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R&D Achievement Awards Recognize 81 in Army In-House Labs

U.S. Army 1971 Research and Development Achievement Awards —one of the most prestigious forms of recognition attainable by Army in-house laboratory personnel— will recognize 81 scientists and engineers selected from about 8,000 eligible for the distinction.

Army Chief of Research and Development Lt Gen William C. Gribble Jr., Deputy CRD Maj Gen George Sammet Jr. and Army Chief Scientist Dr. Marvin E. Lasser will share in presenting awards to 16 teams and 17 individual researchers. Each award consists of a wall plaque, lapel pin and a citation of

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OR Focuses on Next Decade Objectives

Operations research has never been more important to Department of Defense and Army decision-makers on critical problems than in helping them meet the current challenge of keeping the nation militarily strong with reduced manpower and funding resources.

Keynote speaker Lt Gen John Norton, commanding general, U.S. Army Combat Developments Command, aggressively presented this viewpoint at the Tenth Annual U.S. Army Operations Research Symposium, held on the campus of Duke University, Durham, N.C.

Sponsored by the Army Chief of Research and Development, the May 26–28 symposium was focused on "Operations Research in the Next Decade." The U.S. Army Research Office-Durham (ARO-D), commanded by Col William J. Lynch, was host for the tenth year. Army Director of Research Brig Gen George M. Snead Jr. was presiding chairman.

Army Chief of R&D Lt Gen William C. Gribble Jr. introduced General Norton as a leader who has distinguished himself by continuingly progressive action since he graduated as captain of his class, U.S. Military Academy.

General Gribble termed the keynoter a "pioneer in airborne doctrine," including duty as commanding general of the 1st Cavalry Division (Air-

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Nixon Cites Leonard For Prosthetics Aids

Biomechanical devices that have helped to restore hope for a normal life to many military amputees and to similar patients in civilian hospitals have made Dr. Fred Leonard a recipient of the President's Award for Distinguished Federal Civilian Service.

President Richard M. Nixon made the presentation to the scientific director of the U.S. Army Biomechanical Research Laboratory in a recent White House ceremony. Reading from a citation, the Chief Executive credited Dr. Leonard with saving the lives of "critically wounded American soldiers."

Known most widely for 23 years of research and development activity in inventing and engineering prosthetic devices, Dr. Leonard also gave "energetic and devoted efforts" to development of a tissue-receptive adhesive hemostatic agent for non-suture closure of wounds "in place of, or as an

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PRESIDENT Richard M. Nixon presents the President's Award for Distinguished Federal Civilian Service to Dr. Fred Leonard, scientific director of the U.S. Army Biomechanical Research Laboratory, as Mrs. Leonard observes.

NLABS Make Sugar From Waste Paper

Enzymatic conversion of waste paper to glucose sugar, evaluated by the U.S. Army Natick (Mass.) Laboratories as one of their outstanding research achievements in 25 years, is reported as a result of the Army In-House Laboratory Independent Research Program.

Announcement in June that the process—essentially developed 100 percent by in-house researchers—offers a "realistic potential for converting an over-abundant waste material into useful products" follows by almost a year the experimental success.

In view of national concern about reducing souces of environmental pollution, the discovery is considered particularly significant, in that waste paper (cellulose) can be converted into useful products such as food or fuel without contaminating the air in the process.

Cellulose is the major component of cardboard boxes, kraft paper, paper bags, correspondence paper and news-

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Featured in This Issue . . .

Army R&D Newsmagazine

Vol. 12, No. 3

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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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Nixon Nominates Froehlke as Secretary of the Army

President Richard M. Nixon has nominated Robert F. Froehlke, Assistant Secretary of Defense (Administration) since Jan. 29, 1969, to succeed Secretary of the Army Stanley R. Resor, who resigned after serving since July 1, 1965. Resor served three months as Under Secretary of the Army.

When selected for the top Army position, he was Assistant Secretary of Defense (Administration).

Froehlke, 49, was born in Neenah, Wis., and received his LLB degree from the University of Wisconsin Law School (Order of the COIF) in 1949. In June 1943 he enlisted and served during World War II in the Infantry in the European Theater of Operations. He was discharged with rank of captain in September 1946.

After serving one year with a private law firm, Froehlke became a member of the University of Wisconsin law school faculty for a year. He resigned to join the legal department of Sentry Insurance.

After rising to assistant general counsel of this firm in Stevens Point, Wis., and serving until 1959, he was promoted to executive vice president and in 1967 was named vice president for sales, Sentry Insurance Companies. For a year prior to joining the Defense Department staff, he was

Robert F. Froehlke

resident vice president of Sentry Insurance in Boston, Mass.

When he was assigned responsibility for all intelligence resources in the Department of Defense, Aug. 1, 1969, Froehlke was chairman of the board of Sentry Indemnity Co., president of Sentry Life Insurance Co. in New York, vice president of the firm in Wisconsin and vice president of all the other companies in the Sentry Insurance group.

Secretary of Defense Melvin Laird appointed Froehlke to head the Blue Ribbon Panel Action Committee, effective Aug. 26, 1970, and on Feb. 18, 1971 selected him chairman of the Defense Investigative Review Council.

President Cites Leonard for Prosthetics Aids

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adjunct to, conventional surgical sutures."

Application of this agent to severely wounded soldiers in Southeast Asia is credited with "saving the lives of (those) who would otherwise have died of their battle injuries. . . ."

Under his direction, an electromechanical hand with automatic proportional control of grasp has been developed in recent years and is currently receiving clinical evaluation. The hand enables an amputee to grasp and lift objects of different weights without slippage or overgrasping.

The Presidential citation states, in part, that Dr. Leonard "through inspirational leadership and outstanding ability in the fields of research chemistry and biomechanical engineering . . . has successfully directed many interdisciplinary medical research efforts which have contributed significantly to the progress of medicine and the health of all mankind. . ."

In 1948 Dr. Leonard joined the staff of what was then the U.S. Army Prosthetics Research Laboratory in Forest Glen, Md., starting as chief of the Resin Section. Promoted in 1950 to chief of the Plastics Development Branch, he was elevated in 1961 to director of what became the Biomechanical Medical Research Laboratory in 1963.

Dr. Leonard received the Department of the Army Meritorious Civilian Service Award in 1962, the Army Decoration for Exceptional Civilian Service in 1965, and the Department of Defense Distinguished Civilian Service Award in 1968. He was honored with awards for disclosures of inventions in 1962 and 1967, Superior Accomplishment Awards in 1954 and 1966, and six Outstanding Performance Awards (1956–70).

Graduated from the University of Arkansas with a BS degree in 1938, he received an MS degree from Polytechnic Institute of Brooklyn in 1942 and his doctorate from PIB in 1947.

Dr. Leonard is a member of the American Chemical Society, the American Association for the Advancement of Science, the New York Academy of Sciences, and American Society for Artificial Internal Organs.

Operations Research Symposium Focuses on Next Decade Objectives

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mobile), which successfully demonstrated in Vietnam the Howze Board airmobility concepts. General Norton also has served as CG of the Aviation Systems Command and as assistant commandant, Infantry School, Fort Benning, Ga.

In submitting three major challenges to operations research systems analysis (ORSA) technologists, General Norton urged them to be innovative in presenting essential information in mathematical model form to make it more easily comprehensible and credible for decision-makers.

"It's your job to communicate as well as to analyze," he said. "In addition to developing ways of explaining what you have done, you must also come up with more convincing ways of validating your mathematical models, so that studies that lean so heavily on them are more believable.

"Until we do this, we run the risk of having the good work ignored. In other words, brush away the fog of uncertainty about the credibility of our methods."

Another of his challenges was to "Use ORSA on ORSA." He explained that ORSA personnel should be able to help managers decide how much value ORSA can contribute to a given problem; also, where to apply the ORSA talent that is available, in order to make the best use of skilled specialists.

"The decision-maker in Washington, or anywhere in the Army, always faces these two problems," he said. "How much better—or worse—will my conclusions be if I invest in an ORSA-type study than if I use other sources of information? Also, he knows only too well that there is a limited number of people available—civilian or military—who have the talents and the training required to conduct good ORSA studies."

General Norton's third challenge was to "be bolder—and to be smart about being bolder. In fact, the last bold thing we did may have been getting started on the ORSA trail in the Army 10 years ago. What is there in ORSA that can be called 'new'?

"We are relying heavily on techniques that were developed in the ORSA explosion during the 40s and 50s. We are relying on classical mathematics. Where are the breakthroughs? Do we really have any classical major improvements? I'm inviting this group to move out and come up with new and different ways of attacking our basic problems...."

ORSA technology, he said, has been able to assign fairly satisfactory measures of effectiveness to firepower, mobility and logistics. However, with electronics technology exploding on the battlefield, measures of effectiveness are "desperately" needed for intelligence, command and control, in order to make wise investments in the new electronics.

"The shortcoming of many of our ORSA studies is that we have been unable to evaluate the aspects I have mentioned—and also morale, and fatigue, and leadership and training, and weather, and terrain—and even fear.

"The impact of these factors on the outcome of an engagement is at present very unpredictable. We have been content to call them unquantifiable. But in telling you to be bold, I'd have to say, that in one way or another, we must deal with unquantifiables because they often dominate the outcome of land combat actions."

Another problem area he cited as requiring effective application of ORSA techniques is that of trade-off analyses between noncompetitive systems—is it better to spend money on an extra artillery battalion or on a different type of reconnaissance unit?

In discussing the possibilities of gaining the most profitable use of ORSA specialists, General Norton mentioned the problems of force design, new tactics, materiel and major weapon systems componentry, reconnaissance, targetry, and program planning.

"The point I want to make is," he said, *"if you can tell me how cost-effective a conceptual weapon system is going to be, then you ought to be*

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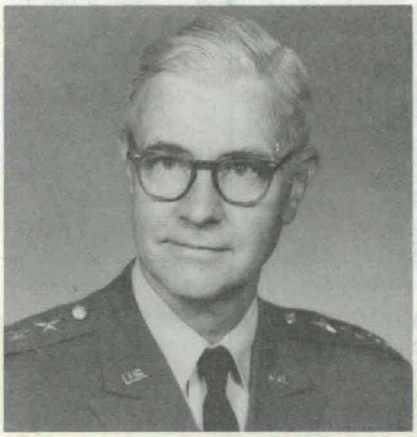
Starbird Takes Newly Created ODDRE Adviser Post

Advising the Secretary and the Deputy Secretary of Defense concerning policy for test and evaluation of all important weapon systems and equipment is the new responsibility of Lt Gen Alfred D. Starbird (USA, Ret.).

Effective June 7, he became the first incumbent of a newly created position, recommended by the Blue Ribbon Defense Panel, as Deputy Director (Test and Evaluation), Office of the Director of Defense Research and Engineering. The BRDP submitted a 237-page report July 1, 1970, recommending far-ranging reorganization of the Department of Defense.

Responsibilities of General Starbird will include insuring that test schedules are consistent with important decision milestones in the materiel acquisition process. He will:



Lt Gen Alfred D. Starbird (USA, Ret.)

- Insure that the Military Services identify the critical issues to be addressed by development tests and operational tests.
- Review test results and provide recommendations prior to the production go-ahead order.
- Review Service offices of test and evaluation plans and monitor their execution.
- Initiate and coordinate test and evaluation activity involving more than one Military Service.
- Exercise over-all policy direction of the operation, development and programing for Department of Defense test ranges and facilities.

From November 1967 until his retirement in March 1971, General Starbird was the Army System Manager for the Safeguard Antiballistic Missile System program. In his military career, he has had broad experience in the development and testing of major weapons systems.

While assigned to the U.S. Atomic Energy Commission (1955–61), he was director of Military Applications, charged with supervising and directing the development, testing and production of atomic weapons.

In 1961, as commander of Joint Task Force 8, he directed the last atmospheric atomic test series. During the latter years of a 1962–67 assignment as director, Defense Communications Agency, he organized and directed the Defense Communications Planning Group, which developed, produced and deployed the integrated sensor equipment for Southeast Asia operations.

SYMPOSIUM KEYNOTE SPEAKER Lt Gen John Norton, CG of the U.S. Army Combat Developments Command, enjoys a coffee break chat with (left to right) Chief of Research and Development Lt Gen William C. Gribble Jr., who introduced him; Army Research Office-Durham Commanding Officer Col William J. Lynch; and the Director of Army Research Brig Gen George M. Snead Jr.

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able to tell me how cost-effective your study methodology is. You should be able to show trade-offs between using ORSA and not using ORSA. . . ."

General Norton stressed also that he is in favor of having ORSA specialists use all of the best objective inputs, "including your own, *as long as we don't sacrifice any professional, intellectual integrity by making the studies 'prove' preconceived notions...*"

In closing, he reemphasized these points:

- Tell me in ORSA terms how better to use ORSA.
- Clear away the ORSA fog.
- Be bold in developing new tools to use in . . . qualitative analysis.

Deputy Under Secretary of the Army for Operations Research Dr. Wilbur B. Payne, Office of the Secretary of the Army, headed a panel of distinguished senior scientists in discussing the challenge to military OR analysts anticipated in the 1970s.

Panel members included Dr. Clive Whittenbury, vice president, Research Analysis Corp.; David C. Hardison, scientific adviser, Combat Developments Command; Dr. Joseph Sperrazza, director, Army Materiel Systems Analysis Agency; Dr. Donald N. Fredericksen, assistant director (Land Warfare), Office of the Director of Defense Research and Engineering.

Accented during the panel discussion was the need to improve a methodology for simulating, in the formulation of mathematical models, military weapons and tactical systems on a more realistic and comprehensible basis; also, development of practicable measures of systems effectiveness of alternative proposals to facilitate the task of decision-makers on development programs or acquisition of military materiel.

U.S. Army Chief Scientist Dr. Marvin E. Lasser presided over another high-level panel that considered the Integrated Battlefield Control System (IBCS) as related to the interoperability of computers. This was focused on Army efforts to achieve major improvements in command and control capabilities as related to increased combat effectiveness.

"Preparedness with a Severely Constrained Budget" was the topic of a panel headed by T. Arthur Smith, director of Cost Analysis, Office of the Comptroller of the Army. One of the key presentations was a detailed discussion of the "Framework of Army Planning," by Jack E. Hobbs, Office of the Assistant Secretary of the Army for Financial Management.

Banquet speaker William H. Megonnell, assistant commissioner for Standards and Compliance, Air Pollution Control Office, Environmental Protection Agency, detailed the far-reaching impact of the 1970 Clean Air Control Act. In many ways, all Americans will experience effects of the strict enforcement measures invoked by this legislation.

"Without question, it is tough," he said. "It is complicated to say the least. It has been described as having

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ONE OF THE LIVELIEST of several sessions that provoked spirited discussions featured Dr. Seth Bonder, University of Michigan (left), and Dr. John G. Honig, chief of the Weapons Systems Methodology and Concepts Office, Office Vice Chief of Staff, HQ DA, who discussed "Analytic Modeling."

MODERN VOLUNTEER ARMY special session speakers included (from left) Maj Peter Dawkins, former USMA All-American end and Rhodes Scholar; and Lt Col Jack R. Butler, Office of the Special Assistant for the Modern Volunteer Army, Office, Chief of Staff.

BEHIND THE SCENES of the smooth functioning of the Tenth Annual Operations Research Symposium was a hard-working team that included John Jordan, ARO–D administrative officer (since reassigned to ARO-Washington), shown here with Mrs. Ronda Rice, his secretary and symposium registrar. Others on the team were Dr. Marion Bryson, general chairman of arrangements; Lt Col Edgar G. Hickson, ARO–D executive officer; Maj Richard T. Detrio; ARO–W adjutant; Maj Gerald R. Wetzel, ARO–W action officer for the symposium; Capt Robert M. Sims, ARO–D adjutant; and J. B. Caulder, administrative assistant for ARO–D.

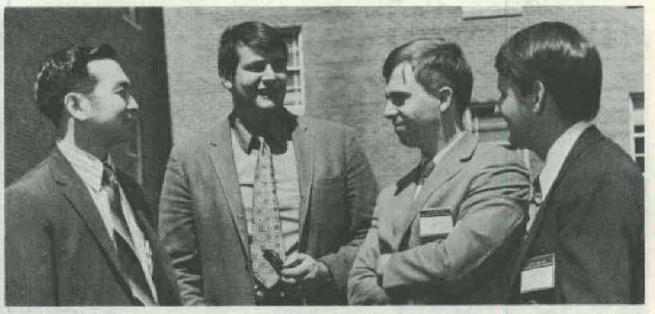
INTEGRATED BATTLEFIELD CONTROL SYSTEM panel discussion following Lt Gen John Norton's keynote address was headed by Dr. Marvin E. Lasser, U.S. Army Chief Scientist. Panel members, all with the Office of the Assistant Chief of Staff for Force Development, included Col Lucien E. Bolduc Jr., chief, Tactical Command and Control Division; Lt Col Gerald E. Galloway Jr., assistant director, Doctrine, Evaluation and Control; and Manfred Gale, technical adviser, Doctrine, Evaluation and Command Systems.

PREPAREDNESS WITH A SEVERELY CONSTRAINED BUDGET was a panel discussion that, judged by response, contributed much to success of the symposium. Members included (from left) Jack E. Hobbs, staff assistant, Office of the Assistant Secretary of the Army (Financial Management); Rex Brugh, director, Economic and Cost Analysis Directorate, Systems Analysis Group, Army Combat Developments Command; T. Arthur Smith, director, Cost Analysis, Office of the Comptroller of the Army; Edward R. McCauley, acting chief, Data Analysis Division, and Brian R. McEnany OR analyst, Force Analysis, DCA, OCOA.

UNITED KINGDOM REPRESENTATION included (from left) Brion A. P. James, John A. Booth and Maj. A. Mornement. Booth is superintendent, Weapons Assessment, Royal Armament Establishment, Kent, England. James is with the Defense Operational Analysis Establishment (DOAE), Surrey, England. He participated with Mornement, DOAE, in "Analyzing the Land-Air Battle in the European Theater."

CANADIAN DEFENCE RESEARCH BOARD staff members Dr. N. J. Hopkins, director, Land Operational Research, and John W. Wayne, director general of Operational Research, share a relaxing moment with Richard P. Blake, deputy chief, Canadian Defence Research Staff, Washington, D.C.

FRIENDSHIP BASED ON MANY YEARS of association in operations research activities is common to this group. Left to right: Dr. Julius E. Uhlaner, director, Behavior and Systems Research Laboratory, part of the U.S. Army Manpower Resources Research and Development Center; Dr. Joseph Sperrazza, director, Army Materiel Systems Analysis Agency; Dr. John Honig, chief, Weapons Systems Methodology and Concepts Office, OVCS, HQ DA; Dr. Marion Bryson, general chairman of arrangements for the Army Operations Research Symposium for six years and technical director, Institute of Systems Analysis, Combat Developments Command; and Dr. C. W. Clark, former Director of Army Research, who has served as vice president of Research Triangle Institute since he retired as a major general.



YOUNG SCIENTISTS who participated in the symposium included (from left) Dr. John D. Hwang, employed at HQ U.S. Army Materiel Command since he received his doctorate three years ago at age 26 from Oregon State University; Dr. Clark E. Runnion, who served two years in the Army after receiving his PhD in mathematics from the University of Washington at age 26 and has been employed during the past year at the Army Logistics Management Center, Fort Lee, Va.; Capt (Dr.) Gary D. Mather, Army Materiel Command, who has been with the Systems Analysis Division for six months following graduation from Rensselaer Polytechnic Institute at age 25 with a PhD in electrical engineering; and Dr. John J. Jarvis, who graduated in 1968 at age 26 with a PhD from Johns Hopkins University in operations research. Dr. Jarvis is in industrial and systems engineering and assistant professor, Georgia Institute of Technology.

Operations Research Symposium Focuses on Next Decade Objectives

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more mandatory deadlines per square inch than any other piece of legislation enacted within the past 20 years. It is the best blueprint for clean air this nation ever has had."

Primary standards must protect human health and welfare. The definition of welfare includes but is "not limited to effects on soils, water, crops, vegetation, man-made materials, wildlife, weather, visibility and climate, damage to or deterioration of property, hazards to transportation, economic values, and personal comfort and well-being."

Megonnell said he was surprised at being asked to make a major address to an Army R&D symposium since he has never, in any way, been involved in R&D activities. However, Army concern about clean air and other aspects of antipollution control, is based on a rapidly developing program of R&D activities that will provide the know-how for effective control measures.

One of the liveliest highlights of the symposium was a presentation on the Modern Volunteer Army (VOLAR) by two officers on the headquarters staff of Lt Gen George I. Forsythe, VOLAR director, Office of the Chief of Staff. The speakers were Lt Col Jack R. Butler and Maj Peter Dawkins, the latter a Rhodes Scholar following graduation from the U.S. Military Academy and renowned as an All-American end in football.

Jerome H. N. Selman, HQ U.S. Army Munitions Command, and Dr. Gary Mather, Army Materiel Command, cochaired a session on "Risk Analysis."

COFFEE BREAK afforded participants time to compare notes on proceedings of the symposium. From left are Col George T. Morris Jr., director, Plans and Analysis Directorate, U.S. Army Test and Evaluation Command, Aberdeen (Md.) Proving Ground; Col Lauris M. Eek Jr., chief, Management and Evaluation Division, OCRD; Col Neil B. Downey, Department of Operations Research, Army Management School, Fort Belvoir, Va.; Col John E. Sutton, chief, Systems Analysis Division, Army Logistics Doctrine, Systems and Readiness Agency, New Cumberland, Pa.; Dr. Geoffrey E. H. Ballard, director, Advanced Telecommunications Sciences, Army Strategic Communications Command, Fort Huachuca, Ariz.

Papers were given by Dr. C. E. Runnion, Army Logistics Management Center, "Use of Network Techniques"; Dr. J. R. Rabung, ALMC, "Use of Utility Theory and Subjective Evaluation"; and Dr. J. D. Hwang, Army Weapons Command, "Risk Analysis versus System Analysis for the Materiel Acquisition Process."

Dr. Leslie G. Callahan Jr., Georgia Institute of Technology, chaired a session devoted to contributed technical papers by:

Dr. Thomas B. Cochran, Litton Scientific Support Laboratory, (LSSL), "Validation of Terrain Models"; Dwight B. Clark, LSSL, "An Attitude and Flight Path Predictive Model for Rotary Wing Army Aircraft"; Herbert N. Cohen, Army Ballistic Missile Defense Agency, and Dr. Stanley S. Dick and Willard W. Perry, Keystone Computer Associates, Inc., "Techniques for Minimizing the Deployment Cost of Hardside Ballistic Missile Defense Systems."

Dr. Badrig M. Kurkian, Army Materiel Command, presided at a session on contributed papers by:

Charles A. Haase, Engineering Topographic Laboratories, "Computer Simulation as a Tool to Predict the Performance of a Future Army Electronic Surveying System"; Channing L. Pao, Combat Developments Command Institute of Land Combat, "Performance Analysis of Proposed Materiel Options"; John J. Healy, U.S. Army Construction Engineering Research Laboratory, "Survival Effectiveness for Hardened Facility Systems."

"Measures of Effectiveness" was the topic of a session chaired by Dr. Frank E. Grubbs, chief operations research analyst, Aberdeen (Md.) Research and Development Center (ARDC). Speakers were:

Ronald L. Simons, Army Materiel Systems Analysis Agency, "Measures of Effectiveness for Direct Fire Infantry Weapons"; John A. Blomquist,

INFORMAL DISCUSSION, typical of many held at the Operations Research Symposium, involves (from left) Cecil Johnson, Behavior and Systems Research Laboratory, U.S. Army Manpower Resources R&D Center; Dr. Robert Stevenson, American Institute for Research, Washington, D.C.; Brig Gen John R. Jannerone, dean of the Academic Board, U.S. Military Academy; Robert F. Robertson, technical director, Studies and Analysis, General Purpose Forces, HQ U.S. Air Force.

ARDC, "Measures of Effectiveness for Indirect Fire with Non-Nuclear Artillery Weapons"; Harry X. Peaker, Army Materiel Systems Analysis Agency (AMSAA), "Measures of Effectiveness for Surface-to-Air Weapons"; and

Lt Col (Dr.) Robert W. Blum, CDC Institute of Systems Analysis, "Measures of Effectiveness for Tactical Systems"; Bernard B. Rosenman, Frankford Arsenal, "Conflicting Measures of Performance in Inventory Systems"; and Andrew J. Eckles III, ARDC, "Human Engineering Measures for Effectiveness of System Performance."

Presentations at a session chaired by Maj Gerald R. Wetzel, Army Research Office, OCRD, Washington, included:

"A Computer Model of a Semiautomatic Flight Operations Center (SAFOC) Using the General-Purpose Simulation System," Dr. Edwin Biser, Army Electronics Command, John Mikula, Arthur Coppola and Herman Mencher, American Electronics Laboratories; "Paper on Model of Support Force Analysis and Planning," Richard H. Gramann and Dr. Bruce Taylor, Research Analysis Corp.; "A Unified Set of Algorithms for Conducting Command/Control System Synthesis Studies," Harold H. Burke and Toney R. Perkins, AMSAA.

United Kingdom representatives highlighted the concluding session with a presentation on "A Method of Analyzing the Land-Air Battle in the European Theater." The speakers were Maj A. Mornement and Brian A. P. James, both of the Defense Operational Analysis Establishment.

Dr. John Honig, Army Office of the Assistant Vice Chief of Staff, and Lt Col Robert W. Blum, Combat Developments Command, joined in presenting "Results of Model Review Committee." This was a summary of the highlights of a forthcoming report detailing an in-depth study of the current state-of-the-art in techniques of mathematical models used for system analysis and evaluation.

Dr. George E. Nicholson Jr., chairman of the Department of Statistics, University of North Carolina at Chapel Hill, who will be general chairman of arrangements for the Army Operations Research Symposium in 1972, presented the concluding summary and analysis of results.

SYMPOSIUM ATTENDEES included (from left) Dr. Daniel F. McDonald, Braddock, Dunn and McDonald, Inc., El Paso, Tex.; Dr. Richard B. Haley, scientific adviser to the Director of Missiles and Space, OCRD; L. Hugh Devlin, systems analyst, Information Systems Office, OCRD; Col Archibald Arnold, chief, Classification and Standards Division, Office of the Deputy Chief of Staff for Personnel; Col I. F. Carpenter, chief, Strategy and Tactics Analysis Group, ODCSOPS.

From the viewpoint of numerous participants who were queried regarding their reaction to the program, the consensus appeared to be that they considered the conference the most successful of the Army Operations Research Symposiums held to date.

In introductory remarks, ARO-D Commander Col William J. Lynch termed the symposium "the largest that ARO-D has accommodated." He also explained the ARO-D mission, which currently consists of more than 450 contracts and basic research grants — primarily with universities but also with nonprofit, government and industrial laboratories, averaging $20,000 to $30,000 each (total about $14.5 million annually).

ARO-D conducts that part of the Army basic research program in mathematics and the physical, engineering and environmental sciences. ARO-D also provides a liaison function between the Army scientific community and the scientific community at large—principally through locating and arranging for the services of uniquely qualified scientists to provide assistance and advise on R&D.

This includes the ARO-D Army Laboratory Research Cooperative Program, which permits highly qualified university scientists to work in Army laboratories on research tasks, usually for three months during the summer vacation, and to exchanging knowledge regarding Army interests.

SOCIAL HOUR DISCUSSION. From left are Dwight B. Clark and Dr. Thomas Corcoran of the Litton Scientific Support Laboratory, Fort Ord, Calif.; Dr. Lester G. Callahan Jr., former CO of the Harry Diamond Laboratories and former director of the Avionics Laboratory at the U.S. Army Electronics Command, Fort Monmouth, N.J.; Maj Gerald R. Wetzel, Army Research Office.

AMC, MUCOM, *Picatinny Arsenal*—From left, Marcel Blais, Dr. Harry D. Fair Jr., Dr. David Downs, Arthur C. Forsyth, Dr. Thaddeus F. Gora Jr.

R&D Achievement Awards Recognize 81

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the achievement. The arrangements for ceremonies were pending as this publication went to press.

Criteria established when the awards were initiated in 1961 require a scientific or engineering achievement by in-house laboratory personnel that (1) establishes a scientific basis for subsequent technical improvement of military importance; (2) materially improves the Army's technical capability; and/or contributes materially to national welfare.

Nominations for the awards are submitted by each of the major commands or organizational elements engaged in research, development, test and evaluation activities—based upon a thorough screening of notable accomplishments reviewed by immediate supervisors and laboratory technical directors.

Achievements upon which 1971 award winners were selected range over a broad field of scientific disciplines and subfields, reflecting the extremely diversified spectrum of Army research and development interests oriented to military requirements.

Winners were selected by an 8-member panel of judges chosen from within the Office of the Chief of Research and Development for their expertise in the major scientific areas. Dr. I. R. Hershner Jr., chief of the Physical and Engineering Sciences Division, Directorate of Army Research, was chairman.

Members included Dr. Carl Lamanna and Lawrence F. Ayers, Directorate of Army Research; Lt Col Clifford J. Fralen and Lt Col Carl G. Hermann, Directorate of Developments; Dr. Richard L. Haley, Directorate of Missiles and Space; Lt Col John R. Matteson, Directorate of Plans and Programs; Maj Jerry K. Patterson, Directorate of Advanced Ballistic Missile Defense.

Selection of 1971 award winners attests to the rising trend in recent years to team effort as opposed to individual research—that is, the pooling of knowledge of specialists in several disciplinary areas to solve the increasingly complex problems of greater sophistication in materiel.

Another trend is the increase in recent years in the number of R&D Achievement Awards. In 1961 a total of 22 awards gave recognition to 27 persons. In 1969 the awards were made to 45 individuals, including seven teams. Recognition in 1970 was given to 52 scientists and engineers.

Responsibility of the Army Materiel Command for control of about 90 percent of Army in-house laboratories is reflected by the choice of AMC personnel for 26 of the 1971 R&D Achievement Awards. Employes of the Office of the Chief of Engineers will receive five awards and two will be presented to Office of the Chief of R&D activities.

Winners, the installations at which they are employed and a brief description of the achievements adjudged deserving of recognition are:

AMC MUNITIONS COMMAND. A 5-man team from Picatinny Arsenal at HQ MUCOM, Dover, N.J., was selected for conceiving, developing and assembling new solid-state spectrometers. Using new experimental techniques, they extended solid-state theory to determine the electronic properties of explosives and other complex and hazardous solids.

Team members are *Dr. Harry D. Fair Jr., Dr. David Downs, Dr. Thaddeus F. Gora Jr., Arthur C. Forsyth* and *Marcel Blais.*

"The new capabilities," their citation states, "are contributing to our knowledge of the electronic structure and its relationship to the instabilities of explosives. This knowledge is invaluable in determining how explosive solids absorb energy." Production of explosives with improved performance and safety thus becomes feasible.

"The instrumentation and techniques developed for hazardous and complex explosive solids should be equally valuable in other research areas," the citation continues, "especially in studying the electronic structure and energy transport in semiconductors, polymers and other important materials such as biological substances."

Silvio Rampone, William G. Joseph, Sidney Jacobson, John Howell, Theodore Zimmerman and *Edward Wurzel* comprise a 6-man Picatinny team credited with developing and fielding the 152mm XM409 Heat MP Cartridge for use with the M551 Sheridan vehicle.

This dual-purpose cartridge is cited as a major achievement in munitions design. It incorporates features such as a nonmetallic cartridge case; fluted shaped-charge liner; high-fragmenting, forged-steel projectile body and a fuze-initiating electrical system designed to operate on hard-target impact and graze impact with the ground.

The XM409 project was the first attempt to incorporate all these features in a single round of ammunition.

Robert F. Van Ness, William H. Meyer, Michael A. Chiefa and *Warren G. Reiner* were selected to receive awards in recognition of their innovative leadership and technical achievements. They contributed to an advanced development program that culminated in the successful demonstration of a container system for the XM517 projectile.

Designed initially to meet specific Army needs, the system is ultimately expected to find a broad range of government and commercial applications associated with the protection of valuable commodities.

Seymour Fleischnick, Theodore W. Stevens, Hyman D. Rutkovsky and

Alfred J. Fiorentino were acclaimed for contributions to advancement of shaped-charge munitions technology.

This effort included the introduction of advanced concepts and techniques for manufacturing, and was carried out in cooperation with personnel of the Ballistic Research Laboratories, U.S. Army Aberdeen (Md.) R&D Center. Their achievements, applied to experimental, developmental and product-improved shaped-charge warheads, have resulted in significant advancements in weapons performance.

Elie L. Barrieres, Gerald E. Gaughan, Stanley D. Kahn and *Robert W. Kantenwein*, a Picatinny team of engineers, were honored for ingenuity and creativeness in conceiving and demonstrating feasibility of a Terminal Delivery Vehicle (TDV).

A novel payload concept for artillery projectiles, the TDV is ejected from a conventional artillery shell in flight. Upon reaching the ground, the payload in the vehicle performs its mission, providing the Army with a total new capability in the field of artillery ammunition.

MUCOM—Edgewood (Md.) Arsenal. Successful development of the XM191 Multishot Portable Flame Weapon earned an R&D Achievement Award for *William J. Weber, Joseph G. Schaffner* and *Jacob Klein.*

The trio conceived the idea of a lightweight (26 pounds) pyrophoric flame delivery system, multi-modular in nature, projected by rocket rather than the conventional compressed-air rod projection.

They accomplished the preliminary effort in-house, then directed the engineering, design, construction and test of the system under the aegis of an industrial contractor.

Many new concepts, mechanisms and features are incorporated into the design of the weapon. The increased range greatly reduces gunner vulnerability and casualties from enemy fire.

MUCOM—Frankford (Pa.) Arsenal. *Richard A. Meinert* and *Charles E. Sallade* of Frankford Arsenal Ammunition Development and Engineering Laboratories were commended for a technological breakthrough on mortar and artillery projectiles.

The citation states that their achievements in shell-steel metallurgy permit the manufacture of high-explosive shells with increased fragmentation and lethal effect. The technological advance has been applied to mortar shells and the team is conducting studies to apply the manufacturing process to other shells.

AMC ELECTRONICS COMMAND (ECOM), Fort Monmouth, N.J. Development of a Laser Target Designation System provides the basis for an R&D Achievement Award to a 6-man ECOM team. Members are *Michael R. Mirachi, Robert G. Palazzo, Richard J. Newton, Vito J. De Monte, Alexander G. Mondrick* and *Maj Maynard A. Nagelhout.*

Developed and evaluated in extensive field tests, the equipment has proved reliable in Southeast Asia operations. Capabilities of the Army are reported materially enhanced. The system furnishes target information not available before the laser technology was developed by the ECOM team.

An 8-man team from the Night Vision Laboratory at ECOM was selected to receive an award for development of a Handheld Thermal Viewer that enhances the Army's ability to operate at night. Members are *Patrick J. Daly, Walter M. Mannherz, William S. Sims, Gerald T. Bean, James E. Perry, Joseph J. Weidman, Edward J. Butcher and Jon L. Ulanet.*

The group originated the concept and carried out development of components and systems in a rugged, reliable device. The operator receives a visable image corresponding to the temperature differences in the object or scene under observation.

No visible light is required to illuminate the scene, which permits the viewer to be used under a complete cover of darkness. The viewer weighs less than six pounds and uses a 5-pound battery for 12 hours of continuous operation.

Another significant feature is a self-contained solid-state cooler that eliminates the need for cryogenic liquefied gases often used with infared detectors.

In addition to enhancing the Army's ability to operate at night, the viewer is expected to have widespread nonmilitary applications.

Dieter Lohrmann and *Arthur Sills* will receive awards for their concept of a radio frequency synthesizer design that will increase combat effectiveness of the foot soldier. This development reduces the total life-cycle cost of tactical radio equipment. They are employed as the modulation technique team, Transmissions Technical Area, Communications/ADP Laboratory at ECOM.

Due to its small size, weight and power consumption, the synthesizer is particularly useful in manpack equipments operating from HF through the ultra-high frequency (UHF) spectrum. Implementation of this concept has resulted in a 5:1 reduction in size and input power consumption, compared to conventional digital frequency synthesizers.

Design of the synthesizer is compatible with microcircuit technology. Further reduction in size can be achieved through application of large-scale integration techniques.

An Army R&D Achievement Award will be presented to *Dr. Norman K. Shupe* for his significant contribution in developing a unique and powerful mathematical model to prove the fundamental theory of hingeless rotored helicopters.

Advances in stabilization systems achievable through development of this advanced design capability are

(Continued on page 67)

From left, Dr. Abdul R. Rahman, AMC, *Natick Labs;* Robert B. Oswald, Dale R. Schallhorn, Harvey A. Eisen and Nick Karayianis, AMC, *Harry Diamond Labs.*

Army Natick Laboratories Make Sugar From Waste Paper

(Continued from page 1)

print or any product of wood pulp. Hundreds of thousands of tons of waste paper are generated in the United States every month, and a large part originates within facilities of the Department of Defense.

Glucose is a universal growth substrate that can be consumed by man, fed to animals as molasses, or converted to single-cell protein such as yeast. Fermentation can convert it into alcohol (a clean-burning fuel), industrial solvents such as glycerol, or into amino acids or vitamins that can be added as supplements to foods deficient in these amino acids or vitamins.

Practiced enzymatic conversion of cellulose to glucose sugar is a serendipitous outgrowth of basic research initiated in the Natick Laboratories about 25 years ago when they were known as the Army Quartermaster Research and Engineering Laboratories.

Research at that time was directed to a method of preventing the destruction of cotton fabrics by fungi (mildew), resulting in millions of dollars damage annually during World War II operations in hot, humid environments.

Development of the enzymatic process represents a coupling of basic with applied research. Translation of basic research knowledge into the applied phase has been accomplished by NLABS under a project supported with a small portion of the funds provided under the Army In-House Laboratory Independent Research Program.

Feasibility of the process has been well demonstrated, NLABS officials report. Based on laboratory data, a 15-gallon reactor would have a conversion rate of one ton of cellulose to one ton of glucose per year.

Much of the basic design engineering for the conversion of cellulose to glucose sugar exists in the starch industry, which uses enzymatic hydrolysis to convert hundreds of thousands of tons of starch annually to glucose. The source of this starch has generally been corn.

Much of this glucose is used in bakery and other food products. The know-how and equipment for growing protein-rich yeast or producing fermentation products of industrial interest from glucose already exist in industry.

NLABS investigators say the enzyme cellulase is quite specific for cellulosic materials and is not readily inhibited by other organic and many

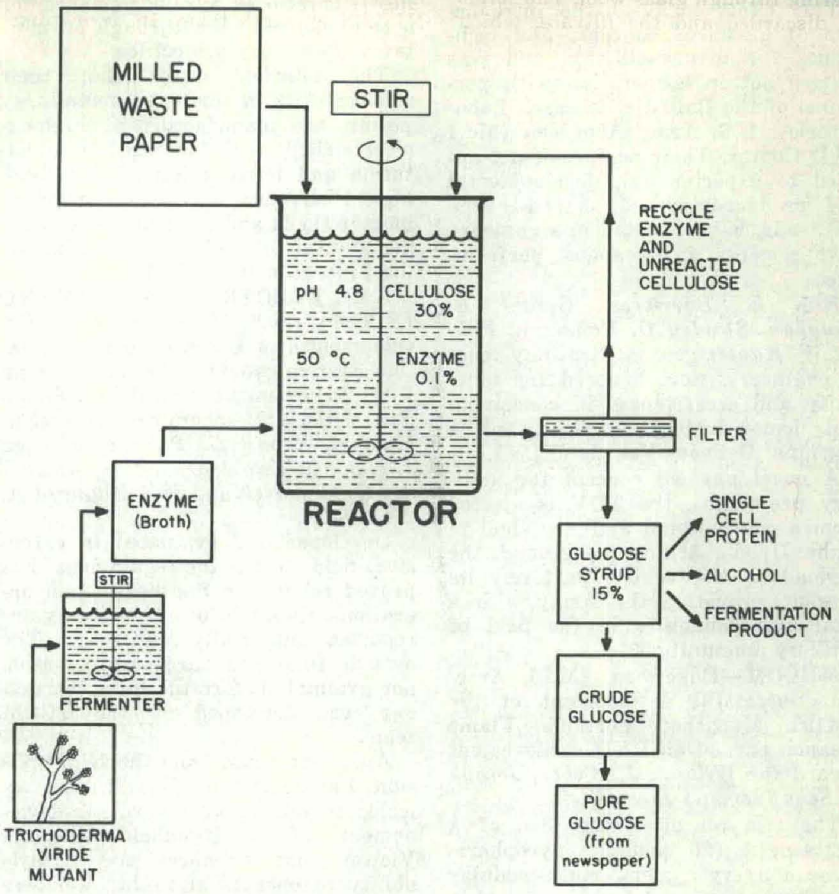


Fig. 1. Conversion of Waste Paper Products to Glucose Sugar

inorganic materials. Experimentation indicates that such foreign matter as shredded and/or finely ground plastic film will not interfere with the conversion process. Noncellulosic materials remain in the reaction vessel as a residue to be withdrawn from time to time.

Internationally recognized as a center of knowledge relative to cellulolytic microorganisms, the NLABS today house a collection of more than 10,000 fungi associated with the deterioration of materials. The sequence in the progress toward the successful enzymatic hydrolysis of waste paper to glucose sugar has been:

1. Identification of the fungus *Trichoderma viride* as the source of a powerful cellulase capable of totally converting cellulose to glucose.

2. Developing optimum cultural conditions for production and processing of large quantities of enzyme.

3. Doubling the enzyme yields through improvement of the strain by mutation.

4. Pretreatment of cellulosic materials by pulping, followed by milling, to increase available surface and bulk density (the latter being essential if glucose syrups of high concentration are to be attained).

5. Production of 30 percent glucose syrups in test tube experiments by incubating concentrated enzyme with 50 percent suspensions of milled cellulose.

6. Continuous production of 5 to 15 percent glucose syrups in one-to three-liter model systems.

7. Retention of enzyme and cellulose in the reaction system by the use of ultrafiltration membranes.

8. Discovery in 1970 that the enzyme is retained by the undigested cellulose, thus eliminating the need for the expensive ultrafiltration membranes—a critical and economic barrier to process practicality.

Figure 1 shows schematically the process developed by NLABS researchers. The fungus *Trichoderma viride* is grown in laboratory fermen-

ters on cellulose medium for two weeks. The culture is harvested by filtering through glass wool. The solids are discarded and the filtrate, which contains 0.5 to 1.0 milligram of enzyme (protein) per millimeter, is adjusted to pH 4.8 and used as the enzyme preparation without further processing.

Waste paper is shredded in a paper disintegrator and is then ball milled to less than 50 microns average particle size. This treatment gives a highly reactive cellulose and allows preparation of usable suspensions of up to 50 percent weight of solids to volume of solution.

In conducting continuous reactor experiments, enzyme (culture filtrate) is mixed with 10 to 20 percent cellulose in a vessel where it is stirred and maintained at 50° C. A continuous feed of milled cellulose maintains cellulose concentration as digestion proceeds.

The adsorbed enzyme is released as the cellulose is hydrolyzed, and is readsorbed to be reused on fresh cellulose. Very little enzyme is found in the solution where it would be wasted.

When gluclose concentration reaches the desired level (5 to 15 percent), milled cellulose, buffer and a small amount of diluted enzyme (as make-up) are fed continuously into the system by a peristaltic pump. An equal volume of glucose syrup is concurrently harvested through a coarse filter. The retained enzyme-cellulose complex is returned to the reactor.

Systems such as here described have been operated continuously for up to seven weeks, maintaining high rates of glucose production. Glucose yields in reactor experiments of two to four grams per liter per hour for 24 to 72 hours of digestion have been obtained. These values are approaching the yields in commercial production of glucose from corn starch.

The glucose syrup produced by this reaction can be dried and purified by crystallization if desired. Glucose sugar, as stated earlier, is used extensively in bakery products and other processed foods. However, the crude syrup need not be purified for many practical applications.

For example, the syrup can be concentrated to a molasses for feeding to cattle, sheep, hogs, poultry or as an additive to ensilage.

With the current national emphasis on clean-burning fuels to minimize pollution of the air, the potential for using the glucose syrup as an excellent growth substrate for microorganisms that could ferment the glucose to ethanol or methane gas appears attractive.

Protein-rich microorganisms grown on the syrup can be a food supplement for meat-eating animals or even for human beings, in the opinion of the NLABS research team. In developing countries that are deficient in protein sources, this potential might be one of the most important applications of the enzymatic process.

Other microorganisms that produce vitamins, amino acids, antibiotics such as penicillin, or organic chemicals such as citric or gluconic acids, also could be grown on the syrup.

NLABS researchers currently are experimenting to obtain more active enzymes through mutation of *Trichoderma viride*, the fungus that produces the enzyme cellulase. They also are examining the conversion of a variety of cellulosic products, ranging from rice hulls, sawdust, paper bags and waxed paper cartons to water-repellent cardboard boxes.

Every cellulosic material tested to date, when shredded and pulverized, has responded well to the Natick-developed process of enzymatic conversion to glucose.

Increased R&D Interest Shown in Environmental Quality

Army R&D efforts that contribute directly or indirectly to the quality of the environment have become the object of extensive planning and action.

Presidential Executive Order 11507 requires that actions by all federal facilities to comply with air and water quality standards be completed or under way by Dec. 31, 1972.

Although several other directives preceded and followed the Feb. 4, 1970 Executive Order, 11507 differs in that it calls directly upon federal agencies to provide leadership in the nationwide effort to protect and enhance the quality of air and water resources.

Following the Executive Order, environmental quality has become a major consideration in the research, development, test and evaluation cycle.

Army Chief of Research and Development Lt Gen William C. Gribble Jr. has appointed Director of Army Research Brig Gen George M. Snead Jr. to coordinate OCRD actions in pollution control. Col Donald L. Howie, chief of the Life Sciences Division, and Maj Curtis G. Unger as project officer on his staff, have been designated as the OCRD contact points for environmental quality matters.

OCRD conducted a conference in November 1970 (For a detailed report see *Army R&D Newsmagazine*, Nov-Dec 1970, page 3) directed towards pollution abatement and the enhancement of environmental quality.

Developing agencies were encouraged to formulate programs and request funds to accomplish the necessary research and development for the solution of known pollution problems. A list of primarily Army pollution problems, possibly requiring R&D effort for solution, was prepared at the conference and furnished to the developing agencies.

The U.S. Army Materiel Command (AMC), Office of the Surgeon General (OTSG), and the Office of the Chief of Engineers (OCOE) have since prepared pollution abatement R&D plans, and included them in presentations to program and budget review boards.

Each of these plans requested additional funds and indicated an intention to use current funds for pollution abatement efforts. Plans call for expenditure of about $2 million in FY 1972, and about $8 million in FY 1973 for Army R&D efforts that contribute directly to pollution abatement.

Environmental quality plans of the COE include the development of methods to make military facilities, military construction and engineering support of military operations more compatible with environmental protection goals.

The OTSG plans include the development of environmental protection standards for the Army, and improvement of monitoring methods. R&D activities to improve methods for disposal of field hospital wastes also are projected.

Materiel Command planners also are concerned with waste disposal, whether generated by the field army or from explosives and petroleum products. Plans for improved disposal include recycling and biodegradation.

Another AMC pollution abatement effort involves a new vehicle engine being developed at the U.S. Army Tank-Automotive Command (TACOM) in Warren, Mich. (*Army R&D Newsmagazine*, March 1971.

Although not expected to be ready for production before 1976, the engine uses a new type combustion system that is a hybrid between spark ignition and diesel type engines. This system results in more complete combustion and greatly reduced exhaust emissions. Another ongoing developmental cycle is expected to yield further reduction of polluting emissions. Antipollution methods for other engines are also being investigated.

Specific examples of the planned effort, as here outlined, demonstrate the heightened interest and willingness of the Army R&D community to act in environmental quality matters within the guidance set forth in Executive Order 11507.

National Growth of Nuclear Power Plants Based on Army Effort

Nuclear power plants are an increasingly important part of the American way of life in metropolitan areas, as well as for numerous special military requirements. Only 14 years ago the U.S. army's SM–1 helped blaze the trail for industrial development.

Still located at Fort Belvoir, Va., the SM–1 is the world's oldest operational nuclear power plant—used as a tool for continuing research and development and as a training vehicle for student operators.

Graduates have traveled to all parts of the world to assist in setting up, maintaining and operating nuclear power plants. In June, when the 14th anniversary of the SM–1 was observed, 731 students had completed training—419 Army, 211 Navy, 101 Air Force and five civilians assigned to the Army nuclear power plant in Alaska.

Army Chief of Research and Development Lt Gen William C. Gribble Jr. was one of the pioneers of the Army nuclear power plant program. From 1953 to 1956 he was deputy assistant director, Reactor Development Division, U.S. Atomic Energy Commission.

General Gribble received the Legion of Merit in 1957 for developing the technical specifications for design, construction and test operation of the SM–1 plant at Fort Belvoir.

Today the construction of nuclear power plants with sufficient capacity to serve large cities is a multimillion-dollar industry. An outstanding example of the Army's continuing special developmental effort is the MH–1A, the first floating nuclear power plant, dedicated Apr. 26, 1968.

ORIGINAL CREW MEMBERS of SM–1 Nuclear Power Plant were on hand recently when Lt Col Max E. Satchell, deputy director of the U.S. Army Engineer Reactors Group (USAERG), cut a birthday cake to mark the 14th anniversary of the oldest operational nuclear power plant in the nation. They are (from left) Charles R. Feavyear, now a nuclear engineering technican with USAERG; M/Sgt Robert T. Shakour, SM–1 plant supervisor; Harold L. Allen, chief, Mechanical Training Section at USAERG, Fort Belvoir, Va., where the SM–1 is located.

With a capacity of 10,000 kilowatts —and about 200 million kilowatt hours of electrical power for two years "without any further major logistical support"—this barge-mounted plant is in the hull of a modified Liberty Ship, requisitioned from the "Mothball Fleet."

Currently, the MH–1A is being used to provide emergency power for the Panama Canal operation. However, it is designed to be towed to disaster or off-shore areas where emergency power is needed.

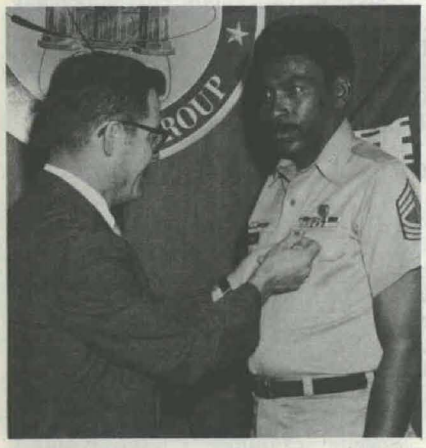
The Army Nuclear Power Program, an association of Department of Defense and U.S. Atomic Energy Commission activities, is responsible for developing nuclear power plants capable of supporting land operations of the U.S. Armed Forces.

Emphasis, as a result, has been on development of portable nuclear power plants, capable of being broken down into units transportable to remote locations. For example, the first portable plant was the PM–2A, fabricated in 27 modules and test-erected in the U.S. prior to shipment to Greenland to provide power in 1961 for Camp Century, the Army's experimental "City under the Ice."

Improved and larger capacity versions of the PM–2A have since been installed and have satisfactorily met operational requirements in Alaska, the Navy's McMurdo Sound installation in the Antarctic, an Air Force radar station atop a mountain in Wyoming, and other areas.

The U.S. Atomic Energy Commission in Washington, D.C., issued on Apr. 15, 1971, a listing of the "Status of Nuclear Power Plants, as of Mar. 31, 1971." It shows 21 operable plants in the United States with a capacity totaling 8,303,800 kilowatts.

Fifty-six plants with a total capacity of 47,102,000 kilowatts are under construction. Thirty-seven



MERITORIOUS SERVICE MEDAL was presented to M/Sgt Talbert Young Jr. by Col Harvey L. Arnold Jr., USAERG director, for exceptional performance with the group in progressively responsible duties since 1961.

SPECIAL ACT OR SERVICE award is presented to George B. Manning (right) for presenting a technical paper on TCS 670–B turbine at Amer. Society of Mechanical Engineers conference.

plants are planned, that is, the reactors are ordered, with a capacity of 36,727,000 kilowatts.

A map accompanying the AEC listing of plants shows that all except 15 plants that are operable, under construction, or under order, are east of the Mississippi River. Twelve are strung along the West Coast.

Another AEC listing compiled as of Mar. 1, 1971, provides, detailed information on all nuclear power plants in operation, under construction or planned (reactors ordered).

When the U.S. Army Engineer Reactors Group (USAERG) marked the 14th anniversary of the SM–1 at Fort Belvoir, three members of the original operating crew were in attendance.

In the general time frame of the anniversary celebration, a number of USAERG personnel were cited for their achievements. M/Sgt Talbert Young Jr. was presented with the Meritorious Service Medal, in recognition of his exceptional performance with the group in a series of progressively responsible assignments since March 1961. The award was made prior to his retirement after 20 years of military service.

A suggestion to improve the safety of the *Sturgis*, the nuclear power plant barge now in Panama, earned a $260 award for Sp/6 Edward G. McGowan through the U.S. Army Incentive Awards Program.

Another $150 "Special Act or Service Award" was presented to George B. Manning for authoring and presenting a technical paper before the American Society of Mechanical Engineers. It was titled "The Performance of the TCS 670–B Turbine in the Closed Cycle Test Facility at Fort Belvoir."

The selection, presentation and publication of the paper in the conference proceedings of the ASME Turbine Conference and Products Show in Houston, Tex., this spring was termed "a significant report in a field in which the USAERG is the leader."

Lotz Goes to NATO; Foster ECOM CG

Presidential nomination of Maj Gen Walter E. Lotz Jr. for 3-star rank, coincident with assignment to HQ NATO in Belgium, resulted in a change-of-command ceremony May 20 that made Maj Gen Hugh F. Foster Jr. his successor as CG of the Army Electronics Command.

General Lotz is now Deputy Director General of the NATO Integrated Systems Management Agency, a newly created position he assumed May 24. Following Senate confirmation of President Nixon's nomination, he was promoted to lieutenant general June 4.

Since September 1969 he had served as CG of the Electronics Command (ECOM), following an assignment since Apr. 11, 1968, as CG of the U.S. Army Strategic Communications Command. Until he departed in September 1963 to become the Director of Army Research in Washington, D.C., he served at HQ ECOM as deputy commander and then deputy CG following duty as comptroller and director of programs.

COMMAND CHANGE of the U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J., is completed as Maj Gen Hugh F. Foster Jr. accepts Army Materiel Command (AMC) flag from Lt Gen Woodrow W. Vaughan, deputy CO, Army Materiel Command.

Army Materiel Command Deputy CG Lt Gen Woodrow W. Vaughan participated in the ECOM change-of-command ceremony and presented the Legion of Merit (third Oak Leaf Cluster) to General Lotz for achievements as ECOM CG.

Eight generals wearing a total of 13 stars were in attendance, including Maj Gen Thomas M. Rienzi, CG, Strategic Communications Command, Pacific; Brig Gen Richard C. Horne III, Army Signal School Commandant at Fort Monmouth, N.J.; Brig Gen Harold W. Rice, CG of the TRI-TAC Office; Brig Gen Albion W. Knight, ECOM Deputy CG; and Brig Gen Richard W. Swenson, CG of the Army Communications Systems Agency.

General Foster was CG of ACSA from July 1967 to August 1969 when he departed to become CG of the Strategic Communications Command, Pacific, in Hawaii. In June 1970 he was assigned to the First Signal Brigade, Vietnam.

Graduated from the U.S. Military Academy in 1941, he did graduate work in electronics and radar at Harvard University and Massachusetts Institute of Technology. Some 20 years later he returned to Harvard to complete the Advanced Management Program. He is a graduate from the Command and General Staff College and the Army War College.

Maggio Succeeds Mulheron as Watervliet Arsenal Co

Col Christopher S. Maggio will assume command of Watervliet Arsenal on July 15, succeeding recently retired Col William Mulheron Jr.

Col Maggio, with the Deputy Chief of Staff for Logistics (DCSLOG) since 1968, has most recently served as chief, Procurement, Equipment and Missiles, Army (PEMA), Executive Division. His previous assignments with DESLOG included chief, Artillery Branch for Commodity Management and chief, Commodity Management Division.

Graduated from Rutgers Unversity in 1943 with a BS in mechanical engineering, Col Maggio was commissioned to the Ordnance Corps after graduating from Officers Candidate School. He accepted a Regular Army commission in 1949, and received a Master's degree in business administration from Syracuse University in 1956. He has graduated from the Army Command and General Staff College and the Armed Forces Staff College.

Prior to his DCSLOG positions, Col Maggio commanded the 702d Maintenance Bn., 2d Infantry Division, Korea, spent four years on a Washington tour of duty heading the Programs Division in the Office of the Assistant Secretary of the Army (Installations and Logistics) (1963–1967), served in Vietnam as chief, Tri-Service Military Assistance Material Programing Office (1960–1962), and was engaged in management and procurement of guided missiles, Office, Chief of Ordnance, Washington, D.C. (1956–1959).

Col. Christopher S. Maggio

Annual Report Summarizes Pioneering Research Laboratory Achievements

Technical abstracts of 88 basic and applied research tasks, summarizing accomplishments of the Pioneering Research Laboratory (PRL) of the U.S. Army Natick (Mass.) Laboratories, are presented in PRL's 15th annual report for Calendar Year 1970.

The PRL in-house effort in the physical, life and behavioral sciences encourages a close interface with scientists and scientific advances from all sources—academic, institutional, industrial and governmental.

The 91-page report covers 66 basic research projects in the fields of biology, chemistry, physics and psychology; 17 applied research projects in microbiology, entomology and psychology; and 5 projects initiated by PRL in response to requests from Department of Defense agencies.

Titles of reports on research tasks and the authors follow:

BASIC RESEACH, *BIOLOGY.* Taxonomic Studies of Fungi; also, Mycological Survey of Thailand and Indonesia, E. G. Simmons and B. J. Wiley. Heat Inactivation of *Bacillus megaterium* Spores, M. T. Hyatt and H. S. Levison.

Carbohydrate Transport in Fungus Spores, G. R. Mandels and A. Maguire. The Sensory Proteins in Taste Perception, F. R. Dastoli. Spore Germination Properties of Mutants of *Bacillus megaterium* QM B1551, N. G. McCormick and H. S. Levinson. Surfactants as Stimulants of Enzyme Production by Microorganisms, E. T. Reese, A. Maguire, R. Blum and F. W. Parrish.

Isolation and Purification of Proteolytic Enzymes from Beef Muscle, F. M. Robbins and R. E. Andreotti. The Sensory Proteins in Taste Perception, F. R. Dastoli. Computer Simulation of Cellular Processes, F. Heinmets. Aggregation Behavior, L. M. Roth and S. H. Cohen.

The Lethal Effect of Ultra Violet Light on Insects, S. H. Cohen, D. R. A. Wharton, J. A. Sousa and L. M. Roth. Mechanisms Controlling Reproduction in Insects, L. M. Roth. The Use of Male Genitalia for Establishing Identity and Phylogenetic Relationships, L. M. Roth.

Sensory Mechanisms of Insects, G. J. Florentine. Behavior of *Tribolium castaneum*, G. J. Florentine and J. G. Holsapple. Conformation of Tyrosine and Tryptophan Side Chains in d-Lactalbumin, F. M. Robbins, L. G. Holmes and R. E. Andreotti.

CHEMISTRY. Photochromic 1-aryl-2-nitroalkenes, J. Weinstein and A. L. Bluhm. Stable Radicals by Photooxidation of Nitrones, A. L. Bluhm and J. Weinstein. Radical Trapping, A. Bluhm and J. Weinstein. Free Radicals in Tobacco Smoke, A. L. Bluhm, J. A. Sousa and J. Weinstein.

The Reactivity of Oxidizing Radicals With Simple Amides in Aqueous Solution, E. Hayon, T. Ibata, N. N. Lichtin and M. Simic. Action of Ionizing Radiation of Simple Peptides, M. Simic, P. Neta and E. Hayon. Absorption Spectrum of the Peptide Radical -NHCHCO-, M. Simic and E. Hayon.

Pulse Radiolytic Investigation of Aliphatic Amines in Aqueous Solution, P. Neta, M. Simic and E. Hayon. Study of the Mechanism of Radiation Protection by Sulfhydryl Compounds, M. Z. Hoffman and E. Hayon. Pulse Radiolysis of Inorganic Phosphates in Aqueous Solution, E. D. Black and E. Hayon.

Spectroscopic Observation of Coordinated Free Radicals, M. Z. Hoffman and M. Simic. Spectroscopic Investigation of Peroxy Radicals, M. Simic and E. Hayon. Intermediates Produced on Irradiation of Liquid Amides, N. Hayashi, E. Hayon, T. Ibata, N. N. Lichtin and A. Matsumoto.

Yield of Ions and Excited State Produced in the Radiolysis of Polar Organic Liquids, E. Hayon. Flash Photolysis of Some Photochromic N-benzylideneanilines, E. Hadjoudis and E. Hayon. Free Radical Reactions of

White Sands Tests Lance Missile System

Engineering tests on the first complete set of Lance missile system production hardware will be conducted during coming months at the White Sands (N. Mex.) Missile Range.

Numerous test firings subjected the system to a variety of environmental and torture tests, including actual firings to insure that the missile and its ground support equipment satisfy Army design requirements.

WSMR is conducting the test program for the U.S. Army Test and Evaluation Command (TECOM), headquartered at Aberdeen (Md.) Proving Ground. Col R. P. Hazzard, Lance project manager at HQ U.S. Army Missile Command, Redstone (Ala.) Arsenal, turned the production units over to WSMR for testing.

Participants in the turn-over ceremony included Col Henry F. Grimm, TECOM deputy chief of staff; Col Robert J. O'Leary, WSMR deputy commander; and Robert E. Lechtenberg, technical director, WSMR Army Missile Test and Evaluation Directorate.

Lance is termed one of the most versatile missiles ever developed for the Army. It includes a warhead section, a guidance package, fuel tanks and a sophisticated engine that provides maximum performance from launch through supersonic flight to target destination.

Built to withstand rough handling and severe climates, Lance is the first Army missile to use prepackaged storable liquid propellants and to have a simplified inertial guidance and control system.

The missile can be placed in action quickly by a team of only six men. Highly mobile, it can be transported and fired from a tracked vehicle, truck-towed on a lightweight launcher, airlifted, delivered by helicopter or dropped by parachute.

LANCE project manager Col R. P. Hazzard (hands on hips) discusses mobility kit for the Lance missile lightweight launcher with Col Henry F. Grimm, TECOM deputy chief of staff. Others (l. to r.) are Jerry Parsons, LTV Aerospace Corp.; Frank Dark, Lance Project Manager's Office; Col Robert J. O'Leary, WSMR deputy commander; Robert J. Lechtenberg, technical director of the Army Missile Test and Evaluation Directorate, WSMR.

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Qualitative Analysis by Vapor Phase Thermolytic Dissociation, C. DiPietro, M. L. Bazinet and C. Merritt. Detection of Irradiation of Foods by Analysis of Volatile Constituents, P. Angelini, C. Merritt and D. J. Bilesky. Shelf-Life Extension of Poultry by Radiation Pasteurization, P. Angelini, J. J. Howker and D. J. Bilesky.

Synthesis of Sugar Alcohols for Determination of Sweetness Characteristics, F. W. Parrish and H. R. Moskowitz. Chemical Composition of Tropical Foods, R. C. Clapp and L. Long Jr. Cyclopentenoid Cyanogenetic Glycosides in Plants, R. C. Clapp, M. G. Ettlinger and L. Long Jr.

Isolation and Characterization of Gymnemic Acid From *Gymnema Sylvestre*, G. P. Dateo Jr. and L. Long. Apiose Chemistry, M. H. Halford, D. H. Ball, F. H. Bissett and L. Long.

Heterocyclic Derivatives of Mercaptoalkylamines, R. C. Clapp and L. Long. Neighboring Group Participation Reactions, R. C. Chalk, D. H. Ball and L. Long. Variable Temperature NMR, F. H. Bissett and L. Long.

PHYSICS. The Physics of Foods, M. N. Pilsworth Jr., R. A. Segars and H. J. Hoge. Thermodynamics of Jets, R. A. Segars and H. J. Hoge. Basic Studies of Thermal Conductivity, M. N. Pilsworth Jr. and H. J. Hoge.

Properties of Materials Under High Rates of Strain, M. N. Pilsworth and H. J. Hoge. Spectroscopic Studies of Laser-Induced Photochemical Processes, J. A. Sousa, J. F. Roach and M. Nakashima. Generation of Shock Waves From a Laser Beam, J. M. Davies, J. F. Roach and W. Zagieboylo. Radiation Physics, J. M. Davies, W. Zagieboylo, J. F. Roach, P. H. Peter and R. J. Goff.

PSYCHOLOGY. The Brain Vertex Potential in Auditory Recruitment, T. L. Nichols. Studies of Taste Additivity, H. R. Moskowitz. Studies of Taste Mixtures, H. R. Moskowitz. Effect of Flow Rate on Taste in Humans, H. L. Meiselman and W. Nykvist.

Investigation of Cross-enhancement Phenomena in Taste, L. M. Bartoshuk (with D. McBurney, University of Pittsburgh). Taste of Water in Cat: Effects of Sucrose Preference, L. M. Bartoshuk, L. H. Parks and M. H. Harned. Investigation of the Transitivity of NaCl Preferences, R. L. Gentile and L. A. Hoff.

APPLIED RESEARCH, *MICROBIOLOGY*. Culture Collection of Fungi and the National Index of Fungus Cultures, B. J. Wiley and E. G. Simmons. Kynol Fiber, T. M. Wendt and A. M. Kaplan. Coated Nylon, T. M. Wendt, M. Greenberger and A. M. Kaplan. Shoe Counter Material, T. M. Wendt, M. Greenberger and A. M. Kaplan. Gelled Fuels, M. R. Rogers and A. M. Kaplan. Studies Concerning the Effectiveness, Stability and Reliability of Germicidal Compounds, M. R. Rogers and A. M. Kaplan.

ENTOMOLOGY. The Effects of Insect Infestation in Taste, Odor and Baking Qualities of Flour, L. W. Smith and D. G. Irwin.

PSYCHOLOGY. Properties of Ratio (Magnitude) and Hedonic (Category) Scales of Food Acceptability, H. R. Moskowitz and H. L. Meiselman. Psychology of Vegetable Gums —Sensory Scales, H. R. Moskowitz and W. H. Gantz Jr. Hunger Scaling in Human Subjects, H. L. Meiselman.

The Effect of Hunger Level on Acceptability, H. L. Meiselman and J. A. Beck. Effects of Temperatures on the Delay of Sweet Suppression of *Gymnema Sylvestre*, H. L. Meiselman and R. D. Hart. Consumer Survey to Indicate Reasons for Non-Utilization of Army Mess Halls, H. Kiess, J. B. Swanson, R. Johnson, J. McGinnis, H. Meiselman, H. Moskowitz, B. Hasenzahl, J. Beck, L. Branch and H. Jacobs.

Cold Exposure and Manual Performance, J. M. Lockhart, H. O. Kiess and T. Clegg. Measurement of the Dexterity Afforded by Handwear, J. M. McGinnis. Human Factors Evaluation of the Encumbrance of Nylon/Titanium Body Armor, J. M. McGinnis. Colorimetric Assay for Lipase Activity in Chocolate Candy Products and Ingredients, N. E. Harris, E. T. Reese and F. W. Parrish.

SERVICES. N. M. R. Spectral Service, F. H. Bissett and R. C. Chalk. Mass Spectral Service Analyses, M. L. Bazinet and W. G. Yeomans. Food Acceptance Testing, D. Bloomquist, B. Hasenzahl, D. Smith, J. Beck, B. Bell, L. Albertini, C. Busby, A. Stauber, T. Wehrly, S. Liberty, J. MacDonald and E. McMorran. Human Factors Analysis of Army Equipment, J. M. McGinnis, H. O. Kiess, M. M. Lockhart, T. L. Nichols and J. F. Hearns. Biochemistry Services, F. M. Robbins and L. G. Holmes.

Sibley, Former OCRD Officer, Assigned to USAIB

Lt Col Nathan C. Sibley has been assigned as chief of the Methodology and Operations Division, U.S. Army Infantry Board, Fort Benning, Ga., following a tour of duty in Vietnam with the Advanced Research Projects Agency (ARPA) R&D Field Unit.

He was assigned to the U.S. Army Element, Office of the Secretary of Defense in September 1969, following service with the Office of the Chief of R&D (OCRD) as executive officer to the Director of Army Research and as a staff officer in the Studies and Analyses Division.

Lt Col Nathan C. Sibley

Subsequent to an assignment with the Joint U.S. Military Advisory Group, Thailand, he completed the Command and General Staff College course in 1966. From 1960 to 1964, he was an assistant professor of military science at the University of Virginia, following a 4-year tour of duty in Hawaii.

Col Sibley received a BS degree in physics from Georgetown University in 1950. He has completed the Basic and Advanced Infantry Officers' Courses, the Ranger Course, and the Air Ground Operations Course.

Among his awards and decorations are the Silver Star, Bronze Star, Meritorious Service Medal, Joint Service Commendation Medal, Army Commendation Medal, Vietnamese Honor Medal (1st class), and the Purple Heart.

MERDC CO's Awards Featured By Gelini Medal Presentation

An innovation at the 14th annual Commanding Officer's Awards for Leadership, Technology and Science, June 4, at the U.S. Army Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, Va., was the presentation of the Gelini Medal.

Named in honor of the late Col Walter C. Gelini, who was commanding officer of the center at the time of his death in May 1970, the new medal was awarded to Joseph W. Latka in recognition of achievement in administrative and technical support activities.

General Henry A. Miley, CG of th U.S. Army Materiel Command, was the guest speaker, and Col Bennett L. Lewis, CO of the center, served as master of ceremonies.

Selected from a field of 19 nominees, each of the winners received a certificate, a plaque-mounted medal, and a $50 cash award, the latter through the Army Incentive Awards Program.

Dr. Hermann T. Spitzer received the Scientific Achievement Award, George Gornak the Technological Achievement Award, and Calvin W. Hood the Leadership Award.

Deputy Assistant Secretary of the Army (R&D) Charles L. Poor presented the award to Dr. Spitzer for his contributions to the science of thin-film superconductors.

Employed in the Electrotechnology Department, Dr. Spitzer is credited with producing the highest quality superconducting films available in the United States. They are expected to improve greatly the power density of power generation equipment.

Dr. Spitzer was educated at the University of Munich and has been employed at MERDC since 1966. He was chosen over two other nominees, Robert C. McMillan and Robert A. Falls.

Technological Achievement. George Gornak of the Electromagnetic Effects Department received the technology award from Edward M. Glass, assistant director for Laboratory Management, Office of the Deputy Director of Defense Research and Engineering (Research and Technology).

Gornak was selected for success in meeting "unprecedented technological challenges with creative engineering solutions." Results contributed to development of a major Army weapon system "critical to national defense."

He earned a BS degree from Geneva College in 1959, joined the center in 1961 and is now employed in the Systems Evaluation and Hardening Division of the Electromagnetic Effects Laboratory.

Other nominees included A. Louis Jokl, Franklyn P. Good Jr., James A. Dennis and Dwight L. Gravitte.

Leadership Award. Calvin W. Hood, representing the Mechanical Technology Department, was chosen over five other nominees for the leadership award. Brig Gen George M. Bush, CG of the U.S. Army Mobility Equipment Command, St. Louis, Mo., presented the award.

Hood was selected for superior leadership and management, including the standardization and commercial construction equipment programs, and outstanding performance of special assignments.

MERDC COMMANDING OFFICER AWARD WINNERS and dignitaries who participated in outdoor ceremonies at Fort Belvoir, Va., include: Bottom row (from left)—George Gornak and Edward M. Glass; second row—Dr. Hermann J. Spitzer and General Henry A. Miley Jr.; third row—Joseph W. Latka and Mrs. Walter C. Gelini; top row—Calvin W. Hood; Brig Gen George M. Bush; William B. Taylor, MERDC technical director; and Col Bennett L. Lewis. Deputy Assistant Secretary of the Army (R&D) Charles L. Poor (not shown) presented the Scientific Achievement Award.

He received a BS degree in civil engineering from North Carolina State University and entered Civil Service in 1951 as an employe of the Corps of Engineers, Wilmington (N.C.) District. He transferred to MERDC in 1964 and is now deputy chief of the Construction Equipment Division.

Other leadership nominees were CWO Richard L. Townsend, Richard P. Schmitt, William H. Deavers, John C. Orth and John A. Christians.

Gelini Award. Mrs. Gelini, widow of the late MERDC commanding officer, presented this award to Joseph Latka for his work in explosives technology, in connection with the barriers and countermine research and development program.

Latka entered Civil Service in 1941 and was employed at Picatinny Arsenal, Dover, N.J., before joining the MERDC in 1950. He is employed in the Barrier and Countersurveillance Division.

Other Gelini Award nominees included Mrs. Olive S. Deane, the second woman nominated for any of the CO's Awards since they were initiated 14 years ago (Dr. Maxine L. Savitz won the Scientific Award in 1967); Sp/4 Quincey C. Murphree; James Campbell Jr.; and Kenneth B. Bradshaw.

DoD Begins Course at New Defense Management School

Drawn equally from the Army, Navy and Air Force, the first class of 60 students will begin a 20-week course Aug. 2 at the recently established Defense System Management School, Fort Belvoir, Va.

The school reflects a Department of Defense review group's report that candidates for managerial positions for major defense programs should be selected earlier in their careers. Personnel attending the course are majors or lieutenant colonels or GS-12 or GS-13 civilian employes.

Brig Gen Winfield S. Scott, who was recently Tri-Service project manager for the 2.75-inch rocket system at HQ U.S. Army Munitions Command, Dover, N.J., is the first commandant of the new school. Command will be rotated among the three services for 2-year tours of duty.

AMMRC Installing Nondestructive Nuclear Testing Facility

Nondestructive testing utilizing one of the highest intensity sources fabricated from the man-made isotope Californium-252 is scheduled to begin in the near future at the U.S. Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass.

The AMMRC has signed an agreement for loan of a 5-milligram Californium neutron source with the U.S. Atomic Energy Commission's Savannah River Operations Office. The isotope is produced in specially configured nuclear reactors and the AMMRC is completing remodeling to house the new test unit in the former "swimming pool" reactor phased out about a year ago.

Under the direction of Dr. Homer F. Priest, chief of the AMMRC Materials Sciences Division, basic studies in testing of materials characterization and quality assurance will be performed. Dr. Priest was a winner of an Army R&D Achievement Award in 1970.

The average neutron emerges from the source with 2.35 Mev of kinetic energy; to be useful for the AMMRC materials studies this energy must be reduced by a factor of about 10^8.

This is accomplished by slowing down collisions in hydrogenous materials which are a part of the working source assembly. Slow neutrons of interest have speeds between 2,000 and 200 meters (6,560—656 ft) per second.

Neutrons of these speeds are readily absorbed by nuclei of materials, allowing detection of small quantities of certain atomic species via thermal neutron activation analysis.

The AMMRC is finding an increasing need for thermal neutron activation analysis because of consideration by the Army of materials for structural use of which little is known due to a lack of prior interest.

For example, silicon nitride is presently under study as a substitute for turbine components. But the history of production and use of silicon nitride to date has not required a knowledge of the impurity content to the extent this application demands.

Thermal neutron radiography has for some time been known as a very useful complementary procedure to X-radiography in the nondestructive testing of materials. As the Army moves toward the use of lighter, less dense materials for structural components, the capabilities of X-radiography are strained because the number of electrons in the material available for interaction with the X-rays is necessarily lowered.

Distinguishing between two different lightweight materials, such as graphite fibers and an epoxy matrix in a composite material, is best accomplished with neutron radiography. This is due to the fact that graphite is quite transparent to neutrons, but the hydrogenous epoxy is not. To X-rays, both components of this composite appear to be of similar transparency.

An even more difficult situation occurs with graphite-aluminum composite material. Graphite and aluminum are quite transparent to X-rays and to neutrons.

AMMRC scientists feel that not all is lost, however, in the matter of obtaining a radiographic image from this composite. They expect to exploit neutron interaction phenomena involving crystalline structure differences in the individual materials to find a solution.

For example, they have estimated that if radiographs can be made with neutrons selected to have speeds in the vicinity of 600 meters per second (1970 ft/sec), the image contrast will be at least doubled over the usual neutron radiograph.

The radioactive neutron source to be obtained by AMMRC is on the borderline of intensity needed for the projected studies, but this also is a challenge to be pursued. The extremely high neutron flux density of the Californium-252 is unlike anything obtainable before and its merits will be explored.

A commonly used large radioactive neutron source is a 5-curie plutonium-beryllium source. The volume of a ready-to-use encapsulated source is 42 times larger than that of the Californium source to be used by the AMMRC, yet the Californium source emits 1,000 times the number of neutrons per second.

Furthermore, this Californium source strength could be more than doubled without changing its external size. The production of useful quantities of slow speed neutrons has in the past been pursued by AMMRC scientists at a nuclear reactor. The technique is to place an hydrogenous slowing-down material cooled to cryogenic temperatures just outside the core of the nuclear reactor to trap neutrons, slow them down, and have them issue as a beam for studies.

The very small physical size of a Californium source relative to a reactor core will allow placing the source of neutrons *within* the cryogenically cooled material. This is expected to yield a marked improvement in slowing-down efficiency. Hopefully, this procedure will make this much smaller source a practical source for materials studies and quality assurance testing requirements.

Wallace Appointed Commander of Frankford Arsenal

Col James L. Wallace became Frankford (Pa.) Arsenal's 59th commanding officer recently when he succeeded Col Eugene C. Barbero, who retired after 30 years of military service.

Col Wallace served until recently as director of the Command and Staff Training Department, U.S. Army Ordnance Center and School (USAOC&S), Aberdeen Proving Ground, Md. He was at Frankford Arsenal from 1950 to 1954 as control officer and then as chief of the Gauge Department.

Col Wallace said he does not foresee any major changes in Frankford's role in the near future, explaining "In this type of job, changes are evolutionary rather than revolutionary."

His academic qualifications include a BA degree in business administration from the University of Maryland and completion of the Ordnance School officer advanced course and the U.S. Army Command and General Staff College course.

During the past 10 years, he has served as Ordnance adviser to the Belgium and Luxembourg Armies; personnel management officer, Colonels Division, Department of the Army, Washington, D.C.; commander of the 62d and 86th Maintenance Battalions and executive officer of the USAOC&S.

He has served overseas tours of duty in North Africa, Corsica, Italy, Puerto Rico, Korea, Japan and Vietnam. Among awards and citations, he holds the Legion of Merit, Bronze Star Medal, Army Commendation Medal with second Oak Leaf Cluster (OLC), and National Defense Service Medal (w/OLC).

Col James L. Wallace

Materials Microanalyzer Serving As Tool in Brain Disease Research

Human brain tissue studies directed toward determination of causes of disease are being conducted with the aid of an electron probe microanalyzer used at the Army's Watervliet (N.Y.) Arsenal for materials research.

Dr. Arnulf Koeppen, acting chief of the Veterans Administration neurology service at the VA hospital in Albany, N.Y., and Watervliet Arsenal chemist Joseph F. Cox are partners in an off-duty research project.

In studying a brain disorder related to Parkinson's Disease, they are examining brain tissue to ascertain the presence of abnormal amounts of iron and other elements that might be suspect of causing the disorder.

The microanalyzer that is enabling them to measure quantitatively small amounts of chemicals is used primarily at Watervliet Arsenal to detect impairments (fatigue, fracture, corrosion) in materials intended for fabrication into components of Army weapons systems.

Brain tissue containing particles with diameters five ten-thousandths of an inch has been examined by Dr. Koeppen and Cox. The presence of several chemical elements has been identified by irradiating the specimen with a finely focussed beam of electrons.

The electrons interact with the elements in the specimen to produce X-radiation that is then analyzed for X-ray characteristics of the chemical elements present in the sample. Under suitable experimental conditions, the measured X-ray intensities can be used to obtain the chemical composition of the specimen under investigation.

Preliminary results, Dr. Koeppen said, indicate that the probe method is quite suitable for examination of human brain tissue sections.

For example, the microanalyzer has provided conclusive evidence of iron, sulphur, phosphorus and calcium in the specimen examined. Hopefully, this method eventually may replace more conventional techniques as the electron probe method is further refined.

Definite conclusions can not be made at this time, the researchers stressed, but results to date do point to the possibility of advancing technology to permit treatment of human brain disease.

WATERVLIET ARSENAL research chemist Joseph F. Cox (left) and Dr. Arnulf Koeppen, Albany VA Hospital neurologist, examine human brain tissue in an off-duty research project to determine the presence of abnormal amounts of iron and other elements in various states of human disease.

Traylor Retires to Jacksonville As Director of Central Services

Logistical training and experience accumulated by Brig Gen John P. Traylor, who retired in June to end a 31-year military career, will be put to good use starting July 1 as director of central services for the expanded city of Jacksonville, Fla.

General Traylor has served since September 1968 as deputy CG of the U.S. Army Aviation Systems Command, St. Louis, Mo. Jacksonville recently consolidated with the surrounding county to form what is believed the largest city government, area-wise, in the United States.

TECOM Policy Change Releases Publications

Relaxation of controls on Materiel Test Procedures (MTPs), announced June 2 by the U.S. Army Test and Evaluation Command, makes a series of 952 technical publications releasable through the Defense Documentation Center, Cameron Station, Va.

The change in TECOM policy is in response to a recognized need of prospective developers and manufacturers of Army hardware for detailed knowledge of military test procedures. TECOM, the Army's principal testing organization, anticipates time-saving economies to result in the materiel development process.

Under development since 1964, the MTPs have been available until now only to Army commands and activities responsible for design, development, and testing of new equipment. They do not provide detailed test procedures for any specific item. Described are the test criteria and the general testing procedures and techniques prescribed for use in engineering and service tests conducted by the Test and Evaluation Command.

The complete series of some 1,200 MTPs will consist of an introductory volume and nine commodity-oriented volumes. The latter will cover wheeled, tracked and special purpose vehicles; armament and individual weapons; ammunition and explosives; missile and rocket systems; electronic, avionic and communications equipment; aviation and air delivery equipment; CBR equipment; general supplies and equipment.

Authorized users may obtain either microfiche or hard copies of MTPs from the Defense Documentation Center, DDC-TSR-1, Cameron Station, Va. 22314.

Fort Detrick WDP Relocating As Part of Aberdeen Complex

Transfer of the Warning, Detection and Protection Laboratory of the Biological Defense Research Center from Fort Detrick, Md., to Edgewood (Md.) Arsenal as part of the new Aberdeen-Edgewood Proving Ground complex will take place shortly.

Involved in the relocation will be 52 civilian and 21 military personnel, which will offset the reductions in civilian and military personnel spaces associated with the consolidation of the proving ground and arsenal.

Edgewood officials said the biological defense element will function as a separate activity and will not be a part of the arsenal's chemical commodity mission. Personnel will be housed temporarily in four buildings assigned to the Medical Research Laboratory until existing facilities are renovated to meet specific needs.

CDCEC Probing Helicopter Combat Role in Future

Experiments calculated to determine the combat effectiveness of helicopters, and how helicopter teams should be organized and equipped, were completed recently by the U.S. Army Combat Developments Command Experimentation Center, Fort Ord, Calif.

The susceptibility of helicopters to detection and attack by high performance aircraft was the primary purpose of one series of simulated combat experiments at the 175,000-acre Hunter Liggett Military Reservation south of Fort Ord.

BAHT (Basic Attack Helicopter Team) was the title of a second series of simulations. The primary purpose was to test and compare the capabilities of various teams to acquire and attack an enemy armor force; also, to measure their susceptibility to acquisition and attack by an enemy force.

In the air-to-air experiments, the gun ships took off to fly simulated armed reconnaissance and aerial fire support missions against simulated ground targets. The Cobras were armed with the heat-seeking Redeye Air Missile System (RAM) and gunnery results of the air battles were recorded on film to determine the validity of "kills."

While hunting targets of opportunity, either troops or armored vehicles, the crews established a maneuver profile—speeds of the aircraft, altitudes and directions they maintained. They were warned to be on the alert for "enemy" aircraft in the area.

The enemy threat was portrayed by two Navy F–4 Phantoms or F–8 Crusaders provided by Squadron VX4 from Point Mugu, Calif. Aggressor fighter-bomber pilots were briefed that aircraft were operating in a designated forward battle area and were directed to detect and eliminate the threat.

An air battle commenced when aggressor aircraft detected the helicopters and attacked. Helicopter pilots used evasion tactics and, if the opportunity was presented, returned the attack. Trials lasted from 105 to 130 minutes, depending on the type of missions given the light fire team.

Researchers hope the data collected will answer specific questions such as the number of detections, time required, the means of detection (visual or radar), and the time it took the aggressors to redetect a target that succeeded in eluding them.

The experiment also pitted Cobra against Cobra aircraft in cat-and-mouse tactics at speeds up to 130 mph and altitudes from 50 to 3,000 feet.

To ensure that results reflected the performance of the system, and not the comparative individual skills of personnel involved, crew members were carefully selected and trained. Selection was based on combat experience in Vietnam and 1,000 hours flying time in the Cobra.

The reasoning was that combat-experienced crews are less likely to over-estimate their own capabilities or to over-extend the performance requirements of their equipment. Pilots of this type also understand tactical implications of the operation.

Prior to the start of training for the experiment, teams were matched and balanced according to the type of air-to-air operations they had experienced. Concentrated training familiarized the pilots with the flight profiles and maneuvers, and also equalized experience of the crews.

Effects of crew motivation, morale, learning potential and combat realism of the data gathered will be interpreted in the final report.

The full impact of the results has yet to be determined. By reducing and combining the experimental data into measures of effectiveness, the Army aims to develop knowledge that will be helpful in future Army studies of the Air Cavalry Combat Brigade.

BAHT EXPERIMENT. The Basic Attack Helicopter Team trials were conducted by CDCEC Project Team IV under Col Raymond Lehman as chief. Teams were organized into six various mixes of Light Observation (Scout) and Attack helicopters, and 79 trials were conducted over four types of terrain.

Aggressor force was composed of medium tanks, armored personnel carriers, scout vehicles, self-propelled air defense vehicles and wheeled vehicles. Attack helicopters were provided by the Third Aviation Company at Yuma, Ariz., and the OH–58 Reconnaissance Helicopters (Scouts) came from the Eighth Squadron, First Cavalry, Fort Knox, Ky.

Maintenance support for all helicopters was provided by the 411th Maintenance Company, Fort Lewis, Wash. "Friendly" surface-air defense weapons were provided by Fort Bliss, Tex., and Fort Carson, Colo.

The scenario of a typical trial called for the Basic Attack Helicopter Team to land at the battalion command post in a forward area for a briefing, set at H hour minus 30 minutes. During this period, the aggressor jet fighter reconnoitered friendly positions and attacked all targets located.

AH1C Cobra Attack Helicopter

Scouts of the BAHT began their search after the briefing and, upon detection of the enemy armor force, radioed a report to the Command Post, including number and types of vehicles, speed and direction of travel. The scouts then called in friendly artillery fire and directed attack elements into position.

After three engagements by the BAHT, the trial ended and all forces returned to their initial staging area. Evaluations of data then were made to determine the type of vehicle and weapon mixes that displayed the most promise for further experimentation. Two additional byproduct benefits resulted:

- Data provided the basis for an improved training program for pilots and crews of scout and attack helicopters.
- An insight was given into improved methodology and instrumentation for follow-on experiments.

One of the findings was that the Vietnam experience of attack helicopter pilots, though valuable, still had to be supplemented with a vigorous training program. All pilots had to learn the tactics of low-level flying and pop-up firing techniques as related to survivability in a mid-intensity combat environment.

Many of the lessons learned will be related to the training programs being established for the Air Cavalry Combat Brigade and the Tri-Cap Division at Fort Hood, Tex. Intensified use of instrumentation is planned for follow-on tests, including devices like laser direct-fire simulators and range-measuring systems.

Data gathered during the CDCEC experiments will be used by the Combat Development Command to determine tactical doctrine, employment and techniques of operation; also, the best mix of attack and observation helicopters in an attack helicopter team.

All CDCEC simulated battle experiments are being used to insure that the Army extracts the greatest possible combat capability from available and projected resources.

HumRRO Publishes Report on 1970 Accomplishments

Working towards "competence in the application of behavioral science technology" is the purpose of Human Resources Research Organization (HumRRO) whose 1970 efforts are outlined in a recently published annual report.

The report, "To Improve Human Performance," sketches programs grouped into six major categories involving 78 projects funded by 19 sponsors.

Activities focused on "Man the Indidividual" included assisting in the implementation and management of a program at the U.S. Naval Academy, and developing training guidelines for the Department of Agriculture Work Incentive (WIN) Program.

"Man in the Organization" included studies of effectiveness of on-the-job training, and effectiveness of tank crews as affected by performing for extended periods. Another major area was "Man as a Leader" training programs. Identifying the socio-cultural factors affecting indigenous civilians employed by U.S. military overseas was part of the "Man in New Cultures" area.

HumRRO's largest project required development of an effective and efficient computer-administered instructional (CAI) system with accompanying multiple-track (branching) individualized programs of instruction. This instructional technology and the management of systems are the final two areas of behavioral research in which HumRRO is involved.

HumRRO, on contract with George Washington University for 18 years, changed its name from Human Resources Research Office to *Organization* when it announced separation from the university as of Sept. 1, 1969. HumRRO has since been an independent, nonprofit corporation.

ARPA Appoints Dr. Lukasik as New Director

Dr. Stephen J. Lukasik, the new director of the Advanced Research Projects Agency (ARPA), had served as deputy director since February 1968, and acting director since January 1971. He joined ARPA in 1966 as director of the Nuclear Test Detection Office.

ARPA is a separately organized agency within the Office of the Director of Defense Research and Engineering (ODDR&E). ARPA executes research projects stemming from promising advanced ideas that are not identifiable with specific military requirements or which relate to the function of more than one military service.

Dr. Stephen J. Lukasik

Exercising authority delegated by the Secretary of Defense through ODDR&E, Dr. Lukasik is responsible for direction and control of projects and the allocation of ARPA funds.

Dr. Lukasik received a BS degree in physics from the Rensselaer Polytechnic Institute in 1951, and MS and PhD degrees in physics from the Massachusetts Institute of Technology in 1953 and 1956.

Prior to joining ARPA, he was chief of the Fluid Physics Division and director of the Computer Center at Stevens Institute of Technology in Hoboken, N.J. From 1955 to 1957, he was a scientist with Westinghouse Electric Corp., where he conducted research in nuclear reactor physics.

DeBrocke Assigned Director, Material Testing Directorate

Col William P. De Brocke has been assigned as director, Materiel Testing Directorate at Aberdeen (Md.) Proving Ground after completing a tour of duty as assistant chief of staff for Logistics, 24th Corps, Vietnam.

Prior to service in Vietnam, he was commander of the 2d Basic Training Brigade, Fort Jackson, S.C. (1968–70). In July 1966 he was assigned to the Combat Developments Command Infantry Agency at Fort Benning, Ga., followed by a tour of duty as commander, Division Support Command, 6th Infantry Division, Fort Campbell, Ky.

After a 3-year tour of duty with the Combat Materiel Division, Office of the Chief of Research and Development, HQ DA, he attended the National War College at Fort McNair, Washington, D.C., in 1965.

Col W. P. De Brocke

Graduated from Cathedral College in New York, and then from the United States Military Academy in 1943, he received an MS degree from George Washington University, Washington, D.C., in 1965. He was graduated from the Army Command and General Staff College in 1957.

Prior to 1961 he served in Frankfurt, Germany; Fort Benning, Ga.; Korea; Hawaii; and Southeast Asia.

Among his awards and decorations are the Silver Star, Legion of Merit (w/two OLC), Bronze Star Medal (w/two OLC), Army Commendation Medal, Meritorious Service Medal, and the Purple Heart (two awards).

Dr. Payne (DUSA) Among 5 To Receive DCSA for 1970

Deputy Under Secretary of the Army (Operations Research) Dr. Wilbur B. Payne was among five recipients of the Department of Defense Distinguished Civilian Service Award for 1970 honored at a Pentagon ceremony June 4.

Secretary of Defense Melvin R. Laird presented the awards, honoring also Don R. Brazier and Dr. William C. Valdes, Office of the Secretary of Defense; J. Arthur Boykin, U.S. Air Force; and Milton S. Zaslow, National Security Agency.

Dr. Payne's citation states in part: "Through his exemplary management, scientific leadership and extraordinary analytical ability, Dr. Payne has created within the Department of the Army the capability for conducting scientific investigations of operational problems . . . he has most effectively directed and supervised the use of that capability in providing a quantitative basis for decisions. . . ."

The Distinguished Civilian Service Award is the highest recognition that may be bestowed upon civilian employes by the Department of Defense. The award is presented annually to selected employes who during the preceding year have made the greatest contributions to efficiency, economy and other improvements in the operations of the Department of Defense.

ABMDA Uses Modeling In Studying Effectiveness Of Missile Defense Ideas

A system of analytical models for evaluating the cost effectiveness of proposed ballistic missile defense concepts was the subject of three technical papers recently presented by Herbert N. Cohen of the U.S. Army Ballistic Missile Defense Agency (ABMDA).

The ABMDA technical director for the model development program spoke at a Safeguard Simulation Symposium, the Strategic Nuclear Force Exchange Modeling Symposium and the 10th annual U.S. Army Operations Research Symposium.

Cohen came to ABMDA in 1969 from Aerospace Corp., where he was a senior systems analyst concerned with the feasibility of defenses against ballistic missiles. His work with loiter interceptors, and with the adaptation of surface-to-air (SAM) missiles against ballistic missile threats, brought him recognition in the field of ABM systems analysis.

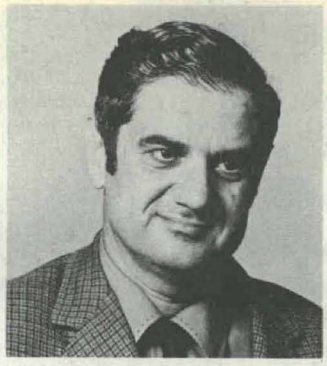
ABMDA's Advanced Systems Division now uses his talent in developing analytical models for evaluating new missile concepts. Cohen pointed out in his recent presentations that ABMDA has the problem of sorting out promising technology improvements. It is not enough to show that a particular development will improve the performance of a radar or an interceptor; it must also improve the over-all cost-effectiveness of ballistic missile defense to merit an investment.

Two features of the ABMDA models make them particularly useful. One is the integrated system logic, which puts all significant component parameters in "system context," allowing rapid determination of those parameters that drive system cost-effectiveness (as opposed to those that primarily affect the performance of one component but whose net effect on the defense *system* may be small).

Another feature is the flexibility that allows modifications and additions to be easily incorporated.

The system of models consists of several separate models, each treating a particular aspect of the defense. The models are linked through a common set of variables and parameters. They relate over-all defense system effectiveness, component performance characteristics, and defense system costs. The models are integrated and tailored for particular problems.

Generally, the models evaluate a defense concept in terms of the minimum defense system cost required to insure a desired survivability. ("Survivability" might be measured, for instance, by the number of surviving targets).



Herbert N. Cohen was for nine years in charge of several advanced concept groups for development of nonnuclear and nuclear munitions at Picatinny Arsenal, Dover, N.J. He departed to work with General Dynamics in Pomona, Calif., and was later employed with Aerospace Corp.

Cohen graduated from the College of the City of New York with an engineering degree in 1943. In 1948 he left the National Advisory Committee for Aeronautics to obtain his master's degree in applied mathematics at New York University. His major field of interest is systems analysis and its application to new and challenging concepts.

The minimum cost is affected primarily by the unit costs of such defense components as radars, computers, interceptors, and interceptor farms.

Unit component costs vary both with performance and with the number of units purchased. The model then arrives at the system configuration with the optimal number of components, at specified performance characteristics, for the needed survivability.

Other evaluation model features are:

- Allowable deployments against a given threat are established by taking into consideration the range of possible radar coverage capabilities, and the number and location of interceptor farms.
- For each deployment, the minimum number of interceptors required to insure the desired survivability is computed by allowing the offense his "best" attacks, considering both the defense system and the "value" of the target being defended.
- Data processing and radar traffic handling requirements are determined for each deployment. Performance constraints of data processing and radar traffic handling equipment, which limit the deployment of such equipment, are also established.

Dinger Becomes MERDC Associate Deputy

Donald B. Dinger has been promoted to associate deputy for Research and Development at the U.S. Army Mobility Equipment R&D Center (MERDC), Fort Belvoir, Va., after serving as chief, Electromagnetic Effects Lab.

MERDC Commander, Col Bennett L. Lewis announced the promotion of Dinger, a MERDC employe since July 1958. He was engaged in research, development and evaluation of military electrical power generation equipment and concepts until 1961. Then he became leader of a project to investigate nuclear electromagnetic pulse (EMP) effects on field Army power systems.

In January 1965 Dinger assumed responsibility for the Army Materiel Command (AMC) lead laboratory program on the EMP nuclear weapons effect. This is recognized currently as one of the two principal Department of Defense programs in this area.

Dinger received a Commanding Officer's Scientific Achievement Award in 1965 and has earned a number of Outstanding Performance Awards. Elected a Fellow of the Washington Academy of Sciences in 1966, he is a member of the Institute of Electrical and Electronics Engineers, and the Scientific Resear Society of America.

Donald B. Dinger

Dinger has served on a Nuclear Weapons Effects Panel of The Technical Cooperation Program involving Canada, the United Kingdom, Australia and the United States. He also has been a member of the Defense Atomic Support Agency EMP Advisory Group, the Safeguard ABM System EMP Vulnerability Working Group, and was chairman of the EMP Subcommittee, AMC Nuclear Weapons Effects Research and Test Committee.

In 1958 he was the outstanding senior electrical engineering student at the University of Rhode Island, where he received a BSEE degree as a Distinguished Military Graduate. He earned an MS degree in engineering at George Washington University in 1964 and is studying there for his doctorate.

Computer Systems Command Names Consultants

Twelve of 27 nominees nationally known for achievements in automatic data systems will be selected as the Army Computer Systems Command newly established Scientific and Management Advisory Committee. The remaining 15 will be available to the SAMAC as consultants.

Brig Gen Wilson R. Reed, CG of the Computer Systems Command, addressed the distinguished group when they held their first meeting June 17–18 in Washington, D.C., relative to responsibilities assigned to them.

Army Assistant Vice Chief of Staff Lt Gen William E. De Puy gave the keynote address and Prof. Laurence H. O'Neill, chairman of the Army Scientific Advisory Panel (ASAP) was the banquet speaker. O'Neill is a professor at the Electrical Engineering School and director, Electronics Research Laboratories, Columbia U.

Selection of the 12 members of SAMAC is scheduled prior to the next meeting in the early fall. USACSC Chief Scientist will serve as a member ex-officio and Ellsworth E. Seitz, chief, USACSC Long-Range Planning Office, is executive secretary.

Nominees for SAMAC are: Dr. Daniel G. Bobrow, Bolt, Beranek and Newman, Inc., Cambridge, Mass.; Dr. Richard M. Brown, professor of physics and electrical engineering, University of Illinois; Thomas E. Cheathan Jr., Aiken Computation Lab, Cambridge, Mass.; and

Dr. Thomas H. Crowley, Bell Telephone Labs, N.J.; Dr. G. F. di Roccaferrera, Syracuse University; Dr. William L. Everitt, dean, College of Engineering, University of Illinois; Dr. Michael J. Flynn, associate professor, Electrical Engineering and Industrial Engineering and Management Sciences, Northwestern University; and

Dr. Carroll B. Gambrell Jr., vice president for Academic Affairs, Florida Tech University; Dr. Malcolm M. Jones, Massachusetts Institute of Technology, assistant director, Project MAC, and assistant professor, Sloan School of Management, MIT; Dr. Gilbert W. King, vice president, Laboratory Operations, Aerospace Corp., Los Angeles; and

Dr. Leonard Kleinrock, University of California; Prof. David Kuck, Computer Science, University of Illinois; Dr. Vincent Luchsinger, Department of Management, Texas Tech University; Dr. Adrian M. McDonough, professor of industry, Wharton School of Finance and Commerce;

Dr. Michel A. Melkanoff, chairman, Computer Science Department, School of Engineering and Applied Science, University of California at Los Angeles; Dr. Francis J. Murray, on leave from Duke University, director, Special Research in Numerical Analysis; Dr. Thomas F. Piatkowski, associate professor, Thayer School of Engineering, Dartmouth College; and

Dr. Bertram Raphael, Stanford Research Institute; Dr. Robert F. Rosen, professor, Department of Computer Science, State University of New York at Buffalo; Dr. Morris Rubinoff, professor of electrical engineering, University of Pennsylvania; D. Tracy Rumford, Computer Sciences Department, Rand Corp., Calif.; Robert L. Smith Jr., vice president, Automation and Planning, Blue Cross-Blue Shield of Texas; Dr. Thomas G. Stockham, University of Utah; and

Dr. Daniel Teichroew, professor and chairman, Department of Industrial Engineering, University of Michigan; Eric W. Wold, Washington manager, Computer Systems Division, Bolt, Beranek and Newman, Inc.; Dr. A. Wayne Wymore, Department of Systems Engineering, University of Arizona; and Dr. Norman Zachary, director, Computer Center, Harvard U.

Col Connell Assigned Assistant Deputy For Laboratories

U.S. Army Materiel Command Assistant Deputy for Laboratories, under Dr. Robert B. Dillaway, will become the new title of Col (Brig Gen designate) George W. Connell in mid-July.

Currently, commanding officer of Edgewood (Md.) Arsenal, he will relieve Norman L. Klein, who has served in an acting capacity for about 2½ years and will return to his primary assignment as chief, AMC Laboratory Operations.

Brig Gen William W. Stone Jr., now retired, was the Edgewood Arsenal commander until he departed in September 1967 to fill the newly created position of AMC Assistant Deputy for Laboratories. He was later director, Chemical and Nuclear Operations, Office of the Assistant Chief of Staff for Force Development, where Col Connell was his deputy.

Col John K. Stoner Jr., currently commanding the Pine Bluff (Ark.) Arsenal, will assume command of Edgewood Arsenal at the end of July. Lt Col Sampson H. Bass, director of the Edgewood Weapons Development and Engineering Laboratories (WDEL), will be CO at Pine Bluff.

Col George W. Connell

NLABS Employe Receives Graduate Study Fellowship

An Alfred P. Sloan Fellowship for a year of graduate study at the Massachusetts Institute of Technology has been awarded to Gaetano Falabella, the first Natick (Mass.) Laboratories employe to be so honored.

Initiated in 1931, the Sloan Fellows Program is the oldest executive development course of study in the nation. Designed to provide mid-career executives with 12 months advanced study, it leads to an MS degree in management.

Gaetano Falabella

Special courses with senior members of the MIT faculty are supplemented by a program of field visits and management seminars. In this way Sloan Fellows have an opportunity to meet outstanding leaders in business and government in the United States and abroad.

As deputy director of the Airdrop Engineering Laboratory at Natick, Falabella heads the technical staff responsible for developing equipment, systems and techniques for the airdrop of Army personnel and cargo for aircraft in flight.

Dr. Peter P. Gil, associate dean of the Sloan School at MIT, said Falabella's selection "is a tribute to his outstanding record of achievement and to his potential for further significant progress." Falabella earned his BS degree (1949) and MS degree in aeronautical engineering at MIT.

Fluidics Earns HDL Director Inventor of Year Award

Selection as the 1970 Inventor of the Year is Billy M. Horton's latest of many high honors recognizing him as the basic inventor of the principle of fluid amplification—credited with triggering worldwide industrial response during the past 11 years.

Fluidics is an emerging technology that is finding many applications to civilian as well as military requirements. Various publications have predicted that these applications will have worldwide economic impact.

The Patent, Trademark and Copyright Institute of George Washington University, Washington, D.C., presented the Inventor of the Year Award to Horton, technical director of the Harry Diamond Laboratories, on May 20.

Among other major honors conferred upon him are the Arnold O. Beckman Award of the Instrument Society of America, in 1960, and the John Scott Award, in 1966. The prestige of the latter award is indicated by the selectivity of its presentation to such immortals as Orville Wright, Sir Alexander Fleming, Vannevar Bush and others for "inventions useful to mankind in the development of chemical, medical or any other science or development of industry in any form. . . ."

The Department of Defense recognized Horton's invention of fluid amplification by presenting him the Distinguished Civilian Service Award in 1967, at that time citing many of the important contributions the new technology is making.

Among the applications in use or under development are control mechanisms for jet engines, air-condition systems, stabilization of aircraft and rockets, control of diesel locomotives, control systems for many chemical and industrial processes, for use in digital and analog computers, and for a family of medical life-saving and life-support devices such as heart pumps and respirators.

BILLY M. HORTON (right) receives certificate award from Adm O. C. Colclough (USN, Ret.), director emeritus of the Patent, Trademark and Copyright Institute, George Washington U.

CEEIA Gains NCC Branch Of Communications Command

A new subordinate element of the U.S. Army Communications Electronics Engineering Installation Agency (CEEIA) has been created to support the National Communications Command at Fort Huachuca, Ariz.

Brig Gen Jack A. Albright, CG of CEEIA, said the new organization (CEEIA-NCC) at Fort Detrick, Md. will assist in engineering computer software development and maintenance; also, the installation, test and evaluation of communications systems in the Army portion of the Defense Communications System (DCS) and other Army networks in the United States.

The NCC and CEEIA are part of the Army's worldwide Strategic Communications Command (STRATCOM). Since its formation in July 1970, CEEIA has been responsible for STRATCOM's communication electronics engineering, installation and test activities. CEEIA subcommands are in Europe and the Pacific. The agency also has CEEIA-Western Hemisphere and field offices in Iran, Spain and the Philippines.

Canham Shares Clinical Nutrition Award

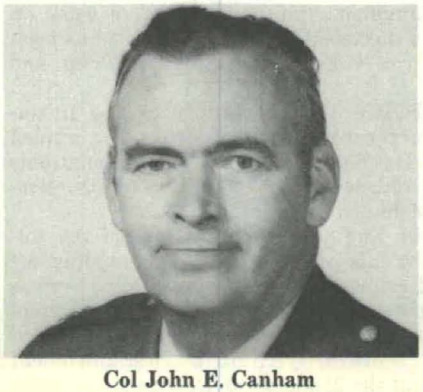
Col (Dr.) John E. Canham, commander of the U.S. Army Medical Research and Nutrition Laboratory, Denver, Colo., shares the 1971 Joseph Goldberger Award in Clinical Nutrition with Dr. Robert E. Hodges, professor of medicine at the University of Iowa College of Medicine.

Selected for their collaborative studies of the pathophysiology of Vitamin C and Vitamin A deficiencies in man, they received the award, a $1,000 cash honorarium and a plaque, at the American Medical Association's annual convention in Atlantic City, N.J., June 20–24. They presented a technical paper, "The Evaluation of Human Micronutrient Requirements."

The award is presented annually by the AMA Council on Foods and Nutrition with the cooperation of the Nutritional Foundation, Inc.

Col Canham's laboratory, on the grounds of Fitzsimons General Hostal, is one of 13 major laboratories or installations of the Army Medical Research and Development Command, with headquarters in Washington. Dr. Hodges was cited for work funded by the command.

The 5-building complex in Denver has scientific equipment valued at more than $5 million and an 8,000-volume library. The staff consists of some 60 military and civilian scientists and about 80 enlisted men, many with a college degree in a medically related field.



Col John E. Canham

The laboratory has made numerous studies concerning the soldier's nutrition, including one that showed a connection between intestinal enzyme activity and human weight extremes.

To aid the study of the interaction of high altitude and diet, the Army nutrition group also has a building and equipment at the 14,110-foot summit of Pikes Peak in Colorado.

Col Canham has been assigned to the Denver laboratory since 1961, except for a year when he served as commander of an evacuation hospital in Korea and another year as a student at the Army's Command and General Staff College. He is the author of nearly 40 books and papers.

Graduated with a medical degree in 1949 from Columbia University, he studied nutrition and metabolism at Vanderbilt University School of Medicine, and served his internship and residency in internal medicine at the Army's Letterman General Hospital in San Francisco.

He is a member of the National Board of Medical Examiners and the American Board of Nutrition, and an affiliate professor of chemistry, and food science and nutrition at Colorado State University.

Gregorits Heads New Jersey Engineers

John Gregorits, chief of the Engineering Sciences Laboratory, Feltman Research Laboratory at Picatinny (Dover, N.J.) Arsenal, was recently installed as president of the New Jersey Society of Professional Engineers. He had been serving as vice-president of the 3,000-member organization.

Gregorits received a BS degree in mechanical engineering in 1951 and his master's in 1962 from Newark College of Engineering. He is a member of the Pi Tau Sigma honorary society for mechanical engineers, the American Ordnance Association, and the Scientific Research Society of America.

SARS Fellowships Enable CRREL, WRAIR Scientists To Study Abroad for Year

Secretary of the Army Research and Study (SARS) Fellowships will enable a physicist and a chemist to extend their research on Army projects during a year of foreign study with international authorities.

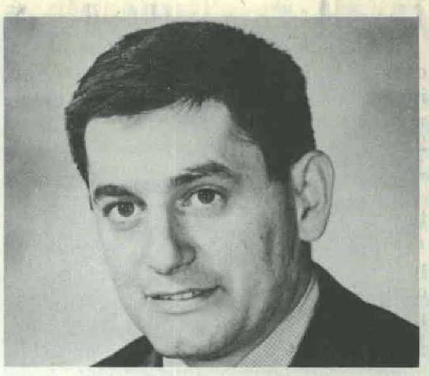
SARS fellowships are awarded annually to encourage development of civilian employes whose records indicate outstanding potential for future service to the Army. The program requires submission of detailed technical reports upon completion of their research studies.

DR. PIETER HOEKSTRA, a GS–14 research physicist with the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), Hanover, N.H., will study at the Department of Electrical Engineering, Technical University of Denmark.

He was selected on the basis of his work at CRREL since 1963 and submission of his proposed project on "The Investigation of Electromagnetic Techniques for the Exploration of Ice, Snow and Frozen Ground."

His research project is to develop and test electromagnetic systems for detecting the presence of large masses of ice in permafrost regions, and for remote sensing of lake and sea-ice thickness. Results are expected to have important applications in frozen-ground engineering for military operations in Arctic regions.

Leo Kazyak



Dr. Pieter Hoekstra

Dr. Hoekstra is credited with an outstanding record of contributions to the science of cold regions research and engineering during his past seven years at CRREL. Particularly significant is his work on freezing pressures, which has resulted in a faster, simpler method for testing the frost susceptibility of soils.

He has delineated the processes involved in movement of moisture to a freezing point in porous media, and provided the means for identifying unfrozen water in frozen ground. His pioneering efforts have stimulated other research at the Massachusetts Institute of Technology, the University of Surrey (England), the University of Munich (Germany) and the Road Research Laboratory in Switzerland.

Dr. Hoekstra's work has been recognized and presented in professional journals, including the *Journal of Geophysical Research*, the *Journal of Colloidal and Interface Science*, and *Water Resources Research*.

He has served as a visiting professor at the University of Illinois, a visiting lecturer at Dartmouth College, and a research assistant at Cornell and McGill (Canada) Universities. He earned a BSc degree from Wageninjen Technical University, the Netherlands; MSc degree from McGill University, and a PhD degree from Cornell University.

LEO KAZYAK, a GS–13 research chemist, Division of Biochemistry, Walter Reed Army Institute of Research (WRAIR), Washington, D.C., will work with Dr. Alan Curry, in charge of toxicology at the Central Research Establishment, Aldenmastor, Reading, Berks, England.

His research project is concerned with the establishment of a comprehensive data library that will include a registry of human toxicology; gas chromatography, ultraviolet, infrared, and mass spectral data on compounds of toxicological interest; and drug distribution and metabolism information.

The study is intended to provide an efficient program of international cooperation in data exchange, and to establish computerized retrieval facilities for toxicological information.

Kazyak earned a BS degree in chemistry from the University of Detroit in 1950 and did post graduate work (1953–55) in education at Catholic University.

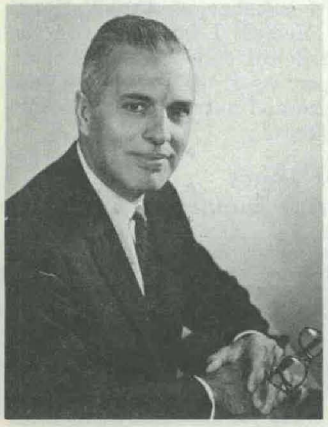
HDL Leader Heads Panel, Presents 3 Papers

When representatives of the Technical Cooperation Program of the United Kingdom, Canada, Australia and the United States convened in London May 19–28 for their ninth meeting, the head of the U.S. Army, Navy, Air Force 0–4 panel was P. Anthony Guarino.

U.S. leader of the panel since 1967, Guarino is associate technical director of the Army's Harry Diamond Laboratories (HDL), Washington, D.C. He presented three technical papers to report on HDL research activities.

The papers are titled "Short Intrusion Artillery Proximity Fuzes," "Multi-Option Mortar Fuzing," and "Termal Batteries." He also reported on HDL's work with "Low Cost Miniature Detonators," "Fluidic Generators for Fuzes," "High-Performance Fuze," "Overview on Fuze-on-Chip Research," "Artillery Simulator," "Influence Mine Fuzing," "Electronic Time Fuze," "M429 and M429E" and "XM588 and S&A Device."

Progress has been made, he said, in a jointly funded project in which HDL and one of its Canadian counterparts are developing an extremely low-cost detonator, based on a process originally devised by the United Kingdom. Similar cooperative work on plate stock material for batteries also has been done by the U.K. Power Supply Group and HDL.



P. Anthony Guarino

The TTCP 0–4 Panel on "Fuzes and Initiators" is not concerned with fuzes for guided missiles. Its field of effort covers nonatomic research and development for proximity, electronic, mechanical and impact fuzing.

While in England the panel visited the following UK laboratories to review ongoing efforts and exchange information: Royal Armament R&D Establishment (RARDE); Explosive Research and Development Establishment (ERDE); Royal Aircraft Establishment (RAE) and the Ministry of Defense.

TACOM Details Vehicle Needs at Industry Briefing

Logistical and tactical vehicle needs of the U.S. Army, currently, in the immediate future, and from a long-range viewpoint, were detailed May 26–27 at an Advanced Planning Briefing for Industry in Warren, Mich.

Maj Gen Shelton E. Lollis, CG of the Tank-Automotive Command (TACOM) said the purpose was "to provide a comprehensive picture of our research and development program from a standpoint of plans and future requirements."

The American Ordnance Association (AOA) joined TACOM in sponsoring the classified briefings, which attracted over 450 representatives of more than 240 industrial firms from all sections of the U.S. as well as from England, Australia and Canada, all of which sent defense establishment representatives.

Retired Army Lt Gen Jean E. Engler, AOA director of Advisory Services, and General Lollis were co-hosts. Col Richard H. Sawyer, director of the TACOM Research, Development and Engineering Directorate, was chairman.

Presentations on TACOM activities ranged from the Qualitative Requirements Information (QRI) Program to the Long-Range Time Frame Vehicle Program. A panel discussion, followed by questions and answers, concentrated on R&D programs and procurement planning, including componentry and complete vehicle systems.

The banquet speaker was Lt Gen Woodrow W. Vaughn, deputy CG of the U.S. Army Materiel Command (AMC), who discussed AMC efforts to emphasize military career development in the materiel acquisition field.

General Vaughn said the AMC has recently upgraded several materiel acquisition positions to the rank of brigadier general. This action is a "reasonable approach" to attract skilled and knowledgeable military professionals to procurement activities.

TACOM is responsible for the engineering development, procurement, maintenance and spare parts supply for tracked and wheeled vehicles assigned to all the military services. This involves a fleet of 1,500,000 vehicles, and management of over 62,000 items ranging from tires and mufflers to 10-ton trucks. Procurement of these items in 1970 cost more than $800 million.

New vehicle procurement, which makes up the bulk of the TACOM buying program, is expected to total $690 million during the current fiscal year. Contracts awarded for purchase of repair parts will total an estimated $160 million.

TACOM's total funding program reached a peak of $1.35 billion in fiscal year 1967, and has declined steadily since that time to reflect cutbacks in defense spending.

Other featured speakers included TACOM Chief Scientist Dr. Ernest N. Petrick; Wayne S. Anderson, Chief, Propulsion Systems Division; Lt Col Oscar C. Decker Jr., project manager for the Armored Reconnaissance Scout Vehicle (RSV); Lt Col Peter B. Kenyon, project manager for the Mechanized Infantry Combat Vehicle (MICV); George O. Newcomb, chief TACOM Systems Development Division; and Lowell H. Barnett, chief, Vehicle Components and Materiels Division.

MUCOM Picks Advisers to Aid Small Business Firms

In continuing efforts to stimulate and assist small business firms, Maj Gen E. M. Graham Jr., commanding general of the U.S. Army Munitions Command, has designated seven advisers.

Certificates of appointment were issued recently to Woodson Ely, small business adviser, HQ MUCOM; Elton Holloway, chief, Small Business Office, and Joseph Sebastian, small business adviser, Picatinny Arsenal;

Gerald Correll, small business economic utilization adviser, Ammunition Procurement and Supply Agency; Allan Lawson, small business economic utilization adviser, Joliet, Ill.; William Burr, acting chief, Small Business Office, Frankford Arsenal; and John Kaufman, Small Business Office, Edgewood Arsenal.

HQ MUCOM at Picatinny Arsenal, Dover, N.J., has been conducting a series of seminars since May 1970 on "Small Business Participation in Research and Development." Established on the recommendation of an ad hoc group formed at Picatinny in 1968, the seminars have provided training to 145 personnel in field agencies. Instruction consists of six sessions of 3½ hours each.

Copies of the course textbook have been furnished to other Army Materiel Command subordinate commands for review and implementation of similar seminars. The Harry Diamond Laboratories, Washington, D.C. conducted a seminar in February 1971 and Frankford Arsenal is planning a seminar.

The purpose of the seminars is to alleviate what the ad hoc committee reported was a widespread lack of knowledge of Department of Defense small business policy, particularly in research and development areas.

SMALL BUSINESS appointment certificate is awarded to Woodson Ely by Maj Gen E. M. Graham, MUCOM CG.

Former AMC Surgeon Becomes MRL Chief at Edgewood

Col Frank C. Leitnaker succeeded Col Henry T. Uhrig as chief of the Medical Research Laboratory, Edgewood Arsenal, Md., effective Apr. 15, after serving two years as surgeon, Army Materiel Command, Washington, D.C.

The AMC assignment was preceded by duty as deputy commander, 9th Hospital Center, Landstuhl, Germany.

Col F. C. Leitnaker

He received a BA degree from Baker University, Baldwin, Kans., in 1949, MD degree in 1952 from the University of Kansas, and an MS in public health radiological hygiene from the University of North Carolina in 1963.

He completed his internship at Fitzsimons Army Hospital, Denver, Colo., in 1953, and from 1963 to 1965 studied at Walter Reed Army Institute of Research under a radiation biology fellowship.

Col Leitnaker is a Fellow of the American Public Health Association and a member of the American Academy of General Physicians, the Association of Military Surgeons of the U.S., and the American Medical Association.

Army Awards RDT&E, Procurement Contracts Exceeding $373 Million

Army contracts for research, development, test, evaluation and procurement of materiel, each exceeding $1 million, totaled $373,761,654 for the period from Mar. 1 to Apr. 30.

FMC Corp. is receiving $26,081,776 for M113A1 Armored Personnel Carriers; Hughes Aircraft, $24,030,500 for TOW missiles; Hercules, Inc., $20,665,892 for operation of facilities producing propellants and TNT.

Uniroyal, Inc., was issued two contracts totaling $19,377,227 for operation of ammunition producing facilities; Philco Ford Corp. received four contracts totaling $18,490,513 in connection with the FAIR II Measurement Program, for engineering services on the Chaparral weapons system, for communication subsystems, and for a study on exoatmospheric target designation.

Western Electric Co. gained $17,931,990 in contracts for work on the Safeguard Ballistic Missile Defense System; Chamberlain Manufacturing Corp. will receive $17,401,130 for 155mm and 175mm projectile parts.

Two contracts totaling $16,008,914 to Day and Zimmerman, Inc., are for support services and operation of an ammunition plant; Chrysler Corp. is supplying TOW missiles under a $12,018,335 contract.

Sanders Associates is receiving $11,287,456 (two contracts) for engineering services and production of FAAR (Forward Area Alerting Radar) hardware and test equipment; Donovan Construction Co. will receive $10,699,800 for 155mm projectile parts.

Contracts under $10 million. RCA Corp., $8,687,574 (two contracts) for research and development of the Land Combat Support System, and for three AN/MPS–36 radar systems and spare parts; National Presto Industries, $8,306,455 for projectile parts;

Olin Corp., $8,259,189 for operation of an Army ammunition plant and for the manufacture of ammunition; Gulf and Western Industries, Inc., $8,049,440 for cartridge cases; U.S. Steel Corp., $8,016,878 for metal parts for projectiles; and

Litton Systems, Inc., $7,726,411 for AN/ASN–86 navigation sets and special tooling and test equipment; Remington Arms Co., Inc., $7,376,149 for operation of a government-owned ammunition facility; and

Raytheon Co., $6,769,380 (four contracts) for repair of oscillators for Hawk missiles, for traveling wave tubes, for missile-site radar antenna array supports, and for engineering development definition of the SAM–D weapon system; and

Atlas Chemical Industries, Inc., $6,603,384 for operation and maintenance of ammunition producing facilities; Norris Industries, $6,204,802 for 105mm cartridge cases; Textron, Inc., $6,065,112 for rotary-wing blades for UH–1 helicopters; and

Sperry Rand Corp., $5,602,237 (two contracts) for 155mm illuminating projectile parts and for classified work; AVCO Corp., $4,718,865 (two contracts) for a product improvement program for turbine engines; and

Sperry Rand Corp., $4,619,141 for operation of a government-owned ammunition producing facility; Waterbury Farrel, $3,878,500 for one new-generation submodule for production of a new 5.56 cartridge case; Institute for Defense Analyses, $3,875,000 for studies to assist the Director of Defense Research and Engineering and the Joint Chiefs of Staff; and

Perkin-Elmer Corp., $3,861,853 for a Midcourse Airborne Target Sensor System; HARSCO, $3,577,600 for 175mm, self-propelled tracked vehicle; Honeywell Inc., $3,138,790 for grenade fuzes; and

LTV Electrosystems, Inc., $3,083,482 for AN/ARC–114 radio sets; Hoffman Electronics Corp., $3,011,200 for TACAN aircraft navigational sets; Marathon Battery Co., $3,007,456 for dry batteries; and

White Motor Corp., $2,850,000 for engineering services for 2½-ton trucks; Harvey Aluminum Sales, Inc., $2,836,283 for operation of a government-owned ammunition facility; Epic Manufacturing Co., $2,745,067 for 105mm projectiles; LTV Aerospace Corp., $2,733,339 for engineering services for the Lance missile system; and

Electromagnetic Systems Labs, $2,500,000 for electronic equipment; Walter Kidde, Inc., $2,196,224 for metal parts for fuzes; Kisco, Inc., $2,080,559 for 105mm cartridge parts.

Contracts under $2 million. General Motors Corp., $1,988,810 for a product

4 R&D Employes Named for Federal Award

Four employes at Army research and development installations are among nominees for the Federal Service Employe of the Year 1970 Award in the Philadelphia, Pa., and State of Maryland areas of competition.

Donald R. Furmanski of the Army's Frankford (Pa.) Arsenal was a scientific achievement winner for a 5-county Philadelphia area.

He has been cited for developing a novel drive mechanism for the Sheridan Tank telescope, a pilot sight for the UH–1 series of helicopters, and the XM76 antioscillation sight (Dynalens) used on Army helicopters. The Dynalens also won an Oscar award from the movie industry in 1970.

Furmanski was acclaimed for his success as a project engineer during development of the Army's first passive far infrared airborne fire control system. He also coordinated development of tracer ammunition for use with the system.

Glen L. Shira, a mechanical engineer at the U.S. Army Land Warfare Laboratory, Aberdeen (Md.) Proving Ground and Aberdeen R&D center, was selected among three State of Maryland scientific award finalists.

The accompanying citation credited Shira's contribution to development of an illumination warhead for the 2.75-inch rocket and a perimeter illumination rocket used by aircraft.

Richard W. Johnson, chief of the Technical Support Division, Materiel Test Directorate at the APG, was nominated for a "wide range of accomplishments" during his federal career, particularly during the past year. He has a BS degree in mechanical engineering from the Newark (N.J.) College of Engineering in 1941 and shortly thereafter began his career at the APG.

James C. Fulton was nominated for numerous achievements as chief of the APG Procurement Division since 1954. First employed at the proving ground in 1946, he was employed earlier at Edgewood (Md.) Arsenal.

FRANKFORD ARSENAL systems engineer Donald Furmanski receives plaque naming him Federal Employe of the Year 1970 in a scientific field. Frankford Arsenal CO, Col James L. Wallace presented the award which is sponsored jointly by the Federal Business Association and the Philadelphia Federal Personnel Officers Group.

improvement program for T–63-series engines; Owens Illinois, Inc., $1,881,168 for 10 cinetheodolites for tracking airborne objects; LTV, Inc., $1,766,626 for RT–525 receiver-transmitters; and

Pace Co., $1,762,485 for illuminating signals; General Motors Corp., $1,725,479 for diesel engines for armored personnel carriers; REDM Corp., $1,659,437 and E. Walters & Co., $1,654,343 for fuze parts; and

Goodyear Tire and Rubber Co., $1,629,411 for track shoe assemblies for M60 tanks; A. C. Electronics, Inc., $1,573,279 for 2.75-inch rocket launchers; Holt Instruments Labs, Inc., $1,561,716 for frequency response test sets; Honeywell Information Systems, Inc., $1,500,000 for electronics equipment; and

Boeing Co., $1,495,073 for system analyses and evaluation on Safeguard; Electrospace Corp., $1,452,889 for AN/PRC–77 radio sets and RT–841/PRC–7 receiver-transmitters; Maxson Electronic Corp., $1,444,566 for inertial fuzes for Pershing missiles; and

Mason and Hanger, Silas Mason Co., Inc., $1,420,872 for operation of a government-owned facility for loading, assembling and packing ammunition; Harvey Aluminum Sales, Inc., $1,419,091 for operating an ammunition plant; the University of Wisconsin $1,370,000 for interdisciplinary research in mathematical sciences;

Cummings Engine Co., Inc., $1,342,504 for power train package sets; Teledyne, Inc., $1,273,036 for cylinder assemblies for the M48 tank; General Time Corp., $1,272,960 for mechanical time fuzes; Mine Safety Appliances Co., $1,265,207 for reworking M17A1 protective field masks;

TRW, Inc., $1,261,289 for research and development on engagement logic and control for the Antiballistic Missile Defense Agency; North American Rockwell Corp., $1,240,057 for file loading and retrieval for the Army Materiel Command Technical Data Configuration Management System;

Brown Engineering Co., $1,233,792 for ballistic aerial target systems; and Applied Devices Corp., $1,193,651 for directional gyroscopes and gyro magnetic compass sets.

PEQUA Discusses Coordination of Materiel Programs

Industrial Preparedness Plan with the Materials Research, Development, Test and Evaluation (RDT&E) Program were discussed May 12–13 at an Army Production Equipment Agency meeting.

Responsibilities for coordinating the Army Materiel Command's 5-Year

Sessions at PEQUA headquarters, Rock Island, Ill., were chaired by Dr. George R. Thomas, chief of the Materials Laboratory at the U.S. Army Materials and Mechanics Research Center, Watertown, Mass.

Members of the Technical Working Group in attendance included Gerald Gorline, U.S. Army Aviation Systems Command; Phillip A. G. Carbonaro, AMMRC; Dr. Vito J. Colangelo, Watervliet (N.Y.) Arsenal; Donald H. Kleppinger, Frankford Arsenal; William Powers, Picatinny Arsenal; Emil J. York, Mobility Equipment R&D Center; and L. Thomas Mazza, Aviation Materiel R&D Labs.

Technical Working Group (TWG) members serve as an advisory body on the relevancy and adequacy of the Army Materiel Command's Manufacturing Methods and Technology (MM&T) Program with regard to Army needs and problems.

The Manufacturing Technology Division of the U.S. Army Production Equipment Agency monitors and coordinates the MM&T Program, which is an important part of the AMC 5-Year Industrial Preparedness Program.

The TWG examines proposals for working the newer materials, composites, ceramics, ferrites, etc. into the 5-Year Industrial Preparedness Plan, including evaluation of advanced manufacturing methods, processes and techniques. Tracking R&D and MM&T projects for time-phasing, funding and feasibility is in the TWG function.

Coordination with the R&D segment of the Materiel Command aims to assure that the latest state-of-the-art production processes are available by the time the newer materials have completed the RDT&E cycle.

Edgewood Speeds Up Personnel Data Center

Data processing equipment capable of three times the speed of less sophisticated computers was installed in May by the Army Personnel Data Support Center, Edgewood (Md.) Arsenal.

Brig Gen Carl V. Cash, CG of the Army Personnel Information Systems Command, cut the ribbon at the inauguration of the third generation Burroughs 3500 Information Processing System.

Lt Col James Paul Fahey commands the center, which is staffed by 10 officers and 195 enlisted personnel, consisting largely of programers. systems analysts, electric accounting machine operators, automated data processing operators and analysts.

The center is responsible for the daily accounting of all basic trainees, students and newly commissioned officers not permanently assigned to a particular unit. This involves processing over five tons of mail each month and making some 350,000 changes to keep 200,000 records current. Despite this heavy work load, a recent audit of operations revealed a 99.99 percent accuracy.

Formerly known as the 7th Data Processing Unit, the center moved from the Pentagon in Washington, D.C., to Edgewood Arsenal in 1966.

ARMY PERSONNEL INFORMATION SYSTEMS COMMAND CG Brig Gen Carl V. Cash cuts ribbon to inaugurate new Burroughs 3500 computer information processing system at the Army Personnel Data Support Center (PDSC), Edgewood Arsenal, Md. Assisting (from left) are Michael C. Goglia, manager of Burroughs Federal Systems Department; Lt Col J. P. Fahey, PDSC commanding officer; and Col George W. Connell, Edgewood Arsenal commander.

★ ★ ★

"Allow me to express now, once and for all, my deep respect for the work of the experimenter and for his fight to wring significant facts from an inflexible Nature, who says so distinctly "No" and so indistinctly "Yes" to our theories." *Hermann Weyl*

JSHS Accents Creative Thinking for Innovative Problem Solving

JSHS ADVISORY COUNCIL shown at June 5 meeting. Seated (from left) are Col William J. Lynch, CO, U.S. Army Research Office-Durham (ARO–D), N.C.; Dr. Harry L. Levy, professor of Humanities, Fordham University; Mrs. Adalie Brent, director, Louisiana Arts and Science Center, Baton Rouge, La.; Brig Gen George M. Snead Jr., Director of Army Research, OCRD; Dr. Ernst Weber (chairman), president emeritus, Polytechnic Institute of Brooklyn; Mrs. Grace Boddie (executive secretary), ARO–D; Col George F. Leist (USA, Ret.), treasurer, Toledo (Ohio) Technical Council; Dr. S. C. Donnelly, director, Safeguard Project Operations, Western Electric Co. Standing are Dr. Sherwood Githens, professor of education Duke University; Franklin D. Kizer, supervisor of science, Commonwealth of Virginia, State Department of Education; Prof. G. G. Acker, Department of Biology, Bowling Green (Ohio) State University; Dr. Edward M. Eyring, Department of Chemistry, University of Utah; Dr. George R. Seidel, Delaware State College; Michael J. Naylon, director of Field Services, Environmental Service Center, Minneapolis, Minn. Standing at far right is Donald C. Rollins, director of the JSHS program. Other council members not present when photo was taken are Robert H. Rines, president of the Academy of Applied Science, Belmont, Mass.; and Rev. A. John Wilson III, assistant chaplain of the U.S. Military Academy, West Point, N.Y.

Stimulus to creative thinking that may help to solve many of the complex social, economic and political problems of the world they soon will enter as adults was provided to a highly select group at the Ninth National U.S. Army Junior Science and Humanities Symposium, May 5–8.

Sponsored by the Office of the Chief of Research and Development under the auspices of the U.S. Army Research Office in Durham, N.C. (ARO–D), the symposium was attended by six selected representatives from each of the 29 regional JSH symposia throughout the nation during the past year.

Superintendent of the United States Military Academy Maj Gen William A. Knowlton, the host officer, welcomed the participants, including internationally renowned speakers, members of the JSHS Advisory Council, regional JSH symposia directors, selected teachers and industrial representatives—about 300 in all.

Two notable innovations highlighted the symposium. For the first time, the students were permitted to judge presentations of selected technical papers. Previously, the student papers have not been presented but have been published in abstract form, as they were again this year.

Based upon the voting of the students, authors of five of the papers were selected to participate—again for the first time—in the International Science Fortnight, which will continue for two weeks in London, England, beginning July 27. This is a new exchange program in which five English students will be selected for a 2-week visit in the United States.

The Ford Motor Co., represented at the Ninth National JSHS by executive John V. Coombe, will sponsor the trip of students selected to make the trip to England. They are:

John L. Quattrin, Antioch (Calif.) High School; Jerome A. Johemko, Nathan Hale H.S., West Allis, Wis.; Patricia Culp, Holy Name H.S., Wyomissing Hills, Pa.; Donna N. Wilkes, Immaculata Preparatory School, Washington, D.C.; and Brion S. Pearson, Indio (Calif.) H.S.

Quattrin's award-winning paper, "Application and Possible Molecular Configuration of Mucus Solutions Derived from the Pedal Gland of Helix Aspersa," reported on his research on the common brown garden snail.

Johemko reported results of studies of "A Light Modulated Liquid Crystal Communications Device," in which the compound para-aminophenylacetate (APAPA) was selected and used successfully in a liquid crystal cell. An electrical current modulated beam of light corresponded to a verbal message.

Miss Culp's paper was titled "Osteoid Demineralization in the Skeleton of the Chicken Embryo." Her research involved the injection of 500 fertile eggs, on the eighth day of de-

CREATIVE ENGINEERING science address was presented by Dr. C. Stark Draper, professor, Massachusetts Institute of Technology. Col John S. B. Dick, head of the Department of Mathematics, USMA, session chairman, is a brother of former Army Chief of R&D Lt Gen William W. Dick Jr. (Ret.).

TRIP TO ENGLAND for International Science Fortnight (two weeks starting July 27) was awarded to (from left) John L. Quattrin, Jerome A. Johemko, Patricia Culp, Donna N. Wilkes and Brion S. Pearson. In the rear are Brig Gen George M. Snead Jr., Director of Army Research; Col William J. Lynch, CO, U.S. Army Research Office—Durham N.C.; Brig Gen John R. Jannerone, dean of the Academic Board, USMA; and John V. Coombe, representative of Ford Motor Co.

velopment, with varying concentrations of cortisone acetate and oxytetracycline suspended in a saline solution. Results ascertained effects upon development ossification of bones.

Miss Wilkes described, in "Location of Urease in Mouse Tissues," her experimental use of a catalytic stain on frozen tissue sections to localize urease. The theory of the reduction of keratin by DDT was introduced to account for the staining of squamous epithelial cells.

Brion Pearson's research paper, "Ozone Denaturation of Aveolar Cell Membrane Protein," described results of ozone inhalation in rats, involving measurements of protein from lung sections of 10 exposed and 10 control animals. A normal control ratio was established between the protein measured by two spectrophotometric methods.

Four distinguished educators contributed outstandingly to the over-all success of the symposium. Dr. Morris Rubinoff of the Moore School of Electrical Engineering, University of Pennsylvania, gave the keynote address.

His topic was "Communication and Information," in which he discussed scientific information dissemination as affected increasingly during recent years by automatic data processing and computer technology.

Dr. Rubinoff devoted the major portion of his address, however, to his contention that "we no longer can afford the luxury of separating science from the humanities. The time has come for us to face up to the problem —that we live in One World. . . . Science and the humanities must not only work together but merge together and become one."

In discussing an article by Harold G. Cassidy, "Scientific Thought: A Force in Human Life," published in the September-October 1970 edition of *American Scientist*, he quoted:

". . . only a full understanding of the science education problems . . . on the part of the non-scientist . . . will enable our children to seize the opportunities of a science and engineering career." Largely through lack of communication, Dr. Rubinoff said, that full understanding has not been achieved.

Probably the main strength of science, Dr. Rubinoff cited Cassidy as saying, is that both the theoretical and applied scientist can contribute meaningfully to society—because of their experience in developing an ordered relevance of reproducible experiences to a corresponding world model, and their controlled repeatable experiments in an objectively designed laboratory.

"The basic uneasiness felt toward generalizations regarding human problems," Dr. Rubinoff said, "stems originally from the difficulty of designing reproducible and objective experiments. But it is enhanced by the frequency with which unqualified conclusions are broadcast to the lay

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AMONG PRINCIPALS who participated in the Ninth National Junior Science and Humanities Symposium at the U.S. Military Academy, May 5–8, are (center) Maj Gen William A. Knowlton, USMA Superintendent, and Dr. Morris Rubinoff, the Moore School of Electrical Engineering, University of Pennsylvania, flanked by (right) Brig Gen George M. Snead Jr., Director of Army Research, and Col William J. Lynch, CO, U.S. Army Research Office-Durham, N.C.

JSHS Accents Creative Thinking for Innovative Problem Solving

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public through news releases and TV talk-fests.

"This concern has recently been expressed to the Council for the Advancement of Science by Dr. Edward E. David, Jr., science adviser to President Nixon, when he stated:

" 'This has been called the age of instant, if not accurate and complete information. Indeed . . . through the efforts of . . . television and radio, the average person in the United States is probably better informed than presidents, premiers and dictators in many parts of the world.

" 'Yet I heard a friend of mine say recently . . . that never in history have so many people been so sure with so few facts. . . . I think it is true that we find today many glib people taking strong adversary positions on public issues in which science and technology are involved.' "

The answer to "What to do?" about the current situation and the foreseeable trends in the emerging national and worldwide situation, Dr. Rubinoff contended, "lies with the college and high school students of today—and particularly with yourselves, the gifted science and humanities students who have been assembled for this annual symposium.

"For clearly, we believe that, as scientists, we have the basic techniques and the information to apply to the problems of mankind, the people problems that face the world today.

"If the humanities are to produce a leadership with a better understanding of science, then it is up to us to communicate our principles and techniques . . . to educate by demonstration."

He quoted again, in closing, from Cassidy's article:

" 'We must adhere to that one-way signpost which says that it takes reason to recognize irrationality, not the other way around. We must treasure what we have learned about how to reason. It has been hard-won over the ages, with many sacrifices on the part of our forebears, and it must not be given up—not one tiniest jot of it.' "

Banquet speaker Dr. Maynard Miller, director, Glaciological Institute, Department of Geology, Michigan State University, made it clear—as he spoke considerably beyond his allotted time—that he was as wrapped up in his audience as they obviously were in what he had to say. He has long been prominent in JSHS activities at the regional level in the midwest, and admits to being "thoroughly sold on merits of this program."

Because Dr. Miller's address was, based upon a later poll of students regarding their reaction to various features of the symposium program, "the most memorable highlight," it is reproduced on pages 32–35.

Students also demonstrated strong interest in an address by Dr. C. Stark Draper on "Creative Engineering," in which he pointed to the potential they have, when they emerge into the adult world, of taking important parts in a constructive—not destructive—approach to many of the nation's problems by rational action.

Known as one of the nation's top scientists, and president of the Charles Stark Draper Laboratory and professor, Massachusetts Institute of Technology, Dr. Draper was introduced by Col John S. B. Dick. Professor and head of the Department of Mathematics at the U.S. Military Academy, Col Dick is a brother of former Army Chief of R&D Lt Gen (USA, Ret.) William W. Dick Jr.

While working with the Sperry Gyroscope Co., Dr. Draper made numerous contributions to aircraft instru-

DISCUSSION PANELS. Section C, "Protection of Prenatal Development." From left, Maj Conley G. Lacey, Department of Obstetrics and Gynecology, USMA Hospital; Dr. T. Reginald Porter (moderator), professor of biology, Sonoma State College, Calif.; Dr. Herbert S. Posner, head, Section on Growth and Development, National Institutes of Environmental Health Sciences. Section D, "Environmental Impact on Air Pollution and its Control," Dr. Delbert S. Barth, director, Bureau of Criteria and Standards, Air Pollution Control Office; Dr. Donald D. Bode (moderator), University of Utah; Lt Col A. Shea, USMA.

DISCUSSION PANELS. Section A, "What is the Federal Role in Our Efforts to Achieve Environmental Quality?" From Left, Maj Robert E. Klein, USMA Department of Earth, Space and Graphic Sciences (DESGS); Lt Col Thomas C. Winter, staff member, Federal Council on Environmental Quality; Dr. John A. Hoppes (moderator), Department of Civil Engineering, University of Wisconsin. Section B, "Aquatic Ecology and Pollution," Dr. John K. Beadles, chairman, Division of Biological Sciences, Arkansas State University; Dr. John A. Yarborough (moderator), Meredith College, Raleigh, N.C.; Maj Thomas H. Magness III, USMA.

mentation and controls, earning the nickname of "Mr. Gyro." His interest developed during the time he served as an officer in the Army Air Force. Among his numerous important inventions was the Mark 14 gunsight, which from 1942 on during World War II played an important role in combatting Japanese Kamikaze pilots.

Creative engineering, Dr. Draper said, now demands a look at the total social, economic, environmental and political system in the United States and its interfaces with other nations. It demands an awareness of all factors involved. Constructive creativity, in effect, changes the environmental situation to make it more desirable.

Dr. Draper contended that creativity, with respect to working out solutions to national and world problems, calls for imaginative innovation based upon knowledge and understanding of what should be done. He emphasized the need for a compelling motivation to "become involved"—to use resources within the individual.

"We know how to do many things by using the laws of nature," he said. "The thing we lack is effective decision-making. . . . We are decision-limited more than technology-limited. Technology is available and we must learn how to use it to the best advantage. . . . Emotion too often provides motivation for decision-making, rather than sound rationalization."

Dr. Harry L. Levy, professor of humanities at Fordham University, and a long-time member of the JSH Symposia Program Advisory Council, introduced Dr. Paul L. MacKendrick, who gave the "humanities" address.

Dr. MacKendrick is professor of classics at the University of Wisconsin and an internationally recognized scholar and researcher. "The Future of Tradition: Roman Architecture" might not sound like a subject that would absorb the interest of high school science students.

Obviously, it did, however, as presented in Dr. MacKendrick's manner, for the question-and-answer session upon its conclusion indicated a very lively interest among many of his listeners. The address was illustrated with numerous pictures of famous buildings that traced the continuing impact of Roman architecture throughout the ages among nations of the world.

One of the unscheduled "bonuses" of the symposium was the showing of a film titled "The Good Earth," dealing with the subject of letting technology solve the urgent problems of pollution. The film, humorously and also poignantly hard-hitting, was produced by the Structural Support Division of the academy.

DISCUSSION PANELS. Section G, "Emission Control in Internal Combustion Engines." From left, Dr. Robert B. Gaither (moderator), Department of Mechanical Engineering, University of Florida; P. E. McKee, Emission Programs manager, Auto Emissions Office, Ford Motor Co.; Maj Karl M. Henn, Department of Engineering, USMA. Section H, "Power Sources of the Future," Dr. Leonard Geller, vice president of Research, S. M. Stoller Corp.; Dr. Roscoe F. Ward (moderator), assistant dean of the School of Engineering, University of Massachusetts; Lt Col David E. Wheeler, Department of Engineering of the USMA.

Eight simultaneous discussion panels were the attraction at the concluding session of the symposium. Lt Col (Dr.) Thomas C. Winter, staff member of the Federal Council on Environmental Quality, was a featured speaker on "What is the Federal Role in Our Effort to Achieve Environmental Quality?" A presentation also was given by Maj Robert E. Klein, USMA Department of Earth, Space and Graphic Sciences. The moderator was Dr. John A. Hoopes, Department of Civil Engineering, University of Wisconsin.

"Aquatic Ecology and Pollution" was moderated by Dr. John A. Yarborough, professor of biology, Meredith College, Raleigh, N.C. Presentations were given by Dr. John K. Beadles, chairman, Division of Biological Sciences, Arkansas State University, and Maj Thomas H. Magness III, USMA Department of Earth, Space and Graphic Sciences.

Dr. T. Reginald Porter moderated a panel on "Protection of Prenatal Development" that featured presentations by Dr. Herbert S. Posner and Dr. (Maj) Conley G. Lacey. Posner is head of the Section on Growth and Development, National Institutes of Environmental Health Sciences. Lacy is with the Department of Obstetrics and Gynecology, USMA Hospital.

"Environmental Impact of Air Pollution and Its Control" was moderated by Dr. Donald D. Bode, research professor, University of Utah. Presentations were given by Dr. Delbert

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DISCUSSION PANELS. Section E, "Drug Abuse." From left, Prof. George G. Acker, Department of Biology, Bowling Green State University; Dr. Norman J. Doorenbos, chairman of Pharmacognosy and professor of Medicinal Chemistry and Pharmacognosy, School of Pharmacy, University of Mississippi; Maj William L. Wilson, Office of Military Psychology and Leadership, USMA. Section F, "Humanities in the Computer Age," Prof. Richard T. Scanlon, professor of Classics, University of Illinois; Dr. Sherwood Githens (moderator), professor of Science Education, Duke U.; Col Jack Capps, head, English Department, USMA.

The Environmental Crisis—What is the Question?

Empathy could not have been more evident than it was during Dr. Maynard Miller's banquet address at the Ninth Annual National Junior Science and Humanities Symposium at the U.S. Military Academy in June. In response to a questionnaire later, students indicated by a wide margin that his address was the most memorable of many impressive experiences at the symposium. In view of its current significance, the complete address is published.

* * *

Dr. Maynard M. Miller, professor of geology at Michigan State University and world renowned scholar of geomorphology and climatology, earned his BS degree at Harvard University, MA at Columbia and PhD at Cambridge University, Cambridge, England. Among his prestigious achievements are research associate with the Lamont Geological Observatory (N.Y.); director of the Juneau Icefield Research Program (Alaska); and director of the Foundation for Glacier Research. Prof. Miller has also been a prominent contributor to regional Junior Science and Humanities Symposia for many years. Among his current areas of investigation are glaciology, volcanology, photogrammetry and glaciometerology.

By Dr. Maynard Miller

Today, the greatest challenge facing man is the challenge of extraordinarily rapid change. To illustrate the poignancy of this, I am reminded of the story of the political science professor who was criticized for giving, year after year, the same final examination. Seemingly, this was a set-up for off-campus "ponies," peddled to provide answers to re-used exams. But the professor was more alert than that, for when approached by another staff member who had listened to student complaints he answered, "Of course, I give the same questions each year. But the world is changing so fast that *I expect quite different answers!*"

We all know that good students can be developed by good teachers, but there is a limit to what can actually be taught. Students still must in some way learn by themselves what no instructor can give, for no verbal vaccination can possibly impart one's own competence to another. The role of the teacher is to put students in a self-learning situation, first by convincing them that he, himself, has a worthwhile commitment; secondly, by showing that the problems he poses are worth solving; and thirdly, by demonstrating that there is some technique which can be applied.

The final task is to motivate the student to engage in the inquiry himself and to reach some form of solution. In all this, the most important part is for the teacher to get his students to ask the significant questions, for to evoke personal commitment the right question can be far more important than any hoped-for answer.

Too many people today are demanding answers to questions that they have never bothered to ask. An answer, without a question, is no answer at all.

This kind of intellectual honesty and the accountability it represents are underscored by the legend of Gertrude Stein's life. While lying on her death bed, she looked up at her dear friend and companion of long years, Alice B. Toklas, and whispered "Alice, what is the answer?" Alice answered, "Gertrude, I don't know." Miss Stein, after a long pause, said "Well, Alice, then what is the question?"

This is the way I feel as I come before you at this National Junior Science and Humanities Symposium . . . where I fear you may expect useable answers instead of frustrating statements . . . such as: "What are the questions we should be asking?" But with the environmental crisis pressing hard on mankind today, we *must* demand consideration of the basic questions.

Corroborating this approach is a paraphrase of H. L. Menken's delightful yet alarming remark that "the American public wants quick answers and they want them simple and neat . . . and wrong!"

Yes, in our complex, crisis-riven world, simplistic answers are more than likely to be wrong. But the questions, too, can be misleading. Let me illustrate with some general systems thinking on the environmental challenge facing man today.

The December 6, 1970 issue of the *New York Times* carried an interesting article by the science writer, Walter Sullivan. The title was "Probing Questions too Tough for a Mere Brain." This article posed the question, "Is man intelligent enough to survive his present crisis?" It pointed out that the crisis is man-made; that we have "built a world so complex, with so many interacting factors, that the human mind can no longer see its way through the maze to discern the ultimate effects of decisions and actions taken today."

As a result, attempts are now being made to program into massive computers these complex problems and the factors that govern them. Numbers are being attached to the basic factors of population and productivity, and even to that elusive concept, the "quality of life."

The *New York Times'* article discussed one such study at MIT currently being conducted under the title, "Project on the Predicament of Mankind." This project delineates the general systems interplay of four environmental curves, to which I will add several more.

As expected, the basic curve is sharply upswinging and depicts the exponential *growth in worldwide population.* Statistics for this have been so well advertised that they need not be repeated here. The inexorable population trend is recognized as the bête noir of most of our environmental problems. It is the center of our most fundamental question, the phrasing of which can be left to you.

Recognizing the basic effect of population growth on the future of society, the State of Michigan Division of the United Nations Association, at its annual conference this year, passed a resolution urging both state and federal government studies of optimum population growth. It was suggested that these studies take into account "the limiting factors of physical, social and cultural factors" which could control a desirable steady-state population.

Dr. Guy Gresford, an Australian who is currently Director of the Office of Science and Technology of the United Nations Secretariat in New York City, reinforced the conference position by citing the vast increase in international problems faced by developing nations that have already extended their populations well beyond limits of their available resources.

This brings us to the *natural resources depletion curve,* which on a global scale has been trending downwards at an alarming rate for more than the past half century. In America, natural petroleum supplies have

dwindled to such an extent, as have the international sources of oil, that we are faced with the development of reserves in the physically hostile region of the high Alaskan Arctic.

Framed by this urgency, the right question is now being asked . . . i.e., can we find an equable balance between continued economic exploitation and developing conservation awareness and management of our natural world?

If this question is answered with actions leading to a sensible balance between profits and conservation, and if in the long run the physical beauty and purity of nature are not unduly despoiled, important guidelines may well be established for the harmonious blending of man and nature.

This action could serve not only our national purpose; it could be a compelling example to be followed elsewhere in the world. Still it is a "pipe-line" dream (tsk!) to think that this can be done without some loss of our material comforts or, indeed, some damage to our pristine wilderness. But is this to be bemoaned?

The answer is, not if we take stock of the fact that we really have no right "to blow" 4 billion years of natural resources development on our earth in something less than 150 years, which is about the time since the Industrial Revolution began. Clearly, no civilization should have that "privilege." Here we touch upon the moral basis for resource management, something allied, in fact, to every other facet of modern life.

The third significant curve is a steeply upward-trending *pollution curve*, affecting air, water and land. This one is also of global as well as national concern. We hardly need a computer to give us warning on this.

According to study by the Massachusetts Institute of Technology, if allowed to run its present unrestricted course, by the year 2010 pollution will bring about its own drastic curb on global population via pestilence, famine, disease and death, especially in the overcrowded sectors of Asia. But in this there would be suffering and tragedy . . . beyond present comprehension.

And then there is the *quality of life curve*, so intimately interwoven with the other three and which has already begun to decline in almost every sector of the globe. In fact, as difficult to measure as it is (for who can define quality of life), it is clear that this curve began to take a noticeable dip in the decade of the 60s . . . a decade history may record as the end of the age of unrestricted economic growth in the western world.

The MIT study further suggests that to bring the quality of life back to pre-1960 levels, it will require a capital investment of 20 percent over the present one or two percent feedback of industrial profits towards an orderly environment.

To invoke such a capital investment curve would indeed be difficult without severe belt-tightening in every quarter of our society. As more and more realistic data are fed into computers, we should be forewarned that such predictions may go beyond speculation and become part of our future national plan.

But are computers the answer to this dilemma? It is another question deserving attention. No one argues that computers can significantly extend some capabilities of the human brain. One giant computer can, in 30 seconds, do more calculations than have been done by all human brains since *homo sapiens* became *homo ascendens!* So the possibilities for understanding the complexity of our world . . . and our environmental problems . . . are large indeed.

Still, one of my students in environmental geology recently gave a critical answer on an exam in which I questioned the significance of computer solutions to environmental problems: "It is a fine tool, but the computer only handles what we program into it. Although it greatly extends the human brain, it cannot so easily extend the human heart."

The concerned optimism expressed by this alert student's answer reveals that she was thinking deeply—that she had already asked herself the right question. It is heartening to see so many youths sensing this reality—realizing the high potential of human beings who come to know their limitations and their capabilities.

Study of the interplay of the *population*, *natural resources*, *pollution* and *quality of life curves* typifies total systems thinking. Hopefully, such can lead to total systems competence—and this not by computers alone, for man must make the final decisions based on his mind . . . and his heart.

The task ahead is even greater than the dilemma suggested by "speculative forecasts" of the automated analysis. Regardless of the nature and complexity of the environmental challenge, it requires a complex and well-researched response.

Although wisdom is more related to how we use knowledge than to knowledge itself, there is need to become deeply knowledgeable about the environment and all of its inter-relationships if we are to deal with it wisely. This deeper need demands recognition that the only thing in our world today which is not changing drastically is change itself. And so now let us consider further complicating curves.

As I describe these, and attempt to assess their effects on man's future courses of action, I ask another hard question. Its ramifications you may already have sensed in your increasing awareness of the combined roles of science and humanity in decisions relating to man and his environment. This basic and most difficult question is: "Is evolution progressive?"

Do not attempt to answer before thinking about these additional curves and their possible, if not probable, effects.

What about the unpredictable *curve of war*, which has plagued man every few decades since the beginning of so-called civilization—a curve that certainly no computer can delineate or for which it can program no answer? What about the impact of the *world is getting younger curve?*

Statistics tell us that in Manhattan last year more than 50 percent of the population on that former island of the Iroquois were less than 21 years of age. By 1980 more than half of all of South America's population will be under 27 and by 1990 probably 80 percent of the world's great population center, Asia, will be under 25. If it were not for total systems thinking, this trend would not appear so serious, for everyone would like to be young and full of potential.

If we want to examine the consequence, we must consider the more insidious trends of the *world is getting poorer and hungrier curves*, and the seldom-considered yet vastly important the *world is getting dumber curve*. Before you conclude that I suspect that young people are incapable of elevated thought, let me explain.

As the population growth dilemma increases around the globe, and numbers multiply and jobs decrease and hunger increases, the GNP of many lands grows at but a fraction of the population pace. Thus education, relatively speaking, diminishes.

With lowered capabilities for economic strength, the growth of educational facilities must also substantially lessen. There just will be fewer schools, fewer teachers and fewer supportive funds in terms of the vastly increased numbers of human beings.

If the world is getting dumber and younger and poorer and hungrier, where is the expertise and the economic strength to come from to solve our not so neat and not so simple problems?

Does this give much faith that man will be able to respond effectively to

(Continued on page 34)

The Environmental Crisis—What is the Question?

(Continued from page 33)

the awesome environmental stresses we have defined? Probably not, for increasing illiteracy parallels increasing frustration, which leads to increasing divisiveness, increasing suspicion, hostility and anger, with greater irrationality, violence and conflict likely to ensue.

A frightening thought is that Karl Marx may never need to have lived for the aim he expressed, because the conflict he envisioned may come from environmental rather than economic causes. If ultimate debilitating conflict comes, it may be nature's way to achieve a steady population state—albeit with gruesome consequences threatening the very survival of the human race through destruction of anything worth surviving.

As René Dubos has suggested, we may survive, but as something less than human. Must we believe that such is assured? Not if the mandate to your generation and to that of your children is clearly appreciated —and more fully acted upon by you than by any previous generation.

In the West, relative freedom and individual prerogatives still prevail and we still have some time to meet these tasks. But in our seeming corners of comfort in America, Europe or Japan, we are faced with another perplexing trend—that of the *"let George do it" curve!*—which in itself is a product of freedom, our freedom to be irresponsible as well as responsible.

Too often when the going gets tough, we allow ourselves to retreat into selfish niches. We are tempted, for personal protection, to close our eyes to stress on all sides. This becomes a form of *destructive neutralism.* Under stress, others are tempted to develop a "doomsday apathy," which is a form of *destructive negativism,* equally as dangerous. Under the pressure of our times, some have been tempted by a third option: the searching, vainly and frantically, for simplistic solutions—ones usually too simple, too neat, and too wrong! If attempts to go this way are emotionally based, they become a *destructive positivism.*

In each of these cases, we only spin ourselves into cocoons of retreat, apathy or revolutionary dismay, none of which faces up to the reality of the question: "Is Evolution Progressive?" Clearly, *one* answer is "No!"

Can we continue to look the other way or not to look at all? Where survival is at stake, can we afford the luxury of blind emotion, the flailing out and demanding of quick returns to old orders? *Or by violence, forcing a quick change to a new order, and in so doing waive aside all hard-won experiences?*

I believe the answer to these questions is carefully to avoid each such recourse. Instead, we should begin too work towards that personal kind of stamina under stress that makes us take ourselves less seriously, and our public citizenship and our professional jobs more seriously. We must gird ourselves with a "creative patience" that outwits frustration and does not let us be stampeded into the wrong set of answers in the face of crisis.

Basically and essentially, this means we must educate our combined mind and heart to reach for realistic solutions that are totally humanistic and scientifically sound, that is, realistic education and a *constructive positivism* characterized by potential, not our worst.

From the time of Aristotle, man has been recognized as a "rational animal," a question-asking, problem-solving creature, presumably with an imaginative mind and a soul markedly differentiating him from lesser beasts. Every other species might be considered as complete—the cat, the bird, the earthworm possibly being "finished products," or at least with no further possibilities for good or evil in the foreseeable future. Man, thank God, is different! He has been called the "unfinished animal" with what appears to be an assigned task to complete himself. As the columnist, Sydney Harris, has said:

"We seem to have been conferred the dreadful freedom to finish shaping ourselves in whatever way we will. We can become more like Socrates, or more like the men who put him to death. *We alone of all living creatures can elevate ourselves, or degrade ourselves, or totally destroy ourselves."*

The important question here is "How shall we complete ourselves?"

It seems to me that a good part of the answer lies in using our energy, our will and our knowledge with increased emphasis on total systems understanding and total systems competence. In spite of the population numbers game, the role of human excellence (as underplayed as it is becoming today with emphasis on the average and the subaverage) can nevertheless take on new meaning—for there is absolutely no question that ignorance can effectively answer.

The meaning of excellence is survival in a world where more than ever, one Jefferson, one Einstein, one Pasteur, a Newton, a Pericles, a Lincoln, an Emerson not only can but *must* be worth 10 million other men.

This is the only way to counter-balance the degeneration of numbers and the increase of subsistence living for the mass of humanity who will increasingly have nothing left over for creative answers. This, of course, argues against the historical imperative which suggests that the life of one man cannot make a difference.

The great answers and breakthrough solutions of so many crises in the past have shown the Czech patriot, Thomas Masaryk, to be right when he said, "History is not the dead hand of the past upon a people, but history is the covenant of fathers and sons."

Total excellence, which must evolve from father to son and from teacher to student, is the only staff that man will have to aid him in his arduous ascent to some form of "higher destiny."

Thus, in the world of this decade, where the public view of science and technological excellence seems to be suffering a psychologically diminishing curve, the task becomes even more difficult. This brings me to an important final curve, one hearteningly suggested by another of my environmental science students.

We may call this the *growth of knowledge curve,* which we can only hope someday will reflect a growth of increased wisdom on the part of more and more movers and leaders in society. In this there is much hope, if we have energy to insist upon it and faith to withstand the buffeting that such insistence incurs.

A further optimistic note is given by an eminent scientist of our times, Dr. Glen Seaberg, Chairman of the Atomic Energy Commission. In a report to Congress last year, he expressed his faith in this way:

"The despair and negativism of the time is a prelude to deeper and more positive thinking in which man is beginning to examine human values and goals. I believe that one of the characteristics of the human race, possibly the one that is primarily responsible for its course of evolution, is that it has grown by creatively responding to failure."

As a concerned optimist, I, too, believe we live in a time of *creative urgency* and that stress can play a significant role in the positive evolution of man. But again a basic question: *Will it play such a role?*

To answer this, we have to recognize that the value of stress as a

owth impetus fails when the stress vel is so high it kills, as fully as it ils when so low that it leads to apa- y and inaction.

The task is to find stress levels that n be creative and that will allow an to be sufficiently challenged to olve progressively. I call this *crea- e stress*; Martin Luther King un- rstood it as "creative tension." Re- rdless of the semantics, it is essen- al for progressive evolution and we ust learn to recognize it.

In our environmental crisis, we ust let it work for us, not against s. In this I am convinced that we ust let our past knowledge and even r technology work for us. We nnot afford to destroy what we have ready so well discovered; we can nly afford to re-evaluate the use of ur knowledge, including our science nd technology, for the benefit of man.

To know truly the value of stress, nd to be able to control it to an optimum level, requires those qualities of education that I referred to in my opening remarks—those qualities that no teacher, no computer and no general systems theory can provide. It demands realistic-involvement learning, combined with academic grounding; the development of a strong perspective of history; and the attendant ability to look ahead not only rom the present but through the past.

This will require the humility of knowing where we are, where we have been, and where we can go if we but will. It involves the optimism of a Louis Pasteur, who repeatedly advised youth in his day that "chance favors the prepared mind."

The reason natural evolution must not blindly be said to be progressive is found in the records of geologic time—in the 5,000 classes of animals that have had a beginning, a middle and an end—and have become extinct! Man, the "unfinished animal," is no different, except that he has a sensitive mind and a heart—which together can exercise a positive influence on the evolution of humaneness that can go beyond animalistic survival.

But this will only come if visionary men, who are high-quality men of substance and leadership, look and act beyond themselves as wise and articulate leaders who point the way for the vastly increasing hordes of human beings who are becoming trapped in over-stressed circumstances, *making men less than men.*

Although generally change is the essence of our times, it has been life's essence in every age. Twenty-five centuries ago Pericles, in his timeless oration to the Athenean dead at the end of the second year of the Peloponnesian War, spoke words as ringing today as then.

"In the hour of trial," he said, "Athens alone is superior to the report of her . . . . An Athenean citizen does not neglect the state because he takes care of his own household; and even those of us who are engaged in business have a very fair idea of politics. We alone regard a man who takes no interest in public affairs not as a harmless, but as a useless, character. . . ."

Such men, as scientists and humanists, can be the self-regulators of society—the evolvers of that urgent awareness that we have but limited control on our destiny. They must believe that if we do not push the various curves pressing on us too far, and if we do what we must to live in harmony with the natural world, a self-regulation and a steady state can be achieved for civilization.

At least a dynamic equilibrium in the basic problem areas of population and pollution is essential if we are to minimize dangerous conflicts and achieve a steady state in the essentials of educational opportunity and the maintenance of that important ingredient, excellence, rather than suffer a continual deterioration in our quality of life.

As I reach for a helpful conclusion, it seems to me that all of us must try not to be so condescending about man's ability "to play God" and strive a little harder for reverence for natural systems and our place in them. We must not forget that man, too, is a mass-energy system obeying the ultimate laws of the universe.

In this we can be guided by reference to another mass-energy system in the world of environmental science. I refer to a river that has reached its "most probable state" by developing a beautiful sequence of meander patterns when the surface of the land has become relatively flat, i.e., when the fluvial downcutting stresses upon the land have reached copable limits.

These meanders then follow another kind of curve. We call it a sine-generated curve, one which has an equal distribution of energy in all of its segments and which expresses the most efficient of all stream geometries. Such a river is called a "graded stream," and it is an example of a self-regulating open natural system in a state of dynamic equilibrium.

It seems to me that society, too, can distribute its energy in more or less equal parcels throughout its system. I believe it must if it, too, is not to suffer the over-stress of too-rapid down-cutting on some occasions or the under-stress of too-stifling deposition or in-filling at others.

To make the analogy clearer, I should note that even a graded stream has its temporary disequilibriums. Unequal distribution of energy produced by temporary increases in water supply, by floods and other abnormal inputs up-stream, are examples we have all seen in nature.

Nevertheless, in its total system, the stream adjusts to these stressful perturbations by development of an efficient over-all profile, any one segment of which may be undergoing necessary change to maintain general equilibrium in the total system.

Streams, as society, can become overly efficient. When the meander becomes too circular, and develops a broadly sweeping rather than a tighter sine-generated curve, the stream suddenly cuts itself off; a dried-up ox-bow channel is left as a reminder of a former evolutionary state that went too far.

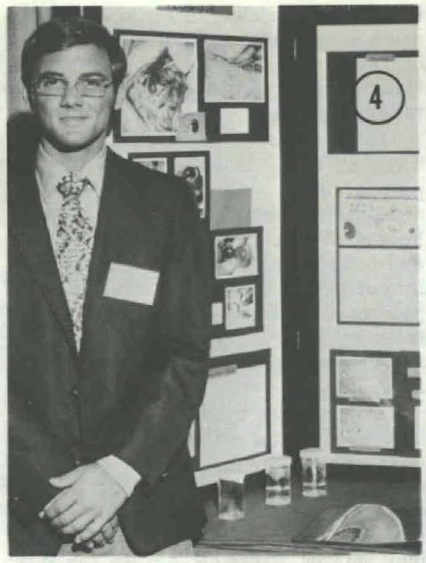
Momentarily, geologically speaking, the stream in its "frustration" returns to inefficiency. It runs faster, downcuts a new lateral course, and evolves a new meander until it achieves, once again, an efficient, steady state. And so it is—or could be—with society.

The environmental crisis is, in effect, the prelude to our "sociological ox-bow," which must be cut off by the mind and heart if man is to achieve a dynamic equilibrium or "steady state" in his society—a state which is not forced upon him by assured pain and suffering if left to nature's inexorable self-regulation. We should not be naive about this. Nature remains oblivious to man; but, to survive, man must not be oblivious to nature.

As a natural stream reflects adjustments along its total channel, society, too, must willingly regulate itself along the whole line, in a total systems response. And so, we return to our seeming dilemma and that most fundamental question: "Is Evolution Progressive?"

The answer must be based on the clear fact that we can no longer ignore the environmental hazards about us. Because of my faith in the role of well-informed, articulate and aware individual leadership, and my belief in the potential effectiveness of those six simple words of Abraham Lincoln —"Every public issue is settled here" —(namely the influence of the vote of well-fed, well-informed, concerned and active public citizens), I suggest an answer which is another question.

"Why not?"



Army Judges Name 22 International Fair Winners

U.S. Army judges at the 22d International Science and Engineering Fair (ISEF) in Kansas City, Mo., May 10–14, selected 22 winners of superior and meritorious achievement awards from more than 400 entries. The theme was "A New Concern for Air, Earth and Water."

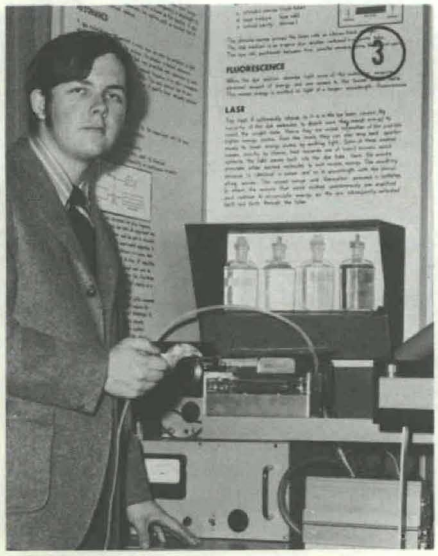
Formerly the International Science Fair (ISF), and popularly termed the "World's Biggest High School Science Show," the exposition was expanded this year to include awards in engineering. Other categories were behavioral and social sciences, biochemistry, botany, chemistry, earth and space sciences, mathematics and computers, medicine and health, microbiology, physics and zoology.

Twenty-two Army judges, including 10 representatives of Reserve R&D activities, chose winners representative of 15 states, Canada and Japan.

The more than 400 entries were the finalists from more than 400,000 participants in 223 ISEF-affiliated fairs sponsored by Science Service, a nonprofit administrative organization, in the United States, Puerto Rico, the United Arab Republic, Sweden, Canada and Japan.

Science Service has the cooperation and support of most of the U.S. scientific and technical societies, educational institutions, industry, and the Department of Defense in sponsoring the ISEF. Science Pioneers, Inc., of Kansas City was the host organization for the 1971 fair.

Director of Army Research Brig Gen George M. Snead Jr. presented awards to the Army winners, all of



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ARMY ISEF Superior Award Winners: (1) Debra Rhodes. (2) Maureen King. (3) John S. Youngquist. (4) Gary C. Vitale. (5) Mary C. Hensley. (6) Stephanie Sue Smith. (7) Virginia Anne Mann. (8) Shirley Hekman. (9) John M. Broschat. (10) Lucy J. Zientek. (11) Martin P. Koskella.

Army Lists Internat

Administrative arrangement for the 22d International Science and Engineering Fair (ISEF) were coordinated by Science Service Director Edward G. Sherburne Jr. and Mrs. Dorothy Shriver, assistant director. The general coordinator was Howard L. Weisbrod.

U.S. Army participation in supporting the ISEF was arranged by Jack B. Fenn of the Information Systems Office, Office of the Chief of Research and Development. Col Sidney L. Loveless (USA, Ret.) was the Reserve officers' coordinator.

Dr. J. Fred Oesterling, deputy scientific director for research, U.S. Army Natick (Mass.) Laboratories, was chairman of the Army judges panel. Other members and disciplinary areas of expertise in which they judged the students' research exhibits are:

Dr. Lynn E. Baker (psychology), U.S. Army Research Office, OCRD; John W. Barry (botany), Deseret Test Center, Fort Douglas, Utah; Dr. Clarence Broomfield (biochemistry), Research Laboratories, Edgewood Arsenal, Md.; Roy Buckrop (physics), U.S. Army Weapons Command, Rock Island (Ill.) Arsenal; and

Dr. Gordon Bushey (chemistry), Office of the Deputy for Laboratories, U.S. Army Materiel Command; Maj Robert M. Cohn (internal medicine),

whom received superior and meritorious achievement citations. Superior award winners also received offers of summer employment or a one-week, expense-paid visit to an Army in-house laboratory doing work in their areas of interest.

In accordance with a program initiated in 1963 and continued annually,

l Science Fair Aids

U.S. Army Medical Research and Nutrition Laboratory (USAMRNL), Denver, Colo.; Warren Grabau (geology), U.S. Army Waterways Experiment Station, Vicksburg, Miss.; and

Dr. Francis J. Sullivan (physiology), USAMRNL; Dr. Charles Hassett (zoology), Research Laboratories, Edgewood Arsenal; Dr. Gilford G. Quarles (engineering), Office of the Chief of Engineers, Washington, D.C.; and

Dr. Durwood Rowley (microbiology), U.S. Army Natick Laboratories; L. B. Underwood (engineering-geology), U.S. Army Corps of Engineers, Missouri River Division, Omaha, Nebr.

Reserve officers on the panel included Capt Salvador L. Camacho (physics), Somers, N.Y.; Maj Kennard D. Fearing (mathematics and computers), Iowa City, Iowa; Col Roy B. Mefferd Jr. and Maj John R. Montgomery (medicine and health), Houston, Tex.; and

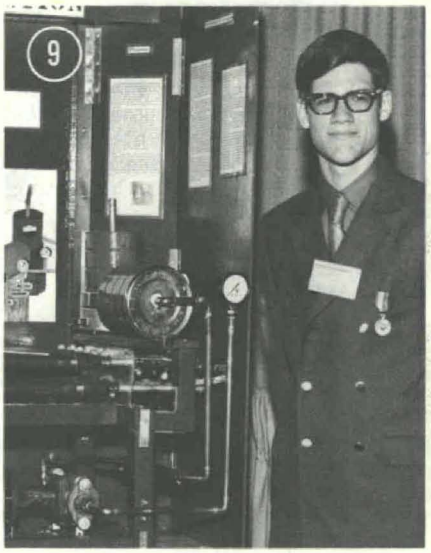
Col Edwin M. Vaughan (physics), Bettendorf, Iowa; Maj Harold Zallen (biochemistry), Bowie, Md.; Lt Col John V. Perry Jr. (mathematics and computers), College Station, Tex.; Capt Ronald D. Stricklett (zoology), Salt Lake City, Utah; Col William L. Surovik (chemistry), Caldwell, Tex.; and Maj John M. Taylor (botany), Greenbelt, Md.

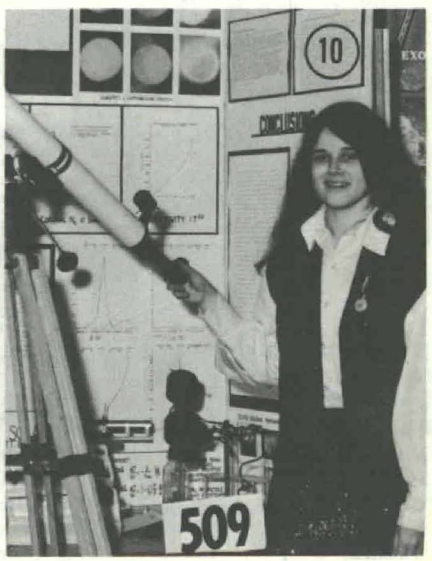
the U.S. Army, Air Force and the Navy each selected a representative to display their award-winning research exhibits at the Japan Student Science Awards. The students spend about 10 days each January in the Tokyo area on an intensive tour of activities that enables them to serve as good-will envoys.

Debra Rhodes, 17, a senior at Los Alamos (N.Mex.) High School, will represent the Army in Tokyo next January in what has become known as "Operation Cherry Blossom" among the Armed Forces sponsors. Her basic research project is "A Cumulative Analysis of the Chemical Nutrient Assimilation of the Tomato Plant from Seed to Maturity."

Debra spent most of last summer in determining quantitatively the chemical needs of a tomato plant through all stages of its life cycle. The plants were grown by a hydrophonic tech-

(Continued on page 38)





Army Judges Name 22 International Fair Winners

(Continued from page 37)

nique and the objective was to develop an optimal formulation for feeding (fertilizing) for maximum production. She hopes to continue her career in the biological sciences.

Maureen King was selected as alternate winner for the Japan trip. A 17-year-old junior at Clairemont High School in San Diego, Calif., she displayed an "Electrophoretic Study of Two X-Chromosome Coded Enzymes."

The Navy selected *Kevin M. Cawley*, 18, a senior at Kuemper High School, Carroll, Iowa, for "Fluorocarbon: Liquid Breathing, Artificial Blood." *Brenda Lea Reis*, Navy alternate winner and a 16-year-old sophomore at Napoleon (N.Dak.) High School, displayed "Transplantation of Tissues in *Mus musculus* Treated With Antilymphocytes."

David Kent Yates, 18, the Air Force representative, is a senior at San Angelo (Tex.) Central High School. His display was "Electrostatic Coding." Air Force alternate *Timothy J. DiLaura*, 17, a junior at Lakeview High School, St. Clair Shores, Mich., exhibited "Inquirer I: Earth-Orbiting Laboratory."

SUPERIOR AWARDS. Army judges selected the following for Superior Awards:

Mary Claire Hensley, 17, Choteau (Mont.) H.S., for "Diagnostic Test for Cognitive Development"; *Stephanie Sue Smith*, 17 Canton (Okla.) H.S., for "Concentration of Catalase in Livers of Various Animals"; *Lucy J. Zientek*, 17, St. Dominic Academy, Bayonne, N.J., for "Magneto-Hydrodynamic Vortex Whorl as Primary Excitation Mechanism of Sunspots";

John M. Broschat, 16, Williston (N.Dak.) Sr. H.S., for "Gas Injection for Low Temperature Oil Flow"; *John S. Youngquist*, 17, Fort Erie (Ontario, Canada) Secondary School, for "Selective Laser"; *Martin P. Koskella*, 18, Divine Child H.S., Dearborn, Mich., for "Mk–4: Laser Orientation to Computer Digital Communications"; and

Gary Charles Vitale, 18, Miami (Fla.) Norland Sr. H.S., for "Renal Transplantation in the Rat: Study of Acute Allograft Rejection"; *Shirley Hekman*, 17, Holland (Mich.) Christian Sr. H.S., for "Color of a Food Coloring Solution"; *Virginia Anne Mann*, 17, Terry Parker Sr. H.S., Jacksonville, Fla., for "Infrared Sensitivity in the Parietal Eye of *Anolis carolinensis*."

MERITORIOUS AWARDS. The winners of Meritorious Awards and their exhibits are *Shin-ichi Yanagishima*, 18, Nagano (Japan) Sr. H.S. of Technical Engineering, for "Studies of Wagtails at Susobana River"; *Carol Ellen Weisman*, 18, Academy of Richmond County, Augusta, Ga., for "*in Vitro* Synthesis of Long-Chain Fatty Acids"; and

Kevin D. Jones, 17, Basin (Wyo.) H.S., for "Effect of Environmental Ionization on Plants"; *Cathy Conley*, 18, Farmington (N.Mex.) H.S., for "Cactus Ecology"; *Susan Melinda Lamb*, 17, Bryan Adams H.S., Dallas, Tex., for "First Order Reaction Kinetics"; and

Edward J. Hoskins, 17, Las Cruces (N.Mex.) H.S., for "Vernier for a Gravimetric Sensing Device"; *Harold A. Scott*, 18, West Springfield (Va.) H.S., for "Nationwide Automatic Telephone Weather System"; *Walter V. Murphy III*, 16, Xavier H.S., Floral Park, N.Y., for "Language Conversion in a Sequential Binary System";

John C. Bundren, 16, Sooner H.S., Bartlesville, Okla., for "Characteristics of Immune Serum Produced in Goat"; *Michael J. Thompson*, 17, Bardstown (Ky.) H.S., for "Antimicrobial Substances in Seeds"; *Kraig L. Derstler*, 17, Columbia (Pa.) H.S., for "Echinoderm Fauna of the Kinzer Formation, Pennsylvania."

NAVY AND AIR FORCE "Operation Cherry Blossom" award winners, alternates, and officers who presented the awards for each service include, from left, Navy winner Kevin M. Cawley, Rear Adm Richard R. Kiene (USNR, Ret.), and alternate Brenda Lea Reis; Air Force winner David K. Yates, Maj Gen Lee V. Gossick, U.S. Air Force Systems Command, alternate Timothy J. DiLaura.

DISPLAY OF EXHILARATION by Debra Rhodes was captured by cameraman as Director of Army Research Brig Gen George M. Snead Jr. announced her selection as Army winner in "Operation Cherry Blossom." At left is Maureen King, alternate for trip to Japan Student Science Awards.

Illustrative of the widespread support given to the ISEF to inspire greater interest among students in the fields of pure and applied science is the large number of special awards given by the following organizations.

American Association of Petroleum Geologists; American Astronautical Society; American Chemical Society; American Dental Association; American Institute of Mining, Metallurgical and Petroleum Engineers; American Medical Association; American Meteorological Society; American Patent Law Association; American Pathology-Medical Technology Award; and

American Pharmaceutical Association; American Phytopathological Society; American Psychological Association; American Society for Microbiology; American Society of Agronomy; American Veterinary Medical Association; Entomological Society of America; and

General Motors Corp.; Institute of Electrical and Electronics Engineers, Inc.; National Aeronautics and Space Administration; Naval Institute/Marine Technology Society; Optical Society of America; Patent Office/U.S. Department of Commerce; Society of Aeronautical Weight Engineers; and

Society of Exploration Geophysicists; Society of Photographic Scientists and Engineers; U.S. Atomic Energy Commission; U.S. Department of Agriculture; Water Quality Office/ Environmental Protection Agency.

ARTADS Center Directed to 'Army of the Future'

ARTADS "directed toward the complexities of the Army of the future" will be the function of a new master computer activity being established as a component of the U.S. Army Electronics Command, Fort Monmouth, N.J.

The Project Manager Office for ARTADS (Army Tactical Data Systems), expected to have a staff of more than 100 when fully operational, will be headed by Col (Brig Gen designate) Albert B. Crawford Jr. Temporary headquarters are in Building 429.

Plans provide for about 50 employes to be on duty early in July and the staffing to be completed by January 1972. Most of the personnel will come from existing agencies.

The office has a funding allocation of about $500,000 and its prime responsibility will be to design and control the manufacture of a system that will assimilate some other computer operations in the Electronics Command.

ARTADS will absorb three major operational projects—Tactical Operations System (TOS); Tactical Fire Direction System (TACFIRE); and the Air Defense Control and Coordinating System (ADCCS). An additional project has been designated the Automatic Flight Operation Center (AFOC).

Support units dealing with administration, procurement, production, logistics, systems engineering and a configuration management office will be assimilated into the new office.

Fort Monmouth will provide accommodations for the headquarters and for the ARTADS design center. Field offices are being established at Fort Belvoir, Va., Fort Hood, Tex., San Diego, Calif., and Van Nuys, Calif.

The Fort Hood office will serve as an early field test and experimental station, with work conducted by Project MASSTER (Modern Army Selected Systems Test, Evaluation and Review) and supervised by ARTADS personnel.

Project ARTADS has been termed one of the Army's "top priority research and development efforts." Col

Col Albert B. Crawford Jr.

Crawford, a U.S. Military Academy graduate with master's degrees in both electrical and industrial engineering, considers establishment of the office he now heads as "indicative of the urgency and the importance of automation in the future."

Edgewood Improves Pollution Abatement Facilities

In line with Edgewood (Md.) Arsenal's continuing pollution abatement program, the filtering and treatment plant has been modernized by a recently completed $1 million addition that double processes all waste water before disposal. The expanded facility is capable of processing two million gallons daily.

Tests following treatment indicate that more than 90 percent of the biochemical oxygen demand has been removed from the waste water. This far exceeds the maximum pollution protection requirements imposed under national pollution control standards. The Bush River is used for disposal.

The treatment plant services all arsenal facilities, five Hartford County schools adjacent to the military reservation, and about 1,000 homes in the arsenal's residential area.

Improvements to the existing system have been under construction since 1967. The new additions include two secondary settling tanks, a pump house, four new sewage pumps, two new sludge pumps, two trickling filters capable of re-circulating 6½ million gallons daily, and a chlorine contact chamber.

The plant is equipped with a complete laboratory, supplies and equipment for conducting a wide range of continuous tests to determine cleanliness of the waste water discharged.

A technician monitors influent and effluent (incoming and outgoing) waste water. Tests are made to determine the dissolved oxygen, chemical oxygen demand, bio-chemical oxygen demand, suspended and volatile solids, phosphates, nitrates and bacteria.

Morrissey to Head Armed Forces Institute of Pathology

Under the plan of rotating the 4-year assignment among the Army, Navy and Air Force, Col Robert W. Morrissey, USAF, will take over Aug. 1 as director of the Armed Forces Institute of Pathology (AFIP).

Navy Capt Bruce Hamilton Smith, who has headed the AFIP since 1967, has announced his retirement effective upon completion of his tour of duty. Col Morrissey has served as deputy director since August 1969.

From 1965 to 1969, Col Morrissey was stationed at Wilford Hall U.S. Air Force Medical Center, Lackland Air Force Base, Tex. That duty followed a 1963–65 assignment to the USAF hospital in Wiesbaden, Germany, and a 7-year tour at Maxwell Air Force Base, Ala.

In each of these assignments Col Morrissey was chief of the Department of Pathology at three of the largest Air Force hospitals.

Graduated from St. Ambrose College in Davenport, Iowa, with a bachelor's degree, he received a master's in biochemistry from the University of Iowa and obtained his medical degree in 1948 from Albany Medical College. He completed his residence training in pathology at the Army's Walter Reed General Hospital (1952–56), Washington, D.C.

Col Morrissey is a Fellow of the College of American Pathologists and the American Society of Clinical Pathologists. He is a member of the American Medical Association of Military Surgeons, and the Aerospace Medical Association.

Col Robert W. Morrissey

Short Film Depicts AEHA Efforts To Control Environment Problems

"For A Better Environment," a new 25-minute film, depicts the efforts of the Army Environmental Hygiene Agency (AEHA), Edgewood, Md., to control the problems which threaten man's environment.

Produced as part of the Army's "Big Picture" series, the film shows AEHA personnel conducting laboratory and field studies on pesticide development, toxic effects of rocket fuels, occupational health hazards, sanitary engineering and air and water pollution.

Some of the agency's automated equipment is shown making tests of specimens exposed to radiation. Work performed by AEHA is portrayed as beneficial to the Army and neighboring communities in the same environment.

Col Robert J. Baer

Col R. E. Ingalls

Col R. E. Lazzell

Col W. H. Hubbard

OCRD Announces Numerous Key Personnel Actions

Retirements and reassignments of key personnel within the Office of the Chief of Research and Development, Department of the Army, triggered a chain reaction of recent changes.

Brig Gen Donald D. Blackburn, Director of Developments since January 1971, has announced his retirement effective June 30. During a 33-year military career, he has distinguished himself in many high-level duties, including a recent assignment as deputy director, Operations (SACSA), Office of the Joint Chiefs of Staff.

Col (Brig Gen designate) Robert J. Baer has been assigned to succeed General Blackburn July 1. Since February 1971 he has served as chief, Firepower Systems Division, Systems Directorate, Office of the Assistant Chief of Staff for Force Development (OACSFOR), Washington, D.C.

Assigned to OACSFOR in April 1969, he served successively as special assistant to the director, Doctrine and Systems Directorate (DSD); chief, Combat Vehicles Office; deputy director, DSD.

Col Baer was assigned to Vietnam for 14 months in 1967–68, first as plans officer, R&D Support Branch, Civil Operations Revolutionary Development Support (CORDS), HQ MACV. He then became chief, R&D Support Branch, Plans and Programs Division, followed by duty as deputy, Territorial Sector and (later) as CO of the 1st Brigade, 1st Cavalry Airmobile.

Graduated in 1947 from the U.S. Military Academy at West Point and from the Army War College in 1967, Col Baer has completed courses in numerous military schools.

Among his decorations are the Silver Star, Legion of Merit with OLC, Air Medal with 11 OLCs, Army Commendation Medal with OLC, Vietnamese Gallantry Cross with Gold Star, Vietnamese Service Medal with 4 Battle Stars, and the Combat Infantryman Badge.

Col Guy E. Jester will end an 11-month assignemnt as chief, Information Systems Office, and director of Army Technical Information, to become district engineer, St. Louis (Mo.) District, Corps of Engineers.

Effective July 12, his new position adds to a series of key engineer assignments, including deputy and then director of the U.S. Army Waterways Experiment Station, Vicksburg, Miss. (1965–67) and in Vietnam (1968–69) as division engineer and commander, 15th Engineer Battalion, 9th Infantry Division.

Graduated from the United States Military Academy in 1951, he has an MS degree in structural dynamics and a doctorate in engineering, both from the University of Illinois.

Col Robert E. Lazzell has reported for duty as chief of the Information Systems Office (ISO), which reports directly to the Chief of Research and Development, and as director, Army Technical Information.

Assigned to the Office of the Chief of R&D since July 1968, Col Lazzell has served in the Plans Division Mid-Range Plans Branch, chief of the Long-Range Plans Branch and, since February 1970, as Plans Division Chief.

Col Lazzell graduated from the Armed Forces Staff College after returning from 1966–67 duty in Vietnam as chief, Research and Evaluation Division; deputy G–3, HQ II Field Force; and executive officer, and deputy commander 1st Brigade, 9th Infantry Div.

While with HQ U.S. Army Materiel Command, Washington, 1962–66), he was deputy project manager for Airborne Surveillance System MQM-58A.

Currently enrolled at George Washington University in the College of General Studies, working toward a master of science and administration degree, Col Lazzell has a BS degree in electrical engineering from the University of West Virginia.

During 26 years active duty (five in the Active Reserve), he has received the Legion of Merit with Oak Leaf Cluster, Army Commendation Medal with OLC, Bronze Star Medal, Purple Heart, Korean Service Medal with OLC, National Defense Service Medal with OLC, Air Medal with Valor Service and two OLC, Combat Infantryman's Badge (3), Vietnam Cross of Gallantry with Palm, United Nations Service Medal, and the Meritorious Unit Commendation with OLC.

Dr. Vitalij Garber has moved into a PL–313 position (GS–16 equivalent) as scientific adviser to the Director of Developments, a position vacant since early this year when Harry L. Reed

Lt Col D. W. Pulsifer

Dr. Vitalij Garber

Morton Stromberg

Jr. returned to the U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Md.

Dr. Garber, at 33, is one of the Army's youngest PL–313s. His credentials include BS and MS degrees in physics from the University of Minnesota, doctorate from the University of Alabama, and post-doctoral studies at Harvard University under a Secretary of the Army Research and Study (SARS) Fellowship.

Born in Frunze, Kirghizia, in Soviet Central Asia, Dr. Garber has completed the U.S. Army Infantry Officers Leadership Course and also the Airborne Course at Fort Benning, Ga., and the Armor Officers Course at Fort Knox, Ky. He commanded an armored personnel carrier platoon with the 58th Mechanized Infantry, responsible for demonstrating armor-infantry tactics at Fort Benning.

As assistant director of the Stanford Research Institute element at Huntsville, Ala., from April 1968 through March 1971, he supervised and conducted supporting research programs in the area of guidance and control systems design and optimization.

Dr. Garber also was charged with SRI studies in air defense systems, helicopter armament, and the Pershing and Jupiter missile systems. He was a research physicist with the Army Missile Command (1961–68), Huntsville. In addition to about 50 technical reports, he has authored a 1968 book titled *Topics in Fields and Solids* and numerous articles in professional journals.

Morton Stromberg was appointed to a newly created GS–15 position as general engineer in the Topographic Sciences Branch, Environmental Sciences Division. In May 1967 he was selected for an Army R&D Achievement Award, as a member of a 5-man team at the U.S. Army Engineer Geodesy, Intelligence and Mapping Agency, Fort Belvoir, Va.

Stromberg was credited with a significant contribution to a 6-year, multimillion dollar project that produced three Universal Automatic Map Compilation Equipments (UNAMACE), the first automated high-speed stereocompilation instruments of their kind.

Graduated from City College of New York in 1957 with a degree in civil engineering, Stromberg served a year in the Army before he joined the professional staff of the U.S. Army Topographic Engineer Laboratory. A project engineer until 1968, he has since served as a technical operations officer, responsible for developing and managing R&D programs.

Col Robert E. Ingalls, promoted to that rank June 15, was assigned June 1 as the chief of the Research Programs Office, following duty since July 1970 as a staff officer in the Programs and Budget Division.

Col Ingalls was chief, Manpower and Organization Branch, Office of the Joint Chiefs of Staff, for a year following 1966–67 duty in Vietnam as a battalion commander, 1st Infantry Division. In 1965–66 he was a staff officer in the Management Office, Office of the Deputy Chief of Staff for Logistics. He has served in the Office of Personnel Operations, HQ DA, and as chief, Plans and Projects Division, Quartermaster Branch, OPO.

Graduated from the University of Rhode Island with a BS degree in industrial engineering, he received an MS degree in the same field from Ohio State University. Col Ingalls has graduated from the Industrial College of the Armed Forces and the Army Command and General Staff College.

Col Ingalls' military honors include the Legion of Merit, Bronze Star with 2 OLCs, Air Medal with 3 OLCs, Joint Service Commendation Medal and Army Commendation Medal (3 OLCs).

Lt Col Donald W. Pulsifer, who had served as chief of the Research Programs Office since June 1969, has a new assignment as executive to Director of Army Research Brig Gen George M. Snead Jr.

Graduated from Harvard Business School with a master's degree in 1969, Col Pulsifer has a bachelor's degree from Norwich University. (His biographical sketch was carried in the August-September 1969 edition.)

Lt Col John N. Albertson concludes a 3-year OCRD tour, the past year as executive to General Snead, for a new assignment in August with the U.S. Army 9th Medical Laboratory in Vietnam.

Elected as a Fellow of the American Association for the Advancement of Science in 1970, in recognition of his research and administrative contributions to science, he will be a consultant in microbiology and infectious diseases for the theater.

Col Wallace H. Hubbard, acting chief of the Environmental Sciences Division since Dr. Leonard S. Wilson died in December 1970, will take over July as chief of the Laboratory Review Office under the Director of Army Research. *Col Robert B. Bennett*, who became the first incumbent of that office in 1970, retired to end a 29-year military career.

Col Hubbard returned for his third tour of OCRD duty in 1970 after serving in Vietnam as operations chief, J3, HQ U.S. Military Assist-

(Continued on page 42)

Maj Gen Coffin Assigned as Deputy Director, ODDR&E

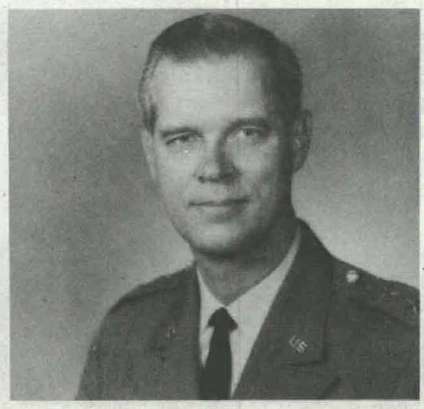
Selected for assignment as Deputy Director (Administration, Evaluation and Management), Office of the Director of Defense Research and Engineering, Maj Gen Robert E. Coffin is nominated for 3-star rank when he assumes that title this summer. A firm date has not been announced.

General Coffin was Deputy Chief of Research and Development, Department of the Army, from September 1967 until he departed in March 1969 for his current assignment as CG, Southern European Task Force, Vicenza, Italy.

Until assigned as DCRD, he was chief, Nuclear Activities Branch, Supreme HQ Allied Powers Europe (SHAPE) for more than two years. He also served in the Office of the Chief of R&D, HQ DA, as chief of the Atomic Division in 1955 and later as chief, Missiles and Space Division.

In 1959 General Coffin was G–3 at HQ SETAF and in 1960 was assigned as commander of the First U.S. Army Missile Command in Italy. From 1961 to 1963 he was chief of the Plans, Operations Division, HQ U.S. Army Europe and then assistant chief, Operations, USAREUR, Heidelberg, Germany. He served the following two years as assistant commander of the 2d Infantry Division, Fort Benning, Ga.

The general began his military career as a second lieutenant in the 3d Infantry Division following graduation from Stanford University in 1939. He served in North Africa and in the European Theater of Operations during World War II. He is a graduate from the Command and General Staff College, Armed Forces Staff College, and the National War College.



Maj Gen Robert E. Coffin

OCRD Announces Numerous Key Personnel Actions

(Continued from page 41)

ance Command (MACV). He was an R&D coordinator with the Combat Materiel Division (1967–69) and was with the Missiles and Space Division, 1961–64. He was executive officer, 1964–67, U.S. Army Section, Joint U.S. Military Aid Group, Greece.

Educational qualifications of Col Hubbard include a U.S. Military Academy BE degree in 1948, master's degree in mechanical engineering from the University of California in 1960. He has graduated from the Armed Forces Staff College and Army Command and General Staff College.

Lt Col Gerald G. Gibbs Jr., new chief of the Plans Division, is a 1952 graduate from the U.S. Military Academy, where he served three years as an assistant professor of mathematics. He has a master's degree in mathematics from Columbia University, and has completed courses at the Army War College and the Army Command and General Staff College.

Col Gibbs has been chief of the Army Joint Plans Branch, Plans Division, for the past year. He was commander of the 1st Battalion, 78th Artillery, 2d Armored Division at Fort Hood, Tex. (1968–69), province senior adviser at Pleiku in Vietnam (1967–68), and with the Institute of Special Studies, U.S. Army Combat Developments Command (1965–66).

Lt Col Elmer H. Birdseye concludes 3-year tour of duty as chief, Research Technology Division (and its predecessor designation) to join the U.S. Army Standardization Group, United Kingdom, with duty station in London, England. Scheduled to report in July to his new assignment, he will be the air defense and artillery representative.

Col Richard A. Rooth, who succeeds Lt Col Birdseye as chief of the Research Technology Division, has served during the past year as inspector general at the U.S. Army Training Center, Fort Bliss, Tex. He was assigned there in June 1969 as commander of the 2d Air Defense Training Battalion.

Col Rooth was with the Defense Intelligence Agency in Washington, D.C., for three years during which he was a faculty adviser and later operations officer, Office of the Deputy Commandant, Academic Affairs.

From 1965 to 1967 he was a graduate student at the University of Minnesota and has almost completed requirements for his doctorate in anthropology. He has a BA degree from the University of Nebraska and was graduated from the Army Command and General Staff College in 1965.

After serving three years (1960–63) with the U.S. Army Artillery Board as a project officer on the Honest John and Little John missiles, he was assigned to IV Corps, Military Assistance Command, Vietnam as a civil affairs adviser.

Lt Col Edward P. Lukert Jr. is newly assigned as chief of the Air Mobility Division, following a year of duty as chief, Aviation General Support Group, Weapons Systems Analysis, Office of the Assistant Vice Chief of Staff, Department of the Army.

Graduated from the U.S. Military Academy in 1951, he also has bachelor's and master's degrees in aeronautical engineering from Georgia Institute of Technology. He has completed the Army War College and the Army Command and General Staff College courses.

In 1968–69 he was assigned to the U.S. Army Materiel Command in Washington, D.C., as project manager for the Utility Tactical Transport Aircraft System (UTTAS). He was assigned to Vietnam in 1967–68 as commander of the 52d Combat Aviation Battalion and then as deputy aviation officer, HQ IFFV.

Lt Col William E. Reilly, a 1952 U.S. Military Academy graduate with a master's degree in nuclear engineering from Massachusetts Institute of Technology, became chief of the Programs Branch, Programs and Budget Divison June 30 when Lt Col Lynn R. Raybould retired.

For the past 30 months he has been senior project director, Military Engineering Systems, Engineer Strategic Studies Group, HQ DA. In 1967–68 he commanded the 326th Engineer Battalion, 101st Airborne Division in Vietnam, following a 3-year tour of duty as assistant professor, Department of Physics, U.S. Military Academy. He graduated from the Air Command and Staff College, Maxwell AFB, Ala., after serving in Korea with the 11th Engineer Battalion.

Dr. Fred Frishman achieved that coveted title in June after almost 10 years of evening study and research at George Washington University, Washington, D.C., where he has served since 1955 as an instructor and, more recently, as an assistant professorial lecturer.

Double cause for happiness came in the form of an assignment that will take him to the U.S. Army Research Office-Europe, London, England,

HDL Gains EEL in Nuclear Lead Lab Role

Transfer of control of the Electromagnetic Effects Laboratory from the U.S. Army Mobility Equipment Research and Development Laboratory to the Army's Harry Diamond Laboratories (HDL) is effective July 1.

The action is part of the continuing consolidation of Army nuclear weapons effects research and development activities under HDL control.

U.S. Army Materiel Command Deputy for Laboratories Dr. Robert B. Dillaway, in a command letter of Nov. 20, 1970, designated the HDL as "lead laboratory" for nuclear effects research and testing.

No movement of personnel or facilities is involved in the transfer of the Electromagnetic Effects Laboratory to HDL control. The EEL occupies three large buildings on 640 acres of land near Woodbridge, Va., and is staffed with about 50 scientists, engineers and support personnel.

In the future the EEL will be known as HDL Laboratory 1,000 and Ronald J. Bostak will continue as chief.

Assignment of "Lead Laboratory" responsibility to HDL for nuclear effects RD&E includes formulation, coordination, management and the conduct of a program responsive to the AMC mission. The HDL Nuclear Weapons Effects Program Office will:

- Prepare the budget and allocate the NWER Program funds.
- Review and coordinate NWER proposals.
- Provide technical assistance to commodity commands and managers in NWER evaluation.
- Prepare annually the Materiel Command's NWER 5-year test plan.
- Coordinate the AMC input to the NWER Qualitative Requirements Report.
- Review and coordinate for the AMC the NWER Qualitative Materiel Requirements, Small Development Requirements, and Qualitative Materiel Development Orders.
- Plan nuclear effects simulation facilities.
- Serve as a focal point for exchange and dissemination of NWER information and monitor technical content of the AMC program.

Ronald J. Bostak

for a 14-month tour of duty. As a mathematician, he will work with colleges and universities participating in the ARO–E program.

Dr. Frishman has served as chief of the Mathematics Branch, Physical and Engineering Sciences Division since 1952, and has achieved numerous distinctions during his career as both an Army and Navy mathematician.

Federick Jones returns to OCRD, where he worked as a contracts specialist, ARO (1967–70), to become chief, Contracts and Grants Branch, Research Programs Office. His interim supervisory assignment was with the Office of Economic Opportunity (OEO).

Jones has served with the Washington Procurement Division (WPD), Electronics Command (ECOM), with the Defense Contract Administration Services and the Air Force (1963–66); and the Field Services Division, Melpar, Inc. (1958–63).

Patrick Tunstall Jr. earned a Letter of Commendation during his first few weeks as an action officer in the Research Programs Office, in recognition of his work in preparing budget information for Congress.

Tunstall was a court reporter and office manager for the U.S. Navy (1968–71) in Norfolk, Va., where he also worked six years as a legal investigator and assistant office manager. He was a market analyst with Dun and Bradstreet (1948–61), has completed a course in programing and budgeting in the Army Finance School, and has received the Navy Meritorious Civilian Award.

Lt Col Charles W. Prime returned from duty in Korea as a battalion commander in the 2d Divison to become a staff officer in the Combat Materiel Division. He was with the U.S. Army R&D Group Europe (1967–70), stationed in Frankfurt, Germany.

Other assignments have included a 3-year tour with the U.S. Army Missile Command's predecessor organization in Redstone (Ala.) Arsenal and a 3-year tour with White Sands (N. Mex.) Missile Range.

Col Prime has a BA degree from Syracuse University, prior to four years at the U.S. Military Academy (BS degree in 1953) and a master's degree from Babson Institute.

Hugh Devlin and *John F. Day* are recent newcomers to the Information Systems Office. Devlin is assigned as a computer specialist with the ISO in the Pentagon. He has a BE degree from Johns Hopkins University, and a master's degree in operations research from George Washington University, and is doing graduate work in electronic engineering at the University of Maryland.

Preceding a 1967–71 assignment with the Systems Analysis Division, Office of the Chief of Naval Operations, Devlin was an operations test manager for seven years in the Applied Physics Laboratory, Johns Hopkins University, Baltimore, Md.

John Day is assigned as a systems analyst and is backed by experience from 1951 to 1968 as a machine records and data processing technician. For the past three years he has been concerned with field reporting and systems documentation, including regulatory documents. He is completing work for a BS degree at the University of Maryland.

Capts Kenneth C. Kvam and Leon R. Yourtee III are assigned to OCRD but will spend the next two years as research associates in nuclear physics at the Lawrence Radiation Laboratory, Livermore, Calif.

Capt Kvam was graduated from the U.S. Military Academy in 1964 with a BS degree. He has master's degrees in nuclear engineering and civil engineering from Massachusetts Institute of Technology, where he studied (1967–70) under the U.S. Army's graduate studies program.

He was a student officer at Fort Belvoir, Va. (1967–68), following tours of duty in Vietnam with the 8th Engineer Battalion, 1st Air Cavalry Division, and in Korea with the 13th Engineer Battalion, 7th Infantry Division.

Capt Yourtee graduated from the U.S. Military Academy in 1964 and received a master's degree in nuclear engineering from Massachusetts Institute of Technology in 1970 after studying there three years. He completed a tour of duty in Vietnam in March 1971, serving first as an engineer battalion commander and then as a ground surveillance officer.

Col Clarkson Takes Command of Army LWL

Rapid response to urgent demands for new or improved items of materiel for combat in Southeast Asia is a primary mission for the U.S. Army Land Warfare Laboratory, whose new commander is exceptionally qualified by experience for his duties.

Col Richard L. Clarkson reports to the Aberdeen (Md.) Proving Ground laboratory with a background of R&D training that includes an assignment in 1969 as chief, R&D Division, Army Concept Team in Vietnam (ACTIV). He later became commanding officer of the unit.

ACTIV was established to conduct combat evaluations, perform R&D functions for the U.S. Forces in Vietnam, and provide assistance to the Republic of Vietnam forces in an advisory or coordinating capacity. Two major activities have been ENSURE (Expediting Non-Standard Urgent Requirements for Equipment) and VLAPA (Volunteer Laboratory Assistance Program Army).

Col Clarkson's series of important R&D assignments began in 1951 when he was a staff officer in the Office of the Assistant Chief of Staff, G–4—forerunner to the Office of the Chief of Research and Development.

In 1964 he was assigned for a tour of duty with the Plans Division of OCRD and later completed an assignment with the R&D Division, J–5, Joint Chiefs of Staff. Other assignments have included White Sands (N. Mex.) Missile Range; the Artillery School at Fort Sill, Okla.; Fort Bliss, Tex.; and in Alaska, Germany, Korea and Turkey.

Graduated from Wesleyan University, he has completed courses at the Command and General Staff College, the Army Strategic Intelligence School, and the Army Language School.

Among his decorations are the Legion of Merit, Bronze Star Medal, Meritorious Service Medal, Army Commendation Medal, Vietnamese Army Distinguished Service Order, Korean Distinguished Unit Citation, and various service medals.

Col Richard L. Clarkson

Army SG Creates New Directorate

Army Surgeon General Lt Gen Hal B. Jennings Jr. reorganized his staff on July 1 to form a new Directorate of Health and Environment that includes the Preventive Medicine and the Physical Standards Divisions, formerly in the Directorate of Professional Services.

Col (Dr.) Jerome H. Greenberg, MC, is Director of Health and Environment, and Col Bernard L. Goldstein, MSC, is the executive officer.

Col (Dr.) Robert W. Sherwood, MC, became chief of the Preventive Medicine Division, succeeding Dr. Greenberg. Col (Dr.) Joseph J. Bellas, MC, will continue as chief of the Physical Standards Division.

Pace Awards Honor 2 for Army-Wide Contributions

Presentation of the ninth annual Pace Awards May 7, with former Secretary of the Army Frank Pace Jr. officiating, recognized outstanding contributions to management of Army communications, and to the drug abuse prevention and control program.

James Dunn, a specialist in the Communications Systems Directorate, Office of the Chief of Staff for Communications-Electronics, Department of the Army, was cited for systematic and managerial changes in telephone communications credited with annual savings of millions of dollars.

The citation also acclaimed Dunn for making improvements in telephone service to Army barracks, thereby contributing to the Army-wide effort to enhance attractiveness of service life.

Lt Col William B. Holden received the Pace Award in recognition of his contributions to development of the Army's drug abuse prevention and control program while serving as the principal staff officer of a group in the Military Personnel Policies Directorate, Office of the Deputy Chief of Staff for Personnel. Graduated from the Military Academy in 1952, he has served in Korea, France, Vietnam and in Continental U.S. assignments.

Created in 1963 by members of the Army Secretariat who had served with him while he was Secretary of the Army, the Pace Award consists of a plaque and a marble desk set. Recipients must have accomplished a task which significantly benefits the Army through an improvement in service, a financial saving, or a technological development.

AMMRC Investigates Qualities Of High-Output Magnets

Initiation of a program to investigate the properties of high-performance permanent magnets, including effects of stress under certain operational conditions, has been announced at the U.S. Army Materials and Mechanics Research Center.

The theoretical limit for iron-based alloys is estimated at about 100 MGO, but centuries of development have produced only about 8 MGO. These iron alloys also have been useless in highly demagnetizing operations where the available materials have been PtCo (high priced) or ferrites with a lower energy product.

In view of these facts, the development of $SmCo_5$ magnets, with an energy product of 18 MGO compared to a theoretical value of 23—also usable in completely demagnetizing configurations—is regarded as an important breakthrough.

Considerable additional knowledge about the properties of these newer type magnets is required, however, before they can be utilized to their potential in Army applications. For example, nothing is known at present about their response to stress, such as might be found in a high-speed generator.

Optimum processing for a magnet that has to withstand appreciable stress may be considerably different than for one which does not. Thus it is important to understand the relationship of preparation conditions to both the magnetic and mechanical hardness.

The AMMRC research program will seek definitive answers to some of the problems of these relationships.

Franz Coordinates APG-Edgewood Consolidation

Special assistant to the commanding officer of Edgewood (Md.) Arsenal is Lt Col Robert Francis Franz Jr.'s new title, a "trouble shooter" assignment in which he will be the coordinator for the pending Aberdeen-Edgewood Proving Ground consolidation.

Upon completion of the merger in July, he will enroll as a student at the Industrial College of the Armed Forces, Fort McNair, Washington, D.C. He returned recently from a one-year tour as chief, Chemical Branch, Office of the Assistant Chief of Staff, Operations, Military Assistance Command, Vietnam.

Col Franz, a member of the Army R&D Specialist Program, served from 1964 to 1968 in the Office of the Chief of R&D, HQ DA, the last two years as chief, Chemical-Biological Branch, Nuclear, Chemical and Biological Division. He then became director, Defense Development and Engineering Laboratories at Edgewood.

Lt Col R. F. Franz, Jr.

His academic background includes a BS degree from Xavier University (1951), MS from the University of Wisconsin (1956), completion of the Chemical School Advanced Course, the Chemical-Biological-Radiological Weapons Orientation Course, and the Command and General Staff College.

Among his military honors are the Legion of Merit, Air Medal, Meritorious Service Medal, Joint Service Commendation Medal, and the Army Commendation Medal (w/two OLC). He qualified for the Combat Infantryman Badge.

CONTINUING EXPANSION OF INTEREST in scientific research at the United States Military Academy at West Point, N.Y., is being evidenced in numerous ways. Wayne S. Anderson, chief, Propulsion Systems Laboratories, U.S. Army Tank-Automotive Command, addressed cadets in mid-May on "Pollution and Thermodynamics in Army Engine R&D." He reported on TACOM's hybrid-engine program to reduce air pollution from vehicle exhaust gases and also to improve fuel economy. (See March 1971 *Army R&D Newsmagazine* for complete report on this program.) Cadets shown here are enrolled in basic or advanced thermodynamics courses. (Left to right are George W. Heyworth, Edmonds, Wash.; Mr. Anderson; Guy H. Richardson, Poplar Bluff, Mo.; Ray E. Ward, Bozeman, Mont.; and Lt Col Joseph A. Shea, an assistant professor in physical sciences, USMA.

TRICAP Division Formed as Experimental, Test Unit

Formation of the 1st Cavalry Division TRICAP (Triple Capability—Armor/Airmobile Infantry/Air Cavalry) is scheduled by mid-1971, using assets of the 1st Armored Division.

Secretary of the Army Stanley R. Resor announced that the colors of the 1st Armored Division will be transferred to Europe, displacing those of the 4th Armored Divison, whose colors will be inactivated.

Consisting of an armored brigade, an airmobile infantry brigade and an air cavalry combat brigade, and necessary combat support and service units, the TRICAP Division will be an experimental and test unit.

The division will test combined armor, airmobile and air cavalry organizations, develop concepts and tactics for employment of these units, and use materiel currently being field tested. This will be the first major experiment with new materiel, tactics, techniques and doctrine involving Army air mobility since the 11th Air Assault Division was tested in 1963 and 1964.

TRICAP testing will be done under the management of the director of Project MASSTER (Modern Army Selected Systems Test, Evaluation and Review), a special project begun in October 1969 to test doctrine, concepts and materiel that might be used on future battlefields.

TRICAP organization and structure of the armored brigade, airmobile brigade and support units will be similar to those in other active divisions. The air cavalry combat brigade will be a new organization, eventually consisting of an aerially mounted, combined arms team of attack helicopters (capable of destroying tanks day or night); air cavalry; airmobile infantry; signal; engineer; and selected combat service support units organized for independent operations.

Throughout the formation and testing period, personnel and equipment of the unit will be maintained at a high state of readiness so that the division can meet NATO or other worldwide commitments.

The TRICAP Division is flying the colors of the 1st Cavalry Division which were returned from Vietnam.

Christie Raised to Deputy ASD (Systems Analysis)

Promotion of Dr. John D. Christie to Deputy Assistant Secretary of Defense for Systems Analysis, General Purpose Programs, Office of the Secretary of Defense, has been effected.

The assignment gives him over-all responsibility for the need for general-purpose forces and weapons systems—including Army and Marine Corps land forces, tactical air power (both sea and land-based), antisubmarine warfare, amphibious forces and other Navy forces, and mobility forces.

Dr. Christie has been with the Systems Analysis Office since 1966, as a staff member in 1966–67 and, from 1967–71, as Director of the Nuclear Weapons, Command and Control Division. The strategic command and control function was added in 1969.

Prior to joining the Office of the Assistant Secretary of Defense for Systems Analysis, he was a member of the technical staff at the Bell Telephone Laboratories, Whippany, N.J.

Born in 1937, he attended the Massachusetts Institute of Technology from which he received his BS (1959), MS (1960) and ScD (1964) degrees in mechanical engineering. He is a member of the Pi Tau Sigma, honorary mechanical engineering fraternity, and Sigma Xi, scientific honorary society.

Dr. John D. Christie

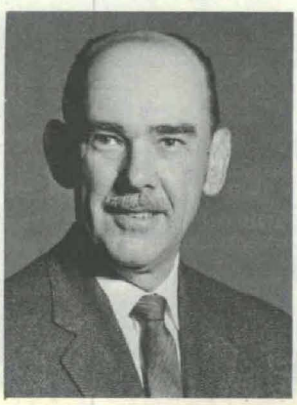
Rafert Named Deputy Research Director at RIA

Col Walter E. Rafert (USA, Ret.) has been named deputy director, Research Directorate, the Army Weapons Laboratory, Rock Island, Ill., has announced.

Immediately prior to his retirement from active duty he was the first commanding officer of the U.S. Army Small Arms Systems Agency and was awarded the first Oak Leaf Cluster to the Legion of Merit for his achievements. He was awarded the Legion of Merit for service as deputy director of Developments, Office, Chief of Research and Development, Department of the Army, in 1968.

Graduated from Purdue University with a degree in mechanical engineering (August 1943), Stanford University awarded him an MSME degree in 1949 and a degree in mechanical engineering in 1950. He studied operations research at American University, Washington, in 1964–65.

While assigned as the assistant professor of Ordnance (1956–60) at the U.S. Military Academy, he authored the text, "Elements of Armament Engineering." He is a member of the American Institute of Aeronautics and Astronautics and the American Society for Engineering Education.



Col Walter E. Rafert (USA, Ret.)

Army QRI Managers Review Program Results at USARO

Qualitative Requirements Information (QRI) Program results, procedures and objectives were reviewed June 15–16 at the U.S. Army's second annual meeting on this subject.

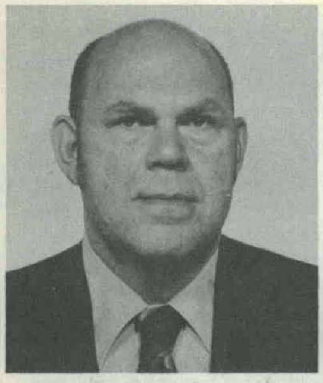
More than 30 QRI managers at Army installations and other related procurement personnel dealing with Bidder's Mailing Lists information participated in discussions at the U.S. Army Research Office, Washington.

Army Regulation 70–35 designates the U.S. Army Materiel Command as the proponent command to establish Army-wide QRI procedures. H. L. Mourning, AMC QRI coordinator, and James G. Peirce, Frankford Arsenal QRI data files officer, was cochairman.

QRI managers reported on progress during FY 1971 at their installations. Registration procedures were considered in use of DD Form 1630 (R&D Capabilities Index) and its interface with the QRI Program.

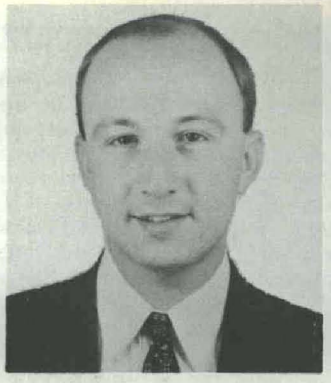
Harold Davidson, Office of the Chief of Research and Development Advanced Planning Information Program action officer, reported on results of the OCRD survey of the QRI Program. Army Director of Research Brig Gen George M. Snead Jr. has approved the report for presentation to Chief of R&D Lt Gen William C. Gribble Jr. in July.

Two working groups were formed to review DA Pamphlet 70–20, QRI Managers Guide, and draft DAP 70–20–1, QRI Managers Guide to Automated Procedures for the QRI Data Bank (RODATA). They will provide recommended revisions.



Robert M. Rosen

Truxton R. Baldwin



Curtis L. Mills

Lowell H. Barnett

ODCSPER Selects Civilians for Service Colleges

The Office of the Deputy Chief of Staff for Personnel (ODCSPER), Training and Development Division, has announced selection of eight Army civilians to attend senior service colleges during the 1971–72 school year.

NATIONAL WAR COLLEGE (NWC), Fort McNair, Washington, D.C. This course is conducted to enhance the preparation of selected personnel of the Armed Forces and State Department for the exercise of joint and combined high-level policy, command and staff functions; also, for the planning of national strategy.

NWC selectee *David C. Hardison* has been serving since 1964 as scientific adviser to the commanding general of the U.S. Army Combat Developments Command (CDC), Fort Belvoir, Va.

He served at the U.S. Army Ballistics Research Laboratory (BRL), Aberdeen Proving Ground, Md., since 1951 when he obtained a master's degree in mathematics from Duke University. He earned his bachelor's degree in mathematics from Atlantic Christian (Wilson, N.C.) College in 1949.

Hardison was recognized for his work in the field of armored weapons systems at BRL through an Army R&D Achievement Award in 1963. He received the Robert H. Kent Award and the Meritorious Civilian Service Award in 1964. He was awarded the Exceptional Civilian Service Award, the Army's top civilian employe award, in 1968 for his work at CDC.

INDUSTRIAL COLLEGE OF THE ARMED FORCES (ICAF), Fort McNair, Washington, D.C. Operated as a joint educational institution for the Armed Forces under direction of the Joint Chiefs of Staff, the ICAF is acclaimed as the capstone of the U.S. military education system in management of logistical resources for national security.

Army selectees among the 180 Department of Defense pesonnel who will attend the next course include:

Truxton R. Baldwin is chief, Technical Management Division, Office of the Advanced Aerial Weapons Systems Project Manager, U.S. Army Aviation Systems Command (AVSCOM), St. Louis, Mo.

Baldwin is backed by 18 years experience with the U.S. Air Force and the U.S. Army in engineering management of rotary-wing aircraft systems. Currently he serves as the Army technical director for the AH–56A Cheynne and the AH–1G Cobra weapon systems.

He has a BS degree in engineering from Yale University (1951) and is pursuing graduate studies in R&D management at the American University Center for Technology and Administration.

Lowell H. Barnett is chief, Vehicular Components and Materials Laboratory, U.S. Army Tank-Automotive Command (TACOM), Warren, Mich.

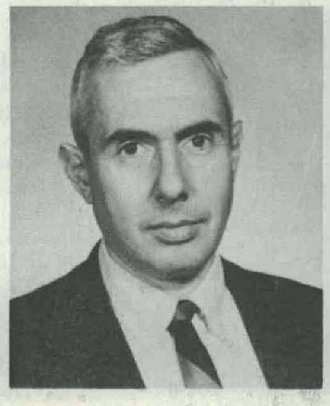
Barnett's responsibilities include full-line authority for the direction of a laboratory engaged in a scientific and engineering program. He is concerned with research, development and production engineering of mechanical, hydraulic and electrical components for tactical and logistical vehicles.

Graduated with a BS degree in mechanical engineering from the University of Illinois (1949), he earned a master's degree in industrial engineering from Wayne State University (1967). He has done graduate work at Catholic and George Washington Universities.

Marvin E. Chapman is chief, Career Management Division, Office of Civilian Personnel, Office of the Deputy Chief of Staff for Personnel (ODCSPER), Department of the Army, Washington, D.C.

Chapman began his Army career in 1942 and served 23 years with the Office of Civilian Personnel, HQ

Marvin E. Chapman



Seymour Gordon

David C. Hardison

Valcris O. Ewell Jr.

Third U.S. Army, Fort McPherson, Ga. He received the Meritorious Civilian Service Award for his effective leadership.

In 1965 he became chief, Employe Staffing and Employe Relations Branch, HQ U.S. Army Area Command, Munich, Germany. He was promoted to civilian personnel officer, South Bavaria District, Munich, and served three years.

Chapman earned a BS degree in personnel administration from the University of Georgia (1952) and did graduate work in industrial management at Georgia Institute of Technology.

Seymour Gordon is chief, Missiles Branch, Maintenance Directorate, U.S. Army Materiel Command (AMC) Headquarters, Washington, D.C. He is responsible for planning, programing, establishing policies, and analyzing execution of worldwide maintenance of U.S. Army missile materiel.

From 1958 to 1969, he served in a supervisory capacity in R&D configuration management, engineering, and logistic support elements at the U.S. Army Missile Command, Redstone Arsenal, Ala. He was employed in a supervisory position with the Ordnance Corps at Raritan Arsenal, Metuchen, N.J., from 1949 to 1958.

Gordon holds a bachelor's degree in electrical engineering from Cooper Union (N.Y.) School of Engineering (1949) and is working toward a master's degree at George Washington University.

Robert M. Rosen has been employed since 1967 as a missile materiel acquisition specialist in the Office of the Assistant Secretary of the Army (Installations and Logistics), Washington, D.C. He has held key positions involved with the guided missile program while employed with the Army Materiel Command and with the Office of the Chief of Ordnance.

Rosen obtained a BS degree in business education from New York University (1950) and has completed courses in business administration at George Washington University. He is a veteran of World War II, with overseas duty in Europe as an Army Ordnance bomb disposalman.

THE ARMY WAR COLLEGE, Carlisle Barracks, Pa., provides the final stage of Army professional education for selected officers and civilians within the Department of Defense, and is regarded at the same level as the NWC and the ICAF.

Valcris O. Ewell Jr. is serving as deputy project manager, Heavy-Lift Transport Aviation Systems, U.S. Army Aviation Systems Command (AVSCOM), St. Louis, Mo. He was a procurement and production officer with the Advanced Aerial Fire Support System (AAFSS) Project Manager Field Office (1965–67) subsequent to three years as a contract negotiator/specialist with AVSCOM.

Ewell attended Prairie View (Tex.) A&M College before he received his BA degree from Bishop College, Dallas, Tex., in 1953. He has done postgraduate work at St. Louis University and at the University of Oklahoma.

Curtis L. Mills has been serving since September 1964 as foreign affairs officer, Office of the Deputy Chief of Staff for Military Operations (ODCSOPS), Washington, D.C.

He has an AB degree in political science (1949) and an MA degree in international relations (1950), both from Marshall University, Huntington, W. Va.

Highlights of his career include positions as statistical assistant, Department of Labor, Washington, D.C. (1950–51); foreign affairs officer, Department of State, Washington, D.C. (1951–56); second secretary and vice consult, American Embassy, Tokyo, Japan (1956–59); consul American Consulate, Brisbane, Australia (1959–64); and international relations officer, Department of State, Washington, D.C. (1964).

JSH Symposium Accents Creative Thinking

(Continued from page 31)

S. Barth, director, Bureau of Criteria and Standards, Federal Air Pollution Control Office, and Lt Col Shea, USMA Department of Mechanics.

Dr. John W. Shrum moderated the panel on "Drug Abuse." He is professor of science education at the University of Georgia. The speakers were Dr. Norman J. Doorenbos, chairman of the Department of Pharmacognosy and professor of medicinal chemistry and pharmacognosy, School of Pharmacy, University of Mississippi (Oxford).

"Humanities in the Computer Age" was moderated by Dr. Sherwood Githens, professor of science education at Duke University, Durham, N.C., who made a presentation along with Prof. Richard T. Scanlon, professor of classics, University of Illinois.

Dr. Robert B. Gaither, Department of Mechanical Engineering, University of Florida, moderated the panel on "Emission Control in Internal Combustion Engines." Speakers were P. E. McKee, manager, Emissions Programs, Auto Emission Office, Ford Motor Co., and Maj Karl M. Henn, USMA Department of Engineering.

"Power Sources of the Future" was moderated by Dr. Roscoe F. Ward, assistant dean, School of Engineering, University of Massachusetts. Presentations were offered by Dr. Leonard Geller, vice president of research, S. M. Stoller Corp., and Lt Col David Wheeler, USMA Department of Engineering.

During their 2-day stay the JSHS participants were privileged to spend considerable time with the cadets, while eating in the West Point Army mess and on tours of USMA laboratories. Their association with "the Nation's Finest" young men obviously impressed the visitors deeply, as did a full-dress parade.

Religion as an influence in the lives of cadets was brought home to the visitors during a tour of the beautiful West Point Chapel. "Completely enthralled" describes their reaction to the inspiring music (also mixed in with a little improvised popular and "rock") played on the grand organ (one of the world's largest with 15,200 pipes) by John A. Davis. Organist at the Chapel for 17 years, he played for about an hour. If the students had had their way, it might have been an all-night session.

The concluding feature of the symposium was a Saturday tour of United Nations Headquarters in New York City, an experience that appeared to leave a deep impression.

Army Director of Research Brig Gen George M. Snead Jr. presided at most of the symposium sessions. Col William J. Lynch, commander of the Army Research Office-Durham, was chairman of the introductory session.

Donald C. Rollins, ARO–D director of the national JSHS program, had the big job of seeing to the requirements of the visitors. Credited with major assists were USMA representative Col John S. B. Dick and USMA project officer Maj William E. Seltz. ARO–D project officer was John W. Jordan, administrative assistant.

* * *

So much knowledge has been forthcoming in the behavioral sciences over the past two decades that in the seventies the matter of personal and institutional change has at last moved into the position of a legitimate science with its own technology. If so much is known and useful, why is it that development activities are not finding their way more rapidly into the bloodstream of society?

Robert R. Blake,
President of Scientific Methods, Inc.

Kudos

EXCEPTIONAL SERVICE. *Dr. Charles F. Pickett* was posthumously awarded the Department of the Army Decoration for Exceptional Civilian Service. It recognized his scientific accomplishments as former director of the U.S. Army Aberdeen Research and Development Center (ARDC) Coating and Chemical Laboratory, Aberdeen (Md.) Proving Ground.

Signed by Secretary of the Army Stanley R. Resor, the DECS citation was presented to Dr. Pickett's widow by Brig Gen Charles D. Y. Ostrom Jr., CG of the U.S. Army Ordnance Center and School and former CG of the ARDC.

The Decoration for Exceptional Civilian Service was awarded recently to *John E. Harris*, materiel program officer, Materiel Directorate, HQ Combat Developments Command (CDC).

Lt Gen John Norton, CG, Combat Developments Command, presented the award to Harris for his exceptionally outstanding achievements as chairman of the Joint Combat Developments Command/Army Materiel Command Ad Hoc Board on Materiel Development Objectives/Requirements Documentation.

MERITORIOUS CIVILIAN SERVICE. The Army's second highest commendation for a federal service employe was presented recently to *Marvin P. Carroll*, electronics engineer in the TOW Project Office.

Maj Gen Edwin I. Donley presented the Meritorious Civilian Service Award to Carroll, praising his unusual initiative and engineering skill. He specifically cited Carroll's work in modifying TOW missile training devices.

Leonard S. Croan, materiels engineer, HQ U.S. Army Materiel Command (AMC), and *Harold Markus*, metallurgist, Frankford Arsenal, recently received Army Meritorious Civilian Service and Special Achievement Awards.

During the same ceremony at HQ AMC, *Alois J. McDonald*, former president of the Steel Founders' Society of America, was awarded the Department of the Army Outstanding Civilian Service Medal.

AMC Chief of Staff Maj Gen C. T. Horner Jr. commended the recipients for promoting meaningful cooperation among Army research, U.S. industry and our allies abroad.

Miss Marilyn Levy, an internationally recognized expert in photographic research, was recently presented the Meritorious Civilian Service Award by Col James H. Davis, commander and director of the Combat Surveillance, Target Acquisition and Systems Integration Laboratory, Army Electronics Command.

Miss Levy is head of the Unconventional Color Techniques Team in the Photo Optics Area of the Army Electronics Command's Combat Surveillance, Target Acquisition and Systems Integration Laboratory.

OUTSTANDING Handicapped Federal Employee of 1970, Miss Alice Chancellor, a multiple amputee blind in one eye since a childhood accident, receives congratulations from First Lady Mrs. Richard M. Nixon at ceremonies in Washington, D.C. An Army Materiel Command electronics engineer employed at Fort Huachuca, Ariz., Miss Chancellor was selected from among 10 federal agency finalists. She was named Department of the Army Handicapped Employee for 1970 on Mar. 24, making her eligible for the federal award, sponsored annually by the U.S. Civil Service Commission (see March edition of *Army R&D Newsmagazine*, p. 15).

LEGION OF MERIT. *Maj Gen Edward H. deSaussure Jr.*, CG of the White Sands (N. Mex.) Missile Range, recently received the first Oak Leaf Cluster (OLC) to the Legion of Merit (LOM). Maj Gen Frank M. Izenour, TECOM CG, presented the award during the U.S. Army Test and Evaluation Command (TECOM) Commanders Conference at Aberdeen Proving Ground, Md.

General deSaussure was cited for exceptionally meritorious service as CG of Task Force Eight and the Test Command at Sandia Base, N.Mex., from September 1968 to March 1970.

Brig Gen Wilbur H. Vinson Jr., Director of Missiles and Space, OCRD, was recently awarded the LOM with third OLC by Lt Gen William C. Gribble, Army Chief of R&D.

General Vinson was commended for his efforts as CG, I Corps (Group) Artillery, January 1970 to February 1971 in "command operational control, fire support coordination, and artillery fire planning for 41 U.S. and Republic of Korea artillery battalions."

The citation refers, in part, to his "leadership, professional competence, and dedication to duty," through which his units were "maintained in the highest state of combat readiness."

Col Henry T. Uhrig was awarded the LOM for outstanding service since June 1968 as chief of the Medical Research Laboratory at Edgewood (Md.) Arsenal. He was assigned recently to the William Beaumont General Hospital in El Paso, Tex.

The citation accompanying the nation's second highest noncombat decoration lauded his "efforts in resolving problems involved in the latent effects on anticholinesterase poisoning and for providing medical evaluations and support for the binary agent program."

Departing for a new assignment at HQ Third U.S. Army, *Col Thomas C. Kearns* received the LOM for his achievements at White Sands Missile Range from February 1968 to April 1971 as post engineer and director of the Instrumentation Directorate.

Col Dan Crozier, commanding officer of the U.S. Army Medical Research Institute of Infectious Diseases at Fort Detrick, Md., recently received the first OLC to the LOM. Brig Gen Richard R. Taylor presented the award and citation.

Col Crozier was commended for his work from July 1961 to October 1970 in the development and testing of vaccines, and for his role in "establishing this nation's present medical defensive posture against the threat of biological warfare."

Col Paul A. Troup Jr. was awarded the LOM for accomplishments as director of the Aberdeen Proving Ground Materiel Testing Directorate from 1967 until his recent retirement.

Maj Gen Frank M. Izenour, CG TECOM, commended Col Troup, in part, for his contributions to the "effectiveness and reliability of a wide range of DoD materiel vital to combat operations in Southeast Asia." He was further commended for his support of in-depth metholology investigations, personal interest in all phases of testing, and innovations in organization and management techniques in MTD.

Col Robert E. Cooper, MSC, was awarded the LOM prior to his recent retirement for two years of service as chief of the Class II Branch, Manpower Management Division, Army Surgeon General's Directorate of Personnel and Training.

MERITORIOUS SERVICE MEDAL. Lt Col Rocco J. Colafranesco, former chief, Support Office, Eustis Directorate, U.S. Army Air Mobility Research and Development Laboratory (AMRDL), Fort Eustis, Va., was recently presented with the Meritorious Service Medal by Col John R. Adie, commanding officer.

Lt Col Clifton A Sands, chief, Plans and Readiness Operations Office, presented *Dr. Theodore S. Echert* with a Special Act or Service Award in a recent ceremony at Edgewood Arsenal, Md.

Dr. Eckert was lauded for numerous achievements throughout 26 years of service at Edgewood. Specific achievements cited include preparation of "numerous technical committee papers of vital national importance, efficient technical committee procedures, and chemical advisory reports to key officials."

EDGEWOOD ARSENAL CITED. Edgewood Arsenal's Technical Escort Center was a recent recipient of the First Oak Leaf Cluster to the Meritorious Unit Commendation. Army Chief of Staff General W. C. Westmoreland lauded the center for exceptionally meritorious achievement from August 1966 through December 1968. During this period the center demonstrated noteworthy performance in support of Department of Defense efforts to equip and supply U.S. Forces in Southeast Asia.

ARMY COMMENDATION MEDAL. *Capt Richard S. Smith* and *Capt Harold R. Evensky*, medical officers assigned to the U.S. Army Environmental Hygiene Agency, recently received the Army Commendation Medal.

Capt Smith, a sanitary engineer, was praised for his professional capabilities in the field of water quality engineering and pollution abatement. Capt Evensky, an industrial hygiene survey officer, was lauded for successful improvement of data processing procedures and simplified calculation of ventilation rates for open surface tanks.

Lt Col Max E. Satchell, deputy director, U.S. Army Engineer Reactors Group (USAERG), presented the Army Commendation Medal to *Chief Hospital Corpsman Henry J. Magee* for meritorious service as senior instructor at USAERG, Fort Belvoir, Va.

Sp/6 Robert J. MacDonald was cited by the U.S. Army Engineer Reactors Group, Fort Belvoir, Va., for meritorious service as an operator and shift supervisor at the SM–1 Nuclear Power Plant. Col Harvey L. Arnold Jr., director of the USAERG, presented him with a Certificate of Achievement at a recent ceremony.

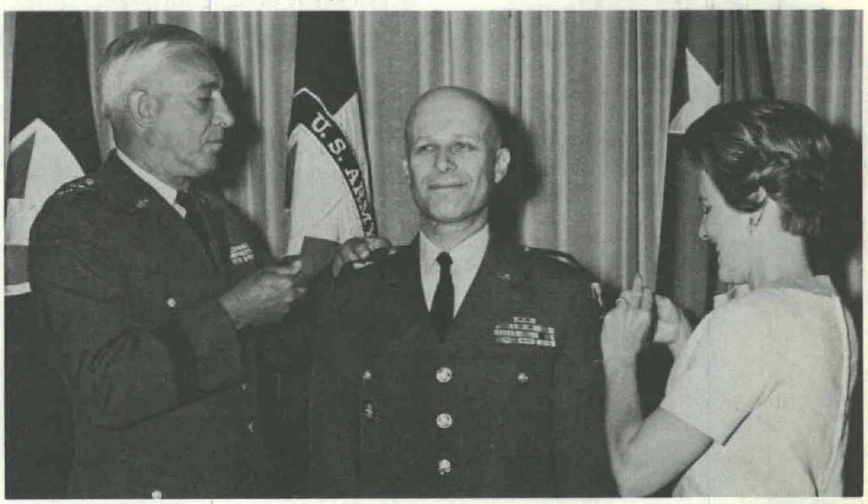
PERFORMANCE AWARDS. Col John R. Oswalt Jr., commander of the U.S. Army Engineer Topographic Laboratories, Fort Belvoir, Va., recently presented work performance awards to *James F. Tazelaar* and *Walter R. Cook*. Tazelaar received an Outstanding Performance Rating (OPR) and a Sustained Superior Performance cash award for achievements as a geologist in the Geographic Sciences Division. Cook, an intelligence research specialist, received an OPR.

Bernice M. Greene, Communications Electronics and Space Division, and *Joan M. Smith*, Air Defense and Missiles Division, Office of the Chief of Research and Development, were presented OPRs.

Maj Gen John W. Barnes, Director of Plans and Programs, OCRD, presented OPRs to *Austin L. Duncan, Albert T. Finnell* and *Catherine G. Buranitz*. Duncan also received a cash award for Sustained Superior Performance.

General Barnes also awarded *Robert J. Facey* a Commendation Certificate for Sustained Superior Performance with Quality Salary Increase. OPRs were presented to *Emma G. Robertson, Kathryn Porelle, Joyce Waller, Doris Ekstrom* and *Barbara Chambers*.

Army Director of Research Brig Gen George M. Snead Jr. recently presented OPRs to Mrs. Alice C. Arnold, Jacob L. Barber, Dr. Rudolph G. Berkhouse, John L. Cleveland, Mrs. Donna Fields, Fred Frishman, Mrs. Josephine J. Fulcher, Mrs. Maria R. Murcny, Mrs. Janice B. Sexton and Dr. Thomas E. Sullivan.



AN ENLISTED MAN TO GENERAL story climaxed June 1 when Army Missile Command CG (Maj Gen) Edwin I. Donley pinned new insignia on Brig Gen Louis Rachmeler, MICOM Deputy CG, with assistance from Mrs. Rachmeler. General Rachmeler was an enlisted man until selected to attend the U.S. Military Academy. The 48-year-old officer graduated in 1947 and has a master's degree in electrical engineering from Stanford University. He is an Army War College, and Command and General Staff College graduate.

Where We Are Heading in Army Aviation R&D

By Paul F. Yaggy

The U.S. Army Aviation research and development program has the objective of developing the technology for superior aircraft to provide the aerial fire support, supply, surveillance, command and control, and communications that are essential to intra-theater air mobility and support to ground forces.

The helicopter has provided the Army with an unprecedented mobility capability that has removed many of the communications and supply restrictions imposed by the hazards and barriers of ground routes. As helicopter and other VTOL technology is refined and improved, it is expected that these improvements will be translated directly into greater air mobility and improved quick-reaction capability.

Projections indicate that a comprehensive R&D program can produce aircraft that lift higher payloads with increased maneuverability; also, that fly faster over greater distances and under all weather conditions.

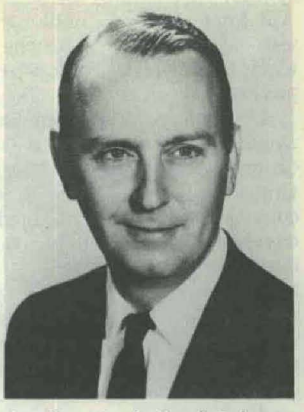
Although the specific performance requirements have not been defined for many of the proposed aircraft systems, it is, nevertheless, possible to identify the most promising concepts and the research efforts required to develop the technology base needed to support these concepts.

The concepts include advanced helicopters, compound helicopters, slowed/stowed rotorcraft, tilt rotor/prop aircraft, telescoping motor/prop, and tilt-wing V/STOL aircraft.

Army experience to date indicates that low disc loading, relatively low-speed aircraft concepts, such as these, are most likely to be able to satisfy the Army's mission requirements and live in the Army's environment. An indication of projected improved capability of advanced systems is shown in Figures 1 through 7.

For these highly advanced concepts to become effective, new technology must be investigated well in advance of the time frame of the specific aircraft development effort. Technology advances are achieved as a result of a "sequence" of R&D projects requiring a continuity of support even though considerable uncertainty exists in the long-range plans where the alternatives cannot even be foreseen.

Although the programs must be sufficiently flexible to respond to variations in the objectives of the Army's strategic operation plan, new capabilities can be obtained only through an aggressive R&D program.



PAUL F. YAGGY, technical director of the U.S. Army Aeronautical Research Laboratory (USAARL) since it was established in 1965, became director when the USAARL was reorganized late in 1970. Headquarters of the new U.S. Army Air Mobility R&D Laboratory (USAAMRDL) are at Ames Research Center, Moffett Field, Calif.

Yaggy was an aeronautical research scientist with the National Aeronautics ond Space Administration (NASA) for 19 years and has more than 25 years of federal service.

Educated at the University of Notre Dame, Taylor University and San Jose State College, he is an associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA). Serving on technical committees of the AIAA, the Society of Automotive Engineers, and American Helicopter Society, he is also a member of the Fluid Dynamics Panel of the Advisory Group for Aerospace R&D of the North Atlantic Treaty Organization and the NASA Advisory Subcommittee for Aircraft Aerodynamics.

Yaggy is the author of 16 technical papers and has been a guest lecturer at the von Karman Institute in Brussels, Belgium, the Royal Aeronautical Society in London, and Stanford (Calif.) University.

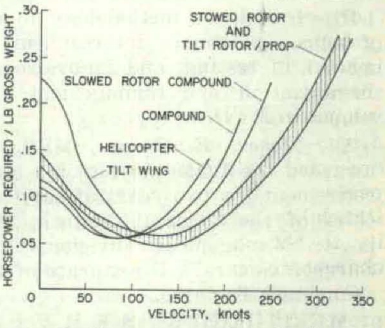


Fig. 2. Horsepower Required Per Pound of Gross Weight For Each Concept

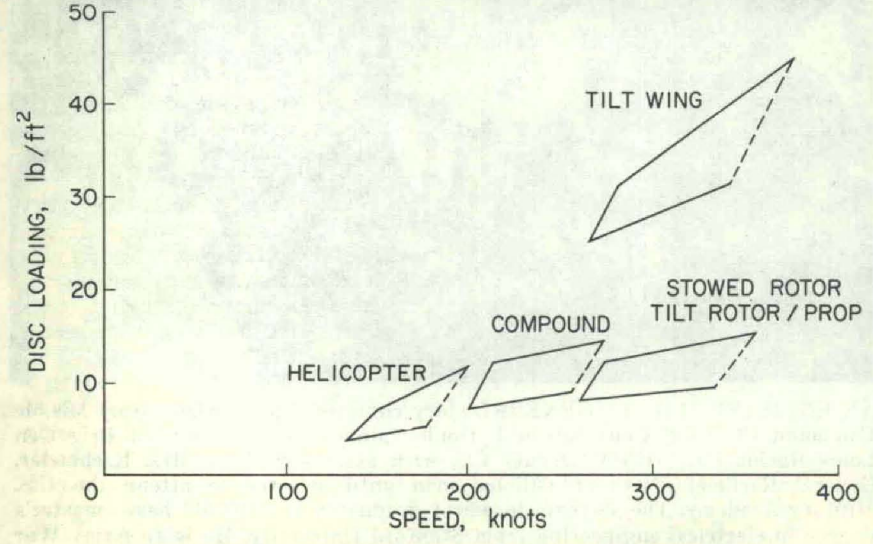


Fig. 1. Concept Speed Ranges as a Function of Disc Loading

TECHNOLOGICAL OBJECTIVES. In the category of aerial fire support, an order of magnitude increase in the combat effectiveness of current helicopter aerial weapons carriers is foreseeable by achievable increases in maneuverability, ammunition capacity, weapon accuracy and endurance.

The proposed UTTAS (Utility Tactical Transport Aircraft Systems) to replace the UH–1 series helicopters for performing the tactical-assault-supply, and command-and-control roles can be expected to provide a 50 percent increase in cruise speed at an over-all decreased total cost per combat soldier delivered.

Beyond 1975, other rotary-wing concepts could provide still further gains in both performance and reduced cost per soldier delivered, provided an adequate technology base is laid for those concepts.

For heavy-lift supply and resupply aircraft, the current technology base should be capable of supporting the

development of a 30-ton lift capacity by 1980, and an increase in cruise speeds.

Beyond 1980, technology could provide the base for a very-heavy-lift (VHL) helicopter of 40- to 50-ton payload.

Intelligence acquisition aircraft should be able to provide a battlefield commander with accurate and real-time displays in both VFR and IFR conditions, day or night. Continued development of the technologies associated with other VTOL and STOL aircraft, as well as helicopters, is needed to achieve the capability to satisfy the requirement for a tactical airlift and resupply aircraft.

The current technology base for such aircraft could produce a 30 percent increase in cruise speed if the configuration remained a helicopter. If the technology of tilt rotor/prop and stopped-rotor aircraft were adequately developed, up to 100 percent increase in cruise speed is possible.

Progress in improving performance of helicopters and other low disc loading VTOL concepts will be paced by the technological advances in the development of propulsion systems, drive systems, rotors, flight controls and materials. These must be tempered with considerations of maintainability, reliability, and survivability to achieve acceptable operational characteristics.

Concomitantly, there must be improvements in the aircraft subsystems such as avionics and weapon systems for greater reliability, higher efficiency and more capability.

Propulsion Systems. Propulsion efficiency, in the form of low specific fuel consumption together with minimum engine size and weight, is of primary concern to the aircraft designer. Introduction of the turboshaft engine provided a breakthrough in power plant size and weight, but not without some sacrifice in fuel consumption compared with reciprocating engines.

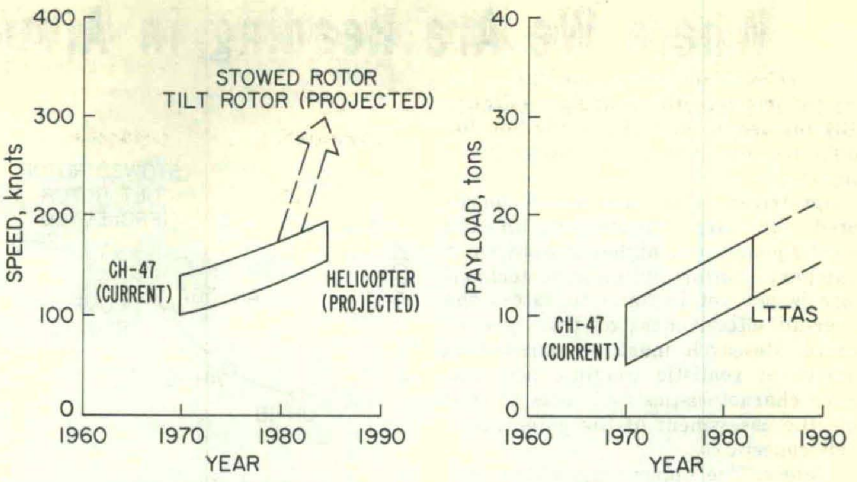


Fig. 4. Aircraft Capability Trends for Tactical Airlift (Transport)

Further improvements in engine power-to-weight ratio will depend, to a large extent, on increases in the turbine inlet temperature. This will be achieved through developments in the technology of cooling the combustion and turbine inlet sections; also, in the technologies associated with the manufacture and use of new, high-temperature materials. An indication of this potential is given in Figures 8 and 9.

Research will be directed toward further reductions in the specific fuel consumption (SFC) of gas turbine engines of the sizes required for Army aircraft. Current technology can support the development of an engine with significantly reduced total and partial power SFC. Still further reduction in SFC could be achieved through establishing the technology needed to support the development of a regenerative-cycle engine.

Maintainability and reliability are important factors to be considered in developing new engine technology. The deficiency of the turboshaft engine compared with the turboprop engine, in both maintainability and reliability, could be alleviated through research aimed at providing the design criteria and technology for future turboshaft engines. The potential improvements are indicated in Figures 10 and 11.

Drive Systems. For shaft-driven helicopters and other V/STOL aircraft, the transmission of power from engine to rotor or proprotor requires a primary subsystem contributing to the weight, cost, reliability, maintainability and survivability characteristics of the aircraft. The primary components of the transmission are the gears and bearings, and their technological advances pace those of the drive system.

Continuous exploitation of advanced technology for high-speed gears, bearings and shafts must be pursued to develop a reliable, lightweight, primary-power transmission system capable of reduction ratios which are compatible with the high rotational speeds of gas turbine engines. The potential in terms of weight is shown in Figure 12.

Although current technology has produced rotor hubs that function adequately, their complexity requires a high level of maintenance and component replacement, resulting in high operating costs and low aircraft availability.

A primary technological objective is to eliminate the need for lubricants in helicopter rotor hubs by developing bearings that can accommodate oscillating motion without sliding or rolling elements. A program has been initiated to establish the service suitabil-

(Continued on page 52)

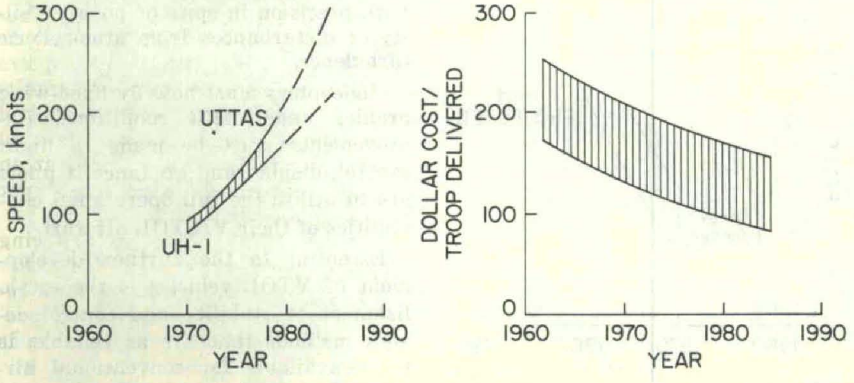


Fig. 3. Aircraft Capability Trends for Tactical Assault and Resupply

Where We Are Heading in Army Aviation R&D

(Continued from page 51)

ity of elastomeric bearings (Figure 13) for use in the UH–1 rotor hub for both flapping and pitch-change bearings.

Jet-driven rotors are being considered for large helicopters in the 80,000-pound and higher gross-weight category. Unfortunately, the technology is not yet in hand to assess the over-all effectiveness of this type of drive. Research must be pursued to arrive at realistic weights, performance characteristics and costs to enable the assessment of the potential of this concept.

Rotors. The upper limit of the helicopter speed range results from the aerodynamic anomalies experienced by the advancing and retreating blades during high-speed flight. Design of lifting rotor systems to avoid or delay these problems have, so far, yielded only limited rewards in return for substantial effort.

Analytical techniques must be developed to cope with the 3-dimensional, unsteady flow environment of the outer portion of a rotor blade. A better understanding of the boundary-layer and transonic effects leading to the proper design of the outer portion of the rotor blade could result in an increase in performance of a pure helicopter.

Although refinements in rotor design could produce significantly better performance, the pure helicopter would still be limited to relatively low flight speed. An intermediate speed range is available by resorting to tilt wing, tilt propellers, or tilt rotors, allowing an in-flight conversion from a helicopter to a fixed-wing configuration.

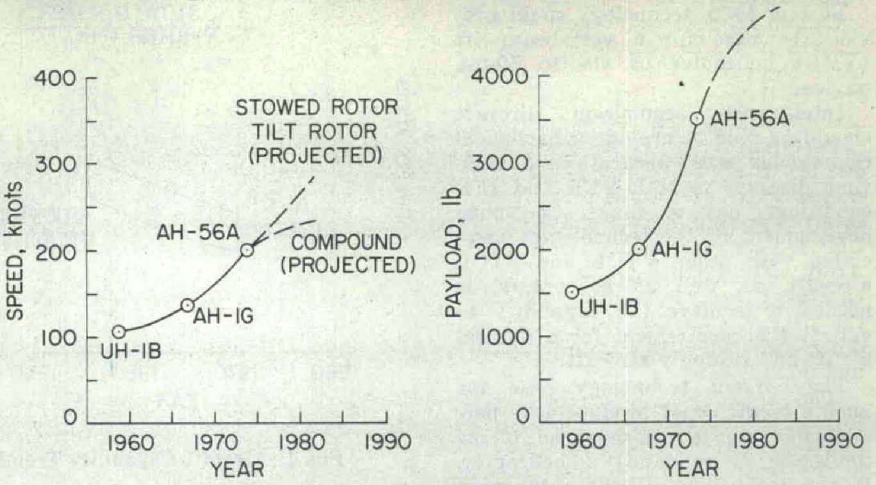


Fig. 6. Aircraft Capability Trends for Fire Support

Stopping and stowing the blades of a conventional rotor or a tilt rotor could become a reality if the dynamics of the sytem could be made to assure stable aircraft operation.

The dynamics and associated aeroelastic characteristics of rotary-wing vehicles constitute the least understood problems of these aircraft. In the past, specific dynamic instabilities have prevented new rotary-wing vehicle designs from attaining their design goals. The development of accurate prediction techniques for such instabilities is a primary objective.

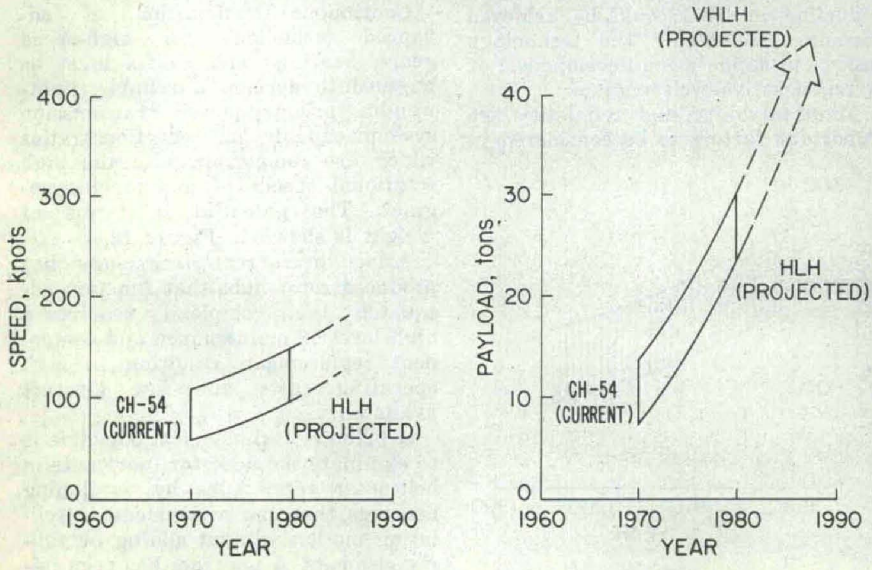


Fig. 5. Aircraft Capability Trends for Tactical Airlift (Heavy Lift Supply)

Control of the vibration levels and reduction of noise of rotary-wing vehicles are severe problems facing the designers and users of aircraft. Vibratory loads restrict many rotary-wing vehicles to operating limits considerably below their installed power capabilities. Objectives of research in the technology of rotor dynamics are reductions in the vibratory loads and the noise of rotary-wing aircraft.

Flight Controls. Among the technology areas that will pace improvements in performance of helicopters and other low disc-loading VTOL aircraft are flight controls and handling qualities. For military-type operation, the V/STOL is required to operate out of installations ranging from the large secure base to the assault zone.

Instrument landing must be possible on camouflaged strips and under blackout conditions. For V/STOL aircraft to be used effectively, it is essential that the pilot be able to execute the landing and take-off maneuvers with precision in spite of poor visibility or disturbances from atmospheric turbulence.

Helicopters must now fly fixed-wing profiles under IFR conditions. Improvements must be made in flight control, display and guidance if pilots are to utilize the full operational capabilities of their V/STOL aircraft.

Essential to the further development of VTOL vehicles is the establishment of stability and control design methods that are as reliable as those available for conventional aircraft. Stability and control characteristics of a VTOL vehicle system are critical aspects of its over-all effec-

tiveness, because control power is obtained at the direct expense of performance parameters such as payload, range, and hover time.

Currently, a large margin must be allowed in the design of a VTOL vehicle because of the low confidence level in the prediction of aerodynamic stability and control characteristics.

Performance is frequently limited due to the unsatisfactory handling characteristics of the aircraft with an externally slung load. To achieve the full load-carrying capability of future Army aircraft such as the HLH, the effects of externally slung loads on the aircraft stability, control and handling qualities must be predictable and minimized.

The capability of an aircraft to perform a given task depends upon its handling qualities. An immediate need is for improvement in the handling qualities of helicopters; also, for the establishment of handling qualities criteria for advanced helicopters and other VTOL aircraft.

Improvements to ground-based simulation of rotorcraft are being pursued to extend the present capability to study and evaluate helicopter flight dynamics. An objective of this research is to provide handling qualities criteria for the concept formulation phase that will allow the design of an aircraft highly responsive to the desires of the pilot, and one that can be flown safely with a minimum of training and effort.

Army air mobility is severely limited by what current helicopter instrumentation allows pilots to do—especially with regard to nap-of-the-earth operations. Present-day Army helicopter cockpits are characterized by a disarray of a variety of separate instruments and controls. There is little component standardization and, in general, a complete lack of adherence to well-developed standards of geometry and arrangement.

Simplicity is the key to successful displays and procedures. This means minimizing the number of displays or displayed parameters and presenting key data in a small, centralized area.

Emphasis in the Army R&D program in this technology is currently on functional evaluation of existing fixed-wing, head-up displays, flight directors, maps and navigation displays, and vertical format engine indicators to assess the practicality of adapting these devices for effective helicopter pilot use. The objective is to reduce the special hazards to helicopter pilots of spatial disorientation and low-altitude navigation.

Materials. The 1975–85 time frame offers many prospects for significant advances in materials technology if a viable research and development program is maintained. The use of composites could result in significantly more efficient and lighter aircraft structure.

With improved fiber manufacturing techniques and use of appropriate polymeric filler (matrix material), it will be possible to tailor properties of composites to meet most combinations of property requirements.

Composites can be tailored to have extremely attractive structural characteristics such as stiffness, high tensile properties and high strength-to-density ratios. They are finding uses as aircraft structural components by providing strength at reduced weight as well as providing inherent damping for reduced vibratory stresses.

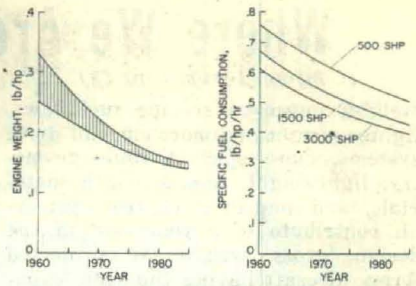


Fig. 8. Engine Weight and Fuel Consumption

Of the four major light metals, it is expected that the processing of titanium will experience the greatest technological advancement within the next 10 years. Research and development of newer, high-strength, high-toughness titanium alloys, together with improved processing, will promote greater utilization of titanium in helicopters and V/STOL aircraft structures. Galling, seizing and fretting characteristics associated with titanium alloy surfaces in sliding and rolling contact remain as major problem areas requiring further research.

The next decade will see improvements in new processing techniques for steel structures, resulting in significant increases in the usable strength of steel without loss of toughness or in improved toughness at constant strength level.

Several improvements should be realized also in aluminum technology. Higher strength alloys with improved resistance to corrosion and stress corrosion cracking will be available to the aircraft industry.

Utilization of powder metallurgy techniques in preparation of raw materials has enabled the tensile strength of aluminum alloys to break the 100,000 psi barrier with good ductility and toughness.

Cast aluminum alloys exhibiting mechanical properties equivalent to wrought products could be available for structural components such as landing gears. Improved welding techniques could make possible the joining of high-strength aluminum alloys as structural components.

Significant improvements in magnesium technology are also forecast for the next five years. Beryllium's high strength-to-density and high modulus-to-density ratios are sufficiently attractive for aircraft application to spur continued research and development programs.

SUMMARY. Such technological advances as reduced engine

(Continued on page 54)

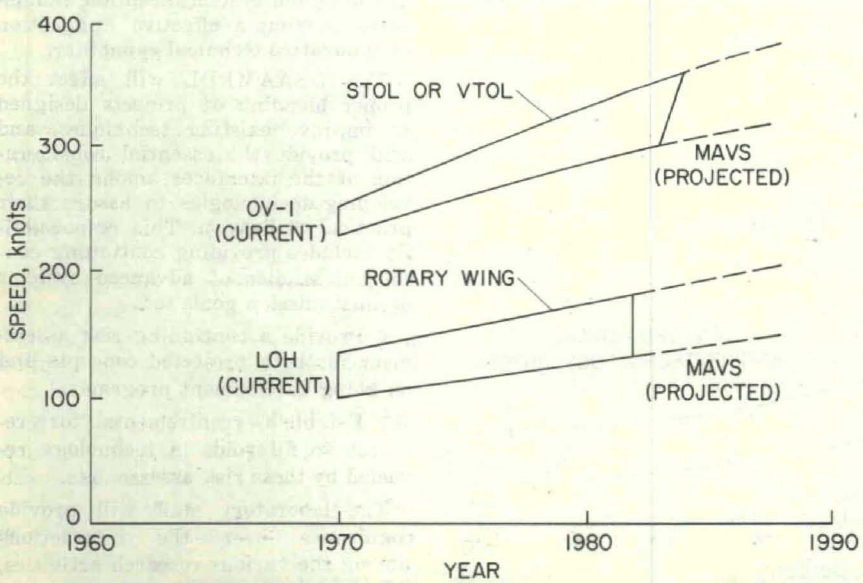


Fig. 7. Aircraft Capability Trends for Intelligence Acquisition

Where We Are Heading in Army Aviation R&D

(Continued from page 53)

weight, improved specific fuel flows, lighter weight and more efficient drive systems, more efficient rotor geometry, lightweight, high-strength materials, and improved control systems all contribute to a reduction in the design gross weight of projected Army aircraft having the same capability or effectiveness as current aircraft (Figure 14). Conversely, these advances will enable major improvement in capability while retaining a marked cost-effective advantage over present Army aircraft systems.

Over the past decade (or more), there has been a continuing effort to develop technology in support of combining the maneuverability, range and payload capabilities of the conventional aircraft with a vertical take-off-and-landing capability. However, there have been all too many examples of the waste and inefficiency that have been brought about by rushing into flight development, new designs, and even new concepts before adequate theoretical, experimental, and component research and development have taken place.

To focus and integrate the technology, it is necessary to establish research and development programs that are directed toward a well-defined objective Hence, the operational requirements, missions and goals for VTOL systems must be carefully established.

The forcing function behind the development of any system technology base is a recognized specific, defined, and accepted system need. Although the developing technologies can be expected to produce substantial gains in aircraft performance, efficiency, and servicability, significant change depends on needs and demands that are yet undeveloped. The U.S. Army Air Mobility Research and Development Laboratory (USAAMRDL) was established recently as a part of the Aviation Systems Command for the purpose of coordinating the research capabilities and focusing them upon these needs.

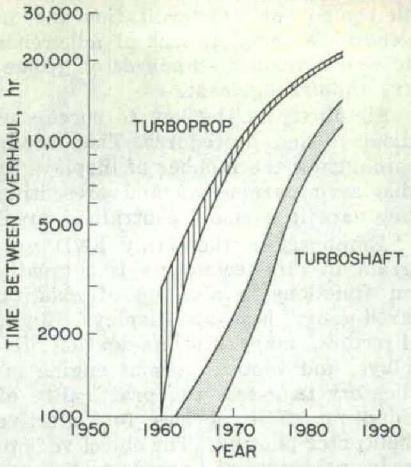


Fig. 10. Engine Maintainability Time Between Overhaul

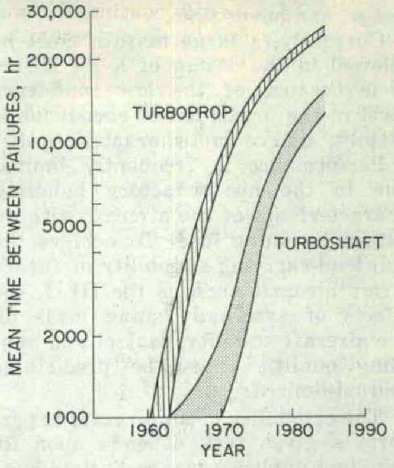


Fig. 11. Engine Reliability Mean Time Between Failures

MANAGEMENT OBJECTIVES. An objective of the new USAAMRDL is to provide the unified direction, coordinated performance and maximum exploitation of a comprehensive program. This effort extends from research and experiments concerned with the development of a particular technology to hardware demonstration in components and prototype aircraft which establish the feasibility of these new technological concepts.

The USAAMRDL staff manages and executes the basic research and exploratory development programs of the Aviation Systems Command (ASC). In conjunction with the ASC Deputy for Research, Engineering and Data, the laboratory manages, as assigned, selected portions of the advanced engineering and engineering development programs in support of project managers.

This centralized guidance assures consideration of requirements from the point of view of their total integration from system inception and assures maximum effective application of innovative technical capability.

The USAAMRDL will effect the proper blending of projects designed to improve existing techniques, and will provide the essential consideration of the interfaces among the developing technologies to assure their practical utilization. This responsibility includes providing continuing conceptual studies of advanced systems against mission goals to:

- Provide a continuing risk assessment for both projected concepts and on going development programs.
- Establish requirements for research to fill voids in technology revealed by these risk assessments.

The laboratory staff will provide cognizance over the interactions among the various research activities, the Army's developmental programs, and the mission requirements that are

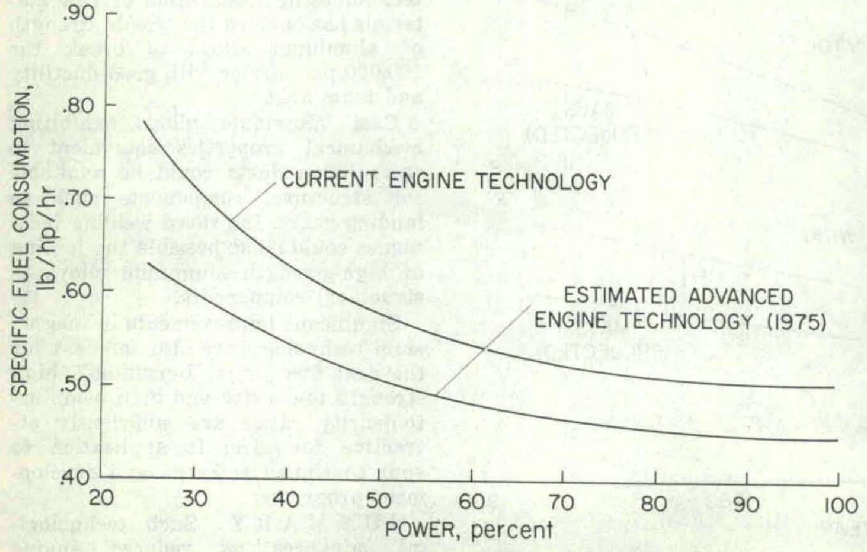


Fig. 9. Specific Fuel Consumption at Partial Power

essential to the establishment of relevance and priority.

By maintaining a continual monitoring of technological opportunities and breakthroughs, of threat variations and disturbances, of timing of payoffs from development activities, and of fiscal resource availabilities, this laboratory will be able to identify the most pressing areas of need for new technology. System development managers and system analysts will be kept informed of what new technology to expect and when in efforts to meet future systems requirements.

USAAMRDL key staff members maintain a close liaison with industry, with the academic and scientific community, with Army project managers and with other Aviation Systems Command elements and with other pertinent Army elements. Liaison is also maintained with the Air Force and the Navy.

One of the unique aspects of the laboratory is that three of its directorates are collocated with NASA research centers and function under the terms of NASA-Army agreements for joint participation with the NASA organization at each of these locations.

A November 1969 agreement between the Army Materiel Command and the National Aeronautics and Space Administration provides for joint use of existing NASA test chambers, wind tunnels and other facilities by scientists and engineers of the two agencies for conducting aeronautical research.

Programs are negotiated jointly by Army managers with NASA managers on a center-wide basis for Army requirements. This arrangement provides for maximum return on the investments of the resources of both agencies; also, for the immediate response of NASA expertise to Army problems, and vice versa, when appropriate on a daily basis.

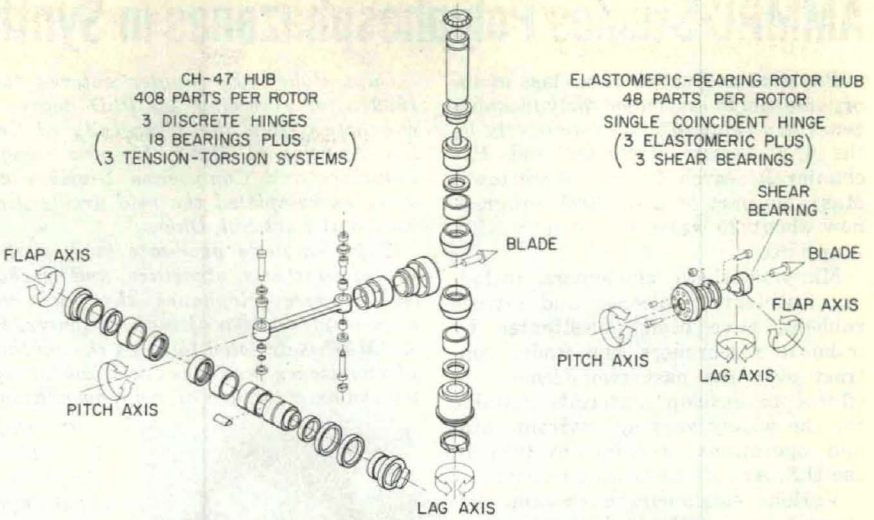


Fig. 13. Comparison of Rotor Hub Lubrication Components

The organization of the Air Mobility R&D Laboratory is expected to result in a major addition to the Army's capability for establishing definitive plans for research and development programs directed toward improved Army aircraft. Long-range planning is vital in all aspects of Army management, but in the research and development field it has become critical.

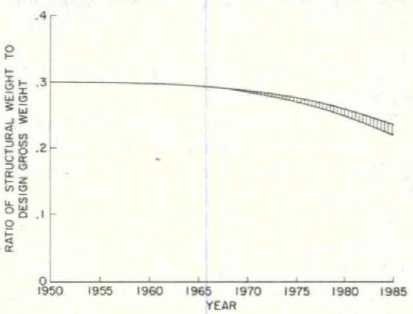


Fig. 14. Trend of the Ratio Of Structural Weight To Design Gross Weight

While long-range plans will not, in themselves, insure success, failure to develop such plans will certainly result in the lack of a truly responsive and relevant aviation research and development program. Unnecessary R&D duplication of effort, items of marginal benefit and items for which there is no requirement must be eliminated—now and in the future.

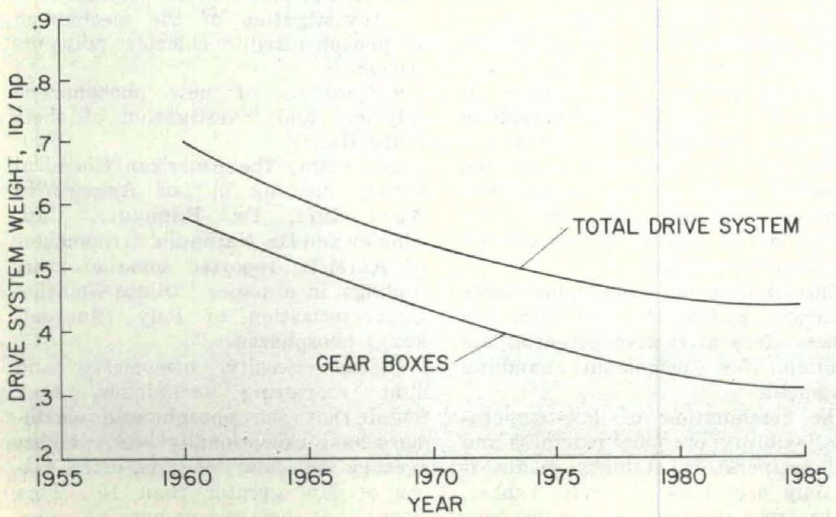


Fig. 12. Drive System Weight Trends

STRATCOM NCC Announces Relocation at Fort Ritchie

The National Communications Command (NCC) (Provisional) will move from the Hoffman Building, Alexandria, Va., to commence operations July 1 from its new headquarters at Fort Ritchie, Md., Col John N. Medinger, commanding officer, has announced.

One of five major area commands of the U.S. Army Strategic Communications Command (STRATCOM) located around the world, the NCC operates a network of strategic and special communications sites from coast to coast within the continental United States. These include the East Coast Telecommunications Center at Fort Detrick, Md., fixed satellite relay stations in California and New Jersey, and other important facilities.

Among several special communications systems supported by the NCC are the nationwide networks of Civil Defense.

AMMRC Studies Polyphosphazenes in Synthetic Rubber Research

Physical properties of a class of inorganic polymers called polyphosphazenes are being studied intensively by the U.S. Army Materials and Mechanics Research Center, Watertown, Mass., as part of a research program now about 20 years old to meet U.S. Army needs.

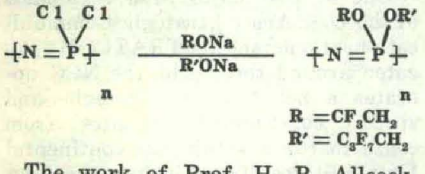
Many synthetic elastomers, including fluorinated silicones and nitroso rubbers, have been investigated by in-house researchers and under contract over the past two decades—in efforts to develop materials suitable for the widely varying environmental and operational factors involved in the U.S. Army's worldwide mission.

Various elastomers have been discovered and synthesized on a production basis to meet certain U.S. Army requirements. None of the materials developed prior to phosphazene elastomers has achieved the combination of low cost, chemical inertness, high-temperature stability and low-temperature flexibility that researchers are seeking.

Polyphosphazenes, which have been investigated on a continuing basis under the AMMRC program both in-house and under contract during the past three years, are yielding encouraging progress. Complexities of the polymerization mechanism, however, present difficult problems to resolve for large-scale production requirements.

Described as ring or chain compounds, phosphazenes contain alternating phosphorus or nitrogen atoms in the skeleton, with two substituents on each phosphorus atom. Cyclic hexachlorotriphosphazene is the simplest and most readily available member of this class of compounds.

When the cyclic phosphazene is heated in vacuum, it polymerizes to form an open-chain high polymer. First prepared about 75 years ago, this inorganic rubber was insoluble in common organic solvents and was hydrolytically unstable.



The work of Prof. H. R. Allcock, presently at Penn State University, was instrumental in the development of soluble hydrolytically stable polyphosphazenes. Allcock's work is being partially supported by the U.S. Army Research Office at Durham, N.C.

When the chloro polymer is modified by substituting the chlorides with perfluoroalkoxy groups, a new, tough, white, rubbery material is produced.

Capt Robert E. Singler entered the Army in 1970 after receiving his PhD degree in organic chemistry from the University of California at Los Angeles (UCLA). He was assigned to the Polymers and Composites Division at AMMRC after he completed the field artillery officer basic course at Fort Sill, Okla.

Capt Singler's graduate studies at UCLA involved synthesis, structure, and mechanism studies of paracyclophanes that are commercially used in production of high polymers. His work at AMMRC is directed towards the synthesis of polyphosphazenes and the relation of synthesis to molecular structure of polyphosphazenes.

Dr. Gary L. Hagnauer joined the AMMRC staff in October 1969. He earned a BA degree from Southern Illinois University (1965) and MS and PhD degrees in physical chemistry from the University of Iowa (1965–70).

Dr. Hagnauer's current work at AMMRC involves the molecular characterization of polmers that have potential Army applications as fuel-resistant, low-temperature adhesives, and biological barriers.

Studies of this rubber have shown that it possesses the best combination of desirable properties to date of any fluorine-containing elastomer developed under the long-term Army rubber research effort.

This phosphazene fluoroelastomer was first synthesized by Dr. Selwyn H. Rose of Horizons, Inc. (J. Polymer Sci., Part B, *6*, No. 12,837–1968).

The Army's interest in phosphazene elastomers originated with a contract with Horizons, Inc. Since 1968, the Polymers and Composites Division at AMMRC has continued to support this research and development.

Initial compounding studies were done at Natick Laboratories for AMMRC (A. Wilson, NLABS Technical Report 70-10-CE-August 1969).

The elastomer has a glass transition temperature of —77° C., an initial decomposition temperature of 300° C. in air, and is nonflammable in an oxygen atmosphere. It appears to be unaffected by prolonged immersion in boiling water, common organic solvents, concentrated mineral acids and various bases such as potassium hydroxide and pyridine.

Since it does not swell appreciably in various hydrocarbon solvents, this rubber offers attractive potential application for petroleum handling equipment.

The combination of low-temperature flexibility, chemical inertness and good temperature stability makes it not only useful as an arctic rubber, but in other temperature applications as well. Further development has resulted in increased tensile strength (over 1,500 psi) and the lowering of the cost below $10 per pound.

Dr. Wenzel Davidsohn, acting chief, Polymers and Composites Division, points out that many applications are possible such as tires, hoses, gaskets, seals, gun pads, potting compounds, coatings, gas mask components and fluorine-resistant materials.

In conjunction with contracted efforts to develop phosphazene rubber, Dr. Gary Hagnauer and Capt Robert Singler of AMMRC are conducting an in-house program designed to gain a better understanding of its chemistry and to determine how these materials can be best utilized. The research has three major goals:

- Elucidation of the molecular structure of phosphazene polymers.
- Investigation of the mechanism of phosphonitrillic chloride polymerization.
- Synthesis of new phosphazene polymers and investigation of their properties.

Addressing the American Chemical Society meeting in Los Angeles in April 1971, Dr. Hagnauer, Capt Singler and Dr. Nathaniel S. Schneider of AMMRC reported some of their findings in a paper "Dilute Solution Characterization of Poly (fluoroalkoxy) phosphazenes."

Using viscosity, osmometry and light scattering techniques, they found that the phosphazene elastomers have exceptionally high weight-average molecular weights, often values of Mw greater than 10^7. This means that some chains have as many as 60,000 phosphorus and nitrogen

atoms alternating to form the backbone of a single polymer molecule.

High molecular weights undoubtedly contribute to the exceptional strength of these rubbers. The polymers also have unusually broad molecular weight distributions—the ratio of weight to number average molecular weights (Mw/Mn) greater than 16 and sometimes as large as 100, meaning that each rubber sample is composed of molecules with widely varying sizes and properties.

To identify possible structure-property relations, one rubber sample was fractionated into three components of different average molecular weights.

The lowest molecular weight fraction (Mn = 30,000) is a colorless, transparent, tacky, highly viscous oil that responds elastically when stretched and immediately released.

The middle fraction (Mn = 50,000) is also colorless, tacky and elastic but less transparent and retains its shape.

The highest fraction (Mn = 150,000) is a tough, pliable, white elastomer. The properties of these fractions indicate that a variety of rubber products for different applications may be obtained from a single synthesis.

The broad polydispersity (Mw/Mn >16) in the AMMRC studies on polyphosphazenes in an interesting observation. The AMMRC scientists' discovery that the phosphazene elastomers are mainly linear polymers suggests that the polymerization mechanism is largely due to factors other than chain branching. Lt William Cross, recently added to the research team at AMMRC, will aid in utilizing gel permeation chromatography to seek a better understanding of the polymerization mechanism.

A prerequisite for the large-scale production of this polymer is that the preparation should be reproducible and uniform properties should be obtainable.

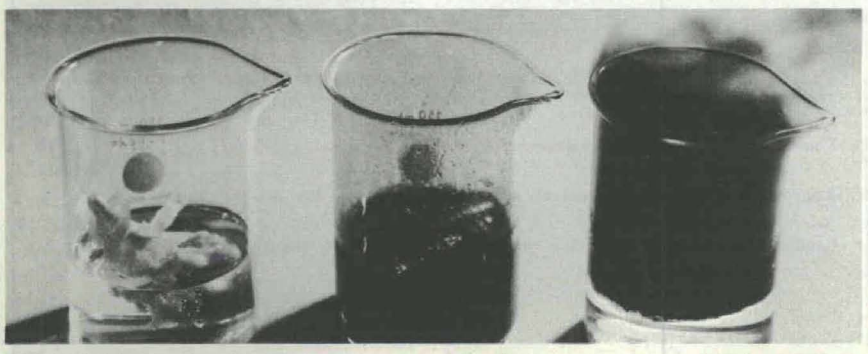
One of the major obstacles to the successful development of this rubber was the uncontrollable synthesis and nonuniform properties. For example, the elastomers from successive preparations were found to have substantial differences in the percent yield, molecular weight, molecular weight distribution, and chemical stability.

The AMMRC scientists contributed to the understanding and solution of some of these basic problems in polyphosphazene synthesis, and were able to synthesize polymers with similar properties.

Since contract work has demonstrated that large-scale synthesis is feasible, AMMRC has requested funds for the large-scale production of phosphazene elastomers in FY 73.

In addition to monitoring the work of Horizons, Inc., AMMRC research leaders are planning production of prototypes in specific areas such as helicopter seals. The Navy is also interested in the potential applications of polyphosphazenes and has recently contracted with AMMRC to do some work in this area.

The work on polyphosphazenes is considered a breakthrough in the development of elastomers, and the AMMRC anticipates that this class of materials will be applied to many important Army needs.



TREATMENT of rubbers in concentrated nitric acid. From left are phosphazene rubber (30 min.), gum rubber (5 min.), polysulfide rubber (5 sec.).

Redesignated NCG Joins Waterways Experiment Station

Redesignation of the U.S. Army Engineer Nuclear Cratering Group (NCG), Livermore, Calif., as the Explosive Excavation Research Agency (EERA), a field agency of the Waterways Experiment Station, Vicksburg, Miss., is effective July 1.

Established in 1962, the NCG was charged with carrying out the Corps of Engineers portion of a joint Office of the Chief of Engineers-Atomic Energy Commission agreement to develop the technology required to use nuclear explosives for construction.

The redesignation, it was stated, better describes the total program of the EERA, which includes the development of excavation technology using either nuclear or chemical high explosives.

Emphasis is on acceptable cost-competitive techniques for civil engineering construction projects.

Chemical explosive excavation techniques have been demonstrated successfully on a water conveyance channel (Project Pre-GONDOLA), a harbor (Project TUGBOAT) and a railroad cut (Project TRINIDAD).

Additional projects are planned for the continued development of the technique and demonstration of its applicability to highway cuts, balanced cut-and-fill road projects and underwater obstacle removal projects.

The agency will remain at the Lawrence Radiation Laboratory in Livermore to continue its coordination with the Plowshare Program and the joint program of developing nuclear explosive excavation.

Redesignation of EERA as a field agency of the U.S. Army Engineer Waterways Experiment Station is designed to achieve better integration of Corps of Engineers research activities. In addition to the Civil Works-oriented efforts, the EERA conducts research relating to the use of explosive excavation for military engineering and construction purposes.

Col Robert LaFrenz, director of the Nuclear Cratering Group since January 1971, will continue as EERA director. He is a 1955 graduate of the U.S. Military Academy and has received his master's and doctorate degrees from Iowa State University.

CDC Proposes Aerosol Spray To Disperse Supercooled Fog

Dispersal of supercooled fog above airfields by use of a propane aerosol spray capable of clearing an area about five-eights of a mile long and 100 yards wide is a new concept proposed for investigation.

The idea is suggested by the U.S. Army Combat Developments Command, headquartered at Fort Belvoir, Va., which has a responsibility of developing advanced concepts intended to meet future Army requirements.

The CDC envisions use of this method at airfields located above 40 degrees north latitude. Supercooled fog is composed of droplets of water suspended in air at 32° F. or below, dispersal of which can be triggered by the propane spray.

Designers suggested that the tank, valves and nozzles be truckmounted. CDC writers of requirements have also recommended the system be manportable and capable of being air-dropped and operated from an Army aircraft.

U.S. Army Industrial Relations for Research and Development

By Maj Donald E. Gauntner

The accelerating progress of American science and industry is providing the U.S. Army with opportunities for enhancing its strength and effectiveness as a fighting force greater than ever before known in our history.

In efforts to assure the maximum exploitation of these opportunities, the Army Chief of Research and Development recognizes the importance of a progressive industrial relations program, as an integral and vital part of the research and development efforts.

It is incumbent upon the Army to provide current advanced planning information and a better and broader understanding of the materiel needs of the military to industry. On the other hand, industry must do its share in return so that its capabilities are known to the Army.

At Department of Army level, the Chief of Research and Development maintains a Technical and Industrial Liaison Office (TILO) where Army programs, plans and problems can be discussed on an individual basis and in a definitive manner with industry representatives.

TILO attempts to satisfy industrial planners by providing authoritative and current information in the form of reviewing plans and documents.

TILO provides a service to industrial organizations that have established a need-to-know and possess the necessary security clearances. Under these guidelines, industry can be provided with specific requirements of the Army, the efforts needed to satisfy approved requirements, and the projects within the categories of research that are programed to accomplish those requirements.

The purpose of this article is to inform industrial planners of research and development, document available for review, and the principles and procedures governing authorization for visits to TILO.

R&D PLANNING INFORMATION. Several Department of the Army long-range planning documents are available to industry that provide guidance for research and development projected 20 years into the future.

Army Research Plan (ARP) is a CONFIDENTIAL document that provides an enumeration and appraisal of the research and exploratory development programs responsive to long-range concepts, operational capabilities objectives, and materiel objectives of the Army of the future.

MAJ DONALD E. GAUNTNER is serving in the Technical and Industrial Liaison Office, following assignment with the Program Management Office, U.S. Army Advanced Ballistic Missile Defense Agency, OCRD. He earned a BS degree in education from Indiana (Pa.) State University (1957) and completed the Command and General Staff College (1970). Maj Gauntner was a program and budget adviser with the Korea Military Advisory Group (1967–69), following two years with the U.S. Army Aviation Systems Command, St. Louis, Mo., stationed at the Airborne Electronics and Special Warfare Board, Fort Bragg, N.C. Assignment with the 5th Special Forces in Vietnam (1964–65) followed duty with the 1st Airborne Battle Group, 504th Infantry, Germany.

Combat Development Objectives Guide (CDOG) is a SECRET document that provides guidance for combat development activities and for the research and development program of the Army. The CDOG is a composite formulation of needs identified by five types of entries that directly concern Army research and development. They are: Operational Capability Objectives (OCOs), Qualitative Materiel Development Objectives (QMDOs), Advanced Development Objectives (ADOs), Qualitative Materiel Requirements (QMRs), and Small Development Requirements (SDRs).

The OCO is a Department of the Army approved description of an operational capability needed primarily in the long-range time frame (10–20 years).

The QMDO is broad in nature. It

COMPANY LETTERHEAD

Chief of Research and Development
Department of the Army
ATTN: Security Officer
Washington, D.C. 20310

Reference: DOD Industrial Security Regulation 5220.22–R, Paragraph 3–201b.

In accordance with reference, approval is requested for the following employees to visit your facility:

Full Name **Job title**	**Clearance, date issued**	**Date, place of birth**

Purpose of visit: To visit TILO.

Dates of visit:

Person to be contacted: (In Army, if known.)

Statement of facility clearance: XYZ Corp. has a (type of clearance) facility clearance granted on (date) by (granting agency).

I certify that clearance information set forth above is correct.

Approval for this visit is assumed, unless information to the contrary is received.

Cognizant security office for the corporation is (name of DCASR or other office).

I. M. Secure
Security Officer

Fig. 1. Visit Authorization Request

defines a need that exists for the development of new materiel. The feasibility of such a development is considered unknown or in question and research or exploratory development is necessary.

The ADO directs advanced development effort aimed at furnishing research and development items for experimental or operational test. Its purpose is to clarify cost, operational, or technological factors prior to commencing engineering developments of items for military use.

The QMR describes a military need for a new item, system or assemblage for which technical feasibility has been demonstrated. The desirable or essential military characteristics are properly detailed.

The SDR prescribes a need for small items of equipment or materiel of proven feasibility that can be produced in a relatively short time. Requirements are not as complex in QMRs and are low in cost.

Four of these objectives/requirements documents will be converted to a single Materiel Needs (MN) document in a phased process in the near future. The MN document will establish the need for new or improved materiel for the Army, and provide guidance to the developer throughout the life cycle of materiel.

The MN is intended to establish closer coordination between the requirements agency and the developer. All MN documents will be generated at the concept formulation stage (comparable to the position of the QMDO in the old system) and be revised throughout the life cycle of the materiel item by face-to-face efforts of combat and materiel developers.

Total feasibility will be determined before an item enters the engineering design phase of development. Since one MN will replace QMDO, ADO, QMR and SDR documents, the administrative processing time should be reduced from 30 months to 30 weeks.

The Army Systems Coordinating Document (ASCOD) is a new classified document that develops an analysis of each of the materiel objective areas. The purpose is to enhance the planning system for coordinating R&D activities, proceeding from approved objectives through requirements to the ultimate allocation of research, development, test and evaluation (RDT&E) resources.

The ASCOD covers the R&D efforts associated directly with the materiel objectives of the Army Strategic Objectives Plan (ASOP). Each identifies the effort needed to satisfy approved requirements, highlighting the pacing activities and problem areas.

This new family of documents—an Army "first" on the problem of resource allocation—features the following materiel objective areas:

Air and Ballistic Missile Defense
Air Defense
Air Mobility
Electronic Warfare
Communications
Indirect Fire
Infantry
Intelligence/STANO
Logistical Support
Surface Mobility
Tactical Command and Control
Tactical Nuclear Operations
Tank/Antitank
Chemical/Biological

Threat Estimates, relating to each of the materiel objectives of the ASOP, provide succinct information on the tactical and technical threat. This is a companion series to the Army Systems Coordinating Documents.

The Nonmateriel Objectives Coordinating Document (NMOCOD) identifies R&D effort associated with the nonmateriel objectives of the ASOP in much the same fashion as the ASCOD series addresses materiel objectives.

The Research and Technology Coordinating Document (RTCOD) presents the technology needs and problems identified in the ASCOD series, together with similar items from the NMOCOD, and those items of opportunity or high payoff not yet related to specific materiel systems.

The Army Research and Development Project Listing is an across-the-board look at the total Army R&D program within the categories of research and all related activities. This compilation lists the projects that have been established in the Five Year Defense Program to accomplish requirements.

Each project listed is reported on a *DD Form 1634 and DA Form 3664-R, Research and Development Planning Summary*, which reports all ongoing and planned Army RDT&E funded work at the projects and task area levels. These R&D planning summaries provide a means for evaluating the relevancy of RDT&E efforts to approved Army requirements and objectives.

The OCRD Technical and Industrial Liaison Office has the above documents. TILO is like a library with the shelves lined with publications describing the Army's materiel development needs—cross referenced with ongoing tasks or projects supporting those needs and planned actions for future work.

These documents, or portions of these documents, are available to industrial planners so that industry can determine what the Army needs and what is being done to fulfill specific requirements.

Department of the Army policies preclude the release of the following:

(1) Funding information
(2) Proprietary information
(3) Qualitative figures that indicate project purchases, total quantities, or number to be procured for test and evaluation.

WHERE CAN DOCUMENTS BE SEEN? Planning documents can be reviewed daily by qualified industrial representatives at the Technical and Industrial Liaison Office, Office of the Chief of Research and Development, located in Room 3D380, The Pentagon. Companies may schedule a reading room for a half day or preferably a full day on the first visit. Three briefing rooms enable TILO to accommodate up to six industrial representatives a day.

Companies should make appointments at least two weeks in advance. The aforementioned requirements for qualification and a statement of specific areas of interest must be made in writing to:

Chief of Research and Development
Department of the Army
ATTN: Chief, Technical and Industrial Liaison Office
Washington, D.C. 20310

At the same time, a visit authorization request must be sent to:

Chief of Research and Development
Department of the Army
ATTN: Security Control Officer
Washington, D.C. 20310

The 2-week lead time for the visit authorization request is needed for mailing and processing. Information to be included in the visit authorization request is shown in Figure 1.

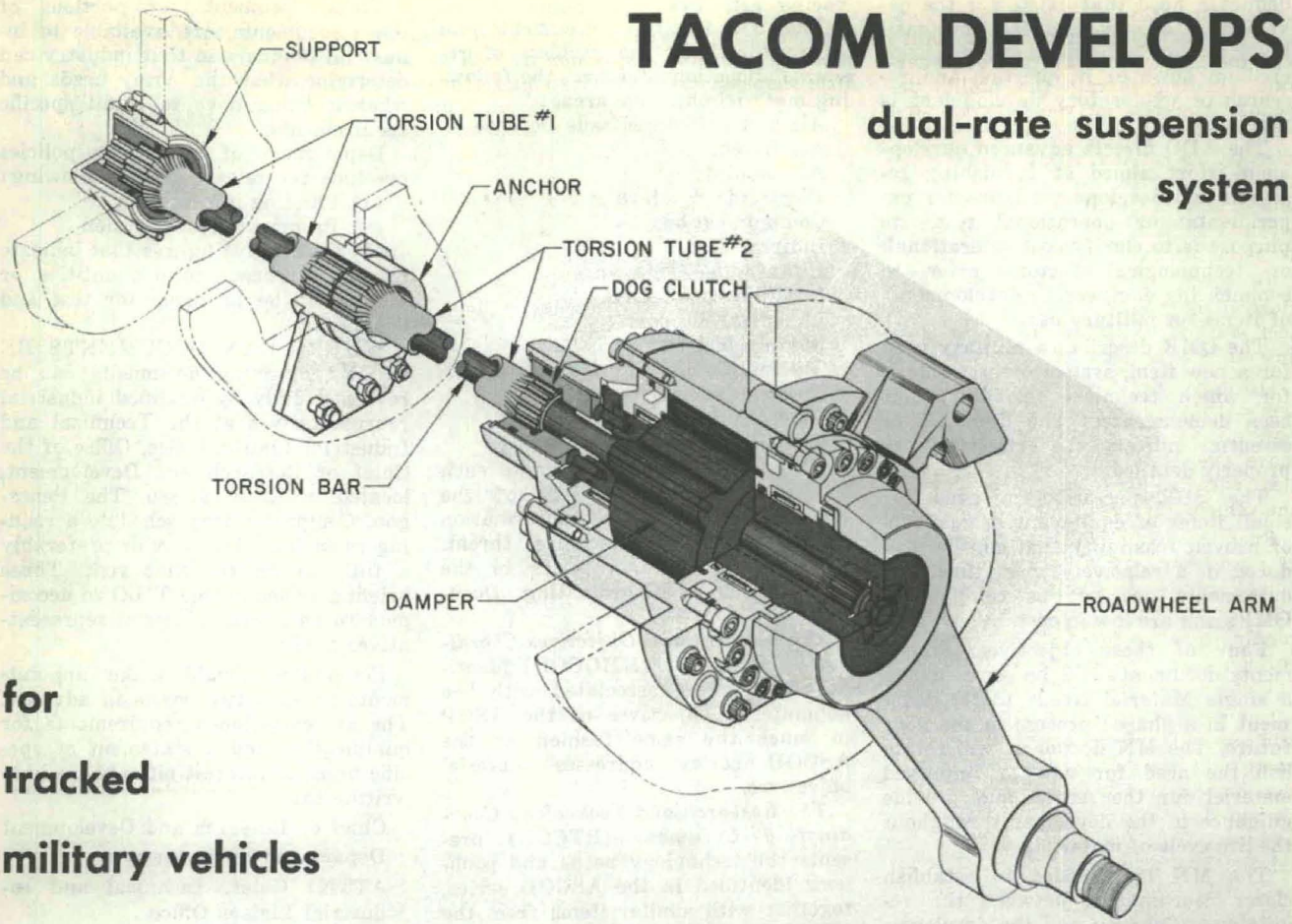
The request for visit may be made to cover up to a one-year period. This is provided for in DoD Industrial Security Regulation 5220.22–R, paragraph 3–201b. This reference should be noted on the request for visit.

The request should be annotated to indicate that the individual representative has been designated by his company as an authorized messenger for transmission of classified material. The request should also be annotated with the phrase, "To visit TILO."

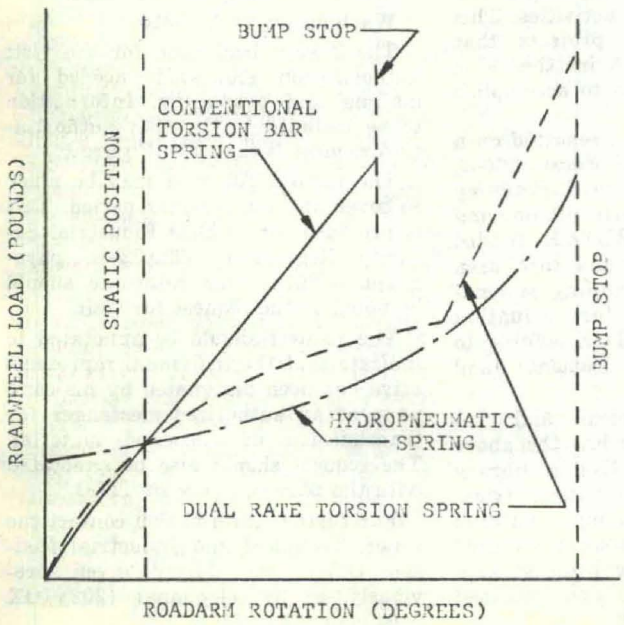
For further information contact the Chief, Technical and Industrial Liaison Office, at address given previously, or by telephone: (202) OX 5–6496 or OX 5–6471.

TACOM DEVELOPS

dual-rate suspension system for tracked military vehicles



by Richard W. Siorek



In the graph, at the left, the compound spring curve, shown in dashed lines, compares favorably with a typical hydropneumatic curve, shown as a dash-dot line. The solid line depicts a conventional tracked-vehicle torsion-spring curve, which typically provides only a little better than one-half the travel from static to bump stop of the advanced suspensions as shown in the graph. This spring curve serves as a comparison to the low-spring rate, large-wheel travel suspensions to indicate the improvements provided by current developmental suspension springs in TACOM project.

Cross-country speed capabilities of tracked military vehicles may be increased substantially with a Dual Rate Torsion Bar and Tube Suspension System designed and developed by the Surface Mobility Division, U.S. Army Tank-Automotive Command.

Current indications are that the changes will raise the average cross-country speed of various vehicles from the present 10 to 12 miles an hour to averages ranging from 15 to 24 mph.

New vehicle qualitative materiel requirements issued recently reflected user needs for increased cross-country speed of tracked vehicles. Since existing systems could not fulfill this objective, the Mobility Systems Laboratory initiated several efforts to explore new concepts. One of these programs resulted in development of the dual-rate suspension system.

The first step in its development was a study of the

basic attributes of a high-speed suspension as they effect vehicle mobility and the ability to traverse rough terrain. On firm terrain this ability depends primarily on vehicle pitch and bounce reactions. These are related directly to spring mass characteristics, spring rate, the damping factor, wheel travel geometry, vehicle velocity and contour of the ground wave, to name a few.

In softer terrain other considerations predominate. However, this project was primarily aimed at improving ability to traverse firm terrain.

On hard surfaces a suspension system with a relatively soft spring rate normally will allow the wheels to move over minor surface irregularities without significantly disturbing the vehicle hull.

Such a system will not be capable of producing and transferring a sufficient amount of energy—while crossing over relatively large surface irregularities—to prevent full-wheel excursion bump-outs with their attendant effects on hull platform stability.

Conversely, a suspension with a stiff spring rate, while providing more energy to prevent full-wheel excursion bump-outs, does not allow deflection of the wheels over small surface irregularities. The result is transmittal of many minor road shocks to the hull, with subsequent degradation of platform stability.

Operation over large obstacles with a suspension of this type will possibly prevent many full-wheel excursion bump-outs. Since the road wheels are not able to deflect upon obstacle impact, the hull platform will be forced to oscillate to allow the road wheels to clear the obstacle. This, also, is not a desirable situation because it will result in an unstable hull platform, just as with the soft spring, but for the opposite reason.

Recent experience with experimental suspension systems which, by means of closed hydropneumatic columns, provide a spring curve approximating the adiabatic (constant temperature expansion) gas compression curve, indicates the desirability of providing position-sensitive springing.

These suspensions allow small road wheel oscillations to occur with little change in the supporting forces provided by the road wheels. The result is, as with a soft spring rate suspension, that very little disturbing force enters the hull platform because little additional force is generated by small wheel deflections.

For extended wheel travels, however, the spring rate mounts at an increasing rate. This smoothly applied road wheel decelerating force reduces hull disturbing effects to the minimum. Simultaneously, it provides the forces required to reduce or even eliminate many full-wheel excursion bump-outs.

Damping also plays a critical role in vehicular performance. Insufficient damping will allow imposed oscillations to build on themselves in random fashion—sometimes maintaining stability but more likely allowing oscillations to grow to uncontrollable proportions. Too much damping will have the same effect as will a spring rate that is too stiff.

While excessive damping would not allow oscillations to build up, neither would it allow the suspension to absorb terrain irregularities. Again, referring to the experience with hydropneumatic suspensions, it was found that high-capacity, properly chosen, road-arm rotation velocity-sensitive damping provided a better ride experience than was obtainable with standard shock absorbers.

In addition to the fact that the damping was better matched to vehicle characteristics—which in itself provided an improved ride—the high work absorption capacity of the hydraulic shock absorbers on the test vehicle allowed them to remain functional long after normal strut absorbers would have overheated and ceased functioning.

Additional influences of increased ground clearance and wheel travel allow easier clearance of larger obstacles than is possible with tracked vehicles presently in the field. With the hull further out of the way, degradation of the ride through direct contact between the hull and obstacles encountered is reduced.

Movement of the hull to a higher elevation also allows road wheel travel to be increased. This increase puts larger obstacles within the realm of the suspension's capabilities, as opposed to requiring oscillation of the hull to provide the necessary clearance.

A final factor, not totally related to the suspension system but nonetheless an important parameter in over-all vehicular performance, is the horsepower available for vehicle propulsion. This bears directly on a vehicle's ability to maintain speed over terrain since much horsepower is absorbed during this type of operation.

Tests have shown that if sufficient momentum is maintained, a hull is not affected as much by obstacle inputs as it is if the vehicle is moving slower and the hull has proportionately less inertia to keep it steady under suspension impacts.

With this background in mind, the Surface Mobility Division program was aimed at providing as many of the desirable suspension attributes as possible in a simple, low-cost package. The result was the Dual Rate Torsion Bar and Tube Suspension System, which is a theoretically logical and efficient follow-up to the torsion bar suspensions currently in service.

More specifically, in the dual rate system the torque normally required to support a vehicle is developed by the torsion bar acting in series with torsion tube number one (see Figure 1). This extended spring provides a high wheel travel with a relatively soft spring rate that allows the road wheels to cross over small obstacles without causing major disturbances to the hull.

When the road wheels pass over a large obstacle, however, the second tube comes into play by means of a dog clutch. This piece of equipment connects the second tube in parallel with the bar and first tube at a point where the road wheel has traveled 80 percent of the way to the bump-stop. This provides a snubbing action that reduces the severity of—and even eliminates—many full-wheel excursion bump-outs.

Included in this suspension, as installed on a test rig, is an integral, high-capacity, rotary, rectangular vane damper system. The valving installed in this system provides a damping configuration which, because it is velocity-sensitive, provides ratios of actual damping effort (c) to critical damping (c_c) in the bounce mode, —from 0.025 at 25 mph to 0.7 at creep speeds.

The over-all average damping ratio

(Continued on page 62)

RICHARD W. SIOREK is a mechanical engineer in charge of development of dual-range torsion-bar and tube suspension as well as other vehicle suspensions at the Systems Laboratory, U.S. Army Tank-Automotive Command, Warren, Mich.

Siorek holds a BS degree in mechanical engineering from Wayne State University in Detroit, and is registered as a professional engineer in Michigan. He has five years of government service.

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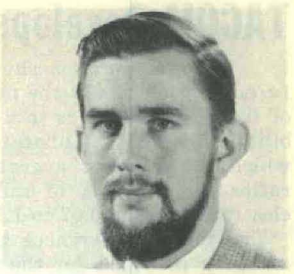


TACOM Develops Dual-Rate Suspension System

(Continued from page 61)

(c/c_c) expected is in the neighborhood of 0.4. This compares to a recent Mobility Systems Laboratory study which showed that average damping ratios for the bulk of military vehicles ranged from 0.07 to 1.15.

The major differences between the damping provided for the test vehicle and that provided for vehicles currently in the inventory are the generally lower damping ratios at all speeds and the extended energy absorption capabilities of the test vehicle's dampers.

A general thought in designing the dual rate suspension was to include most of the best characteristics and the most up-to-date knowledge gained in previous developmental effort in one new suspension. This carefully mixed blend, it was hoped, would attain superior performance over firm terrain and verify the new limits of the state-of-the-art of suspension design methodology.

Testing to date has shown that this hope was properly founded. The suspension system, installed on a 25-ton test rig, has proved remarkably agile. Field tests to date over man-made bump courses indicate a 3-fold improvement in performance of this suspension system over tracked vehicles equipped with a conventional torsion bar spring.

Installation of this type of suspension on a new production vehicle is currently being sought. In the future the dual rate system could become standard, as the torsion bar suspension is now, on all U.S. Army tracked vehicles.

Army Depot Introduces Driverless Tractors

Spooks are driving tractors around warehouses at three U.S. Army depots these days—at least that's what uninformed spectators may believe.

Little less than eerie is the sight of the electrically powered tractors towing trailer beds for cargo, without a visible operator.

The "spook" drivers are electronic controls, expected to save the U.S. Government about $28,000 annually at Sharpe (Calif.) Army Depot—and many times that if the current experiments are successful, leading to installation of the system at other Army depots.

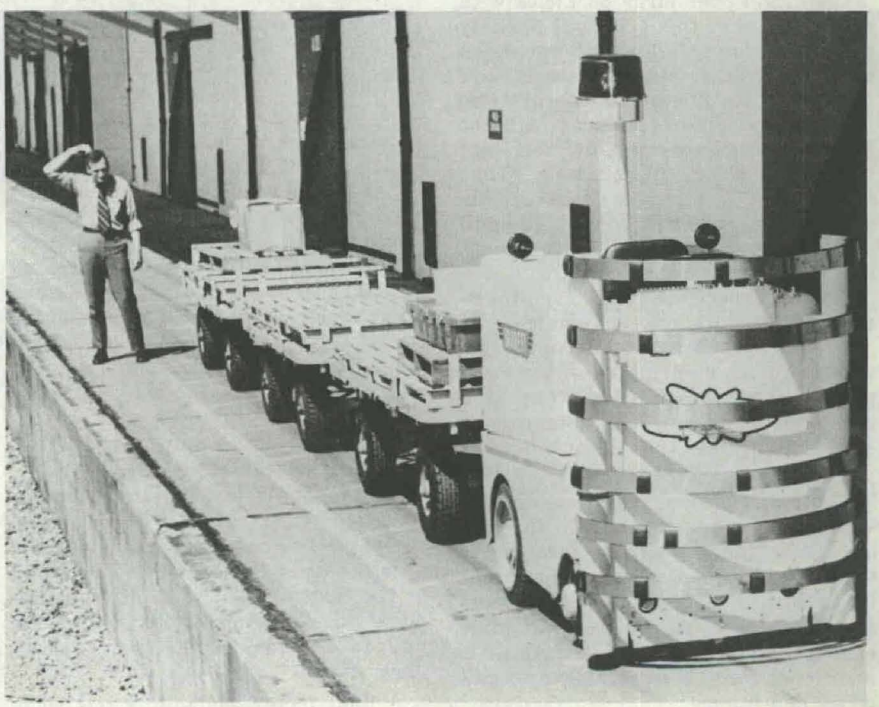
Ten of the driverless tractors have been procured by the U.S. Army Materiel Command for the test project, which is being conducted also at the Sacramento and Atlanta depots. Each tractor is capable of pulling three cargo trailers.

What would you believe, if someone had not explained the system, when you saw one of the tractors barreling along a ramp with its warning light flashing and its horn beeping—if you watched it stop for about five minutes and then take off again, without sign of a human driver?

Actually, the tractors follow painted tracks to certain destinations and pause only at designated cargo loading or unloading points. The guidance path consists of multistrand 14-gauge copper wire buried one-fourth inch deep into the concrete floors, ramps and the street.

Bright yellow paint denotes the path, which leads up and down ramps, around corners, indoors and out, with a turn-around near a manually operated control panel in the warehouse. Currently, the panel at Sharpe Army Depot is programed for 11 station stops in receiving and shipping materiel. Additional stops can be added should the need arise.

An automatic horn sounds as the tractor arrives at a station. An area warehouseman then pushes the control button to delay the tractor until materiel is loaded or unloaded. Loading tables and the attached trailers are equipped with gravity rollers and conveyors for handling of supplies.



SO WHO'S DRIVING? No one, in fact, as this electronically controlled tractor rolls down a warehouse ramp at Sharpe Army Depot, one of three Army Materiel Command depots at which the tractor is being evaluated.

Frankford Arsenal Hosts Meet On Powder Metallurgy Gains

Technological advances in powder metallurgy technology were reviewed June 2–4 at a seminar sponsored by the American Powder and Metallurgy Institute and the Metal Powder Industries Federation, with the Army's Frankford Arsenal serving as host.

Army weapons and ammunitions experts participated with industrial representatives in discussions of "Powder Metallurgy in Ordnance," an exchange of information on recent advances in the state-of-the-art. Various improvements, it was indicated, present the promise of permitting reduction in production costs.

Materiel items produced by powder metallurgy now can be made stronger, larger and in highly complex forms. Density of materials can be easily controlled and even varied from section to section of an individual piece.

Powder metallurgy also permits parts to be fabricated to closer tolerances and more easily machined than ever before. Elimination of scrap from the forming operation and reductions in assembly time are viewed as factors that can cut costs.

AMMRC Summarizes Ballistic Data in Armor Materials

State-of-the-art knowledge is presented in "Summary of Terminal Ballistic Data on Lightweight Armor Materials," a technical report published by the Army Materials and Mechanics Research Center, Watertown, Mass.

AMMRC TC 69–17 (AD504360L) provides the armor designer with reliable ballistic performance data of various homogenous and composite armor materials, to assist him in seselecting a material to provide maximum protection at minimal weight.

One of the primary investigators who has contributed richly to the vast store of information accumulated by the AMMRC is Francis S. Mascianica, employed there for 25 years. He has a BS degree in mechanical engineering from Northeastern University.

Mascianica has served as a project engineer in coordinating and conducting research programs related to armor materials and terminal ballistics. He has established master ballistic curves for designing personnel, aircraft and lightweight vehicular armor against various ammunition.

World War II was conducted with steel as a primary armor material. Many homogenous materials and an almost infinite variety of composite armor combinations can now be used.

Experience has demonstrated that no single armor material provides maximum protection throughout the entire range of armor weight when impacted by various projectile types, geometric shapes and striking velocities, Mascianica states.

Each material has certain attributes and limitations. In many instances an armor material that provides excellent protection against small arms ammunition attack does not necessarily provide adequate protection against fragmentation munitions, carbide projectiles or attack by special weapons.

The AMMRC report is a compendium of ballistic information on the protective level of types of armor materials when impacted by various types of ammunition. Ballistic curves are presented as a function of armor thickness or areal density, obliquity, projectile velocity and environmental parameters of significant importance in designing protective capabilities. The report contains 375 master ballistic performance graphs.

The AMMRC has continued with the compilation of state-of-the-art data since the report was distributed, especially for new and increased ammunition threats currently encountered in Southeast Asia.

To provide all interested U.S. Government and private organizations with an up-to-date reference on ballistic performance data, a revised version of AMMRC TR 69–17 is planned for release this year. The handbook will contain more than 500 ballistic performance graphs and tables.

SCIENTIFIC CALENDAR

Symposium of Nonlinear Functional Analysis, sponsored by MRC and University of Wisconsin, Madison, Wis., May 3-5.

19th Annual Meeting of the Radiation Research Society, Boston, Mass., May 9-13.

Fluids Engineering Conference, sponsored by ASME, Pittsburgh, Pa., May 9-14.

AIAA Joint Strategic Missile Sciences Meeting, Annapolis, Md., May 10-12.

Seminar on Advanced EDP System Design, sponsored by CD Corp., Minneapolis, Minn., May 12-14.

Symposium on Validation of Materials and Structures, sponsored by ASTM, Philadelphia, Pa., May 16-17.

International Microwave Symposium, sponsored by HDL, Washington, D.C., May 16-20.

Seminar on Design of Data Communications System, sponsored by CD Corp., Washington, D.C., May 17-19.

Design Engineering Conference and Show, sponsored by ASME, N.Y.C., May 17-20.

National Aerospace Electronics Conference, Dayton, Ohio, May 17-19.

International Microwave Symposium, sponsored by IEEE, Washington, D.C., May 17-20.

Spring Computer Conference, sponsored by AFIPS, Atlantic City, N.J., May 18-20.

10th National Conference on Environmental Effects on Aircraft and Propulsion Systems, sponsored by Naval Air Propulsion Test Center, May 18-20.

Atmospheric Turbulence Conference, sponsored by Royal Aeronautical Society, AIAA and Canadian Aeronautics and Space Institute, London, England, May 18-21.

25th Annual Spring Meeting of Research and Development Associates for Military Food and Packaging Systems, N.Y.C., May 20-21.

Computer Operations and Management Seminar, sponsored by CD Corp., Washington, D.C., May 24-26.

17th Annual Tri-Service Radar Symposium, sponsored by AMC, Fort Monmouth, N.J., May 25-27.

17th Conference of Army Mathematicians, sponsored by ARO–D, Redstone Arsenal, Ala., May 26-27.

Electrical and Electronic Measurement and Test Instrument Conference, sponsored by IEEE, Ottawa, Canada, June 1-3.

Conference on Laser Engineering and Applications, Washington, D.C., June 1-4.

3d International Conference on Digital Computer Applications to Process Control, sponsored by IFAC and IFIP, Helsinki, Finland, June 2-5.

1971 IEEE Symposium on the Applications of Ferroelectrics, sponsored by IEEE, ARO–D and IBM Watson Research Center, Yorktown Heights, N.Y., June 7-8.

17th Annual Meeting of the American Nuclear Society, Boston, Mass., June 13-17.

International Communications Conference, sponsored by IEEE, Montreal, Canada, June 14-16.

International Conference on Nuclear Reactors and Radioisotopes, Montreal, Canada, June 20-23.

5th Symposium on Temperature Measurement and Control in Science and Industry, Washington, D.C., June 21-24.

Applied Mechanics Conference, sponsored by ASME, Philadelphia, Pa., June 23-25.

Design Automation Workshop, sponsored by IEEE, Atlantic City, N.J., June 27-July 1.

74th Annual Meeting of ASTM, Atlantic City, N.J., June 27-July 2.

Symposium on Dynamic Response of Structures, sponsored by ARO–D, AFOSR, ONR and NSF, Stanford, Calif., June 28-29.

Chemical and Transport Process in D-Region Aeronomy, sponsored by BRL, Urbana, Ill., July 6-8.

Summer Power Meeting, sponsored by IEEE, Portland, Ore., July 18-23.

23d International Congress of Pure and Applied Chemistry, sponsored by ACS, Boston, Mass., July 25-31.

2d International Conference on Light Scattering in Solids, sponsored by AROD and ONR, Paris, France, July 19-23.

USAIB Tries New Antitank Weapon Performance Evaluation

Service testing of the Dragon, the U.S. Army's new antitank weapon, will take a new approach to evaluation of its performance, the U.S. Army Infantry Board at Fort Benning, Ga., announces. The board is an element of the U.S. Army Test and Evaluation Command.

The method combines the essential materiel testing with the training and field testing of a mechanized rifle unit equipped with the Dragon to perform under simulated combat conditions.

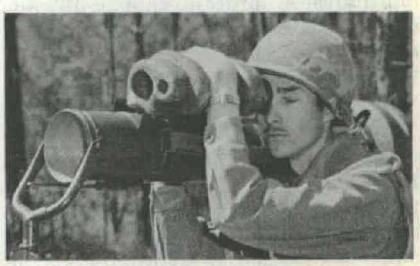
Powerful enough to destroy enemy armored vehicles and other battlefield targets, the Dragon consists of two major components—the expendable round and the reusable tracker.

The man-portable, shoulder-fired weapon, weighing 29.9 pounds loaded, uses an automatic command-to-line-of-sight wire guidance system that requires the gunner to aim through a telescopic sight and hold the cross hair on target until missile impact.

Known officially as the XM47 Surface Attack Guided Missile System, the Dragon is scheduled for service testing the latter part of this year by the Infantry Board with participation by the Combat Developments Command and the Infantry School at Fort Benning.

Three mechanized Infantry platoons from the 197th Infantry Brigade will engage in the service test. Two platoons will be equipped with Dragon weapons systems. The third will use the control or comparison weapon, the 90mm recoilless rifle.

If successful, the combined service test and training evaluation is expected to expedite procurement and placement of the Dragon system in the hands of infantrymen. It will complement the heavier TOW weapon system that has been phased into the rifle battalions in Europe.



XM47, Dragon

Reverse Osmosis Offers Potential Solution to Water Purification

Reverse osmosis purification of water, currently undergoing intensive research and development effort, was acclaimed in a recent address by General Henry A. Milly, CG of the Army Materiel Command, as a process offering great potential to meet field army potable water requirements under virtually all conditions.

General Miley commended this project as one of many in-house laboratory R&D activities (see March 1971 Army Research and Development Newsmagazine, page 2) that are contributing importantly to requirements of the Modern Volunteer Army. The following article was written in response to the editor's request for information on this effort.

★ ★ ★

By R. P. Schmitt

The Army Mobility Equipment Research and Development Center (MERDC), Fort Belvoir, Va., is responsible for the methods and equipment required to provide drinking water for the soldier in the field. The bulk of the drinking water produced for the field army today is by treatment of the fresh surface water sources found in the rivers, lakes and streams.

The present Army supply system includes six different water purification units, varying in capacity and size corresponding to their field deployment. The smallest unit, 7½ pounds, is manually operated and is for patrols in remote locations; the largest is an electrically powered water plant mounted on a 2½-ton truck supporting large troop concentrations.

When only sea or brackish water sources are available, trailer-mounted vapor-compression distillation equipment is used. If unusual chemical, biological or radiological contaminants are present in water sources, ion exchange equipment and/or special chemical pretreatment processes are used to augment the normal water purification methods.

The Army systems are effective and efficient in production of potable water. However, with the high mobility and ever-changing locations and situations in which a modern field army functions, the right process may not be on hand at the right time. Therefore, the Army is seeking a multipurpose process that will produce potable water from whatever source is available or even treat waste water for reuse. For this reason, the Army is currently directing its efforts to investigation of reverse osmosis.

Water supply equipment required for the forward tactical elements of the Army must be transportable. It may be delivered by parachute, as a sling load from a helicopter or as cargo in a fixed-wing aircraft. The air movement is difficult but land transport is not any easier.

The preferred Army method is to place the unit package on whatever vehicle, truck or trailer is available and to move quickly to the water source, whether over improved or unimproved roads or cross country. In either case, the equipment must withstand the severe shock, vibration, rough handling and stresses encountered in overland movement, and at the same time be something that can be quickly assembled or disassembled to make it ready for rapid mobile transport.

An equally difficult requirement, although more related to the process than the structural properties of the equipment, is the need for the process to remove from water any chemical, biological or radiological contaminants that may be encountered. These will occur both as soluble and insoluble substances requiring very high efficiencies of removal, because of the toxicity implications resulting from only trace quantities if taken internally.

Another typical military use requires built-in protection for operation in tropical environments, such as is being experienced in Vietnam today. The problems of fungi or microbiological attack on materials and equipment are accelerated in the hot-humid climates.

Certain material cannot be used for this environment; for others, special protective measures must be adopted. Operation in subfreezing environments is even more difficult. Equipment, when operating, must be in heated shelters; when not operating, it must be completely drained.

The packaged equipment producing potable water from fresh river sources should perform equally well when obtaining water from the ocean or from a brackish well supply at inland semiarid locations.

The Army's requirement when treating ocean or brackish water is the same as that for domestic or civilian uses—reduction of the soluble sea salts or troublesome scale-producing salts to an acceptable potable level.

In addition to these general requirements, the Army would like the process to be compact, lightweight, simple to operate and easy to maintain; also, requiring a minimum of manpower and logistic support with maximum reliability under all modes of intended use. These are the guidelines for the multipurpose water production unit for the future Army.

Following a thorough system analysis, the Army has determined that the reverse osmosis (RO) process has the greatest potential for meeting these requirements. Invaluable inputs have been obtained from industry, universities and other governmental agencies.

With this encouragement, present investigations at MERDC are designed to add to the information to establish the feasibility for attaining the Army's goals.

A series of tests in 1968 demonstrated the capability of an RO system with cellulose acetate (CA) membranes to remove one biological and four chemical contaminants from natural waters.

The tests were conducted under specially controlled conditions, using a turbid fresh water supply from a stream and a brackish supply from a tidal river. Sufficient contaminants were added to the two sources to result in level of approximately 30 mg/liter. An arsenic compound and a number of selected other chemical and biological materials were used.

Without any pretreatment, the contaminated water was pumped directly to a reverse osmosis test unit equipped with CA membranes. Operating pressures were maintained at about 600 pounds per square inch (psi). Duration of each test run varied from 6 to 24 hours and three different grades of CA membranes were used. Results are summarized in Table I.

TABLE I

Water	Flux Rate	% Removal Chemical Materials				
		As	VX	GB	BZ	BT
Fresh	25 gpd/sq ft	96	57	23	30	99.8
	14 " " "	97	98	48	98	99.99
	8 " " "	98	99	70	99	99.99
Brackish	8.5 " " "	—	98	56	96	99.9

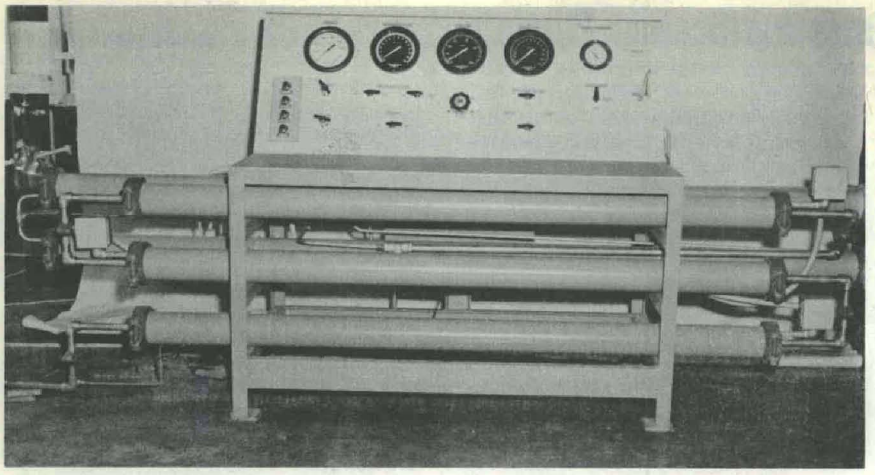


Fig. 1. Spiral-Wound Reverse Osmosis Unit

The results show that the tighter membrane with the lower flux rate gave the better removal of the contaminant. Although the percent removals were high (equivalent to vapor compression distillation), only the water contaminated with arsenic was suitable for drinking. The drinking water tolerance for arsenic is 2.0 ppm; tolerance levels for the other contaminants are measured in parts per billion. These very low levels are more difficult to attain.

All results were considered satisfactory, however, because the bulk of the contaminant had been removed and subsequent treatment making use of chlorination, absorption or pH adjustment would make the water safe for drinking.

Similar results were obtained relative to the removal of soluble radioactive material from water with CA membranes. A raw water contaminated with strontium 85 to a level of 5,440,000 pico curies/liter was reduced to 391,000 pc/liter, or approximately 94 percent removal with a CA membrane having a flux rate of 10 gpd/sq ft.

Following the CBR field tests, more extended operations of three units (Figures 1, 2 & 3) having either spiral-wound, tubular or hollow-fiber membranes were performed at Fort Belvoir for demineralization of waste waters. Each unit represented the utilization of membranes in a different configuration having different physical features and operating characteristics of special interest for military field use.

The purpose was to obtain information on the feasibility of treating and reusing wastewater from field laundries, showers and kitchens. Each unit was operated for 426 hours, using a composite synthetic water simulating wastewater from kitchens, laundries and showers.

The wastewater was chemically coagulated and filtered prior to pumping to the RO membranes; however, the RO feedwater had high concentrations of soluble salts and residual quantities of detergents and grease.

Because the intended treatment was for reuse of the water, the brine blowdown or water discharged to waste was never greater than 20 percent of the feed supply. The RO modules were operated at 600 psi on 8 hour/day operating cycles. The average quality of feed water to the membrane is tabulated in Table II, along with a typical analysis of the product water.

TABLE II

Characteristics	Feed	Product
pH	6.8	5.7
Turbidity (JTU)	3.5	0.1
Total Dissolved Solids (mg/1)	3550	105.
Alkalinity (mg/1)	188	10
Hardness (mg/1)	234	2
Chloride (mg/1)	900	46
Sulfate (mg/1)	2.5	0.2
Silica (mg/1)	68	9
Phosphate (mg/1)	35	1
Chemical Oxygen Demand (mg/1)	78	0
Temperature (°F)	83	86
Flux (gpd/sf)	—	9.6

The quantity of product water was excellent although filtration through granular carbon was required to reduce trace quantities of detergent. Several interesting events occurred in the course of this operating cycle. A gradual reduction in flux during the first 50 hours of operation, attributed primarily to compression of the CA membrane, was followed by a continuous slow decrease in flux. Some of this was due to decrease in water temperature and some to possible fouling of membrane surfaces.

After 210 hours of operation, the flux rate decreased rapidly to a level below rated capacity. At this point 1.45 mg/l of iron was found in the feedwater. The test cells were operated only during the day. During the initial flush of the brine stream upon start up in the morning, it was apparent that H_2S was present.

Close examination revealed that several severely corroded iron fittings in the plumbing system apparently contributed iron to the feedwater.

(Continued on page 66)

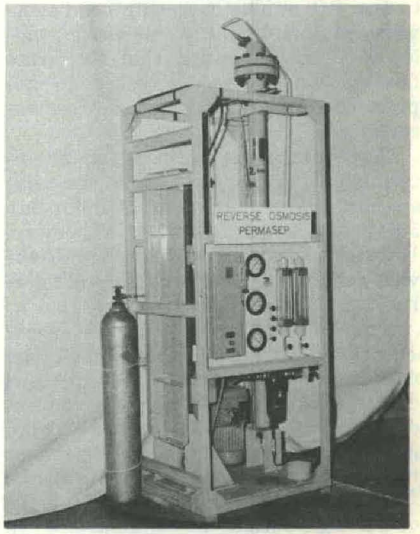


Fig. 2. Hollow Fibers Reverse Osmosis Unit

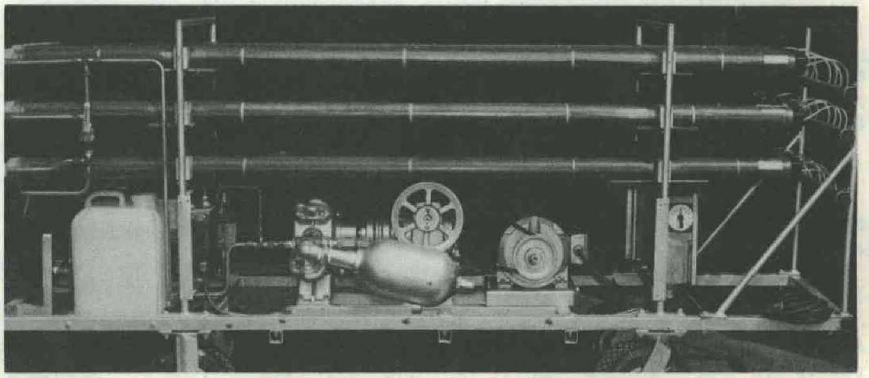


Fig. 3. Tubular Reverse Osmosis Unit

Reverse Osmosis Offers Water Purification Potential

(Continued from page 65)

These were replaced with plastic material and soon the iron content in the feedwater was no more than a trace at 285 hours.

Concurrently at 210 hours, when the first rapid decrease in flux was observed, the membranes were cleaned with an enzyme detergent. This cleaning restored the flux rate temporarily for about one week, or another 40-hour operating cycle.

Again, at the 285-hour point, the acidity of the feedwater was depressed to pH6 by continuous addition of hydrochloric acid. Depressing of the pH maintained a more constant flux for the remainder of the test, concluded at 426 hours. With the high concentration of carbonates in the brine stream, the pH adjustment kept the membrane surfaces clean of scale depositions.

Using the same three RO units representing the different configurations, tests were initiated for treatment of Potomac River water pumped directly to the RO units. Operating conditions were similar to the wastewater studies with the exception that the brine flow to waste was increased to approximately 50 percent of the feedwater input.

Test units were operated on an intermittent 8-hour-day cycle and also on continuous cycles of 24-hour-day 5-day weeks for a total of 674 hours. During this period, the Potomac River was cold and clear, with low alkalinity and chloride content.

Quality of Potomac River water will change due to periodic high turbidities during the spring runoff; increased chloride, organic and nutrient content during the dry season; and very high algae growths during the summer months. The range in quality of the feedwater and product water for the operating period is summarized in Table III.

The feedwater turbidity was very fine, possibly colloidal, because it did not subside with long-term settling. Regardless of the variation of feedwater, the product water for all three types of RO configurations remained fairly constant and acceptable for drinking water purposes.

In present tests with Potomac River water only two enzyme cleaning treatments have been applied. No adjustment of pH is being made and there is a gradual decrease in flux rate with continued operation. The flux recovers after a rest or relief of operating pressures on the membrane. After recovery, the rate of flux decrease is rapid within the first 24 hours, after which the rate of decrease is very gradual.

The recovery and decrease of flux appears to be following a pattern and may continue as long as there are no significant variations in the quality of the applied water. This pattern has an impact on total performance and method to clean membrane surface or condition feedwater to maintain flux rates should be studied.

Chlorination of the Potomac River water has produced worthwhile benefits. Without chlorination, there has been gross accumulation of total bacteria on the feedwater side of the membrane. Noted also is subsequent gross accumulation of bacteria on the product side, especially after the units have been stopped and inoperative over weekend periods.

With addition of chlorine (calcium hypochlorite) to the feedwater in sufficient quantity to assure a chlorine residual in the product water, coliform bacteria were not found in the water nor in the brine blowdown.

From a military standpoint, the addition of chlorine to the feedwater is desired because it insures the presence of residual chlorine in the finished water prior to distribution for troop consumption. Results of MERDC testing to date on the Potomac River water are not conclusive. The three test units have been operated for 1,110 hours without change in membranes or occurrence of any significant operational or mechanical problems.

TABLE III

	FEED POTOMAC RIVER WATER	PRODUCT WATER
pH	7.6–8.1	7.4–7.7
Turbidity, JTU	15–28	0.3–0.1
Temperature (°F)	52–64	—
Total Dissolved Solids (mg/1)	180–240	20–26
Chlorine Residual (mg/1)	5–10	1–5
Bacteria/100 ml	2000	0

These units and other modules are being instrumented for continuous operation and monitoring to obtain information, and hopefully, knowledge on performance of reverse osmosis on a river water supply that encounters significant changes through the four seasons of the year.

New ideas, results and operating experiences from others are contributing significantly to the improvement of reverse osmosis treatment of water. Some of the new ideas or improvements that would make reverse osmosis more acceptable to Army multipurpose use are as follows:

1. Effective operation and storage of osmotic membranes at ambient temperatures ranging from —80°F. to +155°F.
2. Operation with natural waters without adjustment of the pH or troublesome compounds such as iron.
3. Improved resistance of membranes to fungi and microbiological attack, both in storage and intermittent operations under all environmental conditions.
4. A simple method for repair and/or replacement of membranes in the field.
5. Membrane and supporting accessories to produce drinking water from sea water on a single cycle.
6. Field procedures to reduce fouling of membranes or, if fouled, methods for cleaning or restoring flux rates.

* * *

KXY NXXDXD VXRY MUCH. *Xvxn though my typxwritxr is an old modxl, it works quitx wxll, xxcxpt for onx of thx kxys. I havx wishxd many timxs that it would work pxrfxctly. It is trux that thxrx arx forty-six kxys that function wxll xnough, but just onx kxy not working makxs thx diffxrxncx. Somxtimxes it sxxms to mx that our organization is somxwhat likx my typxwritxr—not all the kxy pxoplx arx working propxrly. So thx nxxt timx you think you arx only onx pxrson and that your xfforts arx not nxxdxd, rxmxmbxr this typxwritxr and say to yourszlf: "I am a KXY PXRSON in thx organization, and I am nxxdxd very much! . . .* HumRRO Highlights.

★ ★ ★

RICHARD P. SCHMITT is chief of the Sanitary Sciences Division, Military Technology Department, U.S. Army Mobility Equipment R&D Center, Fort Belvoir, Va.

He received a BS degree in civil engineering from the University of Iowa, just prior to joining the MERDC in June 1942. His service in the Medical Corps from 1944 to 1947 included duty in the Asiatic-Pacific Theater.

Schmitt is a member of the American Water Works Association, the Conference of Federal Sanitary Engineers, and the Society of American Military Engineers. Authorship of a number of papers for presentation and publication has earned him several awards.

R&D Achievement Awards Recognize 81 in Army In-House Labs

(Continued from page 9)

expected to prove of significant benefit for a variety of advanced Army helicopters.

Results have demonstrated that future stability and control studies of fuselage motion of rigid helicopters must include the transient flapping of the blades due to potential coupling between motion of the rotor shaft and motion of the rotor blades.

Dr. Shupe led a design team that synthesized and evaluated an electronic stabilization system for the Lockheed AH–56A. The system was tested from the standpoint of aircraft stability, handling qualities, flight safety reliability, and the details of flight control hardware.

Results have confirmed his theory that the recommended design is feasible and provides the flight control required for tactical operations.

AMC WEAPONS COMMAND (WECOM) Headquarters, Rock Island, Ill.—Watervliet (N.Y.) Arsenal. A 5-man team from the Benet Research and Engineering Laboratories at Watervliet Arsenal will receive an R&D Achievement Award for investigations leading to solutions of fracture mechanics problems for thick-walled cylinders.

Dr. Moayyed Hussain, Raymond Scanlon, Joseph Throop, John Underwood and *Ralph Lasselle* comprise the team. Results of their research are proving useful in predicting the safe life of gun tubes; substantial increases in the number of rounds a gun tube can be fired are yielding large savings in operational cost.

Design data from their analyses and measurements provide greater firepower for tanks, artillery and aircraft weapons. The same techniques are applicable to industrial high-pressure vessels and piping.

Investigative results of the team have been published by Watervliet Arsenal as "Technical Report WVT–7026, A Compliance K Calibration for a Pressurized Thick-Wall Cylinder With a Radial Crack"; also, "Technical Report WVT–7035, Fatigue Crack Tolerance in Thick-Walled Cylinders."

Donald R. Furmanski of Frankford Arsenal, Philadelphia, Pa., was selected for his "exceptional contributions" to the improvement of armed helicopter capabilities in Southeast Asia.

His efforts resulted in delivery to Southeast Asia of a stabilized binocular, an imaging infrared system, and associated covert ammunition that significantly enhances the weapon delivery capability of the Army.

AMC MISSILE COMMAND (MICOM), Redstone Arsenal, Ala. Two MICOM nominees were selected for R&D awards on the basis of their individual achievements in the advancement of laser technology.

Russell T. Gambill was cited for major contributions to advancement of missile guidance and control technology; also, for advancement of semi-active laser guidance technology and application of that technology to weapon systems.

"As a direct result of Mr. Gambill's initiative, major technical obstacles to application of this technology were addressed and resolved," the citation states.

"His keen appreciation of system engineering and the advanced technology employed in laser guidance, and his initiative in applying these skills, has had significant and far-reaching impact upon Army weaponry."

Charles M. Cason III was selected in recognition of contributions to high-energy laser technology. His studies of the carbon-dioxide gas-laser have been directed primarily toward development of new concepts for high-powered lasers; also, techniques for analyzing the performance of such lasers.

The citation notes that his invention of the differential excitation laser (supersonic mixing laser) and the electro-adiabatic laser (an electrically augmented gas-dynamics laser) are "significant advances in high-powered laser technology.

"His diagnostics work on measurements of laser level lifetimes provided a new, reliable and practical method. . . . His work on theoretical models. . . . has been very useful in showing the functional relations among the many variables which must be considered in design of gas-dynamics laser hardware for experiments."

AMC MOBILITY EQUIPMENT COMMAND (MECOM) Headquarters, St. Louis, Mo.—Mobility Equipment R&D Center (MERDC), Fort Belvoir, Va. *Dr. Tibor G. Horwath* was selected for his outstanding efforts in design and development of sensors, signal processing and guidance concepts. Results reportedly are having long-range implications in applications to weapons systems for national defense.

The citation states that he has been a key participant in the HOMINE closed-loop analog simulation. His research is credited for contributing to development of a sensor that "provided the technological breakthrough to make acoustic homing technically feasible."

Taylor H. Jefferson (MERDC) received recognition for research on fuel decontamination in which he demonstrated the feasibility of removing water and surfacing additives from fuel.

The citation says increased use of fuel additives, such as corrosion inhibitors, anti-icers, detergents, etc., has made it difficult for existing decontamination equipment to meet current fuel cleanliness requirements.

Jefferson has demonstrated that exposure of contaminated fuel to an electric field induces dipoles in the dispersed water droplets, resulting in coalescence that permits removal of the water from the fuel.

Diesel fuel treated with maximum amounts of additives can be decontaminated to insure that safety, reliability and performance of future equipment will not be limited by inability to provide clean, dry fuels.

A M C TANK-AUTOMOTIVE COMMAND (TACOM), Warren, Mich. *Dr. Richard A. Lee* is credited with development of a technique to measure amplitude and phase of eye-motion due to vehicle vibration; also, application of the technique to optimization of vehicle design based on limitations of human capabilities.

This approach has resulted in design equations to establish a heretofore suspected, but previously unmeasured, delay between head motion and eye motion. The equations and computer programs he developed are cited as a completely new approach. They will be applied to the design of improved vehicle and stabilization systems.

AMC AVIATION SYSTEMS COMMAND (AVSCOM) Headquarters, St. Louis, Mo.—Air Mobility R&D Laboratory (AMRDL), Fort Eustis, Va. Technological progress in the Army's 1500 hp Demonstrator Engine Program earned R&D Achievement Awards for *LeRoy T. Burrows, Paul Chesser, Nicholas C. Kailos* and *Henry L. Morrow* of the Eustis Directorate, AMRDL.

This program, the citation states, will provide the Army with candidate low-development-risk advanced technology engines for the next generation aircraft. The improved engine capability is expected to reduce future aircraft costs, reduce logistics support, and provide increased survivability.

AMC CENTRAL LABORATORIES—Harry Diamond Laboratories

(Continued on page 68)

From left, Richard A. Meinert, Charles E. Sallade, Donald R. Furmanski, AMC, MUCOM, *Frankford Arsenal;* Dr. Tibor G. Horwath, AMC, MECOM, *Mobility Equipment R&D Center;* Dr. Richard A. Lee, AMC *Tank-Automotive Command.*

R&D Achievement Awards Recognize 81

(Continued from page 67)

(HDL), Washington, D.C. *Gregory V. Cirincione* was cited for contributions to the AN/TPQ–34 program. His work has advanced the state-of-the-art in the radar field by improving the Army's technical capability for detecting personnel in heavy foliage at ranges up to about 12 miles.

Cirincione managed all aspects of the program, in-house and with industry, and was cited for his personal technical contributions to pulse coding, signal processing, and displays. Careful scrutiny of the contractor's circuit designs, the citation states, enabled him to forestall problems that would have led to inadequate performance and delays in a "crash" program.

Nick Karayianis was selected to receive an Army R&D Achievement Award in recognition of outstanding contributions to the theory of the optical properties of rare earth ions in crystalline solids.

His work at HDL has resulted in the establishment of a good scientific basis for the development of new materials of military importance in the field of quantum electronics; also, for possible improvement of devices currently in service.

Robert B. Oswald, Dale R. Schallhorn and *Harvey A. Eisen* will receive R&D Achievement Awards for participation in an experimental program to develop a radiation-hardened transistor. Leading a group of contractors composed of radiation experts and transistor manufacturers, they succeeded in defining the failure mechanisms and finding a means of rectifying the failure by design changes.

Natick (Mass.) Laboratories. *Dr. Abdul R. Rahman* of NLABS developed a scientific method for reversible compression of dehydrated fruits and vegetables for use in military feeding systems, thereby winning an Army R&D Achievement Award.

Reductions in volume by compression equivalent to the reduction in weight effected by dehydration have been achieved for peas, corn, green beans, spinach, onions, carrots, cherries and blueberries.

For example, one container of compressed, freeze-dried green beans is equivalent to 16 containers of the uncompressed product. When rehydrated, they expand to virtually their original shape and quality.

The reduction in weight and volume, together with increased convenience and stability of subsistence, is considered of paramount importance in current and future military feeding systems.

Aberdeen R&D Center (ARDC), Aberdeen Proving Ground, Md. *Dr. Robert Eichelberger, Dr. Coy M. Glass, Joseph M. Regan* and *Richard Vitali* of the ARDC Ballistic Research Laboratories worked as a team in winning their awards.

They have conducted theoretical and analytical investigations in the basic phenomena governing the behavior of shaped-charge antitank warheads to penetrate armor.

Basic research showed that the lethality and effectiveness of shaped-charge warheads depends upon rigid control of tolerances of the metal cone-liner and the precision of the warhead assembly. A substantial improvement in weapons effectiveness was brought about through their efforts in advancing fabrication techniques.

Gary L. Horley, ARDC Human Engineering Laboratories, was recognized for devising methodology for measuring total and component weapon system performance; also, for development of new artillery forward observer techniques. Artillery commanders are thus enabled to reduce significantly the amount of ammunition used and increase first-round hit probabilities.

OTHER AMC ACTIVITIES—Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass. Research efforts by *Dr. Dennis J. Viecknicki* and *Frederick Schmid* established a scientific basis for growing single crystals (man-made sapphire) by a gradient furnace technique, meriting R&D Achievement Award selection.

The method offers good promise for producing crystals to meet the Army's needs for lightweight transparent armor. Crystals produced by this method are extremely heat-resistant and also are being studied for civilian applications such as high-temperature windows.

OFFICE, CHIEF OF R&D (OCRD) Headquarters, Washington, D.C.—Land Warfare Laboratory (LWL), Aberdeen Proving Ground, Md. *Vincent J. DiPaola* was selected for an R&D Achievement Award based on leadership, technical contributions and direction of the Applied Chemistry Branch, Advanced Development Division, LWL.

Included among LWL responsibilities are quick-reaction R&D in surveillance devices, detection of personnel and explosives, nonelectric communication devices including a family of minature signaling grenades, illumination, riot control and smoke screening techniques.

Through effective planning and supervision as well as his direct technical contributions, the citation states, DiPaola has been able to maintain a short R&D cycle—that is, from the time a requirement is placed on his branch to the time the device or materiel is ready for delivery to the Army user.

Achievements credited to his branch include personnel detectors, a plasma chromatograph, a biochemical detector, sandbag preservation, front-line markers, mini-flares, remote sensing systems, and techniques for measure-

ment of military explosive vapors.

OCRD Manpower Resources R&D Center, Behavior and Systems Research Laboratory, Arlington, Va. *Jack J. Sternberg* was selected for his leadership in research to improve combat capabilities at night and performance in sustained military operations.

As program director of the Field Experimentation Unit, Fort Ord, Calif., Sternberg developed methodology for conducting scientific experimentation in the field. Under simulated night operations conditions, soldiers acted as targets in night search operations.

The research has provided the Army with a scientific basis for decisions on doctrine, distribution of equipment in small combat units, and new approaches to training in the use of night observation devices. Procedures developed for using the devices enable soldiers to perform well even after several hours of intensive night viewing.

CORPS OF ENGINEERS (CE)—U.S. Army Engineer Topographic Laboratories, (USAETL), Fort Belvoir, Va. *Drs. Desmond O'Connor* and *P. F. Chen* of the USAETL Research Institute are Army R&D Achievement Award selectees for conceiving and constructing a new measurement system using arrays of photodiodes.

Their system is based on the concept of oscillating or perturbing the images to be measured over the array electronically or mechanically. The resolution of the system without perturbation is equivalent to the array element size.

Maurits Roos, USAETL Automated Mapping Division, will receive an Army R&D Achievement Award for developing and implementing a means to automate precise point measuring and aerial photography. The achievement required more than 10 years of field experimentation.

Installation of an Automatic Point Transfer Instrument at the U.S. Army Topographic Command Production Center permits automatic measurements of precise x and y coordinates of photographic images on aerial photography. The accuracy is within 2 micrometers or .00008 inches.

In a recent comparative test this instrument has performed required operations in one-third the time and with twice the accuracy of conventional instruments. In addition, the instrument is designed to handle a variety of photographic inputs, including formats of up to 9 x 18 inches, and will also mark the images desired and record their coordinates.

The achievement provides the Army's map production facility with a new and greatly improved technical capability. The instrumentation increases the speed and reduces the cost of an important part of the process.

CE Cold Regions Research and Engineering Laboratory (CRREL), Hanover, N.H. *James R. Hicks* was cited in the award nomination for his outstanding contributions in developing techniques for fog dispersal.

Among these are adapting a gas-propelled rocket as a simple reusable device for distributing nucleating agents into low-hanging clouds; development of a ground-based propane gas system for dispersal of cold fogs; and a helicopter technique to disperse warm, cold, and/or ice fogs.

The citation says his work in the area of fog dispersal is recognized as important not only to the Army, but to the nation as a whole. His system was adopted by the U.S. Air Force for operational use in 1970 and is being applied to some civilian airport fog dispersal requirements.

CE Waterways Experiment Station, Vicksburg, Miss. *Thomas E. Kennedy's* award selection stems from his work in the conception, design, construction and testing of two structural models that simulated the Perimeter Acquisition Radar Building (PARB) of the Safeguard ABM System.

The complex, reinforced-concrete models were subjected in July 1970 in Event Dial Pack to the air-blast and ground-shock effects resulting from the detonation of a 500-ton sphere of TNT.

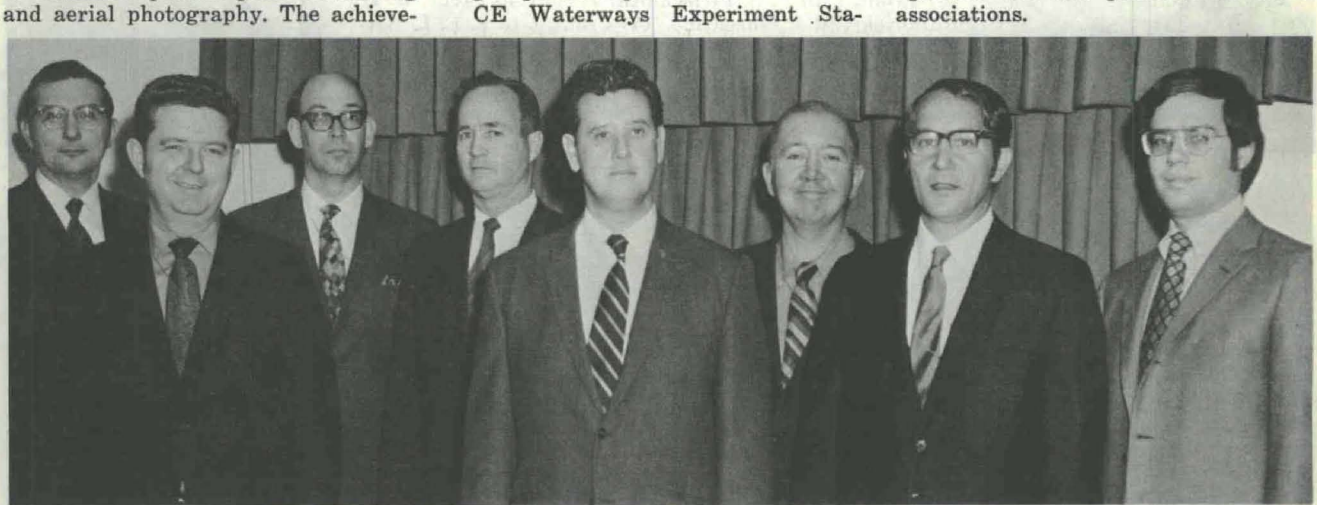
Conducted at the Canadian Defence Research Establishment site in Suffield, Alberta, Canada, the tests proved that the prototype PARB could withstand effects of the postulated nuclear threat. The experiment was under the auspices of The Technical Cooperation Program and U.S. participation was coordinated by the Defense Atomic Support Agency (DASA).

CE Construction Engineering Research Laboratory (CERL), Urbana, Ill. *Dr. Edward L. Murphree's* award nomination certifies his achievement in developing the systems approach to problems of rigid airfield pavements necessary to service jumbo jets of the Boeing 747 class.

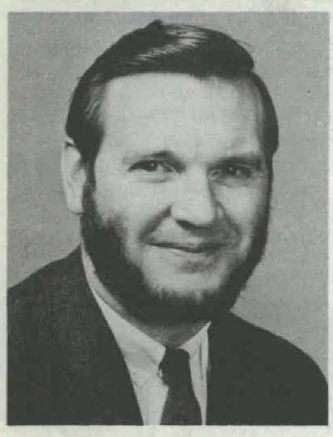
Dr. Murphree's work has also opened the channels of communications among the 28 classes of professionals who are concerned with the airfield pavement—from the pilot to the maintenance engineer.

He formulated the first interdisciplinary conference wherein representatives of the 28 classes of professionals met in one room and learned of each others' needs in pavements.

The meeting was the prelude to a total of five interdisciplinary conferences held under auspices of an academic institution, two government agencies and two professional trade associations.



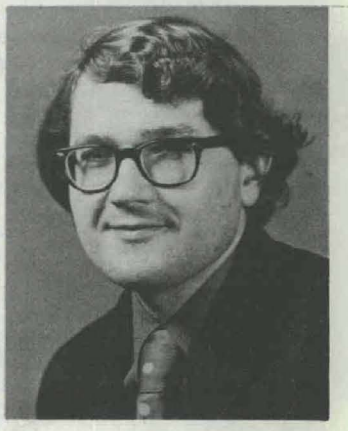
AMC ELECTRONICS COMMAND R&D Achievement Award Team includes (from left) Joseph Widemann, Walter Mannherz, Gerald Bean, William Sims, James Perry, Patrick Daly, Edward Butcher and Jon Ulaney.

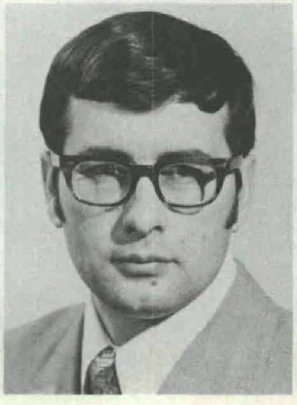


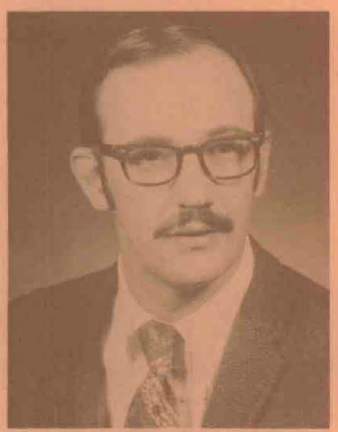
R&D Achievement Award Winners

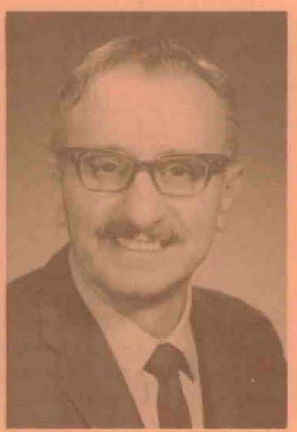
(For photos of other winners and the laboratories with which they are associated, see pages 8, 9, 68, 69, 71, 72. Story begins on page 1.)

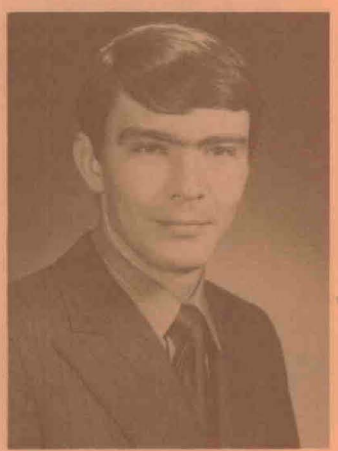
AMC, MUCOM, *Picatinny Arsenal*—(1) Front, l. to r., W. G. Reiner, W. H. Meyer; rear, R. F. Van Ness, M. A. Chiefa. (2) Front, l. to r., W. G. Joseph, J. Howell, S. Rampone; rear, E. Wurzel, S. Jacobson, T. Zimmerman. (3) Front, l. to r., S. Fleischnick, T. Stevens; rear, H. D. Rutkovsky, A. J. Fiorentino. (4) Front, l. to r., E. L. Barrieres, R. W. Kantenwein; rear, S. D. Kahn, G. E. Gaughan. AMC, *Army Materials and Mechanics Research Center*—(5) F. Schmid. (6) Dr. D. J. Viechnicki. AMC, AVSCOM, *Air Mobility R&D Lab*—(7) N. C. Kailos. (8) P. Chesser. (9) L. T. Burrows. (10) H. L. Morrow.







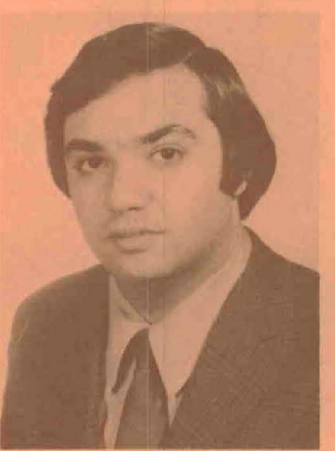


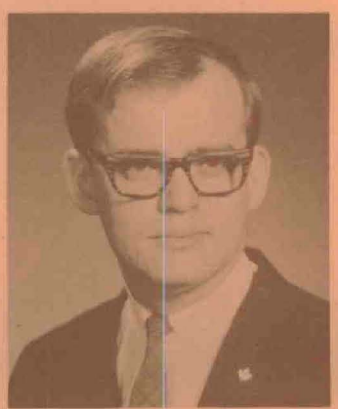


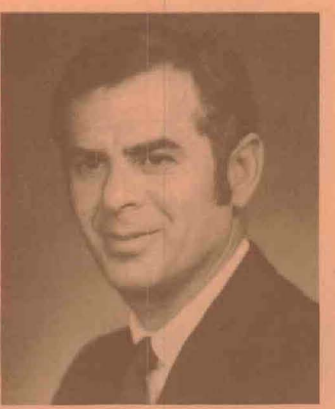
R&D Achievement Award Winners

(For photos of other winners and the laboratories with which they are associated, see pages 8, 9, 68, 69, 70, 72. Story begins on page 1.)

AMC, MOCOM, ***Mobility Equipment R&D Center***—(1) Taylor H. Jefferson, AMC, WECOM, ***Watervliet Arsenal, Benet R&E Laboratories***—(2) Front, l. to .r., Joseph Throop, Dr. Moayyed Hussain; rear, Raymond Scanlon, John Underwood, Ralph Lasselle. OCRD, ***Land Warfare Laboratory***—(3) Vincent J. DiPaola. AMC, ECOM—(4) Vito J. De Monte. (5) Richard J. Newton. (6) Michael R. Mirachi. (7) Maj Maynard A. Nagelhout. (8) Alexander G. Mondrick. (9) Robert G. Palazzo. (10) Dr. Norman K. Shupe. (11) Arthur Sills. (12) Dieter R. Lohrmann. OCRD, ***Manpower Resources R&D Center, Behavior and Systems Research Laboratory***—(13) Jack J. Sternbert.







R&D Achievement Award Winners

(For photos of other winners and the laboratories with which they are associated, see pages 8, 9, 68, 69, 70, 71. Story begins on page 1.)

AMC, MICOM—(1) Charles M. Cason III. AMC ARDC, *Ballistic Research Laboratories*—(2) From left, Richard Vitali, Joseph M. Regan, Dr. Robert Eichelberger, Dr. Coy M. Glass. AMC, ARDC, *Human Engineering Laboratories*—(3) Gary L. Horley. CE, *Engineer Topographic Laboratories*—(4) Dr. Desmond O'Connor. (5) Dr. P. F. Chen. (6) Maurits Roos. CE, *Construction Engineering Research Laboratory*—(7) Dr. Edward L. Murphree. CE, *Cold Regions Research and Engineering Laboratory*—(8) James R. Hicks. CE, *Waterways Experiment Station*—(9) Thomas E. Kennedy. AMC, MICOM—(10) Russell T. Gambill. AMC, MUCOM, *Edgewood Arsenal*—(11) Joseph G. Schaffner, William J. Weber, Jacob Klein. AMC, *Harry Diamond Laboratories*—(12) Gregory V. Cirincione.