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Natick Labs Dedicate $3 Million Institute of Environmental Study

Research credited with saving more than 12,000 lives in Vietnam last year is the mission of the U.S. Army Institute of Environmental Medicine (USARIEM), which occupies a new $3 million laboratory dedicated Oct. 17 at the Natick (Mass.) Laboratories.

Chief of Research and Development Lt Gen Austin W. Betts, among some 400 prominent scientists, statesmen and generals present for the occasion, said that environmental research performed by USARIEM produced medical and physiological knowledge that in 1967–68 saved more than a division in Vietnam.

The mission statement of USARIEM is:

"Conducts basic and applied research to determine how heat, cold, high terrestrial altitude, and work affect the soldier's life processes, his performance, and his health.

"The goal is to understand the complex effects of climatic stresses on the human body, the body's defenses, and the techniques, equipment, and procedures best calculated to make the soldier operationally effective to an optimal degree and give him optimum environmental protection."

Staffed with about 200 employes, 140 of whom are civilians, including some 50 investigators at the doctorate level, USARIEM conducts a broad spectrum of environmental research activities. Studies range from the

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Advanced Materiel Concepts Agency Links With ILC, ITAG in 'Troika' Relationship

Ideas generating alternative systems and concepts of materiel that will impact upon future U.S. Army combat effectiveness are being formulated by the Advanced Materiel Concepts Agency (AMCA) with the Institute of Land Combat (ILC) and Intelligence Threat Analysis Group (ITAG).

Working relations of this recently established "troika" actually are representative of the Army Materiel Command through the AMCA, the Army Combat Developments Command through the ILC and the Army Assistant Chief of Staff for Intelligence through ITAG. Many months of organizational effort have developed the relationship to an effective functional basis.

The first of a series of quarterly meetings is scheduled this month involving General Frank S. Besson Jr., CG of the Materiel Command, Lt Gen Harry W. O. Kinnard, CG of the Combat Developments Command, and Maj Gen Joseph A. McChristian, Assistant Chief of Staff for Intelligence. Their purpose is to review planning activities and coordinate implementation of combat effectiveness ideas associated with the Army of the 1985–95 period.

Established in separate facilities at present, the AMCA, an ILC element and an ITAG element will be collocated as soon as possible in the

(*Continued on page 3*)

Edgewood Arsenal Adds $4.1 Million Laboratory

Development of Edgewood (Md.) Arsenal as a major Army research center was furthered by dedication of a $4.1 million clinical research laboratory building Oct. 16—the third important facility added within the past year.

The General John R. Wood Building contains 62 mission laboratories, 78 support labs, 2 offices and a 200-man conference room. Col Paul R. Cerar, Edgewood Arsenal commander, commented that the new facility "will give added scope to the Army's capabilities in the increasingly

(*Continued on page 4*)

Featured in This Issue . . .

U.S. Army Institute of Environmental Medicine

Harry Diamond Labs Stage 15th Anniversary Program

Ceremonies commemorating the 15th anniversary of the Harry Diamond Laboratories, Washington, D.C., were highlighted recently by participation of General Frank S. Besson Jr., CG of the Army Materiel Command, and other U.S. Government dignitaries.

General Besson presented the newest Department of Defense award, the U.S. Government Civilian Award for Service in Vietnam, to Paul E. Landis, chief of HDL Lab 900, and Clyde D. Hardin, chief of Lab 400, accompanied by letters from Army Chief of Staff General William C. Westmoreland.

The letters were written by General Westmoreland in June when he was CG of the U.S. Military Assistance Command, Vietnam (MACV), in rec-

new Hoffman Complex in Southeast

(*Continued on page 6*)

Army R&D Newsmagazine

Vol. 9 No. 10 November 1968

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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Army Support of Research in Universities

Chief of Research and Development Lt Gen Austin W. Betts, speaking recently to the Armed Forces Communications-Electronics Association in Washington, D.C., emphasized his belief that a strong military-academic basic research program is vital to national security and economic welfare. His appeal for Department of Defense substantial funding of academic research follows:

★ ★ ★

When I agreed to speak to you today on the support of research in universities, I must confess that I had an ulterior motive. Very simply, I thought that this would be a good forum to expound on what is becoming, unfortunately, a somewhat controversial subject. I say "unfortunately" advisedly. In my judgment, the national interest will be seriously damaged if the excellent cooperation that now exists between the Department of Defense and the research community in universities is interrupted for any reason.

As people in favor of a strong military research and development program, you should be seriously concerned about what is happening. In fact, I think you really should make it your business to become involved. Most of you have entree to the academic community, and you have an understanding of the problem that the general public will never have. What is more, you have a personal stake in a strong Defense R&D program, or you wouldn't be here today.

Here is the situation, as it has been reported. A recent magazine article talked about what the editors called a Pentagon "crisis." The theme was the alleged pull-out of the academic community from defense-supported research.

The article purports to show that growing manifestations of the student-faculty resistance to military research . . . resulted in attempts on many campuses to head off future turmoil by withdrawing from classified and military research . . . that many college administrators believe the turmoil created by these student demonstrations far outweighs the monetary gains to the university consequent to military support of research.

Now, I personally disagree with much of this thesis, because I do not believe that universities seek defense support of research for monetary gains. Rather, I believe the academic community must recognize as we do, that extensive military participation in research is absolutely necessary if we in the Defense Department are to stay abreast of advances in technology relevant to military needs.

The Congress entrusts the Department of Defense with vast sums for the development of new equipment and weapon systems. The taxpayer has every reason to expect that the best and most advanced technology will be applied to our development efforts. Our military posture depends on it.

Of course, I do not recognize that there have been significant recent trends toward some university disenchantment with the Department of Defense as a source of funds for support of research programs. While I do not believe that the extent of this trend is great enough to cause panic, the trend is certainly evident.

As far as the Army program for support of research is involved, I am personally convinced that it is vital to reverse this trend. I say this because it should certainly be clear to anyone who is familiar with Army programs for research development or procurement of new weapons and equipment, that we in the Army must be technologically competent in these matters.

Many of you will recall that the Bell Report on operation of government research laboratories made this point very clear. That report was made to the President in April 1962. Among other things, it reached four important conclusions:

- The Department of Defense is the biggest customer of technology in the country.
- It must, therefore, be an independent buyer of technology.
- To be an intelligent buyer, it must be technically competent.
- To be technically competent, it must do in-house work, including basic research.

Therefore, it follows that the Army must do in-house basic research, yet the bulk of basic research in this country is done in our universities. This is appropriate. Logically, in order to avoid doing basic research that unnecessarily duplicates that of the universities—in fact, to be sure that our research leads to a really important advance in technology—we must establish a mechanism for detailed interchange of information between our in-house research effort and that of our universities.

There is no better way to encourage

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Advanced Materiel Concepts Agency Links With ILC, ITAG

(*Continued from page 1*)

Alexandria, Va., to enhance operations of their interrelated missions. Scheduled for completion next spring, the building they will share is near Telegraph Road and the 495 Beltway.

The AMCA was located initially in the Dwyer Building on Duke Street in Alexandria during the preliminary organizational planning phase. Personnel additions necessitated a move in September 1968 to more spacious accommodations in the Nassif Building on Columbia Pike near Baileys Cross Roads, Va.

Col Normal L. Hall, a veteran Corps of Engineers officer who formerly served as deputy chief of the Environmental Sciences Division of the Army Research Office, is commander and deputy director of AMCA. He has guided the organization since he was detailed in August 1967 to the task of drafting its structure and methods of operation.

Emphasis in selection of AMCA personnel is on quality and those "on board' are representative of an extensive screening process. The authorized staff is 83 civilians, 56 in the highly skilled professional category, and 19 officers.

The challenge of AMCAs mission as a "think tank, patterned somewhat along the lines of a number of nationally known contract agencies, with stress on the opportunity and freedom to generate and develop new ideas, is helping to draw top talent from industrial, academic and private research institutions. Recruitment of all except four supergrade scientists is expected to be completed by Dec. 31.

Missions and major functions of the AMCA are prescribed in Army Materiel Command Regulation 10–82, dated July 17, 1968. Col Norman Farrell, commander of the ILC, has furnished a list of functional objectives to the AMCA. Generally. the list provides basic operational tasks or goals visualized for the Army during the 1885–95 period.

As part of its working agreement with the ILC and ITAG, the AMCA will provide alternative materiel systems and concepts geared to accomplish the functional objectives within the state-of-the-art. As spelled out in the memorandum of understanding with the ILC, the AMCA "will identify the systems and current technology as contrasted to conjectured systems or concepts not based on currently conceived techniques.

The AMCA, as set forth in the memorandum, will "stimulate the production of materiel concepts by exploiting the potential of science and technology unrestrained by current doctrine.' This, in turn, may lead to new or changed military doctrine, tactics and organization.

In developing the materiel concepts, the AMCA approach is to maintain close working relationships with representatives of all Army in-house laboratories. Periodic meetings, a number of which have been held to date, will be directed to discussion of objectives, concepts and implementation.

AMCA key personnel recently conducted a briefing of the overall plan on AMCA functions and relations with in-house laboratories. Representatives attended from all of the Materiel Commands major subordinate commands and central laboratories, as well as representatives and top officials of the Office of the Chief of Engineers, Office of The Surgeon General of the Army, the ILC and the ITAG.

Actually, Col Hall told an *Army R&D Newsmagaine* reporter, the in-house laboratories "furnish the deep thinking. The AMCA puts these ideas

(*Continued on page 4*)

Frankford Arsenal Picks First Tech Director

Selection of Dr. Sidney Ross, 42, as the first technical director of Frankford Arsenal's research and engineering activities was announced this month by Col Eugene C. Barbero, commander of the 152-year-old installation.

The new position substantially expanding the responsibility and authority formerly vested in the chief scientist, has been vacant for about a year during an intensive search for a man with the desired qualifications.

Dr. Ross became a research scientist in the installation's Pitman-Dunn Laboratories in 1948 and since 1966 has served as director, Applied Science Laboratory.

Graduated from Pennsylvania State University with a BS degree in physics, he earned an MS degree in physics from the University of Pennsylvania and a PhD from Temple University—the latter two degrees under the Frankford Arsenal Graduate Training Program.

Dr. Ross has been formulating, implementing, and directing an interdisciplinary optical materials program incorporating research activities in the Physics, Chemistry and Metallurgy Laboratories. He also is concentrating effort toward the enlargement of the Frankford Arsenal laser research program to embrace high-powered systems and such advanced concepts as nonlinear optic absorbers, electro-acoustic interactions and doped composite materials.

Dr. Ross has served lately as director of the U.S. Army Laser Countermeasure Program and on various Department of Defense and Department of Army working groups. He is chairman of the U.S. Army Materiel Command Laser Advisory Group working on countermeasures and is U.S. Chairman for Countermeasure and Sensors, United States-United Kingdom Cooperative Laser Research Program.

He also is serving on the Greater Philadelphia Chamber of Commerce Research and Development Committee of the Commerce and Industry Council and the University City Science High School Task Force.

Dr. Sidney Ross

Dr. Ross is credited with notable contributions to recoilless and aircraft weapons systems, small arms Salvo ammunition, an in-line gas launcher, development of a generalized technique for ball propellants and a method for standardization of pressure measurements in ballistic systems. He is the author of numerous technical publications.

A member of Sigma-Pi-Sigma (National Physics Honor Society), he also is affiliated with the American Institute of Physics, Research Society of America, Physics Club of Philadelphia, Optical Society of America, and the Plasma Physics Division of the American Physical Society.

Currently the Army liaison representative to the Ceramics Section of the American Ordnance Association, he is listed in *American Men of Science, Who's Who in Commerce and Industry*, and *Who's Who in the East.*

AMCA Operates in 'Troika' Relationship

(*Continued from page 3*)

together and explores other new areas as part of the long-term planning by the use of special study groups and ad hoc groups."

Operational procedures of the AMCA also provide for extensive use of consultants recognized as national leaders for capabilities in fields of special scientific effort.

Typical of the consultative skills being recruited to inform and advise the study groups, for example, are Dr. Leland Strom, head of the Delex Corp. in McLean, Va.; Dr. Richard E. Stone, professor and head of the Department of Geology at the University of Southern California (Los Angeles); Dr. John A. Uman of the R&D Center of Westinghouse Electric Corp.; and Dr. William A. Ellet of Northrup Corp. All have recently served with the AMCA.

Dr. Peter Lenn was AMCA action officer for the first study: "Future Warfare in Urban Areas. Findings are published in report form and being considered for a final AMCA position. Dr. Lenn departed recently to establish a private consulting firm.

Results of "Adverse Effects of Slopes on Military Operations, a study conducted under Elmer C. Clark, also were published recently.

In progress is a study on "Directed Energy as an Anti-Personnel Weapon, with Dr. Zaboj Harvalik, chief of the AMCA scientific consultant staff, as action officer. AMCA also is sponsoring for the Army Research Office (ARO) a study on "Future Computer Technological Concepts for Field Army Combat Intelligence.—Maj Peter A. Bunevich, ARO Studies and Analyses Division, is action officer.

"Firepower for Future Land Combat is a new study tentatively scheduled for completion this year. Dr. William L. Allan, chief, AMCA Firepower Branch, is action officer.

The AMCA is organized into three divisions. Elements of the Concept Synthesis Division are the Intelligence Command and Control Branch; Mobility Branch; Firepower Branch; and Combat Service Support Branch.

The Operations Analysis Division consists of a Plans and Objectives Branch, Special Forecasts and Analysis Branch, and the Scientific Consultant Staff. The latter is responsible for providing the exceptionally qualified advisers required for highly specialized study areas.

The Exploratory Evaluation Division is organized into five elements—the Problem Analysis and Study Formulation Branch and four task groups in the areas of Intelligence Command and Control; Mobility; Firepower; and Combat Service Support.

The search for a man with the precisely peculiar combination of professional skills desired for the position of the AMCA director has been under way for many months. Robert R. Phillipe, a long-term and eminently respected civilian employe of the Corps of Engineers, and since 1962 with the Army Materiel Command, served as acting director for 4½ months until he died June 6.

Dr. Ralph G. H. Siu, who departed recently to accept an appointment by President Johnson, succeeded Phillipe as acting director of the AMCA in addition to his duties as deputy director of the Materiel Command Development and Engineering Directorate. His successor is expected to continue in both capacities until the director of AMCA is selected.

Col Norman L. Hall was assigned as AMCA deputy director, at first on a detailed basis, from the Directorate of Development and Engineering, U.S. Army Materiel Command. He has a BS degree in engineering from Auburn University and has attended

Col Norman L. Hall

numerous military schools, including the U.S. Armed Forces Staff College and the Army Command and General Staff College.

An Army Corps of Engineers career officer, Col Hall has held a number of key positions, including a tour of duty as command engineer, U.S. Army Forces Southern Command; Army Research Office, Office of the Chief of Research and

Edgewood Arsenal Adds $4.1 Million Laboratory

(*Continued from page 1*)

important field of chemical defense."

Participating in the ceremonies were Congressman Clarence D. Long (D-Md.), who gave the dedicatory address, and Maj Gen Joe M. Blumberg, CG of the Medical R&D Command, along with top representatives of the Department of Defense and the Army.

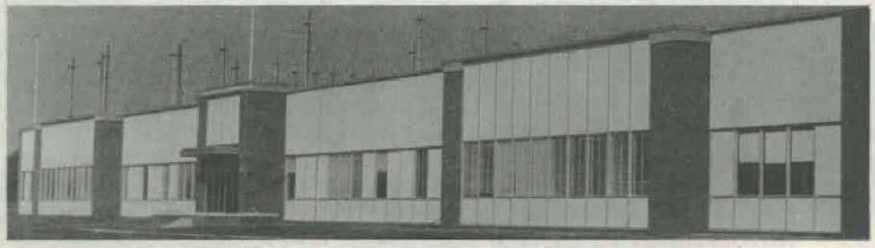
The $4 million Tandem Van de Graaff Accelerator facility was dedicated at Edgewood Sept. 25, 1968, just about a year following dedication of the Amos A. Fries ultramodern building containing 53 laboratories.

Housed in the General Wood Building will be about 250 military and civilian personnel highly trained in medical, physical and biological sciences. The Medical Research Lab is headed by Col Henry T. Uhrig.

Basic and applied research in the fields of aerosols, field toxicology and neuropharmacology will be among the investigations conducted in the new facility, along with experimental medicine, pathology, psychology and human engineering. The building has about 72,000 square feet of space.

Brig Gen John Ruxton Wood, in whose memory the facility is named, was chief of medical research at Edgewood Arsenal from December 1942 to June 1950. Credited with contributing greatly to the development of medical defense against chemical warfare, he later was director of the R&D Division, Office of The Surgeon General, and director of Walter Reed Army Institute of Research.

Edgewood Arsenal has been the center of Army Chemical research, development and procurement since May 1918. Staffed currently with about 3,800 civilian employes and some 1,600 military personnel, it is a commodity management center for chemical weapons, defensive systems and test and handling equipment.



ARMY's $4.1 million General John R. Wood Building

Development, HQ DA; engineer staff officer, U.S. Army Europe; construction and division engineer, Korean Civil Assistance Command.

Col George A. Nabors, acting chief of the Concept Synthesis Division, was commander of the U.S. Army Arctic Test Center, Fort Greely, Alaska, until assigned to AMCA upon

Col George A. Nabors

completion of a 3-year tour of duty.

Graduated from San Diego State College with a BA degree, he has completed the Armored Officers Advanced Course and the Army Command and General Staff College.

Since 1957 Col Nabors has served as adviser to the Chinese Nationalist Army Armor School in Taiwan; operations and training officer in the G–3 Section, HQ Sixth U.S. Army; military adviser to the Operations Research Office (subsequently reorganized as the Research Analysis Corp.); and as chief, Operations Research Branch, U.S. Army Research Office.

Emil M. Szten, chief of the Mobility Branch, Concept Synthesis Division,

Emil M. Szten

was chief of the Vehicle Surface Team, Weapons Systems Division, Ballistic Research Laboratories, Aberdeen (Md.) Proving Ground, at the time he transferred to AMCA. From 1964 to 1967, he was project manager, Operations Research and Systems Analysis, Research Analysis Corp.

Registered as a professional engineer, and a member of the National Society for Professional Engineers, he served during World War II as a hull superintendent on battleship construction and as industrial manager for research, outfitting and overhauling of landing craft and icebreakers.

In 1951 he became an employe of Ingersoll-Kalamazoo Division of Borg-Warner Corp., and was project manager for a variety of military vehicles, including the LARC–V and LARC-XV.

Dr. William L. Allan is chief of the Firepower Branch, Concept Synthesis Division. Graduated from the U.S. Military Academy with a BS degree in engineering sciences and PhD in mechanical engineering from Purdue University. He is also a graduate of the Army Artillery School, Fort Bliss, Tex., and the Ordnance School, Aberdeen Proving Ground, Md.

Dr. Allan served at HQ U.S. Army Missile Command, Redstone (Ala.) Arsenal, as both an officer and a ci-

Dr. William L. Allan

vilian employe, and was chief. Air Defense Office, when he accepted appointment to AMCA. In his last MICOM assignment, he was responsible for the Program Change Request Army Air Defense RDT&E Program-FY 1970–74, and the R&D Long-Range Plan, Air Defense.

Other MICOM assignments included project officer, JUNO II Scientific Satellite Program; assistant project engineer, Pershing Missile System; technical staff. Guidance and Control Laboratory, Army Ballistic Missile Agency; chief, Guidance and Control Section, Future Missile Systems Division; point of contact for the Industry IR&D Programs; and U.S. project officer, Joint U.S./Canadian Development Sharing Program on the STEM Elevated Camera System.

Halvor T. Darracott is acting chief of the Operations Analysis Division and was assigned to AMCA from the Directorate of Development and

Halvor T. Darracott

Engineering, Army Material Command. He has a degree in mathematics from Drury College, Springfield, Mo., and an MS degree in physics from University of Arkansas.

In 1954–55 he was chief of the Administrative Division, Signal Corps Engineering Laboratories, Fort Monmouth, N.J., followed by a year as assistant director of research for the laboratories. From 1956 to 1958 he was chief, Electronics Branch, R&D Division, Office of the Chief Signal Office, Washington, D.C.

After a year as deputy signal officer, Military District of Washington, he was chief, Electronics Branch, Experimentation Division, Federal Aviation Agency's National Aviation Facilities Center (1959–62). He was an executive engineer with Adler Electronics, New Rochelle, N.Y., for a year before he joined the Army Materiel Command Staff.

Lt Col John L. Fahs Jr., chief of the Plans and Objectives Branch, Operations Analysis Division, has a BS degree in engineering from the United States Military Academy and

Lt Col John L. Fahs Jr.

an MS degree in engineering sciences from Purdue University.

Assigned to the National Aeronautics and Space Administration until he joined the AMCA staff, he was chief of the Experiments Branch, Office of Program Control, Apollo Applications Program, responsible for

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Harry Diamond Labs Celebrate 15th Anniversary

(*Continued from page 1*)

ognition of the outstanding achievements of Landis and Hardin while trey were serving as consultants in Vietnam.

The letter to Landis states in part: . . . Your outstanding work on VT fuzing, the Dud Munition and Bogus Dud Project, and the Beehive Utilization Problem contributed immeasurably to the war effort, and served as an inspiration to all who knew and associated with you. . . ."

Hardin was lauded similarly for "far-sighted recognition . . . of the inherent capabilities of the TPS–25 in this theater. . . . There are now demands for many more than we can provide. . . ."

General Besson also made the principal address, in which he commended highly the professional competence of personnel and the role of the Harry Diamond Laboratories in developing many critically needed materiel items that helped to win World War II and have had an important part in U.S. military successes in Southeast Asia.

Participating dignitaries included Lt Gen Austin W. Betts, Army Chief of Research and Development; Dr. A. V. Astin, director of the U.S. National Bureau of Standards; Mrs. Ida Diamond, widow of the founder of the Harry Diamond Laboratories; Brig Gen William W. Stone Jr., assistant deputy director, Research and Laboratories, Army Materiel Command; and Brig Gen Mahlon E. Gates, CG of the U.S. Army Sentinel Logistics Command; and

AMC Commanding General Frank S. Besson Jr. and Mrs. Ida Diamond, widow of the founder of the Harry Diamond Labs, at 15th anniversary.

TECHNICAL DIRECTOR Billy M. Horton and Mrs. Horton at celebration program commemorating 15th anniversary of Harry Diamond Labs.

Robert S. Walleigh, associate director for administration, National Bureau of Standards; Wilbur S. Hinman Jr., first technical director of HDL and later Deputy Assistant Secretary of the Army (R&D) until he retired; Col John A. Ulrich, first HDL commander; and Col M. S. Hochmuth, former commander of the laboratories.

Included among more than 3,000 guests who attended the open house at HDL as part of the anniversary celebration were many scientists who achieved renown at HDL and have since retired or accepted top-level positions with other agencies

Another highlight of the ceremonies was the presentation of the annual Hinman Awards to H. D. Curchak of Lab 300 for 1968 technical achievement and to Gerald Kinzelman of Lab 650 for technical leadership; also, the Ulrich Awards to Charles Apolenis of Lab 700 for managerial achievement and to Mike Boccia of Lab 400 for managerial leadership.

The awards were presented by HDL Commander Col Leslie G. Callahan Jr., since succeeded by Lt Col Peter E. Hexner, and Mr. Hinman. Col Callahan is assigned to the Office of the Assistant Vice Chief of Staff, Department of the Army.

Thirty-year Federal Civil Service employment pins were awarded to Chester M. Carr, Walter M. Dyer, Harold L. Hines, Eugene Carland, Dr. Hans W. Kohler, Joseph Kimmel, Mervin J. Shuck, Mrs. Ruby C. Vanderford, Alfred E. Schneider, Carlisle J. Hoadley, Robert Butterworth and Ben Reznek.

Col Hexner Succeeds Callahan as HDL Commander

Change of command of the Harry Diamond Laboratories, Washington, D.C., followed by two weeks HDL's observance of its 15th anniversary as one of the U.S. Army's foremost centers of scientific research.

Col Leslie G. Callahan Jr., who had headed the HDL since December 1967, departed for an assignment Oct. 14 as a group chairman in the Force Planning Analysis Directorate, Office of the Assistant Vice Chief of Staff, HQ Department of the Army.

Lt Col Peter E. Hexner became his successor after serving since June 1968 as military assistant to the Director of Defense Research and Engineering (Research and Technology), Dr. Donald M. MacArthur.

Commissioned in the Army in 1951, two years following graduation from the University of North Carolina with a BS degree n physics, Col Hexner earned an MA degree in 1960 and PhD in 1962 in physics, both from the University of Virginia. He is a graduate from the Command and General Staff College and Industrial College of the Armed Forces.

Col Hexner has been in defense or R&D-related assignments since he was an assistant professor of military science and tactics at Massachusetts Institute of Technology (1956–58). Chief of the Weapons Research Division, Army Chemical R&D Laboratories (1962–64), he served in the Office of the Chief of R&D, HQ Department of the Army, as chief of the Weapons Branch (1964–66). He then was assigned for two years to the Office, Assistant Secretary of Defense (Systems Analysis).

He has served tours of duty in the Far East and in Europe, earning a number of military decorations and awards, and is a member of Phi Beta Kappa, Sigma Xi, Alpha Xi Sigma and the Raven Society. Among his publications are several articles in scientific and technical journals. He also has presented technical papers at various professional society meetings.

Lt Col Peter E. Hexner

Brooke AMC Picks Pruitt To Head Surgical Research

Prepared for his new assignment by five of his eight years in the Army in various capacities at Brooke Army Medical Center, Fort Sam Houston, Tex., Lt Col Basil A. Pruitt Jr. recently became commander and director of its famed Army Surgical Research Unit.

Maj Gen Laurence A. Potter, CG of the center, announced selection of Col Pruitt to succeed Col John A. Moncrief, who retired to become professor of surgery at the University of South Carolina Medical School.

Returned recently from a year of duty in Vietnam, Col Pruitt served six months as chief of Professional Services for the 12th Evacuation Hospital and a like period as chief of the Trauma Study Section of the U.S. Army Medical Research Team sent to Southeast Asia by Walter Reed Army Institute of Research, Washingtn, D.C.

Graduated from Harvard University in 1952 with an AB degree. Col Pruitt earned a medical degree at Tufts University School of Medicine in 1957 and served the first two years of his residency in surgery at Boston (Mass.) City Hospital.

He entered the Army to serve the last two years of surgical residency at Brooke General Hospital and attended the Associate Army Medical Service Officer Career Course at the U.S. Army Medical Field Service School in 1964. In 1965 he was certified by the American Board of Surgery.

Col Pruitt was chief of the Burn Study Branch of the Army Surgical Research Unit at Brooke AMC in 1960–61 and again in 1965–66. He was chief of the Clinical Division in 1966–67. He is a member of the National Institutes of Health Section on Surgery and an assistant clinical professor of surgery at the University of Texas Medical School.

Lt Col Basil A. Pruitt Jr.

Much-Honored Flaherty Gets Vietnam Service Medal

Presentation of the U.S. Government Civilian Award for service in Vietnam to Charles W. Flaherty, with General Frank S. Besson Jr., CG of the Army Materiel Command, doing the honors, attracted a large group of high-ranking dignitaries.

Flaherty is one of the Army's most frequently honored civilian employes, whose more than 26 years of U.S. Government service have been recognized by numerous Superior Performance Ratings and Letters of Commendation from top Army commanders.

Nominated for the President's Distinguished Civilian Service Award in 1967, he has received the Exceptional Civilian Service Award, the Meritorious Civilian Service Award and an unbroken succession of Superior or Outstanding Performance Ratings for 26 years—a record believed unsurpassed by anyone.

General Besson honored him at HQ Army Materiel Command, Washington D.C., Oct. 16, for his service as AMC special projects officer at Norfolk, Va. Over the past six years he has logged 404 days in 27 trips to Vietnam. The Service in Vietnam Medal is limited to employes who have served at least 365 days in Vietnam since 1962, unless they were disabled by hostile action.

Describing Flaherty as a "trouble-shooter with that special ability and that special desire to take on hard-to-do jobs and get them done," General Besson also presented him with his 26th Outstanding Performance Rating. He said Flaherty's assignments have required him to travel to 19 countries and spend more than 20 months on temporary duty during the past 36 months.

Adding to the prestige of the occasion was the presence of Speaker of the House John J. McCormack, Congressman John Young of Texas, Lt Gen Jean E. Engler, Army Deputy Chief of Staff for Logistics, Maj Gen Thomas H. Scott Jr. of the Defense Supply Agency, G. B. Russell, Deputy Assistant Secretary of the Army (Installations and Logistics), and numerous other officials.

Flaherty heads a staff of 18 Army Materiel Command personnel assigned to the task of handling difficult special project services worldwide for General Besson. During World War II Flaherty served as a Chief Petty Officer, U.S. Navy.

ASAP Passes Resolution After Dr. Thomas' Death

Dr. Jay Tol Thomas, 49, who resigned in mid-September as Army Materiel Command Deputy for Research and Laboratories, died in his home in Alexandria, Va., Oct. 18, following an apparent heart attack. His death prompted the following resolution:

"The Army Scientific Advisory Panel has noted with great sorrow the untimely death of Dr. Jay Tol Thomas and hereby resolves to set forth for the record the Panel's recognition of the very significant accomplishments of Dr. Thomas during his tenure as the first Deputy for Research and Laboratories of the Army Materiel Command.

"Among his many lasting contributions was his development of a 10-year plan to continue the evolution of the Army Materiel Command organization toward an optimum grouping of commodity commands with supporting research and development centers.

"Another of his major accomplishments was his personal and aggressive upgrading of leadership in several Army Materiel Command laboratories. This evidenced his abiding concern with the quality of technical leadership within the laboratories.

"Much to his credit, he continually sought to establish the ideal balance between authority and responsibility at all levels within research and development program areas. His great efforts to develop scientific and technical management talent within the Army laboratory structure promises to have lasting beneficial effects upon the Army research and development effort for many, many years to come.

"His passing is a great loss to the Army, the Defense establishment and to the Nation."

TARC Observes Panama RDT&E Activities

Members of The Army Research Council (TARC) recently visited the U.S. Army Tropic Test Center (TTC) in the Panama Canal Zone for five days to observe research, development, test and evaluation (RDT&E) activities, meet with top Army leaders and hold a full-day business session.

Headed by TARC Chairman Dr. Maurice Apstein, the 12-man council was briefed during its first visit to the TTC by Col John Zakel Jr., commanding officer. Members also met with Canal Zone Governor Walter P. Leber and the staff of Maj Gen Chester L. Johnson, CG of the U.S. Army Forces Southern Command.

The group viewed work being done at instrumented 150-foot towers that the TTC has erected in a jungle site as part of the Environmental Data Base Project supported by the U.S. Army Research Office and the Advanced Research Projects Agency.

Members visited a jungle acoustics investigations site where measurements of sound penetration of the jungle canopy are conducted. They also observed tests on the deterioration and corrosion of 15,000 samples of materials exposed to various environments of the tropics.

At Miraflores Annex, TARC members were briefed on the center's microbiological and air chemistry studies conducted with the National Center for Atmospheric Research.

The council also was briefed on activities of the Smithsonian Institution Marine Biological Laboratory, the Middle America Research Unit, and the Gorgas Memorial Laboratory in the Canal Zone.

TTC officers demonstrated some basic problems of tropical activities, showing how material must be refined to enable men and equipment to function together in the tropics.

The TTC is one of three environmental test centers under the U.S. Army Test and Evaluation Command headquartered at Aberdeen Proving Ground, Md. Others are the Arctic Test Center in Alaska and Yuma Proving Ground in Arizona.

TARC was established in 1964 by the Assistant Secretary of the Army (R&D) to assist in formulating plans, policy and programs for Army basic research and priority areas for exploratory development.

Present membership consists of Dr. Maurice Apstein from the Harry Diamond Laboratories, Washington, D.C.; Dr. Ivan R. Hershner Jr., Dr. Thomas E. Sullivan, Dr. Hoyt Lemons, Col Donald L. Howie, Dr. E. Kenneth Karcher Jr., and Lt Col Sylvester L. Wilhelmi, U.S. Army Research Office, OCRD; and

Dr. J. Post Hallowes, Redstone Arsenal, Ala.; Willard R. Benson, Feltman Research Labs, Picatinny Arsenal, N.J.; Dr. Kay F. Sterrett, U.S. Army Terrestrial Sciences Center, Hanover, N.H.; Col William H. Meroney, Walter Reed Army Institute of Research, Washington, D.C.; and Dr. Leon T. Katchmar, Human Engineering Labs, Aberdeen Proving Ground. Md.

TARC MEMBERS observe as Tropic Test Center technician uses an infrared thermometer to measure surface temperatures attained by sandbags exposed to the tropical environment at the Chiva Chiva Site in the Canal Zone.

CORROSION EFFECTS of the tropics on metals and alloys are examined by TARC members during visit to the U.S. Army Tropic Test Center.

Keys to 'Good Way of Life'. . .

Wisdom of 6,000 Years Compiled in Dr. Siu's Book

Philosophical keys to the "Good Way of Life"—wisdom of all ages applied to every conceivable problem situation, delineated originally some 3,000 years ago in a Chinese classic, *I Ching*, and amplified by the world's great thinkers—are presented in a new book, *A Man of Many Qualities*.

Subtitled *A Legacy of the I Ching*, the publication hailed by critics as an almost certain best seller is authored by Dr. Ralph G. H. Siu and published by the Massachusetts Institute of Technology Press.

Internationally renowned as a U.S. Army scientist, author, humorist, toastmaster and lecturer, Dr. Siu ended a 24-year career as a U.S. Army scientist by resigning recently to accept a presidential appointment. He is now an associate administrator of the new Law Enforcement Assistance Administration, and director of the National Institute of Law Enforcement and Criminal Justice. U.S. Department of Justice.

One of the more laudatory critiques of *A Man of Many Qualities*, which was being considered for Book of the Month Club selection when the *Army Research and Development Newsmagazine* went to press, appears in *The National Observer*.

The critique followed by about a month an article in the same publication titled "The 'I Ching' or 'Book of Changes'—There's a Best-Selling Surge for Ancient Oriental Wisdon." Hippies are reported among the most avid readers of books on *I Ching*, in their quest for better understanding of life's mysteries.

Dr. Siu's book is bidding for recognition as the most ambitious and scholarly approach to the interpretation and orientation of the *I Ching*, since it "transcends the Taoist and Confucian traditions: it consists of passages taken from the world's literature, spaning 6,000 years, representing 60 countries—about 700 excerpts by 65 writers. . . ." (Quotes from *The National Observer*.)

Perhaps the most effective sales pitch that might be made for *A Man of Many Qualities*, however, is the preface by the author. It states:

"My purpose in writing this book is to introduce the Western man of affairs to a remarkable 3,000-year-old Chinese classic called the *I Ching*. I believe his life can be enriched considerably through its influence upon his aspirations and actions.

"For centuries, the *I Ching* has served as a principal guide in China on how to govern a country, organize an enterprise, deal with people, conduct oneself under difficult conditions, and contemplate the future. It has been studied carefully by philosophers like Confucius and men of the world like Mao Tse-tung. Confucius expressed his deep respect by asking the rhetorical question, 'Is the *I Ching* not the perfect book?'"

U.S.-Italy Memo of Understanding Initiates Cooperative Metals Research

Cooperative research effort backed by a Memorandum of Understanding between the U.S. Department of Defense and the Italian Ministry of Defense signed July 31, 1968, by the U.S. Army has been initiated as the result of recent meetings at Frankford Arsenal and Washington, D.C.

The Materials Science and Technology Branch, Research Directorate, Office of the Chief of Research and Development initiated this action in the fall of 1967.

The Memorandum of Understanding, signed by Brig Gen Kenneth F. Dawalt, Deputy Chief of Research and Development (International Programs) as the U.S. representative, is the first project being implemented under a mutual R&D assistance agreement reached between the U.S. and Italy in 1964.

ITALIAN-AMERICAN meeting on cooperative research in metals was held recently at the Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass. Among attendees were (from left) Norman L. Reed, chief of the Materials Advisory Group, AMMRC; H. J. Boertzel, Naval Air Systems Command, Washington, D.C.; Brig Gen Alberto Griselli, Directorate of Labs, IAF; Dr. T. M. Ronald, U.S. Air Force Materials Lab, Wright Patterson AFB, Ohio; Director of Research Athos Masi of Nazionale Cogne, Italy.

Work covered by the memorandum will be performed in Italy by the Instituto Sperimentale dei Metalli Leggeri of Novarra. This research is concerned with the production of aluminum alloy ingots by use of unidirectional solidification techniques combined with new thermomechanical treatments. In the U.S. the solidification techniques have been developed by the Army's Frankford Arsenal, Philadelphia, Pa., both in-house and under contract to Massachusetts Institute of Technology.

Under contract with the U.S. Army Research and Development Group-Europe, the Instituto Sperimentale dei Metalli Leggeri (ISML) has developed new thermomechanical treatment cycles for aluminum alloys. Alloys so treated have proved stronger and more resistant to stress corrosion.

Interest of the U.S. Army is in combining the solidification technique developed in the U.S. with the thermomechanical treatment developed by the ISML, in the hope of producing aluminum alloy ingots and finished forgings which will have higher strength levels and improved ductility characteristics for U.S. armor applications.

Work performed for the U.S. Army under the Memorandum of Understanding will cover a 3-year period and will be monitored by Harold Markus, director of the Metallurgy Research Laboratory, Pitman-Dunn Institute for Research at Frankford Arsenal. U.S. Department of the Army staff direction is the responsibility of the Materials Science and Technology Branch of the Office of the Chief of R&D.

As a result of interest generated by this Memorandum of Understanding, technical discussions were held recently at the U.S. Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass., and at Picatinny Arsenal, Dover, N.J. The discussions at AMMRC were on five proposals for research in the field of metals submitted by the Italian officials.

Brig Gen Alberto Griselli, Italian Air Force, Ministry of Defense, headed the delegation to AMMRC that included representatives of Italian industry as well as the Italian Ministry of Defense. Dr. T. M. F. Ronald represented the U.S. Air Force, J. J. Boertzel the U.S. Navy and Dr. Thomas E. Sullivan the Office of the Chief of R&D, U.S. Army. Representatives of AMC's metallurgical scientists were also present. Norman L. Reed of the AMMRC chaired the sessions.

During the week following the AMMRC discussions, a meeting was held at Picatinny Arsenal for discussion of proposals involving research in solid, liquid and hybrid propellants. General Griselli again headed the Italian delegation which included representatives of industry, the military and the academic community. The AMC was represented by knowledgeable scientists in the propulsion field, and the meeting was chaired by Dr. John Erman of Picatinny Arsenal.

The results of these two preliminary meetings were discussed later at a meeting of the Joint U.S./Italy Steering Committee in Washington, D.C. It was recommended that specific research topics should be more clearly defined by further bilateral discussions in order to be considered for possible action at the May 1969 Steering Committee meeting, Florence, Italy.

AMMRC Scientists Present Papers at ACS Symposium

Presentations at the 50th Anniversary Symposium of the New England Section, American Ceramic Society, in the Museum of Science at Boston, Mass., included six addresses and papers by scientists of the Army Materials and Mechanics Research Center, Watertown, Mass.

AMMRC Technical Director Dr. Eraldus Scala, who reported for his new duties in September after studying as a Guggenheim Fellow in the Netherlands. discussed "Ceramics Research—What, Why and Where."

Chairman of the New England Section is Albert P. Levitt, chief of the Interdisciplinary Research Laboratory at the AMMRC, who presided during the exchange of information.

Frederick Schmid and Dennis Viechnick of the AMMRC Ceramics Research Laboratory reported on "Unidirectional Solidification of Alumina with a Gradient Furnace." Philip Wong and Capt McDonald Robinson of the same laboratory spoke on "Chemical Vapor Deposition of Polycrystalline Aluminum Oxide."

Other technical presentations included "Recent Developments in Refractory Diboride Materials Technology," "The Effect of Environment and Surface Structure on the Fracture Stress of MgO" and "Adhesion of Lunar Soil Simulated by Rock Comminuted in Vacuum."

ECOM Engineers Save $4.7 Million in Cable Costs

Cost-saving engineers of the Army Electronics Command are saving the U.S. Government $4,718,642 on one type of communications cable by keeping in the quality but eliminating unnecessary bulk.

ECOM's Value Engineering Agency reports that the original item was known as Cable Assembly CX–4245/G, a dual coaxial cable used in huge quantities. It provides 12, 24 or 48-channel links in the Army Area Communications System (AACOMS). It may be used to interconnect multiplex terminals (types AN/TCC–43 through 47) with nearby radio relay stations or as wire links over long distances between the multiplexers.

In 1966, ECOM purchased more than 14,000 quarter-mile reels of the original cable at the competitive price.

In line with ECOM's policy of continuing reevaluation of equipment and supplies, the Electronic Parts and Materials Division of the Electronic Components Laboratory conducted a value-engineering study under the direction of Jack Spergel and Morton Pomerantz.

The conclusion was that the cable could be improved by using a more efficient insulating material (with a lower dielectric constant), and thus reduce the diameter of the outer conductor in the cable's concentric structure without any loss in the strength of the signal.

This new cable costs less and is much lighter—which will result in further (but uncounted) savings by reducing the poundage which must be handled. The CX–11230/G engineering models were fabricated and evaluated under a contract with International Telephone and Telegraph Co.

COST CUTTERS Morton Pomerantz (left) and Jack Spergel, of the E-Command's Electronic Components Laboratory, show results of their cost-reduction engineering on communications cable to Paul J. Rappaport of the ECOM Value Engineering Agency.

Value engineers say the $4,718,642 saving breaks down like this: Cost per reel of the original cable was $316.77, but the new type costs only $183.33, for a saving of $133.44 per reel, totaling $2,061,381 for the 15,448 reels ordered in FY 68, and $2,931,409 for the 21,968 reels to be procured in FY 69 and FY 70.

The value engineering study, counting the ITT contact and work of ECOM engineers, cost $274,148.

Watervliet Arsenal Gets New Commander January 1

Effective Jan. 1, Col William Mulheron Jr. will take command of Watervliet (N.Y.) Arsenal, the Army's heavy weapons design and development center.

Lt Col O. W. Lee Jr. has been acting commander since Col Arthur Sweeney Jr. departed Aug. 19 to become deputy commander of the U.S. Army Weapons Command, Rock Island, Ill.

Col Mulheron has served since June 1966 as deputy program manager for the joint U.S.-Federal Republic of Germany Main Battle Tank 1970s developmental program. At Watervliet one of his chief responsibilities will be design and development of the tank's principal weapon, the 152mm gun-launcher.

Born in Chester, Pa., he is a 1942 graduate of Rutgers University, has a master's degree in business administration from the University of Chicago, and is a graduate of the Army Command and General Staff College and the Army War College.

During World War II he served in Africa and Italy, earning seven battle stars. He has also served in Germany, Korea and Turkey as well as at Detroit Arsenal, Office, Chief of Ordnance in Washington, D.C., and at Aberdeen (Md.) Proving Ground.

Col William Mulheron Jr.

Watervliet Tests Autofrettage Process on Huge Tubes

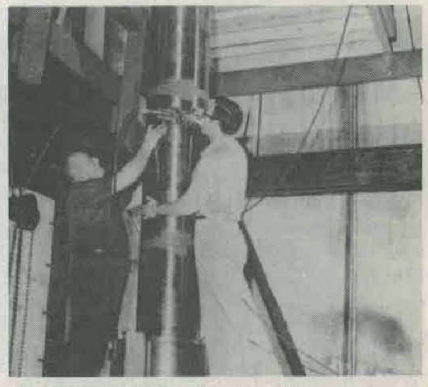
Longer life for the huge 175-millimeter barrels of the M107 self-propelled gun is the goal of experimental autofrettaging being performed and evaluated at Watervliet (N.Y.) Arsenal, U.S. Army Weapons Command.

The WECOM autofrettage processing involves the application of extremely high fluid pressures to the gun tube's interior surface. Resulting stress patterns enable many more rounds to be fired before a tube becomes unserviceable.

Watervliet Arsenal developed the process and has been applying it successfully for many years to substantially smaller gun tubes than the 35-foot-long 175-mm barrels. These tubes are one of the top priority items now being used in Vietnam. Increased life expectancy would mean that fewer replacements would be required, lightening the logistics and cost burden.

Current firing tests of the experimental models are being conducted at the Army's Aberdeen (Md.) Proving Ground, Headquarters of the Army Test and Evaluation Command (TECOM). Technical evaluation of results is being accomplished in the physical and mechanical metallurgical laboratories at Watervliet Arsenal.

Provided that laboratory tests and the field evaluation prove conclusively that the autofrettage process works as well on the big gun tubes as it does on smaller-diameter barrels, Watervliet will be able to apply it to a top-priority production program at the WECOM installation. Watervliet also designed and developed the breech assembly for the 175-mm gun.



WATERVLIET ARSENAL engineers affix electronic dialatometers to a 175-mm gun tube prior to applying the internal autofrettage pressure of about 110,000 psi. These ultrasensitive devices measure the expansion that takes place during the autofrettaging.

Picatinny Engineers Develop Force Stand to Gauge Footsteps

Complex forces exerted by and on the human foot while walking have been accurately measured for the first time by two engineers employed with the Experimental Test Unit at Picatinny Arsenal, Dover, N.J.

While investigating methods to improve land mines, Henry Pontious and Ralph Vecchio designed a force stand that registers the "human footstep force signature." Tri-dimensional, simultaneous interactions between the human foot and the ground surface during a complete step and major components of a single step can be precisely determined.

The force stand (Fig. 1) consists of top and bottom plates made of ½-inch-thick steel measuring 20 x 24 inches. Any force applied vertically on top of the plate is measured by three vertical-force transducers (load measuring cells). Any horizontal force is measured by one or more horizontal transducers, depending on the direction from which the force is applied.

Each force column consists of a force transducer, two thin-plate bending flexures, and a rod-shaped roll-flexure. The latter permits rotation about the columns in their respective axes.

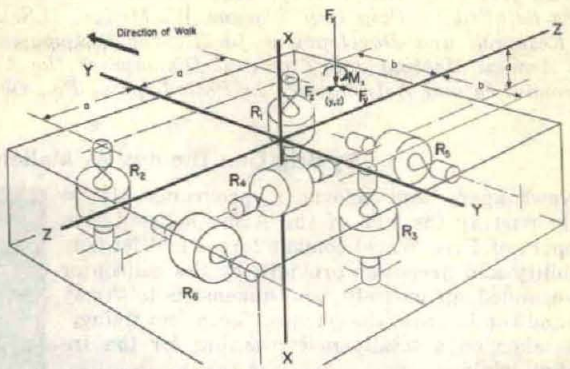


Fig. 1. FORCE STAND configuration and coordinate system schematic. R_1, R_2, R_3, R_4, R_5, R_6 are flexure-supported force-measuring transducers. F_x, F_y, F_z and M_x are components of the load applied at any point y, z. The directions shown are positive and a, b and d are constants.

Tests were limited to two male subjects about the same height and weight. Each made 24 runs without shoes and 36 while wearing regular dress shoes. Each walked the length of the test platform, stepping on the force stand with one foot at a time.

A signature consisting of the various forces imparted to the stand by the entire foot was generated in the form of transducer outputs recorded by an oscillograph.

At the same time, photocells mounted at shoulder height checked walking velocity (held to 60 to 100 steps per minute in the tests). A metronome was used to fix specific walking paces and the desired stride was marked by tape on the platform.

Separate force signatures for the sole and heel were obtained by having the men step on the force stand with only the portion of the foot to be measured. An IBM computer and an automatic curve plotter processed the transducer data into curves, with all paremeters plotted as a function of time.

Walking faster noticeably increased veritical, forward and rearward forces exerted by the foot. Side forces and positive (clockwise) moments were not affected significantly, although there was a definite increase in negative (counter-clockwise) moments.

Naturally, rise time (interval between initial contact with the force stand and the first peak of vertical force) and total contact time were reduced as the walking pace was increased.

For all stridepace values checked in the experiments, the maximum vertical force acting on the sole of the foot was slightly greater than the subject weight. This force was less for heel measurements.

Horizontal forces exerted by the heel were always significantly higher in the forward direction, and sole reactions tended to be similarly greater in the rearward direction.

As might be expected, the negative moment (normal twisting effect) produced by the sole was greater than that of the heel. Sole contact time was much greater than for heel, and rise time was longer.

Curiously, foot signatures for the same subjects walking in socks only were practically identical to those produced while wearing shoes.

The most significant difference between left- and right-foot signatures for the same subjects was in both the horizontal side forces and in the moment measurements.

Knowledge gained through these experiments is expected to be of value in the Army's research and development program and to have a "spin-off" benefit to manufacturers of shoes and artificial limbs. Further tests are planned—but still directed primarily to military objectives.

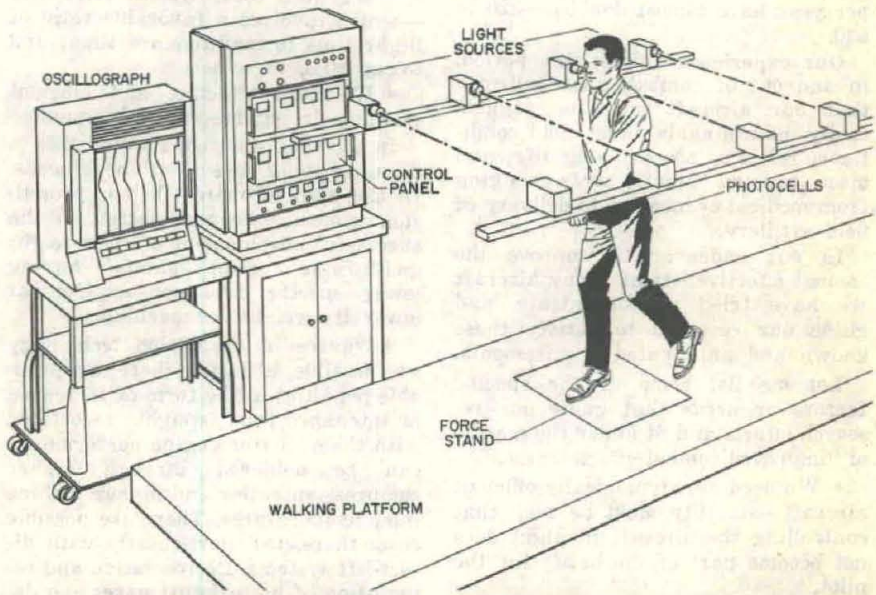


Fig. 2. BIOMECHANICAL DATA SYSTEM, consisting of multicomponent force measuring stand, photocells, control panel and oscillograph recorder. Subject footstep force signature and velocity are recorded during experiments.

Requirements Governing Army Aviation Research

U.S. Army special aircraft requirements and developmental objectives were detailed by Brig Gen Thomas W. Mellen, U.S. Army Deputy Chief of Research and Development for Southast Asia, in an address to the 5th Annual Meeting and Technical Displays of the American Institute of Aeronautics and Astronautics in Philadelphia, Pa., Oct. 21–25, as follows:

★ ★ ★

By Brig Gen Thomas W. Mellen

General Mellen

Newspapers and television programs almost daily portray the role of the Army helicopter in support of Free World combat forces in Vietnam. Mobility and firepower provided by the helicopter have added an entirely new dimension to Army ground combat and the phrase, "keep 'em flying," has taken on a totally new meaning for the Infantry soldier.

This relatively new capability of Army aircraft did not happen overnight. It is the result of an extensive Army- industry effort over the intervening years since the Korean War. Hand-in-hand with the development and application of new tactics and concepts in the use of the helicopter, aviation research and development activities have had a major role in this effort.

Since aviation research is the foundation upon which future aircraft are developed, I am pleased to join you at your fifth annual meeting and relate for you some of the current research goals and activities that pertain to Army aviation.

Today's Army aircraft fleet consists primarily of helicopters, with some specific-mission, fixed-wing aircraft. This fleet continues to grow. Since 1958 the total number of Army aircraft has increased from 5,000 to 10,600 and total flying time has mounted from 1.6 million to 5.3 million hours per year; the flying hours per aircraft per year have almost doubled—320 to 530.

Our experience during this period, in and out of combat, has confirmed that our aircraft must be rugged, easily maintainable under field conditions, reliable, possess long life, and meet mission resuirements ranging from medical evacuation to delivery of field artillery.

In our endeavor to improve the combat effectiveness of Army aircraft we have tried to concentrate and guide our research to satisfy these known and anticipated requirements.

Let me list some of the specific factors or *needs* that guide our research efforts and fit under the mantle of "improved combat effectiveness."

- We need aerodynamically efficient aircraft—stability must be such that controlling the aircraft in flight does not become part of the battle for the pilot.
- We need full use of lightweight yet strong and durable materials and
- We need efficient propulsion systems—in terms of weight and performance.
- We need efficient man-machine interfaces—to match the ever-increasing add-ons to the pilot's activities and responsibilities.
- We need reliable and fully integrated avionic systems.
- We need reliable and accurate weapon subsystems.
- We need reduced vulnerability to crash and fire damage.
- We need the elimination of, or a vastly reduced, infrared signature of aircraft.
- We need total system reliability —which involves a favorable ratio of flight time to maintenance time; and to cap all of these needs.
- We need effective and efficient training procedures and techniques.

In the time allotted, I would like to discuss briefly several of these needs. In the area of more efficient propulsion systems, we are looking to the successful development of lightweight gas-turbine power plants, having lower specific fuel consumption at lower dry weight per machine.

Advances in propulsion technology are possible, although there are probable penalties in the form of increased maintenance and weight associated with them. Better engine performance can be achieved through higher compression ratios and higher turbine inlet temperatures. There are possible costs there, too, particularly with direct-lift systems. Recirculation and reingestion of hot exhaust gases can degrade engine performance through thrust fluctuation, inlet flow distortion, and loss of power.

In pursuit of better propulsion systems, the Army is engaged in an exploratory program with General Electric Co. and Pratt and Whitney. Both are designing and testing a 1,500-horsepower turbine engine. This Demonstrator Engine Program is an exploratory effort to provide input to the next generation of helicopters.

With respect to rotor technology, we are interested in increases in the rigidity of the rotor blade, the reduction of rotor blade stall at high rotational and forward speeds, simplification of rotor head mechanism, and design changes to permit higher allowable blade tip speeds.

The flow phenomena of retreating blade stall, one of the factors limiting helicopter forward speed, is an area under considerable investigation. Army research is concerned and involved with basic aerodynamics of blades, wherein a portion of the blade is submerged in partial or total reverse flow while the remainder of the blade is under relative normal flow conditions. We visualize that many operational advantages can be realized through a better understanding of these transient conditions.

The noise generated by present helicopters detracts from our ability to achieve surprise in combat operations. As you know, the helicopter with its VTOL capability is ideally suited for placing patrols in enemy areas and for insertion of combat troops once the enemy commits his forces.

Unfortunately, a degree of this capability is jeopardized because of the unique noise signature of the helicopter; the enemy reacts or hides. The rotor blade is one of the worst offenders in the production of noise. Much of this blade noise is believed to be the result of the advancing blade cutting through the vortex of the preceding blade.

Another source of noise is the engine and associated gear boxes and transmissions, with noise levels in certain cases exceeding 115 decibels. The compressor is a particular offender on the engine. Due to their location within the cabin structure, gear boxes have proved troublesome components of the power train.

In addition to the consideration of tactical surprise, the noise level impacts on the efficiency of the crew and the combat soldier. The Army is engaged in research—in-house, by contract, and combined effort with other U.S. Government agencies —to reduce the noise signature of the helicopter. A desired goal of this research

is the reduction of the internal noise level to no more than 85 decibels and the external noise level to no more than 80 decibels at 300-foot range and 100-foot altitude.

In the area of avionics, Army aviation needs relate to aircraft with a high survival communication and navigation capability under hostile, natural and artificial environments.

Achievement of this capability has been rather limited to date, but improvements are anticipated through research in the areas of automatic sensors, automatic data processing, and advanced navigation equipment for providing an all-weather, 24-hour aircraft operational capability.

The specific application is for low-altitude flight regimes required to accomplish direct fire support, observation, and surveillance-type missions. The AH–56A, Cheyenne, has been the first helicopter developed by the Army with deliberate, planned integration of avionics, fire control and armament for satisfaction of total mission requirements.

Research directed to improved flight safety is high on the Army priority list. Injuries and fatalities caused by in-flight or crash fires are the areas of primary interest and attention. Seventy-two percent of our UH–1 aviation crash fatalities are the result of fire.

Both the aircraft fuel tank and the fuel itself are targets of this research. We have produced prototypes of crash-resistant fuel tanks which are lightweight and tough enough to resist puncture under severe crash tests. These tanks will also seal bullet holes within a fraction of a second. Flight qualification of this type tank in UH–1 aircraft are scheduled to begin in June next year.

When a liner containing a coagulant is added to this new fuel tank, a rapid self-sealing capability is achieved. Loss of fuel when the tank is punctured by a 50-caliber tumbled bullet is reduced from 150 liters to one-tenth of a liter.

Fuels research has progressed steadily until we now have successfully run jet engines on emulsified fuel without any short-term performance degradation. Research is continuing in this area to eliminate corrosive effects on turbine blades.

In the search for better materials for Army aircraft structures, the Army has ongoing research in the area of composites. Studies include filaments, whiskers, matrix materials, micromechanics of composite structures, bonding and joining techniques, and fabrication methods.

Such basic materials as glass, boron, carbon, graphite and beryllium filaments, as well as metallic and nonmetallic whiskers, are being evaluated as high-strength, high-modulus substrates. New resin and metallic matrix systems, with higher modulus, lower shrinkage, and improved environmental compatibility, are being examined.

The possible advantages that may be realized through the use of composite materials, other than improved structural strength and integrity, are reduced radar reflectivity, improved maintainability, and better aerodynamic characteristics. Through results of the composite materials research program, the Army anticipates lightweight composite structural designs that will have application and benefits in advanced and future Army rotary-wing aircraft.

The increasing capabilities—and attendant complexities—of present and future Army aircraft point up the need for new and more comprehensive methods and procedures for training Army air crews. Maintenance of proficiency is equally important.

One task of our training research program is the application of training devices and simulators. We have a continuing program of research directed to improved training techniques and methods for Army aviators and aircraft maintenance personnel. A promising and interesting item in this program is the synthetic flight training system (SFTS).

Our concept for this sytem is that it will be a fully computerized, flexible simulator for rotary-wing training. The concept formulation phase of development was completed recently and the system will introduce into Army aviation training the very latest advances in training simulator design and instructional technology.

A central computer will service

(*Continued on page 14*)

ECOM Displays Progress in Night-Vision Devices

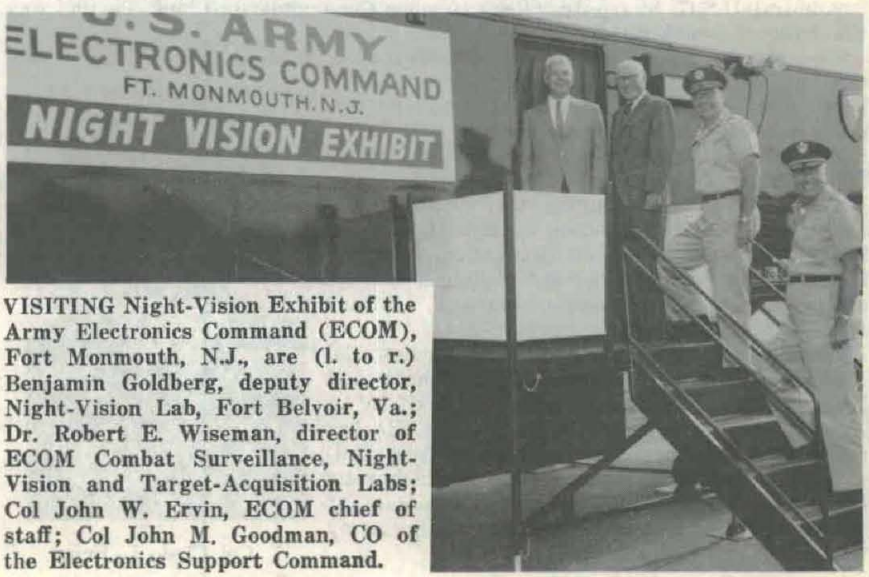
Progress of the U.S. Army Electronics Command in developing night-vision devices for improved combat effectiveness under cover of darkness in Southeast Asia is reflected in a new mobile exhibit.

Mounted in a 30-foot trailer, the display enables visitors to look through a Starlight Scope at a darkened simulated battlefield scene and see the animation as well as it could be seen in daylight.

Designed for use as a sight with the M–16 rifle, the Starlight Scope is the smallest of three light-intensification devices developed by the ECOM Night-Vision Laboratories and already in use in Southeast Asia. (For a detailed description of these devices, see July-August 1967 edition, page 7.)

First shown at the American Ordnance Association 50th annual meeting at Aberdeen (Md.) Proving Ground, Oct. 10–11, the ECOM display also was a popular feature among exhibits at the annual meeting of the Association of the United States Army, Oct. 28–30, Washington, D.C. It also was shown at the Army Night-Vision Laboratory, Fort Belvoir, Va.

The display was built by the Exhibits Office of the Electronics Support Command and the Engineering Support Services Department of the Research and Development Directorate, under the overall supervision of the ECOM Information Office.



VISITING Night-Vision Exhibit of the Army Electronics Command (ECOM), Fort Monmouth, N.J., are (l. to r.) Benjamin Goldberg, deputy director, Night-Vision Lab, Fort Belvoir, Va.; Dr. Robert E. Wiseman, director of ECOM Combat Surveillance, Night-Vision and Target-Acquisition Labs; Col John W. Ervin, ECOM chief of staff; Col John M. Goodman, CO of the Electronics Support Command.

Requirements Governing Army Aviation Research

(*Continued from page 13*)

cockpit modules, instructor stations, and communications modules of various aircraft now in the Army inventory, as well as future aircraft, such as the AH–56 Cheyenne. This system will provide the Army its first rotary-wing simulator which will meet Federal Aviation Administration standards for simulators for inflight instrument instruction and transition training.

The needs and activities I have described to this point are important to successful mission accomplishment of future Army aircraft. However, in my opinion—and I believe supported by Army experience in Vietnam—the key parameters to that successful mission accomplishment are reliability and maintainability.

We have a clear need for improved total aircraft system reliability and maintainability. The Army basically moves and fights on the ground, normally under unimproved and often remote field conditions. Since reliability and long life are reduced by dust, dirt, mud and rain experienced on a daily basis, the task imposed on Army aviation research and engineering is a very demanding one.

The field Army lives and works in the combat environment. Little change is made to the climatic and environmental conditions, and Army aircraft *must* "live with the troops." There are clear tactical advantages to be realized by operating from a dispersed, ever-changing, unsophisticated and natural environment.

In turn, however, this kind of operation demands from Army aircraft a rugged, reliable, self-contained component and total system that can be maintained under "field" conditions without overly sophisticated tools, without highly skilled maintenance personnel, and which requires a minimum of ground support and special equipment.

Our long-standing practice of replacing certain aircraft parts at prescribed flight-hour intervals is inefficient. It is wasteful of man-hours and money. Worse, it is responsible daily for reducing the number of aircraft ready to perform combat missions. We do have a research and exploratory development program to provide diagnostic equipment which can sense the conditions of vital parts and eliminate needless inspection and replacement of components.

The results of the research programs I have mentioned, plus many more, are to be incorporated into our future aircraft systems. The first system to incorporate as many as are available in the time frame involved will be the Utility Tactical Transport Aircraft System. Referred to as the UTTAS, this is the projected replacement system for the current UH–1 series aircraft.

The Army intends the UTTAS to be the most efficient and effective aircraft on the battlefield that American industrial ingenuity can provide. To accomplish this, technology must be pressed in the direction that will provide those improvements essential to mission accomplishment.

In this regard, I think that one of the vexing Army in-house problems will be to find the means and tenacity to assure that *only* those improvements vital to mission accomplishment are incorporated in the UTTAS.

Based on extensive experience with the UH–1D in Vietnam, the biggest bonus may likely be obtained by attaining the highest possible standards in reliability and maintainability—that is, a major reduction of the ratio of maintenance hours to flight hours. The performance characteristics of UH–1D are reasonably approaching those desired for a troop-lift aircraft for the Army in the field.

The benefits that can be projected to future air-assault operations resulting from *substantial increases* in individual aircraft performance are insignificant when compared to the tactical advantages of having a fleet that is reliable and available when the field commander needs it. Thus, in the UTTAS the Army seeks modest improvements in performance and major improvements in terms of reliability and maintainability.

In summary, I have attempted to outline some aspects of Army aviation needs that influence and guide our aviation research program. The Army recognized that most advances will be evolutionary in nature. To date, however, we accept breakthroughs gratefully, and in the past have even been accused of programming them.

I believe that substantial progress has been made on Army aircraft systems through research. Rotary-wing aircraft technology has advanced; so has engine technology; techniques for training pilots have improved; lighter weight and more efficient propulsion systems are on the horizon; and integrated avionics and weapon systems are being demonstrated in the AH–56.

All of these results contribute to give the Army safer aircraft with improved performance. That we are attaining concurrent simplicity has yet to be completely demonstrated. Aircraft noise, reliability and maintainability continue to be areas requiring hard work and resource support.

As in the past, the Army will work closely with those of you represented at this meeting to achieve those necesary improvements. I am optimistic of the results.

Pine Bluff Arsenal CO Receives Amos Fries Medal

Presentation of the Amos Fries Gold Medal to Col Clyde L. Friar, commander of the Army's Pine Bluff (Ark.) Arsenal, highlighted the annual meeting of the Chemical-Biological Division of the American Ordnance Association at Port Hueneme, Calif.

Admiral U.S.G. Sharp Jr. (Ret.), former Commander-in-Chief, Pacific, was the banquet speaker.

The annual award honors the memory of a former chief of the Army Chemical Warfare Service, Maj Gen Amos A. Fries, who served as the second man to hold this position (1919–1922) and was credited with building up the service to receive operational funds from Congress.

The citation accompanying the award to Col Friar noted his "outstanding contribution to the research, development and production engineering programs for chemical and biological defense equipment now in inventory of our U.S. Military Forces. . . ."

A veteran of 26 years military service, Col Friar was director, Defense Development and Engineering Laboratories at Edgewood (Md.) Arsenal prior to his current assignment. He has a BS degree in chemistry from Kent State University, a master's degree from Massachusetts Institute of Technology, and is a graduate of the Armed Forces Staff College and the Army Command and General Staff College.

Col Clyde L. Friar

VPI Study Clarifies Wind Pressures Effects on Shell-Type Structures

Fundamental knowledge termed a "major contribution to accurate determination of wind-load distributions and wind-flow patterns around typical shell structures" is contained in a report on a recently concluded study performed under an Army contract.

Entitled "Wind Pressures on Structural Shells," the theoretical and wind-tunnel research was conducted by Prof. (Dr.) Francis J. Maher of Virginia Polytechnic Institute (VPI), under sponsorship of the U.S. Army Research Office-Durham (ARO-D), Durham, N.C.

Wind loads are considered as major factors in the design of suspension bridges, skyscrapers and other major structures. Information on wind load and associated aerodynamic flow around such structures, however, has been limited. Consequently, building codes pertaining to these two parameters in most instances are nonexistent or inadequate.

The criticality of the situation has been compounded by the advent of lightweight shell structures of complex geometric shapes. The safety, and utility of these modern architectural structures depend, in large measure, on the designer's ability to predict accurately the maximum wind loads and wind-flow peculiarities.

Prof. Maher's investigations were concerned with pressure distributions and flow around elemental geometric shapes such as cylinders, segments of spheres and their combinations. Results revealed certain characteristics wind-load distributions that enabled the investigator to make general conclusions about wind loads that are applicable to more complicated structural shapes.

To demonstrate this capability, exact scale-models of two existing structures with unique architectural shapes were tested in the VPI 6' x 6' stability wind tunnel. The models were the Massachusetts Institute of Technology Kresge Auditorium and the Traveler's Building (New York World's Fair). The Kresge Building is one-eighth of a sphere with a blunt-face front (Fig. 1) and the Traveler's Building is a modified clamshell structure (Fig. 2).

Major features of the wind-load distribution, it was concluded from the tests, could be predicted by translating results of wind-load studies of simple shapes to these more complex structures.

For instance, the positive pressures on the front face, and the high negative (suction) pressures on the front part of the side walls of the Kresge Auditorium were anticipated from previous aerodynamic tests of simpler dome-cylinder shapes.

Traveler's Building model tests provided an opportunity to study effects of major architectural details. For example, it was found that, while the clamshell form indicates a significant reduction of total uplift pressure on the upper shell (due to reduced air flow over the top of the building), some local trouble areas undoubtedly will lead to future wind damage and possible high repair costs.

Determinations on this project have produced a direct correlation to findings of Army research and development on inflatable tent-type structures being carried out under supervision of Constantin J. Monego at the U.S. Army Natick (Mass.) Laboratories. Maher's conclusions "promise a most meaningful impact" on the stability design of tents with respect to wind pressure distributions.

Inflatable tent structures are the basis for the Army's concept of mobile buildings, such as the radically new must (Medical Unit Self-contained Transportable) field hospitals, repair shops and field command posts. These buildings can be delivered on-site in packaged form by helicopters and erected in a few hours by a few men. Evacuation and removal are similarly easy.

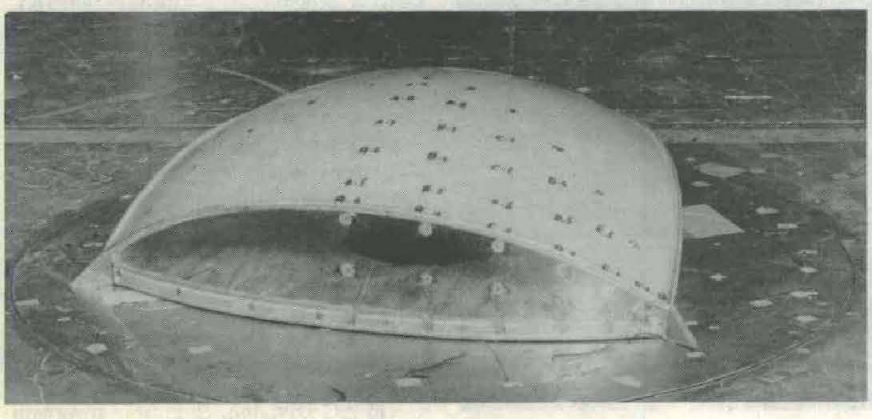


Fig. 1. Scale Model of Kresge Auditorium

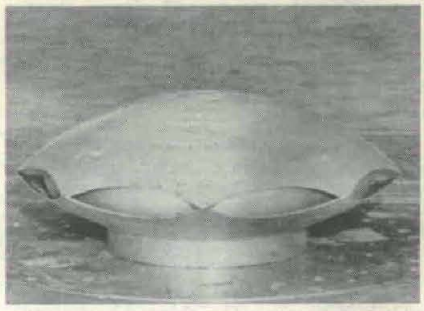


Fig. 2. Model of Traveler's Building

However, instability of the tents resulting from wind pressure (extreme case being a collapse) is a major deterrent for their extensive use in practicable sizes. Therefore, ARO-D brought the tent structure problems to the attention of Dr. Maher during his research.

In coordinating investigations with those of Monego at Natick, Maher found that good preliminary predictions on tent wind loads are possible when deflections of these inflatable structures are small.

In addition to the above benefits to the Army, several conclusions of importance in structural design of shell-type buildings have been drawn from Maher's basic investigations.

One of the more important conclusions is that similar correlation and analysis of future structures be made *before construction* to provide better answers to questions of loads on the structure and, in particular, to the question of maximum local loads on the roof-covering materials.

Another significant aspect of these tests is to ascertain the flow patterns and induced gusts in the vicinity of the proposed construction site due to natural terrain and existing or future buildings and structures. Structural designers consider such determinations extremely important where dangerous high-velocity gusts, whirlwinds and "dust devils" might be generated across landing areas for military aircraft, heliports, assembly areas and walkways.

The Maher report indicates that appropriate correlation studies of proposed building sites can assist the designer in determining the proper shape and location of the proposed structure. Design then could minimize the wind-load and gust hazards due to factors that heretofore were generally undeterminable until after the structure had been erected.

Major RDT&E, Procurement Contracts Exceed $1.4 Billion

Army contracts exceeding $1 million each for research, development, test, evaluation and procurement from Sept. 9 through Oct. 8 totaled $1,474,234,855.

Western Electric Co. received two contracts totaling $475,546,319 for continued devlopment and production work on the Sentinel Ballistic Missile Defense System. Separate contracts for $30,064,984 provided for continued work on the Nike-X advanced development program, for Sentinel training devices, and for Nike Hercules improved kits.

Olin Mathieson Chemical Corp. gained $108,205,434 in contracts for operation and maintenance of a plant for production of propellants, bags, liners, ammunition components and for support services.

Ford Motor Co. was issued $51,482,345 in contracts for various types of trucks and Kaiser Jeep Corp. received a $42,413,060 modification to a contract for 2½-ton trucks.

A. O. Smith Corp. will get $31,733,540 for metal parts for 750-pound bombs. Hercules, Inc., is receiving $26,560,696 for 2.75-inch rocket grains, mixed acids and services.

Two contracts amounting to $24,201,058 with Remington Arms Co. are for small arms ammunition components and support services. Colts Inc., is receiving $23,402,525 for M16A1 rifles and Chrysler Corp., $19,484,712 for M60A1E2 combat tanks.

Brads Machine Products, Inc., will be paid $15,440,000 for metal parts for M557 fuze components. Philco-Ford Corp. was issued two contracts for $15,339,778 covering R&D in the Chaparral missile program and for guidance and control equipment for Shillelagh missiles.

Five contracts totaling $15,301,417 were awarded to General Motors Corp.—a $5,312,199 modification for diesel engines, $3,470,010 for OH–58A helicopter engines, a $3,442,850 modification for 155mm howitzers, a $2,036,578 modification for testing of engines for XM70 main battle tanks, and $1,039,780 for OH–6A helicopter turbine assemblies.

General Electric Co. is furnishing 20mm machineguns under three contracts totaling $15,141,033. Federal

Army Awards $475.5 Million Sentinel Contracts

Sentinel Ballistic Missile Defense System awards totaling $475,546,319 for continued development and production work became effective Oct. 1.

Announced by the Department of Defense, the two contracts with the Western Electric Co., Sentinel System prime contractor, were awarded by the Department of the Army. Continued R&D on the system is funded at $273,171,000 and $202,375,319 is for production and services.

Covered by the contracts are manufacture of the hardware to be installed at the first Sentinel operational sites, production management services, manufacturing and test engineering, and integration work.

The R&D contract, initially funded at $226,754,936 with the remainder awarded in increments during the contract period, includes funds for a prototype model of the long-range Perimeter Acquisition Radar (PAR) at the first Sentinel site near Boston, Mass. The prototype of this radar was built at the Army's Kwajalein Missile Range in the Pacific Ocean.

More than 60 percent of the contracts will be subcontracted, Western Electric officials reported. Some 3,000 companies in nearly every state are involved in the Sentinel program as subcontractors and suppliers.

Secretary of Defense Clark Clifford reaffirmed the Department of Defense decision in September to proceed with the Sentinel deployment program. Thirteen cities have been designated as potential locations for operational sites. Lt Gen Alfred D. Starbird is Sentinel system manager.

The Sentinel System Command, headed by Brig Gen I. O. Drewry and headquartered at Huntsville, Ala., negotiated and signed the contracts. The command is responsible for managing the Sentinel development and production program for the system manager.

Major subcontractors on the system and the approximate amounts planned for their efforts are: General Electric Co., Perimeter Acquisition Radar (PAR), $50,000,000 for R&D and $8,000,000 for production; Raytheon Corp., Missile Site Radar (MSR), $10,000,000 for R&D and $50,000,000 for production; McDonnell Douglas Corp., Spartan missile, $4,000,000 for R&D and $15,000,000 for production; and

Martin Marietta Corp., Sprint missile, $30,000,000 for R&D and $5,000,000 for production; Lockheed Electronics Corp., computer equipment, $2,000,000 for R&D and $1,000,000 for production; Radio Corp. of America, Texas Instrument Co., and Motorola Corp., integrated circuit packages, each $9,000,000 in production funds; Sperry Rand Corp., UNIVAC Division, computer program development, $1,000,000 R&D funds.

Col Beatty Directs Sentinel System Facility Construction

Construction of the approximate $100-million first facility in the 15- to 20-installation nationwide network for the Sentinel Ballistic Missile Defense System is under direction of Col Roy P. Beatty, a career Army Corps of Engineers officer.

Scheduled to be completed within two years, the installation in the Boston, Mass., area will include the Perimeter Acquisition Radar near Sharpener's Pond, North Andover, and the Missile Site Radar (MSR) and launching facilities at Camp Curtis Guild in Reading and Lynnfield.

Preliminary groundwork and construction of a 9,000-foot access road from Route 114 are under way by George Brox, Inc., for $767,000.

Col Beatty was area engineer for years at the National Aeronautics and Space Administration Mississippi Test Facility. Awarded the Legion of Merit for achievement on the $150-million construction project, he was responsible for building space booster testing facilities for the first and second stages of the Apollo-Saturn 5 moonshot rocket.

While assigned to Hawaii, he worked on the Army's Nike Zeus antimissile-missile facilities on Kwajalein and Roi-Namur, Marshall Islands. He is a 1946 graduate from the U.S. Military Academy with a BS degree in engineering and has a masters degree in civil engineering from the University of Iowa. He is also a graduate from the Infantry School, the Engineer School, and the Command and General Staff College.

Col Roy P. Beatty

Cartridge Corp. was issued a $14,162,768 modification contract for operation of a facility for production of small arms ammunition and services.

National Presto Industries is furnishing metal parts for M106 projectiles under a $13,893,750 contract. Seven contracts with AVCO Corp. totaling $13,523,979 are for 155mm, 40mm, and 2.75-inch rocket components, and for UH–1 aircraft engine components. Kisco Co., Inc., will get $13,490,000 for 105mm cartridge cases.

Hercules Engines, Inc., was awarded a $13,247,639 contract for multifuel engine assemblies for 2½-ton trucks and Consolidated Diesel Electric Co., $12,211,480 for 10-ton tractor trucks. General Dynamics Corp. will receive $11,666,844 for Redeye missiles.

Firestone Tire and Rubber Co. added two contracts totaling $10,585,071 for T130 track shoe assemblies for personnel carriers, and for loading, assembling and packing primers and 155mm artillery items. U.S. Time Corp. was awarded $10,500,000 for artillery shell fuzes.

Four contracts totaling $10,443,384 awarded to Raytheon Co. are for engineering and product assurance services for the Hawk missile system, and for metal parts for 750-pound bomb fuzes.

Contracts under $10 million. Kentron Hawaii, Ltd., $9,777,000 for continued operation and maintenance of technical facilities located at Kwajalein; Kennedy Van Saun Corp., $9,515,085 (two contracts) for metal parts for 105mm and 4.2-inch projectiles; Norris Industries, Everett, Mass., $9,150,728 for 66mm rocket launchers; and

Norris Industries, Inc., Los Angeles and Vernon, Calif., $8,285,963 (two contracts) for 105mm cartridge cases; Hughes Tool Co., $7,800,000 for OH–6A helicopter spare parts; Weatherhead Co., $6,456,038 (three contracts) for 105mm projectiles, and for 4.2-inch projectile parts; and

Honeywell, Inc., $6,434,715 (three contracts) for grenade and cartridge fuzes, and for electronic equipment; Eisen Brothers, Inc., $6,040,100 for metal pars for 40mm projectiles; UMC Industries, Inc., $5,500,681 (two contracts) for M18 grenades and loading and assembling 81mm illuminating projectiles; and

Airport Machining Corp., $5,171,305 (two contracts) for 60mm projectiles and metal parts for 2.75-inch rockets; Chamberlain Corp., $5,119,714 for metal parts for 40mm projectiles; Amtron, Inc., $5,000,000 for switchboards.

Contracts under $5 million. TRW, Inc., $4,978,996 for an integrated technical data system for the Cheyenne aircraft; Goodyear Tire and Rubber Co., $4,894,860 modification contract for shoe assemblies for M48 and M60 tanks; Harvey Aluminum Corp., $4,768,577 (two contracts) for M72 rockets and metal parts for 40mm cartridge cases; and

Wagner Electric Corp., $4,559,000 for metal parts for 4.2-inch projectiles; United Ammunition Container, Inc., Philadelphia, Pa., $4,228,427 for artillery ammunition containers; M. C. Ricciardi Co., Alpha, N.J, $4,094,625 for artillery ammunition containers; Amron Corp., $3,960,550 for metal parts for 40mm cartridge cases; Lasko Metal Products, Inc., West Chester, Pa, $3,777,955 for metal parts for bomb dispensers; and

ITT Corp., $3,566,649 contract modification for AN/GRC–144 radio sets and antenna alignment indicators; United States Forgecraft Corp., $3,564,000 for parts for 4.2-inch projectiles; Carter Carburetor Division of ACF Industries, Inc., $3,467,325 for M52 fuze bodies for 60mm projectiles;

Eastern Tool and Manufacturing Co., Belleville, N.J., $3,262,909 (two contracts) for metal parts for M18 rockets and 40mm projectiles; Batesville Manufacturing Co., $3,211,600 for parts for 750-pound bomb nose fuzes; Medico Industries, Inc., Wilkes Barre, Pa., $3,090,600 for parts for a 2.75-inch rockets; and

Parsons Manufacturing and Stamping Co., Cordova, Tenn., $2,912,000 for 4.2-inch mortar assembly components; Jackes-Evans Co., St. Louis, Mo., $2,739,000 for 7.62mm machinegun links; Uniroyal, Inc., $2,728,500 for pneumatic tires for trucks; White Motor Corp., $2,536,068 for 2½-ton trucks; United Ammunition Container, Inc., $2,495,087 for containers for 81mm projectiles; Ametek, Inc., Sheboygan, Wis., $2,452,345 for support assemblies for ammunition containers; and

Ocmet, Inc., Nashville, Tenn., $2,409,000 for parts for 4.2-inch projectiles; Alcan Aluminum Corp., Riverside, Calif., $2,327,336 for metal parts for rocket motors; Bell Aerospace Corp., $2,071,384 (two contracts) for UH–1 aircraft gearbox assemblies; Stanford Research Institute, $2,069,279 for studies for an antimissile-missile system.

Contracts under $2 million. Gibbs Manufacturing and Research Corp., Janesville, Wis., $1,992,600 for metal parts for fuzes for 2.75-inch rockets; Federal Electric Co., Paramus, N.J., $1,977,000 for engineering furnishing, installing and testing of an Integrated LOS Microwave Telecommunication System in the Federal Republic of Germany; and

MIF Industries, Inc., Branford, Conn., $1,956,000 for type G lifting plug for heavy artillery projectiles; Heckethorn Manufacturing Co., Dyersburg, Tenn., $1,808,000 for metal parts for hand grenades; Martin Marietta Corp., $1,785,584 for industrial engineering services for the Pershing weapon system; and

General Time Corp., $1,697,115 for parts for 2.75-inch rockets; Fairchild Space and Defense Systems Division of Fairchild Camera and Instrument Corp., $1,572,516 modification contract for M804 cased unit assemblies with XM78 Shillelagh system detonators and

Supreme Products Corp., Chicago, Ill., $1,436,800 for parts for 750-pound bomb fuzes; Bulova Watch Co., $1,410,232 for parts for 2.75-inch rocket components; Temco, Inc., $1,367,604 for M8 fin assemblies for 106mm projectiles; Dynalectron Corp., Washington, D.C., $1,274,440 for data collection and related support services; National Cash Register Co., $1,180,000 for services and materials to mount ADP systems in government-furnished vans; and

Duffers Associates, Troy, N.Y., $1,165,772 for battery chargers; Highland Industries, Kansas City, Mo., $1,134,629 for tank and pump units for petroleum trucks; Boeing Co., $1,104,288 for industrial prototypes and production engineering services on improved Hawk aircraft wings;

Lear-Siegler, Inc., Maple Heights, Ohio, $1,102,030 modification contract for CH–47 aircraft generators; Brunswick Corp., $1,097,492 modification contract for 35mm launchers; Hol-Gar Manufacturing Corp., Primos, Pa., $1,086,645 modification for generator sets for Xenon searchlights; and

LTV Electrosystems, Inc., $1,061,626 for components of vehicular radio sets; General Plastics Corp., Los Angeles, Calif., $1,050,403 for M565 and M564 supports; Ensign Bickford Co., Simsbury, Conn., $1,019,172 for M56 rocket motor igniters and M29A1 primers; and

Cornell Aeronautical Labs, $1,019,077 for services and materiel to conduct investigation systems integration study and testing; and

Eureka-Williams Co., $1,015,401 for parts for arming devices; Stewart Warner Corp., $1,014,160 for parts for 750-pound bomb fuzes; SKF Industries, Inc., Philadelphia, Pa., $1,000,112 for roller bearings for T–53 engines used on UH aircraft; and Dresser Industries, Inc., Columbus, Ohio, $1,000,000 for electronic units.

Army Continues EASTT Testing With LES-6 Satellite

Continued U.S. Army testing of an experimental, tri-service tactical satellite communications system moved ahead Sept. 26 with the successful launching of an Air Force/Lincoln Laboratory LES–6 satellite from Cape Kennedy, Fla.

Since the LES–5 satellite was placed in orbit July 1, 1967, the Experimental Army Satellite Tactical Terminals (EASTT) have been undergoing evaluation for dependable communications for tactical forces.

Designed by the U.S. Army Satellite Communications (SATCOM) Agency at Fort Monmouth, N.J., the terminals (two jeep-mounted, two shelter installations and one 26-foot van setup, plus two special instrumented test vans) were modified from LES–5 to LES–6 operation.

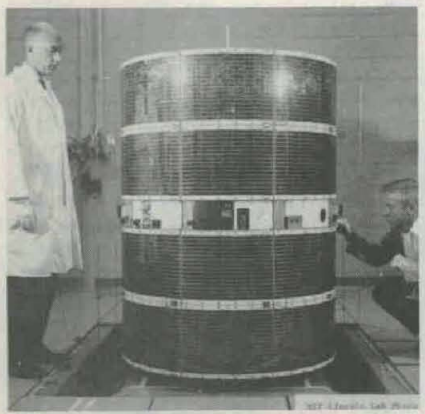
The Army purpose of the LES–6 operation is to exploit the capabilities and functional flexibility of the mobile ground elements and to establish design criteria which may be applicable to the more advanced Tactical Satellite Communications (TACSATCOM) Program.

The first phase of TACSATCOM will be to evaluate a satellite communications system specifically designed for tactical forces. The surface portion will involve use of SHF and UHF terminal configurations developed for operation with the SHF/UHF TACSATCOM 1 satellite.

The EASTT terminals in their LES–5 configuration have been extensively tested by SATCOM Agency military operating teams and test engineers during the past year. The initial technical test series was completed in the early fall of 1967 and was followed by tests in the jungles of the Army Tropic Test Center, Panama Canal Zone.

Results of these test programs reinforced the Army's confidence in the use of small terminals by forward echelon units, leading to a tour of military bases by a SATCOM EASTT team to acquaint tactical forces with the latest in military communications.

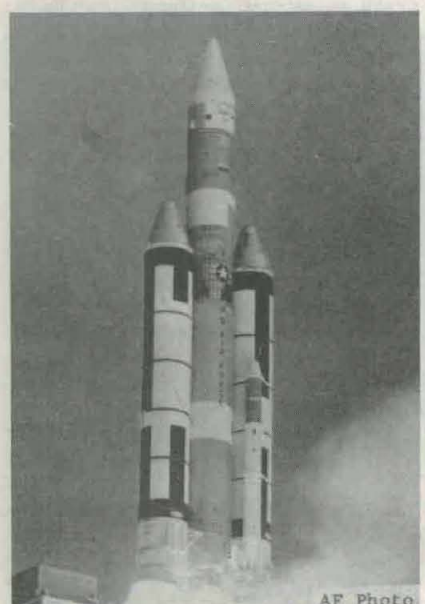
Beginning in early February, the



LES–6, launched by Titan III–C Standard Lauch Vehicle, is designed for tri-service radio communication tests among ships at sea, aircraft in flight, and portable and mobile ground terminals, to aid development of a tactical communication satellite system for the Department of Defense.

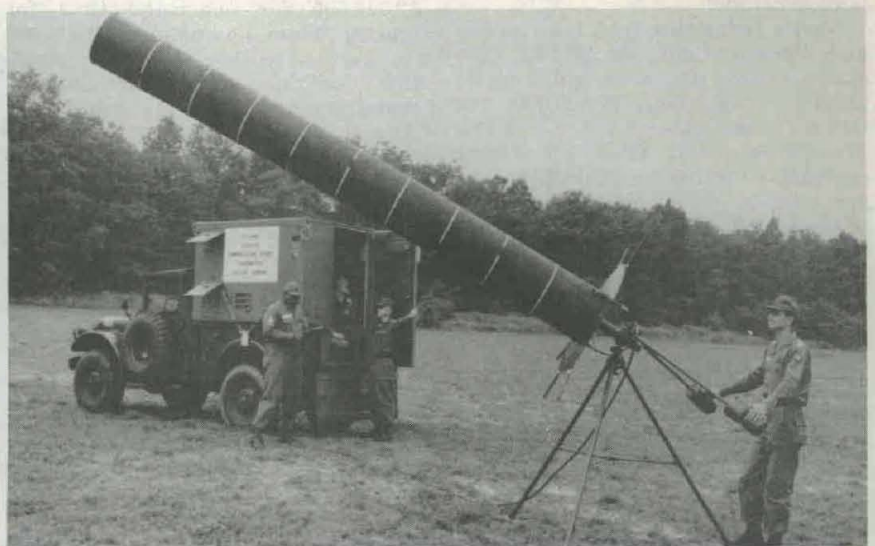
EASTT JEEP satellite communications terminal and cross-polarized yagi antenna locked on LES–6 satellite.

EASTT–5 terminal built for the SATCOM Agency as a "quick-fix" effort using modified equipment and vehicle.



AF Photo

AIR FORCE Titan III–C Launch



EASTT TEST TEAM members adjust special collapsible bifilar helix antenna which can be moved in a ¾-ton vehicle to a selected site, set up by a 2-man crew within half an hour and be ready to handle voice and teletype traffic.

EASTT tour team participated in exercises with 82d Airborne Division Signal elements at Fort Bragg, N.C.; operated with various Signal units at Fort Gordon, Ga.; introduced the system to the Infantry Center at Fort Benning, Ga.; and demonstrated the capabilities to the Strike Command at MacDill Air Force Base, Fla.

In March of this year, the LES–5/EASTT experimental satellite communications system was employed in an actual tactical situation during the U.S. Second Fleet, Exercise Rugby Match in which the Army, Air Force and Marines participated. (See April *Army R&D Newsmagazine*, p. 35.)

Commanded by Col George E. Rippey, the SATCOM Agency is the Army project management activity for satellite communications research and development, with responsibility for development of the ground terminals for military satellite communications systems and for the technical comunications testing of systems.

The agency has a personnel strength of 280, including civilian and military scientific personnel of the United States, Canada and Australia.

Many of the SATCOM Agency personnel are pioneers in space research and development, having participated in early experiments such as Diana which bounced signals from the moon; Score, the world's first communications satellite; Tiros, the world's first weather satellite; and Courier, an advanced communications satellite.

Dr. Dutta Joins AMMRC Staff As Ceramics Research Engineer

Dr. Samuel K. Dutta educated in India and England, has joined the staff of the Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass., as a research engineer in the Ceramics Division.

Graduated from the University of Calcutta with a BS degree, he also received an MS degree from that institution and MS and PhD degrees from the University of Sheffield, England. Since January 1967 he has been a post-doctoral Fellow in physical ceramics at Lehigh University.

Dr. Dutta is a member of the American Ceramic Society, the National Institute of Ceramic Engineers and the British Ceramic Society. He is an associate of the Institute of Ceramics in England.

His investigations as an AMMRC employe are concerned with research and development of stronger ceramic materials for structural applications.

CE Power Capacity Exceeds 10-Million Kilowatts

Hydroelectric power generating capacity of Army Corps of Engineers Civil Works projects passed a major milestone in mid-October when the total of plants in operation exceeded the 10-million kilowatt mark.

When the third 135,000-kw. generating unit went into production at the John Day Lock and Dam, a $450-million Corps of Engineers construction project on the Columbia River three miles from the John Day River, the all-time peak of 10,065,400 kilowatts total capacity was reached.

During the initial construction program at John Day Lock and Dam, 13 additional generating units will be completed progressively and placed in production, making a total installed capacity of 2,160,000 kilowatts. The ultimate installation will be 20 units, each of 135,000 kilowatts, totaling 2,700,000 kilowatts, making John Day one of the nation's largest hydroelectric power producers.

The experience of the Corps of Engineers in the construction and operation of hydroelectric power facilities began in 1909 when an existing water power plant on the Saint Mary's River, Mich., owned by the Edison Sault Electric Co., was acquired by the U.S. Government in accordance with the River and Harbor Act of Mar. 3, 1909. The purpose of the acquisition was primarily for navigation and incidentally for the development of electric power.

Thirty years ago the Corps of Engineers intiated its current hydroelectric power production program. The first project, Bonneville Lock and Dam, located on the Columbia River at Bonneville, Ore., started producing power from its 518,400-kw. power plant in 1938.

During the 30 years since Bonneville began operation and particularly since the end of World War II, the construction of federal multipurpose water resource projects has greatly expanded. The Corps of Engineers has become the largest builder and operator of hydroelectric power facilities in the United States.

John Day Lock and Dam is the 48th Corps of Engineers project to make its contribution toward meeting the nation's electric needs. These 48 projects, which have 221 generating units, are capable of producing in excess of 48 million kilowatt-hours of energy annually—enough to meet the power needs of an area with a population of nearly 10 million people. The Army Engineer production is more than 20 percent of the nation's current total hydroelectric power production capacity.

All 48 projects are part of the nationwide water resources program of the Corps of Engineers for flood control, navigation, and related beneficial purposes. They are operated through the Corps' network of Division and District offices.

Under the law, the Corps of Engineers does not market the power; except at the Edison Sault project, it turns the power over to the Department of the Interior. The Interior Department's marketing agencies for the power include the Bonneville Power Administration, the Southeastern Power Administration, the Southwestern Power Administration, and the Bureau of Reclamation.

Ultimate installed generating capacity of Corps of Engineers power projects now in production or under construction will exceed 21 million kilowatts. Consequently, the 10,065,400-kilowatt total capacity at present means that the projected overall program is about half completed.

INSTALLATION of a System and Components Test Station (SCTS) for the Pershing 1–A missile system is the center of interest for three Redstone Arsenal, Ala., officers most concerned. Maj Gen Charles W. Eifler (foreground), CG of the U.S. Army Missile Command, discusses the new equipment with Lt Col Edwin A. Rudd, Pershing project manager at the command, and Col Paul B. Schuppener, commandant of the Army Missile and Munitions Center and School (MMCS). The SCTS is the first item of P 1–A equipment delivered to the MMCS. Training of soldiers on maintenance of the system will begin shortly.

ATLIS Report No. 19 Available to Army Agencies Through DDC

Army Technical Library Information System (ATLIS) Report No. 19, "Criteria for Evaluating the Effectiveness of Library Operations and Services, Phase II: Data Gathering and evaluation," is off the press.

Prepared under the m nito sh p of Dr. Henry Voos as Picatinny Arsenal project officer, under a contract with J. I. Thompson and Co., the report was coauthored by Dr. Carl J. Wessel, Kenneth L. Moore and Barbara A. Cohrssen. The Phase I report occasioned a wide demand for copies and the new publication is expected to have an even broader impac

Distribution of the document is unlimited and is currently being made to all agencies involved in the ATLIS Program. Copies will be available upon request to the Defense Documentation Center, Cameron Station, Va. 22314. No AD number had been assigned at press time.

The overall study is divided into three phases—state-of-the-art; data gathering and evaluation; and establishing criteria. The report summarizes:

- Data and information collected to facilitate the development of criteria for the evaluation of the efficiency and effectiveness of Army technical libraries.
- Findings on the mission and objectives of Army technical libraries.
- Areas in which adequate standards for performance are feasible.
- Tentative (candidate) criteria and proposed management techniques useful in implementing them.

The criteria applies to four general aspects of library performance: 1) philosophical—reasons for the existence of the library; 2) management influence exerted on the efficiency and effectiveness of the library by management practices; 3) services and products—measures of service or product effectiveness; and 4) operations—criteria potentially useful as a basis for developing adequate standards for performance evaluation of the staff's professional actions.

The preface states that "the dividing line between Phase II and Phase III is neither fixed nor precise. . . . Phase II is not intended to be instructional in application of tentative criteria or methods of implementation.

"Phase III will present and validate criteria and methods of implementation suggested in this phase and will also present detailed instructions on how to apply the tools. Phase III will also present ranks for the criteria and tools according to their relative usefulness at various types of libraries."

A different approach used in the report is that of presenting the summary as the first chapter "so that the reader may better understand the developments in later chapters." The summary defines and explains the purpose of the four general categories of criteria.

Philosophical criteria, for example, are those "which relate to the enunciation of the reasons for the existence of the library and the purposes it serves . . . adequacy and clarity of the library mission statement."

Management criteria are those which "relate to the influence exerted on the effectiveness of the library by the management practices . . . how expertly the librarian . . . directs their efforts toward producing the services which are essential to fulfilling the goals and objectives. . . ."

Services and products criteria relate to "the actual services performed for a client or the products produced for the client's use . . . in fulfilling either individual client's needs or statistically fulfilling the needs of populations of clients."

Operations criteria relate to the "more or less routine, but nonetheless professional, actions which are carried out daily by the staff in operating a library, which actually determine the quality, quantity, usefulness and cost of the services and products."

ECOM Calls for Tech Papers For Frequency Control Meet

Technical papers on frequency control and related subjects are being solicited by the U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J., for presentation May 6–8, 1969, at the 23d Annual Frequency Symposium in Atlantic City, N.J

About 600 representatives of government, industry and educational institutions from throughout the world are expected to attend the meeting.

Approximately 30 of the papers will report research results on quartz crystal devices, atomic and molecular resonance, standardization, quartz crystal filters, frequency control circuitry, advanced technologies, fundamental properties, instrumentation and testing, and applications.

For those desiring to present papers, 10 copies of a summary, in sufficient detail for evaluation of the proposed paper (at least 500 words), together with the authors name, address and telephone number should be sent to: Director, Electronic Components Laboratory, U.S. Army Electronics Command, ATTN: AMSEL–KL–DT (Mr. M. F. Timm), Fort Monmouth, N.J. 07703.

Deadline for submission of summaries is Dec. 15. Authors will be notified of acceptance of papers about Feb. 15, 1969. For additional information, write to Mr. Timm or call 201–65–2882.

CDCIA Appoints Follis as Scientific Adviser to CO

Lawrence E. Follis was appointed recently to a newly created position of scientific adviser to the commanding officer, U.S. Army Combat Developments Command Infantry Agency (CDCIA), Fort Benning, Ga.

Follis will advise Col Thomas W. Brown and his staff on matters involving new developments in the military-scientific world with possible infantry applications. He also will provide scientific liaison with other government agencies and civilian organizations.

Follis was employed until recently at the Army Aviation Command (AVCOM) in St. Louis, Mo., where he directed activities in the helicopter propulsion system and drive system areas. He also headed a major cost-systems effectiveness study on a possible twin-engine UH–1 helicopter.

Lawrence E. Follis

Following completion of military service in World War II, he was employed by Sikorsky Aircraft Division of United Aircraft Division for nine years. He then spent seven years as senior scientist in the McDonnell Douglas Corp. and four years in the Bendix Radio Division, where he established a laser research facility.

He received a BS degree in mechanical engineering from the University of Rhode Island (1943), and earned master's degrees in mechanical engineering (1953) and physics (1961) from New York and St. Louis Universities.

Lt Col James C. McCraw

Lt Col Robert W. Badger

Lt Col Billy W. Fugitt

OCRD Announces 3 Personnel Assignments

Assignments of new officers to fill vacancies in the Office of the Chief of Research and Development, HQ Department of the Army, reached a low point for a 4-week period this year when only three replacements reported for duty this past month.

Lt Col James C. McCraw, new chief of the Policy Branch, Management and Evaluation Division, recently completed a tour of duty in Korea as G2, 2d Infantry Division.

Graduated with a BA degree in education from Texas Western College in 1951, he completed the Command and General Staff College (C&GSC) in 1962 and the Armed Forces Staff College (AFSC) in 1967.

He has served as commander of the 1st Battalion, 61st Artillery (Nike-Hercules), Travis Air Force Base (AFB), Calif. (1964–66), and instructor at the U.S. Military Academy (USMA) Department of Tactics (1962–64). He holds the Bronze Star Medal (BSM) and Army Commendation Medal (ACM) with two Oak Leaf Clusters (OLC).

Lt Col Robert W. Badger completed a tour of duty with the Automatic Weapons Battalion and II Field Force (Artillery) in Vietnam before reporting for duty as a staff officer with the OCRD Management and Evaluation Division.,

He earned MS degrees in mechanical and industrial engineering from the University of Southern California (1963–64), and an MBA degree in qualitative analysis from New York University (1967).

Military assignments have included instructor of engineering fundamentals at the USMA (1964–67); staff officer with a Nike Hercules Missile Battalion in the Maryland area (1958–61); commander of the 105 Howitzer Battery, U.S. Army Pacific, Korea (1957–58); and battery officer, Automatic Weapons Battalion, Fort Hood, Tex. (1955–56).

He holds the BSM, Air Medal (AM) and ACM.

Lt Col Billy W. Fugitt has been assigned as a staff officer with the Research Plans Office, U.S. Army Research Office (USARO).

He earned BS degrees in education and mathematics from Southwest Missouri State in 1957 and an MS degree (1966) in industrial mangement from Georgia Institute of Technology.

He recently completed the Air Command and Staff College at Maxwell AFB, Ala., after serving a tour of duty with the 222d Aviation Battalion and the 73d Surveillance Airplane Company in Vietnam.

Lt Col Fugitt also served with the 2d Battalion, 11th Artillery at Fort Sill, Okla. (1963–64), and with the U.S. Army Aviation School at Fort Rucker, Ala. (1961–62).

A senior Army aviator, he holds the BSM with OLC, AM with 4 OLC, and the ACM.

AMRU Dermatology Chief Receives 'A-Prefix'

Col William A. Akers, chief of the Dermatology Research Program, U.S. Army Medical Research Unit, Presidio of San Francisco, recently received the "A-Prefix," signifying the highest professional attainment within the Army Medical Department.

Col Akers has served in his present assignment since August 1967, and is on the teaching staff at Letterman General Hospital and the University of California Medical Center, San Franscico. He is a former associate professor of medicine at the University of Colorado School of Medicine and the author of 16 papers.

Col Akers received an MD degree from the University of Louisville (Ky.) School of Medicine (1941), and served his internship at the Louisville General Hospital and residency at Children's Hospital in Louisville.

He was assigned as a pediatrician to Walter Reed General Hospital in Washington, D.C., when he entered the Army in 1954. In 1961 he served his residency in dermatology and became a certified specialist at Brooke General Hospital, Tex.

Subsequently he was chief, Dermatology Service at the 121st Evacuation Hospital, Korea; U.S. Army Hospital, Fort Campbell, Ky.; and Fitzsimons General Hospital, Denver, Colo.

A Diplomate and Fellow of the American Academy of Dermatology, he is a member of the American Medical Association, the Society for Investigative Dermatology, the Association of Military Dermatologists, the Association of Military Surgeons, and the Association for the Advancement of Science.

Col William A. Akers

Appropriations Bill Funds Sentinel, Hospital Work

Appropriations in a military construction bill signed recently by President Lyndon B. Johnson included $227.5 million for the Air Defense Command for construction in support of the Sentinel Ballistic Missile Defense System. Work will be done under Corps of Engineers supervision.

General locations for Sentinel System construction, as revealed during hearings before the House Appropriations Committee of Congress, are Boston, Mass.; Grand Forks, N. Dak.; Chicago, Ill.; Seattle, Wash.; Detroit, Mich.; Albany, Ga.; Dallas, Tex.; Salt Lake City, Utah; New York, N.Y.; Honolulu, Hawaii; San Francisco and Los Angeles, Calif.; and Whiteman Air Force Base, Mo.

The bill also contained $17.5 million for a modern building for William Beaumont General Hospital in El Paso, Tex. The hospital presently occupies 51 single-story semipermanent and temporary buildings constructed mainly during 1920–1942.

Provision also is made in the bill for $2,856,000 for construction of additional research facilities at the Forest Glen (Md.) Annex of Walter Reed Army Medical Center.

Kudos

CHIEF OF R&D Lt Gen A. W. Betts presents Exceptional Civilian Service Award to Julian Davidson, director of the Nike–X Development Office at Redstone Arsenal, Ala., for "outstanding contributions in studies to evaluate the effectiveness of the Nike-X System in various deployments.

DISTINGUISHED SERVICE MEDAL. *Brig Gen Thurston T. Paul Jr.* received the DSM for eminently meritorious service from August 1965 to September 1968.

General Paul served as Assistant Deputy Chief of Staff for Logistics from August 1965 to May 1966, then as Director of Plans and Programs, Office of the Chief of Research and Development (OCRD) until Sept. 30 when he retired after 32 years of Army service.

In performing his duties, the citation stated, "General Paul revitalized, expanded and improved the program to automate the R&D management information system.

"Through his sound judgment and managerial talent, he has been able to achieve maximum progress in spite of scarce resources. He instituted management techniques which provided greater returns for funds, manpower and time expended and significantly enhanced the Army's research and development effort.

"He made a major contribution to the defense of the nation by planning, organizing and executing the evaluation which selected a system contractor for an advanced air defense weapons system.

"Throughout his duty on the General Staff, General Paul, because of his vision, objectivity, analytical insight, and ability, has been an invaluable adviser to the Deputy Chief of Staff for Logistics, the Chief of Research and Development, the Chief of Staff and the Secretary of the Army."

MERITORIOUS CIVILIAN SERVICE AWARD. *Frederick R. Hickerson* of the Explosives Ordnance Disposal Center at Picatinny (Dover, N.J.) Arsenal, received the MCS award for his outstanding technical and engineering leadership and technical direction which led to the Center's transition from a primary staff element to an RDT&E activity.

Hickerson, who holds a BS degree in mechanical engineering from Clemson College, has written and published 14 major scientific publications in the field of missiles and missile delivery systems. He has filed for numerous patents munitions.

He is an associate Fellow in the American Institute of Aeronautics and Astronautics, and has acted in an advisory capacity to the Bureau of Aeronautics on technical problems.

Frank R. Larson, recent recipient of a Secretary of the Army Research and Study Fellowship (see October issue of this Newsmagazine), also received the MCS Award for service as chief of the Metals Laboratory at the Army Materials and Mechanics Research Center, Watertown, Mass.

His citation reads in part, "During the period July 1, 1966 through June 30, 1968 . . . his metallurgical investigations of 175mm gun tube failures have resulted in upgrading of specifications in all current and future gun tube production, and increased assurance of the reliability of gun life."

Miss Short Retires After 50 Years With OTSG

Fifty years of continuous service with a single U.S. Government agency ended for Miss Omar Short when she retired recently as chief of the Mail and Records Branch, Office of The Surgeon General of the Army.

Acting in behalf of Army Surgeon General (Lt Gen) Leonard D. Heaton, Maj Gen Glenn J. Collins, DSG, presented to her the Meritorious Civilian Service Award and a 50-year service pin during retirement ceremonies attended by high-ranking military and civilian personnel, congressmen and other U.S. Government officials.

Secretary of the Army Stanley R. Resor, Army Chief of Staff General William C. Westmoreland, Chairman of the U.S. Civil Service Commission John W. Macy Jr., Senator Richard B. Long (D.-Ga.) and numerous other high-ranking officials sent her letters of congratulation and commendation.

Many letters came also from Army Medical Service Corps leaders in various parts of the world. Fellow employes presented her with a color television, $175 in U.S. Savings Bonds and numerous other valuable gifts.

A graduate of Lucy Cobb Junior College in Athens, Ga., Miss Short began her Civil Service career Sept. 3, 1918, at a starting salary of $1,100 per annum. She had intended to work only a year.

Beginning with Maj Gen William C. Gorgas, she has known personally the 10 Army Surgeons General she has worked under and is proud of her collection of portraits and correspondence from them.

Frequently, she has been called upon by historical societies to certify authenticity of furniture, uniforms and other items of the times.

During her service, Miss Short accumulated 2,304 hours of sick leave. The only period of illness on her record occurred in her first year with the Office of The Surgeon General when she became a victim of the worldwide influenza epidemic in 1918.

"Superior work is an everyday quality I have strived for," she commented. "There were times during World War II when we worked six days, and sometimes seven, mostly without overtime."

In her branch, the employes really believe the saying about the mail going through. "Our office is the alpha and omega of The Surgeon General's Office as far as paperwork is concerned. All work starts and ends here," she proudly claimed on numerous occasions.

What does a 50-year employe do upon retirement? In Miss Short's case, returns to her former office two or three times a week to talk to old friends.

DEPUTY SURGEON GENERAL of the Army Maj Gen Glenn J. Collins presents Miss Omar Short with the Meritorious Civilian Service Award.

BRL Applied Mechanics Branch Chief Gets Kent Award

The Kent Award for 1968 was awarded Oct. 11 to Herman P. Gay, chief, Applied Mechanics Branch, Interior Ballistics Laboratory, Army Ballistic Research Laboratories (BRL), Aberdeen Proving Ground (APG), Md.

Established in 1956, the award honors Dr. Robert H. Kent who earned many honors as one of the nation's leading ballistics experts. Dr. Kent served for many years as associate technical director of the Army Ordnance BRL until he retired in 1956. He died in February 1961.

Gay was cited for outstanding contributions in the field of weapons technology and for development of techniques and apparatus for measuring and simulating the forces and motions of automatic weapons.

Employed at the APG as an engineering aid in 1937, he transferred to BRL in 1939. Promoted to ordnance engineer in 1941, after receiving a BS degree in mechanical engineering from Johns Hopkins University, he continued graduate studies there (1946–47) and at the University of Delaware (1948).

During the early part of World War II, a major part of his work was devoted to automatic guns, for which he received the Exceptional Civilian Service Award. Toward the latter part of the war, he developed techniques and equipment for use with high-powered weapons in aircraft and tanks.

Later, as a branch chief with the Ordnance Engineering Laboratory, he participated in the development of soft recoil systems for automatic weapons. His most recent contributions include design and development of a miniature, strain-type pressure gauge and nonmetallic rotating bands, and the development of an automated pressure measuring system for monitoring the interior ballistic characteristics of small arms ammunition.

Gay also is credited with design and fabrication of a pressure gauge calibrator, development of techniques for the analog simulation of gun mechanisms, and gun studies to determine causes of fatigue failures of 175mm guns in Southeast Asia.

Awarded several patents for inventions during his work at BRL, he has written numerous scientific and technical reports. Currently he is serving on nine groups concerned with various aspects of weapon technology and target vulnerability.

KENT AWARD WINNER Herman P. Gay accepts accompanying citation from Dr. R. J. Eichelberger, director of the U.S. Army Ballistic Research Laboratories, as Mrs. Gay looks on.

Mobility Equipment Labs Test Prototype of Heater-Cooler

A prototype solid-state 24,000 Btu/hr. heating-cooling unit is undergoing acceptance tests at the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

The unit is designed to provide ultra-high reliability for field use by the Army in vans and military shelters housing sensitive electronic combat equipment.

Multiple series connected thermoelectric modules employ bismuth telluride pellets sandwiched between aluminum heat exchangers to remove or add heat without moving parts. Wear and leakage common to conventional refrigerant compressors, valves and piping is eliminated.

Control and transfer from heating to cooling are all automatic, accomplished by a power control unit and fans that work directly from conventional electric power sources. The 380-pound, 60 x 28 x 18-inch prototype was designed and built under contract by the Atomic Equipment Division of Westinghouse Electric Corp.

WRGH Spurs Scout's Interest in Orthopaedic Career

When a 14-year-old Eagle Scout interested in a possible career in orthopaedic surgery wrote to the Office of The Surgeon General, Department of the Army, to ask for an interview that might give him facts for a decision, Walter Reed General Hospital gave him "VIP consideration."

Col Charles W. Metz, chief, Department of Orthopaedics, WRGH, granted the interview to Noel DeBacker, a much-decorated Boy Scout, and was one of his hosts on a tour of Ward 34 to see orthopaedic patients. This was a dream come true to Noel, a member of Troop 773 in Bethesda, Md., for he had heard much about the outstanding work done at WRGH.

Following the 45-minute interview, Col Metz formed a party with the head nurse and other staff members to stop at the bedside of each patient to explain to Noel the nature of the injury and the treatment.

Why orthopaedics as a career? Noel's answer is that he had considered cardiovascular or neurosurgery careers in medicine but "I don't think I have enough courage to be a neurosurgeon. I wouldn't want to hold someone's life in my hands all the time. . . . But I always liked the idea of medicine—of helping people."

Part of the indoctrination given to Noel at WRGH was an explanation of the various medical education programs sponsored by the Department of the Army. Each year, selected medical students at schools all over the country are admitted and commissioned in the Army while in school.

Commissioned as second lieutenants, they are stationed at the medical school until they graduate. Then they are activated, at which time they also are eligible for the military internship and then residency programs.

Candidates who apply for the Senior Medical Program are reviewed on a highly competitive basis. Selections are made on the basis of scholarship, character and leadership qualities—also the probability of their remaining in the military service after completing the required active duty.

Noel appears to have most of the attributes. In addition to numerous honors he has won in scouting, he is a good scholar and although only a sophomore has won high school letters in baseball and soccer.

EAGLE SCOUT Noel DeBacker on tour of Ward 34 with Col Charles W. Metz, chief. Department of Orthopaedics, Walter Reed General Hospital.

Dust Control in Vietnam

By William L. McInnis and Royce C. Eaves

WILLIAM L. McINNIS is chief, Expedient Surfaces Branch, Soils Division, U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss. He holds a BSCE degree from Mississippi State University (1944), and served with the Army as a commissioned Officer (1942–46). McInnis has conducted and supervised engineering investigations in civil works and military RDT&E.

ROYCE C. EAVES is a research engineer in the WES Stabilization Section. He received a BSCE from the University of Southwestern Louisiana (1960), and served with the U.S. Army (1952–54). Eaves was a highway construction engineer with assignments in earth moving and base stabilization from 1960 to 1962. He is a registered engineer in the State of Mississippi.

William L. McInnis

Royce C. Eaves

Increased use in Vietnam of aircraft, especially rotary-wing types, under the concept of airmobile operations, has greatly accentuated the need for a large number of expedient airfields and heliports, and for means to provide a dust-free environment.

Dust, defined simply as airborne particles of soil predominantly finer than 0.074mm (passing the No. 200 sieve), can have significant adverse effects on the over-all efficiency of aircraft and vehicles. Results include increased downtime and maintenance requirements, decreased engine life, reduced visibility, and deleterious affects on health and morale of personnel. Dust clouds also can aid the enemy by revealing the position and scope of operations.

Soils in Vietnam consist mainly of laterites, sands and clays. The urgency of controlling or alleviating dust in areas of military operations was recognized by the Army Chief of Staff in December 1965. Logistical problems had been increased greatly by drastic reductions in the "usage expectancy" of machinery and equipment. In some instances the normal estimated life of helicopter engines was reduced by one-half to two-thirds.

Extra maintenance costs for helicopters operating in a dust environment approached $100 million annually. Dust in cantonment areas and on roads was recognized as a serious problem, but the need to alleviate dust in helicopter operational areas was considered paramount.

Corps of Engineers research to find or develop suitable materials or methods capable of stabilizing, waterproofing and dustproofing soils had been initiated in 1946. Most of this effort was applied in stabilization studies for treating areas subjected to heavy traffic.

In January 1966, at a meeting in the Office, Chief of Engineers, Washington, D.C., the Waterways Experiment Station, Vicksburg, Miss., was directed by the U.S. Army Materiel Command to intensify and accelerate its program of research and development of dust-control materials.

Initial emphasis was centered on satisfying the short-term objective of controlling dust in areas peripheral to main traffic areas, such as shoulders adjacent to airfield runways or taxiways and around helicopter pads. Such areas would not normally carry traffic but would be subjected to random foot and vehicular traffic.

The long-range objective was to develop a versatile, multipurpose, dust-control material and/or technique that would effectively suppress dust in all areas where its generation would be detrimental to military operations.

Certain desirable characteristics were established for use in evaluating a material as a dust-control agent. First was that it should be available in large quantities and capable of withstanding open storage under humid, tropical conditions for at least three years; also, it should be noncorrosive and nontoxic and should not contaminate adjacent farm land.

Since time is of the utmost importance in most military operations, the dust-control agent should be effective and operational within four hours after placement and have a useful life of at least six months. Maximum application should not exceed three pounds per square yard and should be accomplished easily and rapidly.

C–130 Landing on Sandy Surface

Subsequently, a conference was held with industry representatives at Waterways Experiment Station in which the dust problems in Vietnam were reviewed. Industry was invited to submit to WES for testing any on-the-shelf product or material that might have potential for controlling dust; also, to submit proposals for contract research to develop a material that would meet the desired characteristics of a dust-control agent.

Since February 1966, WES efforts have been directed toward the testing and evaluation of more than 200 materials and various mulch and erosion-control systems.

To evaluate the capabilities of these items, in-house procedures were developed covering three general phases of investigation as follows: (a) laboratory screening tests, (b) random traffic tests, and (c) helicopter downwash blast tests.

The most promising materials were then sent to the field by the Army Materiel Command for evaluation by the Test and Evaluation Command. Work also was initiated to investigate the feasibility of thermal treatment of soil surfaces for dust control. In addition, six proposals were accepted from industry and research organizations for investigations of various soil-surfacing treatments for dust control.

Materials that have been investigated thus far include: asphaltic compounds, resins, sulfur-based compositions, sodium silicates, urea resins, cationic emulsions, linseed, polyurethanes plus various mulches such as wood fiber, grass root and hay. Erosion-control blankets, such as Ultracheck, Stanmat and excelsior, also have been tested.

An asphaltic penetrative soil binder,

being examined at the time the dust program was accelerated, was quickly determined to have potential as a dust palliative. A considerable quantity of this material was sent to Vietnam as an interim solution.

Results of research on other materials indicated that liquids which will cure rapidly to form a film or membranous ground cover would also be capable of preventing or alleviating dust formation. A small quantity of one of the most promising of the film formers, a polyvinyl acetate emulsion. was sent to Vietnam in 1967.

Reports received from Vietnam on evaluation tests of the asphaltic binder and the polyvinyl acetate emulsion indicate that the latter is definitely effective as a dust palliative. It will withstand traffic on straight roadways but will not withstand abrasion when vehicles turn or brake repeatedly.

Apparently, the major difficulty in using this material involved the equipment (asphalt distributor) used to apply the liquid to the ground surface. The asphaltic binder proved effective in untrafficked areas but frequent applications are required.

Currently, a centrifugal natural latex and a cationic asphalt-neoprene blend are being evaluated as dust palliatives. In addition, the use of continuous-strand fiber glass roving with these materials and with the polyvinyl emulsion is being investigated to improve performance under traffic and severe blast.

Results of present tests are most encouraging, but it is recognized that considerable effort is still needed to define the general versatility of these materials on a range of soil types under different environmental conditions, and to develop equipment for effective and rapid emplacement.

Indicative of the magnitude of the airfield surfacing and dust-control activities of the U.S. Army in South Vietnam are the statistics compiled as of Oct. 10, 1968. WES program managers reported the laying of 62.5 million square feet of surfacing membrane, 100.8 million square feet of M8A1 steel mat, 7.0 million square feet of XM–18 and XM–19 aluminum airstrip matting, and 838,500 drums (55 gallons each) of Peneprime soil-treatment material.

Army Presents Award to Bell

The first annual U.S. Army Aviation Materiel Command contractor cost-reduction award was presented recently to Bell Helicopter Co., Fort Worth, Tex., for its "outstanding cost-awareness program." The award recognizes effort that best meets DoD standards for reducing costs while maintaining schedules, quality, reliability, maintainability and logistic features.

Wilks Award Highlights Design of Experiments Meet

Prof. Jerzy Neyman, University of California (Berkeley), received the Samuel S. Wilks Award, presented by the American Statistical Association (ASA), at the 14th annual Conference on Design of Experiments in Army RDT&E, Oct. 23–25, Edgewood, Md.

The U.S. Army Mathematics Steering Committee (AMSC) sponsors the meeting for the Chief of Research and Development. Dr. Ivan R. Hershner Jr., chief, Physical and Engineering Sciences Division, U.S. Army Research Office, OCRD, is AMSC chairman.

Initiated in 1964 in memory of the Princeton professor who achieved international recognition as the "Statesman of Statistics," the annual Wilks Award is administered by the American Statistical Association.

Each award recipient is recognized for achievement in advancing scientific or technical knowledge in Army statistics, ingenious application of such knowledge, or successful activity in fostering cooperative scientific matters that benefit the Army, the Department of Defense and U.S. Government.

Prof. Neyman's citation acclaimed him as an educator "whose extensive contributions, both to the theory and practice of statistics, have led to fundamental changes in the thinking and methodology of scientists all over the world."

Born of Polish parents in Bendery, Bessarabia, Prof. Neyman received his early education at the University of Kharkov and obtained his PhD degree from the University of Warsaw. He was a lecturer at the Universities of Warsaw and Cracow and headed the Biometric Laboratory of the Nencki Institute of Warsaw.

A Rockefeller Fellowship enabled him to study at the University of Paris and at University College, London. He remained as a staff member from 1934 until 1938, when he went to the University of California as a professor of mathematics. He is now professor emeritus recalled to duty, and director, Statistical Lab.

Prof. Neyman first worked in pure mathematics. Then he turned to the theory of statistics and developed the theory of confidence intervals and helped develop the theory of testing hypotheses.

His interests later turned to sampling theory and applications of statistics in the various sciences, including astronomy, biology and health, and weather modification. His recent theoretical work has been the development of a new procedure for testing composite hypotheses.

Prof. Neyman and the Berkeley Statistical Laboratory worked on tactical problems of the Air Force under the National Defense Research Committtee during World War II. In more recent years he has served on many committees concerned with statistics in government.

He is the author, coauthor or editor of more than 200 scientific publications. Several have been translated into Spanish, Polish and Russian.

Prof. Neyman has received many awards and honors, including honorary degrees from the Universities of Chicago, California and Stockholm; the Guy Medal in Gold of the Royal Statistical Society (London, England); Newcomb Cleveland Award of the American Association for the Advancement of Science; and the Centennial Award of the Academic Senate, University of California.

Prof. Neyman is the fifth recipient of the Wilks Award. Others are Prof. William G. Cochran, Harvard University (1967); Maj Gen Leslie E. Simon, USA, Ret. (1966); Prof. John W. Tukey, Princeton University (1965); Dr. Frank E. Grubbs, U.S. Army Ballistics Research Laboratories, Aberdeen (Md.) Proving Ground (1964).

Col Bottiglieri Named CO, Director AMRU—Presidio SF

Col Nicholas G. Bottiglieri reported for duty in October as commanding officer and director, U.S. Army Medical Research Unit-Presidio, and as chief, Dept. of Research and Development, Letterman General Hospital, San Francisco, Calif.

He recently completed a tour as chief of the Medical Research Laboratory at Edgewood Arsenal, Md. His specialty is in the field of internal medicine and he has authored a number of professional papers pertaining to gastroenterology, pharmacology and cancer chemotherapy.

Col Bottiglieri received his medical degree from the University of Vermont School of Medicine in 1945. He is a Diplomate, American Board of Internal Medicine, and a Fellow of the American College of Physicians.

Col N. G. Bottiglieri

Electronically Active Ionic Devices

By Dr. John N. Mrgudich

From its name, one would infer that the U.S. Army *Electronics* Command would devote all of its attention to the development of useful *electronic* devices which, in a fundamental sense, involves investigation of better and more sophisticated ways to control a flow of *electrons*. Yet this command has for several years supported a modest in-house program to develop electrically active devices based, in effect, upon *absence* of electron flow. This new approach involves the control of a flow of *ions*—that is, a flow of *electrically charged atoms*. Properly speaking, these new devices are, therefore, "*ionic*" rather than "*electronic*."

A basic property of ionic flow is that it involves simultaneous transport of charge *and* matter. This transport of matter as an adjunct of ionic flow is commonplace to the electrochemist who makes use of it, for example, in electroplating. However, to the electronic engineer it means, to give a crude but illuminating analogy, that soldered joints migrate through the circuit as a function of current flow.

This dual charge-mass transport characteristic of ionic devices can be viewed, with considerable justification, as a disastrous shortcoming. More optimistically. it can be considered as a sort of second degree of freedom which, if properly turned, may permit accomplishment of a multiplicity of objectives with a single transport of charge.

An Electrically Controlled Ionic Balancing Device. It has long been known that solid silver iodide (AgI) is a conductor for positively charged silver ions (Ag^+ ions) and an *insulator* for electrons. One can think of solid silver iodide as a material in which a loosely held silver-ion "cloud" is relatively free to move through a rigid lattice of negatively charged iodide ions (I^- ions).

Suppose now that a layer of silver metal powder is compressed onto each flat face of a cylindrical rod of compressed silver iodide to make an Ag/AgI/Ag array that is connected across a source of dc voltage (0.6v), as shown in Figure 1.

Closing switch S will result in an external electronic flow easily controlled by the variable resistor R. Electrons flowing into Electrode E_2 will combine with loosely held AG^+ ions in the Ag^+ lattice to form neutral silver atoms which plate out onto Electrode E_2.

Charge compensation requires that

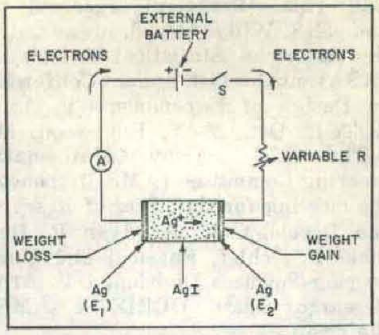


Fig. 1. Balancing Device

an equal number of electrons leave Electrode E_1. These departing electrons are made available by "ionization" of neutral silver atoms in Electrode E_1 into Ag^+ ions and electrons. The Ag^+ ions liberated by the departing electrons are free to enter the AgI to replace the Ag^+ ions that were plated out onto Electrode E_2.

The net result of current passage is a "solid-electrolyte" plating process whereby Electrode E_1 shows a loss in weight and Electrode E_2 shows a gain in weight. The center of gravity of the array, of course, shifts in a direction from E_1 to E_2. Reversing the polarity of the external voltage source will shift the center of gravity in the opposite direction.

The device can be used for very sensitive balancing; one micro-ampere-second of easily controlled external electronic flow will transport 1.117×10^{-9} gm of silver from E_1 to E_2. Plans are being studied to explore the possibility that this method of balancing can be applied to a rather important problem involving easy control of a change of 0.001 gm-cm in the center of gravity of a lightweight free-floating body.

A Deformation-Sensing Ionic Device. Suppose that a thin array of Ag/AgI/Ag, about the size of a dime, is prepared using compressed silver and silver iodide powders and that the rim of this array is clamped between insulating teflon blocks, as shown in Figure 2.

Research has proved that a very gentle, steady downward force applied to the overhanging edge of the clamped array will generate a substantially constant voltage, with the top (stretched) electrode being positive with respect to the bottom (compressed) electrode.

Response and recovery are quite fast since quick, gentle taps result in rather sharp voltage spikes. Applying the same gentle, steady upward force against the bottom electrode results in a generated voltage of the same magnitude but of reversed polarity. It is as if compressing a silver electrode tends to "squeeze" positively charged Ag^+ ions into the AgI and charge-compensating electrons into the external circuit.

Work to date has shown that these easily fabricated, economical arrays (material cost for an array about the size of a quarter is 25 cents) are quite stable. Impedance is quite low (about 100 ohms). Voltage output is quite reproducible and linear, with deformation at about one microvolt output per microinch strain up to one millivolt before the rather brittle array snaps. Array behavior is independent of temperature within at least the range $-15°$ F. to $+105°$ F. provided that both silver electrodes are at the same temperature.

Because of the low impedance, the voltage output is amenable to clean amplification. Output can be increased through use of thicker arrays or by series connection of simultaneously responding arrays. Reliability, of course, can be increased through redundancy by using parallel connection of simultaneously responding arrays.

Data available indicate that the arrays will respond to frequencies at least as high as 5,000 cps. In addition, work by Technical Operations, Inc., of Burlington, Mass., has indicated that

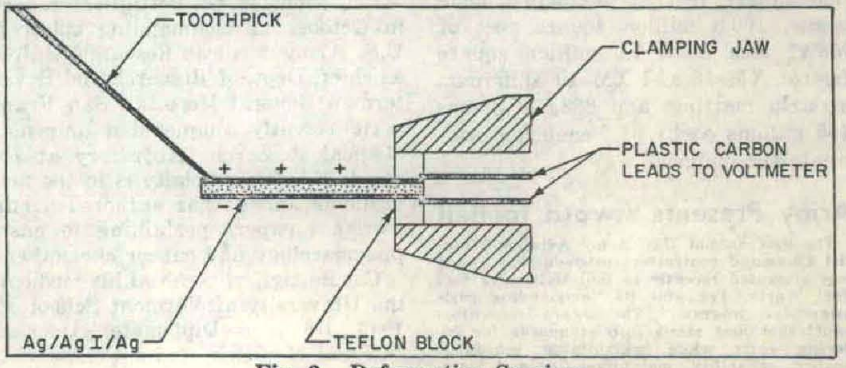


Fig. 2. Deformation Sensing

deformation-sensing arrays may be amenable to fabrication in ultra-thin (0.0004-inch thick) form, using the side design flexibility of vacuum-deposit techniques.

Some problem areas require further research. Silver iodide (originally selected because of its relatively high conductivity at room temperature) exhibits a phase transformation at 280° F. This places an upper-temperature limit on its usefulness.

Other materials, however, become relatively good ionic conductors at high temperatures. There is no theoretical reason why some of these might not be useful, possibly up to as high as 2,500 to 2,700° F.

Another worrisome factor is that the output of a steadily deformed array slowly drops with time. This probably is due to creepage within the silver electrodes or at the silver-silver iodide interfaces.

The creepage effect is smaller with thicker silver electrodes and can probably be minimized further through incorporation of appropriate binder or by interleaving of some AgI powder into the powdered Ag electrodes.

With respect to foreseeable applications, it is unlikely that this "ionic strain gauge" poses any threat to conventional metallic strain gauges whose technology is well advanced. Such conventional metallic gauges, however, require significant power to energize bridge circuits and accessory amplifiers needed to utilize a resistance change induced by gauge deformation.

The ionic device, by virtue of its direct voltage output, can lower these power requirements to permit simplification of unattended, long-term monitoring of remote terrestial, or even lunar, deformable elements such as diaphragms, bellows, bourdon tubes, accelerometers, lightweight seismographs, microphone pickups, covert alarm systems, etc.

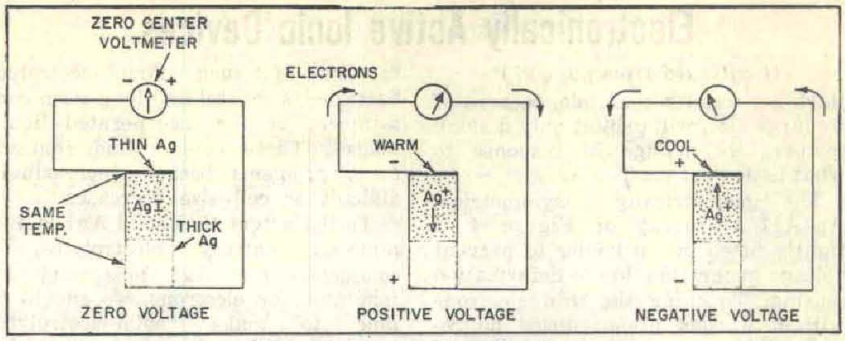


Fig. 4. Temperature Sensing

An interesting suggestion has been made, involving an emergency "heart stimulator." The concept is that such a device, appropriately encapsulated and permanently implanted on open circuit and connected to the heart, could be activated by externally applied pressure to generate appropriately timed voltages to stimulate some types of momentary heart stoppages. Other types of implants to reinforce neuron activity can be envisioned.

A Direction-of-Gravity Sensing Ionic Device. Suppose, as is shown in Figure 3, that we mount equal weights at the center, but on opposite faces, of a thin Ag/AgI/Ag array and then support the array by clamping around its entire outer rim. The configuration is similar to cementing central weights onto opposite faces of a taut drumhead.

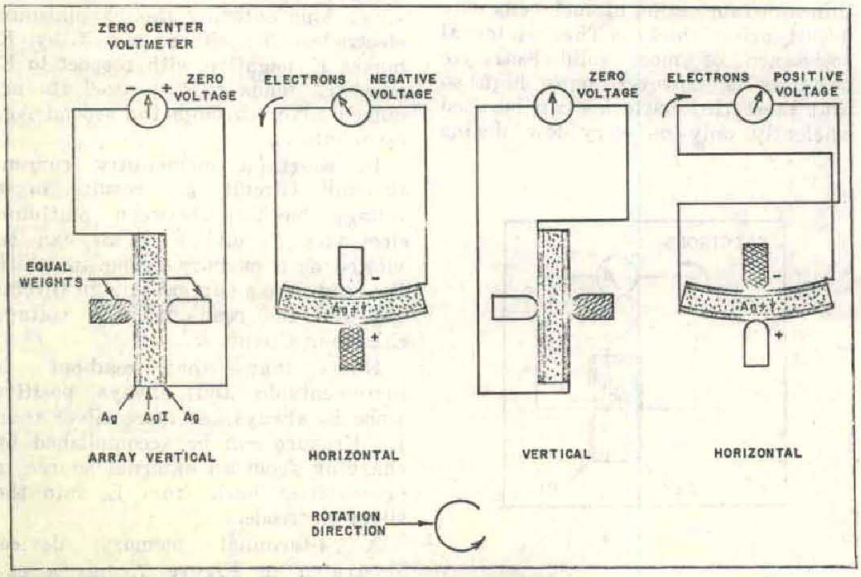


Fig. 3. Gravity Sensing

If this weighted "ionic drumhead" is rotated, the weights will alternately deform the array in one direction and then in the opposite direction. Experiments have shown that constant-speed rotation generates a clean, low-impedance sine-wave voltage. Amplitude at any time reflects the orientation of the array with respect to the direction of the gravitational field.

Simple measurement of the voltage of a nonrotating drumhead determines its orientation, or attitude, and can be used to trigger accessory servomechanisms to maintain any desired rotation angle. In principle, three such devices mounted perpendicular to each of the three orthogonal axes could be the heart of a simple guidance system.

A Temperature-Sensing Ionic Device. If the temperature of one silver electrode of an Ag/AgI/Ag array is higher than that of the other silver electrode, a voltage is generated in which the warmer electrode is negative with respect to the cooler one. It is as if heat tends to "squeeze" Ag^+ ions into the AgI and electrons into the external circuit.

This "ionic thermocouple" effect has been known for may years. Despite reported temperature coefficients of about 0.8 millivolt per °C. temperature difference (which is some 10 to 20 times higher than those of the best metallic thermocouples), there has been little, if any, effort to utilize this intrinsically higher sensitivity.

A possible reason for this lack of interest is that warming one electrode results in heat transport through the AgI to the cooler electrode, with resultant temperature equalization.

The heat-transport problem can be minimized by having the sensing electrode very thin and the AgI and counter Ag layers much thicker (see Figure 4). The heat capacity of the thin sensing electrode is relatively low, so that even a small heat input will reflect as a relatively high temperature change. The thick AgI block minimizes heat transport and the

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Electronically Active Ionic Devices

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thick Ag counter electrode, because of its large size, will exhibit only a small temperature change in response to what little heat reaches it.

The geometrically unsymmetrical Ag/AgI/Ag array of Figure 4 is tightly fitted into a holder to prevent voltage generation due to deformation sensing. Touching the thin electrode with a wooden probe caused no response. However, a mere whiff of warm breath onto the thin electrode resulted in a very fast (0.2-0.4 second) response of 1,000-2,000 microvolts.

"Talking," and indeed inaudible "whispering," generated a rapidly fluctuating voltage as the thin electrode responded to the varying gusts of warm breath. It is quite easy to differentiate between various letters of the alphabet: the sound "H" yields a double spike response while "O" exhibits a much higher symmetrical spike. Heat "microphones" such as these are insensitive to even very high background conventional noise.

Voice "traces," in general, were not reproducible but this is due to variations in speaking characteristics. Array responses were both repeatable and linear with temperature up to at least 150° F. when rubber erasers, heated to predetermined temperatures, were used to contact the sensing electrode.

Several obvious improvements can be made in the design of the temperature probe of Figure 4. The sensing electrode can be made thinner through use of evaporated film. Its area can be made smaller by tapering the AgI block to yield a smaller and lower heat capacity sensing electrode. The probe housing can be modified to accommodate a compartment for ice-water circulation.

Such changes would result in a greater response to breath temperature and a faster recovery time. It seems possible, if a need exists, to develop microprobes capable of sensing subsurface temperatures. Much work remains to be done to exploit the full potential (especially promising in the field of medical diagnosis) of this method of temperature sensing.

Solid-Electrolyte Batteries. Conventional batteries, including the so-called "dry" cell, use ionically-conductive *solutions* as the electronically insulating medium separating the electron donor electrode (zinc in the common dry cell) and the electron-acceptor electrode (manganese dioxide). A major problem in the manufacture of such liquid-electrolyte batteries is control and long-term containment of the incorporated liquid phases. These control and containment problems become increasingly difficult as cell size decreases.

To the extent that solid AgI is, like aqueous battery electrolytes, a conductor for Ag^+ ions and an insulator for electrons, we should be able to make "solid-electrolyte" batteries with subsequent alleviation of the vexing liquid control/containment problems of truly miniature conventional batteries.

Suppose we prepare a thin sandwich of compressed silver, silver iodide and platinum (Pt) powders, as shown in Figure 5. For our purposes we can visualize the silver-rich silver electrode as tending to "squeeze" positive Ag^+ ions into the AgI and hence into the silver-poor platinum (Pt). Thus, there is a *permanent* tendency for internal transport of positive Ag^+ ions and external transport of charge-compensating electrons from the silver to the platinum.

This tendency reflects as a voltage difference, with the silver being negative compared to the platinum. In short, the Ag/AgI/Pt array is a solid-electrolyte battery.

Many such 0.6v solid electrolyte batteries have been made. They are rechargeable at substantially 100 percent efficiency, are extremely rugged, have good shelf life, are operable over a wide range of temperatures (−100° F. to 200° F.) and can easily be miniaturized.

Work at Technical Operations, Inc., has demonstrated the feasibility of thin-film fabrication of such cells only 0.0004-inch thick. The internal resistance of most solid-electrolyte batteries is, however, quite high so that these tiny batteries can be used efficiently only on very low drains (microamperes).

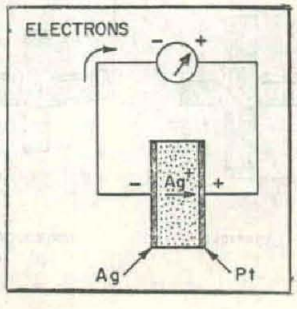

Fig. 5. Solid-Electrolyte Battery

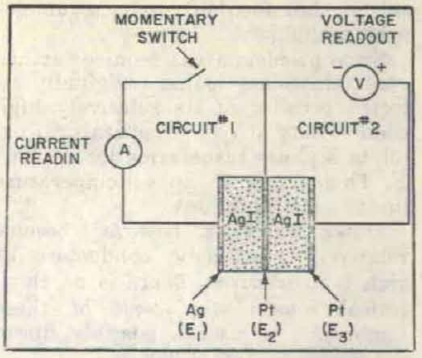

Fig. 6. Memory Device (Readout Always Positive)

Solid-electrolyte batteries using a complex rubidium iodide-silver iodide compound which has a much higher ionic conductivity for silver ions than silver iodide are currently being made by Atomics International of Canoga Park, Calif. These batteries can be used for efficient charge delivery at milliampere drains under very severe spin and shock cditions.

An Ionic Memory Device. Consider a 3-terminal device consisting of one silver electrode, E_1, and two platinum electrodes, E_2 and E_3, separated by layers of silver iodide as shown in Figure 6. The silver electrode E_1 and the first platinum E_2, can be charged to yield a 0.6v battery. The voltage between the two platinum electrodes E_2 and E_3 can be made equal to zero by preliminary shorting.

When we momentarily close the circuit between the E_1 and E_2 electrodes, current will flow with silver ions entering the E_2 platinum electrode. The silver gained by E_2 makes E_2 negative with respect to E_3 since E_2 tends to "squeeze" its acquired silver through the second AgI layer into E_3.

In short, a momentary current through Circuit #1 results in a voltage build-up between platinum electrodes E_2 and E_3. This can be viewed as a memory device in which the read-in is a current flow in Circuit #1 and the read-out is a voltage change in Circuit #2.

Note that the read-out is incrementable and always positive since E_2 always has more silver than E_1. Erasure can be accomplished by charging from an external source to drive silver back from E_2 into the silver electrode.

A 4-terminal memory device, illustrated in Figure 7, has a capability, by appropriate manipulation

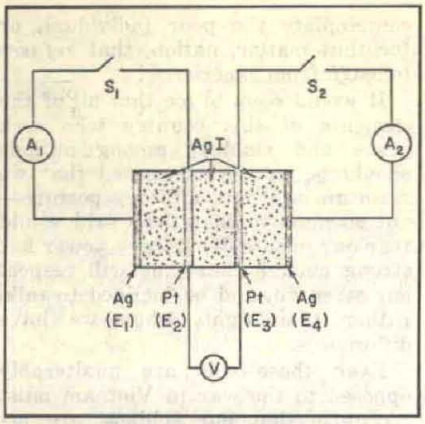

Fig. 7. Memory Device (Positive or Negative Readout)

of Switches S_1 and S_2, of exhibiting either a positive or negative voltage readout. Closing S_1 with S_2 open will cause E_2 to become negative with respect to E_3; closing S_2 with S_1 open will cause E_3 to become negative with respect to E_2.

These same configurations can be used as coulometers (or current integrators) where the total current flowing between E_1 and E_2 can be estimated, after suitable calibration, by measurement of the voltage generated between E_2 and E_3.

Additional work must be done in both the memory and coulometer applications, since the observed voltage changes between E_2 and E_3 tend slowly to decay with time. This decay presumably originates because of diffusion of silver from platinum grain boundaries into the platinum grain themselves.

Scanning the Horizon. We have here listed but a few of the basic sensing and response characteristic of simple solid-electrolyte devices that have already been made by L. L. Wilcox of the ECOM Laboratories. All of these used silver iodide as the common ingredient. Other solid, ionically-conductive materials are known and many others (like the rubidium iodide-silver iodide complex used by Atomics International) can be envisioned.

A rather straightforward materials research program would undoubtedly lead to synthesis of solid ionic conductors tailor-made for a specific application. Furthermore, we must not ignore the possible usefulness of circuits using a multiplicity of ionic devices in which the output of one or more could trigger response in others.

Combining such sensing and response flexibility with the design latitude inherent through use of vacuum-deposition techniques opens a "Pandora's Box" of new and novel applications. Much remains to be done, but through the haze one can see dim outlines of distant castles.

In conclusion, it should be pointed out that the human body consists of some 65 percent water; that body fluids (like all water solutions) are pure ionic conductors; and that the many electrical effects known to exist in living systems originate because of internally or externally stimulated *ionic* charge transport between biologic fluids separated by membranes of variable ionic permeability.

The electronic engineer will have trouble trying to match the often fantastically high sensitivity, responsiveness, adaptability, receptiveness and recall characteristics of biological systems. The ionic engineer will also have trouble doing this; but he has a better chance of partial success, since he is building on the same type of *ionic* charge carriers that the God of living things—the God of ants and bees and cabbages and kings—has found fit to use in His systems.

Dr. John N. Mrgudich is a research physical scientist, U.S. Army Electronics Command, Fort Monmouth, N.J. He earned BS and MS degrees in chemistry at the University of Arizona in 1929 and 1930, and his PhD degree in chemistry at University of Illinois in 1933.

Dr. Mrgudich was awarded a Secretary of the Army Research and Study (SARS) Fellowship to the Massachusetts Institute of Technology (1958–59), and received an R&D Achievement Award in 1967 for his research in the field of ionic conductivity.

He served with the Signal Corps Engineering Laboratories (SCEL) from 1945–46, prior to transferring to a position as technical director of the Electronics Division, Winchester Repeating Arms Corp.

Dr. Mrgudich returned to SCEL in 1951 as assistant to the chief scientist until 1954, then was director of Human Resources until 1958.

AVLABS Test Fiberglass Helicopter Tail Rotors

Helicopter tail rotors made of fiberglass with an aluminum honeycomb core are being tested by the U.S. Army Aviation Materiel Laboratories (AVLABS), Fort Eustis, Va., where they also were designed and fabricated.

Many advantages are being listed for experimental models which are nearly 25 percent lighter than comparable conventional rotors and are of single-unit construction.

Other operational and maintenance features include longer fatigue life, impervious to corrosion under a variety of conditions, and design that eliminates the requirement for field balancing of the rotor.

The need for pitch bearings and lubrication in metallic rotors is eliminated by torsional deflection of the pitch beam portion of the rotor in the plastic experimental models. These were produced by the Kaman Corp. of Bloomfield, Conn., which also conducted preliminary tests.

Performance levels equal to those of metallic blades were achieved in whirl tests of rotors designed generally to UH–1 helicopter specifications. Use of fiberglass permits fabrication of aerodynamic shapes which cannot be accomplished with current metal formation techniques, AVLABS researchers reported.

The next step in the planned AVLABS program will be to design, fabricate and test an aerodynamically optimied tail rotor to take advantage of the inherent features of the experimental materials. Donald P. Neverton is AVLABS project engineer.

A full-scale fiber-reinforced plastic main rotor blade now being tested by AVLABS on the CH–47 helicopter may provide improvement in performance and increased blade life.

Interest in the use of fiberglass and other fibres such as boron is being extended to other areas of aircraft, including the propulsion system. Composite material fan blades, compressor vanes, frames and acoustic treatment are all in various stages of development and test. Fixed-wing aircraft already use plastics in the fuselage, wing and tail components.

Army Support of Research in Universities

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this interchange of information than for us to support research effort in the universities. Such support obligates government scientists to know what is going on in university research, and it obligates university scientists to keep us informed.

In addition to what we might call the research results, there are the added benefits of the existence of a large pool of consultants on whom we can draw when the need arises, plus assisting in the creation of a trained manpower pool from graduate schools.

Unfortunately, it seems to have become popular in the recent past to make some sort of whipping boy out of military-university cooperation. I believe such efforts are misguided, at best, and, at worst, could do this country a great disservice.

Wishful thinking will not make war go away. Undermining our ability to wage a war will not make war less likely. Our first President, in his farewell address, expressed this thought so well when he said: "To be prepared for war is the most effectual means of preserving peace."

You are well aware that there are militant, student activists within our universities, aided and abetted by so-called "liberal" professors, who would like to disengage our universities from this program wherein they receive defense dollars for the support of basic research.

This is a curious thing. Surely our university community should be just as interested in preserving the peace as was President Washington. Surely our university professors are sufficiently well educated to understand need for adequate military strength in international security affairs.

It is very hard for me to understand how *any* informed, objectively motivated, educated man can fail to recognize that we must deal from a position of strength when called on to negotiate with the communists.

Military weakness has invited aggression in so many instances in history that no informed person can question the need for a reasonable balance of military power among the major nations of the world. It was George Santayana who said, "He who cannot remember the past is condemned to repeat it."

Pick up any volume of quotations and you will find the same thought voiced by innumerable learned men, from all generations, from Lord Byron to Confucius, from Patrick Henry to Shakespeare. Indeed it is the latter's quote, "What's past is prologue," that graces the entrance to the Archives Building of the United States. It is a pitiful thing to contemplate the poor individual, or for that matter, nation, that *refuses* to learn from experience!

It would seem to me that all of the elements of this country who seek peace and stability among nations should be equally concerned that we maintain a strong military posture—not so massive that the world would fear our misuse of military power but strong enough that they will respect our strength, and be inclined to talk, rather than fight, when we have differences.

Even those who are unalterably opposed to the war in Vietnam must recognize that our soldiers are actually fighting there. How can we possibly do less than give them the best weapons and equipment this country can produce? Their very lives are at stake.

It is not an easy matter to determine just what is adequate military strength. It takes great wisdom and good judgment on the part of political leaders to reach that determination. One important input to that judgment must be an intelligent understanding of advanced technology that is so fundamental a determinant of our military posture in this technological day and age.

It should be patently obvious that leaders in the universities, leaders in industry, and leaders on the political scene, must be mutually involved with our military leaders as we all seek to reach the most intelligent judgment as to the size and nature of our military forces.

The solution, of course, is cooperative activity and mutual understanding. The universities must have a part to play. In the Army, it is our policy that we will support a strong program of basic research in universities. That program is guided by one overriding factor: the research programs the Army support must be related to long-term military technological needs.

Nevertheless, the research we support in universities is basic, by definition. It is therefore, very hard to see how such support could possibly make the principal investigator, his research assistants or his university in any way controlled by the Army.

The recent misundersanding with some mathematicians is a case in point. In January of this year, a paid announcement signed by 94 such gentlemen appeared in the Notices of the American Mathematical Society, urging mathmaticians not to utilize their talents toward prosecution of the Vietnam conflict.

A check of this list revealed that a few of those who signed this

Natick Mycologist Receives SARS Fellowship

The Secretary of the Army has awarded Dr. Emory G. Simmons, head of the Mycology Group, U.S. Army Natick (Mass.) Laboratories, a one-year Research and Study Fellowship to study tropical microfungi of Southeast Asia and adjacent areas.

Dr. Simmons departed in October to begin studies at the Institute of Applied Microbiology, University of Tokyo, under the monitorship of K. Tubaki, one of Japan's foremost experts on microfungi. His study plan includes five to six months devoted to collecting and isolating microfungi in New Guinea, Indonesia, Thailand, India and England.

Dr. Simmons is the fourth Army employe to receive a Secretary of the Army Research and Study (SARS) Fellowship this year.

Others selected recently for notable achievement and future potential for service to the Army in their respective fields are Dr. Frank D. Verderame, Frankford Arsenal; James W. Erwin. Corps of Engineers, Savannah, Ga.; Frank R. Larson, Army Materials and Mechanics Research Center, Watertown, Mass.

(See October issue of *Army R&D Newsmagazine*, p. 36, for further information on earlier recipients of the SARS Fellowships.)

Dr. Emory G. Simmons

announcement were receiving funds from the Department of Defense for support of their research efforts. It appeared that the apparent inconsistency of certain individuals contributing to the war in Vietnam and at the same time urging their colleagues not to so contribute should be clarified.

Accordingly, on Sept. 3, 1968, the Army agency responsible for the support of research in universities sent a letter to those individuals working under an Army contract, calling to their attention the possible embarrassment to them inherent in the fact that the results of their research have been and are being used by the Army in support of the war in Vietnam.

It seemed to us that the mathematicians in question should be informed of the nature of their contribution to our military capability. It would be up to them to decide whether or not they wish to continue making that contribution.

Generally, it has been our experience that those in universities who work under contract to the Army on basic research are sincerely and positively dedicated to one goal, that is, the pursuit of knowledge. They should understand, and most of them fully recognize the fact, that the knowledge may and probably will be used to strengthen our military posture.

I fail to see how that relationship in any way subverts the basic purpose of the university, which is to educate future generations of Americans. In fact, there is a great deal of evidence that universities would have found it difficult, if not impossible, to stay in the forefront of science and technology without having had the leadership and support of the Defense Community—a community that had to be concerned with pushing the state-of-the-art.

You have reason to ask: Does this system work? Does the public really get its money's worth out of funds allocated to defense research and development that is then funneled into university research? Or would it be just as effective to provide for support of research in universities through the National Science Foundation or one of the other research-oriented government agencies?

As I said earlier, to manage a strong research and development program adequately, we in defense must be involved in support of research.

The director of research of a very large corporation made this point very clear. He said, "If you want to stay in business at a time when technology is marching rapidly, you cannot risk the chance that someone will beat you to the new technology. You have to be at the frontier yourself. If somebody somewhere is about to make a major contribution, a contribution that could obsolete (sic) your product, you must have people who will know about this, who will know what is happening."

That our relationships with universities have been remarkably good, should go without saying. Rather than have you take my word for it, I would like to quote Mr. J. A. Stratton, past president and now President Emeritus of the Massachusetts Institute of Technology on the occasion some two years ago, of the 20th anniversary of the establishment of the Research Laboratory of Electronics at M.I.T.

"Looking back over the 20 years," he said, "I recall that more than one member of the faculty greeted the very idea of military support with undisguised concern. The image of academic resarch as we had known it. in the 30s still dominated, and military affairs had no part of it.

"As it turned out, a more harmonious, understanding relationship between a sponsor and a research laboratory would be difficult to imagine . . . There was freedom of access, complete freedom to publication. The contract was administered with wisdom and a perceptive appreciation of the true nature of a university, and standards were set which have been carefully respected through the years."

At the same meeting, Dr. A. G. Hill, also of M.I.T., expressed similar thoughts, concluding with this statement:

"I firmly believe, however, that the only verifiable conclusion is that military support of university research can be extraordinarily fruitful for both parties. Certainly there are dangers, but care and mutual respect can obviate most of them.

"Personally, I feel that basic research can profit from an association with the applied or programatic research—an association that should be close, but must not be smothering."

For the record, let's look at a few specifics. For example, let's look at the results of research the Army has supported in millimeter radiation. This was done under the first contract for basic research supported by the Department of the Army after the end of World War II. It has since been supported continuously by the three Services.

Extension of the research in millimeter radiation led to the development of the maser for which a Nobel prize was awarded. This in turn was extended to optical wavelengths to provide the basis for the optical laser, a field having great potential promise for military, as well as civilian, applications.

While it is certainly true that this work was very basic in nature, its military potential has always been

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Civil Service Careers Yield Payoff to Orshansky Sisters

Newest addition to the select group of feminine scientists and engineers who have achieved Civil Service rank of GS–14 or higher at HQ U.S. Army Electronics Command, Fort Monmouth, N.J., is Miss Rose Orshansky, a veteran of nearly 25 years at the installation.

Representative of the Department of the Army to the Department of Defense Task Force for Engineering Changes, Miss Orshansky carries the title of supervisory electronic engineer and chief of the Maintenance Value and Policy Division, ECOM Value Engineering Agency.

Rose Orshansky

One of six sisters, two of whom also have supervisory-level positions with the U.S. Government, Miss Orshansky began her career at Fort Monmouth shortly after graduating from Hunter College in New York City with a bachelor's degree in chemistry.

Mollie Orshansky still outranks Rose as a long-time employe of the Social Security Administration, U.S. Department of Health, Education and Welfare, where she is employed as an economist. Another sister, Mrs. Robert Wachtel, is a GS–12 employe of the Federal Housing Administration.

Rose began her career at For Monmouth in the Squier Laboratory, later worked with the Materiel Support Agency and until appointed to her new position was assigned to the Procurement and Production Directorate's policy staff.

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(*Continued from page 31*)

clearly recognized. I doubt very much if it would have been supported under the "pure" science orientation of some nonmilitary agency of government.

Another example is in a recent development that has sprung from research supported by the Army. This invention is called the Plasma Display Panel. It stores and displays digital information, both alphanumeric and graphic, on a rectangular array of insulated, bistable gas discharge cells. Its brightness is adequate for viewing in high ambient light, and the simplicity of its structure suggests that fabrication costs will eventually be small. The technique can be exploited in console displays, in large wall displays, and in the specialized displays of aircraft instrument panels.

Obviously, it was military interest that sparked this innovation, but the potential applications will go far beyond just military interest.

I might make a similar claim for advances that will result from work done at still another university under Army sponsorship. This involves the investigation of operational problems and techniques in wing tunnel testing of V/STOL (vertical and/or short takeoff and landing) aircraft. Since these results were presented in September 1966, wind tunnel testing of V/STOL aircraft has been significantly influenced.

This research on the interaction of downwash on the tunnel walls showed gross inaccuracies in the simulation of rotary-wing flight. For a given-sized V/STOL test vehicle, investigations determined the optimum shape and size of a tunnel, the maximum and meaningful results, the permissable downwash angles, the positioning of the test vehicle in the tunnel, and even the maximum model size that can be tested reliably in a given-sized tunnel.

Rarely does basic research yield such recognizable and timely benefits. It has been estimated that "incurred and anticipated expenditures on aircraft and associated wind tunnel facilities influenced by this research will easily amount to several hundred million dollars."

In this vein, I could go on for hours, since research supported by the military has produced so many important technological advances of great general benefit. In fact, a recent study showed that more than 10 percent of "events" that led to a major advance in weapon system capability came from Defense-supported basic research.

Yet I recognize that there are those in the academic community who continue to agitate for severing all university ties with the military for support of research. I have looked very hard to find some logical rationale for such a view, but in vain. The arguments put forward are mostly vague pleas for academic freedom. No evidence of loss of that freedom has been put forward, at least that I have been able to see. I suggest that when an idea is so strongly held that the holder won't even defend it with logic, one may fairly suspect that it is firmly imbedded in concrete.

I believe it is time we sorted out the difference between policy decisions and performance. Early in my professional career I learned to make my recommendations as well and as forcefully as I could; also, that once a decision was made, I should carry it out to the best of my ability. It is my belief that a democracy cannot remain strong if its citizens use violent disruptive demonstrations to try to force a minority position on the government.

Actually, we are all interested in one ultimate goal, a just and honorable peace in the world. Only our enemies could justify a position that says we should not have adequate military strength. To have an adequate military posture, we must apply the most advanced technology to our weapons and equipment. To stay abreast of advances in technology, the military must be intimately involved in the support of research. The citadels of research are the universities. It would be a national disaster if they could not make an appropriate contribution to our national strength.

I hold that there is no greater contribution we can make to peace than to maintain modern and adequate military forces.

Maj Huber Assigned as MERDC Deputy CO

Maj Thomas H. Huber assumed duties as deputy to Col Edwin T. O'Donnell, CO of the U.S. Army Mobility Equipment R&D Center (MERDC), Fort Belvoir, Va., after completing the advanced course at the Army Ordnance School at Aberdeen Proving Ground, Md.

Previous assignments include assistant chief of staff for Logistics, 7th Infantry Division, Korea; staff officer, 57th Ordnance Group, Europe; and troop and squadron officer, 3d Armored Cavalry Regiment, Europe.

Maj Huber attended the University of Pittsburgh for one year before entering the U.S. Military Academy where he received his BS degree and commission in 1960. He received a master's degree in engineering from Purdue University in 1966.

He has completed basic officer training at the Armor School, Fort Knox, Ky., Ranger and Airborne training at the Infantry School, Fort Benning, Ga., the 7th Army Combined Arms School, and the 17th Air Force Air-Ground School.

Maj Thomas H. Huber

SCIENTIFIC CALENDAR

21st General Assembly of the International Geographical Union, sponsored by ARO, NSF, HEW, ESSA, DIA, USAF and USN, New Delhi, India, Dec. 1–8.

2d Conference on Applications of Simulation, sponsored by SHARE, ACM, IEEE and SCI, N.Y., Dec. 2–4.

Reliability Physics Symposium, sponsored by IEEE and Rome Air Development Center, Washington, D.C., Dec. 2–4.

Meeting of the American Geophysical Union, San Francisco, Calif., Dec. 2–4.

Vehicular Technology Conference, sponsored by IEEE, San Francisco, Calif., Dec. 3–4.

Conference on Lighting and Static Electricity, sponsored by AF Avionics Laboratory, Lighting and Transients Research Institute and SAE, Miami Beach, Fla., Dec. 3–5.

Gravity Gradient Stabilization for Communication Satellites, sponsored by Space and Missile Systems Organization and Aerospace Corp., El Segundo, Calif., Dec. 3–5.

Circuit Theory Symposium, sponsored by IEEE, Miami Beach, Fla., Dec. 4–6.

17th International Wire and Cable Symposium, sponsored by ECOM, Atlantic City, N.J., Dec. 4–6.

Annual Meeting of the American Association of Physicists in Medicine, Chicago, Ill., Dec. 4–7.

National Electronics Conference, sponsored by IEEE, Chicago, Ill., Dec. 9–11.

Fall Joint Computer Conference, sponsored by IEEE, San Francisco, Calif., Dec. 9–11.

22d Military Operations Research Symposium, sponsored by ONR, AFOSR and OCRD, Monterey, Calif., Dec. 10–12.

7th Symposium on Adaptive Processes, sponsored by IEEE and the University of California, Los Angeles, Calif., Dec. 16–18.

Conference on Relativistic Astrophysics, sponsored by the Southwest Center for Advanced Studies, Dallas, Tex., Dec. 16–20.

American Physical Society Winter Meeting, San Diego, Calif., Dec. 18–20.

RAC Ending Study of Tactical Radio Frequency Management

Research Analysis Corp. (RAC), McLean, Va., is entering the final testing and documentation phase of an automated procedure designed to make the signal officer's job easier from division through field Army level.

The project is sponsored by the Office of the Assistant Chief of Staff for Communications-Electronics (OACSC–E), Headquarters, Department of the Army.

The RAC frequency management study is designed to develop and test improved procedures for assigning frequencies and call signs to HF and VHF–FM radio nets within a field Army. A specific task is to indicate where and how automatic data processing equipment can be used to improve assignments.

Procedures developed should improve present assignments in one or more of the following ways:

- Provide a greater number of usable frequencies to tactical forces.
- Assure greater compatibility between frequencies assigned to a list.
- Make faster assignments.

Current FM radios, such as the AN/VRC–12 AND AN/PRC–25 can tune to 920 discrete frequencies between 30.00 and 75.95mhz. Field Army units are authorized use of only a fraction of these frequencies (250–650 is typical).

Often, the use of many of these frequencies is restricted in certain areas within the field Army—by higher headquarters for other military purposes or by the host country for television, fire, police, civilian, or governmental communications in both peace and war.

Each radio in the field Army must be assigned at least one frequency. The number of radios in a field Army depends upon the configuration of its units, but in a 3-corps field Army there are more than 50,000 FM radios.

For example, each mechanized or armored division has approximately 3,000 FM radios. In a 12-division field Army there are 36,000 FM radios in divisions alone. The 50,000 radios in a field Army are formed into 4,000 to 6,000 nets; the radios in each net are assigned the same frequency.

The U.S. field Army does not assign frequencies to the FM radio nets of its subordinate elements. The field Army assigns lists or blocks of frequencies to its major subordinate units who, in turn, assign specific frequencies to specific FM radio nets.

Because of the shortage of frequencies, a list is usually assigned to more than one subordinate unit. Re-use of lists is operationally acceptable when there is sufficient distance separation among units to avoid radio interference. For example, the Seventh Army assigns 10 lists to 30 major subordinate units, so that, on the average, each list is assigned to three units.

The number of frequencies in a list varies from a few to several hundred. In selecting frequencies for a list, the problem is to consider the geographic restrictions on each frequency, to determine which units are to receive the list and restrictions which apply to their areas of operation, and to select frequencies that are not restricted in the areas of operation of the units receiving the list.

In generating lists for the major subordinate units, the mutual compatibility of frequencies must be considered. That is, ideally, radios on any two of these frequencies should be able to operate in collocation without interfering with each other. For technical reasons and because of the size of the lists, it is generally not possible to generate lists in which all frequencies are mutually compatible.

Collocation of two different nets occurs in many command posts and vehicles in major units such as divisions. Consequently, frequencies in a list should be as compatible as possible to allow the greatest assignment flexibility at unit level. Frequencies in a list should be separated as far as possible in the spectrum, and one should not be a harmonic of another.

The RAC frequency management study identified tactical FM list generation to be a problem amenable to computer solution. Visits were made to Seventh Army and Continental United States (CONUS) tactical units for a careful examination of their Signal Operations Instructions (SOIs).

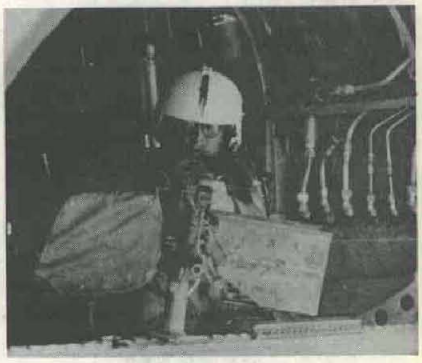
The study team concluded that the constraints imposed by host country geographic restrictions and compatibility presented too great a problem for complete resolution by manual methods. The Army Project Advisory Group agreed and approved the development of an automated procedure for the RAC IBM 7044 computer to demonstrate the feasibility and payoff.

This objective was met in January 1968. Development of a system of eight computer programs was completed and they were tested by the Army using RAC's computer. Tests were conducted by 25 military and civilian personnel from the field, Department of the Army, military schools and laboratories. Present assignments and assignment methods were compared against those of the new procedure. Evaluators concluded that this procedure provides for greater and more efficient use of avaliable frequencies and a more rapid response to assignment changes.

In solving large problems, i.e., one involving 620 frequencies, 25 major units and 29 restricted zones (which restrict 540 frequencies), the total computer set-up and run time is 36 minutes. Equivalent assignments could not be produced by manual methods with several weeks of effort.

It is planned to install and test the procedure in the field in the fall of 1968. Formal documentation for this project will be available within nine months through the Defense Documentation Center and will consist of the following:

VOL I—Summary
VOL IIA—Users Manual—Tactical FM List Generation Procedure.
IIB—Program Documentation—Tactical FM List Generation Procedure.
IIC—Users Manual—CDC 3300.
IID—Program Documentation—CDC 3300.
III—HF Assignment Procedure.
IIIA—Users Manual for Electronic Accounting Machinery Communications Electronic Operating Instructions (EAM CEOI's) Preparation Procedure.
IIIB—EAM Example Assignment.
IIIC—Users Manual—CDC 3300.
IIID—Program Documentation—CDC 3300.
—V—Unit SOI Generation Procedure for UNIVAC 1005.
VA—Users Manual—CDC 3300.
VB—Program Documentation—CDC 3300.



TROOPS IN VIETNAM have received initial quantities of the XM41 weapon subsystem for installation on the rear ramp of the CH–47 Chinook helicopter. The new subsystem includes an M60D machinegun, link and brass retainer, ammunition box and safety harness for the gunner. The armament was developed by U.S. Army Weapons Command, Rock Island, Ill.

AMCA Operates in 'Troika' Relationship

(*Continued from page 5*)

planning and controlling the program for engineering, technological and scientific experiments to be performed in earth orbit or on the lunar surface.

Col Fahs has served as a test officer for all types of ammunition (30mm through 8-inch) at Jefferson Proving Grounds, Madison, Ind., as chief of the Production Engineering Office, Springfield (Mass.) Armory, as a member of the Ordnance Board at Aberdeen Proving Ground, and as CO of a Guided Missile and Special Weapon Depot Company, COMZ, Advanced Weapons Support Command, Pirmasens, Germany.

John Gensior

John Gensior is assigned as chief, Special Forecast and Analysis Branch, Operations Analysis Division. He has BS and MS degrees in mechanical engineering from Newark College of Engineering, and is enrolled in graduate study at American University.

Until he accepted an appointment at Picatinny Arsenal, Dover, N.J., he was an engineer with Worthington Corp. and later with Thiokol Chemical Corp. When assigned to AMCA, he was with HQ Army Materiel Command as an administrator on nuclear munitions development and exploratory work on rocket/missile propellants and advanced propulsion concepts.

Dr. Zaboj V. Harvalik is chief of the Scientific Consultants Staff, Operations Analysis Division. Listed in *American Men of Science*, *Who Is Who in American Education*, and *Leaders in American Science*, he has a BS degree from State College, Prague, Czechoslovakia, and MS, AM and PhD degrees from the University of Prague.

Dr. Harvalik was an instructor and then an assistant professor at the State Technical College in Prague, followed by a research fellowship at Columbia University Medical School in New York City. Subsequently he was a professor at St. Ambrose College in Davenport, Iowa, and later at State College, Duluth, Minn. Later he was an associate professor at the University of Missouri and then professor of physics at the University of Arkansas.

Dr. Harvalik established the Basic Research Laboratory, U.S. Army Engineer R&D Laboratories, Fort Belvoir, Va., and later became director. Under a National Science Foundation grant for "Experiment in Progress,' he served as deputy director and chairman of the advisory committee.

Dr. Harvalik served as a member of the U.S. Army Committee on Detonation and Electrical Interactions and as a member of the advisory committee of the U.S. Army Junior Science and Humanities Program. He is a member of 11 scientific and professional organizations, has served as an officer in several of them, and is author of numerous publications.

Marshall Waller, deputy chief of the Exploratory Evaluation Division, was graduated from the U.S. Military Academy, and retired from the Army in 1962 after 20 years service. He has a BS degree from Massachusetts Institute of Technology and an MS degree in electronics from the University of Illinois.

When he retired, Waller was a general staff officer in the Combat Developments Section, HQ U.S. Continental Army Command. There he was responsible for establishing requirements and guiding R&D efforts for avionics equipment, unmanned aerial vehicles and combat surveillance sensors. He also was CONARC representative in command planning for Army electronic warfare and target acquisition systems.

After serving with the Planning Research Corp. (1965–67) as senior associate and project manager for system analyses of Army and Air Force combat materiel and operations, he accepted an Army Materiel Command assignment as chief,

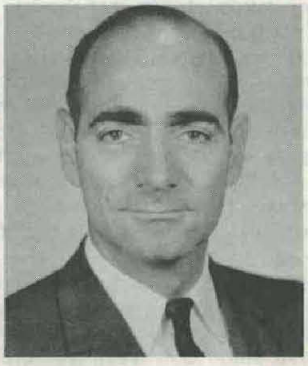
John H. Mathews

Communications Systems Analysis Branch, Materiel Systems Analysis Agency, Aberdeen (Md.) Proving Ground. He served in this capacity until he transferred to the AMCA.

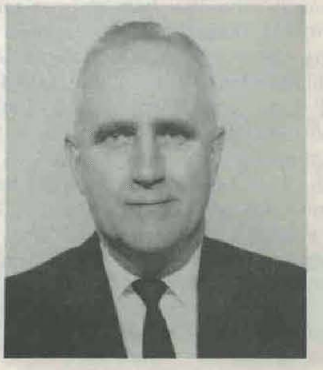
John H. Mathews is assigned as chief, Problem Analysis and Study Formulation Branch, Exploratory Evaluation Division. A graduate of the U.S. Naval Academy, he has attended a technical school in Switzerland and has an MA degree in physics from the University of Michigan, where he was an instructor and research physicist. He also taught at the American University in Washington, D.C.

Other professional assignments

Dr. Zaboj V. Harvalik



Marshall Waller



Theodore S. Trybul

have included research on magnetic phenomena with the Naval Research Laboratory, employment by the Computer Usage Co., and duty with the Foreign Science and Technology Center of the Army Materiel Command until he accepted a position with the AMCA.

Theodore S. Trybul is qualified for his duties as chief of the Firepower Task Group of the Exploratory Evaluation Division by a BS degree in mechanical engineering from the University of Illinois, an MSME degree from the University of New Mexico and as a PhD candidate at the University of Southern California (Los Angeles).

His professional experience includes seven years with Sandia Corp./Atomic Energy Commission as a staff member; two years as a group engineering supervisor with Aerospace Corp.; one year in Operation Research System Analysis with Raytheon Co.; two years as a project officer, Army Engineer R&D Laboratories, Fort Belvoir, Va.; and two years as associate professor at California State College.

Trybul is a member of the American Ordnance Association, Armed Forces Management Association, Military Operation Research Society, American Association for Advancement of Science, American Associa-

David A. Lawson, Jr.

tion of Mechanical Engineers, Naval Advisory Committee on Aeronautics; the U.S Navy Bureau of Weapons Advisory Council; and a number of honorary societies.

David A. Lawson, Jr. is assigned as chief of the Combat Services Support Task Group X, Exploratory Evaluation Division. His professional credentials include a BS degree in physics and an MS degree in mathematics from the University of New Mexico, a Certificate of Completion from the Post Graduate School of the U.S. Naval Academy (aerological engineering/meteorology) and graduate courses at Harvard University and University of Chicago.

In addition he has completed U.S. Army and Air Force courses in nuclear weapons capabilities, meteorological satellites, combat surveillance and target acquisition, air/ground operations, upper-air forecasting techniques and automatic data processing.

Lawson's professional experience includes teaching, serving as an aerological officer with the U.S. Navy, a meteorologist with Trans-World Airlines, training officer and meteorologist with the U.S. Weather Bureau, meteorologist at the U.S. Army Electronics Proving Ground, Fort Huachuca, Ariz., staff meteorologist with the U.S. Continental Army Command, and physical scientist, Combat Developments Command.

Natick Labs Dedicate $3 Million Institute

(*Continued from page 1*)

most highly applied field investigations to basic animal and *in vitro* experiments.

The building dedicated Oct. 17 has 76,000 square feet and includes 13 climatic chambers, two altitude chambers, a 14-foot tank for underwater studies, animal holding facilities and extensive test equipment. It is the result of about six years of study and planning since USARIEM was activated at the Natick Laboratories in October 1961 as a Class II installation of the U.S. Army R&D Command.

Policy formulated for operation of the institute is stated as: (1) perform such basic and applied research in environmental medicine as will solve present problems and anticipate problems of the future; (2) serve as a repository of expertise and consultation in the field of environmental medicine for The Surgeon General and all elements of the Army; (3) provide guidance for rational doctrine in training and maintaining effectiveness of troops under all adverse climatic conditions.

Dr. E. E. Adolph, professor emeritus of physiology at the University of Rochester Medical School, presented the dedicatory address.

Generally recognized as the American scientist whose knowledge of environmental science contributed significantly to the defeat of Hitler's Afrika Korps, by helping to solve the problem of heat fatigue, Dr. Adolph said the day will come when scientists will be able to control man's reaction to his environment.

Maj Gen Joe M. Blumberg, commander of the Medical RD Command, and Brig Gen Felix J. Gerace, CG of the U.S. Army Natick Laboratories, along with Col James E. Hansen, CO of USARIEM, were among other speakers.

Dignitaries present for the ceremonies included Senator Leverett Saltonstall, Governor John A. Volpe and Congressman Margaret M. Heckler, all of Massachusetts, and Maj Gen Glenn J. Collins, Deputy Surgeon General.

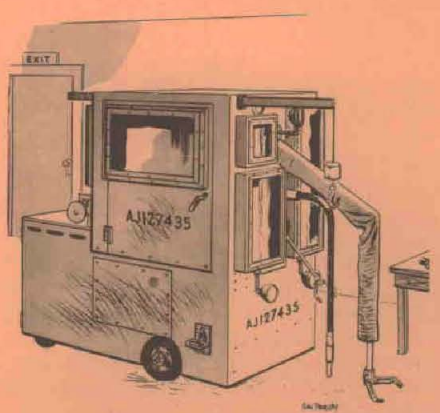
Picatinny Develops Dud Ammunition Retriever

In continuing efforts to improve safety in ammunition handling, Picatinny Arsenal has developed a vehicle to pick up and remove hazardous or questionable items of ammunition without exposing anyone to the dangers of accidental explosion.

Because of its small size and maneuverability, the new ammunition retriever, an improved version of earlier models, can be used in any of the buildings in the loading or testing areas of the arsenal. The 36-inch-wide, 70-inch-long, 79-inch-high inplant retriever also has proved valuable in the remote disassembly of intricate ammunition items.

It has a retractable power boom with a 250-pound capacity, two straight-arm manipulators, a flexible shaft for detorqueing operations. and a dexterious manipulator for disassembly of munitions. Windows and armor can withstand contact detonatoin of an M26 handgrenade.

The cab was designed by Charles Okun, a mechanical engineer in the Ammunition Engineering Directorate at Picatinny. It was fabricated on a special electric truck chassis built to Picatinny specifications by Eaton Yale and Towne, at Dover, N.J.



Resor Westmoreland Palmer Lemnitzer Bonesteel Taylor

Top Army Commanders Speak at 14th Annual AUSA Meet

Presentations by U.S. Army commanders from around the world highlighted the 14th annual meeting of the Association of the U.S. Army (AUSA), Oct 28–30, at the Sheraton-Park Hotel in Washington, D.C.

Secretary of the Army Stanley R. Resor gave the keynote address to more than 6,000 from the ranks of Army retired, National Guard, Reserve and civilian personnel, making it the largest AUSA meeting.

Army Chief of Staff General William C. Westmoreland was the luncheon speaker, and Vice Chief of Staff General Bruce Palmer Jr. reported on the U.S. Army in Vietnam.

General Lyman L. Lemnitzer, Supreme Allied Commander Europe, reported on the U.S. Army Europe. General Charles H. Bonsteel III, U.S. and U.N. Commander in Korea, also gave a featured address.

General Maxwell D. Taylor (USA, Ret.) received the George C. Marshall Medal for "selfless and outstanding service to the United States of America." AUSA president Frank Pace Jr., a former Secretary of the Army, made the presentation.

Other recipients of the medal have been former Presidents Truman and Eisenhower, Generals Omar Bradley and Jacob Devers, former Secretary of Defense Robert Lovett, former Secretary of the Army Gordon Gray and former Assistant Secretary of War and High Commissioner of Germany (post-war) John J. McCloy.

The AUSA also presented its President's Gold Medal Award to Charles S. Stevenson of Kansas City, Mo., for his influence in enlisting public support and interest for the Army. The Anthony J. Drexel Biddle Medal was awarded to Lt Col Josephine L. Redenius (USA, Ret.) for her work as a recruiter for AUSA membership.

More than 95 industrial and Army exhibits covered over 90,000 square feet of space inside and outside the hotel, reflecting the latest industrial and Army scientific community developments of materiel and equipment.

THE HONORABLE Stanley R. Resor and SFC William H. Wheeler view project Manager Exhibit.

CHIEF OF STAFF General William C. Westmoreland at Redeye Exhibit during tour of AUSA meet.

SACEUR General Lyman L. Lemnitzer and Ernie Gotthier check out Gunner's Station at exhibits.

XM6 Platform Display

SPRINT Missile Display

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