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# ARPA-Sponsored Study Probes Research 'Coupling' Problem

Findings and some recommendations of "A Case Study: Coupling of Research to Technology," believed the first in-depth probe of its type conducted in the U.S., were reported in mid-August to the Office of the Chief of Research and Development, HQ Department of the Army.

The study is one of four devoted to the same problem area—coupling research to technology, that is, rapid application of basic research new knowledge to major technological advances—which have been sponsored by the Advanced Research Projects

(*Continued on page 6*)

# ABMDA, SENSO, BESRL Plan Relocation

Concentration of U.S. Government-leased facilities in the Rosslyn Circle "Little New York" complex of imposing 12-story office buildings will increase substantially with the early move of several Army agencies into the new Commonwealth Building in Arlington, Va.

From an Army research and development viewpoint, the moves of most impact will be those of the Advanced Ballistic Missile Defense Agency (ABMDA), the Sentinel System Office (SENSO) and the Behavioral Science Research Laboratory (BESRL). BESRL is under the Army Research Office.

Nearly 1,700 employes will be involved in the relocation of these agencies along with the HQ Data Support Command's Personnel Systems Directorate and certain staff elements, and several directorates of the Office of the Deputy Chief of Staff for Logistics (ODCSLOG).

The Commonwealth Building is a

(*Continued on page 4*)

## Besson Keys Manpower In Human Factors R&D

Focused on "Manpower Considerations in the Developments Process," the 14th Annual U.S. Army Human Factors R&D Conference at HQ U.S. Army Tank-Automotive Command, Oct. 23–25, is expected to attract about 250 invited officers and civilian scientists.

General Frank S. Besson Jr., CG of the U.S. Army Materiel Command, has accepted an invitation to give the keynote address. The "Sponsor's Charge to the Conference" will be delivered by Lt Gen Austin W. Betts, Army Chief of R&D. The host is Maj Gen Shelton E. Lollis, CG of ATACOM, who will welcome the conferees.

Dr. Lynn E. Baker, Army chief psychologist, is general chairman of the conference, the purpose of which is to emphasize requirements for and results from human factors research relevant to all stages of development of equipment systems.

Presentations will deal with many aspects of human factors, integration of manpower resources and training,

(*Continued on page 12*)

## Featured in This Issue . . .



## New Director of ABMDA

Dr. Jacob B. Gilstein

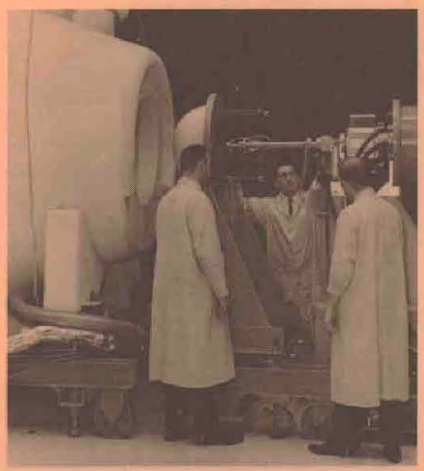
## Westmoreland Accepts Bid to Address ASAP

Army Chief of Staff General William C. Westmoreland has accepted an invitation to give the banquet address at the Army Scientific Advisory Panel (ASAP) fall meeting, Oct. 20–22, at HQ U.S. Army Weapons Command, Rock Island (Ill.) Arsenal.

Other dignitaries scheduled to participate include Dr. Russell D. O'Neal, Assistant Secretary of the Army (R&D); General Frank S. Besson Jr., CG of the Army Materiel

(*Continued on page 3*)

# APG Operating New Weapons Spectrum Generator



WEAPONS SPECTRUM GENERATOR consists of (l. to r.) a liquid nitrogen tank that simulates a half mile of atmosphere, tritium target and an accelerator. BRL physicists John A. Devanny left and James Dante watch adjustment by Carmen Cialella.

Operation of a new weapons spectrum generator (WSG) has started at the U.S. Army Ballistic Research Laboratories (BRL), Aberdeen Proving Ground, Md., Col John C. Raaen Jr., BRL commander, has announced.

The weapons spectrum generator, like the $5 million Army Pulse Radiation Facility (APRF) dedicated June 6 at the proving ground, is designed to simulate the neutron spectrum of nuclear weapons. The generator provides a convenient means of yielding a wide spectrum of neutron energies for research studies. The basic WSG includes an accelerator, neutron converter and a liquid nitrogen tank.

"Scientists throughout the world," said Col Raaen, "have been constantly seeking ways to simulate nuclear effects since the atmospheric test

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Army R&D Newsmagazine

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**Editor . . . . . Clarence T. Smith**
**Associate Editor . . . . George J. Makuta**

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

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# Dawalt Discusses International Military R&D

*EDITOR'S NOTE. Brig Gen Kenneth F. Dawalt, Deputy Chief of Research and Development (International Programs), Department of the Army, addressed a recent meeting of the American Ordnance Association at the NASA-Lewis Research Center. Complexities involved in cooperative international research and development were discussed under the theme, "International Military Vehicle Development—How Has It Worked." Excerpts follow:*

Two months ago the Chief of Research and Development talked to the students and faculty of the U.S. Army War College at Carlisle, Pa. In the post-lecture question period, a very sharp young lieutenant colonel who had been in the R&D business posed this question: "What do we really get from our Allies through international R&D programs?" General Betts replied: "Allies!" However, he was very quick to dispel any impression he may have created that he was not in favor of cooperative international R&D.

On the contrary, we in the Office of the Chief of Research and Development are strong believers in this type of cooperation as a means of maintaining cordial relations between the United States and its Allies, and also creating a degree of standardization of materiel and doctrine in the event we operate together militarily. In other words it is in the national interest to work together in peacetime; we might have to fight together. . . .

My purpose is to tell you something about the policy and the machinery that controls the direction and volume of international research and development, and forecast for the future of such programs.

The overall policy for cooperation with our Allies in research and development of defense equipment is spelled out in a Department of Defense directive. In essence, the policy of the United States is to cooperate with our Allies in the development of defense equipment where such cooperation is in our common interest.

There are presently three major kinds of cooperation in defense R&D. The first of these is the government-to-government exchange of technical data. Here, the mechanism usually takes the form of bilateral or multilateral exchange agreements executed under the aegis of one of the several cooperative R&D programs to which we subscribe.

A second means is the government-to-government agreement for cooperative research and development on a specific program or project.

Third, there is industrial cooperation through licensing, subsidiaries, joint funding, and private contractor-to-contractor sales agreements.

Now, let's get more specific. What are today's existing programs in the government-to-government category?

First, in NATO we have, on the military side, the Military Agency for Standardization, which is directly subordinate to the Military Committee. It promotes nonmateriel standardization such as operations, logistics, procedures, etc., through its three boards, Army, Navy and Air Force, and its subsidiary working parties and panels of experts. A typical example of its work is the adoption of 14mm threads for spark plugs without complete standardization of the plug itself.

On the civilian side in the NATO organization is the Conference of National Armament Directors, which is composed of three Service Armaments Groups and a Defense Research Group. The NATO Army Armaments Group (NAAG) is composed of national research and development representatives. As the Deputy Chief of Research and Development for International Programs, I am the U.S. member of this Group. Currently reporting to this Group are 12 panels, each covering a different area of military equipment. Two of these panels are of primary interest to this forum. They are Panel I, Transport Support Vehicles, and Panel II, Combat Vehicles. You might be interested to know that the agenda for the last meeting of Panel I covered such topics as:

- Identification and Development of Common Concepts (Military and Technical Characteristics) of Future Transport Vehicles.
- Development of Test Procedures and Criteria (to Define Military Characteristics) of Multi-Fuel Engines.
- Identification of Components and Features for Interchangeability.
- Identification of Possibilities of Coordinated Production Programs of Transport Vehicles and their Components.

Panel II considered at its last meeting an exchange of concepts on The Armored Threat, Armored Reconnaissance Vehicles, Armored

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# Army Materiel Command Cites Vietnam Support on Anniversary

Pride in providing increasingly effective logistical support to combat forces in Southeast Asia, tempered by awareness of goals still to be achieved, marked the Army Materiel Command's sixth anniversary Aug. 1.

Army Chief of Staff General William C. Westmoreland, who in June completed four years as CG of the U.S. Army in Vietnam and the Military Assistance Command (MACV), commented:

"The success of our fighting forces in Vietnam is a direct reflection on the Army Materiel Command's ability to keep the fighting men supplied with the best and most advanced materiel. Each member of the command can take pride in its fine record of achievement.

"I join with all the men and women of the United States Army in saluting your accomplishments and in expressing confidence that you will continue in the same tradition of excellence which you have established."

In a message to all AMC subordinate commands, General Frank S. Besson Jr., CG of the AMC since it was activated, offered "deep appreciation for your competence, creativity and teamwork, which have established a truly remarkable record of sustained support of our combat forces . . . Without question, we have substantially extended the soldier's essential ability to move, shoot and communicate.

"Our task, of course, is never ending. Our combat troops in Vietnam and throughout the Free World deserve and expect our continued full measure of support. With full knowledge of your dedication and professionalism, I am confident in AMC's ability to meet the ever-changing tasks and challenges of the future."

In discharging responsibilities for operations of more than 190 laboratories, arsenals, depots, proving grounds, procurement offices and other facilities, the AMC has successfully stressed expedited production and procurement procedures, as well as accelerated development of new materiel.

In addition to an organizational realignment of the headquarters staff, which recently reduced the number of directorates from 12 to 11 and redesignated several others, the AMC established the U.S. Army Sentinel Logistics Command in April 1968. This raised to nine AMC's major subcommands. The U.S. Army Advanced Materiel Concepts Agency also was created.

Listed among the major accomplishments during the past year is the testing of a new concept in worldwide logistics management. Aimed at further improvement of supply service to troops in the field, and at reducing "deadlines" of equipment due to lack of repair parts, the system applies to such major items as tanks, aircraft and weapon systems.

In support of the Vietnam effort, the AMC stepped up its recruitment of highly qualified civilians to serve as members of quick-reaction teams on temporary duty in Southeast Asia. About 350 civilians on these teams assisted in meeting short-term requirements for supply and maintenance of equipment and materiel.

General Besson announced in May the establishment of an AMC award to provide recognition to all AMC

(*Continued on page 14*)

## *APG Operating New Weapons Spectrum Generator*

(*Continued from page 1*)

ban went into effect in 1962. From an economic standpoint, a weapon simulator is more desirable than an actual detonation because the effects caused by the phenomena can be studied in a controlled environment at low cost."

An important test application of the WSG is that of shielding men and equipment from neutron radiation.

The 150,000-volt accelerator strips electrons from a neutral gas and propels the newly formed positive ions through an evacuated tube to a target of tritium. The reaction produces 250 billion neutrons per second, each having an energy value of 14 Mev (millions of electron volts) which is the characteristic neutron energy associated with nuclear fusion.

The tritium target is surrounded by hemispheres of depleted uranium and polyethylene. The 14 Mev neutrons cause fissioning in the uranium and the neutron energy is further degraded by the polyethylene. Increasing uranium and polyethylene thicknesses reduce the fusion spectrum and increase the fission-type spectrum.

The liquid nitrogen chamber, approximating about a half mile of atmosphere, further decreases the energy of the neutrons to the radiation environment which would exist at some distance from the point of detonation of a nuclear weapon.

The generator is capable of producing a neutron energy spectrum that can be varied from one that is similar to a fission reaction (combining two light elements into a heavier element) to one that resembles a fusion reaction (splitting a heavier element into two or more lighter elements).

A typical experiment can produce "second generation" fission and other reactions of neutrons and gamma rays. An instrumentation system that can measure both neutron and gamma ray spectra simultaneously in a mixed radiation field has been developed.

The WSG is housed in a Radiation Room, consisting of 1,600 square feet of floor space, surrounded by 2-foot-thick, high-density concrete walls. Seven 4-foot-wide by 8-foot-high aluminum water containers provide added protection against neutron radiation and gamma rays.

Another protective measure is the continuous scanning of radiation output levels. A 10-foot-high fence outside the building insures personnel safety by precluding entry to the area during tests.

The facility is operated remotely from an adjoining control room and monitored by closed circuit television.

Costs per experiment in the laboratory are vastly lower than an actual detonation in the field. The WSG can operate continuously during an 8-hour day, whereas the principal effects of an actual detonation in the field are over in a few thousandths of a second.

## Westmoreland Accepts Bid to Address ASAP

(*Continued from page 1*)

Command; Lt Gen Austin W. Betts, Chief of Research and Development; and Lt Gen Harry W. O. Kinnard, CG of the Army Combat Developments Command.

Weapons Command CG (Brig Gen) William J. Durrenberger will be host for the meeting and will give the welcoming address. The theme for the ASAP discussions is "The Future of Fire Support for Land Combat," including airmobile, artillery and infantry organic fire support.

Dr. Harold M. Agnew, chairman, and Dean Ralph E. Fadum, vice chairman of ASAP, will be joined by approximately 30 dignitaries from the Department of Defense and the three military departments, along with panel members and senior consultants in general discussions.

Lt Col Wayne D. Miller is executive secretary of the panel.

# ABMDA, SENSO, BESRL Set Rosslyn Circle Relocation

(*Continued from page 1*)

massive brown brick structure at the corner of Wilson Boulevard and Fort Myer Drive, on the continually expanding outer fringe of the complex of new office buildings being erected near the south end of Key Bridge.

Just across the Potomac River from Washington, D.C., this location is about halfway between the principal area of U.S. Government buildings in the national capital and the Department of Defense Pentagon Building, housing some 30,000 employes in Virginia.

During the past two years Army, Navy, Air Force and Department of Defense agencies, along with other U.S. Government activities, have been moving into the Rosslyn Circle complex in ever-increasing numbers.

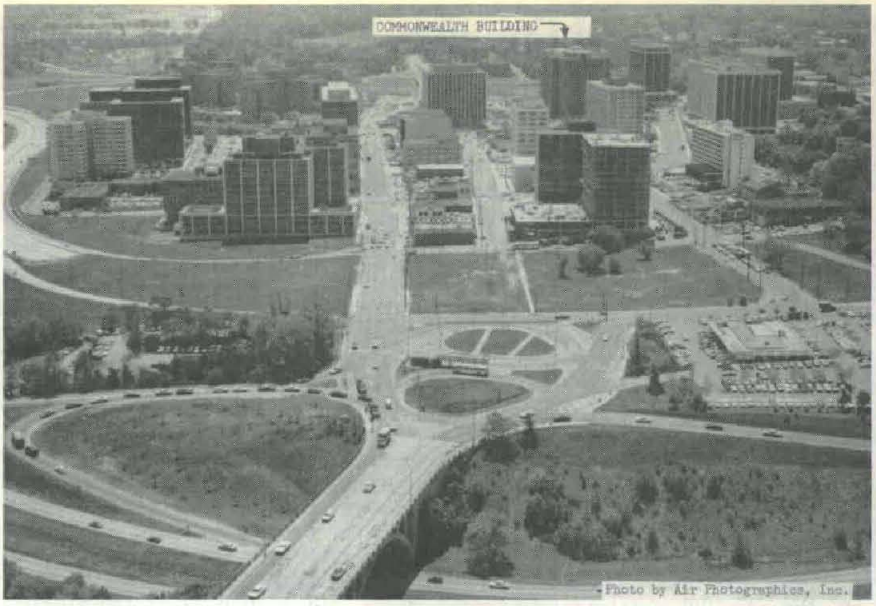
Established in March 1968, the Advanced Ballistic Missile Defense Agency is a Class II activity under the Chief of Research and Development, Lt Gen Austin W. Betts, who is responsible for the Nike-X Advanced Development Program.

The Sentinel System Office, charged with the responsibility of developing and setting up the Communist Chinese-oriented antiballistic missile defense system, is under the command of Lt Gen Alfred D. Starbird as system manager. SENSO is an element of the Office of the Chief of Staff, Department of the Army.

Collocation of ABMDA and SENSO has been planned ever since these activities were set up in temporary quarters, because of the interlocking nature of their responsibilities. Approximately 175 personnel of both agencies will be moved to the 11th and 12th floors of the Commonwealth Building, where they will occupy about 30,000 feet of floor space.

Individual responsibilities of Lt Gen Starbird and Lt Gen Betts were explained in detail in a page one article of this publication in December 1967. A second element of General Starbird's command is the Sentinel System Command, an expansion of the former Nike-X Project Office at Redstone (Ala.) Arsenal, which will "develop, procure and install the Sentinel System." An eventual staff of about 1,000 is planned.

The Sentinel System Evaluation Agency, located at White Sands (N. Mex.) Missile Range, is the third element of SENSO, charged with "independent evaluation, review and testing" of the Sentinel System. The close link between ABMDA and SENSO is indicated by assignment of Brig Gen Ivey O. Drewry, who formerly headed the Nike-X Project Office, as CG of the Sentinel System Command and deputy Sentinel System manager.




**ROSSLYN CIRCLE COMPLEX showing location of Commonwealth Building.**

Similarly, Brig Gen George Mayo Jr., who served as Deputy Nike-X System Manager (Plans) under General Betts, is now Deputy Sentinel System Manager (Plans). Likewise, Dr. Charles M. Johnson was reassigned to SENSO as scientific and technical director and Col Bobbie M. Griffin moved over as assistant system manager.

The Nike-X System Office in Washington was redesignated as the Sentinel Systems Command, in accordance with Army General Order No. 48, issued Nov. 15, 1967.

This order also prescribed that the Kwajalein Missile Range in the Pacific Ocean Marshall Islands be transferred from jurisdiction of the CG of the U.S. Army Materiel Command, General Frank S. Besson Jr., to the Sentinel System Command.

The National Range mission of Kwajalein Missile Range, however, remains under General Betts' management. Brig Gen Drewry exercises command over tactical Sentinel sites, "until acceptance of the operational sites" by the CG of the U.S. Army Air Defense Command.

ABMDA's mission is to conduct advanced development of ballistic missile defense components for possible incorporation into the Sentinel System. The objective is to ensure the Sentinel System retains its effectiveness as the ICBM threat increases in intensity.

When ABMDA was created, the action involved transfer of a major portion of the Advanced Research Project Agency (ARPA) responsibility for Project Defender, whose director, Dr. Patrick J. Friel, and key members of his staff were reassigned to ABMDA.

Effective Sept. 1, Dr. Friel resigned his dual responsibility as Deputy Assistant Secretary of the Army (R&D) for Ballistic Missile Defense and director of ABMDA. His successor in both capacities is Dr. Jacob B. Gilstein, who has specialized in the management of reentry systems for missiles with General Electric Co. in Philadelphia, Pa. Dr. Friel is now vice president of Block Engineering, Inc., Cambridge, Mass.

In his role as DASA (R&D) for Missile Defense, Dr. Gilstein will report to Dr. Russel D. O'Neal, ASA (R&D), and act as his primary adviser for development of policy guidance on the ABMDA program. As director of ABMDA, he will report to General Betts and be responsible to him for the technical management, direction and control of ABMDA.

Another important development relative to ABMDA and SENSO, reported in mid-August, was the transfer from ARPA control to the Army of about a $30 million FY 1969 portion of the Project Defender research program conducted by the Lincoln Laboratories, Massachusetts Institute of Technology.

This Department of Defense decision assigns to the Army cognizance and control of the PRESS (Pacific Range Electromagnetic Signature Studies) at Kwajalein Missile Range (KMR). KMR will be responsible for management of that portion of Project Defender known at TRADEX (Target Resolution and Discrimination Experiments).

*BESRL RELOCATION.* The U.S. Army Behavioral Science Research Laboratory (BESRL) has passed through a long series of name changes since it was established during World War II as an element of the Office of The Adjutant General. Until 1967, it was known as the Army Personnel Research Office, a name it assumed when it was placed under Army Research Office control in December 1961.

Since October 1958, the organization has been located in Tempo A Building in Washington, D.C. Early this month the move started to the Commonwealth Building to satisfy a requirement for about one-third more floor space, long needed for its five major research elements.

These elements are the Military Selection Research Division, Behavioral Evaluation Research Division, Statistical Research and Analysis Division, Combat Systems Research Division, and Support Systems Research Division.

Expected to extend over a period of several weeks because of the mass of laboratory and operational equipment, the BESRL move will involve about 105 civilian personnel, principally behavioral scientists, and ten military officers. The new location on the basement, first, second and third floor levels will provide about 37,000 square feet of floor space.

Col James E. Wirrick took command of BESRL Aug. 28, succeeding Col Marshall O. Becker. Upon completion of his tour of duty, Col Becker was reassigned as professor of military science and tactics at Massachusetts Institute of Technology.

Col Wirrick served, until reassigned, as U.S. Army Senior Standardization Representative in Australia under the Mutual Defense Assistance Program (MDAP) as U.S. Army Standardization Representative. This program involves the American, British, Canadian and Australian armies.

Dr. J. E. Uhlaner has served as director of BESRL and its antecedent organizations for 21 years. Dr. Arthur J. Drucker is backed by 17 years experience as assistant director, Operations, a tenure Dr. Joseph Zeidner has exceeded by one year as deputy director, Manned Systems Research.

BESRL senior research scientists include Dr. Aaron Hyman, deputy director, Human Performance Experimentation; Edmund F. Fuchs, deputy director, Selection Research; Dr. William H. Helm, chief, Behavioral Evaluation Research Division; and Cecil D. Johnson, chief, Statistical Research and Analysis Division.

*DATA SUPPORT COMMAND.* Several headquarters elements of the Data Support Command will begin moving into the Commonwealth Building about Oct. 1. The largest element is the Personnel Systems Directorate, involving about 380 personnel. Lesser elements are the Office of RAPID (Random Access Personnel Inventory Disseminator), the Quality Assurance Office and various staff personnel.

*ODCSLOG ELEMENTS.* More than 500 employes of the Office of the Deputy Chief of Staff for Logistics, HQ Department of the Army, also are scheduled to move into the Commonwealth Building during October.

Occupying all of the fourth, fifth and sixth floors will be the Directorate of Transportation, Directorate of International Logistics, Directorate of Installations, Directorate of Maintenance, Office of Management Analysis, Operations Resources Management Office, and the Logistics Doctrine and Systems Office.

# ARPA Conducts Seismic Detection Tests in Aleutians

Research on seismic detection of nuclear testing, a continuing program of the Advanced Research Projects Agency, Office of the Director of Defense Research and Engineering, will be highlighted this month by an underwater experiment off Amchitka Island in the Aleutians.

Designed to measure seismic wave travel times along the arc of the Aleutian Islands, the experiment will be the equivalent of a 340-ton-TNT detonation. ARPA's contractor, the Illinois Institute of Technology Research Institute (IITRI), has had constructed a cylindrical steel vessel to serve as the test device.

Fifty feet long and 20 feet in diameter, it has a hemispherical nose and a skirted stern, with forward and aft buoyancy chambers and a 5,000-cubic-foot explosive chamber.

Three 30-foot pontoons are located at equal distances around the body for towing stability, with the bottom pontoon flooded for ballast. The explosive chamber contains 250 tons of a slurry made up of 20 percent TNT pellets, 30 percent aluminum particles, 40 percent ammonia nitrate and 10 percent water and jelling agents.

The container will be towed from the State of Washington across the Gulf of Alaska to the site where it was originally planned to detonate the explosive-laden *Robert L. Stevenson* last year off Amchitka Island. U.S. Coast Guard patrol planes and vessels and an instrumentation ship will clear the area of commercial shipping.

After the test vessel is sunk to a depth of 50 feet, large diaphragms in the buoyancy chambers will break to permit sea water to complete rapid filling of the buoyancy chambers to sink the vessel to the test depth.

The explosion will be touched off by a fuze which will become hydrostatically armed at 400-foot depth and hydrostatically actuated at 3,000 feet. Redundancy is built into the system to increase detonation reliability.

Extraordinary safety precautions have been taken to maintain control of the container at all times under any set of circumstances. The experiment has been coordinated with appropriate conservation authorities, and it is believed there is no danger to either fish or wildlife from the planned 3,000-foot-depth detonation of a relatively small explosive device.

### Schremp Heads Night-Vision Unit

Col John E. Schremp, former executive to the Director of Army Research and U.S. Army project manager for night-vision devices for three years prior to his retirement from the Army after 27 years service in January 1968, is now with Electro-Optical Systems, Inc.

As manager of Image Tube Operations, he is responsible for production of night-vision image tubes in a 155,000-square-foot production facility in Pomona, Calif. Col Schremp, a 1941 graduate from the U.S. Military Academy, was awarded the Legion of Merit for his contributions to Army night-vision technology.

# Contract Let for Design Of 2 Sentinel PAR Sites

**Design of the first two Sentinel System Perimeter Acquisition Radar (PAR) sites for defense of the United States against the threat of a Communist China ballistic missile attack is called for in a $3,115,546 contract awarded by the Corps of Engineers.**

**The New York City firm of Ammann and Whitney will design the building to house PAR, related utilities, and the master plan for the total site. The power plant and support facilities will be designed under separate contracts.**

**The Ammann and Whitney design will be used for the PAR sites at Boston and Detroit. Other architect-engineer firms will be engaged to adapt the design for other PAR sites in the Sentinel System.**

**Each PAR site, expected to cover an area of about 250 acres, will have a large electrical power plant as well as living quarters, work space and administrative buildings and other structures for men who operate the PAR.**

# ARPA-Sponsored Study Probes 'Coupling' Problem

(*Continued from page 1*)

Agency (ARPA), Office of the Director of Defense Research and Engineering, for more than three years.

This problem area has been the focus of increasing attention by committees of the United States Congress in recent years, in consideration of justifying to taxpayers the costs of basic research by applications that have returned big payoffs to the economic growth of the nation.

Dr. A. A. Ezra, chairman of the Department of Mechanical Sciences and Environmental Engineering, College of Engineering, University of Denver, gave two briefings in the Pentagon. The first, to division and office chiefs of the Office of the Chief of R&D, was followed by an orientation for key operational personnel.

The study at the University of Denver, conducted through a new Center for High-Energy Forming, was under the service management of the Army. Monitorship was assigned to the Army Materials and Mechanics Research Center, Watertown, Mass., as a joint effort with the Denver division of Martin Marietta Corp.

Similarly, each of the other three studies had a major university as the functional investigative agency, with teamwork by an industrial firm(s) and monitored through one of the services—all ARPA-sponsored.

The study in the technical area of corrosion, effects of which are estimated to cost the U.S. in excess of $10 billion annually, was assigned to Carnegie Institute and Lehigh University. Boeing Co. provided industrial input and the Naval Research Laboratory was service manager.

A study on graphite composites was assigned to Case Western Reserve University. Industrial support came from Union Carbide Co. and Bell Helicopter Co. Management was performed by the Air Force Materials Laboratory.

In the area of short-fiber, high-performance composites, Washington University of St. Louis, Mo., was the investigating agency. Monsanto Chemical Co. (St. Louis division) furnished industrial support and the Office of Naval Research was assigned service manager responsibility.

Dr. Ezra, in his briefings of OCRD personnel, said that high-energy-rate

# ATACOM Evaluates Explosive Metal Forming

Evaluation of pilot and feasibility reports on the explosive one-piece forming concept as a production method for the manufacture of large complex contoured armored sections has been started by the Vehicular Components and Materials Laboratory of the U.S. Army Tank-Automotive Command (ATACOM), Warren, Mich.

ATACOM has received three pilot upper tank turrets from Aerojet General Corp. of Downey, Calif., and three lower tank turrets from North American Rockwell Corp. of Los Angeles, Calif.

The process involves the use of an explosive charge directed at a single die to form materials into specific contours in one operation. Under more conventional manufacturing methods currently employed in the production of upper and lower turrets, as many as seven subassemblies are stamped out and then welded together to form a turret.

The explosive forming process is performed under water. The liquid serves as a media for the transferral of energy-producing shock waves and gas pressure generated by the detonation of the explosive.

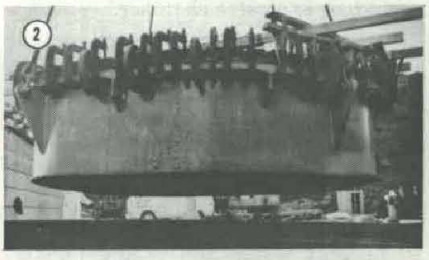
The die, consisting of an epoxy and sand mixture, is poured into a steel beam-reinforced metal die box or container. A steel face plate is formed over the die to provide rigidity.

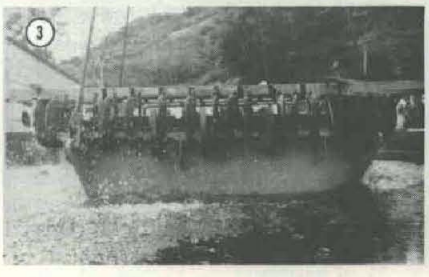
The flat steel armor plate to be formed is placed across the top of the one-piece female die and submerged in a water tank along with the explosive charge.

A vacuum line leading up from the die to a pump holds the armor plate securely in place and keeps the contoured area of the die, under the blank, free of water and air.

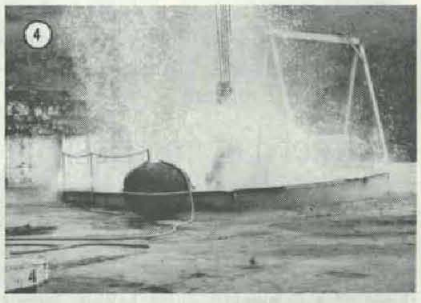
The impact or shock of the detonated charge forces the metal down into the contours of the die.

In checking final turrets, ATACOM engineers will pay particular attention to the residual stress variation factor between one-piece formed turrets and conventionally formed turrets with welds. These and other factors relating to economy, lead time and simplification of procedures will be evaluated before any final decision is reached on adoption of the explosive forming procedure.


**(1) ARMOR PLATE to be formed into the contour of an upper turret for a tank is lowered into place on top of the one-piece female die at Chino Hills, Calif., facilities of Aerojet General Corp. (2) With "C" clamps holding the armor plate in place and long narrow plastic tubes containing liquid explosive taped to 2 x 4s, the die is lifted by a 32-ton crane and moved over the water tank in which the charge will be detonated. (3) The die is lowered into 25-foot water tank. The plastic tube containers of liquid explosive can be seen taped to the bottom side of the 2 x 4s. The 2 x 4s are placed above the die at intervals of about four feet. (4) Detonation sends mountains of water into the air from the tank. (5) The die is lifted and the once flat armor plate (now forced by the impact of the blast into the contour of a tank turret) is removed.**




metalworking was selected for study "as a typical example of a promising new material technology that was failing to achieve its great potential because of an obvious failure to couple science and technology."

This advanced fabrication method, he said, "offers great versatility and power with unlimited growth potential and low capital investment requirements. Still, after a very promising thrust forward in the late 1950s due to the demands of the aerospace industry, large-scale failures were beginning to occur due to extrapolating a limited empirical knowledge too far from too narrow a scientific base."

Full-scale trial and error methods were being used in an attempt to develop explosive-forming procedures for large parts out of high-strength materials, he explained. Consequently, results were exhausting project funds and the patience of sponsoring agencies long before the projects could be brought to a satisfactory conclusion. To illustrate his point, he cited examples of various projects that failed their objectives.

In defining what coupling of research to technology means to investigators at the University of Denver, Dr. Ezra stated:

"While science and technology are strongly related and often share a common methodology, there is an essential difference between the two. The difference lies in the objectives. The goal of science is to understand and interpret natural phenomena. The goal of technology is to use these natural phenomena.

"Science and technology can exist independently of each other and often do, leading separate and sterile lives. The greatest benefits to society have been achieved on a permanent basis when science and technology have interacted with each other, as, for example, the technology of the steam engine and the science of thermodynamics. This is the basic motivation for the desire to couple science and technology.

"The classic role of the engineer in society is the conversion of science to technology. It is the knowledge of this role that must differentiate the education of the engineer from that of the scientist or mathematician. This is often lost sight of in the interminable debates on engineering education that have been going on for the past decade. . . ."

Other significant portions of Dr. Ezra's two briefings follow:

"Our intention has been to discover the mechanisms for converting science into technology, and to use this knowledge to convert high-energy-rate metalworking into a routine, predictable and economically successful material fabrication technology.

"In the course of doing this, we expect to do good research, advance technology and produce a new generation of graduate students who have a clearer understanding of how science and technology interact, and who have an increased respect for applied problems.

"Information dissemination is a necessary element in the coupling of science and technology, though it is by no means sufficient. It can take many forms and, while some are more effective than others, we have tried to make use of every method available to us. . . .

"*Conversion of Science to Technology.* There are many natural barriers to the conversion of science to technology. They provide a measure of protection to existing technology, sheltering it from the immediate impact of every single scientific discovery. We have to understand what these barriers are and to devise swift and orderly methods of overcoming them, because scientific knowledge must be converted into technology to bring about the economic and military benefit we expect from it.

"*Economic Barriers.* The most obvious barrier to the creation of new technology. is the economic one. A technical success can still be an economic failure; unless new technology can become economically self-sufficient, it dies. When a new technology is being used for the first time, the actual costs will most probably be several times larger than expected.

"A reliable figure for cost can only be obtained close to the end of the innovative process, because of the impossibility of foreseeing all the problems of development. A development program can easily cost 10 times the research effort that gave birth to it. A well-planned program must take this into consideration.

"*Psychological Barriers.* Conversion of science to technology is a risky business. To a project engineer, or an engineer whose sole concern is production, the introduction of a new technology is a threat to established schedules and costs. He will, therefore, resist it with all the means

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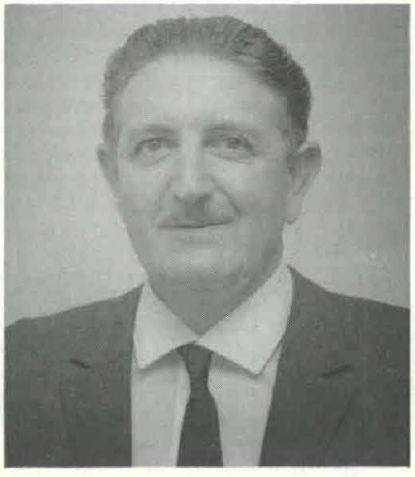
## Israelite Scientist Assigned to Natick Labs

Under the National Academy of Sciences Visiting Research Scientist Program, R. Sidney Kahan, head of Agricultural Applications Group, Soreq Nuclear Research Center in Israel, has joined the staff of the U.S. Army Natick (Mass.) Laboratories.

Assigned to the Irradiated Food Products Division at Natick, Kahan is known for his work in initiating the food irradiation program in Israel. Presently he is coordinator of the Israel National Research Council's irradiation program, in which potatoes and onions have been cleared for consumption.



R. Sidney Kahan

Kahan's work in the atomic energy field also has included the design and operation of pilot plants for separation of heavy water isotopes, correlating data for the initiation of the first nuclear research reaction in Israel, and industrial application of radioisotopes.

The National Academy of Sciences Visiting Scientists Program enables qualified U.S. citizens and foreign nationals to spend either one or two years in research in the fields of biology, biophysics, chemistry, mathematics, organic materials, food and nutrition, geography, climatology, psychology, anthropology and textiles.

Kahan will work with a tripartite study group of scientists from the Natick Laboratories, U.S. Atomic Energy Commission, and Atomic Energy of Canada, Ltd. The group is doing research on radiated chicken, and is also seeking a way to reduce the levels of radiation used in the U.S. Army food preservation program.

Graduated from the University of London in 1938 with a BS degree in chemistry, Kahan also has a diploma from the Imperial College, London University. In 1967 he was appointed a Fellow of the Royal Institute of Chemistry, the highest professional chemical status in Great Britain.

# ARPA-Sponsored Study Probes 'Coupling' Problem

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at his disposal, both covert and overt.

"People at the working level also will resist change for many reasons, one of them being a fear of the unknown. Perhaps it is too harsh to say that you cannot teach an old dog new tricks. It is safe to say that you cannot teach most old dogs new tricks.

"Resistance to the introduction of new technology will take many forms. Perhaps the most sophisticated and effective form of resistance is to question the cost effectiveness of the new technology, and particularly the estimates of cost of the new technology. After all, the new technology has never been used before, so how reliable can be estimates of its cost?

"We are all familiar with the recent newspaper stories of oil-powered aircraft carriers being recommended over nuclear-powered carriers on the grounds of cost effectiveness.

"On the other hand, even though the large-scale generation of electric power from nuclear sources has been more expensive than conventional methods for the past 20 years, the cost differential has been steadily shrinking, thanks to the national policy of continuously designing, building and installing newer models.

"To overcome these difficulties, top-level support and acceptance of responsibility for innovation must be clear and unambiguous. A parallel program (preferably funded by someone else) must be used to identify and solve unforeseen problems, to yield accurate predictions of cost, and to avoid interference with existing methods until the time is ripe. The parallel program also serves to train people, familiarize them with the unknown, and quiet their fears.

"*Education Barriers.* The conversion of science to technology is a complex interdisciplinary process that is not yet taught in schools. It requires a combination of scientific, legal, financial, marketing, sales, administrative and engineering skills that are rarely found in a single individual, though it is not impossible for an individual to acquire them.

"This raises the interesting challenge of whether and how a university can marshall its resources to train such individuals for the future. Society needs them. Billions of dollars have been spent on research by the Department of Defense in the past 20 years; yet Project Hindsight comes to the unsurprising conclusion that no new weapon system in this period resulted from basic research.

"The research organization of an aerospace company, for example, may hardly go beyond providing highly skilled labor for helping to bid on new contracts and helping to impress potential customers and new recruits.

"A Center for Advanced Studies in Invention and Innovation would be an interesting experiment, particularly if its members were recruited from the ranks of those who have had actual experience in the conversion of science to technology.

"Can a program of studies be designed to provide an individual with the right combination of scientific, legal, financial, administrative and engineering skills? What type of individual would benefit most from such a program? These are challenging questions. A center of such a nature, with a steady-state basic funding of a billion a year, could add a new dimension to the research programs of the future.

"*Communication Barriers.* In order to generate a new technology, it is necessary at some point to turn the results of the research program into a development program to carry it to the prototype stage.

"Communication is difficult between research people and development people because of the substantial difference in educational levels.

# WRAIR Psychologists Study Man-Machine Problems

Increased use of automation, involving development of complex man-machine systems and constant monitoring to insure accuracy and reliability, has turned attention of psychologists at Walter Reed Army Institute of Research to total human capability aspects.

In recent months, a new approach has been used to confirm findings of previous studies relative to the degree to which human performance characteristics can be controlled by the design of automated equipment.

Instead of using groups of people for a short period of time, as most other researchers have done, Dr. Thomas W. Frazier and Dr. Vincent E. Bitetto have conducted tests for individuals over a sufficient period of time (numerous trials a day for up to 14 days) for a stable performance pattern to develop.

Results confirm that the manner in which information is programed into a computer, for example, does produce a subtle control over the human observer's response to the machine. Levels of alertness and accuracy tend to decrease or increase as the observer develops response patterns to the machine's programing idiosyncracies.

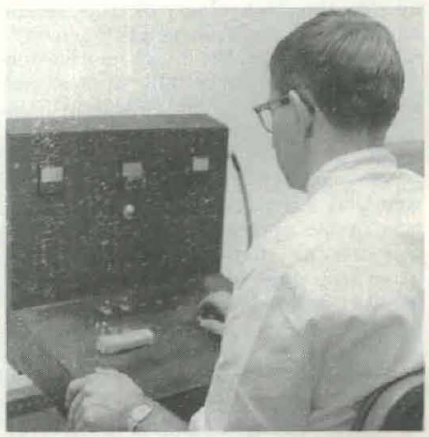
Drs. Frazier and Bitetto have studied situations in which human observation of a complex display can be controlled simultaneously by three schedules of signal programing, each inducing a very different pattern of visual scanning.

When other schedule combinations are employed for signal programing, one schedule, they found, can assume control over scanning of the entire display while the other schedules exert no effects.

Subjects were questioned about the patterns of visual scanning employed; they could only state that they wanted to observe in the manner recorded. Since their scanning behavior was readily manipulated through simple alterations in the choice of presentation schedules, these explanations were unsatisfactory. It was evident that the control exerted by the environment, the machine and its presentation of information, exerted a subtle control of performance.

Present plans provide for continuation of the studies for at least a year. One of the implications of current findings is that assessment of the man-machine factors is incomplete until the design engineer knows how information programing idiosyncracies will affect the human operator's response to the machine.

The ease with which psychological control can be obtained through simple manipulation of information presentation, however, has broader implications in a society where man-machine systems become increasingly complex in the endeavor to increase efficiency and to conserve manpower.



**HUMAN PERFORMANCE subject responds to signals from panel at Walter Reed Army Institute of Research.**

An engineer with a graduate degree will tend to avoid accepting a development job because development work is considered low-brow. As a result, development work is peopled largely by the trial-and-error types who have a profound distrust of theory.

"Scientific concepts which are commonplace to the research man can be quite incomprehensible to the development man. The difference between fact and opinion seems to be a lot clearer to the research man than it is to the development man. The situation is usually aggravated by management's tendency to place responsibility for technical decisions in the hands of the project engineer for the development program.

"When a difference of opinion on a technical matter arises, it has to be remembered that the probability of the research man being right is considerably higher (though by no means certain) since he has the detailed technical knowledge the project engineer lacks.

"The research man has more at stake—his professional reputation—whereas the project engineer can (and usually does) protect himself by blaming inadequate research when things go wrong.

"It is therefore mandatory that during the development phase of a new technology or product the final decision on technical matters is made by the research man. If the research man does not generate enough confidence in management to be given this responsibility, then it is safe to say that this development program should not be undertaken.

"*Administrative Barriers.* Without top management support, any attempt to convert science into new technology must fail. It takes money to do this, since cost of development is high compared to research. Only top-level management can make these amounts of money available.

"Top-level management support is not easy to come by for several good reasons. There is plenty of competition for financial support with a company for one thing. For another, innovation is a risky business. It takes a stout-hearted management indeed to resist panic and the temptation to cancel a program when unanticipated technical difficulties arise.

"The highest level of judgment is required to decide when to move from research to development. If the move is too soon, the results can be disastrous or at best very expensive. If it is too late, you can be preempted by a competitor, who can ruin the potential market if he fails and who can monopolize the market if he succeeds.

"The importance of the administrative role in the successful conversion of science to technology is not clearly understood, particularly by those who have to play this key role.

"The emergence of full-scale research organizations in companies is a relatively recent phenomenon. Management understanding of its own role in relation to research is not as clear as it could be. There is general agreement on one expectation—research should lead to new products, new technology, new profits.

"To do this, management is prepared to provide research money, research labs and facilities. What management is reluctant to face up to is to risk taking a role in deciding what research to single out for conversion into new technology, and when to do it.

"This is a very expensive and very risky business. Many research programs can be funded for the cost of a single serious development program. If one of them does not pan out, there are always a number of others showing enough promise to distract attention from the less successful. Then as prudence dictates, wiping out a less successful one every so often gives the impression of alertness and acts as a warning to the others.

"Research programs in defense agencies and defense-oriented companies face another inherent difficulty. The needs of defense are continuously changing. Effective research programs cannot be started up and changed in direction instantaneously.

"As a result, research organizations in most defense-oriented companies have become window-dressing, serving the functions of impressing the customer with a wide variety of ongoing research, providing a highly educated manpower pool to draw on for help in preparing proposals, and serving as a recruiting attraction for those who want a career in research.

"RECOMMENDATIONS. What recommendations can we make for the effective conversion of science to technology, both in the U.S. Government and in private industry? Possibilities are numerous. Here are a few:

"1. Every year at least one research program should be singled out for special treatment as the one most likely to generate new technology. No research program will ever be completely ready as long as it stays in a purely research environment.

"Top management must participate in the selection of the 'Research Program of the Year.' This will ensure that sufficient understanding exists at the right level. This top-

*(Continued on page 10)*

# CDCEC Selects Hollis as Scientific Adviser

Walter W. Hollis has been appointed to a newly created position as scientific adviser to the commanding general, U.S. Army Combat Developments Command Experimentation Command (CDCEC), Fort Ord, Calif.

Hollis will advise Brig Gen Frederick C. Roecker Jr. and his staff on matters pertaining to the mission of experimentation and combat developments. He will provide liaison with scientific personnel from civilian firms and agencies and explore possible applications of new developments in the military-scientific world to CDCEC's near- and long-range planning.

Walter W. Hollis

Hollis was employed until recently at Frankford Arsenal, Philadelphia, Pa. He served as chief of the Combat Vehicle and General Instruments Laboratory, Fire Control Engineering and Developments Laboratories, and as staff adviser to the director of the Fire Control R&D Division, Pitman Dunn Laboratories.

Hollis has been in U.S. Government service 17 years as a civilian. For his outstanding service as U.S. Army Munitions Command (MUCOM) action officer for the M60/M60A1 Tank Infrared Fire Control Program, he received a special commendation from the MUCOM commanding general.

He is a graduate of Northeastern University in Boston where he received a BS degree in 1949 and remained for two years as an instructor in physics. He also attended West Virginia University at Morgantown as a member of the Army Specialized Training Program, and took graduate work at Boston University and at the University of Pennsylvania.

# ARPA-Sponsored Study Probes 'Coupling' Problem

(*Continued from page 9*)

level understanding will be needed later as the inevitable difficulties arise.

"2. Top management support for converting this particular research program into new technology must be clear and unambiguous. This is absolutely essential to ensure the required level of financial support and the cooperation of the different departments and disciplines that must participate in the innovation process.

"Middle-level management cannot do it. When the first unanticipated technical difficulty arises, middle management fears are quelled by the knowledge that top-level management is backing this program. This releases middle management energies for the more constructive tasks of problem solving. Needless to say, top management must have the courage of its convictions.

"3. A team of key individuals must be temporarily borrowed from the different organizations that will eventually be involved in the development program: engineering, manufacturing, quality control, test, etc. These people must be qualified engineers—no high school graduates with so called "equivalent experience" must be tolerated.

"The research organization must prepare and give a suitably designed course based on the new scientific knowledge that must be acquired by these individuals. If research is not prepared to give this course, the whole conversion effort should come to a complete halt until it is.

"The individuals taking this course must pass it. Therefore, it is wise to pick initially a larger team than will be necessary. Nobody failing this course should be permitted to have anything to do with the innovation program. If nobody can pass this course, it would be wise to stop the whole effort until the right people can be found.

"It is *absolutely essential* for the project engineer who will head up the development program to possess the required technical knowledge.

"4. Without disturbing the research program, a parallel effort must now begin to find suitable applications for this new scientific knowledge, using the services of the engineers who have passed the course. During this study effort, the research people must be available for consultation.

"The results of this study must identify the applications that are promising, the missing knowledge that is needed to make these applications possible. This knowledge in turn should influence the course of the research program.

"If no possible applications can be found, the conversion effort can stop here, either temporarily or permanently. If a suitable application can be found for which the existing level of knowledge is adequate, then a well-planned marketing and sales effort is in order.

"At this point, top management must decide whether to seek outside support for the development program from the U.S. Government or whether to risk its own resources. The eventual gains obviously vary with the degree of risk management wishes to assume.

"5. If a decision is made to initiate the development stage for the purpose of producing the prototype product, care must be taken to observe the following rules.

a. Top management must give its clear and unequivocal support for the initiation of the development program, even if the development funds come from the U.S. Government.

b. The members of the study team must assume key positions in the development program. Since they have passed the required course, this insures that the required level of working knowledge is present in the development team. As an added precaution. the research organization should have a veto power over technical decisions throughout the development program, in addition to their consulting function. This veto power should not be relinquished by the research organization or individual until the end of the development program.

c. Since costs are the key to the successful conversion of science to technology, a well-designed cost accounting system must accompany the development program. If the new technology or new product is expected to replace an existing technology or product, a reliable figure for existing costs must exist before the development program begins.

d. New specifications must be written for the new process or new product.

"*Conclusion.* If these precautions are taken, the results of the development program should answer the question of whether the final step should be taken to replace the existing technology or product, or to market the new one. Again, the final step must have top management backing.

"It can now be seen how the results of the research of even a single individual must grow into a much larger effort involving many people even before the development program can begin. It should now begin to become apparent why the conversion of research into technology is an effort of much greater magnitude and expense than the research program which was the origin.

"Similar steps have to be taken by a U.S. Government agency which desires to convert the results of its research laboratories into technology. The first request for a proposal can be for the formation of the study team.

"Observing these rules will minimize the cost of converting science to technology, and will maximize the chances of success. It cannot guarantee final success. But that is what it takes to convert science to technology."

Dr. Arthur Ezra

**Dr. Ezra has 22 years experience in research, engineering and teaching, and administration of research. Before joining the University of Denver in 1966, he was with Martin Marietta Co. for nine years—the first five in design of the Titan launch vehicles and the last four as manager of the Aeromechanics and Materials Research Lab. He also served as director of the Center for High Energy Forming, a University of Denver-Martin Marietta program.**

**Dr. Ezra received a BS degree in civil engineering from the University of Calcutta (1946), MSE from the University of Michigan (1948), and PhD in engineering mechanics from Stanford University (1958). He is author of several publications, co-author of a book, ROCKET PROPELLANT AND PRESSURIZATION SYSTEMS, and holds a patent on "Surface Vehicle for Traversing Extremely Rugged Terrain" (e.g., Exploration of Moon Surface).**

## 200 Million Messages Sent From Fort Detrick Center

**Transmission of its two-hundred millionth message recently provided the occasion for the U.S. Army Strategic Communications Command's East Coast Telecommunication Center at Fort Detrick, Md., to cite some of the progress since establishment in 1961.**

**The center's first circuits had a top speed of 100 words a minute. Continued acceleration of transmission capabilities has now raised the maximum speed capability to about 5,000 words a minute.**

**Lt Col John E. Mitchell, commanding officer, commended center personnel for their outstanding achievements in improving communications, adding "We can look forward to attaining even better records in the future."**

**The astonishing record of 200 million messages over a 7-year span is made more impressive, it was noted, by the fact that each message averaged well over 300 words.**

## Sweeney Assumes Duties As WECOM Deputy CG; Schafer Appointed CofS

HQ U.S. Army Weapons Command (WECOM) has announced appointment of Col Arthur H. Sweeney Jr. as deputy commanding general, and Col Robert W. Schafer as the new chief of staff at Rock Island, Ill.

Nominated recently for one-star rank, Col Sweeney succeeds Brig Gen Chester H. Johnson. Col Leonard M. Orman, WECOM R&D director, has been acting deputy commander since April, when General Johnson was assigned to HQ Eighth U.S. Army in Seoul, Korea.

A veteran of 26 years of Army service, Col Sweeney has been serving as CO of Watervliet (N.Y.) Arsenal since November 1967, following two years as CO of Springfield (Mass.) Armory.

A graduate of the Massachusetts Institute of Technology, with a master's degree in business administration from Harvard University, he also is a graduate of the Industrial College of the Armed Forces and the U.S. Army Command and General Staff College.

Col Arthur H. Sweeney Jr.

In 1963, he served with the U.S. Army Control and Disarmament Agency with the Department of State.

Other major assignments have included Army Ballistic Missile Agency at Huntsville, Ala., military attache to Switzerland, ordnance officer with the 1st Infantry Division, and member of the U.S. Military Assistance Advisory Group to Cambodia.

Col Robert W. Schafer

COL SCHAFER was assigned to WECOM following a tour of duty at the American Embassy in Bonn, Germany. He had served as defense attache and principal military adviser to the American ambassador since 1965.

From 1963 to 1964, he served as CO of the 19th Air Defense Artillery Group in Highlands, N.J. He was an instructor at the Army War College in 1962–63.

Col Schafer holds bachelor's and master's degrees from Ohio State University. In 1965 he received a master's degree from George Washington University, and he has done graduate work for a doctorate at Syracuse University. He attended the Army Command and General Staff College (1953–54) and the Army War College (1961–62).

## Oswalt Heads Army Engineer Topographic Labs

Col John R. Oswalt Jr., who served with the first Army Chief of Research and Development, Lt Gen James M. Gavin, has assumed command of the U.S. Army Engineer Topographic Laboratories (USAETL), Fort Belvoir, Va.

Col Oswalt was assigned to USAETL after serving 3½ years as director of the Corps of Engineers Waterways Experiment Station (WES), Vicksburg, Miss. He succeeds Col Edward G. Anderson Jr., now assigned to the Defense Intelligence Agency. Col Levi A. Brown, formerly deputy director at WES, succeeded Col Oswalt as director.

Col Oswalt was commissioned in the Army Corps of Engineers in 1941 following graduation from the U.S. Military Academy (USMA), and has a master's degree in civil engineering from the University of California. He has graduated from the Command and General Staff College, the Armed Forces Staff College and the Army War College.

From 1961 to 1964, he served successively as engineer and deputy chief of staff of the U.S. Army, Hawaii. This was preceded by three years as deputy district engineer, U.S. Army Engineer District, Los Angeles, Calif. However, he spent approximately nine months of this time on duty in Washington, D.C., as a member of the Hoelscher Committee to prepare plans for the 1962 reorganization of the Army.

He was senior adviser to the Vietnam Military Academy following completion of his tour with Office of the Chief of R&D, where he served from 1953 to 1957, with staff responsibility for planning, programing and development of engineer equipment.

Other assignments have included a year in the G-3 Plans Division of GHQ, Far East Command; duty in Korea (1947–49) as commanding officer of the 6th Engineer Battalion and, later, chief of staff of the 6th Division; instructor and then assistant professor in the Department of Mechanics, U.S. Military Academy (1943–46).

Col John R. Oswalt Jr.

## 11th Signal Group Equipped With AN/TRC–132 Antenna

Electronic specialists of the 11th Signal Group at Fort Huachuca, Ariz., are familiarizing themselves with the AN/TRC–132 antenna, the newest of its kind in the tropospheric scatter communication system.

Designed for easy moving from site to site, the 30–foot-high structure can be erected within 24 hours to provide long-distance communications in time of disaster anywhere in the world.

The lightweight antenna can be mounted on its own mobile trailer on tracking pedestals or fixed towers. When necessary, the 28-foot parabolic antenna can be disassembled and towed to an airfield where it can be quickly loaded into a C-130 for airlift.

The system transmits multichannel voice or teletype communications up to 250 miles. More than 16 teletype messages can be sent simultaneously.

The 11th Signal Group is the only communication unit in the Army now using the new antenna. The signal equipment is manufactured by the Radiation Systems Inc. of Virginia.

# Besson Keys Manpower in Human Factors R&D

(*Continued from page 1*)
and program development of overseas security operations.

Participating in the general discussion sessions will be representatives of the Department of Defense, Departments of the Army, Air Force and Navy, Army major field commands, other governmental agencies, industrial organizations, R&D contract agencies, United Kingdom, Canada, Australia and Federal Republic of Germany.

An opening-day session on "Human Factors Planning Responsibilities of User and Developing Agencies" is being arranged by the U.S. Army Combat Developments Command, Army Materiel Command and the U.S. Continental Army Command.

Concurrent sessions on "Human Factors Engineering Inputs to Materiel Development," chaired by Dr. John Weisz, and on "Manpower Resources and Human Factors Engineering," with Dr. G. G. Burgess presiding, are scheduled Oct. 23 in the afternoon. Dr. Weisz is technical director, Human Engineering Laboratories (HEL), Aberdeen (Md.) Proving Ground, and Dr. Burgess is a psychologist with the Office of the Deputy Chief of Staff for Operations, HQ Department of the Army.

Speakers in Dr. Weisz's session will be Dr. Leon T. Katchmar and Andrew J. Eckles, HEL, and Gerald Chaikin, HQ Army Missile Command. Presentations in Dr. Burgess' session are listed as Mel T. Snyder, Wright-Patterson Air Force Base; Col Ralph P. Chapman, Office of The Army Surgeon General; Cecil Johnson, Army Behavioral Science Research Laboratory; and Sidney Kaplan, Office of the Deputy Chief of Staff for Personnel, HQ DA. Dr. Daniel Willard, Office of the Deputy Under Secretary of the Army, will be the discussant.

Master of ceremonies at the conference banquet will be Dr. S. Rains Wallace, a former member of the Army Scientific Advisory Panel, now president of the American Institutes for Research, Pittsburgh, Pa.

Col Louis A. Waple, assistant commandant, U.S. Army Special Warfare School, Fort Bragg, N.C., will preside at an Oct. 24 morning session on "Manpower Considerations in Program Development for Overseas Security."

The afternoon session Oct. 24 will be devoted to ATACOM's missions and program, with Dr. Ernest Petrick, chief scientist and technical director, presiding. Presentations will be made by ATACOM key scientists and engineers, including Robert Otto, Fred Pradko, Wayne Anderson, Ralph Marinelli, James Winkworth and Paul Denn.

U.S./Federal Republic of Germany Main Battle Tank 1970s systems engineering techniques, innovations and departures from established procedure will be discussed as a highlight of the ATACOM presentations. A demonstration also will be given of the "Quadruped" or "Walking Truck."

"Job Engineering and the Development Process" is the subject of one of two concurrent sessions on the morning of Oct. 25, both under the general chairmanship of Col W. S. Lancey, ODCSPER. Col W. C. Davis, chief, Personnel Management Development, Office of Personnel Operations (OPO), HQ Department of the Army, will preside over the session on "Job Engineering and the Development Process." Speakers will include H. I. Hadley and L. E. Higgins of OPO, Col C. L. Crain, Office of the Deputy Chief of Staff for Personnel (ODCSPER), HQ DA, David Franklin of Franklin Institute, and Dr. James McKnight, Human Resources Research Office, George Washington University.

Dr. Charles M. Hersh, special assistant to the director, Personnel Studies and Research, ODCSPER, will be chairman of the other concurrent session on "Individual Differences and Training in the Development Process." The scheduled speakers are Harold A. Schulz of the U.S. Continental Army Command, Dr. Howard McFann of the Human Resources Research Office of George Washington University and Edmund F. Fuchs of the Army Behavioral Science Research Laboratory.

# HumRRO Experiments With 'Simulated Tutoring'

"Simulated tutoring" by tape recordings is an innovative program at the Human Resources Research Office (HumRRO), George Washington University, to teach foreign language skills through student self-instruction. Spanish is the language being used in the experiments.

Called AUTOSPAN and sponsored by the Deputy Chief of Staff for Personnel through HumRRO as an Army contractual agency, the language-teaching program is in three phases.

AUTOSPAN I is the development of a procedure for involving the student in an authentic-sounding conversation with the tape.

AUTOSPAN II is concerned with the construction and evaluation of Phase I. AUTOSPAN III is concerned with construction of Phase II and the entire course evaluation.

**TAPE RECORDINGS required for "simulated tutoring" sessions being developed in Work Unit AUTOSPAN are made in recording studio of HumRRO Division No. 7. Testing the "set-up" here are Dr. George H. Brown (standing) and Dr. Richard Beym. With his back to the camera is Sp/4 James P. Whalen, who takes the student's role.**

The simulated tutoring method is based on the premise that the Army has a continuing need for personnel to acquire foreign language skills. Since obvious limitations are involved in having instructors available at varying times and locales, the AUTOSPAN scheme is intended to eliminate the need for in-person instructors in the initial stages of learning.

To create a simulated tutoring session HumRRO provides an experienced language teacher to tutor a live subject in the correct pronunciation of short (4–line) dialogue.

The recording tape contains all of the tutor's directions and instructions to the student and contains pauses which are timed to the right length.

When a bona fide student takes the lesson, he hears the tutor's voice in a natural, spontaneous manner. When he is asked to imitate a certain word or phrase, there is a pause in the tape for him to do so.

After the student speaks, he immediately hears further instructions from the tape. He experiences "a powerful illusion," HumRRO scientists say, "that he is interacting with a real person."

In fact, experimenters say that several students who have gone through such a lesson insisted afterward that a "trick" was being played on them and that a real person was speaking over a microphone to them.

HumRRO scientists do not believe that simulated tutoring is capable of carrying an entire course but regard it as one technique that can be a valuable supplement to the more conventional techniques of programed language instruction.

# Major Army RDT&E, Procurement Contracts Total $380 Million

Helicopter purchases accounted for the largest share of Army contract awards for research, development, test and evaluation and procurement totaling $380,005,600 from July 9 to Aug. 8.

Lockheed Aircraft Corp. gained $92,031,900 in contracts for AH–56A (Cheyenne) helicopters and associated equipment. Bell Aerospace Corp. received $69,845,975 in five contracts for UH–1H helicopters and associated parts.

Raytheon Co. was issued $55,917,855 in contracts for advanced development of the SAM-D missile and for repair and overhaul of RF oscillators for the Hawk missile system.

LTV Electrosystems, Inc., will get $30,318,344 for a 5-year multi-year procurement of vehicular radio set components, and for AN/PRC–25 radio sets. Kaiser Jeep Corp. was issued a $19,118,777 contract modification for M39 series 5-ton trucks.

General Electric Co. is furnishing 20mm subsystems and related parts for AH–1G helicopters, under two contracts totaling $13,375,650.

*Contracts under $10 million.* ITT Corp. is supplying AN/GRC–144 radio sets under an $8,636,850 contract and Magnavox Co. will provide AN/GRC–106 radio sets under a $7,907,034 contract modification.

Mack Trucks, Inc., was issued a $7,057,160 modification for 5-ton truck diesel engines and Caterpillar Tractor Co. $6,633,042 for tractors.

Bulova Watch Co. is receiving $5,261,722 under two contracts for metal parts for 81mm cartridge fuzes and engineering of XM577 fuzes.

*Contracts under $5 million.* ITT Industrial Laboratories, Fort Wayne, Ind., was issued a $4,890,000 contract for night-vision goggles. General Motors Corp. will be paid $4,575,212 (two contracts) for AN/PRT–4/PRR–9 squad radio sets and for main battle tank design efforts.

Two contracts totaling $4,554,132 with Chamberlain Manufacturing Corp. are for metal parts for 105mm and 155mm projectiles. Conductron Corp., St. Louis, Mo., will receive $4,000,000 for electronic equipment and Columbus (Ohio) Milpar and Manufacturing Co. $3,720,000 for metal parts for 81mm cartridge fuzes.

ACF Industries, Inc., received a $3,696,000 modification for metal parts for 81mm cartridge fuzes. Texas Instruments, Inc., won a $3,250,000 contract for night-vision aerial surveillance systems and AVCO Corp. will get $3,088,600 (two contracts) for rotor blades and turbine nozzles for UH–1 helicopters.

Temco, Inc., was issued a $2,740,077 contract for metal parts for XM314A2E1 projectiles, Lockheed Missile and Space Co. a $2,000,000 contract for QT–3 (Delta II) aircraft, and Capitol Radio Engineering Institute, Inc., $2,000,000 for electronic equipment.

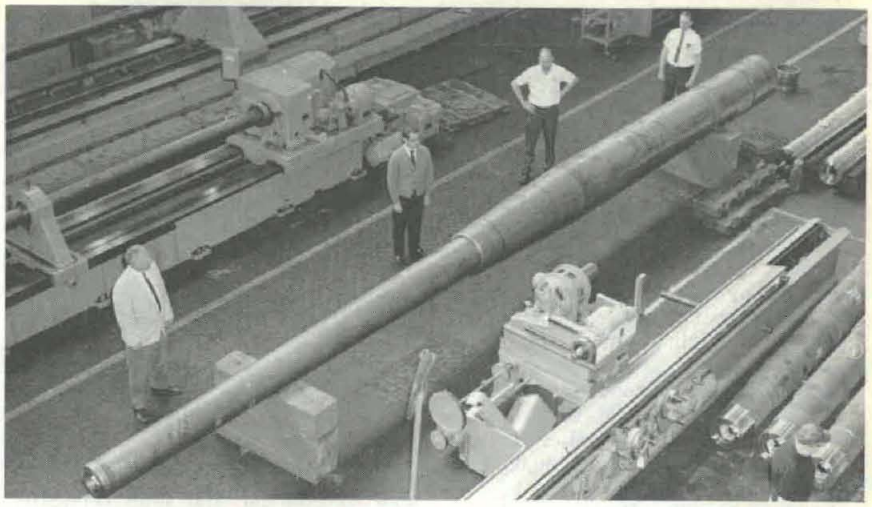
*Contracts under $2 million.* Electrospace Corp., Glen Cove, N.Y., $1,836,374 for AN/PRC–77 radio sets and RT–841 receiver-transmitters; General Time Corp., $1,823,137 for metal parts for M557 fuze boosters; Varo, Inc., $1,773,300 for AN/TVS–3 searchlights; and I D Precision Components Corp., Jamaica, N.Y., $1,762,992 for metal parts for 81mm cartridge fuzes; Action Manufacturing Corp., Philadelphia, Pa., $1,716,130 for metal fuze parts; Zenith Radio Corp., $1,690,128 for 2.75-inch rocket fuze metal parts; and

R E D M Corp., Wayne, N.J., $1,605,000 for metal parts for 81mm cartridge fuzes; G. W. Galloway, Baldwin Park, Calif., $1,604,740 for Shillelagh missile containers; and

Hayes Albion Corp., $1,469,619 for metal parts for 81mm projectiles; Olin Mathieson Chemical Corp., $1,325,551 for 16mm projectiles; Chrysler Corp., $1,263,919 for M60-tank range finders; Northrop Corp., $1.104,314 for flares; and

Bell Helicopter Co., $1,101,132 for cylinder assemblies and flight controls for UH–1 helicopters; Wildinson Manufacturing Co., Fort Calhoun, Neb., $1,097,250 for metal parts for 81mm cartridge fuzes; Hughes Tool Co., $1,091,161 for stabilizers and parts for OH–6A helicopters; and

Z D Products, El Segundo, Calif., $1,065,000 for metal parts for M48 fuzes; A R F Products, Inc., Raton, N. Mex., $1,031,238 for AN/GRC–50 radio sets with ancillary items; and Viz Manufacturing Co., Philadelphia, Pa., $1,026,285 for AN/AMT4D radio transmitter equipment.



**UNDER A $3.3-million contract with the U.S. Navy, Watervliet (N.Y.) Arsenal of the U.S. Army Weapons Command is producing the liners and refurbishing 8-inch and 5-inch gun barrels for the U.S. Navy. The 22-foot-long barrels of 5-inch guns will go on destroyers and cruisers. The 8-inchers, with barrels 37 feet long, are for heavy cruisers. The contract, awarded by the Naval Ordnance Station, Louisville, Ky., is the first of its kind issued to Watervliet Arsenal since the installation produced 4- to 16-inch guns for the Navy in WW II.**

**UNDER A JOINT PROCUREMENT order to meet Army, Air Force, Navy and Marine requirements, Ryan Aeronautical Co. recently received a $20,619,000 contract for BQM–34A Firebee aerial jet targets. The order was the largest in Ryan's 20-year production of the widely used Firebee target, which can travel at speeds from 175 to 600 mph, as low as 50 feet or as high as 60,000 feet, and has an endurance record of 115 minutes in powered flight. The contract will fill 1968 needs.**

# AMC Points to Vietnam Support on Anniversary

(*Continued from page 3*)

civilian employes who complete three months or more of service in the combat area of Southeast Asia. Certificates of Recognition and a lapel emblem are awarded—bronze for three months, silver for six months and gold for nine months.

Cited among improved items of clothing and equipment which AMC is supplying in quantity to combat forces in Southeast Asia are poplin uniforms, nylon reconnaissance boats, and waterproof wrist compasses, as well as a lightweight, collapsible entrenching tool.

Two additional production sources were selected for the M–16 rifle and the previous single supplier is expanding production from 30,000 to 50,000 rifles per month.

Among specific items developed recently by AMC agencies with direct application to field requirements are:

- A new variable body armor being procured for use in Vietnam. Ceramic armor plate is inserted into front and back vest pockets to provide protection against shell fragments.
- Improved aircrew armor for protection of pilots and aircrewmen against small arms fire makes use of ceramic tiles curved to fit the chest and/or back.
- A collapsible, fabric 55-gallon capacity water drum to resupply potable water to platoon-size combat units in Vietnam. The cylindrical container can be transported by vehicle, boat or aircraft. A valve arrangement permits filling of canteens and other containers.

In its sixth year of operations, AMC provided more than one billion pounds of high explosives in support of combat operations in Southeast Asia.

A contract was awarded for development, production and follow-on support of the Tactical Fire Direction System (TACFIRE), with the first system scheduled for fielding in the 1970s. TACFIRE will be employed at battalion, division and corps artillery levels. It provides an automated capability for processing of field artillery, technical and tactical data.

Advances were made in implementing Project ARMS (Army Master Data File Reader Microfilm System), involving transmittal of supply management data via microfilm to the Army in the field. This concept, after initial feasibility testing in 1967, has grown to a current distribution of 400 sets of microfilm data being produced and distributed by the AMC Catalog Data Office. It is anticipated that projected users of microfilmed data will total about 2,500 by July 1970.

Procurement and logistical support of Army aircraft also were expanded. In 1962, the Army aviation inventory stood at 5,692 aircraft, of which 49 percent were rotary-wing aircraft. As of now, the inventory comprises more than 11,000 aircraft, including 79 percent of the rotary-wing type. Army aircraft flew 1.6 million hours in FY 1962. In FY 1968 the total flying hours increased to 6.7 million, with more than one-third of the aircraft inventory operating under combat conditions.

Production and procurement of 375 of the Army's newest combat helicopter, the Cheyenne (AH–56A), was authorized early in January. Designed as a stable weapons platform, able to take off and land vertically, the AH–56A will fly at speeds up to 220 knots. The first engineering test flight of the Cheyenne was completed in September 1967.

The newest version of the Chinook helicopter, the CH–47C, was accepted for the Army in March. Improvements over earlier models include increased speed and payload and longer ferry range.

A production contract was awarded in March for the OH–58A light observation helicopter. It will have performance characteristics comparable to those of the Cayuse (OH–6A).

The Army also formally accepted and deployed the AH–1G Hueycobra, a high-speed helicopter gun ship. In Vietnam, it has proved its capability to perform search and target acquisition, reconnaissance by fire, multiple weapons fire support, and troop helicopter support. As of May of this year, 838 AH–1G helicopters had been placed under contract.

Additional heavy-lift helicopter support has been provided for combat forces in Southeast Asia. Twenty-one CH–54A "Flying Crane" helicopters have been airlifted to Vietnam. In addition to performing normal combat heavy-lift support duties, the aircraft has been credited with retrieving more than 300 downed aircraft since September 1965.

Testing of the Army combat version of an Air Cushion Vehicle (ACV) is under way. AMC, acting under expedited procurement procedures, modified a commercial ACV into a military configuration, fabricated three vehicles, trained the crews, and delivered the equipment to Vietnam in 11 months.

The ACV will travel at speeds up to 70 mph and is capable of engaging the enemy with .50–caliber heavy machineguns, 7.62 machineguns, and other weapons. Vital components and personnel are protected against enemy fire up to and including .50–caliber armor-piercing rounds.

The Armored Reconnaissance-Scout Vehicle (XM800) reached concept formulation stage in FY 1968. This is to be a small, lightweight, lightly armored, highly mobile vehicle for use in the scouting and reconnaissance missions of the armored cavalry and scout platoons. It will replace the M114A1 in the Army inventory.

Publicly exhibited during the past year were the first prototypes of the jointly developed U.S.-Federal Republic of Germany Main Battle Tank and Heavy Equipment Transporter. The tank, capable of firing guided missiles as well as conventional ammunition, features the latest state-of-the-art advances in fire control, suspension,

# MERDC Contracts for Remote-Control Jeeps

Remote control operation of U.S. Army mine-detecting jeeps, by a soldier from any distance up to 300 yards away, is the goal of a contract awarded recently by the Army Mobility Equipment R&D Center, Fort Belvoir, Va.

The $370,000 contract with Ryan Aeronautical Co. calls for prototype remote radio control systems installed in Army vehicles.

Replacing the man behind the wheel will be a foot soldier equipped to start the vehicle, disengage and engage the clutch, shift forward and reverse, advance and retard the throttle, steer the vehicle and apply the brakes.

The system will include two independently powered units—the operator's control pack and a transceiver mounted in a jeep. The Ryan Co. will develop, test, deliver and install the system in each prototype jeep.

armor protection and crew comfort.

Additional uses were worked out during the past year for the M113 armored personnel carrier. Bulldozer kits were developed and tested and have been sent to Vietnam for evaluation. Kits to facilitate recovery of disabled vehicles and repair in the field are under development.

The first production models of the new M60A1E2 combat tank were accepted in March and are now under test. This sophisticated weapon system, an improved version of the currently operational M–60, fires either missiles or conventional ammunition.

Fielding of the newest addition to the Army's fleet of general-purpose vehicles—the M715 series, 1¼–ton, 4×4 trucks—began in January. This new vehicle has a 4-wheel drive, a top speed of 60 mph, and a capacity to negotiate 60 percent grades.

Production of the M561 Gama Goat 1¼–ton cargo truck was ordered in June of this year, with the first vehicle expected off the production line in August 1969. The 6–wheeled, 2–unit vehicle has demonstrated a considerable improvement in off-road mobility. The two units are connected by an articulated joint which permits them to pitch and roll and still maintain ground contact and traction with all six powered wheels.

The Mobile Floating Assault Bridge/Ferry, developed by AMC's Mobility Equipment Research & Development Center, has been delivered to the Army. This versatile amphibious vehicle, primarily designed as a ferry for transporting essential elements across water obstacles, can link up with like vehicles to form a heavy-duty bridge for river crossings by combat units.

Redeye, the Army's smallest air-defense guided missile system, was deployed during FY 1968. It has an infrared homing guidance system which tracks the heat exhaust of low-flying enemy aircraft and guides the missile to its target. The hand-held missile and launcher combined weigh little more than 29 pounds.

Successful development tests were conducted with components of another lightweight weapon, the Dragon antitank missile system which weighs about 27 pounds. Designed for high accuracy against both moving and stationary targets, it will be far superior in range, accuracy, and lethality to the antitank weapon it will replace, the 90mm recoilless rifle.

Production of new ground support equipment for the Pershing 1–A missile system was contracted for during FY 1968. Pershing 1–A involves a shift from tracked to wheeled carriers for all components, including the erector-launcher. The change was prompted by the Army's continuing quest for faster rate of fire, increased reliability, less maintenance, and lower overall costs.

Newly developed additives increase burning rate of solid-rocket propellants to at least three times the present rates and permit the development of rocket motors with shorter burning times and with higher thrust.

Prototypes of the Forward Area Alerting Radar (FAAR), a highly mobile, lightweight, high-resolution radar capable of detecting aerial targets at extremely low altitudes, have been completed and tested.

The FAAR is a component of the Chaparral/Vulcan Air Defense System being developed to defend against low-altitude aerial attacks in the forward battle zone. The system includes the Chaparral surface-to-air guided missile system and the Vulcan 20mm gun, self-propelled and towed. The first production units of the Chaparral and Vulcan systems were delivered in FY 1968 to the Army for testing.

A new fully automatic mortar locating radar, the AN/TPQ–28, is nearing production. It is designed to provide the operator with an accurate first-round location of hostile mortar sites.

AMC achieved a significant improvement in multichannel radio relay communications in FY 1968. The medium capacity (12/24 channels) subsystem, featuring pulse code modulation, was delivered to the first users in Vietnam. An improved version of the AN/PRC–25 manpack radio, the AN/PRC–77, was initially fielded in Southeast Asia.

First shipment of Army standard tactical single sideband communications equipment to Military Assistance Program grant aid recipients was completed in FY 1968. A total of 128 systems for Argentina, Brazil, Colombia and Peru comprised this project.

The United States, United Kingdom, Canada and Australia are participants in the Mallard project, established during the past year as a cooperative international program for development and production of a major tactical trunking and distribution communications system for field armies and elements of other services. The Mallard system is intended to be fielded in the 1975–77 time period. It will provide secure, digital, automatically switched communications.

Announcement was made in May of the Army's latest night-vision devices. Thousands of the devices have been supplied to field units, and many are in use now in South Vietnam. They include the Individual Weapons Sight, the Crew-Served Weapons Sight, and the Night Observation Device, all of which employ "image intensification" technology. This new system amplifies the dim glow of the moon, stars, or even faint skyglow and intensifies it within the target area of the scope. A supplementary light source is not required, and thus the user does not risk detection by an enemy.

The AMC Zero Defects Program, now in its third year and established to motivate all personnel to be more quality-conscious, continued to produce tangible results. AMC employes, as of late FY 1968, had submitted more than 4,200 Error-Cause-Removal (ECR) actions, and management had approved and applied more than 3,000 of these suggestions.

In the aircraft safety field, efforts by AMC and industry to solve the post-crash fire problem have resulted in design of a fuel tank of superior strength to prevent rupture during crashes in which the crew would survive. Stronger tanks and other safety items recently were incorporated into a UH–1 helicopter, which was flown and intentionally crashed in a demonstration. Both engine and transmission were torn from their mountings, but no tanks were ruptured.

In open competition with films entered by the nation's foremost industrial firms, AMC films won important awards from the Industrial Management Society during FY 1968.

U.S. Army Missile Command won first place for its film, "The Standardization Concept," in the management techniques category. The U.S. Army Test and Evaluation Command also took first place for "Quick Change Artistry," in the methods improvement category. HQ AMC won third place in the management motivation category for "Cost Reduction is a Money Splendid Thing."

Film producers were Redstone Arsenal Pictorial Division, the Aberdeen Proving Ground Photographic Lab, and the Army Pictorial Center.

The new Tandem Van de Graaff accelerator at the Nuclear Defense Laboratory, Edgewood Arsenal, Md., is scheduled to begin operation in the fall of this year. This unique research tool will provide the Army with the capability to obtain precise information from basic research in nuclear effects for incorporation into Army materiel designs.

A Smoke Generating Subsystem, Helicopter: XM52, was developed and is currently in limited production. Atomized fog oil is projected into the exhaust of the UH–1D helicopter turbine engine to generate airborne smoke screens. A number of the subsystems are being used in Vietnam.

# President Sends to Senate Nominees for Promotion as Generals

The President has approved and nominated for Senate confirmation a list of 34 officers for appointment to temporary major general, 41 for permanent brigadier general, and 58 colonels for temporary brigadier general.

Major general and permanent brigadier general selections were made by a 6-man board headed by General Theodore J. Conway, the first Director of Army Research (1958–59), now Commander-in-Chief of Strike Command and CIC, Middle East/Southern Asia and Africa.

Other members of the board included Lt Gen Austin W. Betts, Chief of Research and Development, HQ DA; Lt Gen George R. Mather, director, Civil Disturbance Planning and Operations, Office of the Chief of Staff, HQ DA; Lt Gen Harry J. Lemley Jr., Deputy Chief of Staff for Military Operations, HQ DA; Lt Gen Arthur S. Collins Jr., Assistant Chief of Staff for Force Development; Lt Gen Harry W. O. Kinnard, CG, Combat Developments Command.

The zone of consideration for selection to major general included all Army Promotion List officers serving in the grade of brigadier general as of June 24, 1968.

Listed in promotion sequence, they are: *Andrew P. Rollins Jr.*, director of construction, U.S. Military Assistance Command Vietnam (MACV); *William T. Bradley*, CG, U.S. Army Engineer Construction Agency, Vietnam; *Salve H. Matheson*, director, ROTC/NDCC, U.S. Continental Army Command (CONARC), Fort Monroe, Va.; and

*Karl W. Gustafson*, provost marshal, U.S. Army Vietnam (USARV); *William R. Desobry*, deputy director, Plans, Office of the Deputy Chief of Staff, Operations (ODCSOPS), Washington, D.C.; *Leo H. Schweiter*, chief of staff, Provisional Corps, USARV; and

*John L. Klingenhagen*, assistant deputy chief of staff for Logistics, Supply and Maintenance (ODCSLOG), Washington, D.C., *Walter J. Woolwine*, director of Procurement, U.S. Army Materiel Command (AMC), Washington, D.C.; *Ralph L. Foster*, assistant division commander, 1st Armored Division, Fort Hood, Tex.; and

*Herron N. Maples*, deputy CG, Seventh Army Support Command, U.S. Army Europe (USAREUR); *John F. Freund*, chief of staff, VII Corps, USAREUR; *Leo B. Jones*, deputy CG, 1st Logistical Command, USARV; *William A. Knowlton*, Office of the Chief of Staff, Washington, D.C.; and

*Jack J. Wagstaff*, CG, USAREUR and Seventh Army Troops; *Linton S. Boatwright*, assistant division commander, 24th Infantry Division, Fort Riley, Kans.; *Hugh F. Foster Jr.*, CG, U.S. Army Communications Systems Agency, Fort Monmouth, N.J.; and

*Donald H. McGovern*, assistant division commander, 5th Infantry Division, Fort Carson, Colo.; *Orwin G. Talbott*, assistant division commander, 1st Infantry Division, USARV; *Kenneth L. Johnson*, director of Enlisted Personnel, Office of Personnel Operations (OPO), Washington D.C.; and

*Willard Roper*, CG, 18th Engineer Brigade, APO San Francisco, Calif.; *Albert E. Milloy*, CG, John F. Kennedy Center for Special Warfare, Fort Bragg, N.C.; *Donn R. Pepke*, director of Plans, ODCSOPS; *Willis D. Crittenberger Jr.*, assistant commander, 2d Armored Division, Fort Hood, Tex.; and

*Harris W. Hollis*, director of Operations, ODCSOPS; *Francis P. Koisch*, director, Civil Works for Comprehensive Basin Planning, Office, Chief of Engineers (OCE), Washington, D.C.; *Robert B. Smith*, chief of Public Information, and deputy chief of Information, Office of the Secretary of the Army (OSA), Washington, D.C.; and

*William J. Durrenberger*, CG, U.S. Army Weapons Command (WECOM), Rock Island Arsenal, Ill.; *James L. Baldwin*, director, Force Plans Analysis, Office of the Assistant Vice Chief of Staff, Washington, D.C.; *Morgan G. Roseborough*, director, Personnel Studies and Research, Office of the Deputy Chief of Staff for Personnel (ODCSPER), Washington, D.C.; and

*Edward Bautz Jr.*, director of Military Personnel Policies, ODCSPER; *Jack C. Fuson*, director of Transportation, ODCSLOG; *William H. Blakefield*, CG, U.S. Army Intelligence Command, Fort Holabird, Md.; and

*Elvy B. Roberts*, assistant division commander, 9th Infantry Division, USARV; and *George S. Beatty Jr.*, CG, 4th Brigade, 6th Infantry Division, U.S. Army Hawaii.

The board selected 41 officers for promotion to permanent brigadier general from the Army Promotion List, Regular Army, as of June 30, 1967. These include:

*Lt Gen Frederick C. Weyland*, CG, II Field Force, USARV; and *Maj Gens James W. Sutherland Jr.*, CG, Armor Center and commandant, U.S. Armor School, Fort Knox, Ky.; *El-*

# Freund Succeeds Hosking as ISD Director at Picatinny

Trailing his predecessor by just 12 years of service at Picatinny Arsenal, Otto V. Freund took over as director of the 2,800-employe Industrial Services Directorate (ISD) following retirement of Wilfred (Bricky) Hosking after 50 years of service.

Most of Freund's experience centers on work with the directorate he now heads. He served as a supervisor from 1940 to 1958, as superintendent until 1964, and deputy director of ISD until promoted to assistant for production, Office of the Commanding Officer.

Otto V. Freund

Wide experience in ammunition production led to his selection as U.S. Government representative to HQ U.S. Army Europe in conducting engineering surveys on facilities for the Military Assistance Program in various European and middle-Eastern countries.

As a special representative of the commanding general, U.S. Army Munitions Command, Freund served for about six months in 1962 on a program to evaluate the production of the 105mm M444 round. His assistance to various producers of this ammunition round was credited for saving the U.S. Government more than $500,000.

Freund has studied management engineering at Stevens Institute, Colgate University and Newark College of Engineering, and has completed a number of advanced courses at the Army Management Engineering Training Agency.

*mer H. Almquist Jr.*, deputy chief of staff for Military Operations, USAREUR and Seventh Army; and

*William H. Becker*, deputy CG and chief of staff, U.S. Army Combat Developments Command (USACDC), Fort Belvoir, Va.; *George I. Forsythe*, assistant deputy for CORDS to COMUSMACV, APO, San Francisco, Calif.; *Robert C. Forbes*, assistant chief of staff, Personnel, J-1, USMACV; and

*Walter P. Leber*, Governor of the Canal Zone; *Robert E. Coffin*, deputy chief of Research and Development, OCRD, Washington, D.C.; *John H.* Hay Jr., deputy CG, II Field Force, USARV; *Richard J. Seitz*, CG, 82d Airborne Division, Fort Bragg; and

*Clarence J. Lang*, chief of staff, AMC; *George L. Mabry Jr.*, CG, 8th Infantry Division, USAREUR; *John S. Hughes*, CG, U.S. Army Southern Europe Task Force; *Ellis W. Williamson*, CG, U.S. Army Training Center, Fort Polk, La.; and

*William E. DePuy*, special assistant for Counterinsurgency and Special Activities, Washington, D.C.; *Richard T. Knowles*, assistant deputy chief of staff for Military Operations, Washington, D.C.; *Donald H. Cowles*, CG, 3d Armored Division, USAREUR; and

*John R. Deane Jr.*, director of Doctrine, Office of the Chief of Staff for Force Development (OACSFOR), Washington, D.C.; *Samuel W. Koster*, superintendent, U.S. Military Academy (USMA), West Point, N.Y.; *George M. Seignious II*, deputy director, Plans and Policy, J-5, Office of the Joint Chiefs of Staff (JCS), Washington, D.C.; and *Brig Gen James J. Gibbons*, deputy director for NMCS, J-3, Operations Directorate, Organization of the Joint Chiefs of Staff, Washington, D.C.

The remaining 20 officers selected for permanent brigadier general were also listed with appointments as temporary major generals, namely:

Brig Gens Bradley, Ralph L. Foster, Roseborough, Freund, Woolwine, Hugh F. Foster, Boatwright, Rollins, Jones, Desobry, Roper, Talbott, Durrenberger, Pepke, Blakefield, Maples, Schweiter, Gustafson, Smith and Bautz.

*Col Stewart C. Meyer*, Missiles and Space Directorate, OCRD, is among 58 colonels selected for promotion to brigadier general. Others are:

*Harold G. Moore Jr.*, U.S. Army War College (USAWC) staff and faculty, Carlisle Barracks, Pa.; *George W. Casey*, USACDC; *Judson F. Miller*, Office, Chief of Staff; *C. J. LeVan*, Office, Assistant Secretary of the Army for Research and Development, Washington, D.C.; and

*William W. Watkin*, assistant commandant, U.S. Army Engineer School, Fort Belvoir, Va.; *Robert C. McAlister*, 4th Infantry Division, USARV; *Alexander R. Bolling*, 3d Brigade, 82d Airborne Division, USARV; *Frederic E. Davison*, 199th Infantry Brigade, USARV; and

*William L. Starnes*, Office, Chief of Engineers (OCE), Washington, D.C.; *Marlin W. Camp*, Officer Candidate Brigade, U.S. Army Artillery and Missile School, Fort Sill, Okla.; *John H. Cushman*, 101st Airborne Division, USARV; *DeWitt C. Armstrong*, 2d Armored Division, Fort Hood, Tex.; and

*Fred E. Karhohs*, U.S. Army Element, Office of the Secretary of Defense, Washington, D.C.; *Richard C. Horne III*, White Sands Missile Range (WSMR), White Sands, N. Mex.; *Samuel L. Reid*, ODCSPER; *Robert C. Marshall*, U.S. Army Sentinel Systems Command, Redstone Arsenal, Ala.; *James W. Gunn*, HQ 1st Logistic Command, USARV; and

*James J. Ursano*, HQ USAREUR and Seventh Army; *Donald V. Rattan*, John F. Kennedy Center for Special Warfare; *John H. Elder Jr.*, 79th Engineer Group, USARV; *John C. Bennett*, 82d Airborne Division, Fort Bragg, N.C.; *George W. Putnam Jr.*, Office, Chief of Personnel Operations, Washington, D.C.; and

Emmett R. Reynolds, U.S. Army Element, Defense Communications Agency, Washington, D.C.; *George M. Bush*, Office, Under Secretary of the Army, Washington, D.C.; *Dennis P. McAuliffe*, U.S. Army Element, Organization of the JCS; and

*Sidney M. Marks*, U.S. Army Infantry School, Fort Benning, Ga.; *George G. Cantlay*, Office of the Chief of Staff; *Arthur H. Sweeney*, Watervliet Arsenal, Watervliet, N.Y.; *George M. Snead Jr.*, Office, Assistant Chief of Staff for Communications-Electronics, Washington, D.C.; and

*James C. Smith*, MACV; *William R. Bond*, ODCSOPS; *Bertram K. Gorwitz*, HQ, XVIII Airborne Corps, Fort Bragg, N.C.; *John K. Singlaub*, MACV; *John W. Morris*, Office, Chief of Legislative Liaison, Washington, D.C.; *Harold A. Kissinger*, 22d Signal Group, STRATCOM-Europe; and

*Claude M. McQuarrie Jr.*, U.S. Army Infantry School; *Joseph E. Pieklik*, Combat Service Support Systems Agency, Fort Lee, Va.; *Henry J. Schroeder Jr.*, 1st Infantry Division, USARV; *Thomas F. McCord*, U.S. Military Liaison Mission to CINC Group of Soviet Forces in Germany, USAREUR; and

*Edward M. Dooley*, HQ, Sentinel Systems Command; *Hubert S. Cunningham*, USMACV; *Wallace C. Magathan*, Office, Assistant Vice Chief of Staff, Washington, D.C.; *Jack MacFarlane*, U.S. Army Element, Defense Communications Planning Group, Naval Observatory Building, Washington, D.C.; and

*Maurice W. Kendall*, U.S. Army Element, Organization of the JCS; *Harold R. Parfitt* and *Richard H. Groves*, U.S. Army Element, Canal Zone Government; *Richard H. Johnson*, Office of the Chief of Staff; and

*Edwin B. Owen*, U.S. Army Transportation School, Fort Eustis, Va.; *Michael E. Leeper*, HQ, First U.S. Army, Fort Meade, Md.; *David E. Ott*, Office, Chief of Personnel Operations; *Clarke T. Baldwin Jr.*, HQ 2d Armored Cavalry Regiment, USAREUR; and

*Jack A. Albright*, White House Communications Agency, Washington, D.C.; *Hugh R. Higgins*, ODCSPER; *Charles M. Young Jr.*, 1st Armored Division; *Bert A. David*, USAWC staff and faculty; *Sam S. Walker*, Office of the Chief of Staff; and *William B. Caldwell III*, U.S. Military Academy staff and faculty.

# Col Frock Designated Director of AED at Picatinny

Col. Charles F. Frock was assigned recently as director of the Ammunition Engineering Directorate for his second tour of duty at Picatinny Arsenal, Dover, N.J. During his first tour (August 1959–October 1962), he was assistant to the director of the Industrial Engineering Directorate, subsequently absorbed by the Nuclear Engineering Directorate. Later, he was director, Program Coordination Division.

Col Frock graduated from West Point in 1944, served during World War II in the European Theater of Operations, and later was assigned to occupation duty in Germany. Subsequently, he performed various ordnance and engineering duties in the United States and Okinawa.

From November 1965 to June 1968, he served as chief of Munitions Operations Staff, Commander-in-Chief, Pacific, Camp H. M. Smith, Hawaii. He completed the Army Ordnance School at Aberdeen Proving Ground, Md., in 1955, and the Command and General Staff College in 1959.

**Col Charles F. Frock**

# Medical R&D Command Lists 10th Anniversary Achievements

Notable medical research and development achievements during the past decade were cited by Maj Gen Joe M. Blumberg, CG of the U.S. Army Medical R&D Command, in celebration of its 10th anniversary Aug. 20.

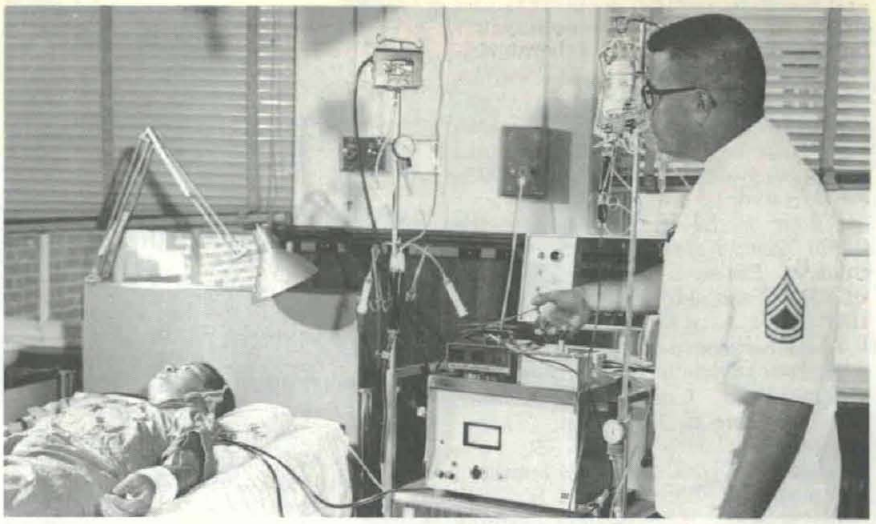
"Medical support requires a vital, mission-oriented R&D program to sustain in combat the Army's most precious asset—Man," he stated. U.S. Army medical R&D results in the past 10 years, he added, have greatly improved capabilities for military operations worldwide.

Many of the accomplishments directed toward preventive control of diseases and advanced methods of treatment have benefited not only U.S. combat forces, he said, but have also found applications to medical needs in underdeveloped nations.

Singled out as one of the most remarkable advances was the development of the inflatable field hospital called MUST (Medical Unit, Self-Contained, Transportable), which has proved highly successful in care of the wounded in Vietnam. The original unit, the 45th Hospital, has been joined by the 3d, 18th and 22d MUST units. Two other units are supporting the U.S. Marines.

Another life-saving product of medical R&D is a spray adhesive developed by the Medical R&D Command for emergency use to stop otherwise uncontrollable bleeding. This technique is still in the experimental phase and is used only when other hemorrhage control measures fail, but it is credited with saving seriously wounded men in Vietnam.

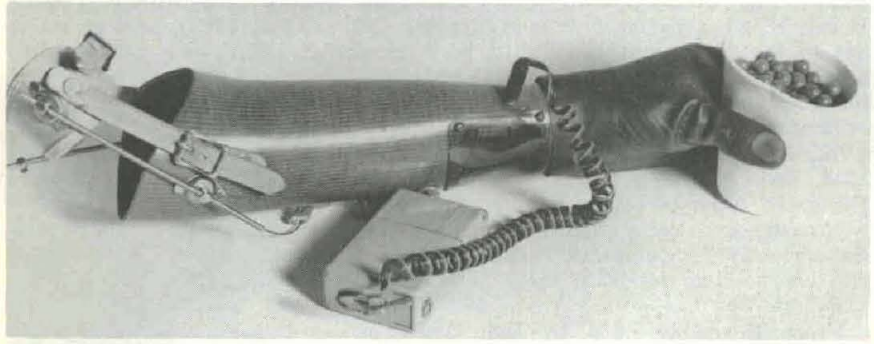
Lifelike artificial hands developed within the past two years also have helped to give new courage to numerous Vietnam amputees. Electrically sensitized, the hands can pick up delicate objects, such as eggs, a plastic container of a beverage or a cigarette, without crushing.



**ARTIFICIAL KIDNEY MACHINE, developed for treatment of acute renal failure, is demonstrated at Walter Reed Army Medical Center, Washington, D.C.**

Similarly, the treatment of many seriously burned patients has been improved dramatically by the use of a new drug, sulfamylon, developed by the U.S. Army Surgical Research Unit at Brooke Medical Center, Fort Sam Houston, San Antonio, Tex. The center is internationally known for its pioneering research in treatment of burns.

Research on blood vessel surgery at Army in-house laboratories and in university laboratories under Army contract has produced significant gains that have helped to save innumerable lives and limbs, it was stated. A new approach to vascular surgery greatly reduces the number of amputations in combat wounds as well as in cases of arms and legs injured in automobile accidents.



**ARTIFICIAL HAND, run by rechargeable batteries, is capable of determining weight of the object lifted, and exerts only required amount of force. In this photo the hand sensed the force necessary to lift a cup of lead shot. The hand was codeveloped by Albert D. Colman, mechanical engineer, and Lloyd Salisbury, electrical engineer, Walter Reed Army Institute of Research.**

Developed originally with Army research funds and first applied clinically during the Korean War, the artificial kidney device, improved by continuing efforts, has contributed to a marked reduction in the mortality of kidney disease patients.

R&D efforts on the U.S. Army-developed artificial heart pump, a joint venture of the Harry Diamond Laboratories and Walter Reed Army Institute of Research, are yielding continuing improvements. Controlled by fluid amplification principles, the pump has no moving parts other than artificial ventricles and tricuspid heart valves.

Requirements for mass immunization, such as for a major disaster involving preventive action for the protection of many thousands of persons against contagious diseases, have been met by development of the high-speed jet injector "gun." This is now used whenever immunization of large numbers of patients is involved at Army installations.

Laser research is one of the "new frontiers" of medical science, including a broad program of investigation of injury hazards in the use of laser devices. Much of this effort is conducted by the U.S. Army Medical Research Laboratory at Fort Knox, Ky., and under contract with university investigators.

Other important medical research advances, spurred by the Vietnam war, are being made in psychotherapy, behavioral science, dental treatment, medical equipment, and physiological responses to conditions of extreme environmental stresses.

Under the jurisdiction of The Sur-

geon General, the Medical R&D Command provides management of Army medical R&D funds, projects, personnel and research facilities. Research efforts are divided about equally between Army in-house laboratories and extramural programs.

Medical research during World War II was directed through the U.S. Army Epidemiological Board. In November 1945, certain medical contracts were assigned to the Medical R&D Board, later to become the R&D Division, Office of The Surgeon General. The Medical R&D Command was formed under OTSG Aug. 20, 1958.

Growth of the command is reflected by a 1968 budget of about $49 million as compared to $12.4 million in 1958. Size of the operational staff for research has grown steadily from about 1,500 in 1958 and is projected to reach about 3,600 by 1975.

With ever-increasing responsibilities, the Medical R&D Command is planning extensive construction projects to add new facilities. A Western Medical Institute of Research is planned for The Presidio of San Francisco in 1970.

Construction of a Central Medical Institute of Research is projected to begin in 1971 at Fort Sam Houston, Tex., home of Brooke Army Medical Center. An annex to Walter Reed Army Institute of Research is planned at Forest Glen, Md., in 1972, and extensive modernizing and expansion of WRAIR facilities is slated in 1973.

The Medical R&D Command accomplishes its mission principally at 14 medical R&D units or laboratories and 15 Army hospitals. Research units outside the Continental United States include the U.S. Army Arctic Medical Research Laboratory, Fort Wainwright, Alaska; the U.S. Component SEATO Medical Laboratory, Bangkok, Thailand; U.S. Army Medical Research Team, Saigon, Vietnam; and Medical Research Units in Germany and Panama.

In the United States, in addition to WRAIR and Walter Reed Army Medical Center (WRAMC), Washington, D.C., command elements include: U.S. Army Medical Unit, Fort Detrick, Md.; Army Research Institute of Environmental Medicine (ARIEM), Natick, Mass.; Brooke AMC, Fort Sam Houston; and

Army Aeromedical Research Unit, U.S. Army Aviation Center, Fort Rucker, Ala.; Army Medical Biomechanical Research Laboratory, WRAMC; Army Institute of Dental Research, WRAMC; Army Medical Research and Nutrition Laboratory, Fitzsimons General Hospital, Denver, Colo.; Army Medical Equipment R&D Laboratory, Fort Totten, N.Y.; Army Medical Research Unit, Presidio of San Francisco, Calif.

## USAERG Announces Organizational Changes

In the first major reorganization of the U.S. Army Engineer Reactors Group (USAERG) since it was established in 1958, HQ Nuclear Power Field Office (NPFO) has been replaced by the Executive Office, USAERG, and an Operations Division created.

Among further changes, departments were redesignated as divisions and the Administrative Branch became the Administrative Office.

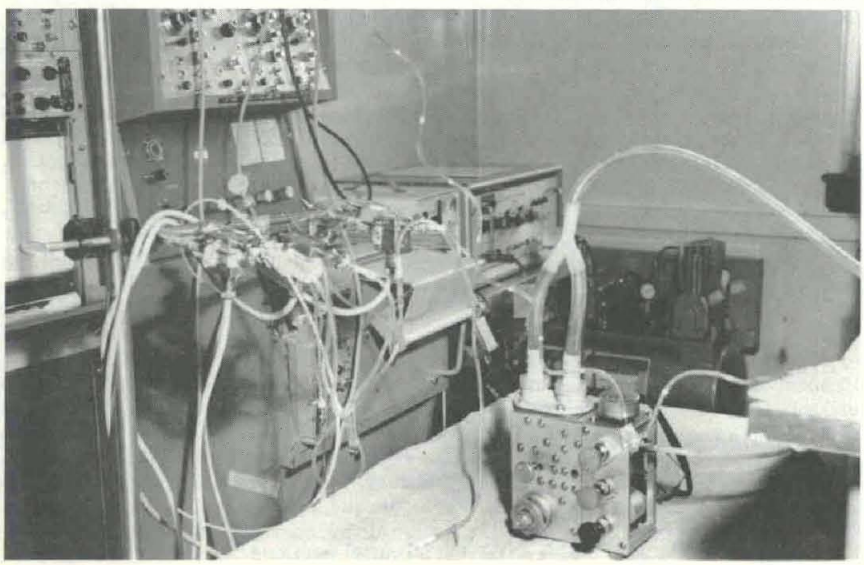
The Operations Division encompasses the Idaho Nuclear Power Field Office, the SM-1 [Reactor] Branch, the SM-IA Branch, Intra-Service Detachments, and the 535th Engineer Detachment subelements.

HQ Operations Division contains the position of chief, a dual position filled by the deputy director of USAERG and the medical officer. Lt Col Veikko E. Jardston, who has served as chief of the NPFO, is now deputy director, USAERG, and chief, Operations Division.

Functions formerly assigned to the NPFO are now the responsibility of the Executive Office, USAERG, such as engineering, operational and administrative support of Army field reactor plants, and service to Air Force and Navy reactor plants as well as Army research reactors.

USAERG's Executive Office also will plan and direct construction programs; train power plant personnel for the Army, Navy and Air Force; operate the nuclear power plants under control of the Army Chief of Engineers and the Advanced Power Conversion Experimental Facility; provide administrative support for USAERG elements; and support assigned portions of the Army-wide nuclear reactor systems health and safety effort.

The Idaho Nuclear Power Field Office, now under the Operations Division, monitors training conducted by contractors at the National Reactor Testing Station, Idaho; provides training for operators of nuclear power plants located at the station; supplies trained crews to operate the plants; and gives administrative support to the Army Nuclear Power Program.



**ARMY HEART PUMP is used for synchronous cardiac assistance. Post-systolic myocardial augmentation can be performed by the experimental-phase device.**

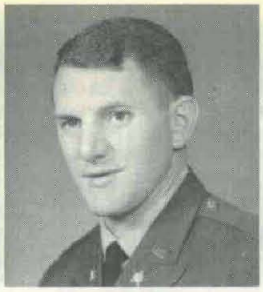
## AVLABS Award $220,000 For UTTAS Design Studies

Preliminary design studies on the Utility Tactical Transport Aircraft System (UTTAS) will be conducted over a 3-month period under four contracts totaling $220,000 awarded by the U.S. Army Aviation Materiel Laboratories (AVLABS), Fort Eustis, Va.

The UTTAS is required to replace the present UH–1D Huey helicopters in the inventory to provide improved tactical airmobility for troop units and to accomplish essential support requirements of troop units during combat operations.

Robert S. Berrisford, AVLABS project officer for UTTAS, said $55,000 each was awarded to Bell Helicopter, Co., a division of Bell Aerospace Corp.; Lockheed-California Co., a Division of Lockheed Aircraft Corp.; Sikorsky Aircraft, a division of United Aircraft Corp.; and the Vertol Division of The Boeing Co.

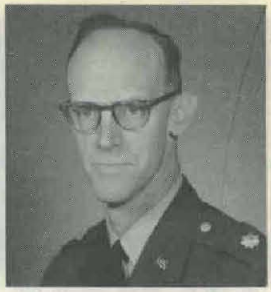
Lt Col
J. F. Castro



Lt Col
M. R. Kortum

Lt Col
W. R. Baldwin

Lt Col
L. P. Hobbs



Lt Col
K. E. Sickafoose

# 10 Officers Report for OCRD Assignments

Ten officers reported recently for new assignments with the Office of the Chief of Research and Development, HQ Department of the Army.

*Col James M. Templeman* was chief, Advisory Division, J-6, HQ U.S. Military Assistance Command Vietnam (MACV), until reassigned to the U.S. Army R&D Operations Research Advisory Group, Research Analysis Corp., McLean, Va.

Col Templeman served (1965–67) as project manager, Army Area Communications System, Fort Monmouth, N.J., and (1963–64) as a staff officer with the Security and Electronic Warfare Division, J-6, Joint Chiefs of Staff.

He earned a BS degree in physics electronics in 1943, a BA degree in mathematics and an MS degree in physics in 1949, all from the University of Washington.

Military schooling includes completion of the Command and General Staff College (C&GSC) in 1958, the Armed Forces Staff College (AFSC) in 1963, and the National War College (NWC) in 1965.

Col Templeman holds the Legion of Merit (LOM) with Oak Leaf Cluster (OLC), the Bronze Star Medal (BSM), and the Army Commendation Medal (ACM) with two OLCs.

*Lt Col Joseph F. Castro* was assigned as a staff officer with the Review and Evaluation Office, OCRD, upon his return from Vietnam as commander of the 26th Engineer Battalion in 1967 and the 39th Engineer Battalion in 1968.

From 1964 to 1967 he served with the 7th Army Support Command, the 24th Engineer Battalion and the Engineer Division, HQ U.S. Army Europe, following three years with the Army Reactors Program, Division of Reactor Development, U.S. AEC.

Lt Col Castro received a BS degree in civil engineering from the University of Rhode Island in 1951 and MS degrees in civil and nuclear engineering from University of Illinois (1959).

He holds the BSM with OLC, the Air Medal with two OLCs, and the ACM with two OLCs.

*Lt Col Marvin R. Kortum* was assigned to the Advanced Ballistic Missile Defense Agency (ABMDA), Nuclear Effects Division, following completion of the C&GSC.

Lt Col Kortum is a 1954 graduate of the USMA and holds MS degrees in civil and nuclear engineering from the Massachusetts Institute of Technology (1960).

In 1966–67 he served with the Military Assistance Command Vietnam, following three years with the 261st Engineer Company and Engineer Logistic Plans Office, 7th Army, Germany.

Other assignments have included 1960-62 service with the Office of the Chief of Engineers, Washington, D.C.; District Engineer, Holoman Air Force Base and White Sands Proving Ground, N. Mex. (1956–58); and the 13th Engineer Battalion, 7th Infantry Division, Korea (1955-56).

*Lt Col Herbert E. Williams* is a new staff officer in the Programs and Budget Division, OCRD, following a year in Vietnam, first in the Office of the Deputy Chief of Staff (Comptroller) and the last six months with the 1st Battalion, 83rd Artillery.

Graduated from the United States Military Academy (USMA) in 1954, he earned an MS degree in physics from Tulane University in 1966, and completed the C&GSC in 1967.

He served with the Electronics Department, Air Defense School at Fort Bliss, Tex. (1962–64). While on duty in Vietnam he was awarded the BSM and Air Medal.

*Lt Col Albert J. Geraci*, a new staff officer with the Geophysical Sciences Branch, Environmental Sciences Division, U.S. Army Research Office (USARO), recently completed a tour of duty with the Office of the Deputy Chief of Staff for Logistics, U.S. Army, Europe.

Graduated from USMA in 1947, and from New York University in 1955 with an MS degree in meteorology, he completed the residence course at the C&GSC in 1961.

Recent major assignments have included duty as battalion commander with the 24th Mechanized Division, Augsburg, Germany (1965–67); Signal Office, 18th Airborne Corps, Fort Bragg, N.C. (1964–65); 82d Airborne Division, Fort Bragg (1963–64); 1st Cavalry Division in Korea (1962–63).

Among his medals and awards are the BSM with V device OLC, ACM with OLC, Parachute Badge with Silver Device, and Combat Infantryman Badge.

*Lt Col William S. Howe* is newly assigned to the Military Advisers Branch, Studies and Analyses Division, following graduation with an MSE degree from Arizona State University. He graduated from the C&GSC in 1963.

Lt Col Howe served with HQ U.S. Forces, Dominican Republic in 1966, preceded by three years as a staff officer and adjutant with the U.S. Army Combat Developments Command, Fort Sill, Okla. From 1960 to 1962 he was assigned to the 42d Artillery Group in Germany. He holds the ACM (1966) and the Purple Heart (1951).

*Lt Col William R. Baldwin* is assigned to the U.S. Army R&D Operations Research Advisory Group, RAC, and graduated recently from C&GSC.

A 1954 graduate of the USMA, where he served as a mathematics instructor (1960–63), he served with the Guided Missile Department, U.S. Army Artillery and Missile School, Fort Sill, Okla., from 1965 to 1967. He completed the Artillery officer's career course at Fort Sill in 1964 and then served a year with the I Corps, Group Artillery in Korea. He was with the First U.S. Army Support Group from 1957 to 1960.

*Lt Col Leo P. Hobbs* was assigned recently as a staff officer with the Laboratories Branch, Southeast Asia Division, after completing a tour of duty with Joint Task Force 2, Albuquerque, N. Mex.

Major assignments since graduation from the USMA in 1954 have included HQ 1st Air Cavalry Division, Vietnam (1966–67); U.S. Army Mis-

sile Command, R&D Directorate, Redstone Arsenal, Ala. (1963–66); Battery D, 4th Missile Battalion, 44th Artillery, 38th Brigade, Korea (1962–63); and the Air Defense Board, Fort Bliss, Tex. (1959–62).

Lt Col Hobbs received the BSM, the Air Medal, and the ACM.

*Lt Col Keith E. Sickafoose* is the new chief of the Low Altitude Systems Branch, Air Defense and Missiles Division.

His assignment follows a tour of duty as chief of the Contract Support Branch, Controls Management Division, and later as chief of the division, U.S. Army Combat Developments Command, Combat Arms Group, Fort Leavenworth, Kans. (1966–68).

Graduated from the USMA in 1949, he earned an MA degree in mechanical engineering from the University of Southern California in 1958, and completed the C&GSC in 1962.

He served as liaison officer to the Allied Land Forces Central Europe (1963–64), and as commanding officer of the 6th Missile Battalion, 517th Artillery, Germany (1964–66).

*Maj Robert C. Tilton*, a new staff officer in the Military Advisers Branch, Studies and Analyses Division, is a 1957 graduate of the USMA with a 1961 MS degree in mechanical engineering from the New Mexico State University.

Maj Tilton recently completed two years duty with the Military Assistance Advisory Group, Japan. From 1964–66, he was assigned to the Hawk Project Manager's Office, Redstone Arsenal, Ala., and in 1963 served as a missile systems analyst with the Engineer Service Test Group, Kwajalein. He was assigned to the Lacrosse and Nike projects from 1961 to 1963 at White Sands Missile Range, N. Mex.

## BESRL Director Elevated To Head APA Division 19

Dr. J. E. Uhlaner, director of the Behavioral Science Research Laboratory (BESRL), recently became president-elect of Division 19 (Military Psychology) of the American Psychological Association.

Dr. Uhlaner will take office in September 1969, succeeding Dr. Launor F. Carter, Systems Development Corp., Santa Monica, Calif.

Active in the American Psychological Association for many years, Dr. Uhlaner has served as public relations director of Division 14 (Industrial Psychology) and has recently contributed two major publications to Division 19 programs. One was devoted to the historical development of military psychology, the other to a review of the state-of-the-art of military psychology.

# Catholic U. Studies Cable Design Under THEMIS Grants

Basic research on "The Structure and Dynamics of the Vitreous State" and methods of improving design and strength of undersea cables will be conducted by Catholic University of America, Washington, D.C., under two Project THEMIS grants totaling $788,000.

Out of one phase of the investigations could come, university officials anticipate, such developments as chemically strengthened glass to make possible an all-glass submarine for oceanographic research. Studies will include molecular structure, microstructure and viscoelectric properties of vitreous substances.

Principal investigator on the 3-year $386,000 contract study is Dr. Theodore A. Litovitz, internationally recognized authority on glassy and vitreous materials. Working in close collaboration with him will be Dr. Pedro B. Macedo, a former National Bureau of Standards employe known as a specialist on the microstructure of molten glasses.

Under a $402,000 contract, the Catholic University Mechanical Engineering Department will investigate fundamental properties and possible improvement of design and strength of undersea cables.

Dr. Patricio A. Laura will be the principal investigator, and will work with Prof. Frank A. Andrews, head of the university's ocean engineering program.

The objective will be to advance the state-of-the-art on fabrication of cables used to lower instruments to the ocean bottom for scientific surveys, to tow photo and acoustic instrument packages, to lift large objects from the ocean floor, and to tow or lift objects from the ground by helicopter.

Known as the author of more than 20 publications on the vibrations of continuous media, elastic stability and heat transfer, Dr. Laura is a reviewer for "Microwaves Theory and Techniques Transactions" of the Institute of Electrical and Electronic Engineers and for the "International Journal of Heat and Mass Transfer."

Working also with Drs. M. J. Casarella and S. R. Heller, Dr. Laura will conduct the first in-depth analytical and experimental study ever done on cable structure, 3-dimensional configurations, shapes and stresses.

Current work at the Catholic University of America Institute of Ocean Engineering will be expanded to develop a mathematical model to describe "interaction of the viscous fluid flow with the dynamic flexibility of an extended body in motion at one end."

Among questions to be answered are how an extended body remains stable, what are the 3-dimensional forces on a cable being used by a surface ship for towing, and what are the effects of water drag, centrifugal forces, ocean currents, temperature changes, surface waves and other vibrations?

Current and proposed oceanographic use of tow cable requires higher tow ship speeds, greater distances between the vessel and the object being towed, increased remote control, and lighter cable weight and smaller size. High winds and storms are met in towing and for recovery and salvage operations at extremely deep ocean levels.

Fourteen faculty members and 42 graduate students are taking part in the CUA Ocean Engineering Institute's current research. The program includes underwater acoustics, underwater navigation, structural dynamics, information for deep-ocean vehicles, heat transfer association with ocean engineering power plants, corrosion and use of radioisotopes in ocean floor sensors.

## Army Sentinel System Command Announces Personnel Changes

U.S. Army Sentinel System Command key personnel changes announced in August by Brig Gen I. O. Drewry, CG, made Col Robert C. Marshall, nominated for one-star rank, successor to Col Hartsell H. Northington as head of the Site Activation Directorate.

Col Northington retired after 30 years Army service, the last two as Nike-X assistant project officer for Corps of Engineer activities until he was assigned to the Sentinel System Command. He was awarded the Legion of Merit by Brig Gen Drewry for outstanding achievement.

Col Marshall, a graduate from the U.S. Military Academy and a recent returnee from a tour of duty in Vietnam, has distinguished himself in a number of major engineering assignments.

He was responsible for Army and Air Force construction in Mississippi, Alabama, Tennessee and northwest Florida, including the National Aeronautics and Space Administration construction in Huntsville and the Mississippi Test Facility.

Col William W. Kirchman, a veteran of 27 years military service, is the new Inspector General of the Sentinel System Command and recently completed a tour of duty in Vietnam. He succeeded J. L. Lahiere, who had served in an acting capacity since the formation of the command.

# Battelle Studies Aerial Map Interpretation

Army aerial reconnaissance interpreters are involved in an experimental program aimed at sharpening ability to locate targets on photographs more quickly and accurately.

Dr. Robert W. Brainard and John R. Powers III are heading a team of Battelle Memorial Institute research psychologists in developing the program under contract with the U.S. Army Behavioral Science Research Laboratory, Washington, D.C.

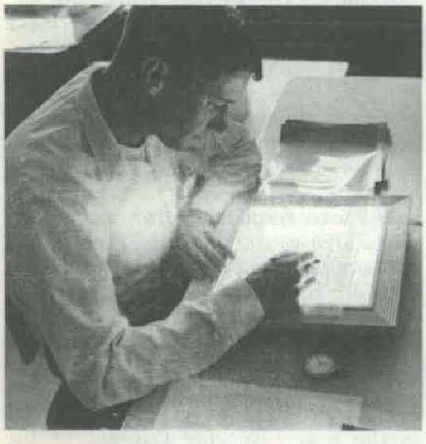
The program consists of three steps: (1) study of commonly made interpretation errors as a means of avoiding errors, (2) expanding the observer's visual field to see more with fewer fixations, and (3) developing search strategies for efficient and systematic scanning.

After receiving practice in error avoidance, the subject's ability to detect targets is improved through experimental exercises which reduce scanning time while simultaneously increasing the field of vision. The interpreters view photographic slides through an aperture-controlled by a high-speed camera shutter.

Initially, the interpreter has a 3-degree angle of observation which, through repeated exposures, he learns to scan in one-tenth second. This angle is increased incrementally until the subject masters a field of nine degrees in the same one-tenth second of allotted time.

The researchers note that all the men were able to reach the 9-degree level in two days. They are now aiming for 15 degrees in the same time.

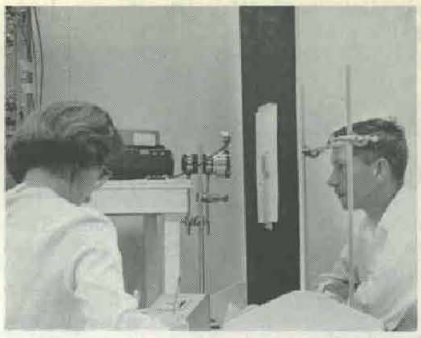
In the final phase of the program, the subjects use different techniques in scanning a photograph. Using the "geometric" pattern technique, the interpreter starts in the upper left and scans toward the right. He then drops to the next grid and goes to the left. This continues until the photograph is scanned.



**RECONNAISSANCE INTERPRETER scans aerial photographs for targets, following lines of communications—rivers, highways, bridges and railroads.**

In another technique, the interpreter scans along the "lines of communication," such as highways, bridges, rivers and railroads.

Individualized, adaptive techniques are being used throughout the program, permitting each subject to proceed at his own pace. Once he has mastered one level, he goes up to the next. With the individualized technique, each man can capitalize on his strong points.



**HIGH-SPEED SHUTTER is used in development of an experimental research program designed to increase proficiency of image interpreters.**

# Project Stormfury Extends Hurricane Seeding Areas

Continuing efforts to modify the weather are being advanced by the Environmental Sciences Services Administration, U.S. Department of Commerce, and the U.S. Navy in Project Stormfury, ending Oct. 15.

Supported also by the Department of Defense, Project Stormfury seeks to lessen the violence of hurricanes by a series of experiments in which storm areas are bombarded with silver iodide "seeding." Long-range goals are improved understanding and prediction, as well as methods of decreasing violence of storms.

Areas in which seeding is authorized have been extended this year to permit experiments in the Southwestern North Atlantic, the Caribbean Sea and the Gulf of Mexico, when the probability is 10 percent or less that the center of the treated hurricane will come within 50 miles of a populated area in the next 24 hours.

A Department of Defense announcement said this expansion of the Stormfury experimental area has been made possible by the increasing accuracy of hurricane forecasts, particularly predictions of storm paths.

Project officials hope that the new criteria will provide a better opportunity for hurricane seeding. Since the program began in 1961, experiments have been performed on only two storms—Hurricane Esther in 1961 and Hurricane Beulah in 1963. Results were encouraging, but definite conclusions could not be drawn from such a small sample.

In this year's experiments, a Navy Intruder aircraft will release the silver iodide generators and other aircraft, flying at levels from 1,000 to 40,000 feet, will record conditions before and after seeding.

Part of this year's intensified experiments will be the seeding of clouds near the eye of the hurricane area with silver iodide five times over an 8-hour period. It is hoped that repeated seeding will produce cumulative effects more pronounced than those observed in the earlier tests, when seeding was done once.

Two planned new experiments are the seeding of hurricane rainbands and of tropical cumulus cloud lines over the ocean. The rainbands—narrow strips of heavy precipitation found at some distance from the hurricane eye—may constitute an important link in the chain between relatively simple cumulus convective activity and a mature hurricane.

Silver iodide generators will be dropped along a section of a rainband, and changes in cloud structure and precipitation patterns will be observed and measured to determine whether modification of a rainband produces any detectable change in the storm's mechanism.

Dr. Robert M. White, director of the Department of Commerce Environmental Services Administration (ESSA) National Hurricane Research Laboratory, is director of Project Stormfury. Capt R. J. Brazzel, commander of the U.S. Navy Fleet Weather Facility at Jacksonville, Fla., is assistant director and Navy project coordinator.

Dr. Pierre St. Amand is the project manager at the Naval Weapons Center, China Lake, Calif., where the silver iodide pyrotechnic generators used for seeding in Project Stormfury were developed.

## *ISF Winners Visit Army Labs*

**Katherine M. Geier, one of the Army's 10 superior award winners at the 19th International Science Fair (ISF), recently spent a week at the Walter Reed Army Institute of Research, Washington, D.C., as a guest of the Army. Her award winning project was entitled "Bacteriocidal and Bacteriostatic Effects of Yellowroot." Another of the two female winners, Eileen P. Bross, enjoyed a one-week visit to the Army research activity of her choice at the U.S. Army Medical Research and Nutrition Laboratory, Denver, Colo. Her winning presentation at the ISF was "Radioprotective Cytological Studies on TRADESCANTIA PALUDOSA."**

# MRC Lists Academic Staff for 1968-1969

Forty-four prominent mathematicians, seven from foreign countries, have been selected by the Mathematics Research Center (MRC), U.S. Army, Madison, Wisc., as staff members for the 1968–69 academic year.

Located on the University of Wisconsin campus, the MRC is in its 12th year as a contract agency performing research in applied mathematics related to military needs.

Under MRC Director Dr. J. Barkley Rosser, staff members furnish assistance and guidance as requested at all Army installations. Dr. Louis B. Rall is assistant director.

Staff members on sabbatical leave from educational institutions pool their knowledge to keep the MRC apprised of the latest trends in mathematics. Members serving this year, their academic affiliations, and fields of mathematical specialization are:

George H. Andrews, Oberlin College, Ohio, graduation and interpolation; Krishna B. Athreya, Stanford University, branching processes, probability theory; Javad Behboodian, Pahlavi U. In Iran, statistics; Fred G. Brauer, University of Wisconsin Mathematics Department (UWMD), differential equations; and

Howard E. Conner and Creighton R. Buck, UWMD, analysis; Hermann Burchard, Purdue U., approximation theory; James H. Case, MRC, differential games; Colin W. Cryer, U.W. Computer Sciences Department (UWCSD), numerical solution of partial differential equations; and

George Eason, U. Of Strathclyde, Glasgow, Scotland, elasticity; David R. Ferguson. MRC, approximation theory; H. Reynold Fiege Jr., U.W. Medical School, applications of operations research and computers to medical problems; Thomas N. E. Greville, MRC, approximation theory and actuarial mathematics; and

John H. Halton, UWCSD, stochastic processes-Monte Carlo methods; Bernard Harris, MRC, statistics; Te Chiang Hu, MRC, integer programming and network flows; R. R. Huilgol, U. of Sydney, Australia, rheology;

Samuel Karlin, Stanford U., statistics and probability; Herman F. Karreman, MRC, stochastic optimization and control; George S. Kimeldorf, MRC, Bayesian inference and actuarial mathematics; Charles H. Kraft, U. of Montreal, Canada, nonparametric statistics; and

Arthur S. Lodge, U.W. Engineering Mechanics Department (UWEMD), rheology; Ralph London, UWCSD, theory of programing and artificial intelligence; Dahlard L. Lukes, MRC, control theory and differential equations and games; and

O. L. Mangasarian, UWCSD, mathematical programing and optimal control; Henry B. Mann, MRC, number theory and statistics; Ben Noble, MRC, integral equations and numerical analysis; Pedro Nowosad, Stanford U., applied functional analysis;

Elmor L. Peterson, U. of Michigan, geometric programing; Jerome Klotz, U.W. Department of Statistics (UWDS), nonparametric statistical methods; Louis B. Rall, MRC, numerical analysis, integral equations and functional analysis; Ben J. Rosen, MRC, nonlinear programing and optimal control theory; and

J. Barkley Rosser, MRC, logic and numerical analysis; Duane Sather, MRC, partial differential equations; Isaac J. Schoenberg, MRC, analysis and approximation theory; Aaron S. Strauss, U. of Maryland, global existence, ordinary differential equations and optimal control theory; Richard Tapia, U. of Calif., Newton's method; and

Dietrich A. Uhlenbrock, UWMD, plasma physics; Constance Van Eeden, U. of Montreal, Canada, biostatistics; James M. Varah, Stanford U., numerical analysis, especially theory of matrices; Peter Werner, Technische Hochschule, Stuttgart, Germany, wave theory; and

Harvey J. Wertz, U.W. Electrical Engineering Department, electrical engineering, numerical analysis; Michael J. Yohe, MRC, computer programing and topology; E. H. Zarantonello, MRC, hydrodynamics and functional analysis; and Zvi Ziegler, Technion-Israel Institute of Technology, convex inequalities.

## Spline Functions

**By T. N. E. Greville**

A very common situation in applications of science, engineering and technology is to have a number of points plotted on a graph and to draw a smooth curve joining them. For some purposes it is satisfactory to draw such a curve freehand. When it is desired to draw it more carefully, a draftsman may use a French curve or a spline, which is a rod made of flexible material, to which weights can be attached at certain points.

In recent years mathematicians have developed spline functions, which are simple mathematical expressions that, when plotted on a graph, produce curves similar to those that would be obtained with a French curve or a spline. There are sometimes advantages in having the curve given by a mathematical formula rather than drawn on a graph.

If computations are going to be made involving the coordinates of points on the graph, it is easier for the computer to calculate the coordinates by the formula than to read them from the graph.

Two different draftsmen, given the same plotted points, would not usually obtain exactly the same curve by the use of a French curve or a spline. However, two mathematicians making the same assumptions would obtain exactly the same spline curve through the given points. In a certain precise mathematical sense, there is a "smoothest" curve through a given set of data points that is given by a spline function easily calculated.

Spline functions are useful to scientists and engineers in problems involving interpolation and approximation of functions, numerical estimation of definite integrals, and solution of differential equations.

The Mathematics Research Center (MRC), U.S. Army, in Madison, Wisc., offers an introductiry course of lectures on spline functions in which their properties and their more elementary applications are developed from the beginning, assuming only a knowledge of elementary algebra and differential and integral calculus.

The lecture notes for these lectures are available for the asking, and arrangements can be made for a member of the MRC to give the lectures at an Army activity having at least 25 eligible participants. Persons interested in these orientation lectures should contact T. N. E. Greville, Mathematics Research Center, U.S. Army, University of Wisconsin, Madison, Wisc. 53706.

On Oct. 7–9, 1968, the MRC will conduct an Advanced Seminar on Theory and Application of Spline Functions, a 2½-day training activity that will elucidate applications and properties of spline functions somewhat more advanced than those dealt with in the lecture notes. Thus, a greater degree of mathematical maturity is required of the attendees.

A copy of the lecture notes will be sent in advance to each participant, and acquaintance with their contents will be the only prerequisite for attendance. All qualified Army personnel are welcome. Those interested in attending should write to Secretary, Advanced Seminar, Mathematics Research Center, U.S. Army, University of Wisconsin, Madison, Wisc. 53706.

# Kudos

DISTINGUISHED SERVICE MEDAL. The DSM was presented to *Brig Gen George A. Kuhn*, assistant for Veterinary Services and chief, Veterinary Corps, for his "strong, inspiring leadership to the Veterinary Corps . . . that enabled the Corps to meet all the problems resulting from the Vietnam buildup."

The Surgeon General of the Army, Lt Gen Leonard D. Heaton, by orders of President Lyndon B. Johnson, presented the award during ceremonies attended by former chief of the Veterinary Corps, Brig Gen James A. McCallum (Ret.) and Brig Gen Jacob L. Hartman (Ret.).

General Kuhn during 32 years in the veterinary corps has watched its mission broaden from responsibility for meat inspection and care of cavalry horses to that of safeguarding the health of troops through food inspection, veterinary public health, and research.

In addition to the DSM, he holds the Joint Service Commendation Medal, and the Army Commendation Medal with Oak Leaf Cluster.

**CHIEF OF R&D Lt Gen A. W. Betts presents Silver Star to Col S. Meyer.**

SILVER STAR. This medal was awarded to Col Stewart C. Meyer, recently assigned as executive officer OCRD, for gallantry in action involving close combat with an armed hostile force in the Republic of Vietnam, Nov. 19, 1967.

Col Meyer served from March 1967 to March 1968 in Vietnam as executive officer for II Field Force Vietnam Artillery and then CO of the 9th Infantry Division Artillery.

LEGION OF MERIT. Lt Gen William F. Cassidy, Chief of Engineers, presented the LOM to *Col John R. Oswalt Jr.* in a recent ceremony.

Now serving as commander of the U.S. Army Engineer Topographic Laboratories (USAETL), Fort Belvoir, Va., Col Oswalt was cited for accomplishments as director of the Waterways Experiment Station (WES), Vicksburg, Miss. (See p. 11 for biographical sketch.)

The LOM was presented to *Lt Col Robert H. Hurst* for exceptionally meritorious service as a staff officer and chief of the Research Plans Office, U.S. Army Research Office, OCRD, December 1965 to July 1968.

He was cited for his efforts in the development of the Army Research Plan, establishment of an interservice technological forecasting methodology study group, and publishing of a Report on Technological Forecasting "commanding great prestige and recognition throughout the military and civilian research and development community."

Col Hurst retired recently to pursue a teaching career in Hawaii.

*Lt Col Hampton Rowland Jr.* received the LOM for exceptionally meritorious service with the U.S. Army Behavioral Science Research Laboratory (BESRL), OCRD, from June 1965 to July 1968.

Serving first as executive officer and later as commanding officer, Colonel Rowland distinguished himself in the design, procurement and construction of the Surveillance Systems Experimental Laboratory.

The citation states in part; "Col Rowland was instrumental in affording the professional staff insight into the interests and needs of the military community and providing sound advice and counsel on the impact and benefits to be derived from research projects assigned to and undertaken by BESRL."

*Lt Col Freddie L. Browning* received the LOM award during retirement ceremonies at Fort Detrick, Md., which concluded 20 years of Army service.

He was cited for outstanding services from June 1967 to July 1968 while serving as director of the Installation and Services Directorate at Fort Detrick.

The LOM was awarded posthumously to *Lt Col Donald M. Nay* for "exceptionally meritorious conduct in the performance of outstanding services from January 1966 to April 1968 while serving as assistant chief, and chief, Utilization and Requirements Section, Installation Branch, Plans Division, Directorate of Plans, Supply and Operations, Office of The Surgeon General."

Col Nay's widow, Margaret Nay, accepted the citation from acting Deputy Surgeon General, Maj Gen Phillip W. Mallory, during ceremonies in the Office of The Surgeon General.

*Lt Col Robert J. Cottey*, and operations officer with the Military Operations Division, U.S. Army Limited War Laboratory (LWL), Aberdeen (Md.) Proving Ground, received the LOM for service in Vietnam.

He was cited for serving as project manager to the director of the Office of the Secretary of Defense, Advanced Research Projects Agency, R&D Unit, from April 1966 to April 1967. He has departed from the LWL for reassignment to the 4th Infantry Division, Vietnam.

EXCEPTIONAL CIVILIAN SERVICE. This highest Army civilian employe award was presented to *Bryant Mather*, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., for service as chief of

**Bryant Mather and Col Levi A. Brown, director of the U.S. Army Engineer Waterways Experiment Station (WES).**

the Concrete Division and for his exceptional and distinguished contributions and services in concrete research and technology.

Mather directs basic research to reduce the cost and improve the quality of concrete as well as the testing of actual materials used in construction of major projects of the Corps of Engineers—the largest single user of concrete in the world.

Mather has been honored with the Sanford E. Thompson Award for a technical paper, the Award of Merit of the American Society of Testing and Materials, and the Roy W. Crum Distinguished Service Award of the Highway Research Board.

MERITORIOUS CIVILIAN SERVICE. The MCS Award was presented recently to those employes of the U.S. Army Electronics Command (ECOM) for their contribu-

tions to military communications and new electronic components.

Maj Gen William B. Latta, CG of ECOM and Fort Monmouth, N.J., presented the second highest Army award for civilian employes to Vincent Kublin, Rudolph C. Riehs and Peter Zakanycz.

*Kublin*, associate director of the command's Electronic Components Laboratory and chief of the Solid State and Frequency Control Division, was cited for "technical foresight, imaginative planning, and dynamic programing of electronic components research and development.

"The products of this creative and forceful leadership, now on the component production lines of U.S. industry, represent significant contributions to military electronic progress and new tactical field capabilities for the U.S. Army," the citation states.

*Riehs*, acting associate director of the Communications and Automatic Data Processing Laboratory (CADPL) was commended for "contributing to the design and development of superior equipment in support of our Armed Forces throughout the world . . . [and for] significant contributions to the international acceptance of U.S. Military communications as the standard of excellence. . . ."

*Zakanycz*, senior engineer in the information processing technical area of the CADPL, was cited for a "major contribution" to the research, design, development and production of the U.S. Army's pulse code modulation systems employed in multichannel radio and wire communications."

*Kenneth L. Calder* earned the MCS for outstanding scientific achievements and contributions in establishing credible evaluations of biological weapons and defense systems at Fort Detrick, Md.

He began his career in November 1949 at Fort Detrick. He served successively as chief of the Meteorology Division, chief of the Field Test and Meteorology Division, and senior research mathematician in the Environmental Analysis Office of the Aerobiology and Evaluation Lab.

Calder is employed in the Air Resources Field Research Office, National Air Pollution Control Administration, Cincinnati, Ohio.

*Charles J. Shoemaker*, chief of the Respiratory Branch of the Defense Development and Engineering Laboratories at Edgewood (Md.) Arsenal, received the MCS Award for technical leadership of a coordinated program to provide a new lightweight and compact protective mask for use in Southeast Asia.

*Pauline Dorman*, secretary to Lt Gen A. W. Betts, Chief of Research and Development, received the MCS Award for exemplary performance from Feb. 1, 1966 to Jan. 31, 1967.

DISTINGUISHED FLYING CROSS. *Lt Col Larry D. Dotson*, now assigned to the Communications-Electronics Division, OCRD, received this award for voluntary actions "above and beyond the call of duty, July 12, 1967, while flying as mission commander in support of airmobile operations near Duc Hoa, Vietnam."

He simultaneously received the Legion of Merit and the 21st Oak Leaf Cluster to the Air Medal for outstanding service from January 1967 to January 1968 while serving consecutively as CO, 68th Assault Helicopter Company, and S-3, 145th Combat Aviation Battalion, Vietnam.

BRONZE STAR MEDAL. *Lt Col George N. Simcox*, newly assigned deputy commander of the U.S. Army Engineer Topographic Laboratories (USAETL), Fort Belvoir, Va., is a recent BSM recipient.

Col John R. Oswalt Jr., USAETL commander presented the medal to Lt Col Simcox for "distinguishing himself by outstanding meritorious service in connection with ground operations against a hostile force in the Republic of Vietnam during the period June 1967 to June 1968.

Maj Gen Charles C. Case, CG of the U.S. Army Mobility Equipment Command, St. Louis, Mo., recently presented one 40-year length-of-service award and six 30-year awards at the U.S. Army Mobility Equipment R&D Center, Fort Belvoir, Va.

*Ernest McClellen* received the 40-year award a day before he retired for the second time. He served in the Army from June 1928 until he retired as a master sergeant in April 1953, and became a Civil Service employe two months later.

The 30-year awards were made to *Charles R. Keatley*, Military Engineering Division; *Warren Mollenhauer*, Standardization Engineering Division; *Edward W. Reynolds*, Small Purchases Division of the Procurement Office; *R. Stuart Sutherland*, Military Engineering Division; *Edward C. Kinker*, Mechanical Equipment Division; and *Ralph E. Beahm*, Environmental Control Division.

# Glassblowing for Scientists Appeals to Youth

Glassblowing is an age-old craft which offers little appeal to most ambitious young men in today's world of increasing automation, but to 19-year-old Frank R. Cooper it holds the promise of a meaningful lifetime career.

Cooper bends, shapes and forms glass at the Army's Natick (Mass.) Laboratories under the President's Youth Opportunity Campaign. He is kept busy repairing broken glassware and fashioning special apparatus for scientists.

Interested in the craft since his junior year as a student at Milford (Mass.) High School, after seeing glassblowers working at historical exhibitions and fairs, he will return to Salem County Technical Institute, Penns Grove, N.J., the only school in the U.S. which teaches glassblowing, when he ends his summer employment.

Cooper and the 11 other students enrolled in the glassblowing course each spend about 22 hours per week in classes, nine hours of which are devoted to glassblowing instruction. They also study English, mathematics and physics during the 2-year curriculum.

Cooper feels secure in his choice of a career. He is convinced that a machine will never be built that can understand, translate and construct what a scientist wants in the way of glass apparatus for a special task.

Frank Cooper

## U.S. Army Engineers Build Important Road in Vietnam

U.S. Army engineers recently completed paving a 25-mile stretch of Highway 19 West which runs from Dragon Mountain near Pleiku, Vietnam, to the Cambodian border.

The vital supply route is part of the most concentrated road upgrading program ever to take place in the Central Highlands. The new portion will service Special Forces and Republic of Vietnamese soldiers at Duc Co, and the 4th Infantry Division at Oasis, located halfway between Dragon Mountain and the border.

The 20th Engineer Battalion (Combat), 937th Group, 18th Brigade, began paving operations at the beginning of the dry season and finished before the Monsoon rains came. Last year the rains washed out all the roads in the area and resupply had to come by air.

# 'Tiny Tim' at Cam Ranh Bay

**By Kenneth L. Treiber**

"Tiny Tim" is doing a man's-size job for the U.S. Army Corps of Engineers in South Vietnam! This Tiny Tim is somewhat of a mechanical monster—a 34-ton pump unit being employed to empty tankers in a minimum of time at Cam Ranh Bay.

The hugh pump unit was recommended for overseas service, following a phone call last January to the U.S. Army Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, Va., for assistance in providing a tanker unloading rate of 7,000 barrels an hour.

Col Fred Johnson, director of petroleum supplies, 1st Logistical Command at Long Binh, requested that the POL project manager contact industry to obtain the pumps required to meet the requirements at Cam Ranh Bay.

Because of the time that would be required to obtain the necessary pumping equipment, it was decided to employ Tiny Tim, which was then being used by MERDC to test other equipment such as ship-to-shore hose, pipe and couplings.

A 1,500-horsepower diesel-powered pump unit, designed for use on the 12-inch military pipeline systems, Tiny Tim had passed all of the required proofing procedure, including service tests by troops. It had been used many hours and required rehabilitation before shipment to Vietnam, to insure that all components were in first-class operating condition.

This 12-inch pump unit is designed for operation at 2,600 and 4,300 gpm (3,700 and 6,150 barrels an hour). The required flow rates at Cam Ranh Bay were 7,000 barrels an hour when pumping to tank farms five miles from the pump site, and 6,250 barrels an hour pumping seven miles to airfield storage tanks. The 7,000 barrels-an-hour rate will fill a 50,000-barrel storage tank in about seven hours.

The unit was shipped from Fort Belvoir to California, and then by ship from Long Beach to Vietnam. There it was unloaded by a 100-ton crane and placed on a 60-ton trailer. After a concrete pad was water-cured for seven days, a portion of the sand in front of it was removed so that two dozers could pull the unit from the trailer onto the pad and then rotate the pump unit into position.

**"TINY TIM" PUMP UNIT (far left) is shown with sand trap (center, right) and strainer during assembly of pumping station at Cam Ranh Bay, Vietnam.**

A sand trap and strainer were considered necessary. The necessary material was not available in stockyards, and a search was then made in a salvage yard. Some 18, 20 and 24-inch pipe was found from which the sand trap and strainer were fabricated. (See photo above.)

The strainer was fabricated by drilling ⅜-inch holes in the 12-inch pipe. By using the three lengths of available 24-inch pipe, the velocity in the 120-inch pipe was reduced from 14 feet per second to 0.9 feet per second, enough velocity reduction to cause the sand, gravel and other heavy particles to fall to the bottom and be periodically removed.

An inlet and outlet pressure gauge indicates the presence of a restriction in the unit, warning the operators that cleaning is necessary. A 2-inch standard size drain, with valve and coupling, is located at the bottom of each 24-inch pipe to drain the fuel out of the unit before the cleaning operating begins. The foreign material is then removed at the two 12-inch cleanouts at the bottoms of each 24-inch pipe section.

The sand and dust, which are everywhere at Cam Ranh Bay, were considered to be detrimental to the erosion-prone lightweight fins on the engine coolant radiator.

A large oil-bath air cleaner, 25 feet long, 18 feet wide, and 11 feet high, was fabricated from scrap material. The oil surface is contained in a scrap ponton 18 feet long, 5 feet in diameter, burned along its girth to form a tub, which may be inspected easily by doors in the housing at each end of the half ponton.

The airflow from the 11-foot height enters through a large wire mesh screen 18 x 4 feet in size. The air then flows over an inverted weir, spilling the sand and dust into the oil before it enters the pump cooling system.

The pump unit manifold was not a special problem because pipe fittings and valves were available in depot stock. Tiny Tim does have a safety feature, however—a filler piece for the product pumped, thereby insuring that no one inadvertently opens the wrong valve.

(The author wishes to acknowledge the cooperation and able assistance given by Col Fred Johnson and Staff at 1st Logistics Command at Long Binh, and Lt Col Harcourt Newman and staff at Cam Ranh Bay in placing Tiny Tim in operation in Vietnam.)

*Kenneth L. Treiber (Lt Col, USA, Ret.) has been associated with the Army Mobility Equipment R&D Center (MERDC), Fort Belvoir, Va., in a military and civilian capacity since 1942. Employed as a mechanical engineer in the Fuels Handling Equipment Division, he recently received his ninth patent. His inventions range from a "rolling fuel transport device" (his latest) to a snow saw and an engine muffler.*

*Treiber received a BS degree in mechanical engineering from Rutgers University in 1932, and is a registered professional engineer in the District of Columbia. In addition to his inventions, Treiber is a lecturer and author of* Living Each Moment, *a book which has had wide circulation.*

## Soler Takes Command Of AVLABS; Cantwell Assigned as Deputy CO

Changes in leadership of the U.S. Army Aviation Materiel Laboratories (AVLABS), Fort Eustis, Va., were announced in mid-August. Col Eduardo M. Soler is the new commander and Lt Col Franklin D. Cantwell is deputy.

Col Soler filled the vacancy left by reassignment of Col. Harry L. Bush as deputy commander for Research, Engineering and Data, HQ Army Aviation Materiel Command, St Louis, Mo. AVLABS will be directly subordinate to Col Bush, who headed the lab for more than two years.

Until reassigned, Col Soler was stationed at HQ AVCOM as project manager for the Utility Tactical Transport Aircraft System.

Graduated from the U.S. Military Academy in 1943, he also has an MS degree in electronics engineering from Georgia Institute of Technology and an MA degree in international affairs from George Washington University. He graduated from the Army War College in 1961.

Col Eduardo M. Soler

Lt Col Franklin D. Cantwell

## MICOM Reports Cost Reduction Techniques to DoD

Improved management techniques at the Army Missile Command have been recognized by the Department of the Army in a recent report to the Department of Defense on cost-reduction initiated in the R&D Directorate and in the Arsenal Support Operations Directorate.

One example is an estimated 2-year saving of $259,974 through cost effectiveness and systems analysis studies on the SAM-D (Surface-to-Air-Missile-Development) engineering and development proposal.

All life-cycle missile-system cost effectiveness and system analysis studies had been calculated manually. Robert Orr, chief of the Operations Research Branch, Future Missile Systems Division, suggested using a computerized cost model to get the required SAM-D data. The model was developed on contract.

While hand-calculation would have required an estimated 9,600 additional manhours at a cost of $67,000, the new technique is expected to result in a net savings of $17,000, even after deducting costs of model development and computer time. The Army Missile Command estimates use of the new technique will bring a $259, 974 savings on other studies during Fiscal Years 1968 and 1969.

Another Missile Command suggestion cited by the Army report is concerned with savings by consolidating files.

Mrs. Faye Larmon of the Arsenal Support Operations Directorate's Consolidated Supply Division, suggested that "due-in" and "expediting" supply files be consolidated in reusable file folders equipped with a pocket to hold both requisition and status cards. By placing both bits of information in a single folder at the expediter's desk, the Army obtains an estimated annual savings of 2,580 manhours and $7,000.

## STRATCOM Establishes Agency To Provide Support to MTMTS

Establishment of a 12th subcommand of the U.S. Army Strategic Communications Command to provide communications-electronics and audio-visual support to the Military Traffic Management and Terminal Service (MTMTS) was announced in August.

Manpower, facilities and funds identified with the MTMTS communications-electronics and audio visual functions were transferred to the control of STRATCOM Communications Agency-MTMTS. Facilities and personnel of the new agency are collocated with HQ MTMTS, Falls Church, Va.

"Assignment of responsibility for MTMTS communications-electronics to STRATCOM, with its long lines capability and technical competence, will help us considerably in improving our responsiveness to defense transportation requirements," stated Maj Gen John J. Lane, commanding general of the MTMTS.

Dewey Allread Jr., formerly director of the Office of Communications-Electronics at HQ MTMTS, is director of the new agency. His responsibilities will involve communications-electronics operation and audio-visual support at HQ MTMTS, headquarters of area commands, military ocean terminals, outports and terminal units.

## SCIENTIFIC CALENDAR

Government Microcircuit Applications Conference, sponsored by DoD, NASA, Department of Commerce, NBS, Post Office Department and other government agencies, Washington, D.C., Oct. 1-3.

Allerton Conference on Circuit and System Theory, sponsored by IEEE and the University of Illinois, Monticello, Ill., Oct. 2-4.

Low-Energy Nuclear Physics Conference, Albany, N.Y., Oct. 4-5.

Electrochemical Society Meeting, Montreal, Canada, Oct. 6-10.

Association for Computing Machinery Workshop on Microprograming, Bedford, Mass., Oct. 7-8.

National Aeronautic and Space Engineering and Manufacturing Meeting, sponsored by SAE, Los Angeles, Calif., Oct. 7-11.

21st Annual International Air Safety Seminar, sponsored by the Flight Safety Foundation, Anaheim, Calif., Oct. 7-11.

12th Annual Organic Chemistry Conference, sponsored by Army Natick Laboratories and NAS-NRC, Natick, Mass., Oct. 8-9.

8th Annual National Conference on Environmental Effects on Aircraft and Propulsion Systems, sponsored by the Naval Air Propulsion Test Center and the Institute of Environmental Sciences, Bordentown, N.J., Oct. 8-10.

International Telemetering Conference and Exhibit, sponsored by the International Foundation for Telemetering, Los Angeles, Calif., Oct. 8-11.

Symposium on Applications of Ferroelectrics, sponsored by IEEE, Washington, D.C., Oct. 10-11.

19th International Astronautical Congress, N.Y.C., Oct. 13-19.

System Science and Cybernetics Conference, sponsored by IEEE, San Francisco, Calif., Oct. 14-16.

Conference on Plasma Instabilities in Astrophysics, sponsored by APS, AAS and AEC, Stanford, Calif., Oct. 14-17.

Packaging and Transportation of Radioactive Materials Conference, sponsored by ORNL and AEC, Gatlinburg, Tenn., Oct. 14-18.

Conference on Matrix Methods in Structural Mechanics, sponsored by AF Flight Dynamics Laboratory and the AF Institute of Technology, Wright-Patterson AFB, Ohio, Oct. 15-17.

Symposium on Switching and Automata Theory, sponsored by IEEE, Schenectady, N. Y., Oct. 15-17.

Conference of Gaseous Electronics, sponsored by APS, Joint Institute for Laboratory Astrophysics, Boulder, Colo., Oct. 16-18.

Seminar on Explosive Chemical Reactions, sponsored by ARO, AFSC and the Naval Ordnance Laboratory, Durham, N.C., Oct. 21-23.

Conference on Silicon Carbide, sponsored by AFCRL, Pennsylvania State University and the Carborundum Co., University Park, Pa., Oct. 21-23.

Seminar on Explosive Chemical Reactions, sponsored by ARO, AFSC and the Naval Ordnance Laboratory, Durham, N.C., Oct. 21-23.

Conference on Advanced and High-Temperature Gas-Cooled Reactors, sponsored by IAEA, Washington, D.C., Oct. 21-25.

5th Annual Meeting and Technical Display, sponsored by AIAA, Philadelphia, Pa., Oct. 21-25.

# USATACOM Uses Time-Sharing Computer System

**By Christina C. Lins**

*Christina C. Lins received BS and MA degrees in mathematics from the University of Detroit. She joined the U.S. Army Tank Automotive Command as a mathematician in August 1962, working in the Scientific Computer Division of the Mobility Systems Laboratory.*

Time-sharing of a digital computer system to solve engineering problems and to train technical personnel in programing techniques has been used by the U.S. Army Tank Automotive Command (USATACOM) since December 1967. Results have been acclaimed highly successful.

Three teletype terminals were installed originally and this number was increased recently to five to provide a wider scope of service. Each terminal is connected via telephone lines to a computer center 25 miles away.

Programing languages are conversational, making the system particularly well-suited for use by people who have little knowledge or interest in the intricacies of programing for large-scale digital computers.

The system permits engineers and scientists to communicate by teletype with the computer from any of the five terminals. Up to 30 teletypes can be on-line with the computer at any given time.

Programs and data are typed at the teletype terminal by the user. The program is then compiled and run by the computer, and the results are sent instantaneously by teletype.

If the program has errors, appropriate diagnostic messages are typed automatically on the teletype. Each user has his own program stored in the computer's disc file. In addition to his own programs, each user has access to several hundred others stored in a common library.

This experiment in making the computer readily available to the engineer has been evaluated by USATACOM as highly responsive to requirements. Utilization of the three original terminals increased steadily from 41 percent in December 1967 to 110 percent in July 1968. Percentages are based on a 40-hour work week.

**ONE OF FIVE teletype terminals installed at the Army Tank Automotive Command for use in a time-sharing computer program. Each terminal is connected via telephone lines to a digital computer center 25 miles away.**

Approximately 350 programs have been written and are available to aid USATACOM personnel.

Varying considerably in size and complexity, and covering a broad spectrum of engineering and scientific problems, the programs have been developed to predict vehicle performance data, such as acceleration, fuel economy, ride and engine performance.

Soil and mobility characteristics, as well as critical design data, also can be determined, and statistical studies are made. In addition, programs are being developed daily as engineers and scientists discover new ways in which the computer can relieve them of the drudgery of computation.

Since the turn-around time for time-sharing programs is instantaneous, data can be obtained when it is desired. Little time is lost waiting for programs to be run, as is the case in a batch-processing environment. This feature has proven to be invaluable for quick evaluations.

A series of three courses is offered regularly to all technical employes. The first 8-week course is designed to introduce the student to the use of digital computers in general and the time-sharing computer system in particular.

A simple user-oriented programing language called BASIC is taught, and the student is given the opportunity to program and solve problems.

The second 12-week course teaches the student to program in the FORTRAN language. The last course is a 6-week seminar in computer applications. Students work together in small groups to find computer solutions to work-oriented problems.

Approximately 100 USATACOM employes have completed courses and an additional 60 are enrolled.

Engineers and scientists report that the system is flexible enough to fulfill their needs, easy to use and, most importantly, readily available when they require computational service. It has proved an effective tool, and it will continue to be used to aid in fulfilling USATACOM's mission of research, design and development of vehicle and other systems.

# GSEL Engineers Invent Simplified Terminal Connector

Invention implies to many people some complicated mechanical or electrical apparatus. Willie K. Patterson and Winfred E. Buffington, engineers in the Army Missile Command's Ground Support Equipment Laboratory (GSEL), have teamed on what has to be one of the cheapest and simplest inventions imaginable.

It is called a "shapable electrical terminal connector" and consists of a small loop of flexible wire fitted into a metal cylinder 1/8-inch thick. When the cylinder is crimped onto a wire, the loop, which is easily shaped to fit virtually any type of terminal, is ready to make the connection.

The shapable connectors are already in use in Vietnam, connecting firing devices for the XM-158 rocket launcher, which also was developed at the GSEL. Troops find the shapable connector a big benefit when performing maintenance on the XM-158, since no special tools are needed.

Patterson, a native of Callison, S.C., received a bachelor's degree in electrical engineering from Clemson College in 1951, after serving in the Navy during World War II. Employed at Redstone since 1954, he is chief of the GSEL Electrical Design Branch.

Buffington was born in Fairfax, Ga., and attended Berry College and Georgia Tech, where he received a bachelor's degree in electrical engineering. He served in the Navy from 1946–1948. Shortly after completing college, he took a position with the Tennessee Valley Authority, remaining until he joined Redstone in 1958.

The pair has applied for a patent through the Army Missile Command Patent Center. Under this arrangement, no royalties will be paid, since the device was developed in-house.

*Army Scientist Tells Fascinating Story . . .*

# Dr. Zahl's New Book Details Development of Radar

High adventure, the challenge, the excitement and the rewards of a career in Army research and development may never be recounted in a more fascinating, fast-moving, rollicking and robust manner than in Dr. Harold A. Zahl's new book, *Electrons Away*.

In telling the highly intriguing story of the invention of radar and the critical role it played in World War II, Dr. Zahl writes with an authority recognized by all who shared with him in this development that opened the whole new world of electronics. He was one of the pioneers.

Tribute to the contribution made to electronics by Dr. Zahl during his 36 years with the U.S. Army Signal Corps Laboratories, and the successor Army Electronics Command (ECOM) is contained in a foreword to *Electrons Away*. Dr. Jerome B. Wiesner, former Presidential Science Adviser and currently the provost of Massachusetts Institute of Technology, is the author of the foreword.

Dr. Zahl joined the research staff at the Signal Corps Laboratories in 1931 shortly after receiving a PhD degree. R&D achievements moved him up the career ladder until he reached the top as director of research and chief scientist, in which capacity he continued when ECOM was created.

In the introduction to his book, the author quotes the report of Walter Winchell in his Sunday night broadcast of Dec. 19, 1948:

"Good evening, Mr. and Mrs. North and South America and all ships at sea . . . let's go to press. Fort Monmouth, N.J. . . . Vera Hiller, the American Airlines' beauty was married to Dr. Harold Zahl, the Army's great scientist. His radar inventions drove Hitler to suicide. . . ."

Many of the big names in today's ever-accelerating parade of electronic marvels who were among the military-academic-industrial team of pioneers in developing radar are fascinatingly linked in *Electrons Away*.

Mixed in to spice the blend of first-hand factual reporting and humorous situations is the account of certain small intrigues that played a sometimes important part in the development of electronic devices.

Characteristic of Dr. Zahl's disposition to bid for the belly-buckler laugh is his letter to his long-time friend and former close working associate at Fort Monmouth, Dr. Richard A. Weiss, now Deputy and Scientific Director of Army Research, announcing publication of his book. It reads:

"I have even received my first fan letter—

'Dear Doctor Zahl:

'So nice of you to write book. Always knew you won World War II, but didn't know that you also scared the Kaiser in World War I. So glad you retired—please stay that way' Ho Chi Minh"

*Electrons Away* is published by Vantage Press, Inc., 120 West 31st St., New York, N.Y. Dr. Zahl has kindly offered to make selected portions of his book available for early publication in the Army R&D Newsmagazine.

Dr. Harold A. Zahl

# 30 Students Take WRAIR Materials Science Course

How to mix materials used for prosthetic devices for physically disabled patients was taught to 30 students from 17 states and from Vancouver, British Columbia, in a week-long course at Walter Reed Army Institute of Research, Washington, D.C.

**OCCUPATIONAL THERAPISTS Lt Col Mary L. Rooney, Naval Medical School, Bethesda, Md., and Nancy O. Brown, Hospital of the University of Pennsylvania, mix materials used for prosthetic devices during course at Walter Reed Army Institute of Research.**

The students were occupational therapists, physical therapists and orthotists. Lectures were given by Col Surindar N. Bhaskar and Lt Col Teruo Matsumoto of WRAIR on polymers used in medicine and dentistry; James T. Hill, research chemical engineer, on reinforced plastics; and Dr. Joseph B. Davis, U.S. Food and Drug Administration.

The lectures were followed by first-hand laboratory experience. Under the direction of Maj Mary H. Yeakel, occupational therapist with the U.S. Army Biomechanical Research Laboratory, an adjunct of WRAIR located at Forest Glenn, Md., students transformed polyurethanes into flexible hand splints and rigid handles. They molded acrylics on pencils for patients who have limited grasp.

The course was devised to give the students a broad understanding of the physical, mechanical and chemical properties of materials used for prosthetic devices. Emphasis was placed upon materials that permit simplified techniques for rapid and effective patient treatment.

Col Mary L. Hamrick, chief of the Army Medical Specialist Corps, presented certificates to the students.

## CE Conducts VE Seminars For Field Office Personnel

Twelve one-week seminars in value engineering will be conducted at Corps of Engineers field offices in the United States and overseas for an 8-month period beginning this month.

Lt Gen William F. Cassidy, Chief of Engineers, said that these sessions, to be conducted by his staff and selected field personnel, will be primarily for Corps personnel unfamiliar with value engineering techniques. Each course will stress the practical application of value engineering principles as a means to reduce construction costs in military and water resource development (civil works) projects.

The seminars will be held in the following locations: Huntington, W. Va., Sept. 23–27; Chicago, Ill., Oct. 21–25; Huntsville, Ala., Nov. 4–8; Vicksburg, Miss., Nov. 18–22; Portland, Ore., Dec. 2–6; Naha, Okinawa, Jan. 6–10; Honolulu, Hawaii, Jan. 13–17; New York, N.Y., Jan. 27–Feb. 7; Sacramento, Calif., Feb. 24–28; Jacksonville, Fla., Mar. 10–14; Fort Worth, Tex., Mar. 24–28; and Omaha, Nebr., Apr. 14–18.

# Error Correcting Codes

**By Dr. John Barkley Rosser**
*Director, Mathematics Research Center, U.S. Army*

No communication system is proof against an occasional garble, which may be due to defective equipment, static, enemy efforts at jamming, etc. A systematic garble, such as transmission of a "w" every time a "t" is sent, would quickly be noticed by the recipient, and would not likely mislead him, though it might cause failure to convey information.

A random garble could be undetected and might result in the recipient being quite misled. Thus if the question is asked whether the colonel has arrived at the outpost and the answer is sent, "He is not here," it would be very bad if it were received as "He is now here," particularly if he were then overdue. If a request were sent for shelling an enemy post and the coordinates of the position were garbled, this could result in the shelling of a friendly post.

Thus it is common to add additional "check" symbols to a message, designed to give an indication if there has been an isolated garble in transmission. A further refinement is to arrange that not only will isolated garbles be indicated, but data will be furnished from which the true message can be reconstituted. Such refinements are called "error correcting codes."

To see how these work, we look in more detail at the communication process. In general, only two kinds of signals can be transmitted. Thus in the original telegraph, only dots and dashes were sent. To make words, each letter was represented by a distinctive sequence of dots and dashes, constituting the well-known Morse code.

In this article, we shall write 0 for a dot and 1 for a dash. Thus each letter or word is represented by a sequence of 0's and 1's, called bits. If there are garbles, 0 may be transmitted as a 1, or vice versa, or a bit may even be obliterated by static or jamming.

We first look at a system for indicating that there has been a garble. The simplest way is to add a "check bit" at the end of the message. A common way to do this is to take the check bit to be 0 if the sequence to be checked has an even number of 1's, and to be 1 otherwise. Thus if there is no error in transmission, the sequence plus its check bit must contain an even number of 1's. If it does not, one can be sure there has been at least one error. Thus if one wishes to send the sequences 01010, 11, 01101101; one would add check bits and send 010100, 1111, 011011011.

If a sequence with a check bit has one bit obliterated in transmission but is otherwise correct, one can readily determine if the bit that was obliterated was a 0 or 1 by counting the number of 1's still intact. If an odd number of bits is changed in transmission, the check bit will not check properly, and the recipient will know there has been an error, but will not know how to correct it. If an even number of bits is changed, there will be no indication of error.

If there is a long sequence, one can break it into shorter sequences, all of the same length (except the last, perhaps), and insert a check bit after each shorter sequence. If the shorter sequences are short enough that occurrence of a single error in a shorter sequence is fairly infrequent, then double errors will be extremely rare. Thus one has reasonable assurance against undetected errors. More elaborate schemes will give better assurance, but it is better to go to schemes which will not only detect errors but will indicate how to correct them.

One way to do this is to send each bit three times. On the receiving end we decode by majority rule. The received sequence is decoded as that bit which occurs two or three times. In this way, we can correct any single error or recover any two obliterations. However, this scheme will make the messages three times as long. If the communication system is congested, as it often is, one simply cannot afford to increase the length of messages generally by a factor of three. Fortunately, there are better methods.

We illustrate with the case of a sequence of eight bits. It will be seen that a similar scheme can be applied to sequences of other lengths. For a very long sequence, it might be advisable to cut it into sequences of eight bits each, and to apply the indicated method to each such shorter sequence.

Arrange the eight bits in two rows of four bits each, like the X's in Figure 1. At the end of each row of X's add a check bit Y for that row. At the bottom of each column of X's add a check bit Z for that column.

*Figure 1*

| | | | | |
|---|---|---|---|---|
| X | X | X | X | Y |
| X | X | X | X | Y |
| Z | Z | Z | Z | |

Consider first the case where the Y's and Z's are transmitted correctly, but one X is in error. Then one can find which row it is in by observing which Y fails to check, and one can find which column it is in by observing which Z fails to check. Thus, suppose that the bits of Figure 1 are as shown in Figure 2. Then one

*Figure 2*

| | | | | |
|---|---|---|---|---|
| 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | |

easily sees that there is an error in the first row and third column, and changes the 0 there to a 1. Detection of the row and column with an error results from use of a form of binary arithmetic, so that an even number of 1's add to 0 and an odd number of 1's add to 1.

If two X's are in error, but the Y's and Z's are transmitted correctly, then one can detect that there are two errors, but one cannot correct

*Figure 3*

| | | | | |
|---|---|---|---|---|
| W | X | X | X | Y |
| X | W | X | X | Y |
| Z | Z | Z | Z | |

*Figure 4*

| | | | | |
|---|---|---|---|---|
| X | W | X | X | Y |
| W | X | X | X | Y |
| Z | Z | Z | Z | |

them. Thus, if the W's in Figure 3 denote erroneous X's, one would know that there are two errors, but would not know which of Figure 3 or Figure 4 represented the true state of affairs.

Turning to the case where some of the Y's or Z's might be in error, we see that every case of a single error among all of the X's, Y's, and Z's could be corrected. A double error in the Y's would be detected, but could not be distinguished from two X errors in the same column. Similarly, a double error in the Z's would be detected, but could not be distinguished from two X errors in the same row.

Finally, we seek a way to detect double errors arising from combinations like one X error and one Y error. For this, we add one more check bit X' which is a check bit for the entire sequence of X's. By observing that it must also be a check bit for the entire sequence of Y's and a check bit for the entire sequence of Z's, the reader can verify that any double error can be detected, including the case where one of the errors is in X'.

In transmission we could send first the X's, then X', then the Y's, and finally the Z's. Thus suppose the message is 01111001. Then we would send 011110011101110.

As noted, this procedure will correct any single error and detect any

double error. Thus, only triple errors or worse would escape undetected, and these should be of extreme rarity unless the transmission were exceedingly bad. In such case, the large number of double errors reported would caution the recipient of danger. This procedure will also recover three obliterations, or simultaneously correct a single error and recover a single obliteration.

This is a better performance than we got by sending each bit three times, since this triple transmission would fail to detect double errors. Moreover, less than doubling the length of the message is now required. Even this can be improved by working with longer sequences. Thus if we have 25 X's, we can arrange them in a square. Then we would have 5 Y's and 5 Z's and an X. Thus the number of check bits would be less than half the number of message bits. However, with a longer message, the likelihood of a triple error (which would go undetected) is considerably greater. Fortunately, still better methods are available.

We illustrate with the case of a sequence of seven bits. It will be seen that the same ideas can be applied to any sequence length $2^m-1$; we are here taking m = 3. If the X's in each

*Figure 5*

(a) (b) (c)

XXXXXXX XXXXXXX XXXXXXX

of Figure 5a, 5b, and 5c represent the bits of our message, then we choose three check bits $Y_a$, $Y_b$, and $Y_c$; $Y_a$ is the check bit for the sequence of bits underlined in Figure 5a, $Y_b$ similarly for Figure 5b, and $Y_c$ similarly for Figure 5c. Thus suppose our message is 1001011. Then $Y_a = 1$, $Y_b = 0$, and $Y_c = 0$.

Now suppose the Y's are correctly transmitted but the message is garbled and arrives as 1001111. If we compare $Y_a$ with the message we see that an error must occur in one of

*Figure 6*

(a) (b) (c)

XXXXXXX XXXXXXX XXXXXXX

the X's underlined in Figure 6a. Similarly, comparison with $Y_b$ will show that the X in error must be one of those underlined in Figure 6b; similarly for $Y_c$ and Figure 6c. However, only one X is underlined in each of Figures 6a, 6b, an 6c, namely the fifth. Indeed, the fifth X was in error, and we correct the message.

A few trials will verify that a single error in the message can always be corrected if the Y's are correctly transmitted. If we also send a check bit Y' for the Y's, then any time there is a single error, one can either be sure the X's are already correct or else the Y's are correct and can safely be used to correct the X's.

If we also send a check bit X' for all the X's, then a careful analysis will show that a double error can always be detected. However, it cannot be corrected, as the following example will show. Suppose the two errors are in the fifth X and in X'. Then X' will check, but $Y_a$ and $Y_c$ will show errors. Suppose that the two errors are in the second and seventh X. Again X' will check but $Y_a$ and $Y_c$ will show errors.

The procedure will also recover three obliterations, or simultaneously correct a single error and recover a single obliteration. However, three or more errors can pass undetected (or else the wrong correction will be made). So this method is an effective as the one given earlier. However, it requires only five check bits for a seven-bit message, whereas the earlier one required seven check bits for an eight-bit message.

If the message contained 15 bits, then we choose four check bits $Y_a$, $Y_b$, $Y_c$, and $Y_d$; $Y_a$ is the check bit for the sequence of bits underlined in Figure 7a, and similarly for the others.

*Figure 7*

(a) XXXXXXXXXXXXXXX

(b) XXXXXXXXXXXXXXX

(c) XXXXXXXXXXXXXXX

(d) XXXXXXXXXXXXXXX

If there is a single error in the X's, but the Y's are correct, then $Y_a$ will tell which half of the message the error occurs in, and then $Y_b$ will tell which half of that half the error occurs in, and so on. Naturally we must add a check bit Y' for the Y's so that we can tell if the error occurs in the X's or Y's when there is a single error. With also a check bit X' for all the X's, one can detect double errors, recover three obliterations, etc. So we need six check bits for a message of 15 bits. Similarly, we would need 7 check bits for a message of 31 bits. This can be contrasted with the former method, which required 11 check bits for a message of 25 bits.

This code agrees in most essential features with one proposed by R. W. Hamming. The original Hamming error-correcting code suggestion involves an additional refinement which in most cases saves one check bit.

We have discussed here only codes for the correction of single errors and in some cases simultaneous detection of double errors. Using powerful tools of algebra and combinatorial analysis, one can construct for any integer t a code which will correct up to t errors.

The Mathematics Research Center, U.S. Army, in Madison, Wis., offers an introductory course of lectures on error-correcting codes in which useful algebraic tools are developed from the very beginning and their application to coding is explained. The lecture notes for these lectures are available for the asking. Persons interested in these orientation lectures should contact Henry B. Mann, Mathematics Research Center, U.S. Army, University of Wisconsin, Madison, Wis. 53706.

## Mobile Calibration Service Provided by USAEPG Van

Mobile calibration service for electronic test and measuring equipment at the U.S. Army Electronic Proving Ground (USAEPG) was initiated in August when a $250,000 semitrailer began operations at Gila Bend, Ariz.

Designed and operated by the USAEPG Standards and Calibration Branch, the new facility is intended for use at locations where there is a high density of equipment, such as the Systems Test Facility and the Electromagnetic Environmental Test Facility.

The transfer standards and other equipment in the van will permit the handling of more than 85 percent of the calibration requirements at such sites as Fort Huachuca, Ariz., Oatman Mountain (near Gila Bend) and Yuma, Ariz. A considerable saving of manhours will result since it no longer will be necessary to transport equipment requiring fine calibration to a fixed calibration facility.

## Natick Microbiologist Elected President of SIM for 1969–70

Morris R. Rogers, a microbiologist at the U.S. Army Natick (Mass.) Laboratories, recently became president-elect of the Society for Industrial Microbiology (S.I.M.) for the 1969–70 term.

A member of the Applied Microbiology Group, Pioneering Research Laboratory, at Natick, he received his BS degree from Syracuse University in 1950 and an MA degree from Hofstra University in 1952.

The Society was founded in 1949 for the professional advancement of microbiological services as applied to industrial materials and processes. It promotes the exchange of scientific information and serves as a liaison between special fields of microbiology.

Incorporated in 1960, the S.I.M. is an adherent society of The American Institute of Biological Sciences and an affiliate of The American Association for the Advancement of Science.

# Dawalt Discusses International Military R&D

(*Continued from page 2*)

Transport Vehicles, and The Main Battle Tank. The terms of reference of all of these panels call for the exchange of information with the goal of identifying potential cooperative R&D projects.

Further, there is a special cooperative agreement among the English-speaking countries which is referred to as the ABCA (American, British, Canadian, Australian) Armies Standardization Program. Through this agreement, the participating armies seek to identify common military requirements and to promote the development of both materiel and nonmateriel standardization, thereby enhancing the interoperability of the four forces.

Figure 1 illustrates the quadripartite organization designed to make the program work. The rather extensive lists of working groups illustrate the broad scope of the total program as well as the specific areas of specialization. Although none of these working groups is exclusively concerned with military vehicles, I think that you can recognize that several would be involved to varying degrees in vehicular development for special purposes, e.g., Armored Equipment and Field Engineering Equipment.

These groups meet periodically to hammer out the details of coordinating equipment standardization at the various stages in the development process. To assist in keeping track of standardization efforts, equipments offered by any one of the four countries for possible standardization are entered on standardization lists, containing over 500 items.

Through the medium of these lists, each country can follow the item through the several stages in the development process, from proposed military requirement through type classification, and can comment at each stage so that it has the opportunity to influence the development. Mutual interest may range from none to complete collaboration.

Another Quadripartite organization is The Technical Cooperation Program (TTCP), which is a tri-service, defense-level program also among the Americans, British, Canadians and Australians. The objective of this program is to exchange scientific and technological information and to identify potential international cooperative R&D projects. It is primarily research-oriented, in contrast to the ABCA Armies Standardization Program which is largely hardware-oriented.

Figure 2 lists the subgroups in the TTCP and, as you can see, they address a great variety of specialized subjects. Each of the subgroups is broken down further into several working panels which address specific facets of the subject. For example, Subgroup P on Materials has the following working panels: P–1, Metals; P–2, Inorganic, Nonmetallic Materials; P–3, Organic Materials; P–4, Methods of Test and Evaluation.

Matters relevant to vehicle development might cut across several of these functionalized groups. A new Subgroup on Ground Mobility is being organized which will explore the vehicular environment in depth.

The objectives of the Data Exchange Agreement (DEA) program are to enhance world security by creating closer alliances; to marshall the technological capabilities of the U.S. and participating nations; to reduce costs and duplication and to promote international standardization.

The DEA program, as originally conceived, had the goal of assisting friendly foreign nations to build up their R&D technological base. It has since been reoriented to a truly mutual program of R&D exchange. This exchange provides a method and an impetus to the identification of possible cooperative R&D projects—either bilaterally or in the NATO arena.

At present, there are approximately 200 DEAs with 15 different countries. Examples of DEAs of particular interest to this group are: Lightweight Vehicles with Australia; Armored Vehicles and Ground Loco-

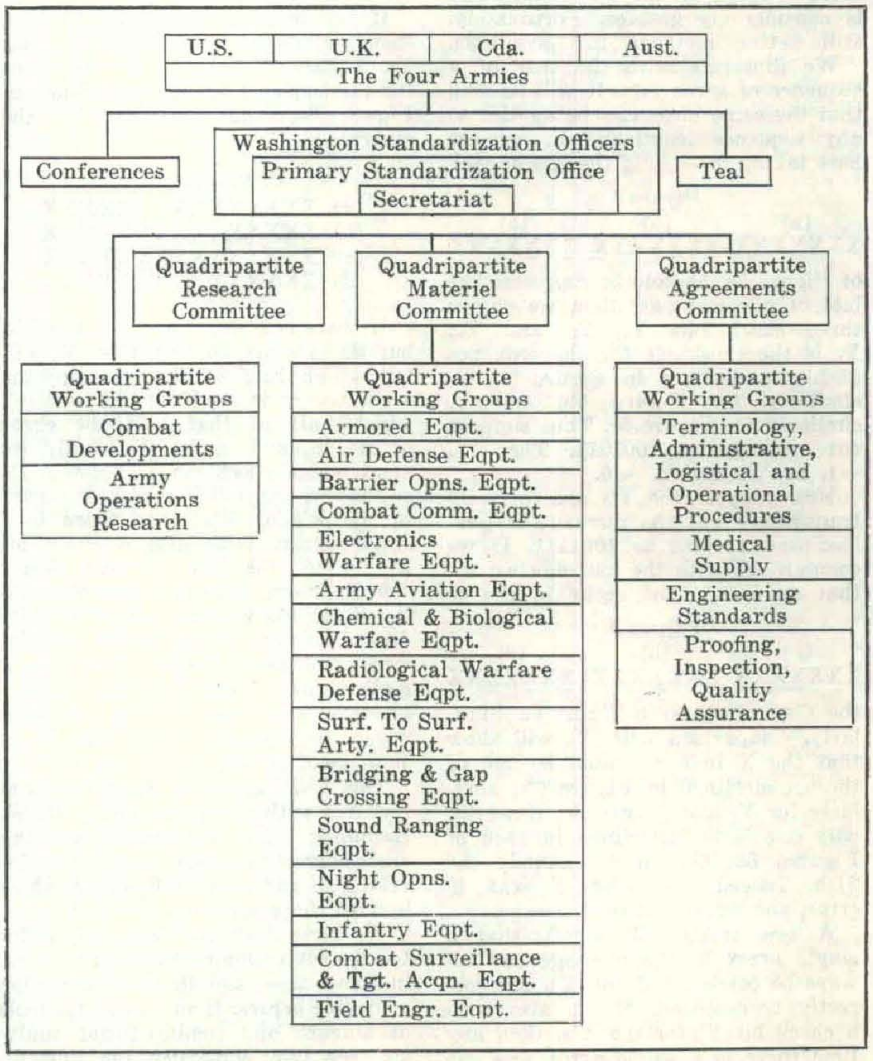



**Figure 1. Quadripartite Organization.**

motion with France; Vehicle Gas Turbines, Multifuel Engines, Land Locomotion, Armored Vehicles with Germany, and many others.

Although difficult to document, it has been estimated that the DEA program has contributed to U.S. sales totaling over $600 million.

Bilateral cooperative R&D arrangements are in effect with several countries, including the United Kingdom, Germany, France, Canada and Italy. The most significant project to come under the aegis of a bilateral agreement is the US/FRG Main Battle Tank program. . . .

A particularly interesting bilateral cooperative R&D agreement, typifying the close relationship of the two countries, is the U.S.-Canadian Defense Development-Sharing Program.

Canada must perforce buy much of her military equipment from the United States. To offset an unfavorable balance of trade and promote a home grown industrial capacity, she seeks to share in the development (and production) of U.S. military equipment. In turn, we are happy to encourage the expansion of the Canadian defense industrial base available to us and share the high cost of development with her. For a joint U.S.-Canadian project, the U.S. will fund at least 25 percent and Canada the rest. Canadian prime contractors perform the work; but the U.S. retains design authority.

One of the more significant projects under the U.S.-Canadian Defense Development-Sharing Program is the XM 571. This is a composite vehicle consisting of a full-tracked utility carrier and an articulated full-tracked utility trailer, both of which are powered when coupled. It has a one-ton payload capacity and is helicopter transportable.

Joint development was agreed to in 1961. Canada funded the basic development of the XM 571, and the U.S. funded the advanced production engineering. Canadair Limited is the prime contractor. . . .

The XM 571 is going into limited production with confirmatory testing in the offing before a decision is made on type classification as standard A. Naturally, with considerable investment already committed, Canada is anxious to have the XM 571 join our inventory, both because it would lead to production possibilities and because only in this way could Canada economically purchase the XM 571 for its own forces.

One U.S.-Canadian project that has been successfully completed without a hitch is the development of a lightweight towed launcher for the Lance missile. Although basically a Development-Sharing project, this deviated somewhat, in that an agreement was made between the two countries to permit a Canadian firm (Hawker-Siddleley, now Orenda, Limited) to develop the launcher acting as subcontractor to Ling-Temco-Vought, the U.S. Lance prime contractor.

The course of international cooperative R&D is not always so smooth, however. Some potentially worthwhile joint projects have difficulty getting off the ground despite the best of intentions. For example, each of the ABCA countries has a requirement for an armored reconnaissance scout vehicle (ARSV). You would think we might work something up together under the ABCA Armies Standardization Program. It was attempted, but the national requirements were too dissimilar.

Canada and the United States then thought they might jointly develop an ARSV under the Defense Development-Sharing Program. Canada went to considerable expense to lay the groundwork, but the Canadian proposal did not fit U.S. requirements. Apparently the United States and Canada will now go their separate ways on development.

We must recognize that military vehicles development on an international scale offers limited promise. Each of the industrial nations with which we have cooperative R&D arrangements has a highly developed and competitive automotive industry. While each of the countries may have similar requirements, it just does not make political or business sense for one country to let another country develop and produce military vehicles when it has its own industrial competence and capability to do so. Of course there are some exceptions, such as the Canadian-developed XM 571, but this is a special-purpose vehicle which will be produced in limited quantities.

Perhaps a couple of examples will illustrate the difficulties. We have a requirement for a mechanized infantry combat vehicle (MICV) as do several other allied countries. The United States and the United Kingdom each has a highly developed competence in this field and each wishes to retain its expertise.

Besides, the production and sale of a MICV to other countries will help national balance of payments problems. Thus, neither the United States nor the United Kingdom is willing to forfeit to the other the opportunity to make these sales. We are not willing to rely on a British source of supply for an item that our own industry can produce at least as well. Thus, it appears that although we have a similar requirement, the United States and the United Kingdom will develop and produce competing vehicles. . . .

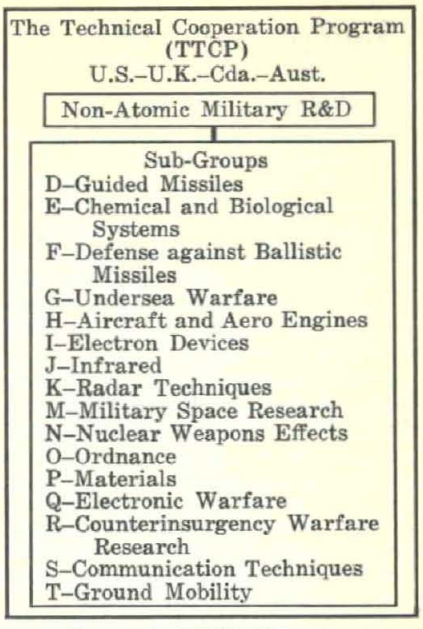



**Figure 2. TTCP Subgroups**

When we turn from special-purpose combat vehicles to the utility class of tactical support vehicles, the propensity to indulge is a variety of differing shapes and sizes makes standardization extremely difficult. In the 1½-ton category, for instance, the U.S. is considering a sophisticated and expensive off-road articulated carrier called the "Gama Goat." The XM 705 is supposed to complement the Gama Goat in that it is a relatively cheap box on wheels designed for road travel.

In contrast, Canada is interested in developing a single vehicle, the RAM, which will combine features of both U.S. vehicles.

Another example of problems encountered in international R&D is to be found in the difficulty the United States and the United Kingdom seem to be having in agreeing to a modest joint program in fuel cell research, an area with application to combat and tactical vehicles. The matter at issue concerns proprietary rights. It is the policy of the United States that both parties to an international R&D agreement should give over to each other, free of any royalty charges, information growing out of the joint work when that information is used for defense purposes.

Counter to this policy is the British view that such information—called foreground information—be furnished the other country at fair

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# Dawalt Discusses International Military R&D

(*Continued from page 33*)

and reasonable cost. These opposed positions go right to the heart of the differing government-industry relationships of the two countries, and hence are not easily resolved. The problem cuts across other potential R&D joint projects than fuel cells, of course, so the two countries are trying to find a way out of the dilemma.

I have not mentioned specific aspects of these exchange programs, other than to point out the very real advantage of trying to attain uniformity and commonality of equipment and materiel with our Allies, as well as the political advantage of keeping these governments and their military components favorably disposed toward the United States.

How successful we have been is certainly a question argued frequently by the Congress, the press, and the man in industry. However, I would like to point out that there are certain tangible advantages.

First off, in the case of the MBT-70 program, the probability is rather strong that the Army would have difficulty funding a new tank program at this time were it not for the international interest.

Secondly, while costs of the MBT-70 program have exceeded our original estimates, the cost to the U.S. taxpayer is lessened considerably by the German contribution. A similar case can be made for the other programs.

Now, let us pull out a crystal ball and gaze into the future. What do we in the Office of the Chief of Research and Development see as the trend for international cooperative R&D, particularly in the light of gold-flow problems, mounting resentment in certain quarters of the press and the public toward the lack of support of Vietnam policy and operations by certain of our Allies?

I believe that we will continue to engage in international cooperative R&D. I certainly believe the exchange type programs will continue at about the same level. As to actual cooperative development programs, I would expect here, too, that we will from time to time, enter into a program of this nature.

For example, there is interest in some quarters to enter into such an agreement with the Germans for the development of a new tactical Multiple Artillery Rocket System called MARS. However, it is too early to say whether such a cooperative effort, let alone MARS itself, will come to pass.

However, I do not see such international cooperation as a threat to American industry, primarily because I believe the programs that will be funded under such agreements will be those that would be difficult for the Army to include in its programs unilaterally.

Gentlemen: It is a pleasure to be with you today and to have the opportunity to describe for you the Army International R&D Program and the environment in which it operates. As you think about what I said perhaps you will see a relationship between my operation and a Turkish philosopher who was discovered one day throwing spoonfuls of yeast upon a lake. The villagers asked what he thought he was doing.

"I'm trying to turn a lake of water into a lake of yoghurt," said the old man. . . . "But Hodja, that's impossible," they cried.

"I know, I know," he replied. "But just suppose it *takes*."

# Picatinny Science Analyst Authors Plate Formulas Book

*Plate Formulas*, a book designed to help practicing engineers do "a good, fast job," is the latest work of William Griffel, physical science analyst of Picatinny Arsenal, Dover, N.J.

Described by the *Army R&D Newsmagazine* more than a year ago as "one of the most prolific freelance writers employed by the U.S. Army," Griffel now has to his credit more than 125 published technical articles.

His first book on formulas for stress and strain was published in 1966 by the New York house, Frederick Ungar Co., and he is a contributing editor for six professional journals in the U.S. and abroad.

*Plate Formulas* contains 139 tabulated cases typically encountered in design. It has a series of tables containing computed data for use in design of structure components which can be idealized as flat, circular, rectangular, square, triangular and elliptical plates.

Polish-born Griffel has been with Picatinny since 1959 and is a recognized authority on strength of materials. He became a U.S. citizen in 1945 after studying at the Lwow, Poland, College of Engineering, and graduating from the College of Engineering, Toulouse, France.

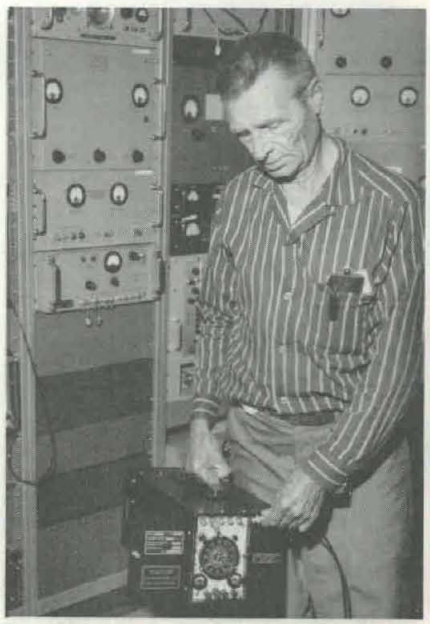
## Solid Propellant Additive Increases Rate of Burning

Recent discovery of a new class of solid-propellant additives may open the way to major improvements in certain Army missile systems.

The discovery was the result of R&D in the Gorgas Laboratory, U.S. Government-owned and contractor-operated (Kohm and Haas Co.), under direction of the Propulsion Laboratory, HQ Army Missile Command, Redstone (Ala.) Arsenal.

The burning rate of solid-rocket propellants can be increased to as much as three times present rates with the new additives, permitting the development of missiles with greater acceleration and corresponding shorter response. Simplified motor designs also will be possible.

The new burning-rate accelerators are effective in all types of solid propellants currently in use, do not significantly affect the propellant's sensitivity to shock, spark or friction, and can be used in future missiles to provide higher velocity without increase in weight.



**ATOMIC CLOCKS aren't yet down to wristwatch size, but they're getting smaller. This rugged, portable model, which measures 7 by 7 by 16 inches, relies on the natural resonance (or "tick") of rubidium to operate with a stability equal to loss or gain of a single second every 3,000 years. Developed by the Army Electronics Command, Fort Monmouth, N.J., it can split seconds into millionths, is more compact, lighter and even more stable than an earlier model. The development contractor was General Technology Corp.**

# New AMC Color-Marking System Traces Origin to World War II

Army Materiel Command development of a refined color-marking system, plus silhouette labels for crated materiel, has broken the language barrier in Southeast Asia with a sure way to deliver supplies to U.S. Armed Forces.

Native stevedores in South Vietnam, trained to use the new coded color pocket guides, have little cause to get a vital shipment mixed so that the basic item reaches the user without correct appurtenances.

Color and special shipping markings date back to World War II. With the 1962 Army reorganization, the system was discontinued because little need for it existed during peacetime operations. The Southeast Asia buildup required a marking plan to expedite flow of materials.

Establishment of an interim procedure for color-marking Army supplies was accompanied by a Department of the Army test in mid-1965. The need for additional marking was realized, and a more comprehensive test was developed by the AMC HQ Transportation Directorate and the AMC Packaging, Storage and Transportability Center (AMCPSTC) at Tobyhanna Army Depot, Pa.

General Frank S. Besson Jr., Army Materiel Command CG, has termed color marking "an indispensable logistics tool that has materially contributed to increasing speed and efficiency with which materiel has been handled and moved through the . . . physical distribution system" in the United States and Southeast Asia.

The general considers color-coding a relatively inexpensive way to facilitate positive identification and expeditious handling of materiel and cargo, whether it is shipped in support of troop deployments, automatic resupply or requisitioned.

Conduct of the U. S. military logistics operation in South Vietnam is dependent to a large degree upon the use of military personnel with limited training and unskilled and untrained Vietnamese Nationals. They are unfamiliar with the highly complex, diverse and sophisticated military standard systems which govern field logistic support operations.

General Besson in November 1966 authorized project managers to go beyond the established color and symbol label requirements and to use materiel silhouettes. The M16 rifle, CH–54, fork lifts and other materiel-handling equipment are now depicted on containers in unmistakable form.

Army Materiel Command monitor for silhouettes is the AMCPSTC which requires project managers to submit exact samples for approval to assure standardization of size, quantity and placement of the labels.

| CARD COLUMN 55 | CATEGORY | REPAIR PARTS SYMBOLS | CORNER COLORS |
|---|---|---|---|
| A | TANK-AUTOMOTIVE |  | YELLOW |
| B | ELECTRONICS | | ORANGE |
| C | CONST & MHE | | RED |
| D | RAIL & MARINE | | RED |
| E | WEAPONS | | YELLOW |
| F | GENERAL SUPPLIES | | GREEN |
| G | PX | | BLACK |
| H | CLOTHING & TEXTILES |  | GREEN |
| J | PUB. - PRINT. MAT. - STA'ERY | | WHITE |
| K | AIRCRAFT COMPONENTS/AVIONICS |  * | BLUE |
| L | AIRCRAFT COMPONENTS/AVIONICS |  ** | BLUE |
| M | MISSILE | | YELLOW |
| N | MEDICAL | | MAROON |
| P | DEVELOPMENTAL ITEMS | | GRAY & BLUE |

The color-code requirements are not applicable to ammunition, troop subsistence and petroleum products which retain the WWII symbols of the red shell, the crescent and funnel.

Basically the color-marking system is between "priority markings" and "category markings."

Within priority one is the Red Ball Express—the Army's highest airlift priority from the U. S. to Vietnam, the modern-day counterpart to the World War II "Express" by ground to front-line positions. Next is Code 999, "super worldwide" air priority of the Department of Defense.

Red Ball—which can also handle Code 999—has the obvious code letters "R E D," a 3-inch red ball inside a 4-inch white circle with "RED" in white letters inside each red ball. Accompanying forms and the red ball labels are applied on each end, each side and on top of every Red Ball container.

Priority two features the blue motif on the DoD shipping form. This priority is shipped by air whenever possible but may go by ship when the Military Airlift Command is at peak.

Project Codes—not priorities as such—are labels that tell the dockside or airfield workers at the receiving end which boxes should be "married up." Thus, all the scattered segments of a particular project are assembled for delivery. Each container is categorized with bold black letters in four white discs on the sides, top and marked end.

Commodity Category Markings use color and symbols. Tank-automotive materiel is identified with a black triangle in yellow rectangle; electronics with a "bolt of lightning" in a field of orange. Each person at the receiving end, Vietnamese or U. S. soldier, has a ready-reference category card—in color—so there can be no mistake.

Color corners of containers tell the general category; additional symbols, such as the lightning label, denote parts for electronic devices.

On the reusable CONEX (container express), the exterior is color-coded if all of the contents are of one category; if more than one category is contained, only the interior cases are marked.

With all the innovations in colors, category markings, priority designations, the logistics of the Army still follow standard procedures such as MILSTAMP (military standard transportation and movement) and MILSTRIP (military standard requisitioning and issue).

The complexities of the color-coding and silhouette systems are spelled out concisely in AMC regulations and in training manuals—printed in English and Vietnamese. Courses are given to U. S. soldiers and Vietnamese in Hawaii, Okinawa and several locales in South Vietnam.

Designers of the color and marking systems agree that there may be a problem if the cargo handler at the other end is color blind—but several years of efficient movement of materiel to the allied warriors in Vietnam indicate this is a remote possibility.

# R&D Leaders Address MERDC Reserve Seminar

Tribute to the professional capabilities and dedication of officers enrolled in the Army Reserve R&D Unit Program was sounded by top-ranking Army leaders at the 11th annual R&D Symposium for Reserve Officers, Sept. 15–28, Army Mobility Equipment R&D Center, Fort Belvoir, Va.

Centered on the theme of "Research, Development, Testing and Evaluation (RDT&E) for Southeast Asia," the symposium was planned and conducted by members of the 1621st Reserve Unit at the MERDC.

The purpose was to acquaint participants with the latest engineering developments, problem areas, and possible contributions the Reserve Unit members might make to the solution of some problems.

Presentations also covered the Department of Defense and the Army RDT&E program as a whole, and the missions of various R&D agencies.

Army Chief of R&D Lt Gen Austin W. Betts discussed the Army RDT&E Program in general, pointing to many of the recent significant achievements in meeting materiel requirements for Southeast Asia and explaining various priority efforts.

Army Materiel Command Deputy and Director of Laboratories, Dr. Jay Tol Thomas, reviewed many of the contributions AMC R&D in-house laboratories are making to the more critical materiel requirements for the Southeast Asia conflict. Maj Gen R. H. Free, AMC Director of Development, also gave one of the major presentations.

Howard P. Gates Jr., special assistant for electronics, Office of the Assistant Secretary of the Army (R&D), discussed "Management of the Army RDT&E Program." Assistant Director of Army Research Col William J. Lynch spoke on the basic research program.

Lt Gen William F. Cassidy, Chief of Engineers, explained the scope of the Corps of Engineers' R&D Program, and Col R. L. Ednie of the Military Construction Directorate, OCE, discussed the Nuclear Power Program.

"Management of Department of Defense Research and Engineering" was the topic of Col George A. Lutz, military assistant to the Deputy Director of Defense Research and Engineering (Southeast Asia Matters).

Maj Gen Charles C. Case, commanding general, detailed many of the functions and operations of the Mobility Equipment Command. Maj Gen A. W. Oberbeck, CG of Fort Belvoir, and Col Edwin T. O'Donnel, commander of the Mobility Equipment R&D Center, joined in welcoming the conferees.

U.S. Army Combat Developments Command functions and relationship to R&D activities were discussed by Lt Col J. W. Ryan, chief, Research and Industrial Liaison. U.S. Army Limited War Laboratories Commander Col Robert W. McEvoy reviewed many of the LWL responses to high-priority requirements in Southeast Asia and the general operations of the LWL.

Others speakers included Mrs. Sally Clements, special assistant, Project Management, Army Materiel Command; J. P. Sale and Lt Col Lawrence Russell, Topographic and Military Engineering Directorate, Office, Chief of Engineers (OCE); W. E. Grabau and W. G. Shockley, Corps of Engineers Waterways Experiment Station; and Lt Col R. E. Cox, Construction Engineering Research Laboratory, OCE.

# 6 DoD Employees Receive DSC Awards

Army prosthetics expert Dr. Fred Leonard was among six employes who recently received Department of Defense (DoD) Distinguished Civilian Service Awards, the highest honor that may be bestowed upon civilian employes by the Secretary of Defense.

Deputy Secretary of Defense Paul H. Nitze presented the awards during ceremonies at the Pentagon. The annual affair honors six employees whose careers reflect "exceptional devotion to duty and extremely significant contributions of broad scope to the efficiency, economy or other improvement in DoD operations."

Dr. Leonard, scientific director, U.S. Army Medical Biomechanical Research Laboratory, Walter Reed Medical Center, Washington, D.C., received the award for his outstanding leadership of a highly successful research and development program which has led to major improvements in amputee prosthetics.

His "energetic and devoted efforts have resulted in a tissue adhesive and hemostatic agent which is saving the lives of severely wounded men, in the development of better materials for facial and hand prostheses, and in major breakthroughs in use of electro-mechanical devices."

Dr. Leonard has been associated with the laboratory since 1948.

Dr. Nils F. Wikner

Dr. Nils F. Wikner, deputy director for Science and Technology, Defense Atomic Support Agency (DASA), DoD, received the award in recognition of his exceptional contributions to the DoD nuclear effects research and test programs.

His "eminent scientific talent and dynamic leadership have resulted in a highly significant and accelerated underground test program, in development of advanced theoretical and simulation techniques and in a greatly improved readiness-to-test program."

Dr. Wikner has been with DASA since 1965. Formerly he was employed in private industry as a physicist, working in the fields of nuclear reactors and effects of nuclear explosions on ballistic missile systems.

Other recipients of the awards are: Donald F. Bradford, Director of Economic Adjustment, DoD; Harry W. Poole, Director for Construction, Office of the Assistant Secretary of Defense (Comptroller), DoD; Henry A. O'Neal, Director of the Ocean Science and Technology Group, Office of Naval Research, Department of the Navy; and Philip F. Hilbert, Deputy Under Secretary of the Air Force.

**DEPUTY SECRETARY OF DEFENSE Paul H. Nitze congratulates Dr. Fred Leonard after presenting him the DoD Distinguished Civilian Service Award.**



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