ARMY RESEARCH AND DEVELOPMENT

MONTHLY NEWSMAGAZINE OF THE OFFICE OF THE CHIEF, RESEARCH AND DEVELOPMENT
Vol. 12 No. 2 • March 1971 • HQ DEPARTMENT OF THE ARMY • Washington, D.C.

Army Symposium Focuses On Operations Research Next Decade Objectives

The U.S. Army's Tenth Annual Operations Research Symposium, May 26-28, in Durham, N.C., is centered on the theme of "The Next Decade" and will be sponsored by the Chief of Research and Development, HQ DA.

More than 200 key managers, scientists and engineers from U.S. Army activities and limited attendees from the other U.S. Armed Forces, the United Kingdom, Canada and Australia are expected to participate.

The U.S. Army Research Office-Durham (ARO-D) is host to the all-invitational symposium and ARO-D Commander Col William J. Lynch will welcome attendees. Army Director of Research Brig Gen George M. Snead Jr. is the general chairman.

Army Chief of Research and Development Lt Gen William C. Gribble Jr. will introduce keynote speaker Lt Gen John Norton, CG of the U.S. Army Combat Developments Command and former director of Project MASSTER (Mobile Army Sensor Systems Test, Evaluation and Review). Subject of the address was not available at press time.

Assistant Commissioner for Standards and Compliance William H. Megonnell of President Nixon's Environmental Protective Agency has been

(Continued on page 9)

Army Develops Coordinating Documents As Aids for Top-Level R&D Managers

Army Systems Coordinating Documents (ASCODs), one each for 14 R&D materiel goals of the Army Strategic Objectives Plan (ASOP), developed during a year of intensive efforts as "desk tools" for top-level R&D managers, were put into initial distribution Mar. 15.

The ASOP describes force objectives and outlines requirements for future weapons and equipment. Updated annually, it presents R&D objectives for both materiel and non-materiel modernization, and the closing of technology gaps. Within these broad guidelines, the Army identifies its most urgent requirements.

Addressed to all major commands and agencies concerned with planning for research, development, test and evaluation (RDT&E), the ASCODs are part of a family of new documents to supplement current managerial aids "within existing procedures."

Assistant Secretary of the Army (R&D) Robert L. Johnson requested, in March 1970, that an analysis be made within each of the materiel objective areas to expose and examine

(Continued on page 6)

Laird Reports to Congress On Defense Concepts, Plans

Changing concepts in defense planning, organization and utilization of resources are detailed in "Defense Report on President Nixon's Strategy for Peace—Toward a National Security Strategy on Realistic Deterrence," a 191-page document dated Mar. 9, 1971.

Appearing before the House Armed Services Committee, Secretary of Defense Melvin R. Laird presented the annual summary that has become known popularly as "The Posture Statement." The official title is: "Fiscal Year 1972–76 Defense Program and the 1972 Defense Budget."

Secretary Laird reiterated one of his 1970 defense report statements:

"Transition to a new equilibrium will take time. We made a beginning in 1969 and are continuing the transition into calendar year 1970. We con-

(Continued on page 3)

National JSHS Schedules Two Attractive Innovations

Arrangements for the Ninth National Junior Science and Humanities Symposium, May 5–8 at the United States Military Academy, West Point, N.Y., indicate that it will be the largest ever held, with winners from 29 regional symposia slated to participate. Attendance of 300 is expected.

The JSHS Program is sponsored by the Department of the Army through the Office of the Chief of Research and Development in cooperation with many major industrial and academic organizations. The Army Research

(Continued on page 9)

R&D Leaders Attend AMC Conference at SwRI

PARTICIPANTS in Army Materiel Command (AMC) Directors/Commanders Conference at Southwest Research Institute (SwRI) included (from left) Lt Gen A. W. Betts (USA, Ret.), SwRI vice president; Robert L. Johnson, Assistant Secretary of the Army (R&D); Dr. Gordon L. Bushey, AMC physical sciences administrator; Dr. Robert B. Dillaway, AMC Deputy for Laboratories; Dr. Martin Goland, SwRI president. (Detailed article is carried on page 5.)

Featured in This Issue . . .

Army R&D Newsmagazine

Vol. 12, No. 2 • March 1971

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

Published monthly by the Information Systems Office of the Chief of Research and Development, Department of the Army, Washington, D.C. 20310, in coordination with the Technical and Industrial Liaison Branch, OCRD. Grateful acknowledgment is made for the valuable assistance of Information Offices within the U.S. Army Materiel Command, U.S. Continental Army Command, Office of the Chief of Engineers, and Office of The Surgeon General. Use of funds for printing of this publication has been approved by Headquarters, Department of the Army, May 1, 1970.

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.

Picture Credits: Unless otherwise indicated, all illustrations are by the U.S. Army.

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

By-lined Articles: Primary responsibility for opinions of by-lined authors rests with them; their views do not necessarily reflect the official policy or position of the Department of the Army.

DISTRIBUTION is based on requirements submitted on DA Form 12-4. Army agency requirements must be mailed to the U.S. Army AG Publications Center, 2800 Eastern Boulevard, Baltimore, Md. 21220.

Distribution on an individual name basis is restricted to members of the U.S. Army Atomic Energy and R&D Officer Special Career Programs and to R&D Mobilization Designees. Otherwise, distribution is made only to the Army installation, office or organizational element to which the requester is assigned.

CHANGES OF ADDRESS for AE and R&D Officer Special Career Program enrollees should be addressed to: Specialist Branch, OPXC, Department of the Army, Stop 106 Washington, D.C. 20315. R&D Mobilization Designees should contact the Office of Personnel Operations, Reserve Components Center, Fort Benjamin Harrison, Indianapolis, Ind. 46249—ATTN: Mob Des Career Branch.

OTHER GOVERNMENT AGENCIES' requirements should be submitted directly to the Information Systems Office, OCRD, Department of the Army, Washington, D.C. 20310, ATTN: Data Management Division, Publications Branch.

ALL NON-U.S. GOVERNMENT agencies, firms and organizations must obtain this publication through the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Single copies sell for 20 cents. Subscription rates (12 issues annually) are: Domestic, APO and FPO addresses, $2.25; Foreign, $3.00.

'AMC's Window to Industrial, Academic Worlds'

General Miley Commends Army In-House Laboratories

Speaking on "AMC and the Individual Soldier," General Henry A. Miley Jr., CG of the U.S. Army Materiel Command, paid tribute recently to the many contributions Army in-house laboratories are making that are important to the Modern Volunteer Army Program.

General Miley stressed particularly "specific programs of our laboratories that will operate to support the Chief of Staff's program" in implementing the MVA concept.

Army in-house laboratories, he said, perform basic research generally in those areas for which there is "only limited interest or capability in industry or the academic world. Our applied research draws on the concepts of the worldwide scientific community."

As "AMC's window to the outside industrial and academic worlds," he said, the in-house laboratories "are in the mainstream of all AMC developments until technical data packages are developed for volume production problems."

General Miley paid special tribute to the role of the Natick (Mass.) Laboratories with reference to food processing, preservation, packaging and responsibility for the Department of Defense Food Program for the past two years. He discussed garrison, field and individual feeding as related to requirements for improvements in the Modern Volunteer Army.

Natick Laboratories also won his acclamation for developing the DMS (Direct-Molded Sole) combat boot "that already stood the gaff in Vietnam." NLABS are working with the Army Surgeon General's staff to "find the absolute last word in combat boots . . . comfort, hygiene and foot protection."

General Miley said a probable result of this study will be "a working boot no one is supposed to try to spit shine—a feature that will probably disappear from the Modern Volunteer Army. It is rather difficult to get a high gloss on a boot that has negotiated a swamp and a spill of crankcase lubricant, and I think the Army is about to face up to this fact."

In discussing the soldier's basic requirement for pure water in any kind of environment, he described the efforts of the Mobility Equipment R&D Laboratories, Fort Belvoir, Va., in developing water purification equipment. The reverse osmosis method is regarded as a potential replacement for four other types of units, each of which can only perform one function.

General Miley stressed, however, that the reverse osmosis principle of processing salty or impure water

(*Continued on page 26*)

PEOPLE TO PEOPLE CHAT *involves General Henry A. Miley Jr., CG of the U. S. Army Materiel Command, 2d Lt Edward O. Savitz (Artillery), an ADP equipment analyst, and 1st Lt Paul I. Welle (Infantry), an AMC operations research systems analysis officer. General Miley talked to them prior to addressing an AMC HQ Junior Officers Council luncheon at Bolling Air Force Base. About 70 junior officers discussed informally with him subjects such as military dissent, junior officers in the Modern Volunteer Army, and civilian-military relationships within AMC. Similar luncheons with other HQ AMC leaders are being arranged. General Miley's basic message was: "It is possible for a junior officer to share in AMC's managerial responsibilities. Learn your trade first because this is your primary task; then, remember that success depends on diligence, energy—even curiosity—and a real desire to take part in the action."*

Laird Reports to Congress on Defense Concepts, Plans Changes

(Continued from page 1)

sider our FY 1971 budget another building block in that transition."

In discussing Department of Defense management of human, material and economic resources, he told the House Armed Services Committee:

"Our Five-Year Defense Plan projects a capability to attain our goal with an efficient and modernized force that, in peacetime, would require no more than seven percent of the Gross National Product and be made up of no more than 2.5 million men and women who are volunteers. . . ."

The plan, he said, "is keyed to the goal of preventing war and securing peace. The security a nation enjoys at any given time is, in great part, the result of past efforts, particularly in the area of technology. The United States and other Free World nations clearly enjoy greater security today than they would if the tremendous efforts of the past 20 years had not been made."

After making a brief comparison of defense policies and programs in the Eisenhower and the Kennedy-Johnson administrations, Secretary Laird said "at least seven factors, taken together, indicate that the economic, political, military, and manpower realities existing now are significantly different from the situation just five years ago. These factors are:

- A growing Soviet military capability and technology momentum.
- An expanding Soviet influence around the world, as evidenced by worldwide deployment of its growing naval forces.
- An emerging Chinese Communist nuclear threat.
- The reordering of national priorities, with a reduced percentage of the GNP for defense spending.
- Sharply rising U.S. personnel costs and a start toward Zero-Draft and All-Volunteer military force.
- A changing world economic environment because of vigorous growth, particularly among Free World nations.
- An increasing awareness among NATO members of the need for burden sharing and among many of our Asian friends of the need for regional support."

Secretary of Defense
Melvin R. Laird

Influenced by these considerations, Secretary Laird said the National Security Council concluded "that we must, whatever else, assure the following criteria in national security plans for the decade of the 1970s:

1. Preservation by the United States of a sufficient strategic nuclear capability as the cornerstone of the Free World's nuclear deterrent.

2. Development and/or continued maintenance of Free World forces that are effective, and minimize the likelihood of requiring the employment of strategic nuclear forces should deterrence fail.

3. An International Security Assistance Program that will enhance effective self-defense capabilities throughout the Free World, and, when coupled with diplomatic and other actions, will encourage regional security agreements among our friends and allies."

In summarizing the report's final chapter on "The Defense Budget and the Economy," Secretary Laird cited the "massive cuts" during the past two years related to national defense spending, adding:

"This year the rate of defense reductions is declining and we are going to do everything we can to keep to a minimum this turbulence, as it relates to our civilian employes, Defense industry employes, and our military people and their families.

"In short, the Defense Budget has been heavily affected in our national reallocation of resources. The period of Defense dominance in national resource allocation is over. Our FY 1972 budget, in constant dollars, will be below the prewar year of FY 1964. This fact cannot be ignored as we plan to implement in the next five years our New Strategy of Realistic Deterrence.

"In current dollars, the FY 1972 Defense Budget transmitted to the Congress by the President totals $79.2 billion in Total Obligational Authority (TOA) and $76 billion in outlays, including amounts proposed for future pay increases. This is $3.9 billion in TOA and $1.5 billion in outlays above the respective amounts for TOA and outlays we now expect in FY 1971."

For the military research and development community Secretary Laird offered a hopeful outlook, saying:

"It is not possible for the Department of Defense to provide for our

(Continued on page 4)

Gen Leber to Succeed Starbird As Safeguard System Manager

Safeguard ABM System Manager Lt Gen Alfred D. Starbird will retire Apr. 1 and will be succeeded by Maj Gen Walter P. Leber, nominated for promotion to 3-star rank.

Secretary of Defense Melvin Laird announced the retirement of General Starbird, who has served as Safeguard ABM System manager since November 1967. His retirement will end more than 37 years active service.

General Leber, presently serving as governor of the Panama Canal Zone, will be replaced by Maj Gen David S. Parker, now chairman of the Special Review Board, Office of the Chief of Staff, United States Army.

Feyereisen Leaves Army To Accept Civilian Offer

While congratulations were coming in to Maj Gen Paul A. Feyereisen on his promotion to permanent 2-star rank, the man who has headed the U.S. Army Materiel Command's high-priority Project PROMAP–70 announced his retirement from military service.

Effective Mar. 31, he will retire to become a senior executive with the International Telephone and Telegraph Corp. (ITT) in New York City.

Commissioned as an ROTC student at the University of Minnesota, General Feyereisen served in the China-India-Burma Theater in WW II.

Immediately prior to his 1969 assignment to the Materiel Command to head Project PROMAP–70, he was U.S. program and project manager for the 4-nation, multimillion-dollar tactical communications Mallard Project.

General Feyereisen was a member of the Hoelscher Committee whose study and recommendations resulted in 1962 Army-wide reorganization.

Graduated with distinction and a master's degree in business administration from Harvard University in 1954, he has a BS degree in economics and social science from Sophia University in Tokyo, Japan. He is a graduate from the National War College, Army Command and General Staff College, and various military schools.

The Materiel Command had not announced his successor at press time.

Laird Reports on Defense Concepts, Plans

(*Continued from page 3*)

security with a constant or falling level of U.S. R&D effort in the face of the expanding military R&D effort being pursued by the Soviet Union. . . .

"I do not know at this time what levels of research we will require by 1975 or 1980; they will depend on what course the Soviets choose to follow. But I do know that for FY 1972 we must increase our technological effort, particularly as we reduce the size of our active military force. . . ."

Secretary Laird devoted 22 pages of his report to "The Threats to U.S. and Free World Security," including intelligence estimates on growth of the Soviet nuclear strike capability (ICBMs, launchers, etc.) and the nuclear submarine fleet, tactical air power, conventional ground weapons, naval forces, and other factors such as aid to allies.

Referring to the technological challenge to the U.S. and Free World, he comments that "Forces in-being and military assistance are only part of the threat to our nation's security.

"The technology behind the capabilities of our potential opponents, particularly the Soviets, is of severe concern to us. With the continuing technological effort on their part, we must expect that the Soviets will be capable of reducing our technological lead in some areas, and at some point in the future we could even lag in certain critical areas.

"Since 1968, the Soviet RDT&E budget has increased at least 10 to 13 percent per year, while that of the U.S. has remained essentially constant.

"Our estimates indicate that the Soviets are now spending, in 1968 equivalent dollars, some $3 billion more annually on military space research and development than we do. The Soviet level of . . . effort appears to be significantly larger than that of the United States.

"With a technological effort of that size, our analyses indicate that the Soviets could reduce our technological lead of several years by approximately one year with the passing of over three years. Towards the mid-to-late 1970s, we may find that we have no technological lead at all—or worse—we may lag several years behind the Soviets in some critical areas by that time.

"Although these comments relate primarily to our estimates of funding associated with Soviet research, the same general trends are evident with regard to other measures—manpower, facility growth, and basic research efforts.

"Given the fact that theirs is a closed society, if the Soviets were to take the technological lead, it would be much more difficult for us to guide our intelligence collection activities, to interpret the information we do acquire, and to make confident estimates based on this information. . . ."

Pages 65 to 110 of the report are devoted to discussion of "Selected Strategic Forces Programs," with actual FY 1971 funding and proposed FY 1972 funding.

For example, the Safeguard ABM deployment program is funded at $1,331 million in 1971 and $1,278 million in 1972. A drop of $5 million to $100 million is shown for 1972 in the Army Ballistic Missile Defense Agency's funding for identification and development of ABM defense technology.

Similarly, FY 1971 funding of $100 million is cut to $87 million in FY 1972 for development of advanced ballistic re-entry systems and technology. An increase from $92 million to $149 million is shown for continued development of the Airborne Warning and Control System (AWACS) and Over the Horizon Radar (OTH).

Secretary Laird concedes that "operational readiness of the Army's

(*Continued on page 28*)

CDCMA Conducts Conference on Materiel Problems

Reliability, maintainability and availability problems related to military materiel were discussed at a recent 2-day conference conducted at HQ U.S. Army Combat Developments Command Maintenance Agency, Aberdeen (Md.) Proving Ground.

Objectives were outlined to more than 80 attendees representative of 10 major agencies by Lt Col John P. Haumersen, chief, Test and Evaluation Branch, Management and Evaluation Division, Office of the Chief of Research and Development, HQ DA. Col Donald H. Greeley, CO of the CDCMA, welcomed participants.

The meeting was sponsored by the Office of the Chief of Research and Development.

Discussion covered how to model and assess operational availability, performance bands and effectiveness numbers, priorities and trade-offs, and how to present reliability, maintainability and availability characteristics in materiel need documents.

Maj Gen Paul A. Feyereisen, deputy CG for Materiel Acquisition, U.S. Army Materiel Command, was the banquet speaker. He discussed problems of materiel reliability as related to his responsibilities as head of Project PROMAP-70 (Program for Refinement of the Materiel Acquisition Process).

Attendees were representative of the Army Materiel Command, Office of the Chief of Research and Development, Assistant Chief of Staff for Force Development, Deputy Chief of Staff for Logistics, Continental Army Command, Combat Developments Command, Logistics Doctrine Systems Readiness Agency, and the Test and Evaluation Command.

MECOM Selects Manning as Assistant RD&E Director

Lt Col Robert L. Manning has been assigned as assistant to the MECOM director of Research, Development and Engineering (RD&E) after serving the past year as director of Product Assurance at HQ U.S. Army Mobility Equipment Command (MECOM), St. Louis, Mo.

The position empowers him with staff supervision over functions and programs for Director of RD&E Col Bennett L. Lewis, who is stationed at Fort Belvoir, Va., as CO of the Army Mobility Equipment R&D Center (MERDC).

Lt Col Manning received a BS degree in mathematics from Florida A&M University in 1955 and a master's degree in industrial engineering from Arizona State University in 1968. He also has completed the engineer officer basic and career courses, airborne and jump master courses, and the imagery interpretation course.

Since he began his military career in 1955 he has had Corps of Engineers assignments in the United States, Germany and Korea. Assigned to the 11th Air Assault Division (Test), which became the 1st Air Cavalry Division in 1964, he served as commander of the Airborne Engineer Company and as assistant division engineer in Vietnam in 1965 and 1966. In 1968 he returned to Vietnam as engineer of the 1st Signal Brigade.

He has been awarded the Bronze Star Medal, Army Commendation Medal, and Purple Heart.

Lt Col Robert L. Manning

R&D Leaders Attend AMC Conference at SwRI

Assistant Secretary of the Army (R&D) Robert L. Johnson participated in the entire program of the Army Materiel Command Laboratory Directors/Commanders Conference, Feb. 23-24, at the Southwest Research Institute.

In addition to this detailed interest by the ASA (R&D), the meeting was notable for the initial participation of representatives from the Office of the Surgeon General and the Office of the Chief of Engineers, HQ DA.

Another highlight was the Army Advanced Ballistic Missile Defense Agency (ABMDA) presentation of a classified orientation on its R&D activities to the 60-odd attendees.

AMC Deputy CG (Lt Gen) W. W. Vaughan emphasized in his opening remarks the importance of maintaining standards of excellence in R&D activities related to and in production of military materiel, despite budgetary constrictions.

AMC Deputy for Laboratories Dr. Robert B. Dillaway presided as chairman of the sessions. Maj Gen Paul A. Feyereisen, AMC Deputy CG for Materiel Acquisition, led a panel discussion on "Interactions of Project Managers with In-House Laboratories." Both speakers emphasized the requirement for involvement of in-house labs in PM programs.

Panel members included B. R. Luczak, PM for the Main Battle Tank; Col H. H. Bolz Jr., PM for the Advanced Aerial Weapons System; Col S. C. Skemp Jr., PM for the Pershing Missile System; and Col Arthur T. Surkamp, PM for Night Vision.

ABMDA Director Dr. Jacob B. Gilstein outlined the history of the organization and plans for future activities, indicating also areas of support needed by ABMDA from in-house laboratories.

Other briefings on ABMDA were given by Archie Gold, deputy director; Vahey S. Kupelian, assistant director for Missile Development; August L. Eykholt, assistant for Radar Systems; and Lt Col J. H. Sloan, coordinator, Nuclear Effects.

Dr. Martin Goland, president of Southwest Research Institute, provided briefings on SwRI facilities, including the government-owned, contractor-operated U.S. Army Fuels and Lubricants Laboratory. He introduced as a new SwRI vice president Lt Gen Austin W. Betts, who retired recently as Army Chief of R&D.

ECOM Scientists, Engineers Share in Grants on 7 Patents

The Army Electronics Command Patent Agency has announced the granting of seven patents to more than a dozen ECOM scientists and engineers.

Dr. Rudolf G. Buser, a research physicist in the Institute for Exploratory Research, is a coholder of two of the patents. One is for "Electrical Pulse Generators," with Raymond L. Ross, also an IER physical scientist, and Gerhart K. Gaulé, Electronic Components Laboratory.

Dr. Buser shares a patent for a "Laser Generator Having a Shock-Induced Narrow Band Illuminator" with Dr. Johann J. Kainz, also an IER research physicist, and John J. Sullivan, formerly with the IER but now in private industry.

Dr. Harold Jacobs, a senior research scientist, George E. Morris, a physicist, and Dr. Ronald C. Hofer, an electronics engineer, all in the Components Lab, share a patent for a "Millimeter Wave Imaging System."

Dr. Kurt Ikrath, a research physicist in the Communications-Automatic Data Processing Laboratory, shared with Wilhelm Schneider, recently retired, a patent for "Detection of Subsurface Mineral Deposits by Coherently Detecting the Modulation Produced by a Directional Seismic Beam."

Richard A. Stern and John P. Agrios, both electronics engineers, were granted a patent for a "Non-Reciprocal Waveguide Phase Shifter Having Side-by-Side Ferrite Toroids." William H. Wright Jr., also an electronics engineer, patented a "Means for Incorporating Materials Having Magnetic and/or Electric Properties in Electron Interaction Devices."

Mortimer H. Zinn, a physical scientist and Munsey E. Crost, a physicist, received a patent for a "Thin Electron Tube with Electron Emitters at Intersections of Crossed Conductors."

FDA to Conduct Toxicological Research at Pine Bluff

Research on biological effects of chemicals found in man's environment, such as pesticides, food additives and therapeutic drugs, will be conducted at a National Center for Toxicological Research to be established at Pine Bluff (Ark.) Arsenal.

The center is being developed by the Food and Drug Administration (FDA) as a result of a growing need for adequate facilities to evaluate chemicals affecting human health that are now untested or inadequately tested. FDA researchers will occupy facilities as the Army vacates them.

Investigations will probe the mechanisms of these chemical substances, their metabolic effect in animal organisms and their rates of absorption and excretion—also dose-response relationships, especially for realistically evaluating effects of long exposure at low doses.

In addition to serving the FDA in its mission of regulating drugs, food additives and other consumer products, the center will be shared by other U.S. Government agencies such as the Environmental Protection Agency.

Arrangements are also being considered through which industry and appropriate parts of the academic community can participate in the program. After an extensive review of possible locations, it became apparent that the facilities at Pine Bluff, which were formerly used for production of biological warfare agents, were well suited for the FDA project.

The Department of the Army will be engaged in destroying biological warfare agents at Pine Bluff for approximately one year, though some facilities will become excess during that time.

WECOM Announces Assignment of Agnor as Chief of Staff

Appointment of Col Thomas J. Agnor Jr. as chief of staff was announced recently by Maj Gen H. A. Rasmussen, commanding general, U.S. Army Weapons Command, headquartered at Rock Island, Ill.

Col Agnor had served a year in Vietnam as senior adviser to the Third Area Logistics Command, immediately prior to his new assignment. He was previously at Rock Island as chief, Electronic Data Processing Office and executive officer (1961–63).

A native of Marshall, Tex., he attended the University of Texas prior to graduating from the United States Military Academy in 1946. He received a master's degree in mechanical engineering from Massachusetts Institute of Technology in 1950.

Col Thomas J. Agnor Jr.

Army Develops New Group Of Coodinating Documents

(*Continued from page 1*)

the "technological tail" behind system developments.

One of the specific goals—in the over-all effort to strengthen the R&D staff capability for resource allocation—was to establish effective support of the planning, programing and budgeting process. This required an objectively · disciplined and documented understanding of the relationships between technology and materiel system requirements.

Within the Office of the Chief of Research and Development (OCRD), in response to the request of the ASA (R&D), a new system of coherent staff planning for R&D was evolved. Development priorities are now provided to the Chief of R&D and the ASA (R&D) to assist in the allocation of scarce resources.

The new documentation adequately serves the allocation process for systems nearing completion of development in that nearly all contributing R&D projects are associated uniquely with individual systems. For less mature developments, system priorities are not adequate, because much of the contributing effort is not tied uniquely to an individual system.

Capabilities for identifying technology gaps and overlaps, and to discern among all the efforts those that are pacing systems developments, are greatly enhanced by the new family of documents.

This blending together of capability objectives, systems and technologies is made more useful by the fact that the developing agencies participated in the analysis. They helped to pinpoint the work to be done, the technological problems to be solved, and the designation of those efforts that lie on critical paths.

In addition to centralized planning together with decentralized execution within existing relationships and procedures of the R&D community, the new approach features:

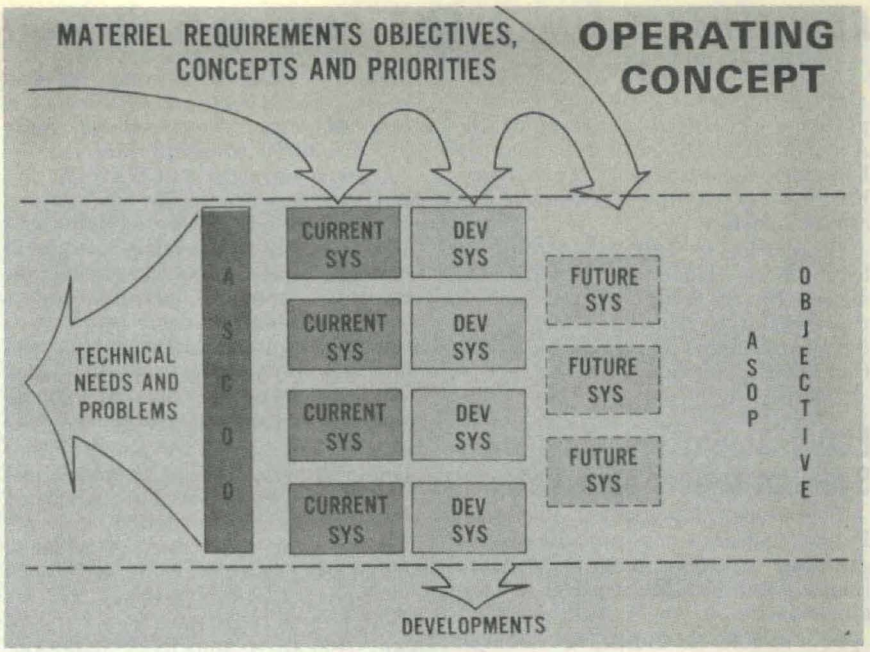
- Focus on R&D objectives of the Army Strategic Objectives Plan (ASOP).
- Threat addressal from an R&D standpoint.
- A brief executive summary documentation.

One ASCOD applies to each of the 14 materiel objectives: Air and Ballistic Missile Defense; Air Defense—Field Army; Air Mobility; Chemical/Biological; Communications; Electronic Warfare; Indirect Fire; Infantry; Intelligence/Surveillance, Target Acquisition, Night Observation; Logistical Support; Surface Mobility; Tactical Command and Control; Tactical Nuclear Operations; and Tank/Antitank.

Each ASCOD has an accompanying Threat Estimate with the exception of those on Communications, and Tactical Command and Control—both served by the Electronic Warfare Threat Estimate.

The primary agency for the new family of planning documents is the Plans Division, OCRD Directorate of Plans and Programs. The Research Technology Division, Directorate of Research, was assigned preparation of the Nonmateriel Objectives Coordinating Documents (NMOCOD) and the Research Technology Coordinating Documents (RTCOD).

The RTCOD describes basic and applied research and exploratory devel-



WES Scientists Seek Sorbents to Sink Oil Spills

Massive oil spills from breaks in undersea pipe lines or disasters to huge oil tankers that have polluted coastal waters may be controlled more quickly and effectively if U.S. Army Engineer Waterways Experiment Station efforts are successful.

WES scientists are investigating materials and methods of sinking the floating oil. Laboratory test procedures are being developed to evaluate all sinking sorbents offered by manufacturers at this time.

TEST TUBE WAR on pollution includes research on all possible combinations of oils and agents that will blot up oil and sink it to the bottom of the ocean, as shown in container.

When applied to floating oil, a sorbent creates, by chemical or physical action, a lump with a density higher than that of water, causing it to sink. WES investigators stress that these agents would be used only after all other control methods are inadequate—when oil is uncontained at sea and in danger of polluting the shoreline.

Sinking sorbents are not to be used in marine waters less than 100 meters deep because of the danger to shellfish and other marine life.

The WES test-tube battle to combat oil pollution involves some 25 different types of materials on the market as sinking agents. Each sinker is tested with six different oils in both fresh and sea water and at various temperatures.

To sink oil, the agent must repel water, attract oil and be heavy enough for application in high winds. It should retain oil on the bottom for a long period of time.

The WES tests are being conducted to evaluate the effectiveness of each sinking material on all oil spills.

opment in terms of support to ASOP materiel and nonmateriel objectives, including ongoing and planned activities. Further, it addresses those items of high potential and opportunity not yet related to specific developmental systems.

The NMOCOD addresses the six R&D nonmateriel objectives of the Army Strategic Objectives Plan, including: Personnel Care, Protection and Survival; Human Performance; Counterinsurgency; Special Warfare and Internal Defense; Environmental Analysis of/for Military Operations; Mapping and Geodesy; and Construction Methods.

Each ASCOD is prepared to present a "diagnostic treatment of technology and other R&D activity associated with systems development." In total, the ASCODs are described as a succinct compilation of existing information in the perspective of R&D activities as they relate to technologies, systems and budgetary structure.

A formal assessment of their utility will be made upon culmination of the annual budgetary process. Revisions will be made as necessary based on comments from using agencies.

Additional documents supporting the planning and budgetary process, but not included in the initial transmission of the ASCOD, the RTCOD and the NMOCOD, include:

- *R&D Planning Guide,* the central document providing essential statements of the R&D guidance and objectives.
- *R&D Priorities Guide,* which translates guidance on materiel and nonmateriel objectives into the framework of RDT&E projects.
- *Laboratory Status Report,* which presents information on R&D community personnel and facilities needed for coherent program planning.

In the budgetary review, two definitions will apply importantly:

Supporting Technology is that technology that has a *general* or *contributory* application to a system *but* which *does not drive* the system *availability* date. *Pacing Technology,* for the purpose of these documents, is that technology *necessary* to field a system in a *given time frame.*

ASA (R&D) Johnson, in his Mar. 23, 1970, guidance to the OCRD divisions assigning responsibility for developing the new family of documents to support the planning and budgetary process, stated:

". . . At this level, we *do not desire* management to use these papers to *manage programs* but rather as an *aid to allocating resources* with some attention to *priorities* and a coherent grouping of *technical activities.*"

Col Robert E. Lazzell, chief of the OCRD Plans Division directed a carefully selected team of planning, management information and technology experts in completing the initial analysis and preparation of the new family of coordinating documents. Among his fulltime analysis are Lt Cols Thomas C. Young, John P. Doyle Jr. and John J. Cook Jr.

Other major contributors include Lt Col Elmer H. Birdseye, chief, and James W. Sterling of the OCRD Research Technology Division; Lt Cols William E. Dismore Jr. and William Y. Epling of the Nuclear, Chemical and Biological Division; Lt Col Clifford Jones Jr. of the U.S. Army Advanced Ballistic Missile Defense Agency; Lt Cols William C. Stephens and Joseph H. Schmalhorst and Maj Kenneth M. Irish Jr. of the Communications-Electronics and Space Division; Lt Cols Dean R. Willwerth and William J. Westhoff of the Plans Division; and special consultants Anton B. Schmalz and Col Julius H. Braun, U.S. Army Reserve.

The U.S. Army Materiel Command cooperated in preparation of the ASCODs. Threat estimates were prepared in coordination with the Office of the Assistant Chief of Staff, Intelligence.

WES Promotes Caldwell to Chief, Engineering Division

From laborer at the U.S. Army Waterways Experiment Station, Vicksburg, Miss., to newly assigned responsibility for directing an Army program involving expenditure of more than $1 billion annually is part of Joseph M. Caldwell's success story.

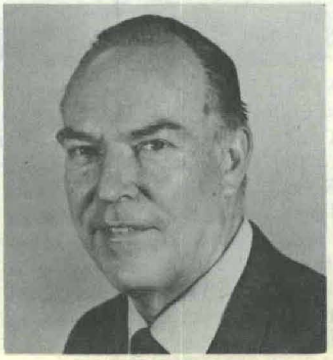
In announcing Caldwell's promotion to chief, Engineering Division, Civil Works Directorate, Chief of Engineers Lt Gen F. J. Clarke termed him a "superb engineer who enjoys professional stature of the highest order. . .who has fully demonstrated skills in supervising complex engineering activities."

While employed at the Waterways Experiment Station, Caldwell advanced to professional engineer status. In 1940 he was appointed chief of the WES Hydraulic Division. He graduated from Mississippi State University and as an assistant professor, taught engineering extention courses.

After serving in the U.S. Army from 1942 to 1946 (discharged as a major), he joined the staff of the Army Coastal Engineering Research Center. Caldwell has performed much of his work under the U.S. Aid for International Development Program. As a coastal engineering consultant, he has served in eight South American countries, four African nations, in Portugal, India, Thailand, South Vietnam. Bermuda and Canada.

Serving presently as chairman of the Civil Engineers, Caldwell also has headed the ASCE tidal hydraulics and research committees.

An ASCE Fellow, he is listed in *Who's Who in Engineering, American Men of Science,* and *Who's Who in American Education.* He is adviser to the Marine Board of the National Academy of Engineering, and in 1958 was selected for the National Service League Annual Career Service Award. He was cited for engineering assistance in Vietnam in 1965.



Joseph M. Caldwell

CSC to Establish FACS For Mid-Career Employees

Federal Automated Career System (FACS) designates a Civil Service Commission plan to establish, on a trial basis, a government-wide, computer-based program involving mid-career employes in personnel management and industrial relations positions.

The plan is designed to match talents of such employes against agency manpower needs for specific skills. The CSC said the plan is intended to:

- Offer well-qualified employes seeking career opportunities a systematic way to present their qualifications to a wide range of potential federal government employers.
- Help agencies meet manpower needs for new programs by providing a direct access to talent available within the federal service.
- Help meet the challenge of the Intergovernmental Personnel Act of 1970 by serving as a valuable manpower resource for filling temporary assignments with state and local governments.

About 10,000 employes are eligible to register in the trial program, but both employe participation and agency use will be voluntary. Employes must be in grades GS–12 through 15 with at least a year in grade and must be working in personnel management or industrial relations positions.

Processing of applications is expected to be sufficiently advanced to permit referrals to begin in April.

FACS application forms may be obtained from agency personnel offices or at CSC regional and area offices. Copies also may be obtained by writing or calling: FACS-BRE, U.S. Civil Service Commission, 1900 E Street, N.W., Washington, D.C. 20415. Tel: 202–632–6000.

Hodges Selected Head of Aberdeen-Edgewood Complex

Command of the huge complex of Aberdeen Proving Ground-Edgewood Arsenal, Md., will pass from retiring Col James O. Jones to Col Warren D. Hodges Mar. 26. Consolidation of the arsenal into the APG is to be completed by July 1.

Col Hodges had served since July 1969 at the APG as deputy chief of staff and then as CofS (Support), HQ U.S. Army Test and Evaluation Command (TECOM).

He served with the Office of the Assistant Chief of Staff for Force Development (ACSFOR) in Washington, D.C., following a 1967 tour of duty in Vietnam, six months as commander of the 2d Brigade, 4th Infantry Division and then as the division chief of staff.

Commissioned in the Coast Artillery Corps in 1943 at the Officer Candidate School, Camp Davis, N.C., he served as a company commander with the 35th Infantry Division in Europe during World War II.

Col Hodges commanded General MacArthur's Honor Guard in Japan from 1946 to 1949, until assigned to the 2d Infantry Division at Fort Lewis, Wash. He accompanied the division's 38th Infantry to Korea, where he served 18 months (1950–51).

His career has included duty with the Office, Chief of Army Field Forces, Fort Monroe, Va.; U.S. Military Advisory Group, Athens, Greece; 54th Infantry, Fort Knox, Ky.; 29th Infantry, 197th Infantry and the Infantry School, Fort Benning, Ga.

Col Hodges served as chief of the Army Element, U.S. Military Advisory Group, Pakistan (1964–66) and then became deputy assistant chief of the Army National Guard Bureau.

Col Warren D. Hodges

Col Hodges has completed courses at the Command and General Staff College and the Armed Forces Staff College. He earned a BGE degree in 1961 from Omaha University and is studying for an MA degree in international relations from George Washington University.

His awards and decorations include the Silver Star Medal with two Oak Leaf Clusters (OLC), the Legion of Merit, Bronze Star Medal with two OLC, Air Medal, Purple Heart, Army Commendation Medal with two OLC, and the Combat Infantryman Badge with two stars.

AMMRC Briefs AMC Leaders on New Materials

Top leaders of the U.S. Army Materiel Command were briefed on R&D efforts to produce some of the new materials needed for improvement of U.S. Army combat capabilities during a recent visit to the Army Materials and Mechanics Research Center, Watertown, Mass.

AMC Commander General Henry A. Miley Jr. was accompanied by Deputy for Laboratories Dr. Robert B. Dillaway, AMC Director for Research, Development and Engineering Maj Gen John R. Guthrie and Assistant Deputy for Laboratories Norman L. Klein.

Among materiel items described by AMMRC briefers were a more efficient helicopter blade, lightweight transparent aircraft armor and other armor, an improved battle helmet, and hardened antiballistic missile materials.

Application of nuclear activation analysis to the M34 primer problem was described along with use of ultrasonic and microwave nondestructive testing techniques in detecting imperfections in munition items in mass production. A system for preparing hydrides for bonding and sintering studies, and development of metal matrix composites also were explained.

Other areas of AMMRC activities included in the briefing were shock dynamics, crack initiation in low-cycle fatigue tests, the gradient furnace technique to grow single crystal sapphires for armor applications, new methods of forging and casting components, new composites for tank armor against shaped charges, research on military applications for special property alloys, analysis of turbine blade failures, and computer exploitation for armor studies.

SINGLE CRYSTAL sapphire armor samples are viewed by Army Materiel Command leaders during recent visit to the Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass. Shown from left to right are Maj Gen John R. Guthrie, AMC director for RD&E; General Henry A. Miley Jr., AMC CG; and Dr. Robert B. Dillaway, AMC Deputy for Laboratories. In the rear is Dr. Alvin E. Gorum, AMMRC director.

Picatinny Arsenal Assigns New Chiefs of Directorates

Picatinny Arsenal, Dover, N.J., has announced that Col James A. Check now heads the Ammunition Engineering Directorate (AED) and Lt Col Charles J. Treat heads the Nuclear Engineering Directorate (NED).

Col Check completed a tour of duty in Vietnam with G–4, following an assignment (1967–70) as M561/XM705 tank project manager, U.S. Army Tank-Automotive Command, Warren, Mich.

In 1963 he began a 2-year tour in the Communications Zone, Europe. He commanded the 84th Ordnance Battalion in Germany from 1965 to 1967. Other assignments have included duty at Fort Carson, Colo.; Aberdeen Proving Ground, Md.; Frankford Arsenal, Pa.; and Fort Knox, Ky.

Graduated from the U.S. Military Academy (USMA) in 1951, he completed the Armed Forces Staff College Course in 1967 and the Command and General Staff College course in 1962. He served as a USMA instructor and assistant professor of Ordnance after he obtained an MS degree in engineering from Purdue University.

Lt Col Treat was assigned in 1969 as 101st Ordnance battalion commander and, subsequently, as logistics staff officer of the Munitions Missile Division, Assistant Deputy Chief of Staff for Logistics, Seventh Army and U.S. Army, Europe.

In 1965 he served with Ordnance companies in Korea, followed by an assignment to the Office of the Inspector General in Washington, D.C.

In 1950 he received a BS degree in chemistry from the University of Arizona and in 1960 earned an MS degree after completing a course on nuclear engineering effects in physics at the U.S. Navy Postgraduate School in Monterey, Calif.

National JSHS Offers Attractive Innovations

(*Continued from page 1*)

Office, Durham, N.C., administrates the program.

Many of the nation's renowned industrial and academic leaders will be guest speakers or participants as chairmen of panel discussions. Dr. Morris Rubinoff, chairman of the Moore School of Electrical Engineering at the University of Pennsylvania, will give the keynote address.

Dr. Maynard M. Miller, director, Glaciological Institute and head of the Department of Geology, Michigan State University, is banquet speaker.

The featured "Science Address" is to be presented by Dr. C. Stark Draper, professor at Massachusetts Institute of Technology and president of Draper Laboratory.

The "Humanities Address" will be presented by Dr. Paul L. MacKendrick, professor, Department of Classics, University of Wisconsin.

Two innovations promise to contribute to the success of the symposium. For the first time, students will be given the opportunity to present their technical papers, instead of merely having abstracts in pamphlet form for distribution at the symposium.

Six selected students in each of five sections, all of them carefully screened on the basis of their performance in the regional JSHS, will compete for honors. Five will be picked to participate in the second innovation, a 2-week visit to the United Kingdom as part of an exchange program involving five British students who will attend the symposium.

Support from major industrial firms will finance the U.S. winners on the trip to England. Likewise, the British students are being supported on a 2-week tour of the United States that will include a tour of the nation's capital city, Washington, D.C., under the leadership of Donald Rollins, JSHS Program director.

The National JSHS will conclude May 8 with a trip to New York City to United Nations headquarters, where students will be escorted on a tour and addressed by UN leaders.

Arrangements for the panel discussions at the Military Academy, with four groups in each of two sections conducted simultaneously, will permit students to attend at least two panels in each section. Each panel will have a chairman, a representative JSHS regional director and a Military Academy staff member.

Group A of Section I, for example, will be chaired by Lt Col (Dr.) Thomas C. Winter, a staff member of President Nixon's Council on Environmental Quality. Group B will be led by Dr. John K. Beadles, chairman, Division of Biological Sciences, University of Arkansas.

Group C leader is Dr. Herbert S. Posner, head of the Section on Growth and Development, National Institute of Environmental Health Sciences, Research Triangle Park, Durham, N.C. Dr. Delbert S. Barth, who heads Group D, is director, Bureau of Criteria and Standards, Air Pollution Control Office, Durham.

Similarly, in Section II, Group A will be chaired by Dr. Norman J. Doorenbos, chairman, Department of Pharmacognosy, and professor of medical .chemistry and pharmacognosy, University of Michigan.

Heading Group B is Prof. Richard T. Scanlon, Department of Classics, University of Illinois. Group C is to be chaired by a representative of the Ford Motor Co. who will speak on "Auto Propulsion Systems." An Edison Electric Co. official from New York City will lead Group D.

USMA cadets are programed for a full dress parade as part of the orientation and recreation program arranged for symposium participants. A tour of academy facilities also is scheduled, along with a social hour.

The JSHS Advisory Council will hold its quarterly business session May 5, the day of registration.

Army Symposium Focuses On Operations Research

(*Continued from page 1*)

invited to present the banquet address.

Deputy Under Secretary of the Army (Operations Research) Dr. Wilbur Payne has agreed to preside over a panel discussion the afternoon of May 26 on "The Future of Operations Research in the Army."

Army Chief Scientist Dr. Marvin E. Lasser is programed to lead a panel discussion on requirements for and envisioned problem areas related to the Integrated Battlefield Control System (IBCS). An Army Material Command spokesman, unannounced at press time, will head a "Risk Analysis" panel.

"Preparedness Within a Constrained Budget" is the topic of a panel discussion to be moderated by T. Arthur Smith, director of Cost Analysis, Comptroller of the Army.

A panel on "Analytic Modeling" will be moderated jointly by Dr. John Honig, Office of the Assistant Vice Chief of Staff, HQ DA, and Dr. Seth Bonder, University of Michigan.

"Measures of Effectiveness" is the subject of a panel on which Dr. Frank Grubbs, chief operations research analyst at Aberdeen (Md.) Proving Ground, will be chairman.

Col Robert Montague, special assistant to Lt Gen George I. Forsythe, head of the Modern Volunteer Army program, will speak on that subject.

One of the conference highlights is expected to be a presentation by a representative of the Royal Armaments Research and Development Center, United Kingdom, as a follow-on of a highly successful innovation in 1970. The speaker then was Prof. Ronald W. Shephard, head of the Ballistics and Operational Research Branch, Royal Military Academy of Science.

The summary critique of the meeting will be given by Dr. George Nicholson, chief of the Department of Statistics, University of North Carolina.

SWEARING-IN CEREMONIES making Dr. Robin M. Williams Jr. the newest consultant to the Army Scientific Advisory Panel (ASAP) were presided over by Col Frank H. Duggins Jr., chief, Behavioral Sciences Division, U.S. Army Research Office (USARO), Office of the Chief of R&D (OCRD). Dr. Williams is director, Social Sciences Research Center, and professor of sociology and anthropology at Cornell University. Also shown (from left) are Dr. Lynn E. Baker, deputy chief, Behaviorial Sciences Division, USARO; Col Douglas W Poage Jr., director, U.S. Army Manpower Resources R&D Center, OCRD; and Dr. Kenneth E. Clark, College of Arts and Science, University of Rochester.

Edgewood, APG Merge; GETA Being Disestablished

Consolidation of Edgewood (Md.) Arsenal base operation functions with those at Aberdeen (Md.) Proving Ground is scheduled by July 1 and the General Equipment Test Activity, Fort Lee, Va., will be disestablished by Dec. 31, the Army Materiel Command announces.

The merger will incorporate property of Edgewood Arsenal as part of adjacent Aberdeen Proving Ground, permitting maximum use of nonmission resources by both installations. Edgewood is a part of the huge APG complex as a tenant activity.

An annual saving of $1.9 million is anticipated by eliminating duplicative management and support activities, involving a reduction in strength of 24 military and 97 civilian employes. Over-all, 946 civilian employes and 146 military personnel will transfer from Edgewood to APG.

Emphasized in the Materiel Command announcement is that no change will be made in the principal missions of the Aberdeen and Edgewood facilities, except that the arsenal will assume procurement functions of the APG, involving 64 APG personnel.

The APG is charged with testing Army equipment and supporting a number of other Army activities as headquarters for the Test and Evaluation Command (TECOM) and the Research and Development Center. The Chemical Commodities Management Center is to be designated Edgewood Arsenal, a Class II activity of the Army Munitions command, and will remain as an APG tenant.

Ninety-one military personnel will be reassigned and 49 civilians will be involved in the disestablishment of GETA. Civilians will be afforded the advantages outlined in Department of Defense policies on stability of employment for career personnel.

GETA's workload will be distributed at the APG, the Armor and Engineer Board at Fort Knox, Ky., and the Infantry Board, Fort Benning, Ga. The action will eliminate duplicative testing facilities and reduce the Army Test and Evaluation Command span of control.

3 ECOM Employes Retire With 105 Years Service

Three U.S. Army Civil Service career employes with more than 105 years total service at research and development installations recently terminated affiliations with those activities.

One of the Army Electronics Command's "most distinguished" scientists, Harry W. Parmer, retired from more than 41 years federal service at Fort Monmouth, N.J., formerly the home of the Army Signal R&D Laboratories.

Since 1965 he had served as technical director of the ECOM Communications/Automatic Data Processing Commodity Area. For 10 years he was director of Technical Plans, the top scientific management position in the Signal R&D Laboratories. He held the rank of lieutenant colonel but continued to serve as an officer in the laboratories from 1942 to 1946.

Parmer was the U.S. national delegate in 1961 to the Von Karman-NATO Long Range Scientific Study Group that convened in Naples, Italy. His responsibilities covered all phases of military communications, including long-range predictions of new techniques and potential systems application to NATO requirements.

Parmer holds eight patents, one for the Army's Random Access Discrete Address (RADA) communication system currently under development as a high-priority project. Author of numerous articles in professional media on technical subjects and management problems, he is listed in "Who's Who in America" and "Who's Who in the East."

Harry W. Parmer

WILLIAM P. McSHANE, a biological technician known to Edgewood (Md.) Arsenal personnel as "Doc," retired after more than 34 years federal service, dating to the time when the arsenal was known as Fort Hoyle. He served as a medic in the Southwest Pacific during World War II, but returned to the arsenal when the war ended.

All of his Federal Civil Service career was served in the toxic emergency aid station in the Edgewood Arsenal Medical Research Laboratory.

ALEX SMALLBERG ended more than 30 years employment with the Department of Defense, most of them with the Army at Fort Detrick, Md., when he departed to become director, Research Contracts and Grants, National Institutes of Health, Bethesda, Md.

Smallberg had served at Fort Detrick since 1953 as director of procurement. He formerly was special assistant for labor relations to the commanding officer, and was responsible for installation-union negotiations.

Success created a demand for his services as a lecturer or teacher at U.S. Government schools, and as an assistant professorial lecturer on procurement and business administration at George Washington University Graduate School.

Graduated from Brooklyn College with a BS degree in economics, he earned a master's degree in accounting and business administration from the College of the City of New York.

Alex Smallberg

SAM-D Passes Flight Tests At White Sands Missile Range

An Army SAM-D missile was tested successfully during a controlled flight test at White Sands (N. Mex.) Missile Range, HQ U.S. Army Missile Command, Redstone (Ala.) Arsenal, announced Mar. 10.

All test objectives reportedly were met, including one which called for the high-performance, air-defense-missile to maneuver in flight.

Further flights of the control test vehicle (CTV) are scheduled at White Sands during 1971.

"We demonstrated that the missile could be controlled and maneuvered," the SAM-D project office at Redstone Arsenal said, "and we have verified the missile's structural integrity."

The SAM-D control actuation system was tested earlier with a full-scale rocket motor during a captive firing at the test facility of the Martin-Marietta Corp., Orlando, Fla. That test demonstrated capability of the control system to operate in the acoustical, thermal and vibration environment of the motor.

Several ballistic propulsion test vehicles were flown successfully in tests of the missile's propulsion system and components leading to development of the shipping-launching canister.

SAM-D is now in advanced development and is scheduled for deployment in the late 1970s. It will be a highly mobile system, capable of acquiring, tracking, identifying and destroying several targets simultaneously.

The SAM-D program is managed at the Missile Command at Redstone Arsenal, under Col James C. Miller and Charles A. Cockrell, civilian deputy.

Military, Civilian Leaders Witness Advances in Army Communications Systems

Major advances in U.S. Army communications systems have been demonstrated impressively in recent weeks to high-level military and civilian leaders.

In Hawaii, on Mar. 17, a large group of dignitaries attended a dedication ceremony marking a new concept called Automated Communications and Message Processing System (ACAMPS), developed over a 2-year period under an Army contract with Control Data Corp.

General William B. Rosson, Commander-in-Chief, U.S. Army Pacific (USARPAC), officially accepted the new system, operated by 174 military and civilian personnel of the U.S. Army Strategic Communications Command.

ACAMPS provides HQ USARPAC with a message processing capability said to have "unparalleled speed and accuracy." The system is linked to other commands in Hawaii and throughout the Pacific and to the Department of Defense worldwide network.

Eliminating many manual message processing functions, the system automatically enters the time of receipt, detects errors in message format, routes messages to intended addressees, and records them on magnetic tape. USARPAC officials said it helps prevent errors "which could cause message delays costly and critical to national defense."

Called the "most advanced military communications terminal in the world," the STRATCOM-PAC facility is capable of storing three million words on magnetic discs and instantly recalling any message entered within the past 72 hours. It also possesses potential for more responsive control of widely dispersed USARPAC units.

Development of ACAMPS over the 2-year period was accomplished under the leadership of Maj Gen Robert D. Terry, now with the Defense Communications Agency in Washington, D.C., Maj Gen Hugh F. Foster, now CG of the 1st Signal Brigade in Vietnam, and Maj Gen Thomas Matthew Reienzi, now in command.

DEMONSTRATION OF RADA. Fort Bragg, N.C., was host to another recent demonstration of an advance in Army field communications capabilities known as the Random Access Discrete Address System (RADA). The demonstration was conducted by the Communications and Electronics Division, U.S. Army Airborne Communications and Electronics Board.

Army Chief of R&D Lt Gen William C. Gribble Jr., Brig Gen John Morrison, director for Communications Systems, Office of the Assistant Chief of Staff for Communications and Electronics, and Brig Gen Mahlon Gates, deputy director for Research, Development and Engineering, Army Materiel Command, were among about 75 dignitaries present.

The demonstration climaxed a 3-month military potential test performed on the RADA system by the Airborne Communications and Electronics Board. It was designed to test the concept of the RADA system, rather than the equipment itself, representing a 5-year development effort by the Aerospace Division of Martin-Marietta Corp., Orlando, Fla.

The system consists of two basic units, a retransmission unit (RU) and a subscriber unit (SU). Prototypes of two RUs and 33 SUs were used for the military potential tests.

The design goal of size and weight has not yet been achieved. SU prototypes weigh 65 pounds and are somewhat oversized for man-pack operations. Designers hope to reduce its weight to 35 pounds.

The RU is mounted on an extended 2½-ton truck; the final design goal is that it must be mounted in an S–250 shelter on a 1¼-ton vehicle.

Designed to handle the switchboard communications requirements of an augmented Army division, the RADA system incorporates the advantages of a radio system with the signaling capabilities of an automatic telephone network; it can handle transmission of voice, facsimile, teletype, and data information.

RADA also provides for conferences with up to nine subscribers, busy override capabilities for emergency calls, and broadcast warnings. It can link up with standard tactical and commercial telephone systems.

The original RADA concept called for a reinforced Army division to have 11 to 17 RUs and up to 2,000 SUs. Each subscriber is assigned a discrete 7-digit number just as in a commercial telephone system. All calls, whether made directly between subscribers or through a range extension network, are processed automatically by equipment logic.

With the completion of the military potential tests, the Army will now study results and determine the future of the RADA concept. If the system is approved as having reasonable potential for Army use, it could lead to an engineering development phase.

Arnold Dodds, government project officer for the RADA system, said even if the concept is adopted, it will be several years before a RADA type communications system reaches the soldier in the field.

Communicators Learn About Magnetic Bubbles

Tiny bubbles—the minute magnetic type—may play a major role in future computer and communications switching machines technology, in the opinion of one of the nation's top experts.

National president Benjamin H. Oliver of the Armed Forces Communications and Electronics Association (AFCEA) expressed this belief in speaking to a recent meeting of the AFCEA chapter at Fort Huachuca, Ariz., the U.S. Army's electronic proving ground.

Magnetic bubbles applications are being explored as a means of compact and inexpensive data storage and processing for tomorrow's computers and telephone switching systems, the American Telephone and Telegraph Co. vice president for government communications told his audience.

In present computer and communication technology, Oliver explained, connections between electronic components are a major factor in costs. The magnetic bubbles can be created, erased, and moved anywhere in thin sheets of magnetic material without interconnection.

Oliver said they could be made to perform a variety of functions—logic, memory, switching, counting—all within one solid magnetic material.

AFCEA national president Benjamin H. Oliver (left) talks to Dr. John Edwards, president of Cochise College. Oliver addressed members of the Arizona chapter of AFCEA and guests on "Magnetic Bubbles," a new concept in the exploratory development phase for possible use in computers and communications switching machines.

DoD Initiates Herbicide Effects Study With NAS

Ecological and physiological effects of herbicides will be studied comprehensively, with special emphasis regarding their impact in military operations in Vietnam, under a Department of Defense contract with the National Academy of Sciences, announced Mar. 5.

The contract requires determinations under the provisions of Public Law 91–441 enacted by the 91st Congress. The NAS National Research Council's Division of Biology and Agriculture will conduct the study and make a recommendation regarding action to ameliorate herbicidal damage in Vietnam.

Under the leadership of Dr. Anton Lang of Michigan State University, the study will be conducted with the approval and cooperation of the government of Vietnam. Special attention will be directed to the military use of defoliants in Vietnam to deprive the enemy of concealment in jungle areas.

Additional study group members will be selected to achieve a diversity of scientific expertise. South Vietnam scientists also will be invited to participate in the research effort.

The planning phase will include a review of available information and consultation with selected experts to establish a suitable background data base and to develop detailed objectives.

The over-all study will involve on-site surveys of areas of interest and is expected to include:

- Such ecological matters as successional trends in forest vegetation following defoliation, any effects of defoliation on soils and watersheds, any effects on animal and bird populations, and any effects on the forest, fishing and agricultural industries.
- The effects of crop destruction operations in South Vietnam on the local population and ecology.
- Medical evaluation to include any changes in the incidence of disease and any effects on human and animal reproduction.
- Recommendation of remedial measures designed to ameliorate any harmful effects or to control any ongoing deleterious process that may be discovered during the study, so that appropriate action can be taken.

The composition of the detailed study will be determined at the conclusion of the planning phase.

MERDC Chemist Demonstrates 'Woman's Touch' in Research

Assignment to the Fuels Handling Division might sound like a man's job, but Mrs. Shirley B. Boulware is giving it the "woman's touch" in her work as a chemist at the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

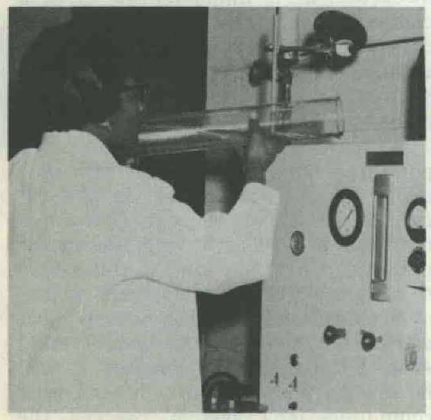
Engaged primarily in development of systems and procedures for purification of fuels, she performs research on the phenomena of water coalescence and micronic filtration of particulate matter from fuels.

Other areas of her effort include effect of additives on coalescence of water in fuels; microbiological decontamination; and new methods to meet future fuel cleanliness standards.

Graduated from Talladega, Ala., College in 1961 with an AB degree, she earned a master's in chemistry from North Carolina Central University in 1963, writing her thesis on "Acyloin Condensation," published in the *Journal of Organic Chemistry*.

Mrs. Boulware then went to Duke University as a researcher on enzyme reactions and in 1964 joined the professional staff of the Mobility Equipment R&D Center. Demonstrated competence has earned her progressively responsible duties with commensurate promotions in grade.

She has written several technical papers in the field of exotic fuels.



Mrs. Shirley B. Boulware

LSPC Incorporates Logistics Objectives in DoD Plan

Logistics support modifications within the framework of the existing organization to improve effectiveness, efficiency and economy are being studied in line with Blue Ribbon Panel Report recommendations.

Deputy Secretary of Defense Packard states in a recent memorandum that Secretary of Defense Laird and he are not disposed to adopt a Blue Ribbon Panel report recommendation to create a single Department of Defense Logistics Command "at this time." The memorandum is addressed to the Service Secretaries and the Director of the Defense Supply Agency.

Instead, the objectives will be incorporated in a DoD Logistics Systems Plan being developed under direction of the Logistics Systems Policy Committee (LSPC). The LSPC is charged with structuring implementing actions with "due consideration for mission accomplishment, system effectiveness, resource expenditure and risk. . . ."

Rules of application for each objective should be considered so that, "taken in combination, the objectives provide responsive support to operating forces in the performance of their assigned roles and mission. . . ."

Deputy Secretary Packard stresses that "these objectives should provide us with the policies necessary to maintain the separate logistics organizations for the Military Departments while we continue our progress toward eliminating unnecessary duplication and expenditures. . . ."

The memorandum states that the objectives are sound and logical and, along with the development of common data systems, "will be of substantial future benefit to the Department of Defense. . . ."

Guidance to the Military Departments in developing plans to achieve Blue Ribbon Panel report recommendations is provided in a "Department of Defense Logistics Systems Policy Objectives 1970–1975" accompanying Packard's memorandum.

Joint Services Exchange Ideas At 'Copter Fire-Control Meet

Army, Navy, Air Force and Marine Corps representatives attended a joint service Helicopter Armament Fire Control Technology Meeting at HQ U.S. Army Weapons Command (WECOM), Rock Island, Ill., Mar. 9–10.

About 65 participants indicated that the sessions were successful in providing a better understanding of fire-control problems and possible solutions. Users and developers exchanged ideas for fire-control systems for attack helicopters, and identified areas for future cooperation.

WECOM Attach Helicopter Armament commodity manager, Lt Col F. T. Bogdanowicz acted as host for the meeting in cooperation with the Naval Weapon Center (NWC), China Lake, Calif.

Technical presentations were made by personnel representing WECOM, the NWC, Frankford Arsenal, Materiel Systems Analysis Agency, Aberdeen (Md.) Proving Ground, and the U.S. Army Aviation Agency at Fort Rucker, Ala.

Pollution Meeting Scheduled Mar. 24-25 at Edgewood

Coordination of civilian and military abatement and control measures will be considered at Edgewood (Md.) Arsenal's second annual Environmental Pollution Conference, Mar. 24–25. About 350 leaders will attend.

Deputy Assistant Secretary of Defense for Environmental Quality Dr. Maurice Patton is programed for the keynote address, in which he will explain recent changes in U.S. Government environmental control activities.

Dr. Stanley M. Greenfield, assistant administrator for research and monitoring, U.S. Environmental Protection Agency (EPA), is scheduled to discuss antipollution legislation.

Joint sponsors of the meeting are the Chemical and Biological Division at the arsenal and Chesapeake chapter, American Ordnance Association.

Arsenal Commander Col George W. Connell will welcome the conferees. Dr. Solomon Love, acting chief, Detection and Warning Laboratory of the arsenal Defense Development and Engineering Laboratories, will share chairman duties with Col Norman I. Shapira (USA, ret.), a chemical consultant.

The Pollution Story Today in Major Cities is the subject of Ronald Chleboski, chief, Bureau of Air Pollution Control, Allegheny County, Pa., and Austin N. Heller, secretary, Delaware Water and Air Resources Commission. Federal Program for Air Monitoring Technology is to be discussed by Dr. Paul A. Altshuller, Division of Chemistry and Physics, Air Pollution Control Office, Environmental Protection Agency, Raleigh, N.C.

"Project Eagle" will be explained by Lt Col Sampson H. Bass Jr., director of Edgewood's Defense Development and Engineering Laboratories and Hugh R. Carlson, also of the DDEL. They will detail the destruction plan for toxic materials at Rocky Mountain Aresenal, Colo., and the monitoring system.

Remote Monitoring Techniques is the topic of Stanley Klainer, Block Engineering, Inc. Robert Beman, chief, air monitoring section, Environmental Health Services, State of Maryland, also is programed for a discussion of monitoring techniques.

William Chalker, Division of Environmental Engineering, E. I. du Pont Co., Newark, Del., is on the agenda for a presentation on Problems in Meeting Emission Standards. Dr. William Lacey, Water Quality Office, U.S. Environmental Pollution Agency, will speak on The Federal Program in Water Pollution Control.

Nuclear power plant operations as related to pollution control will be discussed by Robert Lowe, Baltimore Gas and Electric Co.

Other speakers are Dr. Duane F. Ford, Medical Research Laboratory, Edgewood Arsenal; Wilbur Shields, Maryland Environmental Service, State Department of Natural Resources; Lynn Wallace, chief, Ultimate Disposal Branch, R&D Division, Solid Waste Management Office, Environmental Pollution Agency; Charles Sercu, Dow Chemical Co.; and William Dell, vice president, Combustion Power Co.

AWC to Publish 'Parameters'

Parameters, a new U.S. Army War College tri-annual magazine approved recently by the Department of the Army, is scheduled to make its first appearance with a spring edition.

Col Keith L. Monroe, MPC, will edit the publication, which will carry articles expressing professional thought on matters of broad military strategy, national defense policy, top military management, and other subjects of significant and current military interest.

Authors will be drawn principally from the faculty, students, guest lecturers, panelists and authorities in fields of special interest to *Parameters* readers.

Picatinny Training Offsets Loss of Skilled Employes

Picatinny Arsenal's college cooperative engineering training program continues to pay off in meeting requirements for an influx of new talent to offset losses of highly skilled professionals due to retirements and other causes.

Twenty-five students representative of 16 colleges and universities throughout the nation are currently involved in the program, which originated in 1954 when the need for engineering graduates became acute.

The program is designed to train chemical, mechanical, industrial, electrical and aerospace engineers. Students attending colleges and universities have a 5-year cooperative curriculum to work alternating periods in arsenal laboratories between periods of academic studies.

During their training at the arsenal, where they work alongside experienced professional engineers, the students have made a number of notable contributions to weapons development activities.

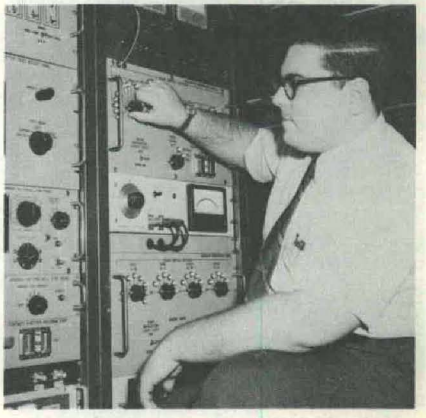
One of the trainee researchers designed circuitry that operates as an independent measuring system on a miniature 8-channel oscillograph recorder. His work provided the Army with an effective way to record effects of electromagnetic radiation on munitions.

Another mechanical engineering trainee worked extensively on experimental comparisons of liquid propulsion variable thrust injector concepts. Results provided the Army with comprehensive information on certain techniques for liquid rocket systems, thereby contributing to the development of the Army's Lance missile.

Trainee student "co-ops" also have taken part in production of a filament-wound plastic recoilless rifle; development of the famed World War II bazooka into a portable unmanned mine system that fires automatically at enemy vehicles; and development of an electronic instrument that measures the level and duration of forces acting on an 8-inch artillery shell as it accelerates on impact.

Among many cooperative training students who have progressed to good positions at the arsenal are George McCoy, mechanical engineer, U.S. Army Munitions Command, who graduated from Northeastern University; Charles Okun, mechanical engineer, Ammunition Engineering Directorate, Northeastern University; Alfred Franz, Nuclear Engineering Directorate, electrical engineer, Virginia Polytechnic Institute; and Michael Szeukula, electrical engineer, Northeastern University.

The program is coordinated by Gerald Goldsworth, employe development specialist, Civilian Personnel Office.



COOPERATIVE engineering training student Kevin Driscoll, whose semesters alternate between New Mexico State University and Picatinny Arsenal, is shown at squib switch tester at the arsenal. One of 25 co-op students assigned to Picatinny's on-the-job training program, Driscoll works primarily on electrical inspection in a high-priority missile program. He also designs electrical testers in the Quality Assurance Directorate.

Night-Vision Scope Used for Wildlife Studies

Knowledge of nocturnal feeding and other activities of the nation's wildlife is being increased substantially with the aid of the U.S. Army's night-vision devices, developed to meet an urgent requirement to combat enemy night operations in Vietnam.

A letter from the United States Department of the Interior's Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, to the Life Sciences Division of the U.S. Army Research Office, Office of the Chief of Research and Development, recently reported on studies by the Northern Prairie Wildlife Research Center, Jamestown, N.D.

The report is one of many that have been received in recent months to describe results of studies of animal nocturnal habits in the United States, Mexico, South America and certain islands in the Pacific.

Biologists at the Northern Prairie Wildlife Research Center used an Army night-vision crew-served weapon sight (Type AN/TVS–2A) during 1970 to study night-time feeding habits of waterfowl and red fox predations upon them.

Researchers said the night-vision scope "proved to be an indispensable aid" and that it "must be considered a significant breakthrough" in overcoming the previous limitations upon noctural studies of wildlife.

Animal food (midges, mayflies, water fleas, etc.) comprised 99.9 percent of the diet of the ducks during their night-time feeding, when intake was much greater than during the day. The report states:

"The sight also was used to observe the behavior of wild red foxes preying on a group of mallard ducks equipped with small radio transmitters. The ducks were placed in an open area with relatively short grass and the scope was located on a small rise approximately 150 yards from the tether site.

". . . Between 2400 and 0100 (hours) two red foxes intermittently visited the site. They killed and partially consumed two of the five ducks. The foxes were clearly observed in unobstructed moonlight. . . . During the bright conditions even the white tips of the foxes' tails were visible.

"Throughout this period the foxes could not be seen with the naked eye. The information gained through use of the scope was extremely valuable and could not have been obtained in any other manner."

Eye fatigue was a limiting factor, however. One observer could use the scope continuously for periods of only three to five minutes before his vision blurred. Even by rotating the scope among three observers, it was impossible to use it continuously.

Although the night-vision scope cannot be used in the same manner as a spotting scope in daylight, to observe behavior of birds and animals for long periods of time, researchers at the wildlife center plan to incorporate its use into other field studies this spring. The Army-supplied equipment is obviously contributing to understanding of biological processes and is a direct contribution to learning how man can learn to live in harmony with nature.

SEVENTY-THREE microfiche cards, which make up the Test, Measurement and Diagnostic Equipment (TMDE) Register, are displayed by D. A. Cox, chief, Army TMDE Technical Coordination Office, U.S. Army Weapons Command, Rock Island, Ill. The register, containing data on 2,800 items of TMDE, is published annually with a supplement published quarterly. In hardcopy form, the information would fill 4 feet of shelf space.

WES Builds Model for Beach Relocation Study

Moving a 6-mile stretch of California beach 600 or more feet out into the Pacific Ocean to permit construction of a highway to full freeway standards between Santa Monica and Topanga Canyon is a civil works project under Army Corps of Engineers study.

Problems incident to a project of this magnitude are many and complex. Involved are considerations of sea action under storm conditions or rip tides that might erode the man-made incursion into the coastline.

To study all aspects of the project, a model is being constructed at the U.S. Army Waterways Experiment Station, a Corps of Engineers R&D activity at Vicksburg, Miss.

When the beach is moved, the natural slope profile cannot be reproduced since it would not intersect the bottom the same way in the deeper water 600 feet from the present coastline.

Army engineers plan to make the beach look the same as it does now by using a "perched-beach" concept. This calls for a toe wall, or a submerged rubble-mound breakwater structure, extending from the deeper ocean bottom, to hold the new beach in a perched position.

Turbulence induced by oncoming waves as they travel over the submerged toe structure would probably pull quantities of beach material seaward. To prevent this, a blanket of stone would be laid against the landward edge of the breakwater to reduce seaward migration of sand.

The perched beach should allow the natural wave action and currents to continue without having to constantly replenish the sand on the beach.

Waves 11 feet high in nature, but reduced in size 109 times, are now hitting on the concrete beach of the model every 17 seconds. After finding the exact location, spacing and magnitude of the rip-current system with the existing beach duplicated on the model, engineers will install the perched beach. Tests will be made to find out what effect the rip currents might have on the structure.

Other studies will be made for the structural design, and to get an estimate of the amount of sand that might be lost by normal and storm wave action.

McMillan Takes SRSA Appointment

The Fort Belvoir (Va.) Branch of the Scientific Research Society of America (SRSA) has appointed Robert C. McMillan as president to fill the unexpired term of Dr. T. G. Horwath who recently transferred to a Navy R&D Center in San Diego, Calif.

McMillan received a BA degree from Southern Missionary College in 1953 and did graduate work at the University of Arkansas. He joined the U.S. Army Mobility Equipment R&D Center at Fort Belvoir in 1956 and is now employed in the Materials Research Support Division.

Army Names Chancellor 1970 Handicapped Employe

Department of the Army Handicapped Employe for 1970 is Miss Alice Chancellor, GS–12 electronic engineer at Fort Huachuca, Ariz., who also will receive her second Meritorious Civilian Service Award.

Selection over 21 other command nominees makes her eligible, as one of 10 federal agency finalists, for the Annual Outstanding Handicapped Federal Employe of the Year Award, sponsored by the U.S. Civil Service Commission. The CSC winner will be announced late in March.

Achievements of Miss Chancellor and nine other nominees employed in Army research and development activities were featured in January-February *Army R&D Newsmagazine.*

Because of the large number of nominations and the outstanding qualifications of the nominees, the Department of the Army ad hoc committee also selected three runnersup (tie) and five other finalists (honorable mention). Winners and the activities at which they are employed are as follows.

RUNNERSUP. *Dr. Edmund H. Inselmann,* Office of the Chief Mathematician, Research, Development and Engineering Directorate, HQ U.S. Army Materiel Command, Washington, D.C.

Miss Cheryl L. Maloney, born without arms, has performed at a high degree of excellence in all aspects of her work as a GS–3 card punch operator at Tobyhanna (Pa.) Army Depot since May 1968.

Doug Powell, blind since infancy, has overcome great odds in attaining his present position of GS–9 computer programer in the Directorate of Data Systems, Systems and Programs Division, HQ Eastern Area, Military Traffic Management and Terminal Service, Brooklyn, N.Y.

The runnersup will receive a letter of commendation signed by Secretary of the Army Stanely R. Resor.

HONORABLE MENTION. Wallace E. Brooks, GS–6 supervisory clerk, Engineering Division, Portland (Oreg.) Engineer District; *Harold F. Combs,* GS–9 physical science technician, Department of Medical R&D, William Beaumont Hospital, El Paso, Tex.; and

William B. Howard, WG–11 photographic equipment repairman, Directorate of Arsenal Support, Redstone Arsenal, Ala.; *Hollis K. Russell Jr.,* GS–9 supervisory histopathology technician, Armed Forces Institue of Pathology, Walter Reed Army Medical Center, Washington, D.C.

Nelms F. Finch, a GS–11 supervisory personnel management specialist with the Civilian Personnel Division, Fort Ord, Calif. Finch, a polio victim who suffered the loss of both legs, was nominated by the Sixth U.S. Army.

Department of the Army Handicapped Employe for 1970, Miss Alice Chancellor, a GS–12 electronic engineer at Fort Huachuca, Ariz., who is secretary of the Arizona chapter, Armed Forces Communications and Electronics Association (AFCEA), talks with Benjamin H. Oliver, AFCEA national president (right), Warner Bair, Arizona chapter head.

3 R&D Officers Assigned To MERDC as Coordinators

Research and development coordinator assignments of three lieutenant colonels, all Vietnam veterans, were announced recently by the U.S. Army Mobility Equipment R&D Center.

Lt Col Ellis H. Gilleland is in the Systems Development Office, Lt Col Lawrence R. Smith in the Technical Programs Office, and Lt Col Peter D. Booras in the Electromagnetic Effects Laboratory at Fort Belvoir, Va.

Since entering the Army in 1953, Lt Col Gilleland has served with the 11th Airborne Division, Army Map Service, Special Forces, and the 1st Cavalry Division. He recently concluded two years duty in Vietnam. He has a BS degree from the University of Maryland and has completed courses in a number of military schools, including the Airborne School.

Lt Col Smith entered the Army in 1951, was commissioned in 1953, and has a recent BS degree in military science from American University. He is also a graduate from the Command and General Staff College. In 1965–66 he served in Vietnam as an engineer adviser and in 1969 returned for an assignment as battalion commander and then chief of operations for an Engineer brigade.

Lt Col Booras was with the Office of the Chief of Research and Development, HQ DA, for about three years until he reported to his new assignment. He served in Vietnam in 1967–68, is a 1955 graduate of the U.S. Military Academy, and a 1970 Armed Forces Staff College graduate. Since entering the Army in 1947 he has served with the 82d Airborne Division and the 8th, 9th and 1st Infantry Divisions.

Army Develops Kit to Test Antifreeze Corrosion

When can "permanent" antifreeze safely remain in a vehicle radiator over the summer, to be used another winter, and when should it be removed because corrosion inhibitors have deteriorated to the point where serious damage to components may result?

When applied to the huge inventory of U.S. Army vehicles, this question assumes considerable monetary importance. After two years of research, the U.S. Army Coating and Chemical Laboratory, Aberdeen (Md.) Research and Development Center, has developed a corrosion test kit that provides an inexpensive, reliable answer.

Scheduled for distribution in the federal supply system in March the kit will be included in the No. 1 Common Tool Set for all Army vehicles. It will be used during all quarterly preventive maintenance services. About 23.5 million units, costing less than eight cents for material for each test, will be needed. Savings totaling $6 million in CY 1971 are expected.

Charles B. Jordon, chief of C&CL's Automotive Chemical Division, stated that the test kit fills a longtime requirement and should provide substantial savings on repair and maintenance of government vehicles.

The kit uses a small plastic strip with a ¼-inch square piece of blotter impregnated with chemicals that change color at various concentrations of alkalinity in the radiator coolant. Immersion for about 15 seconds indicates the degree of alkalinity by comparison with a color chart.

If the antifreeze is noncorrosive, the blotter turns blue. Green indicates a marginal coolant in which some corrosion has begun or could begin in a short time. Yellow shows that the coolant corrosive inhibitors have been used up and that the coolant should be removed immediately to avoid possible damage to the system.

The tester permits reliable control to extend safely the use of antifreeze to the maximum point where corrosion inhibitors lose effectiveness.

DoD Establishes Equal Opportunity Education Program

Two far-reaching actions to improve equal opportunity and promote racial harmony within U.S. Armed Forces—establishment of a Defense Race Relations Education Board, and a Defense Race Relations Institute—were announced Mar. 5 by Defense Secretary Melvin R. Laird.

The program, expected to impact nationwide upon the civilian community as those in uniform are released from military service, has been developed by the Department of Defense Inter-Service Task Force on Education in Racial Relations. The objective is to correct the causes of racial unrest, tension or conflict in the interest of combat readiness and efficiency.

Charged with implementing the program under cognizance of the Assistant Secretary of Defense (Manpower and Reserve Affairs), the Defense Race Relations Education Board will prescribe policy guidance and serve as an advisory group to the Secretary of Defense.

The Assistant Secretary of Defense (Manpower and Reserve Affairs) will serve on the board with representatives from the Deputy Assistant Secretaries of Defense (for Equal Opportunity, and for Education) and the Assistant Secretaries (Manpower and Reserve Affairs) of the Military Departments.

The Defense Race Relations Institute (DRRI), scheduled for early establishment at a site still to be selected, will be a DoD field agency. It will train Armed Forces personnel as instructors in race relations, develop doctrine and curricula for the education program, conduct research, perform an evaluation of the program's effectiveness, and disseminate educational guidelines and materials for use throughout the Armed Forces.

Army Col Edward F. Krise has been appointed DRRI director with Air Force Col Claude M. Dixon as deputy director. The staff will total about 44 officers, enlisted and civilian personnel.

The institute will have a capability for training 100 race relations instructors per class. The course of instruction is estimated at about six weeks, with classes beginning every three weeks. Instructions will range from minority groups history and sociology to teaching skills.

Students will be volunteers from all the Armed Forces, selected on the basis of experience in teaching and group communications skills.

One of the goals is to have approximately 1,400 trained full-time instructors conducting race relations courses throughout the Armed Forces within a year. All military personnel will be required to undergo at least six hours of instruction on an annual basis.

Results of the Race Relations Education Program are expected to impact initially in communities where Armed Forces are stationed, with an enduring carryover into the rest of the country as servicemen return to civilian life.

Etkin Promoted to Brig Gen As Deseret TC Commander

Deseret Test Center at Fort Douglas, Utah, is now commanded by Brig Gen Max Etkin, recently promoted to that rank.

Maj Gen Edward H. de Saussure (desa-shure) Jr., CG of White Sands (N. Mex.) Missile Range, officiated in the promotion ceremony.

A veteran of 28 years of military service, General Etkin has commanded Deseret Test Center since July 6, 1970, following an assignment as CO of the Lexington (Ky.) Blue Grass Army Depot.

General Etkin attended the U.S. Army War College at Carlisle Barracks, Pa., after a tour of duty in Germany as deputy chemical officer, HQ Seventh Army, and then was assigned to the Office of the Joint Chiefs of Staff for two years.

In 1967 he served in Vietnam, where his assignments included CO, An Khe Sub Area Command and, later, acting chief of staff, Security, Plans and Operations for the 1st Logistical Command.

He has been awarded the Legion of Merit (with OLC), Bronze Star Medal (with OLC), Air Medal (with OLC), Army Commendation Medal (with OLC), the Purple Heart, and numerous campaign and service medals for duty in World War II, Korea and Vietnam.

Brig Gen Max Etkin

CSC Review Reduces Rates of Special Salary Schedules

Changes in job-market demands determined in a recent Civil Service Commission review resulted in adjustments of special salary rates, with no further incentives to incoming engineers at grade GS–11 or 12 and physical scientists at GS–11.

New-hire rates for engineers at GS–5, the lowest college entry grade, also are reduced from $9,017, which is equal to the tenth step of the regular rate, to $8,555, the eighth step of the regular rate.

Employes who were receiving special salary rates as of Jan. 31 are shielded from the rate revisions. They will continue to receive those basic rates, including the 5.96 percent general increase to white-collar workers early in January.

The CSC review covered about 80,000 special rate employes and about 50 percent of them were placed back on the general schedule pay scale. Twelve special rate schedules are being cancelled entirely and will be replaced by statutory salary rates.

Fifty-three special schedules are being continued with fewer grade levels covered than before. In these cases, some of the grades previously covered under special rates will be placed back on regular salary scales, and rates for some will be moved nearer to regular rates.

Seventy-six special schedules are being continued for competitive reasons. More than half of these schedules cover medical or hospital-related occupations such as doctors nationwide, and nurses, laboratory workers, X-ray technicians, physical therapists, nursing assistants, etc.

ASM Honors AMMRC Director

Dr. Alvin E. Gorum, director of the U.S. Army Materials and Mechanics Research Center, Watertown, Mass., was among members of the American Society for Metals who were honored recently for distinguished contributions to progress in metals and materials technology.

Dr. Gorum was one of the first group of Fellows ever selected by the ASM and honored at a Fellow Inaugural Convocation in Cleveland, Ohio. He has been director of the AMMRC since February 1970, when he resigned as director of the Materials Sciences and Engineering Laboratory at Stanford Research Institute.

Watervliet Use of M-14 for Cannon Tube Tests Responds to Austerity

Gun tube testing costs that might have totaled nearly $9 million were avoided by the Army's Watervliet (N.Y.) Arsenal in a program to determine if tubes supplied by three manufacturers possessed the same life span.

Normal testing procedures, involving use of three full-size barrels from each of the three suppliers and firing of about 7,000 rounds from each barrel, could have cost an estimated $8,882,000. Budgetary constraints made that approach impossible.

The solution achieved by the arsenal's Quality Assurance Division (QAD) was to fire rounds from M–14 rifle barrels made from the same material the suppliers use in forging the cannon barrels, after stressing them to levels similar to those of the large weapon.

Nine models were fabricated in arsenal shops along with a special test fixture, loading device and barrel vise. Using regular 7.62mm M–14 ammunition, the models were fired some 63,000 rounds, to their point of destruction, at the Malta Test Site of the General Electric Co.

Results of the tests, supervised by arsenal engineering technician Peter G. Goutos, showed an average barrel life of 6,968 rounds. No significant statistical average life difference was noted between materials from three suppliers, although mechanical properties varied.

Vincent T. Chodkowski, chief, QAD Reliability and Test Branch, said the Malta program cost 15 cents a round for a total of $9,500, compared to the $140 per round cost of firing the full-size weapon.

Arsenal personnel who designed and built the test equipment included Philip M. Casey, Frank Guthier, Alfred W. Miller, E. C. Rufenacht and T. V. Smith.

In a technical explanation of the total evaluation effort, it was stated that tests presently used for acceptance of cannon tube forgings—charpy impact at —40° F., standard tensile bar and macroetch examination—yield little correlation with tube fatigue life, whether as single explanatory variables or in combination with other variables.

A fatigue experiment with full-size specimens was termed economically prohibitive although some work has been performed along these lines, i.e., actual firing followed by hydraulic cycling to destruction.

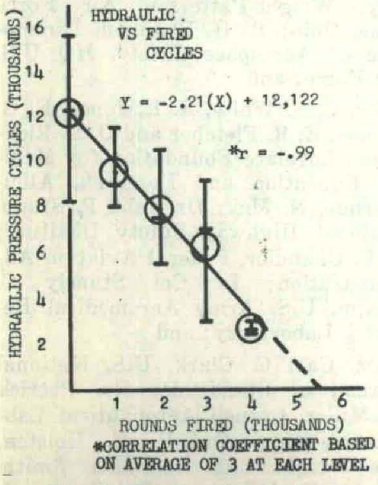


Fig. 1. Relationship Between Fired and Unfired Samples

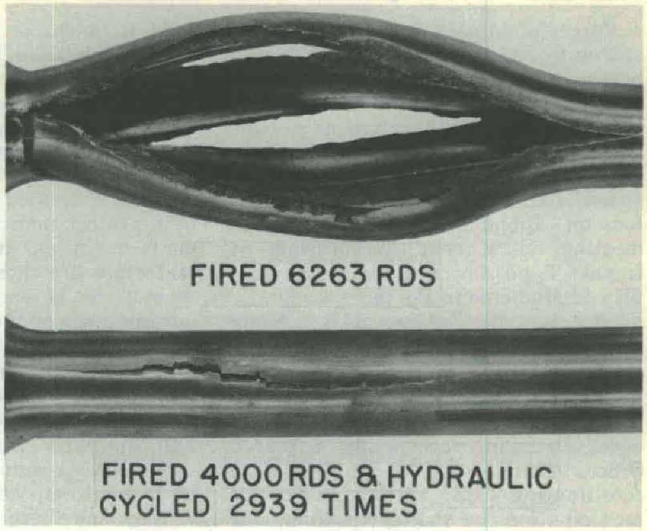


Fig. 2. Typical Failed Specimens

This full-size (major caliber) weapon firing was done essentially at one level, i.e., 1,000 rounds on each of 10 tubes followed by hydraulic cycling to destruction at a pressure equivalent to firing.

Due to firing at just one level, the U.S. Army Test and Evaluation Command (TECOM) questioned the usefulness of the relationship of firing to hydraulic cycling resulting from this test.

Army Materiel Command personnel then visited Watervliet Arsenal and recommended multilevel testing to determine the relationship between firing and hydraulic cycling to destruction.

In-house laboratory testing of M–14 rifles, specially machined to simulate stress intensity in full-size cannon tubes, consisted of firing at five different levels for a selected number of rounds: 0, 1000, 2000, 3000 and 4000 (three fired at each level). Each barrel was then hydraulic-pressure-cycled to failure at rifle pressure and a regression study was conducted from the 15 tests to determine the relationship between fired and unfired samples.

A correlation factor of —.99 resulted. A straight-line regression model yielded the relationship shown in Figure 1 and predicted an all-fired fatigue life of 5,485 rounds. Verification with six rifle barrels of the same configuration resulted in an actual mean life of 6,012 rounds (Figure 2 Typical Failed Specimens).

Encouraged by the success achieved with the regular M–14 rifle barrel specimens, a 2-phase experiment was initiated using M–14 barrels fabricated from cannon tube material from three forging suppliers in the tests at the Malta Test Site.

Further testing is under way, similar to the M–14 project, whereby the relationship between firing and hydraulic cycling for gun tube material will be determined.

Once relationships among fired specimens, specimens hydraulically fatigued and full-size cannon are thoroughly understood, it is planned to develop a "standard" fatigue specimen. When tested to destruction by means other than firing, this specimen would yield a more precise measure of individual barrel life.

Ultimately, it is expected that cannon tube material producers can be selected on the life of their product rather than solely on factors such as yeild strength, impact strength and cleanliness measures which, by themselves, have poor correlation with actual product life.

ECOM Senior Scientist Retires

Retirement of Dr. Rudolph Bechmann Feb. 1 deprived the U.S. Army Electronics Command of services of one of its senior scientists and a man who collected 53 patents in Germany, England and the United States.

Honored repeatedly for his research, Dr. Bechmann received the C. B. Sawyer Memorial Award in 1966 for his achievements in quartz crystal R&D. He is internationally known for a publication titled *Piezoelectricity*, used by students and scientists as a reference handbook.

NATO Group Slates Aircraft, Vehicle Impact Forces Parley

Forces of impact related to aircraft and auto collisions will be considered by the Advisory Group for Aerospace Research and Development, North Atlantic Treaty Organization at a June 23, 25, 26 meeting in Portugal.

Under the auspices of the Aerospace Medical Panel and its Committee on Biophysics, the specialists' meeting on "Linear Acceleration of Impact Type" is scheduled at the Faculty of Medicine in Porto.

Dr. E. J. Baldes, U.S. Army Aeromedical Research Laboratory, Fort Rucker, Ala., will present the introductory paper.

A former member of the Life Sciences Division, U.S. Army Research Office, Arlington, Va., Dr. Baldes is coordinating U.S. arrangements for participation in the symposium, for which the key word is IMPACT.

What impact, for example, can man withstand to his head or to his body such as when he falls from a high building, bridge or when a parachute fails to open, or when he slips and strikes his head on ice? Dr. Baldes said it is important to review in-depth recent aviation and automotive research, and to update knowledge of impact stress on man.

Among other key questions that will be discussed are: How can we best protect man in an aircraft accident, or in an auto collision? What materials are most suitable and how must these be employed in the micro environment of the aircrew in the aircraft and occupants in an auto?

With the current annual death toll in the United States due to auto accidents ranging from 55,000 to 60,000, and similarly high rates in many other NATO countries, conferees will be trying to answer also:

Why has there been such a lack of bioengineering and safety input to considerations involving the man/machine relationship? What can be done to overcome the "worst epidemic" on planet Earth in modern times?

More than 40 experts in biodynamics and safety engineering from Europe and the United States are scheduled to participate. Scientific papers will include biodynamics of impact and models for injury prediction and tolerance limits; studies of impact from blast in air, in water and in air raid shelters; forces involved in parachuting; the pathological aspects of impact trauma and the biodynamics of sports injuries.

Four panel discussions are planned:

- Impact from seat ejection and air blast during escape from disabled aircraft.
- Use of active and passive restraint systems to mitigate the effects of accidental impact due to crash or collision.
- Design and construction of helmets of various types.
- Man-rated experimental facilities especially engineered to study controlled impacts arising from forces due to acceleration or deceleration of the human body.

Among U.S. experts scheduled to present technical papers are Dr. Richard G. Snyder, Dr. James H. McElhaney and Dr. Verne L. Roberts, University of Michigan; Dr. A. K. Ommaya and Arthur E. Hirsch, National Institute of Neurological Disease and Stroke; Dr. John D. States, University of Rochester; Joseph L. Haley Jr., U.S. Army Board for Aviation Accident Research; and

Capt C. L. Ewing, Dr. D. J. Thomas and Dr. G. W. Beeler Jr., Naval Aerospace Medical Research Laboratory; Dr. H. E. von Gierke, Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio; R. H. Shannon, Directorate of Aerospace Safety, HQ U.S. Air Force; and

Dr. C. S. White, R. K. Jones, E. G. Damon, E. R. Fletcher and D. R. Richmond, Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex; Dr. John P. Stapp, National Highway Safety Institute; R. F. Chandler, Federal Aviation Administration; Lt Col Stanely C. Knapp, U.S. Army Aeromedical Research Laboratory; and

Dr. Carl C. Clark, U.S. National Bureau of Standards; Dr. Patrick M. Miller, Cornell Aeronautical Laboratory, Inc.; Dr. R. F. Holsten, The Wright Co.; Henry G. Smith, Hughes Tool Co.; and Dr. George G. Snively, Snell Memorial Foundation.

Watervliet 4-Ounce Model Simulates 435-Pound Brake

Scale model testing, using a device weighing four ounces to simulate a 435-pound muzzle brake for large caliber cannon, is expected to save 80 percent of costs of developing these weapon components at the U.S. Army's Watervliet (N.Y.) Arsenal.

When secured to the muzzle end of a cannon, a muzzle brake reduces the energy transmitted to the recoil system during firing, thereby prolonging the life of the recoil unit. The brake also is credited with contributing to weight reduction, thereby improving mobility of the weapon.

Walter H. Austin Jr., chief of the Component Development Branch, explained that most of the cost of developing a muzzle brake is incurred in test firing, which normally is done at distant Army proving grounds using full-size components.

Robert J. Thierry headed a team of Watervliet Arsenal engineers in designing and building a scale model of the 155mm brake. Other members of the team include Edward J. Turnbull, mechanical engineer, and Donald F. Trudeau, engineering technician.

Mounted on a 30-cal. rifle, the model has been test fired extensively at the nearby Malta Test Station of General Electric Co. Data obtained were used in design of a full-caliber brake for the 155mm cannon. Austin estimates that development costs were about one-fifth of what they would have been if the actual cannon and ammunition had been used at a major Army proving ground.

Scale models can be used similarly, Austin said, to achieve similar economy in developing all large-caliber weapons muzzle brakes.

WATERVLIET ARSENAL engineer Edward Turnbull holds a 4-ounce scale model of a muzzle brake for the 155mm howitzer next to the actual brake. Robert Thierry (right) headed the Watervliet team in designing and building a scale model expected to reduce development costs of muzzle brakes for cannon up to 80 percent.

Leddy Promoted to Deputy Assistant SecDef (ISA)

Raymond G. Leddy, new Deputy Assistant Secretary of Defense (International Security Affairs) for Inter-American Affairs, Foreign Trade, Disclosure, and Military Rights Affairs, was promoted recently after serving in an acting capacity since Sept. 22, 1970.

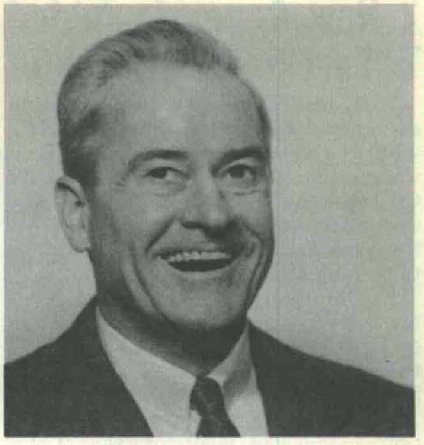
Leddy is a graduate from Holy Cross College (AB), Fordham University Law School (LLB, JD), and George Washington University (MA in international relations). He is a member of the bar of the State of New York and before World War II was an attorney with the Department of Justice.

As a U.S. Foreign Service officer he has served as: First Secretary (Political/Petroleum) at the American Embassy, Caracas, Venezuela (1948–52); officer-in-charge, Central American and Panamanian Affairs, Department of State (1952–55); First Secretary (Energy Resources) at the American Embassies in Buenos Aires, Argentina, and Rio de Janeiro, Brazil (1956–57); and

Counselor of Embassy at Mexico City (1957–61); diplomatic adviser to the commandant, U.S. Army War College, Carlisle Barracks, Pa. (1961–67); diplomat-in-residence, University of New Mexico (1967–68); political adviser to the U.S. Southern Command, Canal Zone, with the personal rank of Minister (1968–70). He retired from the Foreign Service in 1970.

Leddy was appointed Director, Military Assistance and Sales, in the Office of the Secretary of Defense, Assistant Secretary for International Security Affairs May 1, 1970.

Leddy's honors include the Superior Service Award (1955) and Superior Honors Award (1965) from the Secretary of State, and the Outstanding Civilian Service Medal from the Secretary of the Army, which was received twice—first, for service at the U.S. Army War College, and for service at the U.S. Southern Command.



Raymond G. Leddy

ECOM Briefs Top R&D Leaders On Electronic Systems Advances

Assistant Secretary of the Army (R&D) Robert L. Johnson was among top Army research and development leaders who recently were briefed on a new system for keeping field radios properly tuned under all conditions.

Dr. Howard Wichansky and Francis J. Murdoch, employed in the Electronics Components Laboratory, HQ U.S. Army Electronics Command, Fort Monmouth, N.J., explained the system in a paper titled "Nonlinear Dielectrics for Electronic Tuning."

The system uses electronic control of the capacitance of a solid piece of ceramic material to provide automatic compensation in tuning for variations in the position or environment of field radios and their antennas.

Automatic fine tuning is not new, but the system they have devised is about the size of three quarters stacked on top of each other, or about one-tenth the volume of earlier fine-tuning equipment.

The briefing was one in a series to keep leaders informed on significant advances in military R&D.

New Forging Techniques Strengthen Helicopter Gears

Precision forging techniques being developed jointly by the U.S. Army Aviation Systems Command (AVSCOM) and Production Equipment Agency (PEQUA) have demonstrated that teeth of gears can be strengthened as much as 40 percent over conventional methods.

The program was designed to develop advanced manufacturing techniques to forge with high precision a pair of CH-47 Model C helicopter main transmission gears—in the range of 7 to 9 inches in diameter, in the critical power train requiring optimum dependability and performance.

Gear designs chosen for the program represent a significant advance in size, complexity and degree of precision beyond current capabilities. Laboratory tests of 4-inch diameter, 8-pitch pilot spur gears with the precision-forged teeth showed the 40 percent gain in fatigue strength.

Researchers stressed, however, that this advance is achievable only when the forging process is properly selected and controlled. Objectives of the experimental program are:

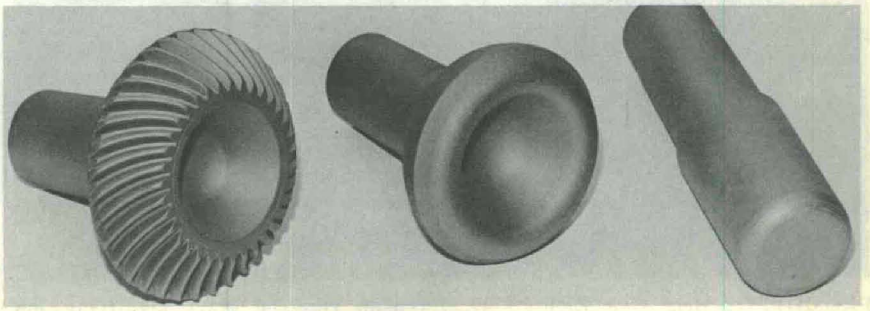
- Prove technical feasibility of the forging process (beyond the current state-of-the-art).
- Demonstrate improvement in gear performance in terms of tooth strength, bending fatigue and dynamic testing as a system.
- Investigate the over-all production economics of manufacturing finished gears in a sequence that includes precision forging the gear teeth.

Initiated in June 1969, the program has produced both gear and pinion forgings with dimensions that conform to the equivalent cut-gear tooth dimensions within .005 of an inch.

Forged die design, die material and die manufacturing problems have been resolved. About 75 forgings have been produced in the development phase to identify and select pertinent processing parameters for objective No. 1.

Pilot lots of precision-forged gears have been heat treated and semifinish machined. The illustration shows the forging sequence completed with one heat and two blows in a 2,000-ton mechanical press.

AVSCOM researchers explained that the balance of the program will be directed to the second and third objectives. Under contract with AVSCOM, the program is being carried out by the Materials Technology Laboratory of TRW, Inc., Cleveland, Ohio. HQ AVSCOM is in St. Louis, Mo. PEQUA is at Rock Island, Ill.



Precision Forging Sequence for Pinion

2 New Generals Added To Fort Monmouth Roster

Two new generals were added to the roster at Fort Monmouth, N.J., with the recent promotions of Brig Gen Albion W. Knight Jr. as deputy CG of the U.S. Army Electronics Command and Brig Gen Richard W. Swenson as CG of the Army Systems Communications Agency.

ECOM Commander Maj Gen Walter E. Lotz Jr. pinned the single stars on Brig Gen Knight's shoulders. That function was performed for Brig Gen Swenson by his wife and father.

General Knight climbed the promotion ladder by way of the Army Atomic Energy Officer Specialist Program, having served in a series of progressively responsible atomic energy and nuclear weapons assignments. In addition to being a 1945 graduate from the United States Military Academy, he is an ordained Episcopal priest.

From 1950 to 1953, he was assigned to the Field Command of the Armed Forces Special Weapons Project at Sandia Base, N. Mex., and was with the Continental Army Command's Office of Special Weapons Development (1955–1958).

During a 1964–68 tour in the Office of the Assistant Chief of Staff for Force Development in Washington, D.C., he was chief, Nuclear Division, and alternate Army member of the Military Liaison Committee to the Atomic Energy Commission.

Assigned then to the AEC at Germantown, Md., as assistant director, Division of Military Operations, he remained until assigned in 1969 to the Office of the Deputy Secretary of Defense.

General Knight studied two years at the University of Illinois under the Army's advanced education program and received a 1950 MS degree in communications engineering. He was graduated from the Army Command and General Staff College in 1959 and from the Industrial College of the Armed Forces in 1963, remaining as a faculty member for one year.

NEWLY PROMOTED Brig Gen Albion W. Knight Jr. receives insignia of rank from Maj Gen Walter E. Lotz Jr., ECOM commander. Mrs. Knight is at right.

BRIG GEN R. W. SWENSON was promoted to that rank Mar. 1, which marked the fourth anniversary of the U.S. Army Communications Systems Agency he has headed since August 1970. The agency provides centralized management of research, development, procurement, installation and logistical support.

Performing as the Army Materiel Command project manager for Strategic Army Communcations (STARCOM) and as a subordinate command of the Army Strategic Communications Command, the USACSA currently handles about 120 contracts and a cumulative investment of more than a billion dollars.

Until reassigned to the Fort Monmouth, N.J., installation he was director, Plans and Operations for the Safeguard Communications Command (P&OSCC), Fort Huachuca, Ariz. Following his first tour of duty in Vietnam in 1960–61, he served three years as a member of the staff and faculty, U.S. Army Command and General Staff College.

An assignment as commander of the 501st Signal Battalion and signal officer, 101st Airborne Division, Fort Campbell, Ky., preceded a year as a student at the Armed Forces Staff College. In June 1966, he went to NATO as chief signal officer, Land Forces Norway. He was graduated from the Army War College in 1968.

During a second tour in Vietnam he commanded the 160th Signal Group, 1st Signal Brigade, and then was assigned to HQ STRATCOM as director of P&OSCC.

Brig Gen Swenson began his military career as a cadet at Kemper Military Academy in Ohio, graduating in 1941. After returning from four years duty in Europe during World War II, he enrolled in 1946 at Cornell University and was graduated in 1949 with a BS degree in hotel management.

In addition to the Master Parachutist Badge he earned with the 82d and 101st Airborne Divisions, he has received the Army Commendation Medal (with OLC), two Bronze Star Medals, Legion of Merit, the Netherlands Order of Orange, and Purple Heart.

PROMOTED: Brig Gen Richard W. Swenson received stars signifying his new rank from his wife and father Wesley T. Swenson at ECOM ceremonies.

Role of Technical Reports Featured at Edgewood Meet

Department of Defense Director of Technical Information Walter C. Christensen was a featured speaker at an Edgewood (Md.) Arsenal meeting Mar. 9 to discuss writing of technical reports. About 250 persons attended.

Christensen discussed the role of the technical report in the information transfer process and the responsibilities of the researcher and the developer in preparing reports.

Arsenal Technical Director Dr. B. L. Harris opened the training session and introduced Christensen, who joined the staff of the DoD Director of Technical Information in 1966, was presented the Meritorious Civilian Service Award in 1968, and promoted to director in 1969.

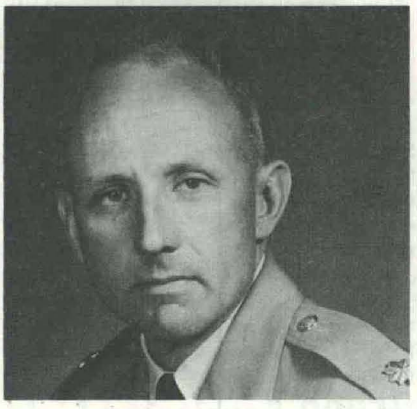
Sheridan Assigned as M60 Tank Project Manager

Assignments in the Army R&D Officer Specialist Program are designed to provide a broad variety of progressively responsible assignments, as illustrated by Lt Col Stan R. Sheridan's new duty as M60 tanks project manager.

This assignment at the Michigan Army Missile Plant in Warren, Mich., transferred him recently from completion of a tour of duty as strategic forces analyst, Studies Analysis and Gaming Agency, Office of the Joint Chiefs of Staff, Washington, D.C.

He completed the prestigious Industrial College of the Armed Forces (ICAF) course in 1970. That career milestone followed duty in Vietnam as commander of the 1st Battalion, 69th Armor and then he became deputy commander, 1st Brigade, 4th Infantry Division.

In 1968 Lt Col Sheridan received the Pace Award (initiated in honor of former Secretary of the Army Frank Pace Jr.) for outstanding achievements since 1965 as tank action officer, Office of the Chief of R&D, HQ DA. His areas of responsibility included the M551 General Sheridan, the M60A1E1/E2 Tank, the U.S./FRG Main Battle Tank, and associated equipment and components.



Lt Col Stan R. Sheridan

Other assignments have included technical intelligence and explosive ordnance demolition adviser to the Vietnamese Joint General Staff (1962) and R&D project officer on the Redstone, Jupiter and Pershing missiles at the Army Ballistic Missile Agency, Redstone Arsenal, Ala. (1959–62).

Graduated from the U.S. Military Academy in 1951, he received an MS degree in mechanical engineering in 1959. He graduated from the Command and General Staff College in 1963, and has completed the Armor Officer Career Course, Fort Knox, Ky.

His decorations include the Silver Star, Legion of Merit (with OLC), Distinguished Flying Cross, Bronze Star (with "V" Device), Army Commendation Medal (with OLC), Air Medal (with 11 OLC), Purple Heart, Vietnamese Gallantry Cross (with two gold stars), the Combat Infantryman Badge, and the Vietnamese Combat Armor Badge.

Joint Test Force Conducts Air-Drop Tests From C-5A

An airdrop from the world's largest airplane of an Army jeep and a ¼-ton loaded trailer successfully climaxed a recent test series of the C–5A Galaxy at Fort Bragg/Pope Air Force Base, N.C.

Both drops were executed from a height of 2,000 feet and the cargo descended accurately into the drop zone under a G–11 cargo parachute.

Maj Fred King, C–5A test project officer, said the jeep, rigged for airdrop, weighed over 3,700 pounds while the trailer with its accompanying load totaled about 2,600 pounds. The Joint Test Force consists of U.S. Army, U.S. Air Force and Lockheed Georgia Co. elements.

During the preliminary test period, 34 test platforms, ranging in weight from 2,500 to 25,000 pounds, were airdropped from the C–5A to gather data to be used in establishing procedures for the airdrop of U.S. Army equipment.

Many other Army items of equipment, including the 35,000-pound Armored Reconnaissance Airborne Assault Vehicle, will be airdropped from the C–5A in future testing.

Col A. K. Charles, chief of the C–5A Test Branch of the U.S. Army Airborne, Communications and Electronics Board and U.S. Army director for C–5A testing, said preparations for the airdrop of Army personnel from the giant aircraft are progressing rapidly.

"Airdrops of personnel-type dummies, both ropehead and instrumented, are currently being conducted," he explained. "Approximately 266 dummies have been dropped to date and indications at this time are favorable for live personnel jumps from the C–5A."

1,000th Student Graduates From 'TECOM College'

"TECOM College," the popular name for the U.S. Army Test and Evaluation Command's Orientation Course on Materiel Testing, recently graduated its 1,000th student since it was established in April 1967.

Maj Russel D. Cox, a plans and operations officer with the U.S. Army Airborne, Communications and Electronics Board at Fort Bragg, N.C., was the 1,000th graduate. Maj Cox, a former enlisted man, was commissioned in 1958 at Fort Benning, Ga.

Established on an experimental basis, TECOM College has become a principal and permanent part of the training program for both military and civilian materiel test personnel.

The 80-hour course is part of TECOM's continuing effort to improve its performance as the Army's principal materiel testing organization.

Classroom instruction is directed primarily towards the application of scientifc and technical methodology to test and evaluation activities. Orientation training also is given in testing philosophy, concepts and objectives.

Classes at HQ TECOM, Aberdeen Proving Ground, Md., are under the supervision of the Personnel, Training and Force Development Directorate, and are administered by the Training Division.

Currently, the course is taught by some 30 instructors selected from the TECOM staff. All are top men in their fields, experienced in research, development and test and evaluation. They represent the level of management immediately concerned with directing and supervising test and evaluation activities of TECOM's 15 subordinate elements.

TECOM, an element of the Materiel Command, provides the Army with an independent, unbiased appraisal of its arsenal. From its test reports, TECOM's only product, the Army can determine if an item conforms to specifications; also, if it is capable of doing the things it was built to do in serving the needs of the American soldier in the field.

1,000th GRADUATE from the U.S. Army Test and Evaluation Command Orientation Course on Materiel Testing, Maj Russel D. Cox, receives diploma from Maj Gen Frank M. Izenour, TECOM commanding general.

JSEP Cosponsors Computers, Automata Meet Apr. 13-15

Under cosponsorship of Armed Forces research organizations, an International Symposium on Computers and Automata is scheduled Apr. 13–15, offering a program arranged by the Microwave Research Institute of Polytechnic Institute of Brooklyn, N.Y.

Cosponsors under the Joint Services Electronics Program (JSEP) are the Army Research Office, Office of Naval Research and the Air Force Office of Scientific Research.

Organized with the participation of the Computer Society of the Institute of Electrical and Electronics Engineers and with the cooperation of the Society for Industrial and Applied Mathematics, the symposium will be held in New York City.

Most of the technical papers programed for presentation will deal with major problems of current concern in the design and use of computers. The methods applied to solution were developed largely in connection with automata and mathematical abstractions.

Two divergent trends will be viewed in presentations: very large multi-user computer systems, and smaller special-purpose computers. In each case, matching military computers with those used in the outside world is essential to success.

Several papers are devoted to designing convenient and efficient programing languages, and to resulting influences on computer architecture and hardware. Developments in integrated circuits have stimulated interest, as noted in papers on cellular computing arrays. Aspects of artificial intelligence and computer reliability also will be discussed.

An introductory session features invited papers by Professors Juris Hartmanis, Cornell University; Dana Scott of Princeton University with Christopher Strachey of University of Oxford, England; and Jack B. Dennis of Massachusetts Institute of Technology.

Consecutive sessions are slated on "Programming Languages," "Operating Systems," "Computation Complexity," "Logical Design" and, "Computer Models."

Other listed distinguished speakers include: A. Avizienis, University of California at Los Angeles; R. B. Banerji and R. J. Nelson, Case Western Reserve U.; E. G. Coffman, Penn State U.; E. L. Lawler, U. of California at Berkeley; P. M. Lewis, G. E. Research and Development Center; E. J. McCluskey, Stanford U.; J. Nievergelt, U. of Illinois; C. V. Ramamoorthy, U. of Texas; and H. Schorr, IBM Watson Research Center.

International representation includes authors of technical papers from Argentina, Belgium, France, Great Britain, Hungary, Italy, The Netherlands, and the Soviet Union as well as Canada and the United States.

Inquiries about the program, registration and the proceedings may be addressed to the attention of Jerome Fox, executive secretary, Polytechnic Institute of Brooklyn, MRI Symposium Committee, 333 Jay Street, Brooklyn, N.Y. 11201.

TECOM Shifts Testing Of Aircraft to Yuma PG

Transfer of responsibilities for engineering tests of aircraft armament from Aberdeen (Md.) Proving Ground to Yuma (Ariz.) Proving Ground will be effected in two phases, by June 30, 1971, and by a year later.

The U.S. Army Materiel Command said consolidation at Yuma Proving Ground is part of the Test and Evaluation Command's programed realignment of mission and personnel.

Yuma PG thus will assume all engineering tests of aircraft armaments, including weapons, associated munitions and related fire control, light intensification, and night-vision observation equipment and systems.

The Yuma facility, it was explained, assures availability of relatively large ground areas and extensive air space required for this type of testing.

Thirty-eight personnel are scheduled for the move from the APG to Yuma by June 30 and the remainder of the aircraft engineering test staff by June 30, 1972. Employes not desiring to move to Yuma will be offered jobs in other areas as vacancies occur, or will be separated from the rolls.

MERDC Developing Lightweight Conveyor System

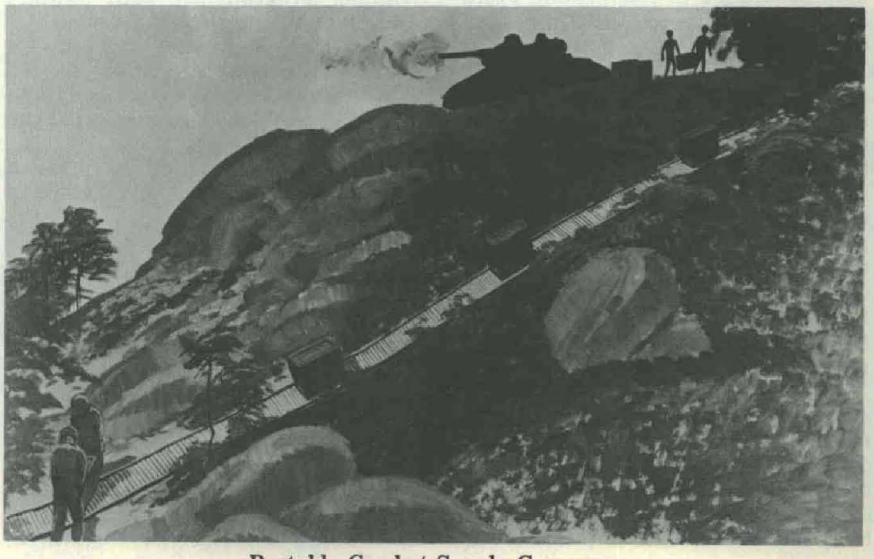
A multipurpose, lightweight conveyor system capable of handling supply loads up to 4,000 pounds is being developed by the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.

Designed to meet Army needs for flexibility and adaptability not afforded by current standard conveyors, it is intended for use over irregular terrain on a field portable basis, as well as in a depot facility in a permanently fixed configuration. The system will facilitate handling of all classes of supply except raw bulk items, such as rock, sand and gravel.

An $89,405 contract awarded to AAI Corp., Baltimore, Md., is for preliminary work in concept formulation and the engineering design. This will serve as the basic specification for procurement of the test model.

The lightweight system will feature both power-driven and gravity sections with a high degree of interchangeability. Sections will permit end-to-end coupling and will include straight, curved and switching modules. The powered sections will operate from a current standard power unit to provide movement on any section of the conveyor.

When available, the new conveyor is scheduled to replace low-capacity forklift trucks and other limited usage conveyors currently in service.



Portable Combat Supply Conveyor

Major Army RDT&E, Procurement Contracts Total $378 Million

Army contracts for research, development, test, evaluation and procurement of materiel, each exceeding $1 million, totaled $377,933,372 for the period Jan. 1 to Mar. 1.

Jeep Corp. is receiving $65,033,142 as the first-year increment to a 3-year contract for ¼-ton trucks. Olin Corp. was awarded three contracts totaling $39,957,729 for projectiles and production of propellants at the Army Ammunition Plant, Charlestown, Ind.

Three contracts totaling $24,844,557 with Day and Zimmerman, Inc., are for producing and packing ammunition at the Lone Star Army Ammunition Plant, Texarkana, Tex., and the Kansas Army Ammunition Plant.

Sperry Rand Corp. was issued $24,545,551 in two contracts for metal parts for projectiles and for operation of an ammunition production facility at the Louisiana Army Ammunition Plant.

Mason and Hanger, Silas Mason Co., Inc., gained $20,562,539 (two contracts) for support services and operation of facilities at the Cornhusker Army Ammunition Plant, Grant Island, Neb., and the Iowa Army Ammunition Plant, Burlington, Iowa.

Uniroyal, Inc., will receive $14,840,680 for operation and maintenance of facilities for production of explosives at the Joliet (Ill.) Army Ammunition Plant. LTV Aerospace Corp. was awarded $14,183,000 for production of Lance missiles.

Teledyne Industries is supplying engine assemblies for M60 tanks under two contracts totaling $13,196,255. National Presto Industries was issued an $11,813,685 contract for 105mm projectile parts. Hazelton Corp. will receive $10,864,000 for AN/TTX–46 interrogators.

Contracts under $10 million. Hughes Aircraft Co., $9,930,500 for ground support equipment for the TOW missile system; Norris Industries, Inc., $9,069,644 (two contracts) for 105mm cartridge cases; R. G. LeTourneau, Inc., $9,019,375 (two contracts) for parts for 750-pound bombs; and

AVCO Corp., $8,542,517 (four contracts) for modification kits and overhaul of turbine engines for helicopters; Hercules, Inc., $8,303,721 for operation and maintenance at the Army Ammunition Plant, Radford, Va.; Etowah Manufacturing Co., Inc., $7,637,950 for M557 fuze components; Chamberlain Manufacturing Corp., $7,578,000 for 155mm projectile parts; and

General Motors Corp., $6,476,822 (three contracts) for diesel engines and transmission assemblies for combat vehicles; AMF, Inc., $6,240,000 for 750-pound bomb parts; Institute for Defense Analyses, $5,161,000 for analysis, scientific investigation and feasibility studies for the Advanced Research Projects Agency.

Contracts under $5 million. Goodyear Tire and Rubber Co., $4,398,376 for track shoe assemblies for M113 personnel carriers; Textron, Inc., $4,323,961 for repair of helicopters; Ravenna Arsenal, Inc., $3,610,320 for operation of Ravenna Army Ammunition Plant; Raytheon Co., $3,420,354 (two contracts) for Missile Site Radar antenna elements and for work on the Hawk weapons system; and

Litton Systems, Inc., $3,390,111 (two contracts) for advanced production engineering of the Air Defense Guided Missile System and for design, fabrication, testing and delivery of an experimental truck-mounted positioning and azimuth determining system;

AVCO Economy Systems Corp., $3,340,770 for manufacturing at Glasgow Air Force Base, Mont.; Defense Ordnance Corp., $3,237,561 for booster parts; Fairchild Hiller Corp., $2,782,340 for Safeguard ABM System for monitoring and control equipment; and

Flinchbaugh Products, $2,524,119 for body assemblies and base plugs for 8-inch projectiles; Bunker Ramo Corp., $2,183,694 for an Experimental Military Command Information System for the Federal Republic of Germany.

Firestone Tire and Rubber Co., $1,973,988 for M41 tank track shoe assemblies; Western Electric Co., $1,929,645 for development of software for the Safeguard Ballistic Missile Defense Center; Bell Helicopter Co., $1,927,207 for UH–1H helicopters; and

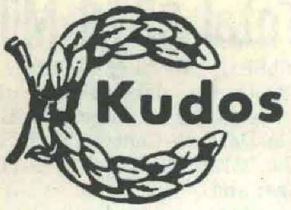
Martin Marietta Corp., $1,840,350 for AN/GVW–3 range finders and test sets; Kennedy Van Saun Corp., $1,786,680 for 105mm projectile parts; Honeywell, Inc., $1,769,260 for fuzes; Industrial Bio-Test Laboratories, Inc., $1,439,419 for a study to provide preservation data on quick-frozen and irradiated beef; and

Temco, $1,405,426 for 106mm projectile parts; Tracor, Inc., $1,350,000 for a Position Reporting and Recording System with data, manuals and one year's maintenance; Federal Electric Corp., $1,347,500 for engineering, furnishing, installing and making operational one Microwave Telecommunications Subsystem; and

Talley Industries, $1,309,297 for metal containers; ITE Imperial Corp., $1,244,428 for procurement of switchgear reactors and resistors for electrical systems for the Safeguard ABM System; Northrop Corp., $1,219,750 for warheads for 2.75-inch rockets;

Baldwin Electronics, Inc., $1,215,083 to improve rocket fuzes used in 2.75-inch warheads; Resdel Engineering Corp., $1,082,900 for signal data recorders; Leece Neville, $1,054,819 for general tactical vehicle alternators; Associated Springs Co., $1,013,400 for 5.56mm 10-round clips; Colt's, Inc., $1,009,511 for 5.56mm rifles; and ESD, Inc., $1,002,436 for batteries.

JAMES H. McCLELLAN AVIATION SAFETY AWARD for 1969–70 is presented to Col Robert W. Bailey, CO of the U.S. Army Aeromedical Research Laboratory, Fort Rucker, Ala., during Army Aviation Association of America's 12th annual meeting. The national award was presented by the Honorable John L. McClellan (D-Ark.) and Howard E. Haugerud, president of the foundation estab'ished in memory of the senator's son. Col Bailey was honored for contributions to Army Aviation flight safety that have defined requirements for development of improved protective clothing for air-crewmen and stimulated aircraft fire prevention research to serve military and civilian systems.



OUTSTANDING CIVILIAN SERVICE. *Harry J. Coster* was awarded the Outstanding Civilian Service Medal for services as a consultant to the U.S. Army R&D Group, Europe, from April 1957 to June 1970. Director of Army Research Brig Gen George M. Snead Jr. presented the award during an orientation visit to group headquarters in London, England.

The citation credited Coster for his role in establishing the group's prestige and reputation with the European scientific community, saying:

"His personal magnetism, integrity and drive, coupled with his diplomacy and knowledge of qualifications and capabilities of individual scientists, enabled him to point the efforts of the group in the most profitable direction. His outstanding contributions and dedicated service merit high praise and recognition."

MERITORIOUS SERVICE. *Robert C. Surina,* technical director for the U.S. Army Communications Electronics Engineering Installation Agency (CEEIA), received the Meritorious Civilian Service Award (MCSA). He was cited for contributions to CEEIA and its senior command, the U.S. Army Strategic Communications Command (STRATCOM), Fort Huachuca, Ariz.

STRATCOM CG Maj Gen William B. Latta presented the award during a luncheon in honor of Surina who recently retired after 36 years of federal service. Except for one year, Surina has been with STRATCOM and its predecessors in a civilian or military capacity, including assignments as assistant chief, Applications Division, Operations Directorate; and director, Test & Evaluation Division.

C. Edward Westerman was awarded the MCSA for services as a supervisory research engineer in surveying and geodesy at the U.S. Army Engineer Topographic Laboratories (USAETL), Fort Belvoir, Va.

Col John R. Oswalt Jr., USAETL commander, presented the award prior to Westerman's retirement with more than 36 years of civilian service, including 24 years at the laboratories.

"As assistant chief of the Surveying and Geodesy Division," the citation states, "he has shown commendable capability as a senior project engineer and a supervisor in carrying out successful research and development programs of highest priority throughout the scientific disciplines in the surveying and geodesy fields."

LEGION OF MERIT. The Legion of Merit (LOM) was presented to six officers on the staff of the Surgeon General, U.S. Army.

Col Glen M. Walsh received the award prior to retiring from military service after nearly 30 years of continuous active duty. His service includes tours in the Southwest Pacific during World War II, Europe from 1949–52; Hawaii from 1957–59, and the Panama Canal Zone from 1964–67. He was assigned to the Army Medical Department's Inspector General Office in July 1967.

Col Lewis J. Strait Jr., who served as Provost Marshal for the Army Medical Department since August 1969, received the LOM when he retired. Army Surgeon General Hal B. Jennings Jr. made the presentation and praised the quality of support rendered by the Military Police Corps at Army hospitals around the world. Col Strait served in Europe, Alaska, Korea, Japan and in the United States.

Col Jeanne Treacy, the first Army Nurse Corps officer to attend the Command and General Staff College (1963), was awarded the LOM when she retired as chief of the Army Nurse Corps Branch with 30 years active duty.

Col Treacy served in Europe during World War II. She has been assigned to Camp Chaffee, Fort Sill, the Valley Forge General Hospital, the U.S. Army Hospital in the Ryukyu Islands and Walter Reed General Hospital.

Her first tour at the Office of the Surgeon General was from 1959–63. She has since been chief nurse, Continental Army Command, and director of the Department of Nursing Science at the Medical Field Service School, Brooke Army Medical Center, Fort Sam Houston, Tex.

Col Clarence "Kappy" Kaplan, executive officer to the special assistant to the Army Surgeon General for Medical Affairs since 1969, was awarded the LOM upon retirement.

His assignments have included duty in Southwest Pacific, Korea, Japan, Hawaii, and more than five years as chief of the Training Branch at Brooke General Hospital, Brooke Army Medical Center, Fort Sam Houston, Tex.

Lt Col Marilyn Anderson, chief of the Physical Therapist Section, Army Medical Specialist Corps, was awarded the LOM for outstanding work (1965–70) at Brooke Army Medical Center, Fort Sam Houston, Tex.

A graduate of the University of Washington at Seattle, with a master's degree from Stanford University, the colonel entered the Corps in 1950 and holds the "A" prefix for professional excellence as a physical therapist.

Lt Col William D. Jones, program manager, Installations Branch, Directorate of Plans, Supply and Operations, received the LOM for achievement as chief of the Engineer Division at Valley Forge General Hospital, Pa. (1968–70).

Graduated from the U.S. Military Academy, he has a master's degree in

OUTSTANDING ACHIEVEMENT in the Program for Refinement of the Materiel Acquisition Process (PROMAP-70) was recognized with the recent award of honorary certificates to four U.S. Army Munitions Command installations. Lt Gen Woodrow W. Vaughan, deputy CG of the Army Materiel Command, presented the awards during an orientation visit. MUCOM CG (Maj Gen) Edwin W. Graham Jr. is shown with General Vaughan and Col William A. Walker Jr. (right), CO of Picatinny Arsenal. Honored also were Brig Gen Peter Olenchuk, CG, Ammunition Procurement Agency; Col Eugene Barbero, CO of Frankford Arsenal; and Col George Connell, CO of Edgewood Arsenal.

engineering from Princeton University. He began his military career in 1953 and has served with the Corps of Engineers in the Far East, following the Korean War, and later in Europe and Thailand.

Col William S. Gochenour, who recently retired as special assistant to the director of Walter Reed Army Institute of Research, received the LOM for service at WRAIR since 1963. He also received the Walter Reed Army Medical Center Medallion and the Surgeon General's Medallion. The latter award is given only to officers in the Army Medical Department with 30 years or more of active military service.

Brig Gen William M. Osteen, chief of the Veterinary Corps, said of him, "He is an outstanding soldier, an outstanding scientist, and I sincerely feel that he has no peer in the Veterinary Corps. . . ."

Col Stephen G. Asbill was awarded a second Oak Leaf Cluster to the LOM for services as director of the WRAIR Division of Veterinary Medicine since May 1965 until his recent retirement. His citation states in part: "Under his direction important advances have been made in knowledge and control of diseases affecting military animals. He directed the highest standards of quality and care in providing large numbers of laboratory animals in support of the research mission of the Institute."

Col Asbill also received the Walter Reed Army Medical Center Medallion and the Surgeon General's Medallion. He had been on active duty for 34 years—longer than any other officer in the Veterinary Corps.

U.S. Army Missile Command CG, Maj Gen Edwin I. Donley presented the LOM to *Col J.R.M. Covert* for meritorious service as Hawk project manager. Col Covert was recently reassigned as CO of the Army Air Defense Command field office of the Safeguard System Command.

MERITORIOUS SERVICE MEDAL. *Lt Col Bert A. Schreiber* received the MSM prior to retirement with 20 years in the Medical Service Corps. He was awarded the Army Commendation medal for each of his last four assignments, including a tour in Korea as chief, Programs and Budgets in the Office of the Surgeon, Eighth U.S. Army. He served on the Special Studies Team, Resources Analysis Group, since last October.

JOINT SERVICE CM. *Lt Col David T. Baker* received the Joint Service Commendation Medal for exceptionally meritorious service as chief of the Development Requirements Branch, HQ Defense Atomic Support Agency, November 1966 to September 1969.

Col Bennett L. Lewis, CO of the U.S. Army Mobility Equipment R&D Center (MERDC) at Fort Belvoir, Va., presented the award prior to Lt Col Baker's retirement after nearly 25 years of Army service. He had been serving in various capacities at MERDC since September.

The citation states in part: "Demonstrating superior professional skill, initiative, and devotion, he developed greatly improved expositions of military operational requirements and specifications for the development of new nuclear weapons, thereby contributing substantially to economies in critical manpower and materials and to improvements in the national nuclear weapon capabilities."

ARMY COMMENDATION MEDAL. The ARCOM was awarded recently to 1st Lt Gilbert W. Buhrmann Jr. for exceptionally meritorious service as R&D coordinator with the Special Item Manager's Office for Commercial Construction Equipment (CCE) at MERDC.

Col Bennett L. Lewis, CO of the center, presented the medal with a citation stating in part:

"Particularly laudatory are his efforts in the production of the CCE system plan, its presentation to numerous and varied audiences, and the development of the financial programs which set up the CCE Special Item Manager's Office and initiated the CCE pilot items program."

COMMENDATIONS. Brig Gen Donald D. Blackburn, Director of Developments, Office of the Chief of Research and Development, HQ DA, recently presented Outstanding Performance Ratings (OPR) to Janice M. O'Donohue, Janet A. Evans and Evelyn L. Vincent.

Morton H. Marks, deputy chief, Information Systems Office (ISO) and Robert Chaillet, chief of the ISO Information Technology Branch, were awarded Outstanding Performance Ratings and Quality Salary Increases.

ATC Chief Tests Chute in Frigid Environment

Lt Col Richard H. Devereaux

In the 77th test of the U.S. Army's new power-deployed reserve parachute in the Arctic, the chief of the USA Arctic Test Center, Lt Col Richard H. Devereaux, recently became the first human to use it in the frigid weather test environment.

Seventy-six drops were made with dummies to determine the reliability of the reserve chute under Arctic conditions. The PRP proved during the test program that it is an improvement over previous reserve chutes, which often became entangled in the main parachute.

When the reserve ripcord handle is pulled, upon failure of the main chute, two black powder charges, contained in an XM233 ejector, are fired to deploy the reserve chute away from the path of the main canopy.

Col Devereaux began his descent at 1,250 feet and deployed the PRP at 750 feet, after spilling the air out of his main parachute.

The wind chill factor was —95° F.

SAME Offers Cash Prizes In Bridge Designs Contest

Bridge designers have an opportunity to win prizes of $5,000, $2,000, or $1,000—with awards duplicated in each of two categories—in a contest sponsored by the Society of American Military Engineers (SAME). Judges may award $4,000 in additional prizes in either category.

SAME is backing the contest at the request of the U.S. Army Materiel Command through its Mobility Equipment Research and Development Center, Fort Belvoir, Va. The categories of design are Fixed, and Floating, as linked to military needs.

Entry is open to all individuals, partnerships or corporate entities, professional societies or institutions whose home office is in the U.S. U.S. citizens residing overseas also are eligible. Specifically exempted are employes of the Mobility Equipment R&D Center and individuals associated with contest management.

A brochure containing full information may be obtained for $2 (for brochure and entry fee) by writing to: Bridge Design Contests, the Society of American Military Engineers, 800 17th St., N.W., Washington, D.C. 20006. Entries must be postmarked not later than June 15, 1971.

General Miley Commends Army In-House Laboratories

(*Continued from page 2*)

"still has some technical problems remaining to be solved. However, I would like to point out that a test unit has purified Potomac River water—which may be a breakthrough in itself."

The U.S. Army Materials and Mechanics Research Center, Watertown, Mass., won a tribute for exploiting new nylon armor material with good prospects for better protection for the foot soldier that will be lighter and less bulky.

The design of protective equipment items using nylon and other new materials is the responsibility of the Natick Laboratories. New boron carbide armor developed by NLABS has proved its merit in providing protection for air crewmen and also offers possibilities for Infantry armor.

"In addition to body armor," General Miley said, "we have a major effort going for a new helmet, flame-resistant suits for helicopter crews and tank crews, and even a totally transparent face mask made out of a huge sapphire crystal, invulnerable as the helmet itself."

Turning to the "unhappy aspect of the soldier's life—the period of time he may spend in or en route to Army hospitals—recovering from effects of a battlefield wound or accident, service-related or otherwise," General Miley cited "innovative things our Harry Diamond Laboratories are working on to improve this unprogramed phase of a soldier's military service.

"HDL is principally famous in ordnance circles for its work on complex fuzes. What is not generally known is its work on medical equipment—a spinoff from its principal capabilities. Most of the funding for this effort comes from the Office of the Surgeon General of the Army. AMC's basic research provides the fundamental technology."

One of the HDL medical items is a portable heart monitor weighing about 17½ pounds with batteries, which can be used by a medical technician in an ambulance or helicopter.

Expected to cost about $600 a unit in production, the monitor was compared to hospital electrocardiogram equipment "which can't be moved, can only be interpreted by a doctor, and costs about $10,000 a copy. Yet the little unit will do all the essential things done by its permanently installed cousin, and, most importantly, do them where the wounded or injured soldier is."

Other HDL R&D activities noted by General Miley included fluidics control and sensing devices "reliable under extreme environmental conditions," in that they usually have no moving mechanical parts or electrical components.

One HDL fluidic device is a volume-cycled respirator that "has been field-tested in Vietnam and found to give greater patient comfort than other units now in use. These other units force the patients to breathe in time with the machine, whether it is his natural breathing rate or not.

"The fluidics control automatically adjusts to the patient's own rate. Most importantly, should a patient whose breathing is being assisted by this machine stop breathing, the machine will automatically take over and breathe for him."

General Miley concluded his address with a discussion of new materiel items to improve combat effectiveness, saying:

"Assuming that we have increased the soldier's personal well-being through, among many other things, more attractive dining, better clothing, and have added to his safety on and off the battlefield by developing lightweight body armor, a better helmet, and more survivable helicopter pilots driving the vehicles on which he rides.

"Now we come down to the payoff —his personal effectiveness on the battlefield vis-a-vis the enemy.

"It goes without saying, I should imagine, that unless our well-fed, well-clothed and protected soldier is superior to his foe in combat effectiveness, his chances of success are rather remote. The attractiveness of joining a second-rate fighting force, I suspect, would be rather low."

In discussing what AMC laboratories are doing "to make our soldier a more lethal ultimate weapon," General Miley described a foxhole radar about the size of a cigar box and weighing less than 10 pounds, listed in the Army inventory as "Listening Post Surveillance Device AN/PSS–14."

Developed by the U.S. Army Land Warfare Laboratory, Aberdeen Proving Ground, Md., the radar has an alarm "rather like a wrist watch that alerts the operator, if he should doze off, when someone approaches his position."

The Ballistic Research Laboratories at Aberdeen, General Miley said, are doing some highly promising work on armor-piercing projectiles that, if their potential materializes, should greatly increase the soldier's threat to armored vehicles.

Another item he described is the developmental effort on a new 66mm grenade with a ring airfoil shape. Instead of following a ballistic trajectory, it glides to the target, and is expected to have twice the present 40mm grenade's range, with greater lethality.

R&D effort is assigned to the Aerodynamics Research Group of the Army's Edgewood (Md.) Arsenal Laboratories. Watervliet Arsenal is working on the Ring Airfoil Grenade (RAG) Launcher for Edgewood Labs.

In conclusion, General Miley described a new rifle sight still in the early stages of development. Known as the Reflex Collimator Rifle Sight, it weighs about a pound and is expected to improve accuracy of fire 25 to 50 percent in daylight.

Using only ambient starlight, the sight is envisioned as providing nighttime accuracy to 150 meters. Developmental work is being done at Frankford Arsenal, Philadelphia, Pa.

"It would be foolhardy to predict," he said, "that all our hopes for the systems and devices I have talked about will be realized. It is absolutely certain, however, that soldiers in the Modern Volunteer Army will have first call on the imagination and technical capabilities of the Army Materiel Command."

FRENCH SCIENTIST Lt Col M. Duffet (left) and Miss Bernadette de Saint-Vaulry recently visited the U.S. Army Mobility Equipment R&D Center at Fort Belvoir, Va., for a discussion of fuel cells R&D progress. They are shown with Lt Col R. G. Boulo, French Liaison officer, Fort Belvoir, viewing low-energy electron diffraction equipment in the laboratory of the Energy Conversion Division. Dr. J. R. Huff, division chief, gave the state-of-the-art briefing.

OCRD Announces 5 Officer Assignments

Office of the Chief of Research and Development (OCRD) assignments of five officers announced recently are:

Lt Col James E. Linka is chief of the High Altitude Systems Branch, Air Defense and Missiles Division. Until recently he commanded the 4th Battalion (Hercules), 65th Artillery, Los Angeles Air Defense.

A 1953 graduate of the U.S. Military Academy (USMA), he earned an MS degree in mechanical engineering from the University of Arizona (1965). He has completed the Command and General Staff College (C&GSC) course at Fort Leavenworth, Kans.

Subsequent to a tour of duty with the Army Concept Team in Vietnam (ACTIV), he was assigned in 1969 to HQ 19th Group at Forth MacArthur in San Pedro, Calif.

Other assignments have included the Combat Developments Command (CDC) Air Defense Agency, Fort Bliss, Tex., and the Artillery School, Fort Sill, Okla. He completed the Guided Missile Maintenance Officers Course at Fort Bliss and served there with the Air Defense Board.

He has been awarded the Bronze Star Medal (BSM) and the Army Commendation Medal (ARCOM).

Lt Col Cecil M. Henry served as an adviser and Infantry battalion commander in Vietnam before his assignment to the OCRD Weapons Branch, Combat Materiel Division.

Graduated with a BA degree in business from the University of Omaha in 1966 he completed the C&GSC course in 1967 and remained as an instructor for two years. He served (1965–67) as battalion S–3 with the 11th Air Assault Division, Fort Benning, Ga.

He holds the Silver Star (SS), Legion of Merit (LOM), and Distinguished Flying Cross (DFC).

Lt Col Robert F. Stanley earned an MBA degree in personnel management from George Washington University immediately prior to assignment as a staff officer, Management and Analysis Branch, Management and Evaluation Division.

A 1955 graduate of the USMA, he completed the C&GSC in 1969. He served (1965–66) as an Artillery tactics instructor at the Artillery School, Fort Sill, Okla., and in 1967–68 as a plans officer with the Department for Reserve Forces, First U.S. Army, Fort Meade, Md.

During two tours in Vietnam, he was an operations officer in 1965 with the IV Vietnamese Corps and in 1967 was a logistics officer with the 52d Artillery Group.

An Army R&D Specialists Program career officer, he has served as battery commander for Mobile Nike-Hercules Surface-to-Surface Test and Evaluation at Fort Bliss, Tex., and Fort Sill, Okla. He holds the BSM with Oak Leaf Cluster (OLC), the Air Medal (AM) with OLC, and the ARCOM.

Lt Col Harold B. Snyder Jr. served as a staff officer with the Training Division, HQ Third U.S. Army, Fort McPherson, Ga., and then completed the Armed Forces Staff College (AFSC) immediately prior to his OCRD assignment in the Air Movement Branch, Air Mobility Division.

He received a BS degree in civil engineering from the Virginia Military Institute in 1956 and an MS degree in aerospace engineering from the Georgia Institute of Technology.

In 1966–67 he was an aircraft maintenance officer, Air Troop, 11th Air Cavalry Regiment at Fort Meade, Md., and then was assigned to Vietnam. During 1965–66, he served in Korea as aviation staff officer with the I Corps Artillery, following a tour with the 5th Infantry (Mechanized) Division, Fort Carson, Colo.

His honors include the BSM, AM, Meritorious Service Medal (MSM) and the ARCOM.

Maj Frederick C. Breslin was senior member of Advisory Team 106, Military Assistance Command Vietnam (MACV), prior to assignment as OCRD military assistant, Reentry Physics Division, U.S. Army Advanced Ballistic Missile Defense Agency (ABMDA).

He has a BS degree in physics from Polytechnic Institute of Brooklyn (1959) and an MS degree in physics from the University of Alabama.

During 1965–68, he served in Germany as CO of the 9th Ordnance Company, U.S. Army Europe (USAREUR) and as nuclear weapons officer, HQ 548th Artillery Group, USAREUR. He was R&D coordinator (1963–65) in the Pershing Project Manager's Office at Redstone Arsenal.

ABA to Review R&D Progress On Treatment of Serious Burns

American Burn Association members will hold their third annual meeting to review progress in research and development for treatment of serious burns in San Antonio, Tex., Apr. 15–17. About 450 attendees are expected.

Arrangements are in charge of Lt Col Basil A. Pruitt Jr., commander and director of the world-renowned U.S. Army Institute of Surgical Research (USAISR), Brooke Army Medical Center, Fort Sam Houston, Tex. Seventy-six technical presentations are scheduled.

Three sessions are planned, one for research papers, a second for reports on clinical material, and the third devoted to topics of interest to associate members—laboratory personnel, dieticians, physical therapists, occupational therapists, nurses, etc.

The American Burn Association is headed by Dr. John A. Moncrief, retired Army Medical Corps colonel and USAISR former commander. He is now professor of surgery at the Medical College of South Carolina.

The Everett Idris Evans Memorial lectureship will be presented to Dr. Martin Allgower of Basil, Switzerland. Drs. Truman and Virginia Blocker, University of Texas Medical School, will receive the Harvey Stuart Allan Distinguished Service Award.

Col Martin Assigned to CEEIA as Test, Evaluation Director

Director of Test and Evaluation is the new title of Col Doyne K. Martin at the U.S. Army Communications Electronics Engineering Installation Agency (CEEIA), Fort Huachuca, Ariz., following a year with the Military Assistance Command, Vietnam (MACV).

From 1967 to 1969, he served with the C-E Directorate, HQ U.S. Army Strategic Communications Command (STRATCOM) at Fort Huachuca prior to MACV duty as deputy director, C-E (J-6).

He served four years as an instructor in the officers department, Army Signal School, Fort Monmouth, N.J., and is credited with installing and operating the first satellite tracking station as part of Project Vanguard.

Col Martin entered the Army in 1940, was commissioned in 1943, and has served in the Aleutian Islands, Alaska, New Guinea, Korea, Japan, Puerto Rico, Cuba and HQ STRATCOM-Pacific, Hawaii. He holds a BS degree in military studies from the University of Maryland and is a graduate of the Command and General Staff College.

His military honors include the Army Commendation Medal and three Legions of Merit.

Col Doyne K. Martin

Laird Reports to Congress on Defense Concepts, Plans Changes

(*Continued from page 4*)

active forces is lower than we would like" due to Vietnam factors and cites among "some encouraging signs" that the Army has been able to begin delivery of several new weapons systems to its forces outside Vietnam.

FY 1972 budget requests provide for "continuing this effort," he said, including issuance of the Chaparral/Vulcan air defense system, the TOW antitank missile system, and the Sheridan armored reconnaissance vehicle.

Reflected also are an increase from $77 million to $87 million in FY 1972 for continued development and advance production engineering for the Main Battle Tank (XM-803), a drop from $92 million to $87 million for continued procurement and modification of the M–60 tank, and a decrease from $131 million to $103 million for procurement and testing of TOW and Dragon antitank missiles.

Procurement of the Lance missile calls for a funding jump from $31 million to $84 million in FY 1972, but buys of Army helicopters are slated to decline from $145 million to $35 million. Funding for continued development and advance production engineering for the Cheyenne armed helicopter is dropped from $18 million to $13 million.

A gain from $83 million in FY 1971 to $116 million in FY 1972 is shown for continued development of a new surface-to-air missile system (SAM–D). Funding for procurement of the improved Hawk and Chaparral/Vulcan surface-to-air missile systems is increased from $106 to $108 million.

Section II of the report is titled "Toward Better Management of Human, Material and Economic Resources in the Department of Defense." Included is a review of some significant actions taken during 1970.

Discussing actions toward decentralization on a selective basis and proper delegation of authority, Secretary Laird comments on the Blue Ribbon Panel's recommendations:

"In implementing our new management concepts, we have deliberately chosen to use an orderly, sequential, step-by-step approach instead of attempting to make comprehensive adjustments all at once.

"A measured rather than precipitous pace seems most wise to us. We intend to avoid unnecessary disruptions in defense capabilities while we make

Edgewood Employes Win Awards for Saving Money

Suggestions for work simplification procedures or elimination of surplus equipment credited with saving the U.S. Government $3.8 million in the Army Cost Reduction Program recently earned citations for nine Edgewood (Md.) Arsenal employes.

Honored by Baltimore Chapter No. 13 of the Society of Manufacturing engineers, eight of the employes are assigned to the Weapons Development and Engineering Laboratories.

Modification of J–57 jet engine containers to use them for storing and shipping Air Force spray tanks is credited by the Army with saving $2.5 million. Robert Lentz, Donald Cohen, Angelo Conti, Larry Shaff and Robert Krauch received awards.

Leonard Burke and Howard R. MacIver were cited for modification of the M5 smoke cannister filler tubes, thereby cutting the cost of a machine shop operation by $113,000.

R. Warren Miller saved $971,000 with ideas to use salvaged components for gunner's handles on flame tanks; using paper inhibitors instead of crystaline volatile corrosion inhibitors in shells; eliminating the requirement to strip and mark edge-grain wood shipping boxes; and redesigning the 40mm cartridge case to simplify machining operations.

Gerald H. Gerhold's idea of using a dry film lubricant for metal forming in punch press operations, along with a suggestion to improve the drilling procedure, saved more than $180,000. He is employed in the Technical Support Directorate.

WSMR Presents 25th Anniversary Coin to Nixon

President Richard M. Nixon was presented the first serial-numbered coin medal commemorating the Silver Anniversary of White Sands (N. Mex.) Missile Range on Mar. 12.

Sponsored by the Rio Grande Chapter of the American Ordnance Association, the medal was received for the President by John S. Davies, Special Assistant.

Making the presentation was Maj Gen (USA, ret.) William K. Ghormley, AOA executive vice president, who filled in when Lt Gen Arthur G. Trudeau (USA, ret.), former Army Chief of Research and Development, had to change his plans.

Produced by the Franklin Mint in Philadelphia, Pa., the coin medals are slightly larger and thicker than a silver dollar, struck in sterling silver, proof-finish, and in limited edition.

The idea of the coin originated and was developed by a group of White Sands Missile Range people who are members of the Rio Grande Chapter, AOA. Thomas Starkweather, National Range Operations Directorate, originated the idea and served as the project chairman.

Austin Vick, Performance Evaluation Division, NRO, designed the coin, and Lt Col Frederick Frank (USA, ret.) formerly assigned at WSMR and Rio Grande Chapter past president, took the coin to Washington.

Attending the cremony in the East Wing of the White House were Senator Clinton P. Anderson of New Mexico; Congressman Harold Runnels, Second Congressional District, New Mexico; Maj Gen William K. Ghormley (USA, ret.), executive vice president of the AOA; T. Odon Mathews, AOA Eastern Area vice president; and Col Archie J. Clapp, U.S. Marine Corps (Retired), director of chapters and public relations, AOA.

ON BEHALF OF PRESIDENT NIXON, John Davies (third from left) receives first serial-numbered coin medal commemorating silver anniversary of White Sands Missile Range. Others (from left) are Maj Gen W. K. Ghormley (USA, ret.), T. Odon Mathews, Senator C.P. Anderson, Congressman Harold Runnels, and Col A.J. Clapp (USMC, ret.).

the transition from wartime to peacetime forces, incorporating the changes in force structure necessary to implement the Nixon Doctrine and the Strategy of Realistic Deterrence, and also needed to complement our transition toward an all-volunteer force."

Speaking later on efforts to improve military operations, he again stressed a carefully studied approach:

"We recognized the existence of many of the problems discussed in the Blue Ribbon Defense Panel Report. We have done a number of things in attempting to solve them, but we do not believe that changes as substantial as they recommend are required or wise in all cases."

One change he said he considers necessary is Congressional authority to appoint a second Deputy Secretary of Defense. He would share with the present DSD the over-all delegation of responsibility, though it might prove desirable to "assign primary areas of concentration." The objective would be "to enchance civilian supervisory management."

Secretary Laird said he plans to ask also for two additional Assistant Secretaries of Defense, "in contrast to the five recommended by the Blue Ribbon Defense Panel."

Turning to the organization and management of research and development, he mentioned that panel recommendations called for a number of changes. Included are abolishing the position of Director, Defense Research and Engineering (DDR&E) and reallocating his functions to two new Assistant Secretaries of Defense—for research and technology, and for engineering development.

The panel also advocated action to make the Advanced Research Projects Agency (ARPA), now directly under the DDR&E, into a Defense Agency. Another proposed change was the creation of a new ASD for Test and Evaluation and a new Defense Test Agency.

"The thrust of these recommendations," Laird said, "was to separate the three related functions, Research and Advanced Technology; Engineering Development; and Test and Evaluation—and in doing so to give each area special and increased attention at OSD level.

"Instead of establishing three new Assistant Secretaries for these three functions, we believe the same thing can be accomplished by designating three deputies within DDR&E, each with responsibility for one of these functions.

"Research and advanced technology will be given increased emphasis in the Office of the Director of Defense Research and Engineering, and new procedures will be established to insure that all areas of new technology applicable to national defense are being addressed.

"In the area of Engineering Development, although the Military Departments will assume full responsibility for the conduct of weapon system development, the Deputy Director of Defense Research and Engineering will be assigned coordinating responsibility and will concentrate on the policy and managerial aspects.

"In order to upgrade and expand our attention to the test and evaluation of our defense systems and equipment, we are establishing within the Office of the Director of Defense Research and Engineering an office under a Deputy Director for Test and Evaluation with full responsibility to coordinate and establish policy for all test and evaluation matters.

"We also plan to keep ARPA within DDR&E for the time being since we see no compelling reason to make it a Defense Agency. We also intend to retain the Defense Communications Planning Group (DCPG) as an action agency under DDR&E but we will retitle it the Defense Special Projects Group and expand its role to encompass a wide range of new projects. . . ." (The DCPG has since been renamed the Defense Special Projects Group.)

Army Power Sources Leader Closes 30-Year Career

One of the U.S. Army's widely acknowledged leaders of R&D in the critical field of improved electrical power sources closed 30 years of service Mar. 19 by retiring as an Electronics Command employe.

Arthur F. Daniel gained international renown for R&D achievements, primarily research on advances in energy conversion. He was presented the Exceptional Civilian Service Decoration by the Secretary of the Army for his contributions to improved batteries in World War II. This is the highest award the U.S. Army can bestow upon a federal employe.

Arthur F. Daniel

Daniel was a principal figure in starting the annual Power Sources Conference, the largest meeting of its kind now held annually under the aegis of the Electronics Command, headquartered at Fort Monmouth, N.J. He served as conference chairman while he headed the Power Sources Division of ECOM's Electronic Components Lab. (1957–67).

Achievements of the Power Sources Division under Daniel's direction in the development of batteries, fuel cells and solar power suppliers, resulting in new and greatly improved electric energy sources for the field Army were internationally recognized.

Daniel holds five patents on batteries, battery components and solar conversion devices. Many of his technical articles have been published in U.S. and foreign professional media.

The Monmouth County Section of the American Chemical Society presented Daniel the Virgil F. Payne Award in 1968. He also is a member of the Electrochemical Society, the New York Academy of Science, the American Institute of Aeronautics and Astronautics, and the Institute of Electrical and Electronics Engineers. He is listed in *American Men of Science and Chemical Who's Who.*

Edgewood Establishes Council To Represent S&E Personnel

An advisory council has been established at Edgewood (Md.) Arsenal to confer with the commander on enlisted scientific and engineering (S&E) personnel assignments to ensure that talents and skills are properly utilized.

Serving arenal S&E personnel assigned to laboratories and research groups, the council will review personnel processing procedures and act as a fact-finding board for complaints and grievances.

More than 80 enlisted S&E personnel with bachelor's, master's or PhD degrees are assigned to the arsenal.

Lt Col Lewis A. Welzel, troop commander, will chair the council, which will meet at least once quarterly or more often if the need arises.

The council was proposed by the Troop Command's Capt Patrick J. Kiggins, who recommended establishing it along the lines of the junior officers advisory board.

"This type of committee," he said, "will give S&E personnel the opportunity to report directly to the commander, through their representative on the council, and help us to keep pace with the need for technicians."

Ochs Takes Control of CDC Experimentation Center

Brig Gen Elmer R. Ochs has assumed command of the Army Combat Developments Command Experimentation Command, Fort Ord, Calif.

General Ochs came from nearly three years of duty in Vietnam, where he commanded the 173d Airborne Brigade (Separate) and earlier served as Military Senior Adviser; deputy assistant CORDS III, CTZ (Civilian Organization for Rural Development, III Corps Tactical Zone), U.S. Military Assistance Command; and chief of Doctrine, Systems and Training G3.

From July 1966 to April 1968, he was chief of the Policy and Plans Branch, Director of Instructions and, later, secretary of the U.S. Army Infantry School at Fort Benning, Ga.

In 1964–65 he was with the Plans, Programs and Review Division, Army Aviation, Office of the Assistant Chief of Staff for Force Development in Washington, D.C., following a year in Korea as CO of the 2d Battalion, 8th Cavalry, U.S. Army Pacific.

He was tactical officer, 1st Regiment, Cadet Corps, U.S. Military Academy (1960–62) and is a USMA graduate (Class of 1946). He also has attended the U.S. Army War College, the Infantry School, and the Command and General Staff College.

Among his decorations, he wears the Legion of Merit (with OLC), Bronze Star with "V" device for valor, Army Commendation Medal, Air Medal (with 4 OLC), Combat Infantryman Badge, and Purple Heart.

Brig Gen Elmer R. Ochs

Land Combat Support System Applied to TOW Weapon Tests

HQ U.S. Army Missile Command (MICOM) announced Mar. 12 that the Army's Land Combat Support System, designed to test guided missile systems in the field, has begun tactically supporting the TOW Weapon System as well as the previously deployed Shillelagh.

Application of the LCSS to TOW marks the first time that one package of automatic test equipment has been used to test two different missile systems. The system enables soldiers to conduct rapid tests and make adjustments to missile equipment under battlefield conditions.

The LCSS consists of the Electronic Test Shelter, Shop Equipment Shelter, and the TOW and Shillelagh Supplementary Kits, which adapt the test set to each missile system. The automatic test equipment achieves standardization, improves the Army logistical system and eliminates undesirable duplication of equipment.

MICOM officials said the LCSS will be available to support Lance and Dragon in the future. Engineering studies are being held to determine other applications for LCSS.

Lt Col Frank A. Matthews, LCCS product manager, and Lt Col Robert W. Huntzinger, TOW project manager, observed the successful initiation of TOW support in a recent ceremony at HQ Army Missile Command, Redstone (Ala.) Arsenal.

Edgewood Miss 'Foster Mothers' Millions . . .

Prolific Pests Play Important Role in Research

Duties as "foster mother" to millions are handled by Miss Mary C. Heckner, employed in Edgewood (Md.) Arsenal's Quality Assurance Directorate, with a minimum of fuss and bother—rather routinely, one might say.

Miss Heckner keeps her brood well-fed and happy with a weekly batch of a special formula no baby would tolerate. But her millions of fruit flies relish and thrive upon it, reproducing in a prolific manner.

The TLC (tender, loving care) method used by Miss Heckner in administering to the needs of her charges is in rather severe contrast to their normal treatment. Fruit growers despise and destroy them; supermarket clerks aim diligently at total annihilation.

Edgewood Arsenal scientists concerned with certain testing requirements find that the Drosophilia-Melonogaster, as fruit flies are scientifically known, perform a valuable role.

[*Significance of that function is explained on page 16 of the January-February edition of the* Army Research and Development Newsmagazine *in an article titled NLABS Scientist Clarifies Purposes of Research on Spores: "Investigations of the fruit fly over the past 50 years have produced much of the current knowledge and techniques basic to an understanding of genetics, speciation and evolution. . . ."*]

TLC for the arsenal brood involves keeping them "climate controlled" all year long—maintaining temperature at 70 to 80 degrees. If the power goes off for any length of time, Miss Heckner has to respond quickly "before tragedy strikes."

She feeds her charges 30 half-pint bottles of formula weekly, plus a side dish of yeast. The formula consists of distilled water, sugar syrup and cornmeal mixed with an algae pigment. She also has to wash thoroughly and sterlize their homes (half-pint bottles) to stimulate "family life."

Originally hired at the arsenal in 1940 as a gas mask inspector, she now performs (when not busy with fruit flies) primary duties in testing chemical materials for all agencies of the Department of Defense.

SCIENTIFIC CALENDAR

Symposium on Nonlinear Functional Analysis, sponsored by MRC, Madison, Wisc. Apr. 12-14.

IEEE National Telemetering Conference, Washington, D.C., Apr. 12-15.

52d Annual Meeting of the American Geophysical Union, Washington, D.C., Apr. 12-16.

Symposium on Computers and Automata-Towards a Common Theory, sponsored by PIB, OCRD, AFOSR and ONR, N.Y.C., Apr. 13-15.

Tactical Reconnaissance and Surveillance Symposium, sponsored by ODR&E and Electronic Industries Assn., Washington, D.C., Apr. 13-15.

Conferences on Fast Reactor Fuel Element Technology, sponsored by Battelle Memorial Institute, New Orleans, La., Apr. 13-15.

9th International Conference on Magnetics, sponsored by IEEE, Denver, Colo., Apr. 13-17.

Seminar on Advanced EDP System Design, sponsored by Control Data Corp., Washington, D.C., Apr. 14-16.

3d Annual Meeting of the American Burn Assn., sponsored by USAISR, San Antonio, Tex., Apr. 15-17.

3d Annual International Geoscience Electronics Engineers, sponsored by IEEE, Washington, D.C., Apr. 18-23.

Seminar on Regressions and Correlations Techniques, sponsored by Control Data Corp., Chicago, Ill., Apr. 19-20.

12th Conference on Structures, Structural Dynamics and Materials, sponsored by AIAA and ASME, Anaheim, Calif., Apr. 19-21.

Meeting on Radioisotopes and Radiation Effects, sponsored by ASTM, Anaheim, Calif., Apr. 19-23.

5th International Conference on Magnetohydrodynamic Electrical Power Generation, Munich, Germany, Apr. 19-23.

8th Space Congress, sponsored by Canaveral Council of Technical Societies, Cocoa Beach, Fla., Apr. 19-23.

8th Symposium on Nondestructive Evaluation in Aerospace, Weapons Systems and Nuclear Applications, San Antonio, Tex., Apr. 21-23.

Variable Geometry of Expandable Structures Conference, sponsored by AAS and AIAA, Anaheim, Calif., Apr. 21-23.

1971 Army Numerical Analysis Conference, sponsored by ARO-D, Washington, D.C., Apr. 22-23.

6th Thermophysics Conference, sponsored by AIAA and University of Tennessee Space Institute, Tullahoma, Tenn., Apr. 26-28.

25th Annual Frequency Control Symposium, sponsored by ECOM, Atlantic City, N.J., Apr. 26-28.

Habitability in Space Stations Meeting, sponsored by AMA and AIAA, Houston, Tex., Apr. 26-29.

Annual Meeting of the Institute of Environmental Sciences, Los Angeles, Calif., Apr. 26-30.

IEEE Southwestern Conference and Exhibition, Houston, Tex., Apr. 28-30.

AMMRC Uses Decomposition Sintering for Titanium Composites

By J. Greenspan,
F. J. Rizzitano and E. Scala

Application of "decomposition sintering" to preparation of titanium composites, in experimentation at the U.S. Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass., has resulted in properties superior to those obtained by conventional sintering.

Titanium reacts in an unusual manner with hydrogen in that it becomes either "hydrided" or "dehydrided," according to the degree of hydrogen pressure acting on the surface.

Titanium metal heated in hydrogen atmosphere for a length of time absorbs hydrogen and eventually forms titanium hydride. Conversely, titanium hydride, or titanium saturated with hydrogen, when heated in vacuum for a length of time, decomposes to titanium metal and hydrogen gas.

Consequently, when titanium hydride powders are sintered in vacuum and the released hydrogen is continually pumped off, a solid mass of pure titanium metal eventually is obtained.

The "hydride decomposition" and powder "sintering" occur simultaneously in this process; therefore, the term "decomposition sintering" (DS) is used to identify the process.

An important DS aspect is that the temperature required to sinter or consolidate the powder particles to an integral mass is considerably less than that normally required to sinter titanium metal powders.

Processing temperature has particular significance with respect to development of microstructure, so that the lower temperature adds versatility to the processing. However, it is the purpose here to indicate implications that may be far reaching with respect to development of advanced titanium matrix composites.

The composites concept of materials design provides for attainment of properties beyond those normally capable of monolithic materials. This is based largely on availability of newly developed fibers of high strength and/or stiffness.

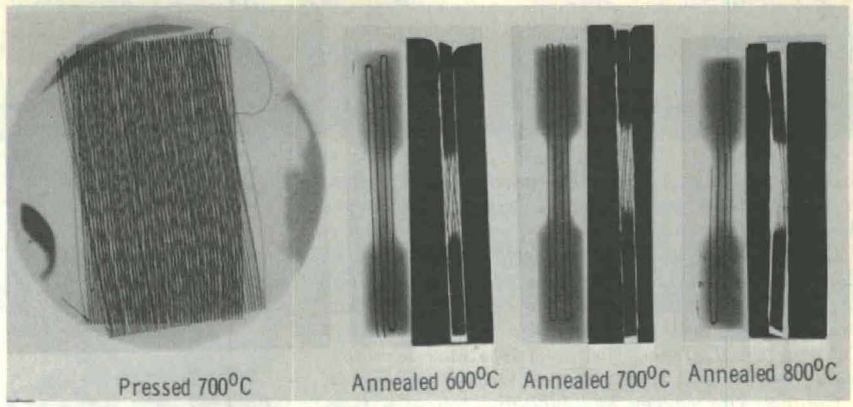


Figure 1. RADIOGRAPHS of Titanium Matrix, Tungsten Reinforced Composite Processed by Decomposition Sintering. Composites being tested at the AMMRC are stable at 600° C. and 700° C., but show deterioration at 800° C.

Some of the new fibers often are degraded by chemical reactions with the matrix during the process of composite synthesis, so that their full potential for reinforcement is lost. Conversely, the properties of the matrix may be damaged by chemical reaction with the fiber.

Fiber-matrix reactivity is in fact a problem commonly encountered in all composites development. Obviously, minimizing the processing temperature will help to alleviate problems of this kind.

A case in point is illustrated in Figure 1 for a composite model consisting of titanium reinforced with high-strength tungsten fiber. This composite was synthesized by decomposition sintering of hydride powders.

Tungsten fibers were preplaced so that the consolidated composite, as radiographed, is as shown in Figure 1a. More specifically, the raw composite was consolidated by die-ram pressing in a vacuum chamber, at a temperature of 600° C. (1115 F.).

Test samples were removed and reheated at 700° C. (1470 F.), which are illustrated after heating in Figures 1b, 1c, and 1d. Degradation by fiber-matrix reactivity is visible only for the 800° C. case.

From separate experiments, it is known that titanium metal powders require a pressing temperature of 800° C. to obtain the degree of consolidation equivalent to that obtained at 600° C. by decomposition sintering.

Composite synthesis in this case, therefore, is feasible only by decomposition sintering. Test samples typical of Figures 1b and 1c do in fact prove feasibility by showing that strength and elastic modulus are increased by fiber reinforcement.

This development is not limited to tungsten reinforced titanium as illustrated. Rather it can be extended to titanium matrix composites in general, regardless of the reinforcing materials. Thus the decomposition sintering process broadens considerably the base for development of this interesting class of materials.

Fourth, Fifth Armies Merged

Fifth Army headquarters at Fort Sheridan, Ill., will be moved to Fort Sam Houston, Tex., where it will merge with Fourth Army headquarters, to become the new Fifth U.S. Army by July.

The Fifth Army will be responsible for Army activities in 14 states: Arkansas, Indiana, Illinois, Iowa, Kansas, Louisiana, Michigan, Minnesota, Missouri, Nebraska, New Mexico, Oklahoma, Texas and Wisconsin.

Army activities in Colorado, North and South Dakota and Wyoming will be transferred to the control of the Sixth U.S. Army, located at the Presidio of San Francisco, Calif.

Intended to reduce management overhead by combining related functions at one location, the consolidation is expected to save $11.4 million annually.

STRATCOM Earns Third Cost Reduction Savings Award

Validated savings of $14,317,000 during Fiscal Year 1970 in the U.S. Army Cost Reduction Program have earned the Strategic Communications Command (STRATCOM) an Army Certificate of Merit for the third consecutive year.

Signed by Army Chief of Staff General W. G. Westmoreland, the certificate commends Maj Gen William B. Latta and his worldwide communications command for its outstanding achievement in the program.

The $14,317,000 total, of which nearly $11 million was credited to application of Value Engineering principles, represented 139 percent of the command's assigned goal. The achievement "demonstrated the degree of managerial excellence practiced by all members of the command . . . (and) the strong resolve to conduct operations in the most efficient manner with the least possible cost."

STRATCOM headquarters at Fort Huachuca, Ariz., credited all its subordinate commands for their efforts, with particular praise going to the National Communications Command, Interagency Communications Agency, STRATCOM-Pacific, Signal Group-South, Signal Group-Air Defense, and the Communications Electronics Engineering Installation Agency, for exceeding their goals.

AMC Project Manager Views Role of Army In-House Laboratories

During its 10-year existence, the *Army Research and Development Newsmagazine* has carried numerous articles, as bylined features or as speech condensations, to present the views of many high-ranking Army R&D leaders relative to the important role of Army in-house laboratories. The following article is the first that has been published on this topic from the viewpoint of one of the Army Materiel Command's 40-odd project managers for major weapons.

Col Robert D. Funke, author of this article, is project manager for the Dragon weapon system at HQ U.S. Army Missile Command, Redstone Arsenal, Ala.

Graduated from the University of Dayton in 1949 with a BSME degree, he received an MBA degree from Babson Institute in 1960. He has graduated from the Command and General Staff College, the Defense Weapons Systems Management course, and Infantry and Ordnance schools.

Col Funke's career has included tours in Germany, Korea and Vietnam, and with the Ballistic Research Laboratory at Aberdeen (Md.) Proving Ground, the Antiballistic Missile and Sergeant Project Office, and the U.S. Army Missile and Munitions Center and School.

His decorations include the Legion of Merit, Bronze Star Medal (with OLC), Meritorious Service Medal, Army Commendation Medal, Combat Infantryman Badge with Star, Vietnam Honor Medal and the Parchutists Badge.

★ ★ ★

Military laboratories operating within the Department of Defense include all research and development facilities of the three Military Departments. Department of the Army activities include research in fields of food, clothing, petroleum, communications, explosives, ammunition, artillery, vehicles, weapon systems, and many other fields.

While the material presented herein will be more clearly associated with Army laboratories engaged in R&D of missile systems, it applies equally as well to all defense laboratories. The term "in-house" is synonymous with government-owned facilities as opposed to privately owned facilities.

Interpretation and analysis of the enemy threat and Army user requirements are functions which cannot be delegated to industry. Objectives and performance standards in satisfying user requirements must be established by the Army, and in-house laboratories are essential to perform these functions.

As I view the in-house laboratories' function, they should not become *deeply* involved in the analysis of the threat to U.S. security. Rather, it is their function to become a part of the mainstream—to be intimately aware of the threat, in order to fulfill their mission in countering the threat. They must serve as interpreters in translating projected military requirements into technological goals.

Army in-house competence is essential for generating materiel concepts and parameters. As the foundation for all weapon systems, this function requires fresh, unique ideas, the exploitation of advanced technology, and the ability to foresee significant breakthroughs.

Decision-making in early phases of R&D is preponderantly the responsibility of the Army and cannot be delegated. Later stages of development are in the domain of industry. In any event, the Army must participate to the extent of assuring that performance objectives are met.

If no in-house work is accomplished during the later stage of development, the Army becomes a poor judge of any contract effort.

The Department of Defense, as the biggest customer of technology in the country, must be an intelligent buyer. It must be technically competent; to be technically competent, it must do its own R&D, including basic experimentation.

In judging contractor effort to support development of its future materiel, the Army must be in a position to display, and utilize, technology in the most advanced stage—to demonstrate effectively a valid capability in technology.

In-house capabilities should be continuously involved in challenging technology areas, and oriented toward establishing a technology base. This base can be incorporated into future Army materiel, and, in this respect, provides the capability to support new concepts.

In-house laboratories have a responsibility to initiate, and carry through to feasibility demonstration, important system components or complete systems—or solutions to practical complex military problems.

Since it is incumbent on the laboratories to advance technology through performance of technical tasks—and since the Army's laboratory people must be constantly up-to-date in technological advancements—how can this be achieved? The answer: By giving challenging assignments.

No one can dispute that, to attain and maintain competence in the Army, we must have, and be able to hold, creative and enthusiastic people. The most effective way of achieving this is by assuring the flow of challenging, interesting work tasks; by encouraging development of the seed of creativity among scientific work teams.

Challenging tasks provide the incentive to remain in scientific work, broaden career objectives, and increase interest in science. Recently educated scientists and engineers need investigative experience related to Army objectives as necessary training and orientation for future work.

Adequate in-house competence, when effectively motivated, generates concepts, advances technology, demonstrates critical component and system feasibility, and achieves concept integration.

With this capability, the Army can continue to support project-managed systems by solving critical problems encountered by project managers for their specific systems—problems which, in many cases, have been considered insolvable by contractors.

The Army requires laboratories to support project managers for major materiel systems in an active and dynamic role rather than on a trouble-shooting basis. Laboratories should have an improtant role in the technical decision process—and not after-the-fact as fire brigades. They must advise the project managers rather than wait to be asked. They must provide the coupling of current technology to development problems.

To avoid creating an engineering function in the laboratory, there must be a proper balance in which scientists and engineers will spend part of their time working on the "bench" in the laboratory, and part of their time helping the project manager solve his day-to-day problems.

In-house laboratories are in no way autonomous bodies. They are entirely dependent on the military needs. They have to be in the mainstream of those needs to make significant contributions. Their responsibilities have to be linked to industry, universities and non-profit organizations working to-

ward the national defense goal.

As concepts materialize throughout the weapons development cycle, the laboratories must be the focal points for assimilating, evaluating, providing and directing the scientific and technical base for the military.

ACHIEVEMENTS of in-house laboratories within the Department of Defense structure have been sufficiently numerous and noteworthy to warrant voluminous reporting. The few discussed herein are credited to U.S. Army Missile Command (MICOM) laboratories at Redstone Arsenal, Ala. The contributions are not limited to Army use but apply similarly to other military services.

Concepts for the Littlejohn, Lance, Pershing, and the M72 LAW were generated at MICOM laboratories. All of these missile systems have been fielded or are in engineering development. Development of concepts for future systems is in progress. The laboratories also have developed aircraft air-to-ground systems, particularly missile launchers, currently being used in sizable quantities in Vietnam.

Fluidics Technology, introduced in 1960 by the Army's Harry Diamond Laboratories, was assimilated rapidly by MICOM for investigations relative to missile control systems.

The world's first successful flight test of a fluidic control system in late 1964 at Redstone Arsenal established the feasibility of this technology for future missile systems. Success of the feasibility model prompted MICOM to proceed with design and development of tactical prototype systems based on rigid guidelines for acceptable accuracy and operation under severe environmental conditions.

In less than three years a flight test program was completed in which the predicted performance was verified. Further development has improved component performance and reduced size, weight and cost of fluidic systems.

Liquid Crystals. MICOM has been responsible for developing a new and highly sensitive nondestructive testing technique for detecting flaws in laminated structures and various types of honeycomb and other heterogeneous structures. The technique uses ultrasensitive cholesteric liquid crystals, derivatives of cholesterol with characteristics of a liquid and a solid. The reflecting iridescent colors produce an easily interpreted picture of flaws related to material discontinuities.

Sensitivity of the technique varies slightly with the thickness of the skin covering the composite, such as a missile wing or a helicopter rotor blade. For 60-millimeter skins, defects the size of a small pea can be pinpointed; thicker skins of 190 millimeters permit detection of inch-square defects.

Tests have been equally successful with aluminum skins, glass cloth skins, titanium skins and glass cloth laminates. The inexpensive, reliable crystals are also capable of detecting corrosion or entrapped water vapor.

Propellants. Ethyl formyl polysulfide/ammonium perchlorate propellants were developed my MICOM to replace non-case-bondable doublebase propellants, thus permitting utilization of propellant as case insulation. This weight-reducing innovation permitted development of propulsion systems which provided a 50 percent increase in missile range over a missile loaded with standard propellants.

Although this propellant system was low in performance and burning rate compared to present day formulations, it represented a major breakthrough in technology. It was the basis for all modern composite propellants, including the Air Force Minuteman and the Navy Polaris systems.

Hypervelocity Technology. Development of a hypervelocity rocket scheme by MICOM demonstrated the techniques and technology required to develop a family of future hypervelocity weapons systems.

First-stage velocities in excess of 1,200 fps (feet per second) have eliminated inherent errors of wind sensitivity and mal-launch associated with free-flight rockets accelerated through the transonic region.

Terminal velocities of over 5,000 fps have been demonstrated. Darts traveling at speeds in this region are very effective antimateriel "kill" mechanisms. Penetration of 12 inches of armor in hypervelocity flight tests has been achieved.

Technologies developed in these hypervelocity investigations include high-thrust/short-burn-time propulsion, and the aerodynamics associated with Mach 5 performance.

High-Energy Laser Applications. MICOM successfully built and tested, late in 1963, an advanced high-energy-pulsed glass laser device. In response to inquiries from the National Cancer Institute, cooperative tests on the interaction of laser radiation with various tissues in test animals were initiated.

Results of these preliminary and successive experiments over a 2-year period led to a request from the National Institute of Health (NIH) asking MICOM to design and construct a device adaptable to clinical research. The device tested at MICOM by NIH surgeons met their requirements as specified, leading to delivery in 1966.

Project Manager Support. As a typical example of support to project managers, MICOM scientists found that a certain missile motor was unreliable after prolonged low-temperature storage because of crystallization of the propellant and consequent loss of strain capability. They solved the problem with the discovery of a molecular sieve desiccant located in the motor cavity.

In support of the efforts of U.S. Army Materiel Command project managers, new technologies involving lasers, fluidics, sensors, terminal homing devices, hypervelocity and specific areas of propulsion, such as smokeless propellants, impose no foreseeable limit in technology.

Exploitation of these techologies for the benefits to be derived in the 1970–1980 time frame, through maintenance of adequate capabilities within Army in-house laboratories, is well worth the investment risk. Technologies will be advanced and new concepts generated within Army laboratories because of their vital role in national defense—a mission demanding that we lead the world in advancing technology and building highly efficient, ultraeffective weapon systems.

Dr. Karpinos Ends CS Career, Accepts Position With HumRRO

Acceptance of a position with the Human Resources Research Organization (HumRRO) recently ended Dr. Bernard D. Karpinos' 32-year federal civil service career and deprived the Army Surgeon General's staff of one of the nation's top biometricians.

Called upon frequently to serve on Department of Defense study groups and panels, Dr. Karpinos represented the DoD in December at the White House Conference on Children.

In recent years he has analyzed general health problems associated with rejection rates of draftees and volunteers for military service. He started publishing studies on population concepts in 1935.

4 Nations Review Progress Of TCP at Edgewood Arsenal

More than 25 Technical Cooperative Program representatives from Canada, the United Kingdom, Australia and the U.S. Department of Defense convened recently at Edgewood Arsenal, Md.

The foreign delegations were led by Hubert James Fish, Canada; G. N. Gadsby, United Kingdom; and W. G. Jowett, Australia.

Arsenal Commander Col George W. Connell welcomed the group. Dr. Seymour D. Silver, director of the arsenal's Research Laboratories and U.S. national chairman of TCP working panel E-1 (Chemical Defense), gave the opening address.

Presentations and discussions covered the progress in research programs of the four nations since the 1970 meeting was hosted by Canada, including a review of chemical and riot control agents, training agents, flame and smoke.

Other topics included field assessment and dissemination of chemical agents, prophylaxis and therapy for chemical casualties, physical protection, detection and decontamination.

The U.S. representatives, all from Edgewood Arsenal, were Dr. B. L. Harris, technical director Col Joseph R. Blair, the Research Laboratories deputy for Medical Sciences; and Bernard Zeffert, chief, Physical Research Laboratory.

TACOM Develops Hybrid Engine for Low Pollution, Fuel Economy

Editor's Note: *The July-August 1970 edition of the* Army Research and Development Newsmagazine *carried an article on the public announcement by the U.S. Army Tank-Automotive Command regarding the development of a "hybrid" vehicle engine. The announcement was made at a meeting of high-level representatives of U.S. Government officials to consider problems of air pollution and abatement methods. The following article by the TACOM project and program engineers amplifies upon the original announcement.*

By Andrew W. Kaupert and George E. Cheklich

The U.S. Army Tank-Automotive Command (TACOM) is developing a combustion system that has demonstrated a capability of sharply reducing harmful exhaust gas emissions while simultaneously improving fuel economy from 20 to 50 percent, depending on the load factor.

Essentially, the Hybrid Combustion Process (HCP) combines the unthrottled, efficient operation of the diesel engine with the soft, controlled combustion in the spark-ignition engine.

HCP is known as the stratified charge or lean air-fuel ratio engine. It uses a fuel-injection system while the spark-ignition engine uses throttling in a carburetor to deliver the proper quantity of air-fuel mixture to the cylinders to control power output.

HCP power output is controlled by varying the amount of fuel injected into each cylinder, as in a conventional diesel engine. The unthrottled air intake results in a leaner over-all air-fuel mixture, better fuel economy and lower exhaust emissions than can be achieved with a carburetor in the same engine. These characteristics are noted particularly at low and intermediate engine speeds.

The basic HCP concept has been known for many years, dating back to Ricardo's experiments of 1922. The U.S. Army program in recent years, however, has provided the impetus for the technological advancements necessary for the evolution of a practical, low-pollution, highly efficient hybrid combustion engine.

During the 1950s and early 1960s, TACOM kept abreast of progress in hybrid combustion engines and conducted exploratory investigations of certain promising systems.

In 1963, a survey was conducted of all known hybrid systems. To assess potential for application to military vehicles, about 40 systems were evaluated, analytically or experimentally.

Systems were classified as (1) homogeneous and (2) heterogeneous-mixture internal-combustion piston engines. Subclassifications were based on various modes of combustible mixture formation, types of ignition, combustion chamber design features, and technical feasibility potential.

ANDREW W. KAUPERT *is project engineer of the hybrid combustion engine program at the United States Army Tank-Automotive Command's Propulsion Systems Laboratory. He earned his BS and MS degrees in mechanical engineering from the University of Detroit. Before coming to TACOM in 1968, he worked on combustion projects for three years at International Harvester and two years at Detroit Diesel plants.*

Kaupert also is project engineer on combustion research projects at the University of Wisconsin, University of Michigan and International Harvester. He is a registered engineer in Michigan.

GEORGE E. CHEKLICH joined the TACOM research staff in 1962 and is an executive program engineer in charge of the advanced engine research program for Army vehicles in the Propulsion Systems Laboratory. After receiving BS and MS engineering degrees from Michigan State University, he worked on various industrial combustion and engine development projects (three years with Ford Motor Co. and four years with Chrysler Corp.).

Cheklich is active in other advanced piston engine research programs in addition to the hybrid combustion engine efforts. He is a registered engineer in Michigan.

Five hybrid systems were selected for exploratory investigation. TACOM's hybrid engine investigations to date have been applied only to the Army's 4-cylinder 141-cubic-inch engine (L-141), used to power the ¼-ton M151 jeep.

Following approximately three years of exploratory research on single-cylinder engines, a detailed technical evaluation in 1966 resulted in selection of two systems for further investigation on both single-cylinder and L-141 engines. The Texaco Combustion Process (TCP) and the Ford Combustion Process (FCP) were chosen.

Primarily, the objective of the HCP engine program was to improve part-load fuel economy through better combustion of the air-fuel mixture. Many vehicles operate with partial loads most of the time, making low fuel consumption in this range particularly important.

Major gains in fuel economy demonstrated in the hybrid engine program vehicle tests could have a significant impact in reducing fuel supplies required to accompany military ground vehicles. With this principal objective in mind, investigators concentrated on the systems developed by Texaco and Ford.

Increasing nationwide concern about the living environment as related to healthful conditions prompted researchers to add a new objective of reducing harmful exhaust gas pollutants. This has not materially affected the original goal, nor has it caused any undo delay in the program. Low pollution levels have been achieved because the HCP engine inherently has low pollution output—resulting from highly efficient combustion in the presence of excess air.

TEXACO CP ENGINE. The TCP engine is spark-ignited, fuel-injected and unthrottled. Fuel injection is initiated near the end of the compression stroke into swirling air.

The first fuel element is ignited to establish a flame front immediately downstream from the injector nozzle. As injection continues, fuel supplied to the flame front is burned almost as rapidly as it combines with the swirling air. (See Figure 1.)

TCP intake ports and valves are shaped to induce rotational motion (swirl) of the incoming air during the intake stroke. This swirl continues during the compression stroke until the air in the final stage of compression is transferred radially inward to a cup in the top of the piston.

The piston cup diameter is approximaely one-half that of the cylinder

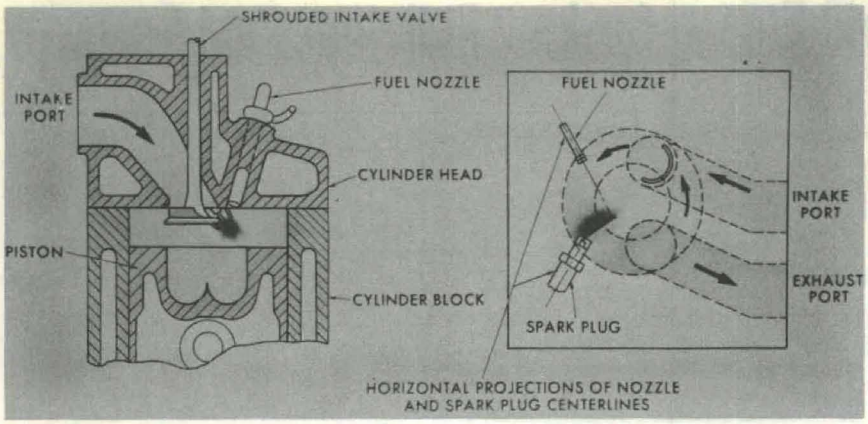


Fig. 1. Hybrid Combustion System

bore. As a result of conservation of momentum, the rotational speed of the air is increased to the desired degree before injection to enhance air-fuel mixing.

The swirling air picks up fuel from the injector and immediately travels to the ignition source. Load control is obtained by regulating the quantity of fuel injected in proportion to the desired engine output.

Full load delivery corresponds to about the time for one complete air swirl revolution. Injected fuel impregnates the air charge with fuel in about stoichiometric proportions. Thus, the part-load operating regime of the TCP engine is in over-all lean mixtures; load control does not require intake air throttling.

Ability to burn lean mixtures and elimination of throttling results in part-load thermal efficiency considerably higher than that of a normal gasoline engine.

Conversely, late injection means that the mixing process at maximum power conditions cannot achieve air utilization as high as that available through the premixing used in a normal engine.

With late injection, however, the TCP is not octane limited and can burn a wide variety of fuels. Direct cylinder injection produces excellent throttle response and warm-up characteristics as contrasted to carbureted engines.

Positive ignition of the first injection increment, almost immediately after it forms a combustible mixture, eliminates the need for a high compression ratio (14–20:1 in a typical diesel vs 10:1 in the TCP).

The high cetane number needed to achieve compression ignition is not required, resulting in a compact, lightweight TCP engine equivalent to a spark ignition power plant.

Maximum cylinder pressures and rates of pressure rise that occur in the TCP are regulated by the rate and duration of fuel delivery—and are considerably lower than those of a typical compression ignition engine.

Combustion loads, noise and shock are correspondingly less severe. The heavy structural requirements of compression ignition engines are not necessary.

Comparative characteristics imply, and experience confirms, the freedom to choose compression ratio and/or air charge pressure, regardless of the octane or cetane number of available fuels. Considerable design leeway thus exists for the optimization of engine parameters.

Elimination of octane and cetane numbers as relevant fuel qualities, coupled with the direct cylinder injection of the fuel, produces an engine with a very broad fuel tolerance, ranging from leaded and lead-free gasoline, and CITE, to diesel fuels.

The capability to burn CITE fuel in a spark-ignition engine opens the door for a possible single-fuel Army vehicle fleet.

FORD CP ENGINE. Fuel is injected into a cup in the piston crown early in the compression stroke and air swirl concentrates the mixture in the cup. A long-reach spark plug, protruding into the piston cup, initiates combustion. The FCP features a low-pressure fuel injection system unitized with the ignition distributor. (See Figure 2.)

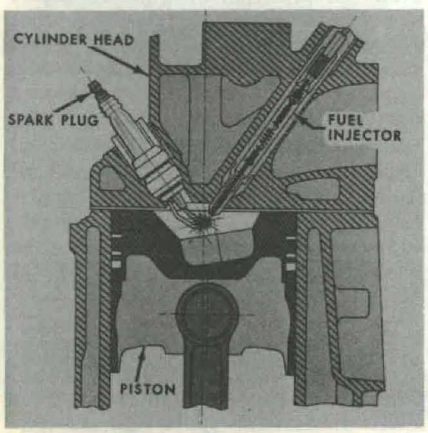


Fig. 2. Hybrid Combustion System

Combustion control is achieved by the timing of the injection and the ignition. At light load operation, full stratification must be maintained to insure ignition of the mixture at the spark plug—by injecting the fuel late and igniting it before injection is completed.

As the load increases, more fuel dispersion is allowable, and even desirable, to obtain fast and complete combustion. For this condition, injection timing is advanced as the load increases.

Because the combustion rate becomes faster at richer mixtures (heavier loads), ignition timing is retarded. As the engine speed increases, an over-all advance of both the injection timing and ignition timing enables the mixture formation and the combustion process to keep up with the increasing piston velocity.

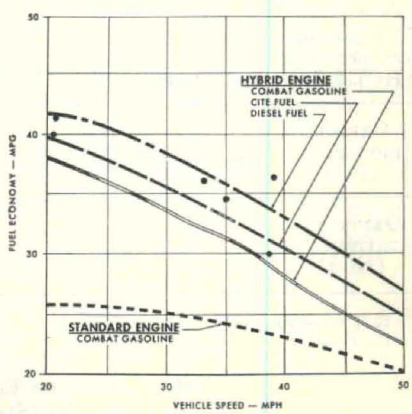
STATUS—TCP. Exploratory development of the L-141-TCP engine was initiated in 1963. One single-cylinder and two multicylinder L-141-TCP engines have been built.

Approximately 950 hours of single-cylinder engine combustion tests have been completed. About 7,000 miles (equivalent) have been accumulated in two M-151 test bed vehicles with multicylinder engines. Roughly 1,100 hours of operation have been accumulated on the two multicylinder engines, with 700 hours high-time on one engine.

Combat gasoline, CITE and diesel fuels were used in all tests.

Following initial tests as a naturally aspirated engine, one multicylinder engine was converted to operate with a turbocharger. This important advantage of compatibility for turbocharging was investigated in preliminary tests and showed a gain of approximately 15 percent in maximum

(Continued on page 36)



TACOM Develops Hybrid Engine for Low Pollution, Fuel Economy

(*Continued from page 35*)

power output without adding more fuel. The smoke level under full power was also greatly reduced.

Emphasis has been directed to achieve the best possible fuel economy.

Figure 3 shows the road load fuel economy of the M-151-TCP vehicle versus the standard vehicle. The variance in economy (up to 50 percent) with three different fuels is largely due to density and heating values.

The major advance in fuel economy confirms that the original objective—significant improvement in part-load fuel economy—has been met, and could have a direct favorable impact on the Army's fuel logistics burden.

STATUS—FCP. The TACOM program on the Ford Combustion Process engine was initiated in 1967. One single-cylinder and two multicylinder L-141-FCP engines have been built. About 800 hours of test time has been accumulated on the single-cylinder and about 700 hours on the multicylinder engine.

Two M-151-FCP test bed vehicular installations have been made. One was labeled best economy and the other best emissions. Roughly 4,000 miles have been accumulated on the best economy vehicle and 1,700 miles on the low-emissions vehicle.

The best economy M-151-FCP efficiency, which is octane limited, is equivalent to the TCP results when operated on combat gasoline, as shown in Figure 3.

Engine Specifications	STD L–141	FCP L–141	TCP L–141
Displacement	141.5	141.5	141.5
Bore & stroke	3.875 X 3.000	3.875 X 3.000	3.875 X 3.000
BHP @ rated RPM	65 @ 4000	73 @ 4000	64 @ 3200
Compression ratio	7.5:1	11.1:1	10.0:1
Max torque (ft. lb.) @ RPM	110 @ 1800	112 @ 2000	115 @2400
Max BMEP (psi)	117	119	122
Weight, dry (lbs.)	328	360	375
Length (in.)	26.9	27.3	27.5
Width (in.)	21.4	22.5	24.5
Height (in.)	23.0	23.0	23.3

Table 2. Comparison Table
Hybrid Combustion vs. Standard Engine

The emissions performance comparison of the hybrid combustion-powered versus the standard M-151 vehicle is shown in Table I. All data were obtained by using a developmental test procedure (cycle) incorporating constant volume sampling.

This cycle is considerably more severe than the 1970 Federal Compliance Test Procedure, but less severe than the proposed 1972 LA4-S3 driving cycle. The APCO (Air Pollution Control Office) proposed 1975 federal standards are shown for reference.

Significantly notable also is that the emissions performance data shown in Table I were obtained from official government tests conducted for TACOM by the APCO.

TCP test results shown were obtained from an engine designed for best economy, with no special emphasis on lowering emissions. The FCP data were obtained using the best emissions engine with and without a catalytic exhaust gas reactor.

From the data, it can be concluded that hybrid combustion engines sharply reduce exhaust emissions as compared to the standard vehicle and, in some instances, approach the APCO 1975 proposed standards.

At this writing, these hybrid combustion engine emissions data are reported to be the best results ever obtained in APCO testing. Table 2 is a comparison table of engine specifications showing the standard L-141 versus L-141 hybrid combustion engines.

This exploratory research achievement indicates the desirability of extending the hybrid concept to a family of engines.

Ranging from four to eight cylinders and 70 to 140 brake horsepower, this family would complement another engine group currently under development, known as the Very-High-Output (VHO) family diesel of engines. Through the use of turbocharging, the hybrid engine power could be augmented to 280 brake horsepower.

The hybrid engine family would permit application of this propulsion system concept to the following types of vehicles: ¼-ton truck, ¾-ton truck, 1¼-ton truck, 5-ton truck, M113—armored personnel carrier and Army 85 vehicles (light and medium).

Incorporation of a family of hybrid combustion engines in these vehicles would provide not only fuel logistic relief; simplification of spare parts supply and the maintenance burden also would be payoffs of the TACOM R&D program.

Due to the high density of the L-141 engine, the prime Army application would be to the M-151 ¼-ton truck. HCP could be applied to equivalent commercial spark ignition engines with appropriate modifications.

NAPCA Data With LA4–S3 Driving Cycle—Constant Volume Sampling (CVS)
Fuel: Unleaded Gasoline

Grams per Vehicle Mile

Pollutant	1972 Federal Stds.	Standard M151 wo/cat	Standard M151 w/cat	Texaco Combustion Process [1] wo/cat	Texaco Combustion Process [1] w/cat	Ford Combustion Process [2] wo/cat Best Econ.	Ford Combustion Process [2] wo/cat Best Emiss.	Ford Combustion Process [2] w/cat Best Econ.	Ford Combustion Process [2] w/cat Best Emiss.	Proposed 1975 Federal Stds.	Proposed 1980 Federal Goals
Unburned hydrocarbons (HC) F.I.D.	3.4	6.40	4.81	4.58	1.74	5.11	1.49	—	.15	.5	.25
Carbon monoxide (CO)	39	76.22	85.0	9.62	2.69	8.04	13.2	—	4.3	11	4.7
Oxides of nitrogen (NOx)	—	3.39	2.75	1.74	2.23	3.14	.67	—	.51	.9	.4

[1] Best economy engine
[2] Ford data

Table 1. Exhaust Emissions Performance
M151 Vehicle (Standard vs. Hybrids)

This Army engine development could also be used in similar vehicles serving other federal agencies.

The next phase of TACOM effort involves the building and *verification* testing of both the TCP and FCP engines. Additional engines will incorporate minor design improvements, as indicated in the initial multicylinder testing.

When installed in the two test vehicles, each of the engines will be operated about 10,000 miles to verify durability and complete the exploratory development phase.

To achieve the most desirable balance, both the TCP and FCP systems will be designed and built to meet the proposed 1975 federal emissions standards and still maintain the best possible fuel economy.

Advanced development of a 4-cylinder hybrid combustion engine is proposed when verification testing is successfully completed. Hopefully, this initial development will be expanded to include a family of hybrid engines in the 70 to 300 horsepower range for military vehicle application—with a high degree of parts interchangeability between various engine models.

Concurrently, the technical feasibility of applying the hybrid combustion process to larger displacement cylinders will be investigated so that its many significant advantages might be extended eventually to other Army vehicles.

BESRL Publishes Reports on Night Operations

Methodology used and findings from the Army Behavior and Systems Research Laboratory (BESRL) Night Operations Program on human performance with night-vision devices have been published as a Technical Research Report.

Search Effectiveness With Passive Night Vision Devices, TRR 1163 (AD 714206), is coauthored by Jack J. Sternberg and James H. Banks. Sternberg was the BESRL senior task leader for tests conducted with support of the Combat Developments Command Experimentation Command (CDCEC), Fort Ord, Calif.

The publication reports on the relative performance of 123 enlisted men with the use of four passive night-vision devices: the Miniscope, Starlight Scope, Crew-Served Weapon Sight, and the Night Observation Device, Medium Range.

Operators were tested at the rate of nine per night under three varied ambient illumination levels. Seventy-two targets were detected during the period covered by the report. They differed in type, contrast and mode, and were stationed at a distance of 100 to 1,200 meters. Detection responses and search behavior recorded on magnetic tape for data analysis are compiled in TRR 1163.

Results of two other projects associated with the BESRL night operations program have also been published. TRR 1164 (AD 712318) *Search Effectiveness With the Starlight Scope and 7 x 50 Binoculars* was coauthored by Sternberg, Banks and John P. Farrell.

Human Performance Experimentation in Night Operations: Technology and Instrumentation for Field Research, Technical Research Note 223 (AD 713463), was coauthored by Sternberg, Banks and Aaron Hyman.

Requests for copies of the publications should be addressed to: Behavior and Systems Research Laboratory, Attn: CRDMRC/BESRL Room 239, Commonwealth Building, 1320 Wilson Blvd., Arlington, Va. 22209.

Pressure Technology Book Reviews Watervliet Work

Related achievements of Watervliet (N.Y.) Arsenal are reviewed in a chapter of *The Mechanical Behavior of Materials Under Pressure*, reporting on publications by some of the world's foremost experts in this field.

Dr. Thomas E. Davidson, chief, Materials Engineering Branch, Benet Research and Engineering Laboratories, and David P. Kendall, a research mechanical engineer at the arsenal, are joint authors of the chapter.

The arsenal is concerned with U.S. Army heavy weapon design and development. They discuss the theory of pressure vessel design and associated analytical techniques related to this responsibility.

Effects of residual stresses in monobloc as well as multilayer 2-element cylinders are described, along with the autofrettage process from a theoretical as well as from a pragmatic viewpoint.

Particular emphasis is placed on metallurgical criteria for materials in pressure vessel applications. The effects of strength, temperatures, ductility, fracture toughness and environment are considered on both an individual and collective basis. Sealing arrangements that can be employed in high-pressure systems are discussed comprehensively.

Dr. H. D. L Pugh, one of the world's leading authorities on high-pressure technology, edited the book printed by Elsevir Publishing Co. of London, England. Dr. Pugh is head, Hydrostatic Extrusion and High-pressure Division, National Engineering Laboratory, East Kilbride, Scotland.

David Kendall and Dr. Davidson

Tri-Service Meet Expedites Publication of FIIG-A354

Picatinny Arsenal was host for the recent reconciliation-service test 4-day conference on Federal Item Identification Guide A354 (Projectiles).

The meeting of Army, Navy and Air Force representatives was held to expedite publication of FIIG-A354, which covers categories of projectiles by caliber. The new guide converts old description patterns to a computerized system format that can handle all categories in one over-all operation. It replaces the electric accounting machine with a separate card for each projectile.

Since the other services rely on the Picatinny guide, they must occasionally make certain "reconciliation" adjustments.

Federal Item Identification Guides are used to build a single logistics record in a format for each item of supply, with a capability for ready retrieval from a master data bank.

Rapid advances in computer technology, mass data storage, and data communications media have made possible the establishment of this master bank to assist in logistics management. Using the FIIG for guidance, data on prospective new items are submitted to the bank and screened against previously recorded data.

The conference was arranged by the cataloging unit of Ammunition Engineering Directorate's maintenance engineering section. William Witek was chairman and Jacob Lishchiner was alternate chairman. Walter Olehnik, associate director, Materiel Management and Maintenance Directorate, Munitions Command, opened the meeting.

Computer Techniques Optimize Iron Fragmentation at AMMRC

By Kenneth D. Holmes

An intensive investigation into nodular or ductile cast iron in support of the shell program of the U.S. Army Munitions Command is being performed at the Army Materials and Mechanics Research Center (AMMRC), Watertown, Mass.

Mortar shell ammunition was originally made of wrought steel because of its comparative ease of fabrication and plentiful supply sources. In recent years a substantial amount of cast-shell ammunition has been utilized. Because of improved fragmentatation characteristics, it is being made of malleable cast iron and some nodular or ductile cast iron.

Current alloy compositions and processing procedures for cast ammunition have been developed generally on an empirical basis. The objective of the AMMRC program is to apply a more scientific approach, in order to develop cast-shell ammunition having optimum and controllable fragmentation characteristics.

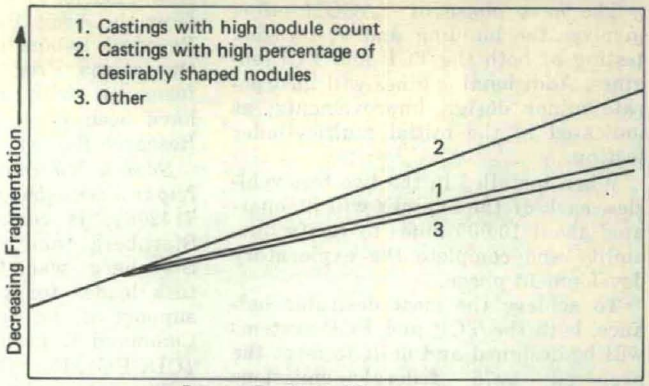


Fig. 2 Linear Regression Analysis Showing Effect of Microstructure on Fragmentation

The program encompasses detailed experiments in foundry metallurgy combined with fragmentation testing, and supporting computer studies.

A portion of this program is a contractual investigation being carried out at Northeastern University, Boston, Mass., by Prof. John Zotos. A computer is used as a tool in developing a series of mathematical models for nodular iron that correlate metallurgical properties and fragmentation properties.

Initially, an exhaustive literature survey was conducted to obtain information on the effects of minor chemical elements in nodular iron. While sulfur is definitely known to be detrimental to the forming of nodules, other elements that influence the process include bismuth, cerium, copper, tellurium, titanium and tin.

Several minor elements were selected as best suited for the program, as a result of the literature survey. Using techniques of statistical design of experiments, a series of heats was cast—some of a base composition and some containing additions of the minor elements selected. (See Fig. 1.)

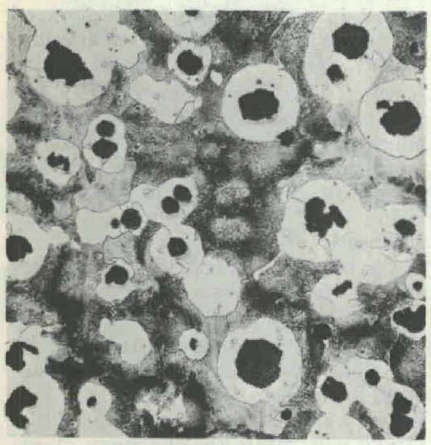


Fig. 1. MICROSTRUCTURE of nodular "as-cast" iron at 200x magnification, showing graphite nodules embedded in ferrite (white), pearlite (dark).

Properties and structures were examined in the as-cast and the heat-treated conditions. Castings were evaluated to determine the effect of trace elements on mechanical properties; also, metallurgical and fragmentation characteristics.

Results have been analyzed using a statistical method to determine variables having significant effects on the data, and to determine all possible interactions of elements investigated.

Effects of the minor elements that were investigated on the various properties of nodular iron were ascertained more conclusively in a computer program—written for calculating confidence bands at the various significance levels for the data obtained in this phase.

The AMMRC investigation thus far has shown that in nodular cast iron, the effect of graphite size and distribution, the effect of some typical impurities and the effect of microstructure can be related to fragmentation and mechanical properties. (Fig. 2.)

In addition, the contractual investigation at Northeastern University has attempted to utilize the data obtained at AMMRC and, along with data obtained from other sources, to implement a scientific analysis of factors affecting the properties of nodular cast iron alloys. This is being done to assess the statistical and metallurgical significance of the results obtained from the computer analyses, and to suggest how to produce improved casting alloys.

The computer analyses of three series of nodular cast-iron data supplied by AMMRC resulted in the development of 94 multiple linear regression mathematical models. They describe the effect of several independent variables on the magnitude of each dependent fragmentation and mechanical property.

Sixty-one out of the 64 mechanical

★ ★ ★

Kenneth D. Holmes was graduated in 1950 with a BS degree from Tufts University, Medford, Mass., and has done graduate work at Northeastern University and at Massachusetts Institute of Technology.

Employed as a metallurgist for the Army since 1954, he has served as chief of the Centrifugal Casting Section, Rodman Lab, Watertown Arsenal, and as the principal investigator of a number of projects at the U.S. Army Materials and Mechanics Research Center (AMMRC) involving metals such as titanium, high-strength steels, and cast irons.

Registered as a professional metallurgical engineer in the Commonwealth of Massachusetts, he is the author of a number of technical publications. He is a Fellow of the American Association for the Advancement of Science, and a member of the American Institute of Mining, Metallurgical and Petroleum Engineers, the American Foundrymens' Society, the American Society for Metals, and National Society of Professional Engineers.

property models produced (or 95.3 percent) and 21 out of the 30 fragmentation property equations developed (or 70 percent) were statistically significant at the 0.01 confidence level, or less.

Two separate computer runs were conducted within each dependent property analysis, i.e., an initial evaluation utilizing all of the dependent variables in the data set, plus a sequel computation which refined initial results by deleting the less significant variable from the first equations. Considering only the refined models, the majority of microstructural and elemental variables retained in these equations were in agreement with metallurgical theory.

Encouraging results achieved thus far have been significant both from statistical and metallurgical points of view, and show promise of opening up new horizons in being able to tailor scientifically metal alloys for specific military materiel requirements.

AMC Applies Numerical Control to Machine Process

Numerical Control (NC) is expected to represent a $20 million U.S. Army Materiel Command investment, by the close of FY 1971, in alleviating some of its urgent and highly specialized materiel logistical problems.

Doing things "by the numbers" is known to everyone who ever has served in the U.S. Armed Forces. Application of the phrase to precisely demanding machine control of manufacturing processes, however, is still a relatively new art.

NC achieves nonverbal communications between man and machine. It guides a machine tool through its manufacturing cycle with digital data supplied in the form of a coded punch tape inserted in the machine—much in the same form that a cassette is put into a recorder.

NC is geared to specialized requirements, and is rarely used in mass production manufacturing. When it comes to satisfying small-lot requirements, however, NC is a technology that can respond rapidly and economically—and a substantial portion of defense needs involve small lots.

Take, for example, the case of an urgent request to the Army for 13 special fuel caps. The Materiel Command had none on hand, nowhere! An AMC installation decided to buy 63 fuel caps, to provide a reserve of 50.

A request for bids from contractors was nonproductive because the order was too small to warrant tooling up. Finally, one firm agreed to produce the fuel caps at $4.41 each, without guaranteeing a delivery date. Eight months later, the order was filled.

Some time later, it was learned that if the AMC installation had been capable of performing the work by NC, the caps would have cost the Army $1.17 each, and could have been delivered within five days.

That is why John C. Williams of the Office of Industrial Preparedness of AMC's Directorate of Requirements and Procurement heads a special PROMAP–70 (Program for the Refinement of the Materiel Acquisition Process) task force. The goal is to expand capabilities for automating short-run manufacturing processes.

The AMC has found that NC permits a man with a few months training to turn out hardware faster, with more precision, and with greater reliability than many a skilled journeyman with 30 years experience.

Take the case of an urgent need for an aluminum chamber for testing gas masks. Only a small quantity was needed and the former cost by conventional machining was $480 apiece, with an average delivery time of seven weeks. NC halved the cost and achieved delivery in four days.

AMC had procured 87 new NC machines by July 1969 and it is planned to have 174 by July 1971 with an investment of almost $20 million. AMC's eight years of experience with NC has shown a 29 percent annual return, that is, the machines should pay for themselves in a little more than three years.

The NC manufacturing process is currently being used and expanded in six AMC major subordinate commands and in five of its depots.

In FY 70, AMC's NC operations spent $8.9 million to manufacture hardware in small lots (the largest order was 1,500 parts). This hardware would have cost $10.9 million by conventional methods.

NC does not stop, however, with a punched tape telling a particular machine what to do and how to do it. This is viewed as only the first step in the use of computer technologies in manufacturing.

Fundamental steps leading to digital computer-controlled NC equipment have been taken. The next steps will lead to entire families of machine tools (20–25) under command of a multistation computer.

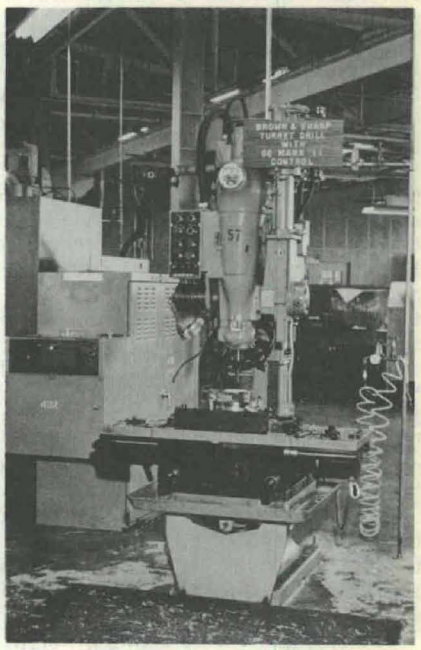
The industrial community calls this Computer Aided Manufacturing (CAM). AMC's manufacturing goal is an automated facility established to satisfy day-to-day job shop requirements supporting R&D and simultaneously performing the day-to-day supply of spare and repair parts.

Most of the hardware and software necessary to achieve this goal already exist as separate entities. Consolidation and expansion of those entities into an integrated facility is the objective of the AMC 5-Year Plan.

The Army Materiel Command total procurement program is planned to respond rapidly and effectively to demands for small quantities of hardware to American troops anywhere in the field. This would be particularly necessary at the beginning of each national emergency, when four to six months of supply time is lost while contractors are getting tooled up and into mass production.

This same quick response capability, it was stated, will serve the Army well in the day-to-day operation of maintenance depots where tomorrow's hardware cannot be anticipated. In an era of limited budgets and austerity programs, AMC is aiming to improve its manpower situation with respect to a scarcity of skilled craftsmen.

AMC recognizes that in the next 5 to 10 years it will be buying from an industrial base that will largely be Numerical Control/Computer Aided Manufacturing—NC plus CAM.



NUMERICAL CONTROL, eliminating the need of an operator, enables this machine to drill precisely a mold plate to satisfy an Army materiel logistical requirement at Edgewood (Md.) Arsenal. Small holes in the tape correspond to specific "instructions" that guide the machine tool completely through the manufacturing cycle. The method permits the Army Materiel Command to cut costs and delivery time for small quantity special items.

Portable Power for Combat Electronics

By David Linden

Modern combat operations depend critically on reliable sources of electrical power for communications, surveillance, navigation and countermeasures—power suitable for use in forward areas under all military environments.

Research and development activities in the U.S. Army Electronics Command Laboratories at Fort Monmouth, N.J., are directed continuingly to smaller size, higher energy capacity, longer life and quieter operation of portable power units.

With respect to logistic considerations only, the types of power sources in the Army system should be limited to a select few. Realistically, the wide range of combat applications requires the use of different types of power sources. Each must have certain advantageous characteristics. Selection of the most suitable source is a compromise or trade-off of the features considered most important for a specialized application.

A primary battery may be suitable for a manpack radio but a rechargeable (secondary) battery is necessary for a higher-powered vehicular set. A high-capacity, lightweight but expensive zinc-silver oxide battery may be justified for special purpose equipment but a low cost, conventional battery may be satisfactory for less critical uses.

Figure 1 compares performance of different types of batteries and illustrates how weight varies with operational life requirements. For short-term or pulse-power requirements, secondary batteries (nickel-cadmium, zinc-silver oxide) are preferable as the lightest weight systems.

The zinc-air battery shows a weight advantage in the 1- to 10-hour range of operation. The fuel cell and thermolectric generator are best for extended periods of operation where their low fuel consumption (compared to the energy density of the battery) overcomes the weight of the fuel cell or thermoelectric engine.

Similar comparisons can be made on other characteristics essential to final selection of the optimum power source for a given application.

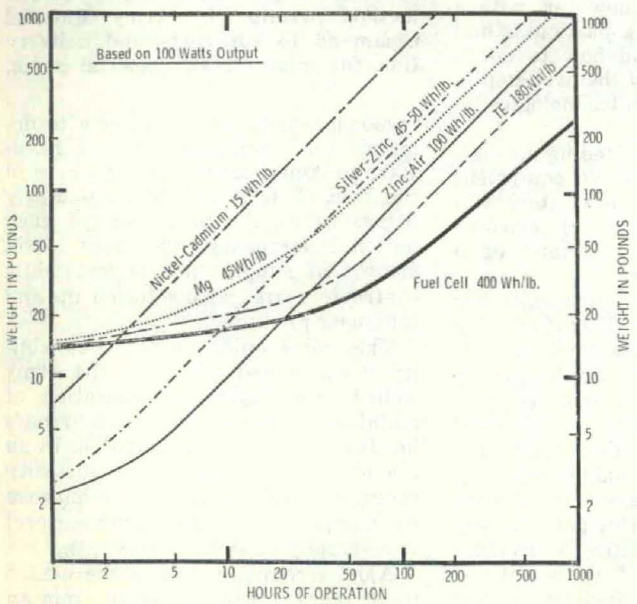


Fig. 1. Comparison of Power Source Systems Weight vs. Service

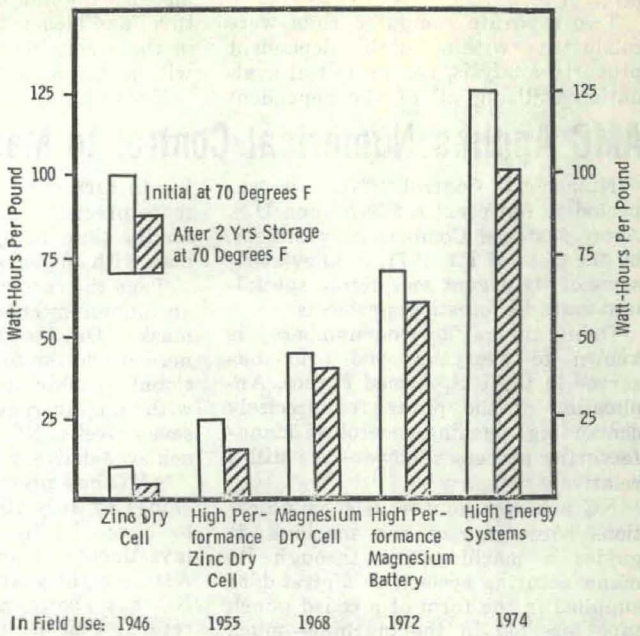


Fig. 2. Improvement of Primary Battery Performance

Batteries. Electrochemical batteries are, and will continue to be, a most important source of electrical energy for portable military equipments. Although advances with other energy sources (nuclear, solar, fuel cells, etc.) are significant, the battery has special characteristics which frequently dictate its selection over these other systems.

Among favorable characteristics of batteries are small size and weight, low cost, and ability to be miniaturized and packaged with unusual flexibility. Other factors are superior performance on a power density basis, established reliability, mechanical strength, and reasonable performance over the wide range of military and environmental conditions in remote areas of operations.

For these reasons, batteries are chosen for most (1) man-portable or back-packed communication and surveillance equipment, (2) missiles and rockets and other modern weapons where high power is required for a short period, and (3) low-power, long-standby or long-term applications as in fuzes and alarms.

Increasing sophistication in electronic equipment for military use demands batteries with greater power and energy densities, improved storageability, and dependable performance under all environmental conditions. These essentials motivate the Army's search for better systems.

Accordingly, the R&D thrust is two-fold. One approach emphasizes the design of families of batteries, with a limited number of types for multiple applications.

The second effort is probing new technologies and systems for special capabilities to fulfill unique requirements. The USAECOM battery program is classified into four areas: primary batteries, secondary batteries, zinc-air batteries, and special-purpose batteries.

Primary Batteries are used most widely for military applications. Being procured by USAECOM in quantities valued up to $60 million annually, they provide convenient

and ready sources of field power and require no maintenance.

Growth in capability of this class of battery has been responsive to requirements for higher energy output per unit of weight and volume; also, long storageability, and operation over the wide temperature range encountered in military operations (particularly at the high temperatures encountered in the Southeast Asia environment).

Figure 2 charts progress since World War II in two of the most important characteristics of the primary battery —its energy density or service life, and its capacity retention or shelf life (storageability).

Noteworthy is that a 4-fold improvement over post World War II zinc batteries was achieved with the introduction of the magnesium dry cell into field use in 1968.

Developed by Electronics Command personnel, this type of battery has achieved significant success in radio set AN/PRC-25, the squad radio and other equipments. Specific advantages are better shown in Figure 3, which compares respective performances of other types in radio set AN/PRC-25 use.

Two main advantages of the magnesium dry cell are that it doubles the initial service hours and it has superior ability to retain this capacity under normal and high-temperature storage. This latter feature has eliminated the costly and inconvenient need for refrigeration of dry-cell batteries; it has vastly simplified the logistic handling of batteries in the field and increased their cost effectiveness.

A further doubling of primary battery performance for the 1974–1976 period is projected as a result of promising current development of high-energy organic electrolyte systems. Using very active electrode materials (e.g. lithium), which are not compatible with aqueous electrolytes used in present systems, the new battery will deliver over 100 watthours per pound. This compares with approximately 50 watthours per pound now available from the magnesium system.

Secondary Batteries. Significant progress has been achieved in the secondary battery field. These batteries are becoming more attractive for military use as higher power and greater peak load requirements develop for newly evolving systems—requirements that cannot be satisfied with the more moderate power capabilities of the primary system.

Secondary batteries can be designed for considerably less maintenance and longer cycle life than prior types,

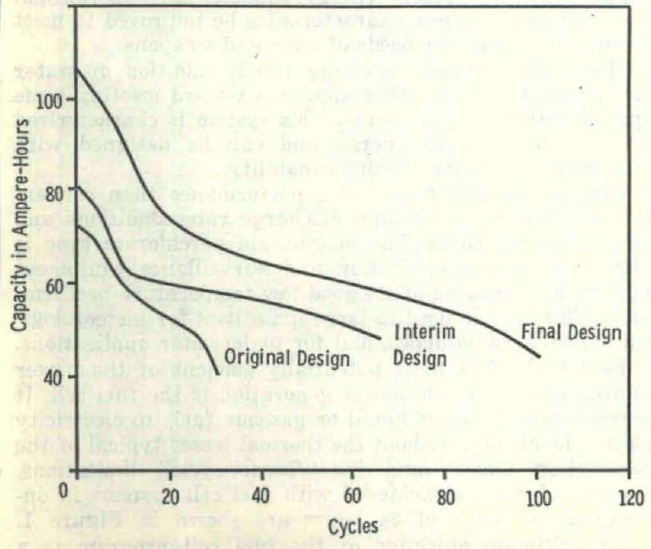


Fig. 3. The Magnesium Dry Cell (Advantages Over the Zinc Dry Cell)

	Lead-Acid	Nickel-Cadmium	Silver-Zinc
Watts/lb.	100	200	180
Watt hrs./lb. (5-hour rate)	13	15	45
$/watt-hour	.110	.50	.50
Cycle life	200	1000	100
$/kwh (Total life)	.55	.50	*5.00
Activation ease	Simple	None	Slightly involved
−25°F. performance (% of 80°F. performance)	50%	80%	50%
Low temperature (−25°F.) charge	No	Yes	No

* Reduced 15% to $4.25 by recovery of silver

Fig. 4. Comparison of Secondary Batteries

and can be handled much easier in the field.

The lead-acid battery still remains the work horse for vehicular use. The nickel-cadmium battery and newer high-capacity silver secondary systems, however, provide superior performance. They are used, for example, in military aircraft and with radar sets AN/PPS-4, AN/PPS-5, NODLR, and other portable communications-electronics equipment.

Again, the special performance capabilities of each system, the nickel-cadmium (NCB), the zinc-silver-oxide (ZSOB) and the lead-acid battery (LAB), make them selectively suited for different Army uses.

The NCB, as shown in Figure 4, though having the lowest energy density of the alkaline types, is the most reliable and has outstanding cycle life characteristics. The ZSOB, with about three times the energy density of the NCB, is most desirable for man-pack use where light

(*Continued on page 42*)

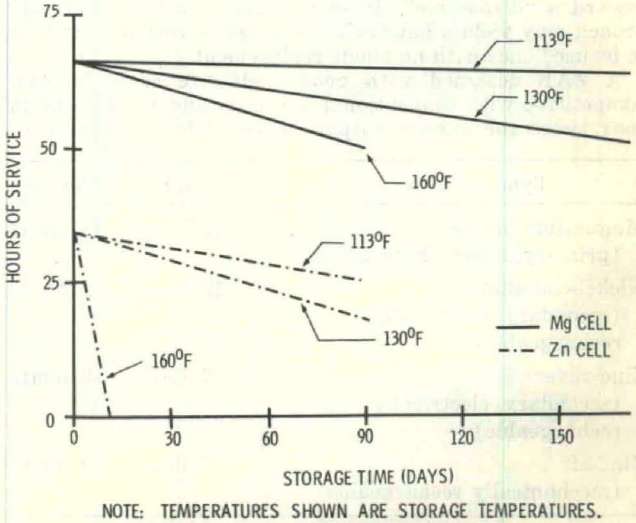


Fig. 5. Improvement of Cycle Life in Rechargeable Silver-Zinc Batteries Used With STANO Equipment

Portable Power For Combat Electronics

(*Continued from page 41*)

weight is of paramount importance (e.g. in STANO equipment, such as radar set AN/PPS-5).

Until recently, use of the NCB was limited because its cycle life was inadequate. Figure 5 shows the improvement made on the cycle life of battery BB–622/U, used in radar set AN/PPS–5. The original battery had a life of less than 10 cycles at the rated capacity of 60 ampere hours; up to 100 cycles can be obtained now with the new USAECOM-developed design.

Zinc-Air Batteries. The mechanically rechargeable zinc-air battery (ZAB) is a new type of electrochemical power source. Just emerging from USAECOM R&D, this battery is recharged simply and rapidly by replacing the discharged zinc anodes with new ones; no electrical recharging is necessary.

Key advantages of this system are: (1) high capacity (100 watthours per pound—twice that of any currently available battery), (2) ability to operate over a wide range of environmental conditions, and (3) the simple field recharging procedure.

A comparison of the ZAB with other types is made in Figure 6, showing the weight and service hours of four different batteries designed to operate radio set AN/PRC–70. Only the ZAB is capable of meeting the weight and service life requirements stipulated in Qualitative Materiel Requirements (QMR) for this set.

Similar advantages exist in other proposed ZAB applications. Its outstanding performance has been confirmed in Continental United States (CONUS) and Southeast Asia (SEA) field tests. The first production order for these batteries, to be used with radio sets AN/PRC–41/47, was placed in October 1969.

USAECOM effort on the ZAB is concentrated on: (1) design of an optimized standard family of such batteries to accommodate the variety of Army applications; (2) development of highly reliable replacement zinc anodes to assure consistent high-level performance; and (3) refinement of electrode design to extend battery cycle life; also, to reduce cost and extend performance at extremes of temperature.

Other work on this electrochemical system is directed toward a "disposable" zinc-air primary battery. This approach may yield a battery low enough in cost to permit it to be used once with no anode replacement.

A ZAB designed with good shelf life could be cost competitive with conventional dry cells and yield three to four times the energy output. It could be a major con-

Type of battery	Weight	Service
Magnesium dry cell (primary, non-rechargeable)	12 lbs.	18 hours
Nickel-cadmium (secondary, electrically rechargeable)	12 lbs.	9 hours
Zinc-silver (secondary, electrically rechargeable)	7 lbs.	12 hours
Zinc-air (mechanically rechargeable)	7 lbs.	30 hours

Fig. 6. Advantages of Zinc-Air Battery Projected for Radio Set AN/PRC–70

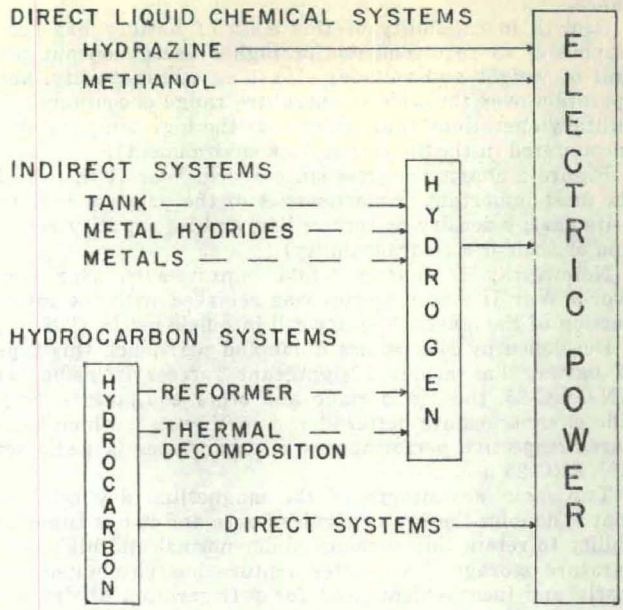


Fig. 7. Approaches to Portable Fuel Cells

tribution toward a truly miniaturized power source for portable equipment.

Special Purpose Batteries. Research in this area is concerned with precise battery requirements for missiles, meteorological equipment, laser devices, special weapons and other applications.

Missile batteries must be storageable for long periods of time, yet provide instantaneous power on demand at high loads for short periods of time. Automatically activated zinc-silver-oxide and thermal type batteries have been used with considerable success.

Because the ZSOB cannot perform at low temperatures, a method for chemically heating and activating these batteries in fractions of a second must be used.

Thermal batteries, using high-temperature (molten) electrolytes, provide reliable battery power. However, limitations of their present energy capacity and operational life require that these characteristics be improved to meet the demanding power needs of advanced weapons.

"Reserve" systems, involving timely addition of water for activation, are another approach toward meeting some special battery requirements. This system is characterized by very active high energy and can be designed with practically unlimited storage capability.

Reserve systems give better performance than conventional batteries under high discharge rate conditions and at low temperatures. The magnesium perchlorate type is attractive in communication and surveillance equipment applications because of its good low temperature performance. This type is used in large quantities for meteorological balloons, radiosondes, and for underwater applications.

Fuel Cells. The most potentially efficient of the newer approaches to electric power generation is the fuel cell. It permits conversion of liquid or gaseous fuels to electricity electrochemically, without the thermal losses typical of the combustion engine and its "Carnot-cycle" limitations. Weight advantages achieved with fuel cell systems in operations in excess of 24 hours are shown in Figure 1.

The ultimate objective of the fuel cell program is a family of standard-sized power packages to satisfy the wide range of military applications, based on a direct-type

fuel cell using military grade hydrocarbon fuels.

From a practical viewpoint, however, such a single "universal" approach to fuel cell operation may not be realizable; also, it may not be the most effective means to fill all the field needs.

Several different means of electrochemical conversion of fuels are being explored. Acceptable systems will be put into use as they are developed, and while research and development continue toward the ultimate objective.

Portable systems, up to a kilowatt in size, are being explored by four main approaches (Figure 7):

a. The direct liquid chemical fuel cell uses partially oxidized hydrocarbon or nonhydrocarbon fuels (such as methanol and hydrazine). These fuels react more readily electrochemically than the conventional fuels and permit a good interim fuel cell system for forward area use. Applications will be limited to low power units where total fuel requirements are small. Advantages are high conversion efficiency (400 watthours/pound), simplicity and quiet operation, which far outweigh the disadvantage of having to supply a "special" fuel.

b. Indirect fuel cells using metal hydrides (as an example) react with water in a Kipp generator to produce hydrogen, which is converted electrochemically to electrical power. One pound of hydride will produce about 800 watthours in a fuel cell operating at 50 percent efficiency. Tank or other sources of hydrogen can be used, but the weight of these is usually greater than the Kipp generator; also, more difficult to resupply compared to the dry metal hydrides.

c. Indirect systems are conventional military fuels (CMF) chemically converted to hydrogen. This is the most advanced CMF type of fuel cell but is not suitable for very low power applications. It can be used to satisfy demands over 250 watts. Disadvantages include lower conversion efficiency, larger size and weight, and the design complexity. Fuel consumption is in the order of 0.1 gallon/kwh (about 1,300 watthours/lb.).

d. The direct fuel cell, using field available hydrocarbons, will have higher conversion efficiency, simplicity and other related advantages. Because of the more difficult electrochemical problems yet to be resolved, this approach requires a broader R&D program to achieve acceptable operational standards.

Thermal Energy Systems. Development of improved static devices for direct conversion of thermal energy into electricity has provided another practical approach to reliable and silent power systems for field use.

Thermal energy converters (TECs) derive a tremendous logistical advantage from the fact that they are capable of functioning on more than one type of military liquid hydrocarbon fuel, and can operate over an extremely wide range of ambient temperatures.

This TEC multifuel capability can more than offset the apparent disadvantages of lower fuel efficiency compared with other conversion systems.

The TEC development is, when compared to effort on the alternative thermionic and thermophotovoltaic technical approaches, by far the most advanced of the current systems. TECs with improved thermocoupling have reached the Engineering Test/Service Test phase.

The thermoelectric system will be most effective in the 100- to 1,000-watt range when used in combination with a storage battery. The generator will provide average power to the load and simultaneously charge the battery; peak load demands will be augmented by the battery. The generator may also supply power directly to equipment or just serve as a battery charger.

Thermionic and thermophotovoltaic conversion systems, however, offer better performance and efficiency potential. Development effort is concentrated on finding materials that can withstand the high temperatures and the flame environment encountered in such fuel-fired converters.

Engineering Test/Service Test developmental effort on TECs is being accelerated on the 10- and 20-ampere units operating at 28 volts. These generators will provide maintenance-free operation for periods in excess of 1,500 hours —a valuable asset for semi-fixed installations, such as avionics beacons or STANO equipments, where continuous operation is essential.

TECs also are being examined as the prime power source in "no-break" trailer-installed power systems required for various types of tactical communications and similar applications requiring no interruptions in the power source.

Each of the technical areas considered in this article is an important approach. Each presents distinctive advantages for fulfilling military portable electrical power requirements. Other sources, such as nuclear and solar energy, have not been discussed, as they do not appear to be competitive at this time for meeting prescribed standards.

The current intent of the Army is not that each of the power systems being investigated will ultimately reach field use, inasmuch as the number of possible sources far exceeds the number that can be handled logistically.

Instead, the Army R&D plan is that these power systems, as they approach the hardware development phase, will be compared competitively, in terms of technical performance, field logistics, trade-offs and costs.

Based on these evaluations, optimum families of power sources will be established. The objective is to make a minimum number of types in the Army inventory capable of meeting all the needs of forces in the field.

David Linden, *acknowledged as an authority on electric power systems for military field equipment, is chief of the Power Sources Division, Electronic Components Laboratory, U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J.*

During 28 years service with ECOM, he has been a major contributor to numerous advances in portable electric power sources. Included in his work are new types of batteries, fuel cells, thermoelectric devices, and solar energy systems used to power instruments of early satellites.

Linden has a BS degree from City University of New York and an MS degree from Polytechnic Institute of Brooklyn. He is a member of the American Institute of Chemists, the American Chemical Society, and the Electrochemical Society.

The author has served on national and international power source groups, including the power sources committee of the Institute of Electrical and Electronics Engineers and the American Institute of Astronautics and Aeronautics. He has been the U.S. representative to the NATO Group of Experts in Electrical Power Sources.

Linden is chairman of the Power Sources Symposium, an annual event that is the largest of its kind. He also is chairman of the Electro-chemical Working Group of the Interagency Advanced Power Group.

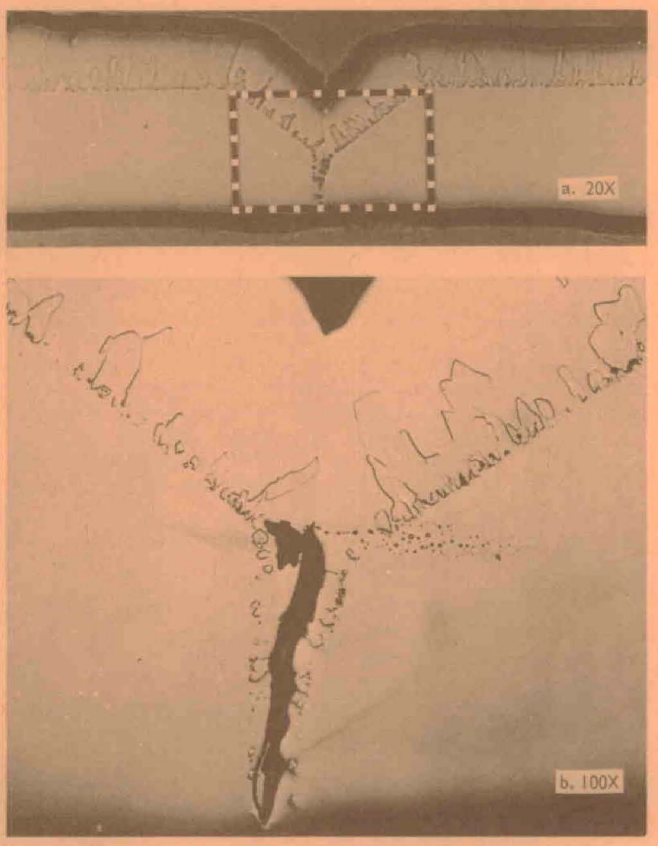


Photo-micrographs of a Cross Section of Weld Joining Two Pieces of Single Crystal Ruby

DR. DONALD R. MESSIER joined the AMMRC staff in May 1968. His current work involves fabrication of structural ceramic materials for potential Army applications such as lightweight ceramic armor and gas turbines. He received a BS degree in ceramic engineering from Alfred University in 1959, and MS and PhD degrees from the University of California (1961–1964). He was engaged until 1968 in research on nuclear ceramic materials at Argonne National Laboratory in Illinois.

PHILIP WONG is an engineer with the AMMRC Ceramic Research Laboratory. For the past three years, his main interest has been the chemical vapor deposition of polycrystalline and single crystal aluminum oxide. He earlier coauthored several papers on corrosion and oxidation kinetic studies. Wong received his BS degree in metallurgy from the Massachusetts Institute of Technology in 1960 and has since been with the Center at Watertown Mass.

AMMRC Welds Aluminum Oxide Crystals by CVD

In response to a U.S. Army requirement for large plates of sapphire for use in transparent armor applications, such as helicopter windshields, a method has been developed for welding single crystal aluminum oxide by chemical vapor deposition (CVD).

The U.S. Army Materials and Mechanics Research Center in Watertown, Mass., announced the new technique is the result of extensive research by Dr. Donald R. Messier and Philip Wong, ceramic engineers. The technique also can be used for welding ruby crystals.

Previous efforts at forming large sapphire plates (6"x6"x⅜") by the chemical vapor deposition process had been thwarted by lack of a large seed crystal that could be used as a parent for any desired number of plates.

Following considerable experimentation, Messier and Wong came up with the idea of forming a large seed by CVD joining of a number of small, readily available crystals to form a mosaic-like structure. The success in joining pairs of crystals is believed the first welding of ceramics in this manner. A patent application has been filed.

The picture here shown depicts merely one of variable results that can be achieved by the process. CVD has been used to fabricate a large number of materials for such diverse applications as thin films for electronic devices and missile radomes.

One of the major advantages of CVD as a processing tool is its capability of producing ceramic materials and shapes that would be difficult if not impossible by other methods.

Dense, high-purtiy material can be processed at temperatures considerably below those required by more conventional procedures. For example, some of the purest sapphire ever produced was made by the CVD method.

Although the principal that is vital to the production of large sapphire windows by CVD has been demonstrated successfully, further experimentation is necessary before the windows can be produced in quantity. Messier and Wong are engaged in exploratory R&D to achieve this goal.

DoD Plans to Consolidate Surface Transportation Activities

Activities of the Military Sealift Command (MSC) and Military Traffic Management Terminal Service (MTMTS) are scheduled for consolidation in a jointly staffed agency that reports to the Secretary of Defense through the Secretary of the Army.

Deputy Secretary of Defense David Packard has directed Secretaries of the Army and Navy to submit a joint plan for consolidation by late April. Except for intra-land transportation in overseas areas, the new agency will be single manager for DoD surface transportation.

Responsibility for operating government-owned and certain chartered vessels will be retained by the Navy, including maintenance, operation and alteration. The Navy will continue to operate vessels used for nontransportation purposes, such as oceanography, and to prepare recommendations for design, specifications and equipment of ocean-going vessels.

Consolidation into the single management agency, still unnamed, is based on reductions in operational costs, including establishment of a single computer system for all surface movements—eliminating present multisystems worldwide. Simplification of billing to military shippers will be an added advantage.

MTMTS and MSC headquarters are in Washington, D.C. Both agencies have subordinate commands in New York City and in Oakland, Calif.