA) standards take into account that the atmosphere can assimilate a certain amount of pollutants. Based on the evaluation, the EHA recommends controls or not.

In another type of test, emission levels sometimes are formulated with engineering equations based on fuel input and other known factors.

USAEHA atmospheric tests, normally preceded by an emission test, serve to determine the quality of ambient air (the surrounding atmosphere) in a particular area of an installation. Most of these tests are at munitions manufacturing and demilitarization (disposal) sites where unusual emissions in large quantities are likely to occur.

Atmospheric tests are made with what is known as an ambient air quality network. This system identifies and evaluates concentrations of the six principal air pollutants set down by the Clean Air Act—particulate matter, sulphur dioxide, nitrogen dioxide, carbon monoxide, total hydrocarbons and ozone, or photochemical oxidant.

The last three of these pollutants combine with sunlight to form photochemical smog, a scourge of many large cities.

Networks consist of a monitoring station with instruments sited at strategic points selected by diffusion analysis; that is, a study of emissions and meteorological conditions.

After monitoring the ambient air for a period, usually two to three months, researchers interpret findings to see if the operation in question is, in fact, degrading air quality, and, if controls are needed, what type.

Most major cities have directed their ambient air work to a geographically large area. MAJ Murphy said the Army's ambient air work has all been on a microscale, perhaps for an area three to five miles square.

As a result of environment concern and clean air laws, the trend nationally in air-pollution engineering is toward microscale work, and the EHA is being called on by groups wanting advice on how to make ambient air studies.

"No potential polluter has done more than the Army to define air quality on a microscale level," MAJ Murphy said. "We're unique in doing it so intensely on geographically small areas.

"A lot of work in air pollution engineering is a first-time effort," he explained. "The field is evolving so quickly you can't readily discern your impact on air pollution technology. We're having to shake a lot of things out."

Questions the agency is answering include: Do the instruments measure what they should, when they should, accurately? What constitutes a valid evaluation? What is the best way to manage data?

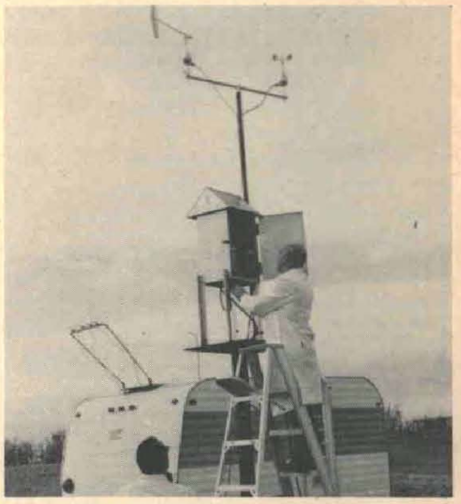
"With command concurrence, we route many of our reports to the EPA and have liaison with all the principal offices of their national air programs; also with many state groups," MAJ Murphy explains.

Informal exchange includes federal and state agencies, educators and manufacturers of air pollution analytical and monitoring equipment. The latter consult with the agency for recommendations.

NEW EQUIPMENT. In 12 to 18 months the AEHA hopes to have new equipment for assessing diffusion patterns, presently done empirically with equations.

The equipment is being designed at Aberdeen Proving Ground following extensive tracer configuration studies. It will simulate tracers with specific pollutants, releasing a known quantity and ascertaining its distribution. This, too, has seldom been done on a microscale. Virtually all Army munitions facilities either have new air-control equipment or have it on the books.

"There's a lot of Army effort to monitor air quality, comply with standards and implement controls," MAJ Murphy said. "Most installations are achieving excellent quality."



WORKMEN service a portion of an ambient air-quality network set up by the U.S. Army Environmental Hygiene Agency to determine if chemical munitions disposal at Army installations are degrading air quality. The weather vane (topmost) measures wind speed and direction; the box below is a high-volume sampler of particulate pollutants; the rectangular frame atop trailer collects acid mists.

Army Testing Floatable Tactical Wheeled Vehicles

"Relatives" of combat-proved "veterans" of operations in the Republic of Vietnam are undergoing intensive testing at Aberdeen (MD) Proving Ground in response to a U.S. Army requirement for a family of floatable, tactical wheeled vehicles for field armies.

The five GOER vehicles being tested are initial production models of a family of vehicles long known to the Army research and development community—in fact, vehicles that underwent tests as early as 1956. Nineteen vehicles were deployed in Vietnam in support of the 4th Division in the Pleiku area following engineering design, service, troop, and check tests.

Aberdeen PG's current Military Test Directorate (MTD) program is being conducted with three M520 8-ton cargo vehicles, one M559 2,500-gallon fuel servicing tanker and an M553 10-ton trucker—all designed for transport operations over all types of roads, rough cross-country terrain, and for "swimming" inland waterways.

Tests involve the twin capability requirements for cross-country mobility approaching that of fully tracked vehicles, and effective logistical support to combat arms in the field.

GOER vehicles achieve high mobility by use of extra-large diameter tires (18.00×33, 10-ply), exoskeletal construction, high-clearance, articulated wagon steering, and a 6-cylinder 213-hp in-line water-cooled diesel engine coupled to a 6-speed power shift transmission with a torque converter.

Incorporated in the test models are components and design principles currently in use on commercial wheeled earthmoving and construction equipment. The vehicles have two basic sections, the forward unit, and a rear trailing unit equipped with either a cargo tanker or wrecker body.

One of the M520 cargo vehicles is being used for engineering performance tests. The other two are undergoing endurance and reliability tests, operating for 25,000 miles each, both empty and loaded.

The M559 tanker is being subjected to 18,000 miles of endurance and reliability testing and the M553 wrecker is undergoing a similar evaluation for 12,500 miles. The over-all MTD test objective is to determine that the three GOER series of vehicles meet all U.S. Army requirements and are suitable for issue to field troops. Other test objectives are:

- To determine if performance is equal to or better than items approved by type classification.
- To verify correction of prior test deficiencies and shortcomings.
- To evaluate performance, including safety, reliability, maintainability, and human factors (toxic gas, noise, etc.).
- To verify that performance conforms to specifications.
- To assure that the maintenance support package, consisting of manuals, repair parts and special tools, is adequate and satisfies current policies.

TACOM Develops More Durable, Reliable Tank Track

More than double the mileage, more than triple the reliability and "dramatic cost savings" are among advantageous claims made for a new track for the M60 and M48 series tanks developed under direction of the U.S. Army Tank-Automotive Command.

Researchers at the Warren, MI, facility reported in mid-August that the T142 track has a life cycle of 7,000 miles compared to 2,200 miles for the T97E2 currently in service. Reliability for the T142 is reportedly 86 percent at 5,000 miles, compared to 25 percent at 2,200 miles for the T97E2.

The T142 is interchangeable with the T97E2 track. It uses similar, but improved, end connectors, centerguides and fastening parts. It also features a replaceable rubber pad instead of the integral molded rubber chevron used in the T97E2. When rubber pads are worn or damaged, they can be replaced without changing an entire track shoe.

The T142 track weighs 25 pounds more per linear foot than its predecessor, adding approximately 2,300 pounds to the over-all vehicle weight. Tests have indicated, however, that the T142 track offers improved performance parameters, while having no significant effect on fuel economy.

The first tests on the T142 were conducted in 1967 on three sets of track. Each set accumulated more than 2,000 miles of operation before tests were halted by failure of the track pins and roadwheel path rubber.

Engineers changed the design of the pins and roadwheel path rubber and conducted durability tests on eight sets of the modified track. Three of the eight sets accumulated 5,000 miles. Four sets continued to operate successfully for 7,000 miles and one is still operating in the Arctic Test Center.

Several design changes in the T142 enabled TACOM engineers to achieve the dramatic improvements in track life and reliability. Unlike the T97E2, it features nondirectional, symmetrical steel grousers. This feature increases life potential, provides needed combat characteristics when operating without pads, and prevents road damage when using pads.

Concurrent with these tests, twenty sets of the track were shipped to Fort Hood, TX, for evaluation by troops. Fifteen sets accumulated an average of 4,000 miles at Fort Hood, and reports indicate that the tracks were considered satisfactory.

NEW TRACK for M60- and M48-series tanks features rubber pads (left) that can be replaced when worn or damaged. The integral molded rubber chevron (right), used in the T97E2, required the replacing of entire track-shoe assembly.

The remaining five sets of track were sent to Vietnam. Operating without pads, one set was worn out after approximately 5,000 miles. The mileage attained by the other sets was not determined due to the loss of physical contact with the vehicles in combat areas.

Responding to a performance questionnaire, troops in Vietnam indicated that the extra weight of the T142 track made it more difficult to replace, but overall performance under combat conditions was considered to be far superior to that of the T97E2.

Upon completion of field testing and troop evaluation, a production contract was awarded in July, 1971, for delivery to the Army of 404 sets of track. Delivery began in February, 1972, and a 5,000 mile initial production test (IPT) was started at the Army's Aberdeen (MD) Proving Ground in April. The track passed the 5,000-mile test and went on to accumulate a total of 7,000 miles.

The T142 performed so well at the outset of the IPT that the Army decided to release it for issue at the 1,500-mile mark of the test. To date, about 200 of the 404 sets of track ordered in the initial production contract have been delivered. TECOM spokesmen indicate that the current T97E2 track will be phased out over the next four years.

Frankford Arsenal Using 'Soft' X-Ray Techniques for Ballistic Radiographs

Radiographs of ballistic phenomena obtained by new "soft" X-ray technology are much more sharply defined than those produced with "hard" X-rays, and are "ideal" for studying the behavior of experimental flechettes and associated sabots in the transitional region . . . gun muzzle to free flight.

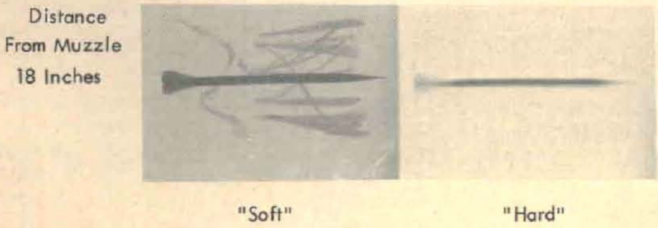
Edwin A. Webster Jr., a physical science technician at Pitman-Dunn Laboratory, Frankford Arsenal, who has been experimenting for 25 years to obtain optimum high-speed flash radiographs of ballistic phenomena, reports that preliminary studies using the technique have proved highly successful.

Based on the findings, the arsenal has constructed a Transitional Ballistic Range instrumented with "soft" X-ray equipment. Six orthogonally oriented stations are positioned in any location in the first 10 feet of travel—the transitional region. Engineers thus are enabled to change relevant parameters in projectile and sabot design and to measure, as well as see, the effects in the transitional region (TR).

Webster's plan calls for the use of "soft" X-ray equipment to obtain useful radiographs for "behind-the-plate" studies of small particles, ejected after projectile penetration of thin aluminum and steel targets. "Hard" X-rays currently are used for this purpose, with associated difficulties in that when penetrating thin and less dense objects they do not form a sharp image.

Lowering the voltage on a "hard" X-ray tube decreases penetration; the contrast between the test object and background decreases without improving the resolution of the component image.

Radiographs produced by this method have showed evidence of flechette bending or flexing, fin deformation and tip bending, along



Typical Flash Radiographs

with some separation of flechette and sabot, and flechette dispersion. Because of the poor edge resolution, making precise measurements and small components definition is difficult.

Conversely, "soft" X-ray tube radiographs of the transitional region show sharp and clearly defined images of thin and low-density components, including associated firing damage.

The flash X-ray equipment used in the tests here discussed is a Fexitron Model 730/2722 with beryllium window X-ray tube (model 5335). This tube produces high contrast radiographs. Beryllium used in the window material allows an enhanced range of energies for the applications described. This window transmits both "hard" and "soft" X-rays.

Kovar, used in the standard tubes, greatly attenuates the X-ray output less than 50 keV and is almost opaque to 20 keV X-rays.

Webster's long association with R&D effort to obtain optimum high-speed flash radiographs of ballistic phenomena has been highlighted by two Sustained Superior Performance awards, more than 20 suggestion awards, and numerous Certificates of Commendation.

TACFIRE Progress Earns ARCOM for Officer

Precedent-setting efforts in testing TACFIRE (Tactical Fire Direction System of Automatic Data Systems), the most complex computer system ever designed for use by field artillery fire direction centers, have earned recognition for MAJ Charles E. Tilson.

MG Charles P. Brown, commander of the U.S. Army Test and Evaluation Command headquartered at Aberdeen (MD) Proving Ground, recently presented an Army Commendation Medal to MAJ Tilson for outstanding performance while serving as project officer during test team operations.

MAJ Tilson was also responsible for coordinating efforts of the various TECOM installations and activities which participated in the tests. Included were White Sands Missile Range, NM, where engineering testing was conducted; the U.S. Army Electronic Proving Ground at Fort Huachuca, AZ, where electromagnetic compatibility and vulnerability tests were done; the U.S. Army Field Artillery Board at Fort Sill, OK, where field testing was accomplished; Yuma Proving Ground, AZ, and the U.S. Army Airborne, Communications and Electronics Board at Fort Bragg, NC, where air transport tests were made

A graduate of the University of California at Berkeley, Tilson has been awarded the Silver Star, Bronze Star with two OLC's Purple Heart and Air Medal with three OLCs.

Low-Light-Level TV System Improves Night Operations Testing Capabilities

By MAJ Wallace B. Eberhard

U.S. Army Infantry Board

The instant replay of combat test operations at night has come into Army use. A new low-light-level television system has been assembled by the U.S. Army Infantry Board (USAIB) at Fort Benning, GA, that adds new dimensions to its night operations testing capabilities.

Assembled by board personnel from commercially available components, the system promises to improve the quality and provide better data on night tests, add to tactical realism and control to the testing situation, enhance observation of human factors, and increase safety. The system already has prevented one night-firing accident that could have caused injuries.

Ever mindful that the soldier must fight at night as well as in daytime, the board's Methodology and Instrumentation Branch has been reviewing ways to provide film or videotape coverage of test operations for four years. Observation of night testing has been largely dependent on two sources for information: the test officer's observation and comments from the test soldier on the weapon, clothing or piece of equipment under test.

Basic elements of the newly assembled low-light-level TV system include two infrared light sources, two cameras with vidicon tubes sensitive to near infrared light, a videotape recorder, receiver/monitor, synchronizer generator, switcher/fader, and 10 kw generator to provide the 110-volt AC current.

The monitor, recorder and all components are mounted in a stepvan, which tows the generator to test sites. One man can set up wiring, lights and cameras in an hour or less.

Cameras and lighting equipment are set up during daylight hours at the test site, and lens and light adjustments made after dark. Effective range of the camera and lights is about 50 meters, although most videotaping has been done at ranges around 20 meters.

Use of two cameras permits observation of test action from different viewpoints. Infrared light sources are not detectable by test soldiers and do not hamper use of night optical devices such as the Starlight Scope.

Cameras may be emplaced either in stationary positions for viewing tests or controlled by cameramen who can be taught the rudiments operation in about half an hour. Directions are transmitted to cameramen by earphones from the man at the monitor console in the van who can view both cameras in action. He has a number of "mixing" options which permit him to feed a split screen image into the recorder.

The black-and-white TV picture produced by this system is below commercial quality but is good enough for viewing test operations. It could be adapted for daylight color videotaping by adding a color camera to the system.

The video cassettes cost about $25 apiece, can record for either 30 or 60 minutes, and may be reused up to 200 times. A digital counter and index system makes it possible to playback only a particular portion of a tape on demand. Field videotapes can be viewed at USAIB headquarters through a conventional TV set.

During a test firing of the M60 machinegun, the monitor showed a stoppage in the making in the form of a misaligned cartridge in the ammunition belt. Reactions of test soldiers tc the stoppage were viewed in detail.

During firing of the 106mm rifle, the .50-caliber spotting rounds were landing on target but the 106mm rounds weren't. A replay of the videotape showed it was firer and not weapon error that caused the misses.

Equipment tests have shown the differences in using one type of helmet chin strap compared to another and the problem that a soldier encounters in trying to use snap fasteners in blackout conditions.

During a test of the 40mm grenade launcher on the M16A1 rifle, a soldier was required to dig a foxhole, shoot, and respond to gas alarms. The console operator saw that dirt had been scooped into the launcher—something the soldier himself couldn't see—and called "cease fire" just before the launching of a grenade. An accident was averted.

AMRDL Awards $1.8 Million for Helicopter Improvement Research

Fourteen research contracts totaling $1,885,000 to improve helicopter performance and safety, lessen maintenance requirements, and facilitate loading were announced recently by the U.S. Army Air Mobility Research and Development Laboratory (AMRDL), Moffett Field, CA.

Two contracts are designed to advance the state-of-the-art of helicopter stability and control for future Army aircraft, by developing more reliable stability augmentation systems based on principles of hydrofluidics.

Fabrication and testing of yaw axis hydrofluidic stability augmentation systems (HYSAS) will be performed according to a $773,000 contract with Honeywell, Inc., which will finalize the design and produce 48 HYSAS for a joint Army-Navy program sponsored by USAMRDL. The effort will provide any potential user of the system with flight experience data based on Army field condition operations.

Another $90,000 contract with Honeywell, Inc., is for development and flight testing a miniaturized roll axis hydrofluidic stability augmentation system.

Four contracts are directed to advancing the structures technology by contributing to development of lighter weight, more reliable systems. They are described as follows:

Structual integrity of Army helicopters will be examined under an $86,000 contract with Technology, Inc. This effort will define and establish the feasibility of a monitoring system to track fatigue damage to critical components in Army helicopters, and objectively will lead to better component design.

Helicopter transparent components such as windshields, windows and canopies involve high procurement and maintenance costs. Marks Polarized Corp. has a patent pending for a superhard coating for application to these transparencies, with a potential for providing a high degree of abrasion resistance. An $82,000 contract with this firm calls for further development, evaluation and testing.

An $85,000 contract requires dynamic tests of helicopter transmission housings to determine the effect of increased stiffness on gear and bearing wear, heat-rejection characteristics of the composite material housing, and collant oil-flow requirements. Work will be done by Bell Helicopter Co.

Graphite-epoxy composite material housing will be installed in place of an existing metal housing in a UH-1 helicopter transmission. Mounted in a stand, the transmission will be run at various power levels to determine the over-all performance with the significantly stiffer material.

A $96,000 contract is for development of a machine to produce 4×4-foot panels of Tetra-core, a 3-dimensional filament-wound structure that was researched and developed at the Fort Eustis (VA) Directorate of AMRDL. The work will be done by Engineering Technology, Inc.

Tetra-core is now made by a slow, tedious, hand-winding process. The new machine will produce the panels on an automated basis to assure panels of uniform high quality, as well as cutting costs and speeding-up production. Extensive testing is planned to characterize static, dynamic and ballistic behavior.

Under an $86,000 contract, Lockheed-California Co. will develop procedures to determine the nonlinear load deflection characteristics of structural elements to be used in crashworthy airframe designs.

This R&D effort is part of the Army's aircraft crash survivability program, aimed at reducing personal injury and material damage from severe, potentially survivable crashes.

The contract effort will determine and verify structural element load-deflection categories for use during crashworthiness design and analysis; formulate crashworthy design procedures; and recommend modifications to reflect findings in the AMRDL TR-71-22, *Crash Survival Design Guide*, and computer program KRASH.

Two contracts are for improving reliability and performance of the Army's advanced propulsion systems. An $85,000 award calls for development of a flowmeter for measuring fuel flow on Army helicopter gas turbine engines. Using the high-frequency sound concept (ultrasonics), the flowmeter produced by Panametrics, Inc., is expected to show several major improvements over current designs.

The flowmeter will have no moving parts, will not restrict the flow of fuel, is expected to be extremely reliable, require little maintenance, and enable the Army to diagnose accurately the efficiency of helicopter engines.

An advanced concept to predict the maximum power available for a gas turbine engine will be developed under a $77,000 contract with Hamilton Standard Division of United Aircraft Corp. Data acquired at partial power conditions will assist the helicopter pilot in determining how much cargo can be lifted. The device will also help maintenance men determine the condition of the engine.

Safety and survivability of aircraft in a combat environment is a major thrust of Army R&D and the following three contracts are aimed at this purpose.

Evaluation of aircrew restraint system design criteria is ordered in a $165,000 contract with Dynamic Science, Ultrasystems, Inc., in a move to reduce fatalities in potentially survivable aircraft crashes. The effort will develop forward-facing, nonejecting aircrew restraint system design criteria representative of practical limits of the state-of-the-art.

Improved criteria for aural detection of helicopters is the developmental goal of a $69,000 contract with Wyle Laboratories.

Noise generated by helicopters often gives unacceptable advance warning during an approach in a combat zone, thereby decreasing the pilot's chances of survival and mission accomplishment. However efforts to cut helicopter noise directly affects the critical balance of power, performance and design.

Reliable criteria to accurately determine detection distance will provide an important design tool for evaluating benefits of applying noise-reduction technology to helicopters. The research will include aircraft fly-bys, field observer responses in expectant and nonexpectant listening modes, and factors of atmospheric and terrain characteristics.

Advancement in helicopter maintenance inspection aids is the purpose of a $67,000 contract with Aerospace Systems Division, RCA Corp.

Analyses of helicopter maintenance effectiveness will be made by Sikorsky Division of United Aircraft Corp. under a $55,000 contract. The study was prompted by reports that many maintenance actions on helicopters were either done improperly or should never have been required.

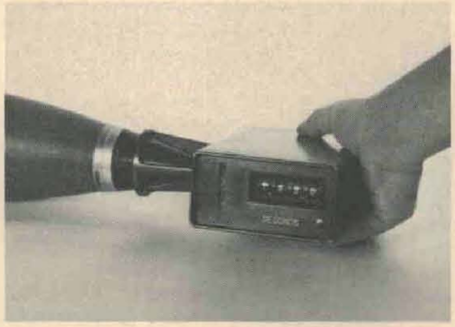
Maintenance data from Army installations, interviews with Army aviation personnel, and questionnaires to maintenance personnel throughout the United States will be used to determine the causes of incorrectly performed maintenance.

Under a $69,000 contract, Parsons Corp. of California will develop preliminary designs for pallets and gondolas used to haul external cargo payloads for Army helicopters, up to the 22.5 tons for compatibility with the Army Heavy Lift Helicopter.

The UH-1, CH-47, and CH-54 helicopters will be used for this research, expected to result in changes in aircraft design, diagnostic equipment, and tools and procedures to cut incorrectly performed maintenance.

HDL Electronic Time Fuze Shows Versatility

Completion of engineering development of an electronic time fuze with advantages of accuracy and versatility as compared to typical mechanical time fuzes was announced in mid-July by the Harry Diamond Laboratories (HDL) of the U.S. Army Materiel Command.



WITH AN ACCURACY better than 0.1 seconds, the HDL electronic time fuze is set by a portable fuze-setter in less than a second to any time from 0.2 to 199.9 seconds in 0.1-second increments.

Use of electronic circuitry enables a setting capability from 0.2 to 199.9 seconds in 0.1 second increments for both high-explosive and nondetonating projectiles. "Nonvolatile memory" is obtained by use of the latest in metal nitride oxide silicon (MNOS) integrated circuit technology.

The HDL announcement termed the electronic time fuze "the first to incorporate MNOS logic circuitry while increasing the accuracy and reducing the setting error usually present with mechanical fuzing."

The electronic method reduces field error in that no moving parts are needed to set the fuze, the announcement explained. The fuze is set by entering the desired time on the dials and contacting the setter to the fuze nose.

The complete setting operation—checking the electronics, calibration of the time base and visual communication that the fuze is set correctly—takes less than a second. Nondestructive surveillance of 90 percent of the fuze electronics is accomplished during the setting, which may be changed at the operator's discretion an indefinite number of times.

MERDC Publishes 7th Fuel Cells Status Report

When the U.S. Army Research Office published the first *Status Report on Fuel Cells*, in June 1959, the widespread interest in this area of unconventional power sources was indicated by the public sale of more than 2,500 copies within less than six months. The *Seventh Status Report on Fuel Cells* made its appearance without much fanfare.

In fact, its distribution was not even brought to the attention of the editorial staff of the *Army Research and Development Newsmagazine*. A recent inquiry established its availability as a publication issued by the U.S. Army Mobility Equipment R&D Center and edited by James R. Huff. Moreover, six years elapsed between the sixth (May 1967) and seventh reports.

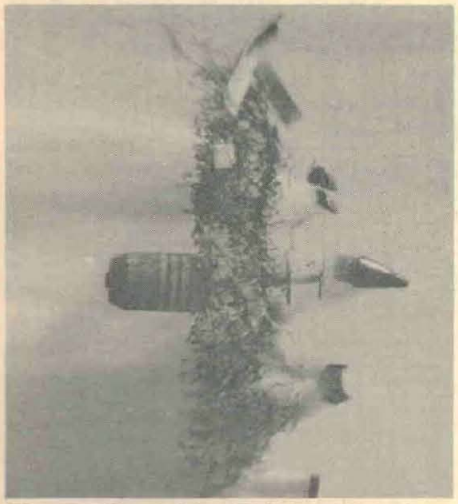
The initial report represented an effort to compile all the known ongoing fuel cell research activities at that time, including foreign efforts. Succeeding editions have followed much the same pattern, at least insofar as citing the available literature in specific areas.

Explained in the introduction to the seventh edition is that, over the past few years, tightened budgets have led to a decline in fuel cell activity and in the number of companies carrying on active programs. "However," it states, "in spite of this (decline) significant strides have been taken toward producing a viable fuel cell for both commercial and military use."

The first four sections of the report are devoted to the areas of U.S. Government funding, i.e., basic research, exploratory development, advanced development, and engineering development.

Summarized in the final section is the information provided by foreign countries on their fuel cell research, in response to inquiries made by the U.S. Army European Research Office in London.

The report carries AD No. 755106 and the sponsoring agency is the Electrochemical Division, Electrotechnology Department, U.S. Army Mobility Equipment R&D Center, Fort Belvoir, VA 22060.



HDL FUZE, which reliably initiates beehive ammunition, converts ram air into electrical energy to power the electronic timer. At 5 meters from the muzzle, the weapon has functioned and the fuze is in front of the 5,000 flechettes while traveling at about 2,500 feet per second.

AMRDL Sponsoring Army Helicopter Symposium

How well prepared are the Army and the helicopter industry to respond effectively to the challenge of substantially improved reliability and maintainability needs in view of rapid increases in material and manpower during a period of severe budgetary cutbacks?

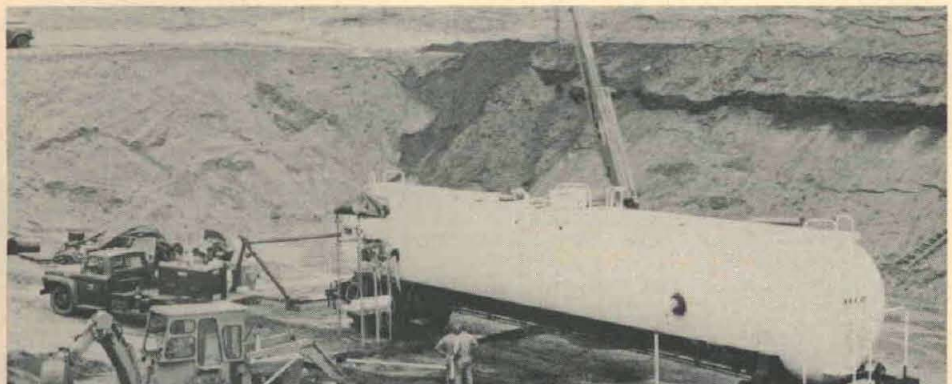
That is the question participants will attempt to answer at an Army Helicopter Reliability and Maintainability Symposium, Nov. 7-8-9, at Williamsburg, VA, under sponsorship of the Army Air Mobility R&D Laboratory.

Participants will strive to establish an improved customer-producer understanding of the many complex factors—technology, specifications, testing, quality control, procurement practices, etc.—which, when combined with management philosophy, control helicopter R&M.

Guest speakers will include MG Stewart C. Meyer, director of the U.S. Army Materiel Command Research, Development and Engineering Directorate; MG William J. Maddox Jr., commander, U.S. Army Aviation Center and School, Fort Rucker, AL; and Gearhardt Newman, General Electric Co. executive.

The symposium is expected to attract U.S. Government system/subsystem R&D lead engineers, project managers and their technical, product assurance and logistics chiefs, R&D middle and top managers, and R&M lead engineers and quality assurance leaders; also, industrial middle and program managers, and system/subsystem and quality control lead engineers.

Telephone inquiries relative to the symposium may be addressed to the cochairman of arrangements, T. L. House (804-878-2704) and MAJ R. A. Mangum (804-878-5305), Fort Eustis, VA.



BURN-TEST PREPARATION of tank-car is carried out during an engineering design test conducted at White Sands (NM) Missile Range to collect data in efforts to improve the tank car's ability to withstand high-temperatures and pressure. Army engineers are shown preparing a ditch to hold 15,000 gallons of JP-4 fuel used to engulf the test car in flames. During the test, results of which were termed "successful," the tanker's internal pressure was measured at 365 pounds psi. Temperature reached 835° F. after the jet fuel had burned 23½ minutes, immediately before the tanker exploded.

4 AMC Employes Selected For 1973–74 ICAF Course

Four U.S. Army Materiel Command employes represent the total Department of the Army civilian attendance at the Industrial College of the Armed Forces (ICAF) 10-month long course which began in August.

Selected by the Army Executive and Professional Development Committee, they are George E. Dausman and Roy D. Greene, HQ AMC; Mason C. Linn Jr., Tobyhanna Army Depot, PA, and John P. Del Vecchio, Office of the Project Manager, Army Tactical Data Systems.

The ICAF course prepares military and civilian personnel for important command, staff and policy-making positions. The curriculum is directed to the economics and industrial aspects of national security and the management of defense programs and resources in a broad political, social and military context.

Dausman serves as a special assistant to AMC Commander GEN Henry A. Miley Jr. and also as an adviser to MG John R. Guthrie, deputy commander for Materiel Acquisition. A graduate of Massachussets Institute of Technology, he has BS and MS degrees in aeronautical engineering and an MS degree in management.

Greene is chief of the Programs Branch, HQ AMC Directorate of Research, Development and Engineering, and began his Civil Service career as a management intern trainee in 1959.

He is responsible for budget formulation, justification, program execution and control, and management reporting of the AMC RDTE program, $1.2 billion per year.

Linn, an executive assistant at Tobyhanna Depot, served there in the Army Signal Corps after entering Civil Service in 1957 as a specialist in stock control operations.

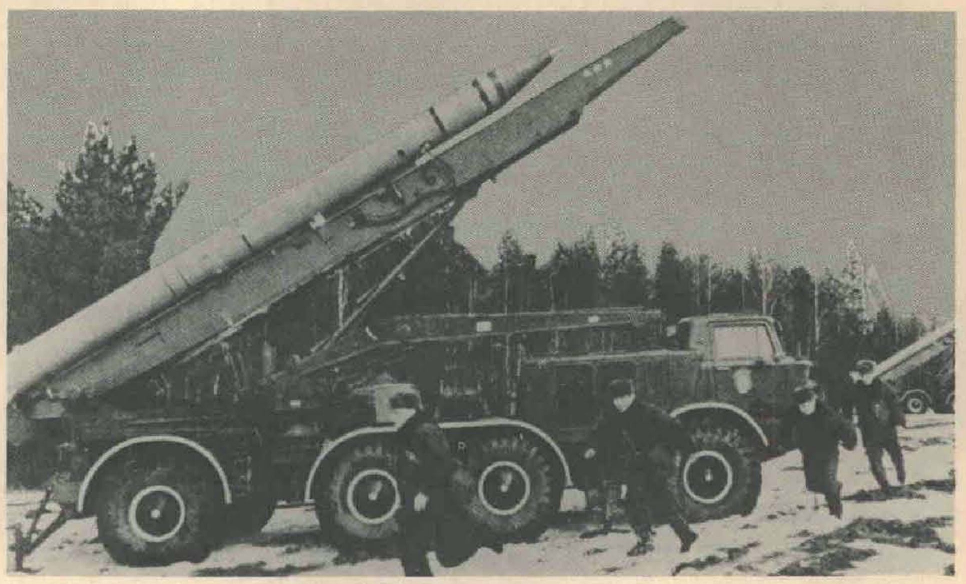
Del Vecchio, chief, Systems, Plans and Evaluation Division, has engineering program responsibility for long-range planning, technical evaluation, early concept formulation and operations demonstrations with Air Force, Navy and Marine Corps tactical data systems.

Soviet Design Philosophy . . .

Research and Its Impact on Weapons Systems Development

By Dr. L. A. Mounter
U.S. Army Foreign Science & Technology Center

The following is the first of a scheduled series of Army R&D Newsmagazine *articles related to foreign scientific and technical developments. In subsequent editions, it is planned to publish also a list of new intelligence documents relating to foreign ground force equipment and technologies. Readers' queries should be directed to supporting intelligences offices, such as the Foreign Intelligence Offices within the Army Materiel Command.*



SOVIET FROG 7

What is the general scientific and technical intelligence process for study of system development? It is, in effect, a technological forecast of national achievement and, in part, a threat assessment; it involves consideration of the interplay of social, political and economic factors together with the progress of science and technology.

Scientific research is an area in which information is frequently available; we can at least make reasonable estimates of scientific capabilities and available technology bases. At the other end of the scale is the fielding of a system, but it must be recognized that we are now faced with a *fait accompli.*

The critical area in which our information may be minimal is in the design and development stages, where we seldom have opportunities to make reasonable assessments. The transition from research through design to systems is, in fact, the area of major intelligence gaps.

Study of the factors which influence weapons systems improvement and design philosophies, however, allows certain conclusions to be reached. This is particularly valuable in assessing status and trends in the USSR.

Today, national defense postures and policies interact more rapidly with science and society and thus alter our intelligence requirements. In these changing times, as the science and technology intelligence analyst becomes more of a specialist, the intelligence collector must continuously broaden his perspectives. As the Russian writer Sergeyev has said: "The intelligence agency of today is primarily a vast scientific research apparatus."

We must recognize that the USSR and its Eastern European allies comprise not only a military but an economic power. The use of the civil and military forces at their disposal is directed by the political system and the socio-economic forces which bear upon their political organization. The Soviet Union and its allies possess the largest of the world's ground forces and maintain these in continuous development.

How, then, do these forces interact with this scientific and technological base of their society? In military affairs, there are fortunately pragmatic factors in evidence which warrant our consideration, for these factors which color Soviet military thinking also influence the design of their weapons systems. Some of these factors are as follows:

• Russia has always been an importer of foreign technology. This does not diminish the achievements of native inventors and engineers who have made and are making independent state-of-the-art advances. This habit of *looking outward has meant that no significant development is likely to take place in the Free World without some counterpart investigation by the Soviets.*

• Soviet military psychology is marked by their own combat experience. From the German Blitzkrieg invasion shock of June 1941 and the victorious Soviet armored push to Berlin in 1945 came the conviction of the primacy of armor and mobile warfare. Soviet writers today state that the advent of tactical nuclear weapons only reinforces this commitment to the tank. Another lesson to emerge was the subordination of all elements of combat power, to include tactical aviation, under the ground commander.

• While the Soviet military enjoys an apparent high allocation priority, it still must compete with demands for limited resources.

• Traditionally, the Soviet Union has maintained large standing ground forces and, consequently, materiel requirements are in turn comparatively large. The size of Soviet ground forces dictates that updating of equipment be incremental. Follow-on systems are phased in during long production runs, which makes desirable some compatability with their predecessors.

Keeping in mind these general constraints and influences, we turn to what might be called Soviet design philosophy.

Given a requirement for a piece of equipment or system to accomplish a given mission, the usual Soviet approach is as follows:

Use extensive training to gain maximum performance from existing systems, or vary employment doctrine..Only if the requirement exceeds the capability of the equipment will hardware improvement begin. Thus operator selection and simulator training have kept early-deployed systems in active service.

Improve a system already fielded in order to allow it to fulfill the new requirement. For instance, to meet the need for longer-range delivery of nuclear fire by mobile launchers, the Soviet Frog heavy artillery rocket family has been progressively improved.

Use proven, off-the shelf components wherever possible, both to shorten development time and to simplify logistics through interchangeability of components and major assemblies. To give antiaircraft artillery a mobility comparable to that of the armored and mechanized units it supports, reliable automotive components from tracked vehicles were chosen for a new self-propelled system.

If priorities dictate, a totally new system will be developed. Such new systems may be state-of-the-art breakthroughs. Most, however, if not lineal descendancts of earlier systems, will be within general worldwide technological capabilities, but will represent a radical departure from Soviet design trends.

Whether product-improved or totally new, a *major design* goal of Soviet weapons systems is *simplicity and ruggedness,* with design for ease of operation and maintenance, yet with sufficient complexity to fulfill their purpose.

All of these design philosophy aspects are, to some degree, characteristic of any prudent research and development program. What sets the Soviets apart is the emphasis they place on simplicity and product improvement, in lieu of sophisticated totally new systems.

The development philosophy of the Soviets can be summarized—put a system in the field as soon as possible, add modifications to upgrade it, take advantage of worldwide technology to develop newer systems, and train extensively to get the best performance from all weapons.

But this is a philosophy not a dogma. We should be cautious in extrapolating principles over too great a time range; it is here that careful examination of technology, and the influence of science upon it, will give additional guidelines for intelligence study. Sources vary from party-approved policy statements to indications of system modifications—the former providing background information on decision-making—the latter detail which may have high significance in relation to that policy and the delineation of new technical objectives and operational requirements.

Thus the national background for scientific and technical development and its relationship to socio-economic progress has been recently summarized. Two points that should be emphasized are apparent:

- The position of science and technology in the political and social concepts of society and the concomitant impact on the status of, and rewards to, the Soviet Scientist are significant.
- Very extensive S&T resources are available for allocation within the framework of a unified state technical policy where, despite strong competition from the civilian sectors of the economy, the national military programs are accorded high priority.

The Soviet economist Aganbegian has indicated that 40 percent of the Soviet economy is to some extent involved in defense programs. A military commentator writes:

"The requirements of the Twenty-Fourth Party Congress (of the CPSU) to improve the planning and control system for the national economy with broad utilization of computers in providing a basis for the plans and finding optimal solutions are the order of the times. This requirement of the party as a whole is also extended to the military forces."

The Soviet Union has been engaged for many years in an extensive weapons research and development program which was accelerated when introduction of nuclear weapons and missiles revolutionized military affairs. This drive for new and better weapons has not been left to the initiative of isolated plants or institutes; it has been centralized and developed under the control and guidance of an intricate network of party, government, military and scientific authorities.

The result of this combined, centralized Soviet effort has been the introduction of a series of new weapon systems of every type and capability. We now require information that will reflect on future systems. We want to know what is new and what will follow the new—for, as was indicated, today's research gives the systems of the following decade.

The requirements for a weapon system, to include research, development and production, can be initiated from one of several places. At the national level, a system may be developed in response to politbureau decisions. Within the ground forces, requirements can come from the field and are examined at troop branch level.

Five main branches of troops act as customers for ground force weapon systems. Each has a supporting military academy and technical directorate who examine project feasibilities and draw up technical specifications. The technical directorate also provides the military representatives who monitor program research and general production. These military representatives are graduates of higher degree courses at the military academies. Their expertise and their interaction between research, development and production are an important factor in assuring that civilian plants produce quality products which will meet military requirements.

The interaction of defense and civilian ministries and the development of skilled scientists and technical personnel within the military forces are also of great importance—because if, as it does, technology is to have impact on the ground forces these factors direct its flow. But who staffs these programs?

Recent Soviet claims are that owing to the increased technological complexity of modern military affairs, attention is being given to raising the role of scientific leadership of the armed forces. Marshal Grechko informs us that 45 percent of all officers were engineers or technicians by 1970, that is, had either higher or specialized secondary education in engineering.

This increase in the number of engineers is not surprising. One of its most interesting features is the emergence, especially since the full-scale review of the officer corps in 1964, of the commander-engineer as a central figure in the Soviet armed forces.

The educational standards and technical skills of the Soviet soldier are also being considerably upgraded. These requirements can be related to the introduction of new systems and new equipment. If we obtain information on how specialist military training is effected, and with what immediate goals, this can be very valuable. Let us review a few factors from what we have said so far and add a few conclusions.

The so-called conservatism of Soviet design philosophy is not due to technical inadequacy, but it is an effective policy, based on sound engineering principles.

The extensive use of training to gain maximum performance assists in definition of problem areas. The large amount of military sciences study—both operational and academically oriented—uses these practically determined limits for the delineation of new requirements. The initiation of research programs is aimed at developing systems to meet these new requirements. The close interactions of the academic communities with design institutes and military planners provides effective organizations to carry out such work.

National scientific and technical development will be reflected in increased complexity and sophistication of Soviet weapons systems. This will occur coincident with upgrading technical capabilities of military personnel.

We are in the midst of a military revolution in which the interface with society in general and rapidly emerging technologies born of new sciences will have profound influences on the status and structure of military forces. It is a characteristic of most revolutionary periods that much is written and much is said. We already have seen quite a few significant Soviet books and journal articles in which the impact of technology on force structure, training and doctrine have been discussed.

Since these writings comprise part of a debate being carried out between field commanders, staff officers and technical personnel, the principles discussed relate to *real* systems operating within *accepted* doctrine.

The Soviet propensity for writing and talking about their plans is important. It is probably at least partly due to the habits developed in a tightly planned economy; we should recognize that the Soviets like to talk about their successes and usually try to do the things they say they intend to do. We can, with some confidence, use the Soviets own military writing as a data base for medium-range technical forecasts. We will not be correct in our prognoses every time, but we shall be in better standing than if we base our forecasts on what *we think* their research and developmental *goals should be.*

As in any other society, the support to, and benefits from, R&D projects vary considerably. Firmly based technical developments can be contrasted with high-risk/high-gain programs. In the light of knowledge of where breaks with traditional Soviet design philosophy are occurring, and with an understanding of the foreign technical officer in his military role, there are indicators which scientists can use in efforts to help fit the items of scientific data into what is believed will be a true picture of the technical forces of today and, more importantly, it is hoped, the forces of the future.

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HDL Marks 20th Anniversary, Looks to Move Into $42.8 Million Complex

Twenty years of achievement and expansion of capabilities that have earned the U.S. Army Harry Diamond Laboratories international repute—with continued acclaim from Congress and the Department of Defense—will be marked Sept. 22 by anniversary ceremonies linked to relocation in a $42.8 million facility at Adelphi, MD.

Secretary of the Army Howard H. Callaway has accepted an invitation to present the 10:00 a.m. address when the cornerstone is laid to the administration building that will connect the two General Purpose Laboratory buildings. He will be introduced by GEN Henry A. Miley Jr., commander of the Army Materiel Command.

Invitations have been extended to more than 150 dignitaries, many of whom have participated during 16 years of numerous site studies and negotiations, architectural considerations, design engineering, and hundreds of problem-solving meetings with federal, state, county and local organizations. The result is termed "one of the nation's finest examples of laboratory design."

Cornerstone ceremonies will take place on a 136.68-acre site that was released to the HDL from the Naval Ordnance Laboratory site at White Oak, MD. This arrangement, ending a long search for an acceptable, available site, provides for cooperative R&D effort, in keeping with government objectives of minimizing duplicative programs.

Assistant Director of Defense (Electrical and Physical Sciences) Dr. George H. Heilmeier, Acting Assistant Secretary of the Army (R&D) Charles L. Poor, Army Chief of R&D LTG John R. Deane and Director of Army Research MG Charles C. Daniel Jr. are among dignitaries who have accepted invitations to attend the ceremonies.

Included in the Maryland delegation will be Senators J. Glenn Beall Jr. and Charles Mathias Jr. and Congressmen Lawrence J. Hogan and Gilbert Gude.

Army Materiel Command invitees include Deputy for Laboratories Dr. Robert B. Dillaway, Deputy for Materiel Acquisition MG John R. Guthrie, MG Stewart C. Meyer, director, Research, Development and Engineering, and BG Robert L. Kirwan, director, Personnel Training and Force Development.

Numerous field commanders, technical directors, program managers, representatives of the Naval Ordnance Laboratory and the Air Force Systems Command, six past commanders of the Harry Diamond Laboratories, HDL's first technical director, Wilbur J. Hinman Jr., and Maryland county and local officials will attend.

When about 500 of HDL's 1,400 employes move into GP Laboratory No. 1 in November—with about 400 waiting for completion of Phase II construction in mid-1974 and 500 for Phase III in the fall of 1975—they will have the pleasure of working in facilities believed the most advanced of their kind in the United States.

Ninety acres of the 137-acre site are planned for laboratory and support buildings in HDL's long-range plans. The remaining area is devoted largely to a buffer zone from the adjacent residential and business area.

RIBBON OF GLASS window treatment of HDL research complex buildings is illustrated by General Purpose Laboratory.

The current 3-phase construction program will provide 555,306 feet of floor space, with 353,305 for labs and 115,254 for the administration building.

Blake Construction Co. of Baltimore is the contractor for Phases I and II, including GP Laboratory No. 1, the administration building and service facilities with 293,141 feet of floor space.

Savoy Construction Co., Silver Spring, MD, was awarded the Phase III contract Aug. 3 on a bid of $17,094,000 for GP Lab No. 2, a Research and Engineering Lab, Radiation Facility including a Cobalt 60 source range, Explosive Load and Test Lab, motor pool and service facilities, totaling 262,165 feet of floor space.

U.S. Army Corps of Engineers and Harry Diamond Laboratories project officers for the planning and construction of the research complex are proud that it is staying close to cost estimates despite the impact of inflation. They also consider it unique in several design engineering aspects, assuring that facilities will be "fully matched to HDL needs."

Located at a mailing address of 2800 Powder Mill Road in Adelphi, the HDL complex is designed in the form of an H. In addition to adjacent support facilities, 600 or more feet away, it consists of four buildings linked together by the administration center at the front end and a center building crossway between General Purpose Laboratories 1 and 2. The crossway provides a secure courtyard at the east end and a west courtyard accessible to visitors.

Continuity of the electrical power supply for maintenance of a controlled environment is critical to the success of many HDL research projects. To meet this requirement, PEPCO has provided two separate substations, each with a 69,000-volt feeder capability adequate for HDL requirements.

In the rare event that a complete cutoff of the East Coast power network should occur, HDL has provided its own emergency generators for lighting to evacuate the building and serve some priority requirements.

Noise pollution, a term common throughout the nation these days with respect to impact on efficiency of employes, is being minimized in the HDL by careful planning and design.

Along the outside perimeter south wall of GP Laboratory No. 1 are four "appurtenances" at ground level that may raise questions. One at each end is designed for intake air and the two in the center for exhaust air from the air conditioning system. Their purpose is to avoid introduction of noise into the two courtyards that would make them less than desirable for employe use.

Without this design feature, and special attention to interior structure, augmented by carpet-covered walls along the corridors in the laboratory sections and specially designed baffles in all air ducts, the noise level would be objectionable for laboratory operations.

These measures, however, will hold the building noise level at about 40 decibels, which is considered minimal, and noise (or classified conversation) cannot pass from one laboratory bay to another.

Computer-controlled heating and air conditioning systems are termed the most modern serving a Department of Defense agency, with chilled water used for air conditioning and high-temperature water for heating. Two 36-inch diameter ducts for air conditioning branch off to feed each floor of the laboratory buildings with a high-velocity, variable-volume air flow.

Solar bronze-tinted windows, standardized in size at 4½ feet wide and 5 feet high for all buildings, provide the effect of a "Ribbon of Glass" around exterior walls. Supporting concrete pillars are well concealed. Heat rising from floor-level sources passes over the windows to prevent any chilling drafts in cold weather. Vertical-slatted venetian blinds will also serve to avoid sun glare.

Another feature is a fully automatic fire-control sprinkler system serving all sections of the buildings. Should fire break out anywhere, the guard station is immediately alerted. All laboratories also have automatic magnetic fire door closers.

Novel also is a classified waste vault-type disposal unit recessed into the wall at each end of the building. Built to specifications of the U.S. Army Materiel Development Office, an element of the Army Intelligence Agency, the HDL system is designed for maximum security in disposing of classified material at all floor levels.

Computer-aided graphics to aid design engineers are conveniently accessible, with remote terminal access on each floor.

Believed unique in its concept is a "working

POWER SOURCES miniaturization for fuzes developed by HDL is typified here.

deck roof" consisting of four inches of lightweight aggregate concrete. This provides 40,000 square feet of wide open space, five stories from ground, with an overview of much of the Washington area, for radar and optical measurement experimentation.

Washing of the vast expanse of windows is simplified by a roof-mounted system that permits automatic electrically controlled raising or lowering of support equipment for the washers.

In keeping with HDL's over-all building concept of design for aesthetic harmony with the neighboring residential area, all roof-mounted equipment is concealed by an 8-foot-high parapet. This same treatment applies to an elevated terrace with trees, shrubbery and rest benches above the auditorium.

Approximately $9 million worth of special research equipment, much of it too heavy or bulky for movement by freight elevators, can be handled expeditiously by another built-in feature. The elevator tower has outside wall "knockout" panels to permit big equipment to be moved into the building by crane at any floor level. Special-strength waffle-type concrete floors are designed to carry the weight of computers and other heavy equipment.

In response to the Army's over-all need for larger, more flexible use buildings, and HDL's ever-changing mission requirements, a new removable partitioning system has been incorporated throughout the H complex. This makes it easy to vary the size of laboratory and office modules for mission needs.

Wall panels in laboratories have a factory baked-enamel finish backed by gypsum board and aluminum foil. A concealed "raceway" in each lab wall and an underfloor duct system provide an almost unlimited capability for changing power or signal cabling from one module to another. Cabling can be run from any lab module to another building by way of the underground duct system between buildings in the complex.

Work benches in laboratories are served by two 15-ampere power lines, each with a circuit breaker for overload safety, to provide a total availability of 30 amperes of power source flexibility for research.

Laboratory lighting is uniformly rated at 100-foot candles and is provided by recessed-mounted, fluorescent, heat-removal type fixtures.

Laboratories are standardized, 27 by 13 feet, but can be subdivided at 4½-foot intervals as desired by the module-type construction. Individual thermostats control heating and air conditioning in each lab unit and office, and office areas are controlled by a zoning method.

Ceiling height is 10 feet in laboratories, 9 feet in offices and 8 feet in corridors carrying air conditioning ductwork and other service lines. The system provides servicing access from above, below and by "wet" wall shafts extending from the first floor to the roof.

Since laboratory requirements place a premium on clean air, the air conditioning and filtering system is augmented by a central vacuum system to facilitate cleaning, with outlets on all floors at 50-foot intervals.

Another facet of the cleaning system is a trash chute that has outlets at each floor level. Deposited trash falls through the chute to a ground-floor room where it is automatically compressed into 3-cubic-foot bundles.

Finding offices and laboratories throughout the HDL complex will be facilitated by a color coded identification plan involving a 5-digit numbering system to denote the corridors.

Central meeting facilities include a 350-seat auditorium, a 50-seat executive conference room and two 30-seat training rooms, with a 270-seat cafeteria. In general, offices and divisions will have their own conference rooms.

The cafeteria, at ground level, overlooks the west courtyard, which will be backed by a veiw of the Research and Engineering Laboratory when completed next year, with a floor to ceiling exposure of windows on three sides.

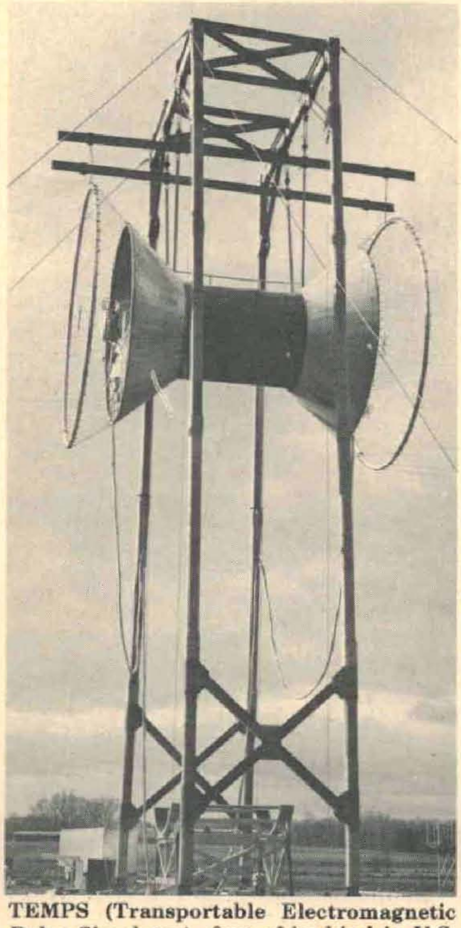
Carpeted and decorated in a mode comparable to the commercial eating places, the cafeteria will provide a pleasant atmosphere and furnishings for employes and guests.

The auditorium, also scheduled for distinctively pleasant decor, is large enough to give briefings for all employes in a single day by four groupings.

Tentatively, the first major public use of the auditorium will be in the fall of 1974 for the first world conference on fluidics since this epochal development was announced by HDL scientists and engineers in 1962.

Fluidics is a field in which the parent U.S. Army Materiel Command has assigned HDL lead laboratory responsibility, along with a similar responsibility in nuclear weapons effects. The meeting is being planned with the U.S. Government Fluidics Coordinating Committee and other U.S. agencies.

In respect to its nuclear effects research mission, HDL has such notable capabilities as the Aurora Facility, the subject of front and back cover and center-spread feature treatment in the March-April 1972 edition of the *Army Research and Development Newsmagazine.*



TEMPS (Transportable Electromagnetic Pulse Simulator)—first of its kind in U.S.

This research facility is concerned with developing methods of "hardening" electronic components of U.S. weapons systems against nuclear radiation damage. Incredible though it may seem, Aurora has the capability of generating, *for one-billionth of a second,* the combined output of all the world's electrical power generators.

Complementing the Aurora Facility, which is located on HDL's new site, about a mile away directly through the forest, are DORF (Diamond Ordnance Radiation Facility, dedicated in 1960 at Forest Glen, MD) and TEMPS (Transportable Electronagnetic Pulse Simulator). TEMPS is a first-of-its-kind-in-the-world development, to be operated by HDL in response to a Defense Nuclear Agency requirement. It will be the subject of a feature article in the November-December edition of this publication.

Anyone desiring to learn about HDL's illustrious record of achievements during the 20 years of its existence will be able to gain a visual appreciation by a visit to its new home when the relocation is completed in late 1975.

Visitors having a required security clearance will be able to browse through the museum, located in the library cross-way building between GP laboratories 1 and 2. Nonclassified displays will be exhibited in the main lobby.

An architectural feature of the entrance to the lobby is a distinctive overhanging exposure of large windows. Leading to the first floor above the lobby is a broad stairway with a spacious corridor designed to permit informal groups during breaks between conference sessions. A skylight window well above the stairway extends to the fifth floor roof.

Innovations are basic to the interior design of the HDL complex, but one of the interesting exterior aspects—other than the four novel "appurtenances" mentioned earlier to limit air-conditioning intake and exhaust air noise, is the street lighting along the entrance driveway. An astronomical clock controls turn-on and turn-off automatically in response to a fixed requirement level.

All buildings in the complex will be faced with large slabs of precast concrete presenting an exposure of multicolored exposed large rough aggregate, similar in effect to terrazzo flooring and very light tan in appearance.

HDL's "Command Post," for the commander, technical director, four associate technical directors and associate director for administration and all HDL administrative offices, is on the fifth floor of the administration building. It faces east with a panoramic view of the suburban area of Washington through the "Ribbon of Glass" exposure from three sides.

As Scottish poet Robert Burns put it: "The best laid schemes o' mice and men gang aft a-gley. . . ." But in the long years of planning and designing the HDL complex, all of the considerations that could be conceived by many of the best minds of the nation with respect to the maximum in practibility and convenience, oriented to over-all mission requirements, were pooled.

Furthermore, a widespread computer survey was made—believed the most comprehensive of its kind ever conducted for a research and development facility—to come up

(Continued on page 18)

(Continued from page 17)
with the "ultimate answer" in meeting requirements. Those involved in this massive effort are confident that purpose is well served.

WORLD WAR II INCEPTION. Responses to World War II requirements in the early 1940s led to the creation of the nucleus of highly skilled scientists and engineers, working under the direction of Harry Diamond, whose transfer from the National Bureau of Standards to the U.S. Army in 1953 marked the beginning of the Diamond Ordnance Fuze Laboratories. About 150 members comprised the initial staff.

"One of the outstanding scientific achievements of World War II . . . second only to the atomic bomb" is one of the many accolades the NBS Ordnance Development Division had earned with its development of the radio doppler proximity fuze. Diamond also had been cited for developing the airborne weather radiosonde, the ILS blind landing system for aircraft, the radio beacon system and other air navigation aids.

When the U.S. Army Materiel Command was established in 1962 in the Army-wide reorganization which merged five of the Technical Services R&D functions in the AMC, the DOFL was redesignated the Harry Diamond Laboratories (HDL), and given a broad mission expansion.

Known today throughout the military establishment as a "full-spectrum" laboratory, with AMC lead laboratory responsibility for fluidic systems and for nuclear weapons effects, the HDL has maintained its international reputation in its specialty areas.

RECORD OF ACHIEVEMENTS. Founded primarily to serve the U.S. Army, the HDL currently is performing many R&D tasks for the U.S. Air Force and the Navy as well as for other federal agencies requiring its expertise.

Perhaps one of the more impressive indications of HDL productivity is in its original primary area of fuzes for weapons systems. During 20 years of continuing economic inflation, HDL has steadily increased the performance and reliability of fuzes while decreasing costs—the most dramatically for the newest fuzes.

Diversity of HDL's current program involves numerous major scientific disciplines and interdisciplinary efforts with other Defense and federal agencies. However, that broad scope is not reflected in the foreword to HDL's recent 20th Anniversary Report. Rather, the emphasis is on assumption of major tasks for the Air Force and Navy as well as for the Army.

Listed among "Some of HDL's fuze efforts since 1953" are:

- The first all-solid-state radio proximity fuze.
- The first automated production techniques for the manufacture of low-cost radio proximity fuzes (done in conjunction with industrial contractors).
- The M990 series of electrical bomb fuzes used by the Navy.
- The M904/905 series of mechanical bomb fuzes used by the Air Force.
- The Mk43 proximity bomb sensor for the Navy's Snakeye weapon system.
- Development of a series of fuzes for armor-piercing antitank munitions.
- Development of guided missile fuzes for the Army, Navy and Air Force.

The report lists ongoing tasks assigned to the Advanced Research Laboratory (100), Nuclear Radiation Effects Lab (200), Systems Research Lab (300), R&D Lab (400), R&D Lab (500), R&D Lab (600), Engineering and Product Assurance Division (700), Research and Engineering Support Division (800), Components Research Lab (900) and Electromagnetic Effects Lab (1,000).

During FY 1973 the HDL engaged in 282 technical tasks, of which 72 percent were directed to Army needs, including support of the "Big 5 Program" of materiel development in coordination with project managers and contractors.

New funding for FY 1973 totaled $72.2 million. Expenditures of $62.7 million included 479 new contracts (almost 70 percent to small business and 42.8 million to nonprofit organizations) and 11,681 procurement actions initiated for a total of $42.5 million. Contracts with a face value of $72.8 million were active at the end of FY 1973.

Statistics such as those indicate the volume of HDL effort performed by a total staff of 1,442 civilians (51 temporary employes) and 10 military officers highly educated and experienced as scientists or engineers. The staff includes 524 professionals, of whom 260 have bachelor's degrees, 155 master's and 155 have doctorates, plus 344 subprofessionals.

Listing of those 282 tasks would serve to show the diversity of HDL effort, indicating properly its "full spectrum" capabilities. The official mission statement succinctly summarizes operational areas as follows:

- Influence, Time, and Command Fuzing;
- Target Detection and Signature Analysis;
- Target Intercept Phase of Terminal Guidance;
- Weapon System Synthesis and Analysis for Fuzing;
- Counter-Counter Measures, Nuclear Effects, and Other Severe Environments;
- Fluidics and Medical Engineering;
- Instrumentation and Simulation;
- Components and Materials;
- Industrial and Maintenance Engineering;
- AMC Lead Laboratory for Fluidics Technology and Nuclear Weapons Effects.

PROXIMITY fuzes developed by HDL (40-mm grenade and 2.75-inch rocket types shown here) have played key role in U.S. weapon systems since World War II.

Stated more tersely: HDL performs work in "all phases of research, development, engineering, and early production and procurement." About one-third of the HDL program is in support of improvement in munitions. Other principal efforts are in transient radiation effects on electronics; fluidics technology for use in medicine, ordnance, control systems and computers; special-purpose and foliage-penetration radars.

Statistics in support of HDL's record of achievements include an average of close to 50 patent awards annually (in recent years HDL has averaged about 15 percent of all U.S. Army patents); and publication of about 100 technical reports annually and about 75 articles in professional journals.

Over the 20 years of its existence, HDL's total listing of scientific and engineering contributions to military requirements—including a great many that have widespread applications to civilian population needs—might fill several bulky volumes. Therefore, FY 1973 is selected as a typical year.

Within this period, engineering development was completed on the Short Intrusion Proximity Fuze XM732, providing a single fuze for all artillery requirements. The Army Munitions Command (now a part of the new

Harry Diamond (1900-1948)
Founding Father of HDL

COL David W. Einsel Jr.
Current HDL Director

Wilbur S. Hinman Jr.
First Technical Director

Billy M. Horton
Present Technical Director

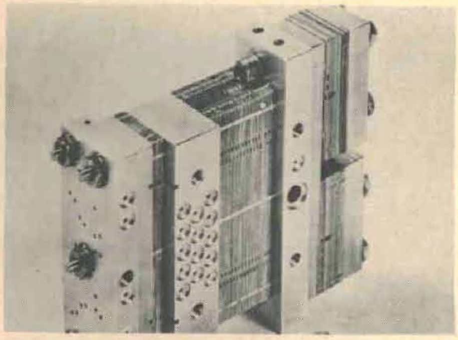
Dr. Henry P. Kalmus
HDL Chief Scientist

Armament Command) estimated that this development, which eliminates the present requirement for deep intrusion cavities and supplementary charges in all projectiles, will result in annual savings of $10 million in projectile procurement. This estimate does not include savings due to simplification of logistics, storage, etc.

A complementary development is the XM734 Multi-Option Mortar Fuze, which is similarly expected to reduce over-all fuze costs and proliferation in the Army munitions program. Internal engineering development on this single fuze for a lightweight company mortar system was completed during FY 1973.

The XM734 requires only a simple setting immediately prior to firing to provide a fully tactical fuze for high-energy mortar shells for company level use—for air burst, near surface burst, impact, and delay after impact burst.

Equipped with two safety checks, and designed to reduce the need for stockpiling the different fuzes now used, the XM734 has performance characteristics described as ". . .



PROGRAMER shown here for use in high-performance missile safing and arming systems is dependent on fluidic control.

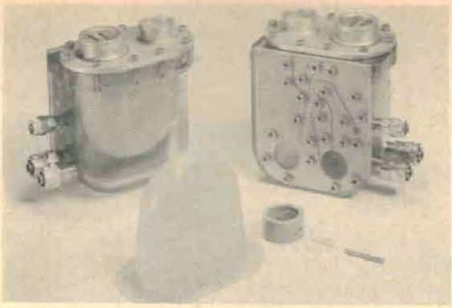
probably the most severe of any required of an air target proximity fuze." HDL developers say it is the first fuze to utilize a fluidic power source in lieu of batteries to provide power for the electronics.

In additional areas of fuze development, HDL continued work on the SAM-D, Chaparral and Sea Sparrow missiles, guidance-aided fuzing, complex investigations for the Army Ballistic Missile Defense Agency, analytic evaluation of whole systems, and high-burst fuze studies. The electronic time fuze XM587EI was fired successfully in 105, 155 and 175mm guns.

Showing "great promise" in HDL work on the next generation of fuzes, with several "breakthroughs" reported in FY 1973, are microwave power sources, novel acoustic transducers, and a dual-pulse ranging system to optimize performance. Analysis of a fluidic bistable switch was completed and laminar proportional amplifiers with dynamic ranges 10 to 50 times better than commercially available amplifiers were developed.

Reportedly "nearing success" are HDL efforts to provide a complete fuze on a single integrated circuit chip, an IMPATT (Impact Avalanche Transit Time) transmitter using dielectric components, a slant-range optical fuze undergoing a cost-reduction study, and a technique for reducing lead oxide adhesion in liquid power supplies expected to reduce production costs.

In using unique capabilities such as its Aurora Facility, along with the Flash X-Ray



FLUIDICS technology developed by HDL was announced in 1960 and applied to rapid development (1961) of heart pump.

Facility and the Diamond Ordnance Fuze Facility, HDL investigators "contributed significantly" to advanced technology of internal electromagnetic pulse (EMP) simulation. Support was provided to the Sprint, Spartan, Lance and Minuteman missile systems.

Study of transient radiation effects on the electronics of the Leopard II tank was continued, and a new program for "hardening" (making it resistant to radiation damage) Pershing missile communication equipment was initiated under working agreements with the Federal Republic of Germany.

Major progress was reported in application of fluidics to numerous military requirements, including safe production and handling of munitions. The first use in ammunition equipment was at Tooele Army Depot. Similar cooperative contracts are involving the Lone Star and Scranton Army ammunition plants, Edgewood (MD) and Frankford (PA) Arsenals, and the Army Mobility Equipment R&D Center at Fort Belvoir, VA.

In progress also is work on a TNT-level sensor, a sensor for safety of forklift and truck loads, and a sensor for use in warehouses having an automatic track-following vehicle control circuit for transporting supplies.

A fluidic sensor circuit for a grenade pin detector and puller operation also is in development, and models have shown the feasibility of using fluidics for noncontact gauging of hot-forged artillery shells. Fluidics also have been applied to detection of small quantities of toxic gas concentrations.

In a joint effort with the Naval Weapons Center at China Lake, CA, a safety velocity sensor that transforms ram-air energy into electrical energy was tested successfully at altitudes up to 35,000 feet for an application to aerial weapon dispensors. Work also was performed with the Naval Ordnance Laboratory, White Oak, MD, on a fluidic environmental sensor (FES) for the Deneye weapon system.

Similar earlier work was done with NOL on a fluidic power supply system to eliminate accidental firing of rockets while an aircraft is on the ground or on carrier decks. A system that fires the rocket only when the aircraft has reached a predetermined velocity was tested successfully.

Other new HDL developments included a visible laser beacon that enables downed pilots to signal search aircraft up to altitudes of 20,000 feet; also a rapid-gelling epoxy that will cut production costs, a practical thin-film magnetometer, and various improved plastics for various ordnance items.

Assisting HDL Commander COL David W. Einsel Jr., Technical Director Billy M. Horton and Chief Scientist Dr. Henry P. Kalmus in developing and evaluating R&D programs is a Scientific Advisory Committee. Members include:

Harry Davis, formerly Deputy Under Secretary of the Air Force (Systems Research); Donald G. Fink, general manager, The Institute of Electrical and Electronics Engineers, Inc.; Dr. Martin Goland, president, Southwest Research Institute; Dr. G. K. Hartman, technical director, Naval Ordnance Laboratory; Wilbur S. Hinman Jr., former HDL technical director and later Deputy Assistant Secretary of the Army (R&D); and

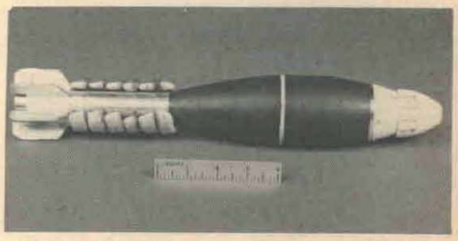
Dr. James D. Meindl, director, Integrated Circuits Laboratory, Electrical Engineering Department, Stanford University; Dr. Donald O. Pederson, EECS Department, University of California at Berkeley; Dr. Joseph R. Rowe, chairman, Department of Electrical and Computer Engineering, University of Michigan; and Dr. Ralph G. H. Siu, formerly one of the Army's most renowned scientists.

Much of HDL's success in a sustained 20-year record of superior performance in meeting numerous high-priority Department of Defense requirements is attributed to an active academic training program to upgrade professional capabilities of established personnel, and to attract ambitious, highly talented young personnel.

In FY 1973 the HDL conducted 24 on-site courses, using its professional personnel and contract instructors and benefiting a total of 439 employes, mainly in the scientific and engineering areas. In four colleges and universities in the Washington, DC, area, 132 HDL employes completed 182 courses. Thirty-two middle managers and first-line supervisors attended an 80-hour R&D management course offered by the Army Logistics Management Center, Fort Lee, VA.

Dr. Maurice Apstein, HDL associate technical director, was awarded in 1973 the U.S. Army's highest honor for a civilian employe, the Decoration for Exceptional Civilian Service, for notable achievement from 1949 through August 1972. He was cited particularly for leadership of the Staff Development Committee, as a consultant to the President's Science Advisory Committee, and as chairman of The Army Research Council.

An active Incentive Awards Program is basic to HDL operations in giving recognition to outstanding achievements. In FY 1973 Tadeusz M. Drzewiecki was a recipient of the HDL annual Technical Achievement Award, John P. Carrier won the Managerial Achievement Award, David L. Bowman received the Technical Leadership Award, and the Managerial Leadership Award was bestowed on L. Jean Marroletti. Howard S. Jones was honored as HDL's Inventor of the Year.



MULTIOPTION fuze used here in lightweight mortar shell is expected to save millions in procurement and logistics.

WES Support of DNA Programs

By Guy L. Arbuthnot Jr.

The Defense Nuclear Agency (DNA) and the U.S. Army Engineer Waterways Experiment Station (WES) have cooperated on research programs since December 1950. Then known as the Armed Forces Special Weapons Project, DNA later became the Defense Atomic Support Agency (DASA).

Participation of WES in DNA programs was concerned initially with studies of effects of underwater nuclear explosions in cratering excavation research and the generation of water surface waves.

The nuclear weapons effects program at WES has expanded in recent years to include surface and underground explosion phenomena such as earth motions, development of protective structure design criteria, computer code calculation procedures, and determinations of the constitutive relationships of earth materials.

Current DNA studies at WES are concerned with the development of computer codes for predicting the free-field effects of nuclear weapons (ground motions, cratering and crater ejecta) and response of both surface and buried protective structures.

In each case these studies are supported by laboratory experiments and by large-scale high-explosive field tests that are utilized to simulate certain phenomena associated with a nuclear explosion, primarily the blast and shock effects.

The major WES activities involve detailed description of the nuclear blast and shock environment, and response of structures, structural components and contents to the environment.

Field Tests. Imposition of the Limited Test Ban Treaty precludes atmospheric nuclear tests; therefore, alternative means are utilized to determine effects and responses from postulated near-surface, large-yield nuclear explosive threats. The current approach is to simulate explosion effects and structural responses, using both physical and mathematical models.

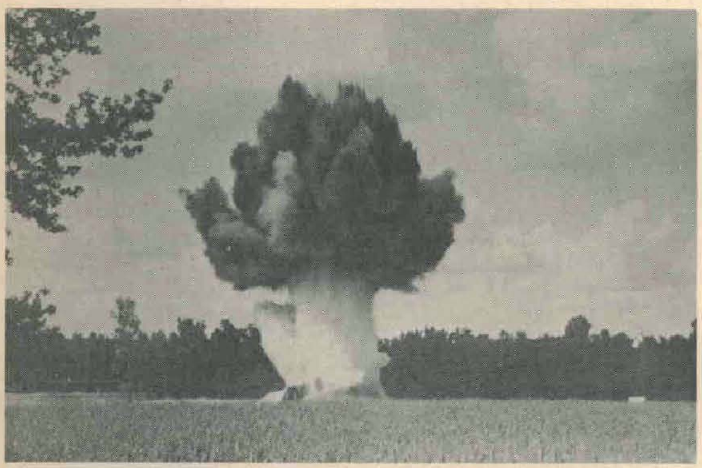
Basic shock phenomenology may be studied by using high-explosive tests. Structural models may be exposed in these tests and in special laboratory blast and shock simulators, such as the WES Large Blast Load Generator.

Explosions effects and structural behavior may be simulated mathematically by using large digital computers. A well-coordinated program managed by DNA provides a balance between these approaches and frequent correlation and evaluation of results.

Major WES field test capabilities are listed in Table 1. Functions performed for DNA on several major research efforts have involved numerous WES organizational elements. Technical project specialties are listed on Table 2. WES has been the primary ground shock measurement laboratory on all recent major high-explosive tests sponsored by DNA.

In addition, WES usually performs cratering experiments and exposes various structures to the blast. For example, a 1/12-scale model of the perimeter aquisition radar building of the Safeguard ABM System was exposed to a 500-ton TNT explosion.

The value of explosion effects field tests in the design of strategic



DETERMINATIONS are made on effects or possible damage of explosions from varying sizes of charges in earth, water and air. Data are obtained on shock-wave phenomena near the blast-point, the characteristics of waves developing in water, and the cratering effects in shallow harbors to deepen them.

defense systems is summarized in Table 3. This simulation method provides improved basic knowledge of explosion effects, a basis for purely empirical predictions, and real data for verification of analytical (computer code) methods—all with improved confidence and monetary savings.

Soils Dynamics. The principal studies in soils dynamics are about equally divided into three general categories, i.e., research and development, field test support, and strategic systems applications. We share a common research objective with a number of people and agencies. That goal is to develop reliable methods for predicting free-field effects such as ground motion and stress.

Basic information needed to support our work toward this goal comes from a combined field exploration and laboratory material property test program. Therefore, to develop reliable techniques for predicting complete stress and motion histories induced in natural earth masses by the effects of nuclear and chemical explosions, one must provide proper input to theoretical calculations.

Table 1
WES Field Test Capabilities

Test planning and direction.
Site selection, acquisition, and development.
Geologic and material property studies.
Engineering and construction support.
Logistical support.
Explosives preparation.
Project participation.

Table 2
Technical Specialties

Blast and shock phenomenology.
Blast and shock instrumentation.
Cratering and ejecta.
Structural modeling.
Structural dynamics.
Earth dynamics.
Timing and firing.
Technical and documentary photography.
Data processing.
Report preparation.

Detailed information must be available regarding soil profiles at sites of interest and their physical and mechanical properties. The laboratory studies define the stress-strain-time or constituent properties which govern the propagation and attenuation of ground shock in earth materials.

Tests results are then translated into useful stress-strain and strength properties. Analytical studies concern the development of rational procedures for calculating the stresses and motions induced by nuclear detonations within a natural earth mass.

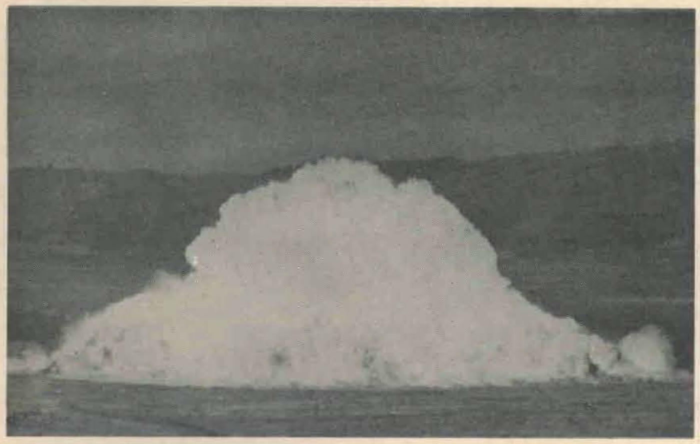
Ongoing studies involve the development of mathematical constitutive models, compatible with both the theoretical restructions of elasticity and plasticity and with experimentally observed constitutive properties.

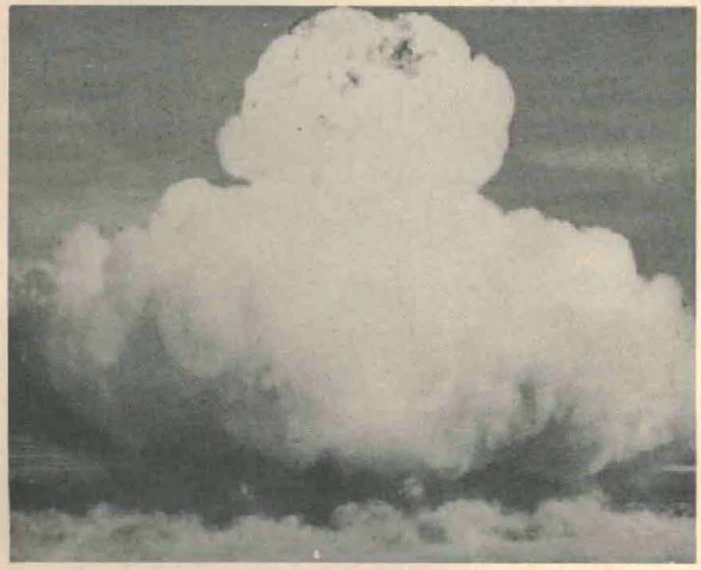
Mathematical models must then be incorporated into the appropriate boundary-value problem, solution schemes or computer codes for calculating the effects due to high-intensity transient loads.

Investigators can then study parametrically the influence of various model, site, and code data details on computed stresses and motions. Thus they gain the insight necessary to interpret code-generated results. Comparative analysis of data obtained during field test events can establish a measure of confidence in calculated nuclear situations.

Our current Minuteman missile system related activities rely heavily upon our R&D accomplishments. These involve detailed soil property investigations at selected Minuteman sites, the selection of representative calculation profiles of properties and the maintenance of the close working relationships with the Air Force and a number of their contractors involved in theoretical calculations.

Our activities for the Safeguard system are oriented more toward the early phases of design and deployment rather than to post-construction evaluation of existing facilities. Detailed analysis serves





HIGH-EXPLOSIVE TEST. Photos above show three phases of a 100-ton sphere of TNT triggered with an electrical charge controlled by the timing and firing system.

to validate criteria used by architectural and engineering firms.

Support of large-scale field tests was demonstrated by our participation in Operation Prairie Flat, one of the 500-ton, high-explosive events conducted at a test site near Medicine Hat, Alberta, Canada.

If field sampling and laboratory testing had not been conducted, the site profile would have been defined solely by seismic survey data which indicated only a 2-layer soil system. Data based on boring logs and laboratory tests indicated that at least a 6-layer profile was necessary to describe adequately material property variations at the site.

Dynamic compression properties for the 2-layer system based on seismic velocities were linear elastic, as dictated by theory; properties for the 6-layer system, based on dynamic laboratory tests, were extremely nonlinear and inelastic.

These profiles and properties were used in a wave propagation code to calculate stresses and motions for the Prairie Flat test. One calculation was based only on seismic property information, the other on exploratory boring logs in laboratory test data.

Cratering and Ejecta. WES crater research under the auspices of DNA has resulted in several noteworthy achievements. Study techniques based upon large-scale crater excavation have been developed to a high degree.

The vertical sand-column method introduced by the U.S. Army Ballistic Research Laboratories (BRL) at Aberdeen (MD) Proving Ground to define limits of small craters has been refined to provide precise horizontal and vertical measurements of subsurface deformation to depths of 50 feet. Overcoring and borehole photography have supplemented this technique for rock media.

Table 3
Value Of Field Tests

Understanding basic phenomenology.
Provides basis for empirical predictions.
Verification of analytical methods.
Verification of modeling procedures.
Improved confidence for design purposes.

Together with accurate surface-displacement measurements, these methods have provided far better definition of the various crater regions than was available 20 years ago. WES also has participated in the development and improvements in the use of aerial photography for crater and ejecta studies.

WES has (with the Boeing Co.) pioneered in volumetric analyses of craters, defining the primary mechanisms which create the crater void and the relative contributions of these mechanisms. This has enhanced the general understanding of craters, improved prediction techniques, and provided insight into scaling laws.

An orderly accumulation of a large quantity of data is available for prediction purposes. The crater compendium, first published in 1960–61, has been provided for retrieval by computer, and will soon be republished in updated form.

WES has also pioneered in large-scale crater ejecta experiments. This important cratering mechanism and long-range hazard was, in years past, often relegated to a position of secondary importance. Modern-day weapon system performance criteria have significantly increased the requirement for a quantitative assessment of the ejecta problem. Some of the more important WES accomplishments in this field have included:

- Development and utilization of the asphalt-strip method of delineating original ground surface and permitting the extraction of large, accurate samples of lip ejecta—thus providing quantities, bulk densities, size and mass distribution statistics.
- Utilization of the color-coded grout method of determining the source regions within the crater void which contribute ejecta to the crater lip and discontinuous ejecta field in rock. These data include mass density measurements as a function of relative distance. This work, similar to that done by the Illinois Institute of Technology Research Institute (IITRI) in soil, has significantly increased the general knowledge of the scientific community in ejecta mechanics.
- Successful prediction of gross ejecta distribution in rock, as influenced by jointing planes.

Structural Models. In assessing the response to determine the collapse loads of complex strategic structures, or in fact any complex structural system, several approaches are available—theoretical to include computer code predictions, experimental, and similitude (use of physical models of prototype configurations).

In general only 2-dimensional theoretical solutions, limited mostly to elastic behavior, are available to analyze 3-dimensional configurations. Consequently, there are some real, practical difficulties in predicting the behavior of a complex structure buried in soil and subjected to transient (dynamic) loadings.

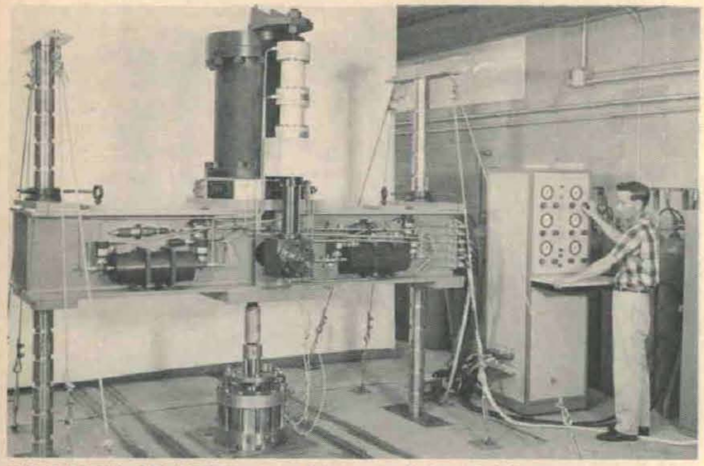
For such systems it usually is not only necessary to determine the capability of the structure to withstand external forces; the internal shock environment also must be defined.

The maximum structural response usually occurs very early in time under transient loading; proper definition of the total shock environment requires much more time. The longer a code has to generate numbers, the greater is the possibility to accumulate error. Consequently, structural response predictions are probably more accurate than internal shock predictions.

(Continued on page 22)

WES Support of DNA Programs

(Continued from page 21)



DYNAMIC LOADER (100-kip) applying high-pressure pulse to soil specimen in Waterways Experiment Station testing.

Another approach for determining the response of a system is to test the prototype structure; however, this can be very costly and in most cases not very practical. The alternative is to test a model of the prototype under realistic and properly applied loading conditions.

If a system is properly scaled, the 3-dimensional aspects, as well as the nonlinear behavior of the material properties, are appropriately taken into account. Consequently, the structural as well as the internal shock response determined from a model test can be scaled to prototype conditions.

Similitude relationships and modeling techniques have been developed and verified by WES researchers through tests of models and prototypes, principally under Defense Nuclear Agency sponsorship.

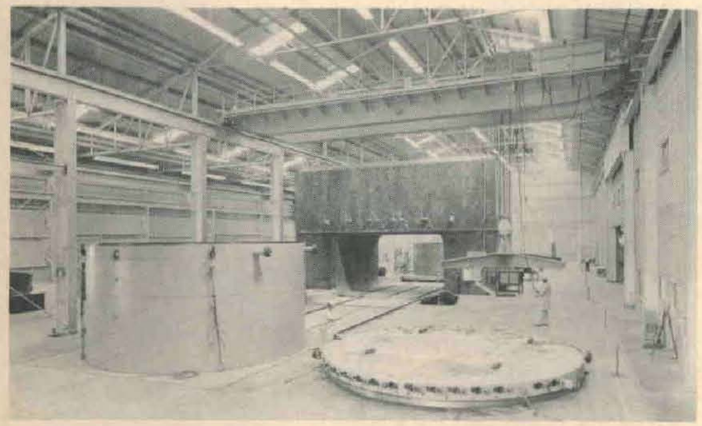
An interesting study that exemplifies the use of a complex model was conducted for the Office of Civil Defense—a ¼-scale model of a 9-panel, reinforced concrete slab floor system built with integral walls.

Use of the same strength of concrete and reinforcement material planned for the actual construction insured that the material properties of the model and prototype would be the same. It was buried in sand and tested in the Large Blast Load Generator.

Using available theory, an overpressure of approximately 15 psi was predicted to cause collapse; however, an overpressure of 27 psi was required to cause collapse.

A 1/24-scale model of the prototype was constructed and tested statically at the University of Illinois. Using the results from this model test, the collapse overpressure of the ¼-scale model was predicted to be 26 psi; thus, for all practical purposes the little model accurately duplicated the response of the large model.

This study, and similar studies in the past few years, verified the usefulness and the important role of a model in predicting the response to shock loading of a complex 3-dimensional structure interacting with surrounding soil.



BLAST LOAD GENERATOR used to test various types of structures and components under dynamic loads that simulate forces that could be produced by full-scale nuclear explosions.

WES investigators are proud of the opportunities involved in research studies for DNA. Over the years we have made significant contributions to the solutions of many problems arising from nuclear weapons effects, and determinations of protective structures criteria.

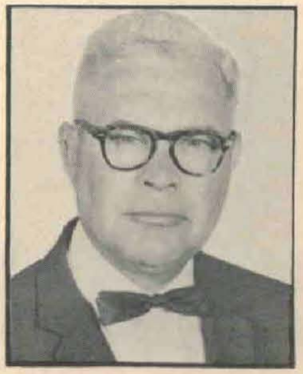
The association with the DNA organization has resulted in development of highly competent technical capabilities at WES which otherwise would not have advanced at such an accelerated pace.

GUY L. ARBUTHNOT JR., former chief of the Weapons Effects Laboratory, U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS, retired in 1972 after 37 years federal service.

He joined the WES staff in 1937 after attending Louisiana State University, majoring in electrical engineering. His initial efforts were devoted to developing use of hydraulic models as engineering tools for navigation, harbor development and flood control problems.

In 1951 Arbuthnot organized a task force for an explosion effects test program and was credited with advancing the state-of-the-art in design and construction of surface and below surface protective structures. He was recognized for increasing knowledge about shock transmission through the ground as affected by soil properties, ground structures interaction, and effects of shock vibrations on structure contents.

Recipient of a Meritorious Service Medal in 1969, he served on numerous standing and ad hoc advisory committees of the Defense Nuclear Agency and other Department of Defense Agencies.



Among his professional affiliations are the Society of American Military Engineers, the American Society of Civil Engineers, the Mississippi Society of Professional Engineers, and the National Society of Professional Engineers.

A registered professional engineer in Mississippi, he is listed in American Men of Science *and in* Personalities of the South.

STRATCOM Redesignated Communications Command

The U.S. Army Strategic Communications Command (USASTRATCOM), organized in 1964 to engineer, install, and operate the Army's portion of the Defense Communications System, was renamed the U.S. Army Communications Command (USACC) effective Oct. 1.

On July 1 of this year, STRATCOM was assigned full responsibility for the communications support of the posts, camps and stations within the Continental United States. The command also is tasked with new duties of a nonstrategic nature in specialized communications such as air traffic control, navigational aids and certain communications aspects of military assistance programs.

STRATCOM Commander MG Jack A. Albright explained that with the evolution of his organization through the years, the title Strategic Communications Command became anachronous in that it did not adequately describe the scope of the missions assigned to about 30,000 personnel stationed in 22 countries.

IEEE Sets International Reliability Physics Symposium

Electronic device failure mechanisms, causative physical and chemical processes, and practical methods for their control will be considered Apr. 2–4 at the 1974 International Reliability Physics Symposium, Las Vegas, NV.

Cosponsored by the electron device and reliability groups of the Institute of Electrical and Electronics Engineers, the symposium will feature original, unpublished material. Submission deadline for subject abstracts is Nov. 13.

Prospective authors must submit a 50-word abstract and a 300–500 word summary appropriate to a 20-minute paper clearly stating: the purpose of the work, how it advances knowledge of reliability physics, and results of the investigation.

Abstracts should be suitable for publication in an advance program, be typed on a separate sheet, and include title of the talk, author(s) name and affiliation, complete return address, and telephone number.

Summaries must be single-sided, double-spaced typewritten and suitable for immediate reproduction and review. The title, author's name, affiliation, complete return address and telephone number should appear on first page. Subsequent pages will list author and paper title.

Abstracts and summaries should be forwarded to: I. A. Lesk, Technical Program Chairman, 1974 Reliability Physics Symposium, Motorola Inc., 5005 E. McDowell Road, M.S. A112, Phoenix, AZ 85008.

Briefing Informs ASA (R&D) of 3 Significant Efforts of Army Materiel Command

Three research reports considered of special significance relative to activities of U.S. Army Materiel Command laboratories are presented to the Assistant Secretary of the Army (R&D) on the second Tuesday of each month.

Initiated by AMC Chief Scientist Dr. Craig M. Crenshaw, Office of the Deputy for Laboratories, this series of briefings has proved a valuable means of apprising the ASA (R&D) of scientific advances based on in-house work believed to have important potential for application to military priority requirements.

The recent briefing topics were: Military Potential of Electroslag Remelted Steels, presented by Dr. E. S. Wright, U.S. Army Materials and Mechanics Research Center, Watertown, MA; Cannon Mounted Velocimeter, Richard M. Satz, Picatinny Arsenal, Dover, NJ; and Inverse Filtering to Increase Radar Range Resolution, Dr. Robert H. Paul, White Sands (NM) Missile Range.

Participants in the Army Materiel Command Laboratory Directors Conference in June 1973 were given a condensed report on the envisioned significance of electroslag remelted steels. AMMRC Director Dr. Alvin E. Gorum predicted that within the next decade the bulk of high-quality steel produced in the U.S. will be made with this process.

Dr. Wright, in his presentation to the ASA (R&D), said the process produces steel having "extremely low impurity content, excellent homogeniety, and good surface finish." Other qualities include "substantially improved ductility, fracture toughness, endurance limit, and ballistic impact resistance."

In cooperation with several AMC commodity commands, he said, the AMMRC is engaged in a broadly based research, development and production engineering program to accelerate the use of ESR steels in a variety of Army applications.

Among cited advantages for medium-carbon, low-alloy steel produced by electroslag remelting are "85 percent cost savings over dual-hardness steel, and up to 50 percent weight savings over standard rolled homogeneous steel against certain small arms threats."

One of the current AMMRC-Armaments Command efforts is directed toward production of hollow ESR gun steel ingots for conversion to cannon barrels by rotary forging. Other potential applications include improved components in aircraft—because of ESR steel's fracture toughness at high-strength levels and high endurance under fatigue loading conditions.

Cannon Mounted Velocimeter. This program originated in response to requests from the commanders of the Munitions Command (since merged into the Armament Command) and the Artillery School at Fort Sill, OK, to demonstrate the feasibility of using gun-mounted strain gauges to measure projectile velocity. This objective has been achieved in a demonstration for field use that attained "desired accuracy of one percent."

The concept is expected to be "extremely cost effective by eliminating the need for registration fire (approximately 10 rounds) to establish empirically the standard velocity for each gun tube propellant lot, ammunition lot . . . and gun lay. Ammunition and propellant lots could be intermixed with one-shot verification of standard velocity," solving a very complex ammunition storage logistics problem.

An additional benefit derived from the low cost, small size and operational simplicity of the strain gauge technique is the capability of outfitting every gun with an independent velocimeter, as opposed to one system per battery under the existing authorization.

Improved Radar Range Resolution. In reporting on the success of R&D to use inverse filtering to increase radar range resolution, Dr. R. H. Paul said the implication of results in experimentation on C-band instrumentation radars at White Sands Missile Range is promising.

By additional processing of the received signal on a pulse-by-pulse basis, he said, the range resolution may be increased at moderately high signal-to-noise ratios from about the width of the transmitted pulse to about one-tenth with an error not exceeding one-fiftieth of a pulse width.

Thus the minimum distinguishable separation of targets by tracking radars could be reduced by a factor as much as 10, Dr. Paul explained.

This would mean, for example, that resolution of the AN/FPS-16 radars in the one-fourth microsecond pulse mode could be reduced from the present value of about 125 feet to approximately 12.5 feet. In the experimentation, for spacings of slightly less than one-quarter of a pulse width and greater, the recovery of the target returns was error free within the resolution of the computation, which was 0.5 percent of a pulse width.

Assisting Dr. Paul in this research are Elwin C. Nunn and Robert A. Voss.

ATACS AN/TSQ-84 Readied to Replace SB-675A/MSC

Circuit-patching facilities presently fielded for the Army Tactical Communications Systems (ATACS) are not adequate to perform all functions required at area and large command signal centers.

That is why a new Communication Technical Control Center, AN/TSQ-84, is being developed by the Army Electronics Command at Fort Monmouth, NJ, to replace the SB-675A/MSC patching panel. Among essential changes the AN/TSQ-84 will provide are additions for 4-wire interconnection capacity, line test and monitor facilities, and adequate space for facilities for operating personnel.

Rocco M. Iamello, general engineering in the Office of the Project Manager for Army Tactical communications and a recipient of both industrial and civil service awards for his work, explained many AN/TSQ-84 features.

The primary purpose of the transportable AN/TSQ-84, mounted in an S-280/G, (2½-ton) shelter, is to provide efficient and rapid inter- and intra-site communications. This test item will be the center for most communication control actions, including circuit tests and service restoral under adverse or emergency conditions.

The AN/TSQ-84 will be an integral component of the ATACS' High Capacity System, a 48/96 channel multi-axis radio relay and cable communications network. The system will provide common user and sole user voice, teletypewriter (TTY), and data circuits to all authorized users in a field army area.

The AN/TSQ-84 is configured primarily for 4-wire operation but has available a 2-wire interface capability. The system is human engineered to separate the constant operator's functions from the more permanent system interconnect areas—by grouping all the voice frequency patch fields, conditioning, and signal equipment on one side of the shelter. This leaves the opposite side free to house all equipments necessary for operator activities.

Space is provided for future insertion of the quality monitor equipments now in advance development by the Comm/ADP Laboratory, USAECOM, Fort Monmouth, NJ. The MDF (main distribution frame) bay has about twice the area of the other bays to facilitate location and patching of circuits that deviate from the normal through configuration. The test and rapid-patch jack bay is relatively free of patch cords, such as exists in the SB-675A/MCS. A monitor jack bay is similarly free of patch cords.

All VF circuits in the AN/TSQ-84 will go to piggyback connectors. This will provide a point of entry, at a later date, for upgraded components to assist operators.

The incorporation of these components will facilitate testing and recording by giving the operator a quick look CRT status display of circuit interconnects and a keyboard controlled test setup to connect any circuit to test equipment. Provided also are the capability of keyboard status update, record keeping system, and hard copy of displayed data.

The circuit handling capability of the AN/TSQ-84 is divided into four functional areas, an MDF patch panel, monitor patch panel, a rapid patch and test panel, and a DC patch panel at the operator's console.

Capabilities of the AN/TSQ-84 include:

- *For the audio circuits,* 74 signal connectors (37 for the local side and 37 for the transmission side). This will provide 888 four-wire circuits (444 in, 444 out) hard-wired normal through, and two signal connectors that will provide 24 four-wire circuits that can be switched from the jack bay to either binding post or 26-pair cable. All of these circuits make an appearance at the main distribution frame (MDF), monitor, and test-rapid patch jack bays except the 24 four-wire circuits above that appear at the MDF only.
- *For DC circuits,* four signal connectors provide 48 four-wire DC teletypewriter circuits that will appear at the operator's console to be patched as required.
- *Eight signal connectors* are provided for alarms, orderwires, and control system. Six connectors are for the orderwire and alarm applique which terminate at the operator's console. This equipment is used to detect system group and super group alarms and to access the system engineering orderwires. One signal connector is for the AN/MSC-32A facilities control and one is a spare.

Picatinny Performing Major Role in Ammo Pollution Abatement

By Irving Forsten

Over-all lead responsibility for pollution abatement measures incident to the manufacture, loading, assembling and packaging of munitions items such as propellants and explosives used by the U.S. Army is assigned to Picatinny Arsenal, Dover, NJ, an installation of the Armament Command.

Under cognizance of the Army Materiel Command project manager for munitions base modernization, this responsibility extends to the 17 U.S. Government-owned contractor-operated plants (GOCO) located in the eastern half of the United States.

Because of the nature of the munitions industry as applied to precise military requirements, many pollution problems of wide concern must be addressed as part of the nationwide efforts to protect the environment.

One mission of Picatinny Arsenal is to perform engineering necessary for manufacturing controls in current and future ammunition manufacture; also, to emphasize pollution abatement in accordance with advanced technology and applicable governmental standards. In their mission areas, Frankford and Edgewood Arsenals provide technical support.

To accomplish this mission, the pollution abatement staff at Picatinny is divided into functional groups including survey, technology, automated instrumentation and control, and pilot plant demonstrations. Each functional group is responsible for air, water and solid-waste pollution abatement in respective technical areas.

The survey team's chief function is to establish definitively the pollution problem to be solved and potential abatement methods for typical manufacturing and loading operations (Figure 1).

The range of pollutants is due to the large number of plants with diverse operations. The survey team is defining the problem in each plant by chemical analysis, relationship to production levels. Water management considerations are included in the survey. Data are compiled in a report form for each plant.

Once the pollutants have been defined by type and amount, the technology team has the responsibility for developing measures to meet the control standards. Such techniques as reverse osmosis, fluid-bed reduction ion exchange, carbon absorption, denitrification and chemical reaction are being used.

Proposed solutions are tested in pilot plant demonstrations to establish design criteria leading to a representative prototype. Each solution is examined to insure that pollution is not simply transferred from one media to another. For example, it would be unsatisfactory to dispose of solid wastes through open burning; a solution would be to use a controlled incineration system where emissions are within acceptable standards.

Maximum use is made of recycle or reuse techniques to reduce the effluent to a minimum. A specific example of adaptive technology is the use of carbon adsorption to remove TNT from wash waters, Figure 2.

Once a control process is established, it must be maintained at a high rate of efficiency. Automated instrumentation will establish monitoring and controls to maintain proper operation. Extremely sensitive instruments must be developed to measure low pollution levels, and requiring a minimum of calibration and maintenance.

Particular emphasis is being placed on instruments which measure NO, NO_2, SO_2, CO, hydrocarbons and particulates for air pollution levels. Suspended matter, dissolved ionic and nonionic materials, and temperature are being investigated for water monitoring.

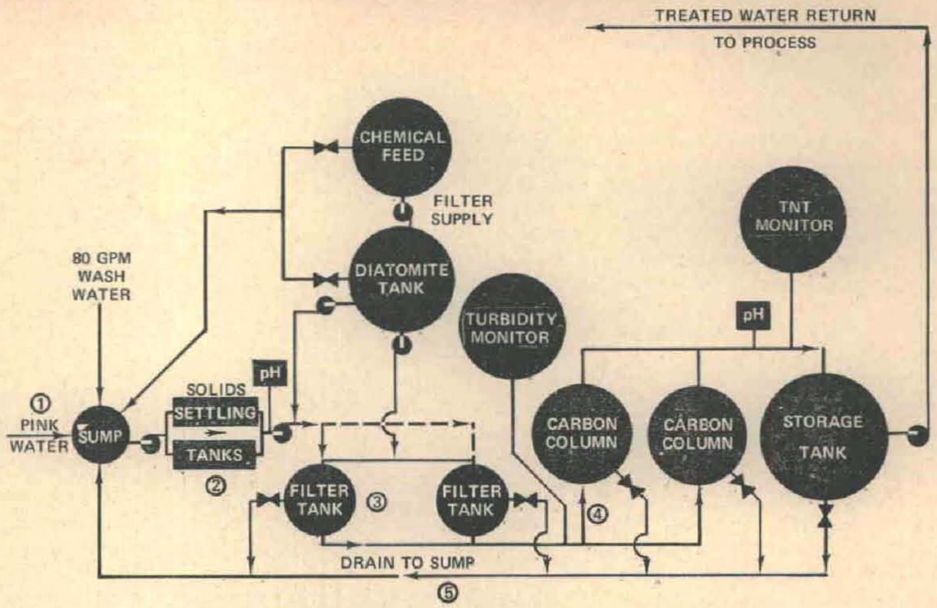


Fig. 2. Pink Water Treatment for LAP Operations

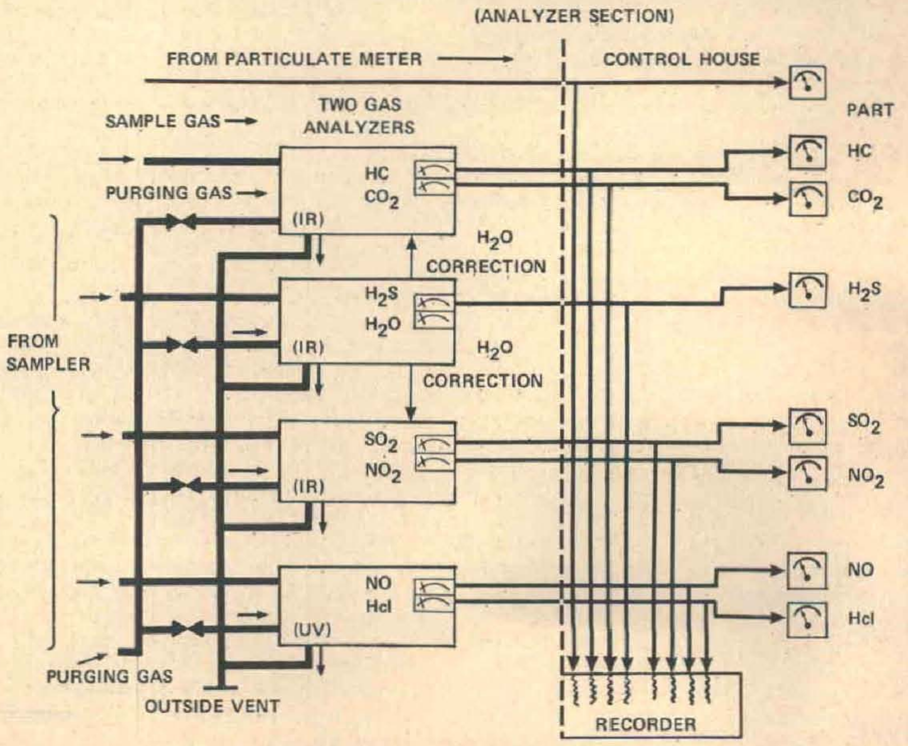


Fig. 3. Exhaust Gas Monitoring System

POLLUTANTS	CURRENT PLANT CONCENTRATIONS	PROPOSED SYSTEM
AIR		
NO_x	18000 - 104000 PPD	MOLECULAR SIEVE
SO_x	1000 - 2500 PPD	WET SCRUBBER
ACID MIST	1000 - 6000 PPD	MIST FILTER

PPD = POUNDS PER DAY

POLLUTANTS	CURRENT PLANT CONCENTRATIONS	PROPOSED SYSTEM
WATER		
RED WATER	40000 - 60000 PPM	REGENERATION
PINK WATER	70 - 150 PPM	CARBON ADSORPTION
SOLIDS		
INORGANIC (NITRATES & SULFATES)	150 - 1000 PPM	CHEMICAL
EXPLOSIVES AND PROPELLANTS	1000 - 20000 PPD	INCINERATION

PPD = POUNDS PER DAY
PPM = PARTS PER MILLION

Fig. 1. Typical GOCO Pollutants and Controls

Commercially available instruments are used wherever feasible. However, for munitions, pollutants such as tetranitromethane, formed in nitration processes and evolving as a stack discharge gas, require development of a special-purpose instrument.

Instruments are evaluated under actual operating conditions to determine which system best meets the needs of industrial operations. Selection is made by a cooperative effort between the GOCO plants, Picatinny Arsenal and other federal agencies such as the Environmental Protection Agency and the U.S. Surgeon General.

An example of instrumentation required for abatement equipment is exemplified by the recorder used to monitor stack gases from the explosive waste incinerator at the Radford Army Ammunition Plant. Figure 3 shows the multiple gases analyzed simultaneously.

Current pilot plant work is being conducted on explosive-contaminated inert wastes, explosive and propellant incineration, fluid-bed technology, molecular sieves for NO_x abatement and SO_x abatement systems. As in all of the team's previous efforts, great emphasis is placed on involvement of the government-owned, contractor-operated plants.

In the pilot plant explosive waste incinerator system, the U.S. Army's accomplishment was without technical precedent. A vertical induced-draft incinerator was used to determine feasibility of burning propellants and explosives at Picatinny Arsenal.

Using a broad variety of explosives, 45 test runs for more than 6 hours each were successful. To insure safe operation, the explosive was ground and slurried with water prior to transmittal into the incinerator.

Figure 4 shows the planned conversion of the Picatinny Arsenal incinerator to a fluidized-bed combustion technique. The advantages of this system to minimize abatement system requirements because of low-level NO_x emission has been demonstrated by Esso Research and Engineering Corp. under contract with Picatinny Arsenal.

As new standards are established, the arsenal's munitions manufacturing operations continue to be responsive by developing new technology and pilot plants with instrumentation controls to protect the environment. The program is reinforced through cooperation of the GOCO plants and other federal agencies, such as the Environmental Protection Agency, U.S. Surgeon General, and U.S. Army Environmental Health Agency.

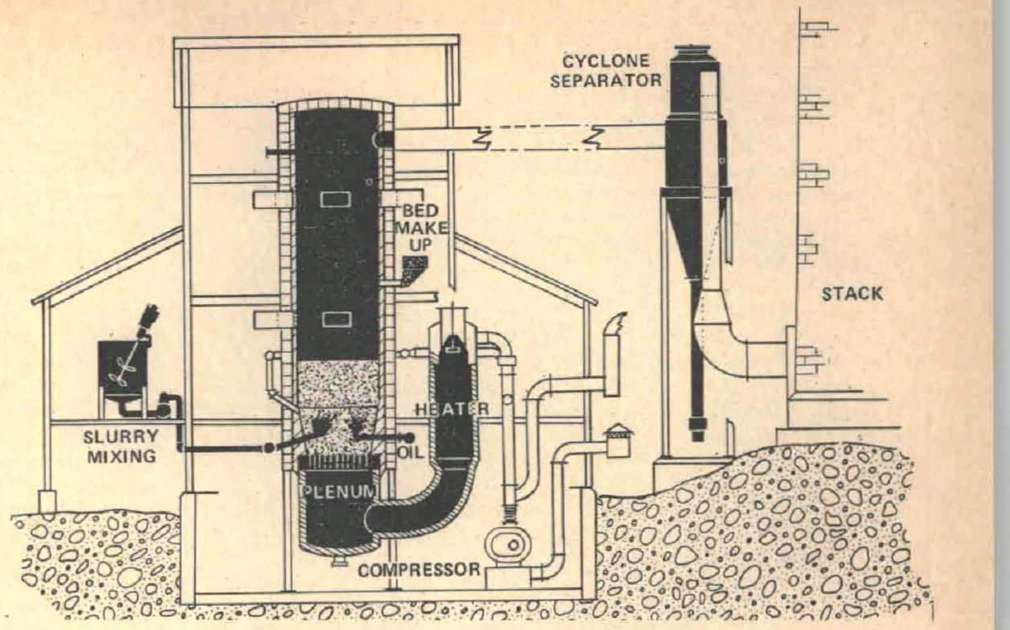


Fig. 4. Fluidized Bed Conversion PA Incinerator

Picatinny Plasma-Arc Facility May Cut Ammo Costs

Temperatures up to 30,000 degrees Fahrenheit, or three times that of the sun, can be produced in a plasma-arc facility now operational at Picatinny Arsenal, Dover, NJ, hopefully enabling substantial cost reduction in production of various types of ammunition.

Actually, this intense heat is achieved by a flame that does not burn like a normal gas welding torch burns. Instead, the ionized gas gives off the intense heat as a high-velocity jet form, that is, a thermal plasma frequently termed the "fourth state of matter."

The arsenal announcement of the plasma-arc facility cautiously stated:

". . . It is conceivable that the plasma torch will greatly affect the cost of production of the 105mm projectiles or any of the RAP (rocket assisted projectiles) rounds for that matter."

This opinion is attributed to Domenic Molella, staff metallurgist who drew up the specifications and worked with Louis Mizzoni, Design Branch, Technical Support Directorate, and his supervisor on the project, William Schoeller.

The plasma-arc can deposit, on rotating bands of various caliber artillery and projectile rounds, for example, inexpensive iron or mild steel in lieu of more expensive copper.

The rotating bands are the dynamics of the projectiles which give the torque, or spin, during emission through the gun barrel. The bands also act as gas sealers so that the burning of the propellant will eject the projectile out of the gun.

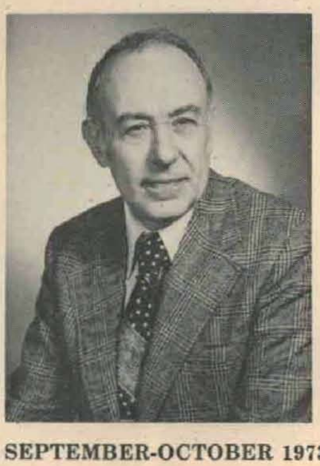
Morever, the copper metal in the bands had been found to contain inherent deficiencies that can now be overcome by the plasma-arc's iron or mild steel spraying process. An iron band can be applied on the 105mm projectile in two minutes.

Other possible applications include depositing hard erosion-resistant coatings, such as tungsten carbide on metallic and filament-wound reinforced gun tubes, launchers, nose cones, rocket nozzles, and retainer rings and wedge rings for missiles.

Other benefits would be the utilization of components that are lower in cost, lightweight, nonstrategic and noncorrosive.

A possible application of the new plasma-arc technique is in welding thin-gauge aluminum parts at speeds up to 200 inches per minute, without affecting the mechanical properties of the base metal, by concentrating the arc in a small area.

IRVING FORSTEN serves as environmental control officer as well as chief of the Facilities and Protective Technology Division, Manufacturing Technology Directorate, Picatinny Arsenal.



In this capacity, Forsten and his staff of multidisciplined engineers and scientists support environmental technology, occupational safety and health and safety engineering requirements, in addition to preparation of facility plans for Armament Command's Production Modernization Program.

Forsten's background includes 30 years of professional engineering experience in process and manufacturing engineering, propulsion technology, and research and development of ordnance items. He has worked with the Departments of Army, Navy, and Commerce, as well as with industry.

He received a bachelor of aeronautical engineering degree (1943) and a master of mechanical engineering degree (1949) from New York University. He holds a professional engineer's license in the states of New York and New Jersey.

Forsten also has authored numberous technical publications, acquired several government patents in ordance and process technology, and is the recipient of a Picatinny Arsenal R&D Achievement Award.

PLASMA-ARC facility is utilized by Carl Puborski, welder, as Domenic Molella, staff metallurgist, watches effect of intense heat on rotating band of projectiles.

SPEAKING ON . . .

(Continued from inside front cover)

come from reliability and maintainability plans, manufacturing plans, resource plans, organizational structures, management plans, procurement plans, program schedules, to name only a few. The whole process of Design to a Cost is so infused into commercial practice that it is not glamorized. It is not a specific technique or discipline, but an attitude and way of life. The Task Force members are afraid that the current DoD interest may precipitate a new "ility" or cult with accompanying specifications, disciples, and seminars. We need help from all sides to avoid this pitfall! As Fred Bucy stated in his forwarding memo in the final report, "Continual reference to this effort as Design to a Cost gives us real concern. The danger is that lip service to this new buzz phrase will be used in place of any real substance in accomplishment of Design to a Cost."

The findings of the Task Force represent statements of what the Committee believed to be the principle conditions or practices in the commercial environment which leads to effective program design. They were:

- First, cost reduction should be a central continuing effort throughout the life of a program.
- Second, commercial producers are directly rewarded for reduction in cost by increased profit margins.
- Third, authority for performance-versus-cost trade-offs is well defined in successful commercial programs.
- Fourth, commercial projects personnel are motivated to reduce costs.
- Fifth, project authority should be vested in a relatively small number of people who are highly skilled and experienced.
- Sixth, continuity in both project management and project tasks is essential, at least over major phases of the program.
- Seventh, specifications should be limited to operational performance requirements, and standardization should be emphasized as an effective means of cost reduction.

The principal recommendations of the Task Force follow from these findings. Recommendations fall into three broad categories.

- The role and organization of program management.
- The method by which requirements are specified.
- The motivational tools that are used to promote cost-effective program execution.

The Task Force recommends that the Department greatly strengthen the role of the program manager. He should be given cost-performance trade-off authority, within some fairly broad limits. To effectively utilize such authority, he must be a man of outstanding competence, and he must have continuity on the program for significant portions of the development and production process. If he is to be competent and motivated properly, there must be career growth potential in the role of program manager. And lastly, he should be supported by a simplified hierarchy of DoD procurement organizations.

In the area of requirements definition, the Task Force feels:

- That the Department should concentrate the acquisition process on end-item requirements consisting largely of performance specifications related to the system operating environment.
- That specifications and requirements of the "how-to-do-it" nature should be eliminated to the maximum extent feasible.
- That the target price be a continuing concern throughout the program, with continued reassessment of relative system "value."

The third general area of recommendations concerns the motivational tools which are required to encourage the Government and the contractor personnel to use their authority and creativity to achieve cost reduction. The Task Force report recommends that more emphasis be placed on competitive procurement and that this competition be extended as long into the program life as is practical. The report recommends that ways be studied to alter the typical contract structure so as to permit the achievement of outstanding design and cost reduction to result in higher reward to the contractor.

In a similar vein, it (the report) recommends that personal reward systems be implemented to motivate the Government personnel in the program management role. Also, the continuous evaluation of requirements and costs is necessary to achieve all that is available in the way of cost reduction. And lastly, the Task Force believes that there are many opportunities for the Department of Defense to achieve cost reduction through the use of commercial products, particularly in noncombat uses.

It was apparent throughout the report that the members consider the achievement of a cost-effective design to be a continuous, iterative process of the interacting technical disciplines and parallel cost/trade-off studies and program estimates, the latter encompassing the complete program plan and schedule, including all of the previously discussed program elements. It is important to emphasize again, as the Task Force did, that the maximum stimulation in this area comes from the pressure of strong continuing competition and the incentive of financial reward.

I'd like to turn now to another area in the Committee's recommendations which deals with the motivation of the military suppliers. The report noted that in commercial practice, competition continues throughout the product life. The pressure of other products, other competitors and changing market conditions continually create an incentive, even necessity, for the manufacturer to improve his product and reduce his cost.

By contrast, it was the feeling of most of the Task Force that DoD's practice of awarding a single-source contract after a paper RFP competition results in the termination of competition with the program award. The study report noted that there is an assumption behind this practice that competition beyond the initial procurement is more expensive.

This implies two premises—one, that there is little difference in the performance capabilities of different contractors and, two, that actual cost performance will tend to normalize. A survey of commercial industries would probably indicate that neither of these premises is true. There are, in fact, significant differences in the capabilities of various companies to achieve good levels of design or cost performance.

Further, even within good companies, it often requires the pressure of competition for them to achieve the most creative designs and the most effective management of their costs. Thus, the report noted that the continuing risk of the loss of business and the resulting organizational instability is a stronger motivation than the profit potentials that are available in the current incentive contract methods used by the DoD.

The emphasis on cost in military contract negotiation was one of the characteristics of the current military/industrial "culture" which greatly concerned the members of the Task Force. Commercial industry has an impressive record of converting costly military-scientific developments into industrial products that can be produced in a price range that makes them attractive to commercial customers. They believe that the price differences between military and commercial products are not wholly explained by their technical differences.

To reach the price range that is commercially attractive demands a technical and management orientation that is quite different from the typical military contracting environment. In the military situation, a great deal of management effort is expended in a continuous negotiation process largely oriented to examining the contractor's estimates of what it will cost to accomplish the work. The perspective is one of proving why the product has to be expensive and it may have the result of blunting management's perception of the possibilities for lower cost.

By contrast, in the commercial product, there is usually a discernible upper boundary on the acceptable cost of the item, and it is often below anything the company has previously been able to accomplish. Hence, survival in the marketplace demands defining product price objectives and finding designs and production processes that can accomplish them for a competitive cost.

Oversimplified, then, and with admitted exceptions, the Task Force concluded that in military and Government work, one tends to justify costs; in commercial work one tends to reduce them. (Italics added.)

The Task Force made a strong recommendation that DoD seriously consider dispensing with the majority of the "how to do it" specs, both in the technical and management area. It is their belief that industry is sufficiently mature; that we do know how to build complex systems; and that commercial practice has already selected the useful aspects of the military management process. Continued application of the existing regulations and specifications can only hamper the effective accomplishment of Design to a Cost.

Moreover, the Task Force was concerned with the magnitude of the job of any significant restructuring of the military procurement process. In some cases, not only time and system inertia must be faced, but also possible regulatory and legislative processes must be addressed. The recommendations in the report were not intended as a criticism of military practices, but emphasize that improvements are possible and should be addressed.

It is fortunate that DoD is just now embarking on the task of preparing its recommendations on the Report of the Commission on Government Procurement. The Congress and the Executive Branch will be concentrating on how to implement the Procurement Commission recommendations. The Bucy Task Force recommendations can be fed into that hard look at our acquisition and procurement procedures.

Looking now at DoD implementation of Design to a Cost, we don't want these simply to become buzz words. We want Design to a Cost to become a management system to control costs. We need understanding of this in all DoD agencies and in industry.

Design to a Cost is a specific cost number, established prior to or during the development phase of the particular program. It is the average "flyaway" cost target and/or threshold, expressed in constant dollars, for a specific number of systems, at a defined production rate. The Secretary of Defense approves the Design to a Cost number and thereafter only he can authorize a change.

One of the first problems we encounter with Design to a Cost is in establishing the correct target cost. There are several ways of arriving at this number. Regardless of the approach, the costs have to be within the pre-established affordability limits. It is also vital that the correct trade-off be made between quantity and performance, making sure minimum force level is preserved.

One approach to the cost target, then, is just to divide the affordable dollars by the minimum acceptable force level; this would be the high end of the range. Another approach is to use parametric cost estimates and try to match the optimum point in the cost versus performance and quantity trade-offs.

Still another way is to simply set the cost for the new system at the cost of the system it is to replace, and then determine if the additional performance of the new system is sufficient to warrant a change. In the final analysis, good judgment is the real key to picking the proper Design to a Cost target.

In each case, we have to select the most appropriate approach, and in every case industrial expertise will necessarily be brought to bear on our decision. Industry contributes "should-cost" estimates and checks our calculations and assumptions—while we check theirs. All of us must do a better job of estimating costs. Too low a cost target can lead to a poor product. Too high a target defeats the whole purpose.

Once we set the ceilings, we must record carefully and clearly our calculations and assumptions.

We have to recognize that there will be times when Design to a Cost targets should be changed. Large changes in potential enemy threats, technology breakthroughs, major shifts in budget emphasis or changes in foreign policy can and will cause adjustment. Any change in Design to a Cost targets have to be reviewed and approved at the highest level in the Department of Defense; thus, assuring adequate definition of program baseline changes and good cost traceability.

With regard to *when* Design to a Cost targets should be set, the most important factors are the state-of-the-art of the required technology and the maturity of the operational concept. If set too early, cost targets may stifle technology. If set too late, they are useless.

Design to a Cost requires a series of decisions which are made incrementally in the light of actual results of the last step taken. The first decision is only to initiate advanced development. Later, another high-level formal decision is made either to go into full-scale development or to stop. A still later basic decision is made to produce—or to leave the developed system as an unproduced option.

Early cost estimates are necessarily rough, but, by the time we have a ready option on the shelf, total costs should be known rather precisely, along with tested performance characteristics. We will then know enough to sign a production contract at a realistic price—or turn to another option.

Failures under the Design to a Cost approach will result in early terminations. I do not foresee any new and startling changes in the over-all methods of contracting. Cost-sharing incentives and award fees will continue to be used but probably with more emphasis on production costs.

Competition will play a more important role in weapon system acquisition. We are already seeing more parallel developments, more major improvements to existing weapons and the evaluation of foreign systems. As more of our new major defense systems are Design to a Cost competitive development programs, I feel sure that industry will become convinced of the shift from performance dominance toward cost emphasis. Technical excellence will take on a new meaning in the sense that it will include constant cost awareness and cost control.

The real key to making Design to a Cost work is individual motivation. This is a most difficult challenge. Without question, it is more fun to design way out, pushing the state-of-the-art, sophisticated, gold-plated and therefore ultra-expensive systems. But there just aren't going to be any new programs where cost is no object. (Italics added.)

Let's look at some examples of applying Design to a Cost to DoD programs. One example is the A-X Close Support Aircraft, now the A-10. The target cost was set early in the conceptual effort, reconfirmed at the program initiation decision and reconfirmed again with the decision to enter full-scale development. The Design to a Cost is $1.5 million dollars, average "flyaway" cost, in FY 70 dollars for 600 aircraft at 20 per month.

The validation phase of the program was a competitive development where each of two companies designed, built and tested two each prototype airplanes. Proposals for the full-scale development phase and a small production buy were submitted to the Air Force, along with the estimated production costs for a buy of 600 airplanes. From evaluation of the prototype flight test programs and the contractor's proposals, the A-10 was selected.

The full-scale development contract is cost plus incentive fee, with the schedule geared to the accomplishment of achievement milestones. Since the A-10 program is considered low risk, the contract includes a ceiling price production option on a fixed-price incentive basis for 48 airplanes $\pm$ 50 percent. Some other examples of Design to a Cost programs are:

- *UTTAS*—The Army Utility Tactical Transport Aircraft System—$600,000 per copy for the airframe only.
- *AAH*—Advanced Attack Helicopter—$1.4 million to $1.6 million in FY 73 dollars. (Program just completed source selection.)
- *PF*—Patrol Frigate—$45 to $50 million per ship, FY 73 dollars.
- *NMBT*—New Main Battle Tank—(XM-1)—Just over $500,000 each in FY 72 dollars.
- *Lightweight Fighter*—Further development of the prototype configuration is to result in an average cost of $3 million in FY 72 dollars for 300 airplanes at 100 per year.
- *Advanced Medium STOL*—$5 million in FY 72 dollars for the 300th production article.

We have had a few problems with the Design to a Cost concept to date. Minor problems have been encountered in cost definitions. These problems will be resolved by using the standard DoD Budget Manual definition of "flyaway," "sailaway," or "rollaway" unit cost.

For instance, the A-X program at first had a "flyaway" unit cost that excluded nonrecurring costs; at the Milestone II decision, this was corrected which resulted in an increase in the Design to a Cost value from $1.4 to $1.5 million. The Advanced Medium STOL Design to a Cost number is being changed from the production unit cost of the 300th airplane to the average "flyaway" unit cost of 300 airplanes.

On the balance, we have had excellent cooperation and support from the Military Departments and industry in establishing Design to a Cost as a way of life in defense systems acquisition.

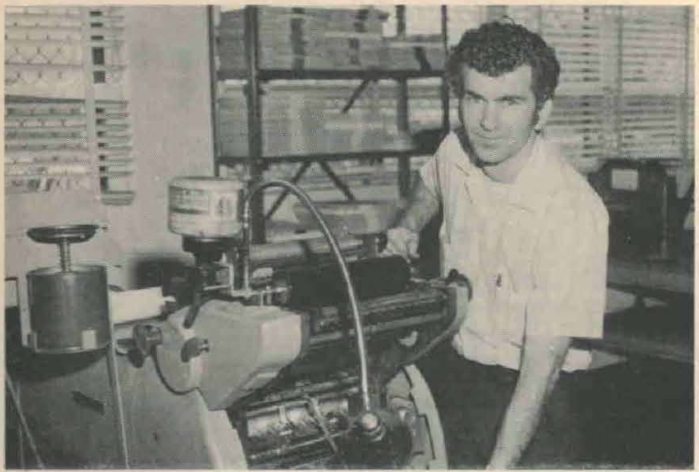
Our ultimate goal, of course, is to design and operate weapon systems in such a manner as to achieve the lowest total cost of ownership: the minimum Life Cycle Cost. I do not believe that we are capable of estimating and controlling Life Cycle Costs accurately enough for their inclusion in contractually binding system specifications at this time.

(Continued on p. 28)

People in Perspective

OVERCOMING HANDICAPS . . .

MICOM Deaf Mute Innovates to Achieve Success



Franklin D. Rushing

Although he cannot hear or speak, Franklin D. Rushing is a man driven by desire for challenging rather than routine jobs.

Rushing is an offset press operator in the Academic Department Reproduction Division at the Missile and Munitions Center and School (MMCS), Redstone (AL) Arsenal. At age 7 he began studying the language of signs and 3 years later was learning printing at the Alabama School for the Deaf in Talladega.

Recently relating his early experience at school, he stated that he had little difficulty in learning because one of his instructors was deaf. He developed his skills at hand composition, proofreading, linotype operation and printing on flatbed and offset presses, all while increasing his knowledge of hand signs.

Today he is able to express himself fully with letter signs, spelling out words for which no signs have been standardized. He believes there is little room for special flair and style if clear communication is to be achieved. During his six years at MMCS, Rushing has taught this delicate art to about 10 of his fellow employes.

Named the 1972 MMCS outstanding handicapped federal employe, Rushing doesn't confine his activities to the shop. One of his biggest accomplishments has been establishing a telephone system for the deaf and nonspeaking residents of Huntsville. The system utilizes a portable teleprinter, adaptable to any telephone.

The user of the system simply dials the number, sets the telephone receiver in a cradle, and types out his message. The receiving party then reads the message from his own printer and transmits it back.

Rushing has also devised an alarm clock and doorbell that activate a light instead of a conventional buzzer or bell. As an aid in attending to the needs of his child he installed a "baby alarm" in his home. The device is triggered by sound and is used by himself and his wife.

As an active participant of his community, Rushing has been named as special consultant and member of the advisory committee of the State of Albama's Vocational Rehabilitation Service. He is also active in the Alabama Registry of Interpreters for the Deaf.

Reader's Guide . . .

Research, Testing Facilities Guide Published

Designed to serve as a guide for scientists and engineers interested in services offered is a recent publication titled *Research and Testing Facilities of the Engineering Mechanics Section, National Bureau of Standards* (NBS), Washington, DC.

Operating characteristics and features of various pieces of testing equipment in the NBS Engineering Mechanics Section are described.

Each major piece of equipment is detailed in a table of pertinent parameters with appropriate photographs. These descriptions include: deadweight force calibration machines; 12 million-pound-force universal testing machine; static testing machines; dynamic testing machines; special purpose equipment (damping measuring equipment and 60,000-pound-mass platform scale); and other test equipment.

1972 Federal Personnel System Report Available

A survey of current developments and projected trends in the Federal personnel system is contained in a recently distributed 97-page pamphlet, *Mandate for Merit, 1972 Annual Report, The United States Civil Service Commission.*

Marking its 90th year of service in 1973, the Civil Service Commission's 89th such report stresses over-all success of the merit system.

Chapter headings, spanning a wide range of topics, are "Mandate for Merit," "Looking and Planning Ahead," "State of the Employe's Economy," "Around the Federal Bargaining Table," "Government Is People," "Toward the New Federalism—Intergovernmental Personnel Programs," and "Other Significant Developments."

Copies are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, $1.25, domestic postpaid or $1.00, GPO Bookstore, Stock No. 0600-00664.

DoD Activity Forecasts Published by USDC

The principal time series on defense activity which may influence short term changes in the national economy are contained in the July 1973 issue of *Defense Indicators.*

Published by the U.S. Department of Commerce, this document includes data on obligations, contracts, orders, shipments, inventories, expenditures, employment and earnings.

Survey topics reported on by the numerous charts and graphs include "Gross National Product and National Defense Purchases," "Advance Indicators of Defense Activity," and "Defense-Related Balance of Payments Components."

HumRRO Reports on Mine, Boobytrap Detection

Identification of significant variables related to mine and boobytrap detection is the subject of a recent Human Resources Research Organization (HumRRO) publication.

Technical Report 73-12, *A Study of Factors Affecting Mine and Boobytrap Detection: Subject Variables and Operational Considerations*, is classified as an initial approach for attacking the problem.

Research results suggest that attempts to identify highly proficient detectors on the basis of nonexperiential variables (psychological, ability, aptitude, interest, background) may prove unsuccessful.

SPEAKING ON . . . *(cont'd. from p. 27)*

We do recognize that there are measurable and controllable factors, other than cost, that must be considered during design, in order to minimize Life Cycle Cost. Probably, the most important are Reliability and Maintainability which we can and do specify contractually, usually requiring demonstration by test. Most of the programs that include Design to a Cost thresholds also have thresholds on Reliability and Maintainability. The point I really want to make is that Design to a Cost is not a license to trade-off production unit costs at the expense of reliability, maintainability, personnel or other support costs.

With regard to other important factors influencing Life Cycle Costs, we are looking hard at means of reducing training costs. Much can be done during the design of a weapon system toward reducing the costs of training personnel in the operation and maintenance of the system. In the era of all-volunteer forces, this is a vital factor.

In summary, we in the Department of Defense believe that Design to a Cost, along with continued emphasis on reliability and maintainability during the *design* of weapon systems, will go a long way toward our ultimate goal of reducing Life Cycle Costs. The question becomes: "With the added emphasis during design on Cost, Reliability, Maintainability and Training, is the Defense Department willing to pay more, during development, to achieve reduced Life Cycle Costs?" The answer is YES!

We believe we are headed in the right direction with designers being required to Design to a Cost, but we need your help, too. We need your ideas and your support if we are to manage our defense systems acquisition so as to lower our costs to stay within affordable limits. The new challenge is to use technology to reduce costs. This must become a part of technical excellence. This part of the challenge is primarily on industry. I believe that industry is up to it—as long as we give freedom to make it work.

Awards . . .

2 AMC Employes Win Presidential Certificates

Development of a supply system resulting in estimated annual savings of $6 million, and a new technique for plating aluminum parts, recently earned Presidential Management Improvement Certificates for two Army Materiel Command (AMC) employes.

Secretary of the Army Howard H. Callaway presented the awards which are the highest granted under the President's government-wide program for improved management effectiveness.

Marion I. Hinson, chief, Stock Management and Policy Division, HQ AMC, assisted in the development of a system of filling supply requisitions through direct shipment from AMC facilities in the U.S. to units in the field. Known as the Direct Support System, it also saved the government $1 million through reduced obsolescence.

Geronimo Escobar, an electroplater at the Sacramento Army Depot, devised an aluminum plating technique which virtually eliminated the disposal of thousands of dollars worth of precision mounts, brackets, slides and various aluminum components.

NLABS' Personnel Named 'Employes of Year'

Three employes of the U.S. Army Natick (MA) Laboratories recently were honored by the Boston Federal Executive Board with designation as "1973 Federal Employes of the Year." Two others received honorable mention.

Dr. Mary Mandels, a research microbiologist in the Food Mircobiology Division, was cited for outstanding achievements in demonstrating the feasibility of converting cellulose waste material into sugar and glucose products or clean-burning fuels through the use of enzymes.

Joseph Assaf, a materials engineer in the Clothing and Personal Life Support Equipment Laboratory, was credited with a technological breakthrough in the development of a lightweight insulated boot.

The insulation is cast-foamed polyurethane and the boot has increased comfort as well as improved protection in extreme cold. It is 50 percent lighter in weight than conventional cold weather boots.

SP4 Joseph K. Schmitt was recognized for personal initiative, exemplary performance and professional competence as a test subject, squad leader and draftsman in the General Equipment and Packaging Laboratory.

Miss Louise V. Dusablon, a research general engineer in the NLABS Clothing and Personal Life Support Equipment Laboratory, was recognized with an Honorable Mention Certificate for outstanding contributions to the ballistic protection of the soldier.

CPT James M. Niemira, NLABS adjutant, also an Honorable Mention Certificate recipient, was cited for continued exemplary contributions as the commander's adviser on military personnel administration.

The awards panel consisted of Albert J. Kelley, dean of the Boston College School of Management, United States Magistrate Willie J. Davis and Frank B. Maher, president, John Hancock Life Insurance.

Dr. Mary Mandels Joseph Assaf SP4 Joseph K. Schmitt

RAISING A CHILD FROM BIRTH through college costs the average American family about $40,000, according to the Commission on Population Growth and the American Future. Additionally, if the wife stays home till the child is 14, the family loses between $40,000 and $120,000 in potential income, depending on her level of education.

EXCEPTIONAL CIVILIAN SERVICE. *Dr. Stephen J. Kennedy* has received the Exceptional Civilian Service Award (ECSA) for 1966–72 service as physical science administrator, U.S. Army Natick Laboratories.

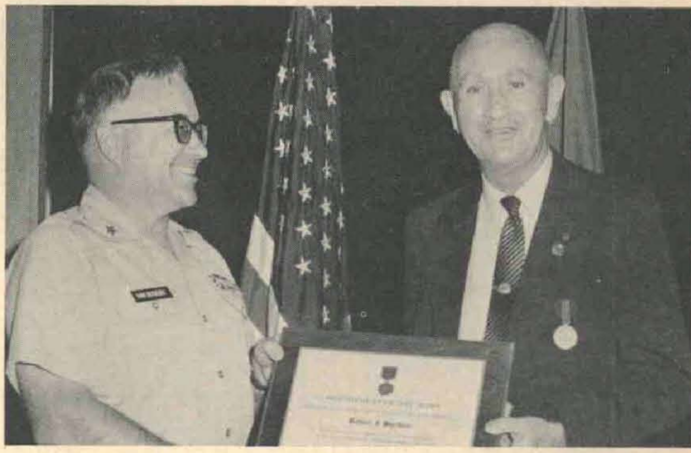
He was cited for contributions to the rapid development of lightweight ceramic aircrew armor. Dr. Kennedy also was credited for his leadership as chairman of the AMC Senior Steering Committee which prepared a Five-Year Personnel Armor Technical Plan.

Dr. Joseph Sperrazza was awarded the ECSA for accomplishments as director of the U.S. Army Materiel Systems Analysis Agency from 1968–72 and for service as chairman of the Joint-Service Technical Coordinating Group for Munitions Effectiveness.

David C. Hardison earned the ECSA for 1968–73 exemplary performance of duty as scientific adviser to the commander, U.S. Army Combat Developments Command.

Robert P. Whitely was presented the ECSA for 1970–71 achievements as deputy project manager for the TOW weapon system and for 1971–72 service as acting project manager for the Dragon Weapon System.

Daniel Katz, chief of the Propellants and Explosive Application Branch, Ammunition Development and Engineering Directorate, Picatinny Arsenal, was a recent recipient of the ECSA. He was cited for outstanding achievement in the completion of developmental and production engineering phases of the XM 205 Non-Metallic Cartridge Case Program.



***Robert J. Surkein,* director of Transportation and Traffic Management, U.S. Army Armament Command (ARMCOM), Rock Island, IL, was recently presented the ECSA.**

BG Lawrence E. Van Buskirk, deputy commander, U.S. Army Munitions Command (MUCOM) (now integrated into ARMCOM), presented the Army's highest award for civilian employes (shown above). The citation states, in part, that Surkein's "dynamic leadership in professional innovations has made inventory in motion a part of the logistics system in ammunition supply."

Frederick R. Brown, technical director, U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS, received the ECSA in recognition of his "superior professional leadership and technical competence while directing an $80 million research project."

Merl G. Ringenberg, technical director for Engineering, Edgewood Arsenal, earned the ECSA for his "outstanding leadership role in the successful accomplishment of the chemical and biological missions of the DA."

MERITORIOUS CIVILIAN SERVICE. *Harry B. Simmons and Warren E. Grabau,* both WES employes, received the Meritorious Civilian Service Award (MCSA).

Simmons was credited with outstanding contributions in the advancement of tidal hydraulics, use of mathematical models and the Corps' effort in improving the environment. Grabau was cited for his outstanding contribution to the development of a system of terrain analysis.

Floyd E. Watts, former technical director of Yuma Proving Ground, AZ, was presented the MCSA at his recent retirement ceremonies. The citation noted "his professional competence and guiding wisdom" which helped YPG develop into a major testing facility.

Dr. Arnold G. Wedum was awarded the MCSA for exceptional service as director of Industrial Health and Safety, U.S. Army Biological Laboratories, Fort Detrick, Frederick, MD. COL Richard F. Barquist, acting commander, Medical R&D Command, made the presentation.

Personnel Actions...

Augustine Succeeds Johnson as ASA for R&D

Norman R. Augustine was sworn in Sept. 14 as Assistant Secretary of the Army (Research and Development), succeeding Robert L. Johnson who had served in that office from Nov. 3, 1969 to Jan. 12, 1973. Charles L. Poor, Deputy ASA (R&D), was acting ASA (R&D).

Norman R. Augustine

Augustine assumes his new title following a 3-year association with LTV Aerospace Corp., Dallas, TX, where he served first as vice president, Advanced Programs, Vought Missiles and Space Co., and most recently as director, Advanced Missiles and Space Systems.

While assigned to the Office of the Secretary of Defense, 1965–70, he earned a Meritorious Civilian Service Medal. He served as staff assistant to the Assistant Director of Defense, Research and Engineering (DDR&E) for Strategic Defensive Systems and later as Assistant DDR&E for Tactical Missiles and Ordnance for Land Warfare.

In 1958, following an assignment as research assistant at Princeton University, he was employed seven years with Douglas Aircraft Co., Santa Monica, CA, as a design group manager, and as chief engineer.

Graduated from Princeton University, Augustine has BS (magna cum laude) and MS degrees in engineering. He was elected to membership in Tau Beta Pi, Phi Beta Kappa and Sigma Xi fraternities.

A Fellow of the Institute of Aeronautics and Astronautics, he has served as a consultant to the Office of the Secretary of Defense, Executive Office of the President, and the Department of the Army. He has been a member of the NATO Group of Experts on Air Defense and is a Texas licensed professional engineer.

Parker Picked as Principal Deputy for DR&E

Robert N. Parker

Robert N. Parker is the new Principal Deputy Director of Defense Research and Engineering, succeeding Leonard Sullivan Jr., recently assigned as Director of Defense Program Analysis and Evaluation.

Parker had served since 1971 as vice president and general manager, NAVCOM Systems Division, Hoffman Electronics Corp., El Monte, CA. During 1970–71 he was deputy assistant secretary, System Development and Technology, U.S. Department of Transportation. He was chief engineer, Autonetics Division, North American Rockwell, for three years following 1954–67 service with the Hughes Aircraft Corp.

A former assistant professor (1961–62) at the U.S. Naval Post-Graduate School, Parker has BS and MS degrees in engineering from the University of California at Los Angeles. He served during 1946–49 and 1951–53 in the U.S. Air Force.

Taylor, Green Become Surgeon General, Deputy

Army Surgeon General Richard R. Taylor, MC, assumed that title along with promotion to LTG Oct. 1 when LTG Hal B. Jennings retired from the Army after 31 years service.

LTG Richard R. Taylor

LTG Taylor, who had served only since March as Deputy Surgeon General, is succeeded in that office by BG Robert W. Green, MC, former commander, Letterman Army Medical Center, San Francisco, CA.

LTG Taylor received his first star in September 1969 while serving as command surgeon, HQ Military Assistance Command, Vietnam. Two-star rank followed in July 1972 while he headed Medical R&D Command.

Assignment as Army Surgeon General ranks him, at age 51, as one of the youngest in recent times to hold that office. MG George E. Armstrong (Ret.), who served 1951–55, was 51 when appointed.

BG Green had served as commander of Letterman Army Medical Center since August 1972. During 1970–72 he was health director, U.S. Army Element, Canal Zone Government, and in 1969–70 was director of the Gorgas Hospital, Canal Zone.

In the Washington, DC, area, he served as chief, Operations Division, Directorate of Plans and Operations, Office of the Surgeon General (1966–69) and was chief, General Medical Service, Walter Reed Army Medical Center (1958–61).

A graduate of Pennsylvania State University, he received his MD degree in 1950 from the University of Pittsburgh School of Medicine and was certified by the American Board of Internal Medicine in 1957. He is a graduate of the Army Command and General Staff College and the Army War College.

BG Robert W. Green

BG Green is a member of the American Medical Association, American College of Physicians and the Association of Military Surgeons. His military honors include the Silver Star, Legion of Merit with Oak Leak Cluster (OLC), Bronze Star Medal with two OLC and the Purple Heart.

Dr. Buchsbaum Heads Defense Science Board

Dr Solomon J. Buchsbaum

Secretary of Defense James R. Schlesinger recently appointed Dr. Solomon J. Buchsbaum to succeed Dr. Gerald F. Tape as chairman of the Defense Science Board.

Dr. Buchsbaum has served since 1971 as executive director of Research, Communications Sciences Division, Bell Laboratories, Holmdel, NJ. Three years after joining Bell Laboratories in 1958, he became head of the Solid State and Plasma Physics Research Department.

In 1968, after serving as director of Bell Electronics Research Laboratory, he became president in charge of research, Sandia Laboratories, Sandia Corp., but returned to Bell in 1971.

Dr. Buchsbaum has BS and MS degrees from McGill University and a PhD from Massachusetts Institute of Technology. During 1970–73 he was a member of the President's Science Advisory Committee.

Among his professional affiliations are the Institute of Electrical and Electronics Engineers, the American Physical Society, National Academy of Engineering and American Academy of Arts and Sciences.

Chartered as the Department of Defense senior technical advisory board, the Defense Science Board is composed of 24 appointed civilian members. Chairmen of the scientific advisory groups of the military departments are ex-officio members. Its function is to advise the Secretary of Defense, through the Director of Defense Research and Engineering, on scientific and technical matters of interest to the DoD.

MG Ellis Takes Over as MICOM Commander

Mg Vincent H. Ellis is the new commander of the U.S. Army Missile Command, Redstone (AL) Arsenal, following two brief assignments as commander of the Munitions Command, Mar. 9 to July 2, 1973, and deputy commander for Logistics Support, HQ U.S. Army Materiel Command.

MG Vincent H. Ellis

A former instructor, assistant professor and associate professor of mechanics at the U.S. Military Academy, MG Ellis has a 1941 BS degree in mechanical engineering from Kansas State College and an MS degree in electrical engineering from Cornell University.

Prior to joining MUCOM he served during 1970–73 as deputy for Materiel Acquisition and deputy for Procurement, Office of the Assistant Secretary of the Army (Installations and Logistics), Washington, D.C.

Other key assignments have included deputy commander, U.S. Army Tank-Automotive Command, Warren, MI; commander, U.S. Army Harry Diamond Laboratories; and chief, Weapons Branch, Development Division, Office, Director of R&D, Army Materiel Command.

MG Ellis also served abroad with the U.S. Army element of the Joint Military Mission, Ankara, Turkey, and as senior logistics adviser to the Republic of Korea Army, U.S. Army Advisory Group, Korea.

He is a graduate of the Army Command and General Staff College, Army Ordnance School, and the U.S. Army Management School.

BG Dirks Follows MG Bernstein as USAMRIID Chief

BG Kenneth R. Dirks

BG Kenneth R. Dirks, MC, former Commander, U.S. Army Medical Research Institute of Infectious Diseases, recently succeeded MG Robert Bernstein, as commander, U.S. Army Medical R&D Command, Washington, D.C.

Elevated to his present rank in July, BG Dirks is known for his expertise in pathologic anatomy and clinical pathology. He holds American Board of Pathology certification, and is a U.S. delegate of the Medical Aspects of Nuclear, Biological and Chemical Operations Working Party, Military Agency For Standardization, NATO.

(Additional biographical data on BG Dirks is presented in the May-June 1973 issue of the R&D Newsmagazine.)

AMC Names Fix International Logistics Director

BG Joseph E. Fix III, the Army Materiel Command's new director of International Logistics, succeeded BG W. C. Magathan Jr. upon his recent retirement. BG Fix had seved since July 1972 as AMC deputy director of Research, Development and Engineering.

BG Joseph E. Fix III

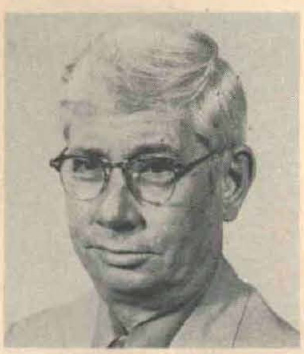
He commanded Detachment 1, Joint Task Force 728, Defense Special Projects Group (DSPG), Germany, during 1971–72 following duty as chief, Operations Division, DSPG, Washington, DC.

Other key assignments during 30 years in the Army have included chief, Sensor Division, Defense Communications Planning Group, Washington, DC; deputy assistant chief of staff, G-1, HQ U.S. Army Vietnam; commander, 1st Brigade, 4th Infantry Division, Vietnam; and concurrent duty as executive secretary, Army Scientific Advisory Panel, Office, Chief of R&D and military assistant to the Chief Scientist, DA.

BG Fix has a bachelor's degree in general education from the University of Omaha and a master's degree in science and international affairs from George Washington University. He also has completed the Command and General Staff College and Armed Forces Staff College.

His military honors include the Silver Star with Oak Leaf Cluster (OLC), Legion of Merit with two OLC, Bronze Star Medal, Air Medal with "V" device and six OLC and the Purple Heart.

Todsen Takes Over as ARMTE Tech Director



Dr Thomas K. Todsen

Dr. Thomas K. Todsen is the new technical director, U.S. Army Missile Test and Evaluation (ARMTE) Directorate, White Sands (NM) Missile Range.

Since he joined ARMTE in 1951 as chief chemist for the Ordnance R&D Division, he has served as chief, Land Combat System Test Division; director, Test Operations Directorate; and director, Combat Directorate.

Dr. Todsen received bachelor's, master's and doctoral degrees from the University of Florida where he served as a chemistry instructor. He is credited with designing the first permanent WSMR chemistry laboratory, and co-authored the first WSMR test plan (Honest John missile).

Listed in *Who's Who in the West*, *American Men in Science*, and *Dictionary of International Biography*, Dr. Todsen is a member of the American Chemical Society, American Ordnance Association, and Phi Gamma Delta fraternity.

Sawyer Becomes Watervliet Arsenal Commander

Col Richard H. Sawyer

COL Richard H. Sawyer, former chief, International Division, Office of the Army Chief of R&D, recently became commander, Watervliet (NY) Arsenal, upon the retirement of COL Christopher S. Maggio.

In 1969, following an assignment as project manager for the Mechanized Infantry Combat Vehicle, U.S. Army Tank-Automotive Command (TACOM), he was named director of Research and Development, TACOM. During 1967 he was commander, 4th Maintenance Battalion, Korea.

His academic credentials include a bachelor's degree from the College of the City of New York and a master's degree from Purdue University, both in mechanical engineering. He is a graduate from the Command and General Staff College and the Industrial College of the Armed Forces.

COL Sawyer is a recipient of the Legion of Merit with Oak Leaf Cluster (OLC), Army Commendation Medal with two OLC, Bronze Star Medal with "V" device and the Purple Heart.

Corkill Assumes Command of Natick Laboratories

COL Harry L. Corkill Jr.

COL Harry L. Vorkill Jr., until recently deputy commander of the U.S. Army Natick (MA) Laboratories, has assumed command of that installation, succeeding BG John C. McWhorter.

Prior to assignment to the Natick Laboratories, he was commander, 46th General Support Group, Fort Devens, MA. During a 30-year Army career, he has served two tours in Vietnam as an airborne adviser to Vietnamese airborne units and as commander, 15th Supply and Service Battalion, 1st Cavalry (Airmobile) Division.

COL Corkill has attended the University of Maryland and is a graduate of the Army Command and General Staff College, Army War College, Air Command and Staff College, and the Special Warfare School for senior officers.

His military decorations include the Legion of Merit with Oak Leaf Cluster (OLC), Air Medal with OLC and ARCOM w/2 OLC.

Bost Succeeds Wienecke as Detrick Commander

COL William L. Bost

COL William L. Bost, MSC, recently succeeded COL Herman E. Wienecke as commander of Fort Detrick, Frederick, MD, after serving there since 1972 as commander, U.S. Army Medical Bioengineering R&D Laboratory.

During 1971–72 he commanded the U.S. Army Medical Equipment R&D Laboratory, Fort Totten, NY (now consolidated at Fort Detrick). He was chief, Plans and Operations Division, Office of the Command Surgeon, Vietnam in 1970–71.

COL Bost served during 1967–69 as deputy director, Department of Military Science and later as director, Department of Non-Resident Instruction, U.S. Army Medical Field Service School, Fort Sam Houston, TX.

A graduate of the Army Command and General Staff College, COL Bost is a recipient of the Legion of Merit, Bronze Star Medal (second award), Meritorious Service Medal, Joint Service Commendation Medal, and the Army Commendation Medal (second award).

Women in Army Science . . .

Army-Sponsored Education Returns Dividends

MERITORIOUS Service Medal is presented to MAJ Jane Frances Sager, AMSC, by COL June E. Williams, chief of the AMSC.

Positive proof of the pay-off of the U.S. Army-sponsored advanced education program for military and civilian employes is well illustrated by MAJ Jane Frances Sager, whose 1966 master's degree thesis on food service data processing is the basis of a developing Army-wide system of exceptional significance.

Assigned to Walter Reed Army Medical Center, Washington, DC, after receiving her master's degree as a dietician from the University of Wisconsin, specializing in institution management, she has worked continuously since 1966 to put her concepts into practical application.

The 3-phase program she has helped to develop through more than six years of effort is reported to be "about 50 percent completed." Involving ADP applications to food production/support, extended recipes, labels for ingredients, and production work sheets, Phase I is in effect at six U.S. Army Medical Centers.

Checked out first at Walter Reed AMC, Fitzsimons AMC in Denver, CO, and Brooke AMC, San Antonio, TX, Phase I is a very recent addition at Tripler AMC, Honolulu, HI, Letterman AMC, San Francisco, CA, and Madigan AMC, Tacoma, WA.

Phase II, which is concerned with nutritional evaluation and analysis of recipes and menus, reportedly is "about ready to be implemented." Phase III, involving a data processing inventory control system, is in the early stage of development, with no projected completion date.

MAJ Sager said the objective of the system is "to provide a management and technical information system to the U.S. Army dietician and physician"—to the dietician by supplying accurate, timely information upon which to base management decisions; to the physician by providing nutrition information as it is needed in diagnosis of disease and treatment of patients.

Graduated in 1961 from Milliken University, Decatur, IL, MAJ Sager began her Army career with a dietic internship at Brooke Army Medical Center, Fort Sam Houston, TX, and later served as a dietician until selected for graduate work at the U. of Wisconsin. She has served at Walson Army Hospital, Fort Dix, NJ, Letterman AMC and Irwin Army Hospital, Fort Riley, KS.

Since 1968 MAJ Sager has been assisted by CPT Kenneth James and since last summer by CPT Anthony Fisher, Army dieticians currently assigned with her at Fort Detrick, MD, in developing and implementing the new program.

COL June Williams, chief of the Army Medical Specialist Corps, recently rewarded MAJ Sager's efforts by presenting her with the Meritorious Service Medal, and acclaiming her as "one of our most outstanding young officers."

Women Register Gains in Federal Employment

Women employed in U.S. Government agencies and their upward mobility in the work force show substantial percentage gains from October 1971 to October 1972, the U.S. Civil Service Commission recently announced.

Over-all progress was noted in the employment of women in professional, technical and administrative occupations—those fields requiring a baccalaureate, higher education or equivalent experience. At the end of October 1972, these jobs showed an increase in female employment of 2,204 personnel or 2.1 percent.

Women accounted for almost 9,000 or 58 percent of a gain of 15,360 federal employes during the period. At grade levels GS-5 to GS-12, women registered an over-all increase of 882 while men decreased by 2,034. Females also showed increases in positions at the super-grade levels.

Significant progress was reported in the medical hospital, dental and public health occupational groups, an increase of 4,355 women (66 percent of the group's net gain) brought the total number of females in medical occupations to 59,252 in 1972.

Occupational groups making considerable gains in the number of women employes included general administrative, clerical, accounting and budget.

HEL Assigns First WAC Officer to R&D Duty

1LT Janet L. Makarevich

Precedent prevalent since the U.S. Army Human Engineering Laboratory was established in 1951 at Aberdeen Proving Ground, MD, was broken recently when 1LT Janet L. Makarevich became the first WAC officer to serve there.

Assigned as a research and development coordinator with the Behavioral Research Directorate, she performs experiments for data reduction of the sensory interactions of the auditory and visual structures of the central nervous system. Determinations are related to HEL's function of designing materiel and equipment for maximum human compatibility in operation.

LT Makarevich joined the WAC College Junior and Student Officer Program in 1971 and was commissioned in 1971 upon her graduation. She received a bachelor of arts degree in biology from St. Mary of the Plains College in Dodge City, KS. Assignment to Aberdeen PG followed completion of the WAC officer course at Fort McClellan, AL.

The assignment to HEL, she says, is providing her with a "thrilling" opportunity to do what she made up her mind to do while in college, that is, to enter a career in research biology rather than in teaching.

LT Makarevich also serves as assistant custodiam of the APG Dependent Children's Activities Fund Council and is a secretary-treasury of the Susquehanna Toastmasters Club. Her hobbies are photography and birdwatching.

Meteorological Effects on Weapons Efficiency

By MAJ Willis Clark Hardwick

This article is a summary of an Army Meteorology Needs Project Management Study prepared by the author at the Defense Systems Management School, Fort Belvoir, VA, where the report (PMC 72-2) may be obtained.

* * *

Meteorological support for the field Army is a vital need at the lower echelons of tactical operations where observations are few, meteorological conditions are greatly influenced by local terrain and geography, and the accuracy of a unit commander's sophisticated weapons systems is highly dependent on accurate and timely weather data.

Under the supervision of the Electronics Command's U.S. Army Atmospheric Sciences Laboratory, a number of individual hardware and software actions and projects related to this problem are currently in progress. Hopefully, these research programs will lead to equipment which will provide the field commander the real-time meteorological information and short-term predictions needed to make his weapons systems more effective.

The approach will be to integrate real-time meteorological data, normally used in support of fire-support weapons systems, with the engineer's data concerning the local terrain, and the larger scale (macroscale) predictions provided by Air Force Global Weather Central (AFGWC).

The processing of this data should provide the commander a practical and useful portrayal of real-time (nowcasts) and short-term (forecasts) predictions of the atmosphere across the tactical area.

To insure that real advances are achieved in making the concept a reality, intensive research into the microscale to mesoscale atmospheric processes must be conducted, and their associated results applied to objective processing techniques and numerical prediction schemes.

The framework around which the concept can be developed is the Automatic Meteorological System (AMS), currently in the concept formulation phase at the U.S. Atmospheric Sciences Laboratory, White Sands, NM.

Currently, AR115-10/AFR 105-3 designates that the Army will be responsible for providing meteorological support for its weapons systems and any other support it can provide more efficiently as determined by an Army and Air Force agreement. The Army provides meteorological support for river stage, flood and soil trafficability forecasts, and the Air Force is responsible for operational air weather predictions through its Global Weather Central, including some of the real-time information needed by Army field forces.

Since the Army is operationally local-terrain oriented, it is mainly interested in the microscale to mesoscale meteorological problem. The artillery is primarily interested in timely and accurate nowcasts while Army aviation is more interested in achieving accurate forecasts.

Because the Army is responsible for providing most of its own meteorological support, the report advocates the introduction of "Project Management" as the means of solving the microscale to mesoscale joint Army/Air Force meteorological support problems, and insuring deployment of support systems peculiar to the Army.

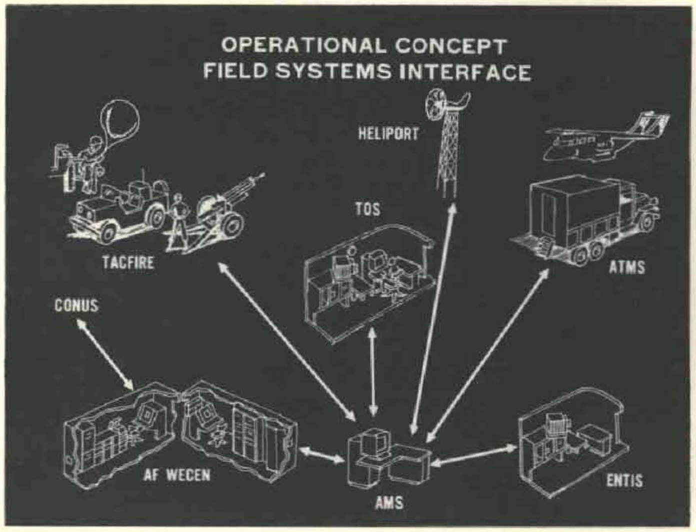
Assuming that the Air Force will be concentrating resources on the macroscale, it seems obvious that the Army must work toward solving the short-term prediction problem from the microscale to the mesoscale. Fog forecasting is a well-known microscale example associated with local terrain and geography.

Conflict exists as to whether the traditional statistical approach or the more recent numerical dynamic approach is the best means of achieving accurate forecasts. The dynamic approach appears to offer the most practical solution for a mobile field Army and should therefore be pursued.

Army observing units can currently take meteorological observations to include the vertical profile on an unscheduled basis. This provides a wealth of data not currently utilized by the air weather service's forecasting techniques, a fact that helped generate a requirement for the development of the Automatic Meteorological System (AMS) currently in the concept development phase.

Numerous other software and/or hardware projects currently in different phases of development must be integrated into an over-all field Army meteorological support system. The vast amount of meteorological data provided currently to the Artillery should be integrated with AFGWC data and the local terrain data, and transformed into useful real-time processing and prediction schemes.

Meteorologists have found that more frequent vertical observations



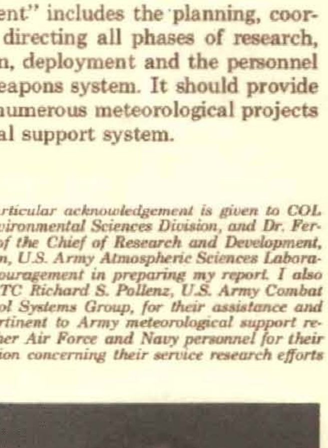
of the atmosphere offer the best chance of making real progress in the field of micrometeorological predictions. The Army, having its own capability of acquiring data in the vertical on an as-required basis, appears to be in a good position to bring micrometeorological predictions to within the state-of-the-art by the time the World Meteorological Organization and the AFGWC can accurately predict the mesoscale boundary layer.

The Army's forthcoming Automatic Meteorological System will hopefully be the framework around which the Army can build to achieve accurate and timely nowcasts and microscale to mesoscale forecasts. Division of functionary areas between the Army and Air Force has caused, and may in the future, some meteorological support requirements and responsibilities to be left open to interpretation, and at times difficult to pin down.

In addition, the meteorological effort within the Army is fragmented into the various branches and activities, each generally concerned only with those requirements unique to its mission. Lacking is a central focal point to coordinate and transform the Army's needs into a sound field Army meteorological support system.

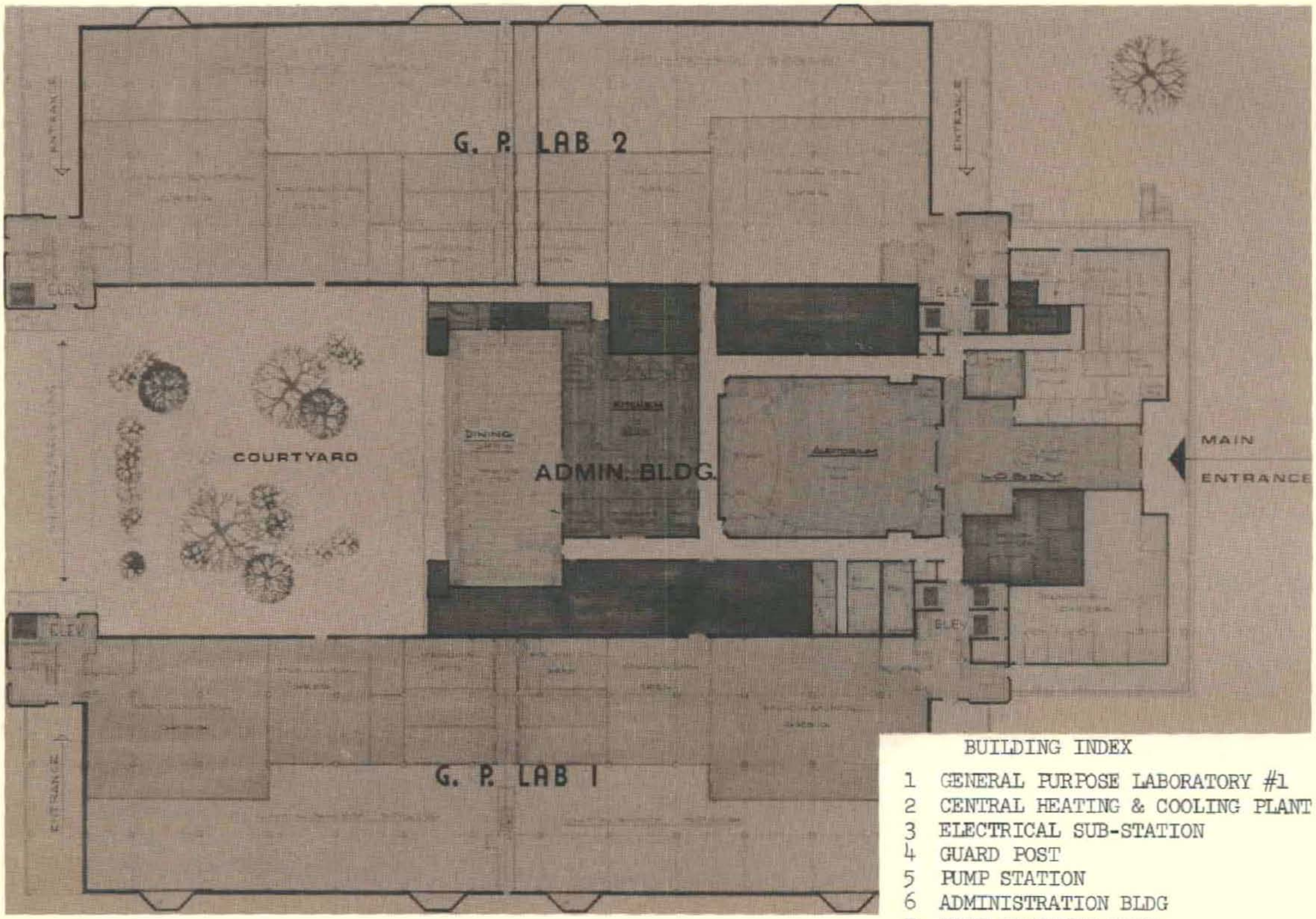
The concept of "Project Management" includes the planning, coordinating, controlling, organizing and directing all phases of research, development, procurement, production, deployment and the personnel training and logistical support of a weapons system. It should provide also the means of integrating all the numerous meteorological projects into a sound field Army meteorological support system.

ACKNOWLEDGEMENTS. *Particular acknowledgement is given to COL Kenneth R. Ebner, former deputy chief of the Environmental Sciences Division, and Dr. Fernand P. de Percin of the same division, Office of the Chief of Research and Development, Department of the Army, and Dr. Joseph H. Shinn, U.S. Army Atmospheric Sciences Laboratory, White Sands, NM, for assistance and encouragement in preparing my report. I also wish to thank LTC Malcom Reid, USAF, and LTC Richard S. Pollenz, U.S. Army Combat Developments Command Intelligence and Control Systems Group, for their assistance and cooperation in providing access to literature pertinent to Army meteorological support requirements. My thanks are also due to many other Air Force and Navy personnel for their cooperation in providing literature and information concerning their service research efforts in the micrometeorological field.*



MAJ WILLIS C. HARDWICK, chief of the Washington Field Office for the 2.75-inch Rocket System, succeeded CPT J. J. Davidson, USN, when he retired in 1972. He received a BS degree from Oklahoma State University in 1959 and master's degree in meteorology and climatology in 1972 from the University of Kansas. Recently graduated from the U.S. Army Command and General Staff College, Fort Leavenworth, KS, he also has completed the Defense Systems Management School Course at Fort Belvoir.

HARRY DIAMOND LABORATORIES



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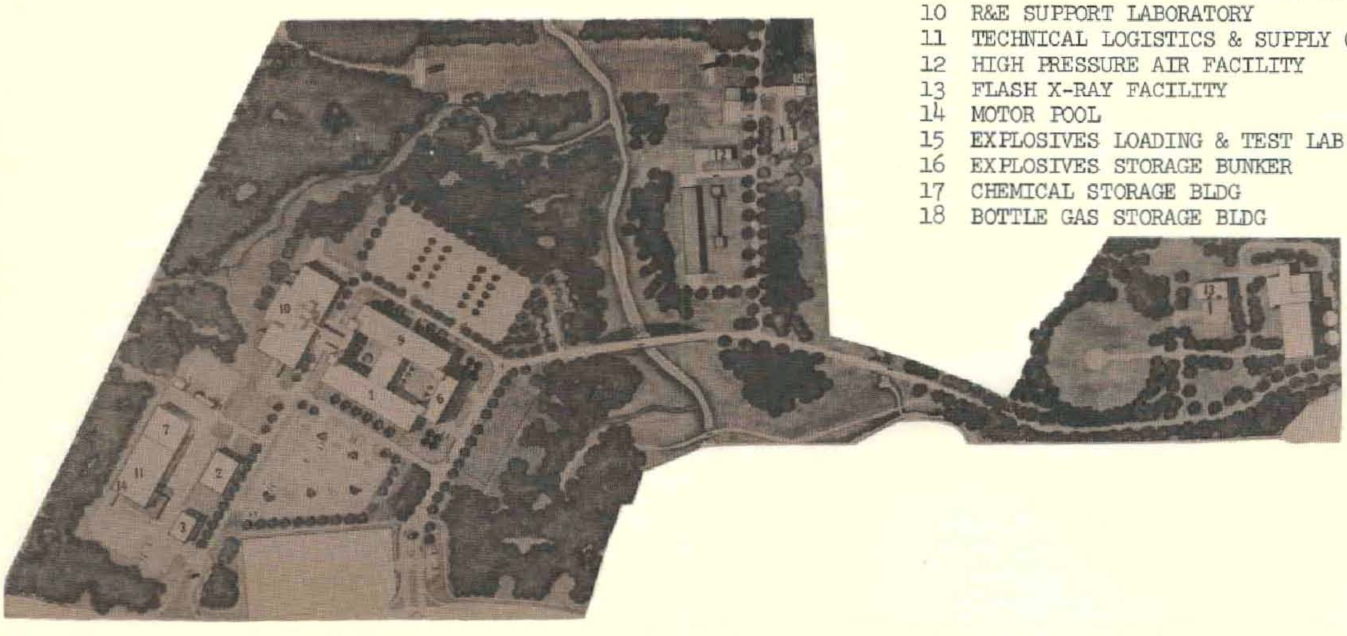

GROUND FLOOR LAYOUT of the "H" complex of HDL administration and laboratory buildings now under construction is illustrative of typical laboratory floor plan for the five stories. On the roof of the auditorium will be the closed, restricted-to-employe-use east courtyard, walled on four sides and accessible at the library level crossway between the laboratory buildings. The cafeteria overlooks the west courtyard, accessible by a down stairway and open for general use.