ARMY RESEARCH AND DEVELOPMENT

MONTHLY NEWSMAGAZINE OF THE OFFICE OF THE CHIEF, RESEARCH AND DEVELOPMENT

Vol. 7, No. 3 March 1966 • HEADQUARTERS, DEPARTMENT OF THE ARMY • Washington, D.C.

Presentations at WRAIR, LWL Give ASAP Insight To Viet Research Needs

Increasing pressure on Army medical research and development requirements was graphically illustrated before the winter meeting of the Army Scientific Advisory Panel (ASAP).

Dr. Harold M. Agnew, Weapons Division Leader of the Los Alamos (N. Mex.) Scientific Laboratory and newly appointed ASAP chairman, presided for the first time over sessions held Feb. 17–18 at the Walter Reed Army Institute of Research

(Continued on page 3)

R&D Leaders Address Fort Huachuca Conference

Nearly 550 high ranking Department of Defense and industrial officials attended a Target Acquisition and Combat Surveillance Symposium at Fort Huachuca, Ariz., Jan. 24–26.

Designed to encourage greater industry effort in support of Army requirements for improved means of finding and fixing enemy targets more rapidly and effectively, the symposium was sponsored by the Association of the U.S. Army. About 90 industrial firms, most of which are already working in the field, were represented.

Assistant Secretary of the Army (Research and Development) Willis M. Hawkins, the featured dinner speaker, and Chief of Research and Development Lt Gen William W. Dick, Jr., headed a group of 14 Army spokesmen who reviewed in detail with the industrial attendees the Army's current capabilities, limitations and requirements in this important area.

Making the luncheon address was Dr. Thomas P. Cheatham, Jr., Deputy Director of Defense Research and Engineering (Tactical Warfare Programs), who reviewed the field of tactical reconnaissance. (For condensation of his remarks see page 2.) Highest ranking U.S. Army officer attending was General Paul L. Freeman, CG, U.S. Continental Army Command, Fort Monroe, Va.

After welcoming remarks by Maj Gen Benjamin H. Pochyla, CG, U.S. Army Electronic Proving Ground, Fort Huachuca, additional principal speakers included:

Lt Gen Theodore J. Conway, Assistant Chief of Staff for Force Development, "The Army of the Future"; Lt Gen Ben Harrell, CG, U.S. Army Combat Developments Command, a presentation of target acquisition and

(Continued on page 4)

U.S., U.K. Defense Chiefs Sign ComSat Pact

The United States and the United Kingdom have signed a Memorandum of Understanding which provides for participation by the United Kingdom in research and development associated with the U.S. Initial Defense Communications Satellite Project.

Secretary of Defense Robert S. McNamara and Minister of Defense Denis Healey signed the Memorandum for their respective countries, as part of a continuing program of joint cooperation on matters of mutual defense and space research.

Under the terms of the Memorandum, the United Kingdom will provide several ground terminals for communications tests and experiments using the U.S. Defense Department communications satellites. Costs of providing and operating these terminals will be borne by the U.K. No charge will be made for their use of the communications satellites for these tests. The Memorandum also provides for a mutual exchange of data resulting from this cooperative program.

(Continued on page 3)

Army R&D Chief Hosts ABCA Group

(See story p. 5.)

MEMBERS OF WASHINGTON STANDARDIZATION OFFICE (WSO), representing the United States, United Kingdom, Canada and Australia, attended the ABCA Army Standardization Program 17th annual reception at Fort McNair. Hosts were Lt Gen and Mrs. William W. Dick, Jr. (right). Representatives and wives are (from left) Brigadier Norman Nichols, Australia; Brigadier Norman Wilson-Smith, Canada; Maj Gen Richard Fyffe, United Kingdom; Brig Gen William F. Ryder, U.S. Army member, WSO.

Featured in This Issue . . .

Deputy DDRE (Tactical Warfare) Discusses Surveillance Systems ..... p. 2
Ballistic Research Labs Plan 2 Rocket Probes for DASA ..... p. 4
LWL Provide Emergency Materiel Requirements for Vietnam ..... p. 6
Guppy Ascends as Enemy of Parasite Causing Schistosomiasis ..... p. 9
U.S. Army, NIH Medical Researchers Combat Hemorrhagic Fever ..... p. 11
AMRAC Combines Expertise of 21 Scientists Noted for Materials Research ..... p. 13
MICOM Runs Tests on Modified Plasma Jet Facility ..... p. 14
Army Awards $285 Million in RDTE, Production Contracts ..... p. 16
DDRE, DoD Team Schedules Industry Briefings ..... p. 16
Editorial AD 2000 Discusses Polymers for Surgical Repair ..... p. 22
Optimal Use of Personnel Resources-Feature by Cecil D. Johnson ..... p. 26
Army Reliability and Maintainability Program-Feature ..... p. 30
ECOM Aerial Photo Team Uses Electronic Flash for Night Color ..... p. 32

Army R&D Newsmagazine

Vol. 7, No. 3 March 1966

Editor.....Clarence T. Smith
Associate Editor.....George J. Makuta
Assistant Editor.....Joseph R. Weikel
Assistant Editor.....Read Wynn

Published monthly by the Army Research Office, Office of the Chief of Research and Development, Department of the Army, Washington, D.C. 20310, in coordination with the Technical and Industrial Liaison Office, OCRD. Grateful acknowledgment is made for the valuable assistance of Technical Liaison Offices within the U.S. Army Materiel Command, the U.S. Army Combat Developments Command, U.S. Continental Army Command, Office of the Chief of Engineers, and Office of The Surgeon General. Publication is authorized by AR 310-1, as extended by the Army Publications Board on Sept. 15, 1964.

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 through 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 Specialist Programs and to members of the U.S. Army Reserve R&D Unit Program. 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 Specialist Program enrollees should be addressed to: Specialist Branch, ECP, OPD, Office of Personnel Operations, Department of the Army, Washington, D.C. 20315. Reserve R&D Unit members should contact: Special Assistant for Reserve Affairs, OCRD, Department of the Army, Washington, D.C. 20310.

OTHER GOVERNMENT AGENCIES' requirements should be submitted directly to the Army Research Office, OCRD, Department of the Army, Washington, D.C. 20310, ATTN: Scientific and Technical Information Division.

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

Deputy DDRE (Tactical Warfare) Discusses Surveillance Systems

Dr. Thomas P. Cheatham, Jr., Deputy Director of Defense Research and Engineering (Tactical Warfare Programs), addressed participants Jan. 25 at the Target Acquisition and Surveillance Symposium sponsored by the Association of the United States Army at Fort Huachuca, Ariz. A condensation of his talk follows, with editorial inserts for continuity indicated by brackets.

By Dr. Thomas P. Cheatham, Jr.

During the time that I have been associated with Tactical Warfare Programs, I have been impressed with the fact that tactical operations in a very real sense are a great deal more complex than are the strategic operations to which we devoted the bulk of our study effort during the 1950's and the early 1960's.

The area of tactical weapons research and development, and its associated area of tactical operations analysis, is particularly challenging and has become of accelerated importance to both the Defense Department and the scientific and engineering community over the past two years.

This is an area that has been relatively neglected over the past decade because of the high priority placed on strategic systems. It was, of course, right that we should place a high priority on these systems, for had the the work not been done as well as it was, our very national existence could have been threatened.

But as we maintain our strategic capability, we feel that we should also place a more appropriate emphasis on research and development for limited warfare. There is no doubt in my mind that the technical challenges in this field are as demanding and as difficult as anything in the strategic and space areas.

Indeed the challenges in Viet Nam, with the requirement to solve problems that face our Army, Navy and Air Force in combat today, may be even more demanding. Nonetheless, the nature of the problem in limited warfare research and development is very different from that of strategic and space systems.

The latter are characterized by relatively few, high-cost, extremely complicated systems designed to perform a rather specific and definite mission. It is quite otherwise with tactical systems. . . . We might very well want very many, and in many models, tailored to perform specific tactical operations. We would like cheap, mass-produced items with long lifetimes, and most of all we abhor undue complexity. We want simple, reliable and sturdy equipment [that] may be used in a variety of environments.

Tactical weapons are difficult to analyze clearly. Their very introduction may alter the battlefield tactics

(Continued on page 18)

AUSA SYMPOSIUM visitors, Maj Gen K. G. Wickham (left), commander of the Combat Service Support Group, U.S. Army Combat Developments Command (CDC), and Lt Gen Ben Harrell (center), CDC commanding general, meet with Maj Gen Benjamin H. Pochyla, Army Electronics Proving Ground commander, at target acquisition and combat surveillance symposium.

WRAIR, LWL Talks Present ASAP With Vietnam Research Needs

(Continued from page 1)

(WRAIR), Washington, D.C., and at the Army Limited War Laboratory (LWL), Aberdeen (Md.) Proving Ground.

Dr. Ralph E. Fadum, as the new vice chairman, assumed the chair for the first day's sessions until the arrival of Dr. Agnew for the evening banquet. Dr. Fadum is dean of Engineering at North Carolina State College, Raleigh.

Formerly vice chairman of ASAP, Dr. Agnew succeeded Dr. Finn J. Larsen, former Assistant Secretary of the Army for R&D, who resigned as ASAP chairman upon appointment by President Johnson as the Principal Deputy Director of Defense Research and Engineering. Col John Dibble, formerly with the Air Mobility Division, OCRD, is now serving as military assistant to Dr. Larsen.

Assistant Secretary of the Army (R&D) Willis M. Hawkins launched with brief remarks the WRAIR portion of the meeting which was hosted by Lt Gen Leonard D. Heaton, The Army Surgeon General. Welcoming address was by Maj Gen Douglas B. Kendrick, Jr., commanding general, Walter Reed Army Medical Center.

Army Vice Chief of Staff General Creighton W. Abrams, Jr., keynoted the evening banquet at Walter Reed with observations and a discussion of his recent visit to Viet Nam.

Through well-organized presentations by WRAIR officials, the ASAP members obtained a close look at new medical encounters and the complexities confronting Army doctors as a result of the jungle war in Southeast Asia.

Brig Gen C. F. Vorder Bruegge, commanding general of the Army Medical R&D Command, gave the scientific advisory panel a composite picture of the Army medical research and development program.

The mission and future plans of WRAIR were summarized by the institute's director, Col William D. Tigertt, before the research agency's division directors and department chiefs gave ASAP members an intimate view of results thus far obtained and the present status of various types of battle-casualty problems occasioned by the Viet Nam war.

Among the subjects presented by WRAIR specialists were chemical structure search, acute respiratory disease, radioprotectant drugs, transfusions, burns, trauma and shock.

(Editor's note: Walter Reed Army General Hospital has recently opened the only U.S. military or Government Intensive Treatment Unit for the treatment of refractory shock. Story appears on page 24.

Host to the ASAP at the LWL, Aberdeen, on Feb. 18 was Col Robert W. McEvoy, commanding officer. Hardware particularly applicable to the war in Asia was demonstrated.

Five new ASAP members were introduced: Dr. Kenneth E. Clark, dean of the College of Arts and Sciences, University of Rochester (N.Y.); Mr. Donald G. Fink, general manager of the Institute of Electrical and Electronics Engineers, New York, N.Y.; Mr. Martin Goland, president of the Southwest Research Institute, San Antonio, Tex.; Prof. Lawrence H. O'Neill, associate dean of the School of Engineering and Applied Science and director of Electronics Research Laboratories at Columbia University; and Dr. Jack W. Rosengren, associate director of Nuclear Design, Lawrence Radiation Laboratory, Livermore, Calif. Fink and Prof. O'Neill are former ASAP consultants.

Maj Marsden P. Earle, Jr., was presented as the ASAP's new assistant executive secretary, succeeding Maj Arthur E. Dewey who has been assigned to the Air Mobility Division, OCRD.

The ASAP Ad Hoc Group chairmen reported on progress at a special session during the 2-day meeting. Combat Vehicle Weapons Systems was discussed by Dr. William C. Tinus, vice president of Bell Telephone Laboratories, and Dr. Allen E. Puckett, vice president of Hughes Aircraft, reviewed the progress of the group on Design Criteria for Future Armored Vehicles. Prof. O'Neill discussed findings concerning Army Tactical Air Defense.

Lt Col Richard A. Smith of OCRD presented the Army's position on Dr. Larsen's final report on Target Acquisition and Combat Surveillance. Lt Col Joseph E. Fix, III, also of OCRD presented the final report on Barrier Research. Chairman of the Barrier Research Group is Maj Gen Leslie E. Simon (USA, Ret.).

Arrangements for the ASAP winter meeting were supervised by Maj Donald E. Rosenblum, ASAP executive secretary; Lt Col Paul J. Wentworth of WRAIR; and Maj V. J. Oddi, LWL operations officer.

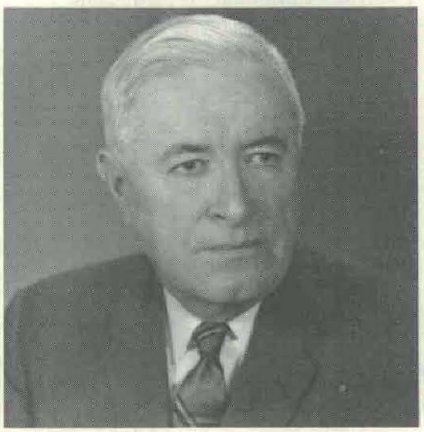
U.S., U.K. Defense Chiefs Sign Communications Satellite Pact

(Continued from page 1)

The U.S. Initial Defense Communications Satellite Project provides for establishment of a space system of up to 22 communications satellites in near-synchronous, equatorial orbits. Satellite launches are planned for this year.

Under the terms of the Memorandum, the U.S. Defense Communications Agency and the Office of the Assistant Chief of Defence Staff (Signals) have been designated as the Project Offices to handle program details and coordination for their respective Governments.

Weber Addresses STRICOM On Technological Future



DR. HAROLD C. WEBER, Army chief scientific adviser, recently aired his views on the "Technological Outlook in the Next Decade" before 80 senior staff officers of the U.S. Strike Command, MacDill AFB, Fla. As the guest of General Paul D. Adams, commander in chief of STRICOM, Dr. Weber forecast changes in the next ten years as a result of technological progress today. He included a discussion of current research and development in lasers, thermionics and cybernetics. Dr. Weber's address was part of the regular monthly STRICOM "Skull Sessions" when a distinguished authority addresses key personnel of the command. General and flag officers of STRICOM later held an off-the-record dinner discussion. The Strike Command consists of members of the U.S. Armed Forces.

Research and Development Leaders Address Huachuca Conferees

(*Continued from page 1*)

combat surveillance in USACDC; Maj Gen John J. Davis, Assistant Chief of Staff for Intelligence, "The Threat"; Col Paul A. Troup, Jr., Radar/Combat Surveillance Commodity Management Office, U.S. Army Electronics Command, Fort Monmouth, N.J.; Col Thomas M. Rienzi, chief Combat Surveillance Office, Headquarters, U.S. Army Materiel Command; Col Harold F. Via, commandant, U.S. Army Combat Surveillance School, Fort Huachuca, Ariz.; Lt Col Richard G. Shank, Office of the Assistant Chief of Staff for Intelligence (OACSI); Lt Col Maxwell V. Jonah, deputy director, U.S. Army Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.; Lt Col Graham M. Sibbles, OACSI.

Opening and closing remarks for the Association of the U.S. Army were delivered respectively by Maj Gen Earle F. Cook (USA-Ret.), vice president, AUSA, and Lt Gen Walter L. Weible (USA-Ret.), executive vice president, AUSA. Participants also were able to witness demonstrations and displays of surveillance and target acquisition equipment of the U.S. Army.

Secretary Hawkins, in his featured address, emphasized the need for new concepts in surveillance and target acquisition systems. He stressed the necessity of handling only essential data and reducing the size of these systems so that they more rapidly and efficiently serve the field commander.

Reviewing the reconnaissance problem, Mr. Hawkins categorized systems capable of solving it as being either open loop or closed loop.

Short lead time or closed loop reconnaissance systems, he explained, provide locations and description of enemy combat elements, real time fire direction and damage assessment and surveillance of combat troop and equipment movement.

Open loop or long lead time systems, he continued, define the environment for potential battle, including permanent features of geography of the zone of combat; determine the long range potential of the enemy such as the change of his support or relief elements or the onset of major build-up; locate and describe logistical and facility targets; determine long range damage assessment.

Mr. Hawkins stated that closed loop systems are characterized by immediate action and reaction resulting from information gained. Open loop is characterized as foundation information for future operation and carefully planned interdiction.

Turning to concept development, Secretary Hawkins reminded his audience that historically, "sensor development has generally lagged vehicle development, if vehicles are involved in the system, and both, unfortunately, have preceded logical overall reconnaissance system concept creation.

"This has put the commander in a position of having to develop his own systems concepts in the field, using the tools at hand."

He emphasized the importance of carefully analyzing field commander functions when considering new concepts in surveillance and target acquisition systems.

Mr. Hawkins posed the following questions:

"At what level in the command organization must the quick reaction systems close the loop? I'd like to suggest that we have tended to put this level too high.

"How much raw data does a field commander really need? How much updated information is required and how often rewarded? In what form must the information be presented to permit his immediate intelligent absorption?

"What staff or subechelons need be in the circuit? How much data can they absorb and in what form should it be presented? Finally, can some of this information go directly to the gun and attack system, bypassing the commander?"

Secretary Hawkins delineated four categories of information, evolved from discussion with many field commanders and analysts who are attempting to simplify total reconnaissance, surveillance and target acquisition requirements: background, trigger, spot, and mission direction or support information.

Under *background* information, he included the availability of accurate maps, the location of permanent targets, buildings, bridges or location of potential targets such as road intersections, plus assessment of how the enemy will use his own real estate to support his tactics.

In the category of *trigger* information, he included the type that is needed to alert a commander that something has changed since the last time he assessed his own status vis-a-vis that of his enemy. In connection with this category, Mr. Hawkins suggested that greater work is needed on intelligent filters, beginning at the source of the intelligence gathering system.

He challenged his audience to devise new types of systems where only the essential information is transmitted to the commander and under which he does not need computer systems, staff assistants, electronic war rooms and other such cumbersome equipment to sort out the essential information from a constant massive flow of non-essential details.

In support of the trigger mission, Mr. Hawkins spoke of another function which he called the *spot mission*. This, as the name implies, is a detail

BRL Planning 2 Rocket Probes for DASA

The Army Ballistic Research Laboratories, Aberdeen (Md.) Proving Ground, will launch two instrumented rocket probes for the Defense Atomic Support Agency (DASA) this spring.

Col Charles D. Y. Ostrom, Jr., commanding officer of the Army research organization, made the announcement through the Department of Defense.

The firings are designed to certify payloads which will be used for scientific measurements during atmospheric testing in the event tests in the environments now prohibited by the Limited Nuclear Test Ban treaty are ever required.

The Defense Atomic Support Agency is the joint services organization that plans and coordinates the Department of Defense (DoD) nuclear weapons programs. In addition to its readiness-to-test mission, DASA responsibilities include nuclear weapons effects research, DoD underground nuclear tests, and monitorship of the nuclear stockpile.

The DASA payloads will consist of a 4-frequency propagation experiment, a langmuir probe, an ion trap, gyro system, aspect magnetometers and a telemetry system.

The Nike Javelin III, a 2-stage rocket, will deliver the modular instrument packages to ionospheric levels of 120 miles.

According to John C. Mester of the measurements laboratory, USABRL and the project officer, apogee of the test firings is 120 miles and the vehicles are expected to impact in the ocean some 50 miles down range.

Monitoring of the free-flight missile payloads will be done from Eglin Air Force Base, Fla., where the flights will originate.

information gathering process directed specifically at an isolated element of enemy information needed, generally to fill in the details necessary when the trigger system has alerted the commander to some change or to verify hypotheses regarding enemy disposition.

The *mission direction* or support intelligence processes include some that are fulfilled reasonably well with current equipment, Mr. Hawkins said. They include fire direction or the spot area surveillance necessary for airmobile operations to cover landing areas, troop advances or to obtain information for direction of aircraft ground support missions.

Reviewing the four categories, Secretary Hawkins observed that background missions are open loop systems since the information they bring triggers no immediate response in the commander but provides information only for relatively long range tactical planning.

The other three missions, however, he continued, are tightly closed loops in which the information is demanded by the commander for the specific purpose of forming a basis for immediate reaction.

He reported that he felt in the spot and trigger mission areas, "we have had very little concept thought." He again emphasized the importance of working on "some kind of reasonable filter at the source of our target and information acquisition systems so that the operational commander need not depend on a monstrous computer to analyze, reanalyze and hopefully regurgitate intelligent information out of a mass of random data. . . ."

Turning to more specific considerations, Secretary Hawkins suggested a correlation between infrared systems and MTI (Moving Target Information) systems or with information from other sources (such as polarization of the radar return; microwave radiometric measurements; the visible spectrum of the target). Instead of the vast computer complex, he suggested "some sort of 'at source' correlation that sends only correlated information to the commander."

Another technical scheme which he proposed was the sampling of air. Successful devices in this field are beginning to emerge from Army laboratories, he stated, but the importance of such a capability in the front lines or in aircraft is yet to be determined.

One kind of correlation and filter plan now under development which Mr. Hawkins mentioned is called VATLS or Visual Airborne Target Location System. He explained that VATLS employs the eyeball and brain of an observer in an aircraft who utilizes a telescope on an inertial reference platform aided by ground tracking (developed from missile control system).

All that is transmitted to the ground are the elevation angle, azimuth, altitude and range, relative to the aircraft, of targets sighted by the observer. The tracking system locates the observing aircraft and closes the loop to determine the accurate location of the target.

"The system is moderately complex," he stated, "but it has the extreme advantage of maximum simplicity in data handling, in that it relieves the commander of any filtering task. The system, in fact, can relieve the commander of involvement in the weapons system loop if the system is hooked to the artillery or is used to command support aircraft.

"We have many subsystems operating in the field that are not directly linked together for mutual support. Obvious in this area are systems which provide electronic intelligence to a very high and sometimes isolated element of command.

"This information could be classified as trigger mission intelligence and it must somehow be more closely linked to quick response or spot systems which obtain correlation information of different kinds, or, perhaps directly to weapons," he stated.

The potential of federated systems, those of the Military Services which are compatible when combined, is very large, Mr. Hawkins said. He cautioned, however, that "in thinking of combined systems we must be careful not to create unique monsters but to try to create tactical command systems which have the potential of a complex combined system or the individual effectiveness of the subsystems as the case determines."

In conclusion, Mr. Hawkins discussed the responsibility of the Army, industry and the Department of Defense in reconnaissance and surveillance concept development.

He pointed out that the Department of Defense can assist such development by not emphasizing too thoroughly tri-service systems.

"The concepts of such systems, logical as they may be," he said, "eventually drive decisions up in the military organization." In surveillance and target acquisition, "we must," he said, "concentrate our efforts in driving the decisions down in the organization in order to keep the information loops tight and closed for quick reaction."

Among materiel items in the reconnaissance and target acquisition field demonstrated or displayed for the attendees were the OV–1 and OV–1C, the two latest versions of the twin-engined Mohawk observation aircraft. The OV–1B carries infrared photo and sensor equipment and the OV–1C is equipped with the new Side Looking Airborne Radar (SLAR).

Also shown were two ground surveillance radar systems, the AN/TPS–33 and AN/PPS–4, tracking and plotting radar, and the MQM–33 Light Target Missile.

The symposium marked the 21st in a series of symposia, conferences and briefings which AUSA has sponsored to improve communication between the Army and the industrial community.

Army R&D Chief Hosts ABCA Standardization Group

Seventeen years of successful cooperation in research and development of military materiel and techniques set the stage for the recent ABCA Army Standardization Program annual reception, attended by representatives of five nations and about 200 guests.

Chief of Research and Development Lt Gen William W. Dick, Jr., who is responsible for U.S. Army participation in the standardization program, and Mrs. Dick were hosts to the formal affair at the Fort McNair Officers Club.

Established in 1947 as the American-British-Canadian (ABC) Standardization Program, the cooperative effort was expanded by the addition of Australia in February 1963. New Zealand, while not a full-fledged member, became an associate member in 1965.

Objectives of the ABCA Army Standardization Program include standardization of materiel to improve allied combat readiness, adoption of common doctrine, furthering mutual interests in research and development, and advancing operational techniques and procedures.

The Chief of Research and Development is represented in the program by Brig Gen William F. Ryder, Deputy CRD for International Programs, who is the U.S. Army member of the Washington Standardization Office. Comprised of one high ranking officer of each of the armies on duty in the Washington Area, the WSO is responsible for overall supervision of the ABCA program.

LWL Efforts Provide Emergency Materiel Requirements for Viet Nam

Foresight of the U.S. Army in establishing a facility unique in research and development annals is paying dividends in responsiveness to urgent materiel requirements in Viet Nam.

Making science serve, on an accelerated basis, unusual needs for a new type of combat in an ancient environment of conflict—the jungle—is part of the mission of the U.S. Army Limited War Laboratory at Aberdeen Proving Ground, Md.

Officially activated in June 1962, the LWL was staffed initially with a commanding officer, a technical director, and less than half a dozen others. Because of high selectivity standards for hard-to-find skills, the qualifications of more than 4,000 scientific and technical individuals were carefully evaluated before the present staff of 134 civilians and 12 military officers was selected.

Renovation of an old building at Aberdeen Proving Ground was completed in November 1963, and Chief of Research and Development, Lt Gen William W. Dick, Jr., attended the dedication ceremony. It was named "York Hall," in honor of Capt Don J. York, Asheville, N.C., who was killed in combat in Viet Nam on July 14, 1962.

Since it became operational, the LWL has produced 24 materiel items that are now serving combat troops in Viet Nam. About 70 R&D projects are underway. Some items have been delivered to the troops in less than six months, by adapting on-the-shelf items to the peculiar needs of jungle warfare. Six to eighteen months usually are required to develop a prototype for evaluation.

Once the requirements for an urgently needed item are specified, whether through formal Combat Development Command channels, the "Quick Reaction Letter", described below, or by LWL liaison officers working in the combat zone with field commanders, LWL operations research scientists diligently attack the problem.

Facilities available to them include an impressive array of scientific equipment. A modern machine shop turns out experimental models and early prototypes in a minimum of time for further refinement as necessary by industrial producers.

The Laboratory is organized into four divisions: Operations and Analysis, Development Engineering, Applied Research, and Technical Support. The latter includes a complete library service.

Jungle Canopy Platform

Scientific and engineering personnel are provided with publications on special warfare, guerrilla and counterinsurgency operations, and reports on current R&D projects of other Government agencies, industrial firms and universities.

To feed these laboratories with "problems," the LWL management relied heavily at first on the "quick-reaction letter." Field commanders were asked to describe a serious problem area in materiel requirements and to request development of an item. Skepticism, if not lack of knowledge about the unique capability that had been established in the LWL, resulted at first in few "call for help" letters.

Knowing that many materiel problems existed, the LWL commander arranged to send a liaison man to the field to talk with commanders, tell them about the LWL, and invite them to discuss needs for new materiel or for adaptation of existing equipment to meet the conditions in Viet Nam.

LWL men sent to the field for liaison duty are experienced in research and development procedures. They are also skilled in observing military operations and making analyses of what may be needed to solve a materiel problem. Rotating LWL liaison men every three months has served as a valuable tool in learning the needs of field forces in the ever-changing conditions of guerrilla warfare.

The liaison man has two principal functions: first, to demonstrate the latest developed items to the field commanders; second, to keep the laboratory informed of the conditions and problems on a day-to-day basis. In this way, ideas evolve regarding materiel for which there may be a critical need, but for which no formal requirement has been stated.

How is it that field forces may not always know what they need, but a research engineer or an R&D oriented combat officer can look at the conditions, talk to fighting men, and frequently come up with an item the troops accept with enthusiasm?

The obvious answer is that combat troops are so busy fighting most of the time that they do not think much about materiel items that might make their job safer or easier. The research-minded liaison man studies problems with the objectivity of noninvolvement.

In this way, LWL liaison men have come up with ideas for several items that are now operational in Viet Nam. Commanders have learned to seek out the liaison man to discuss their problems, because they have observed that the LWL system produces results.

The idea of an R&D organization working directly with troops in the field, and producing hardware on a "quick-reaction" basis, is accepted as perhaps the most revolutionary approach to materiel problems ever taken by any army.

Once the requirement for new materiel has been identified clearly and considered carefully by LWL scientists and engineers, including at times the development of the first model prototype, the LWL relies heavily upon industry for assistance in filling its "quick-response" mission.

Industrial officials are often surprised at the "short fuze" deadlines specified in LWL contracts. Many of them now have learned that the LWL is empowered and has the built-in capability to move with a minimum of impediments in getting a job done.

In the earliest stage of a materiel project, LWL learns the state-of-the-

Cargo/Personnel Lowering System

art thoroughly and quickly, by studying reports and by personal contact with known sources of competence in specific areas.

Once the specific approach to be followed is determined, the project engineer assigned by the LWL follows the project through every stage, from study to experimental development, to prototype fabrication, to the test and evaluation, up to the point of the procurement package.

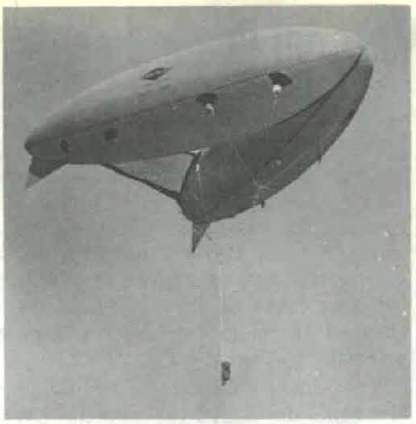
GNI is one of the meaningful acronyms used at the LWL. It stands for Generation of New Ideas, an internal program to encourage and exploit ideas related to limited war research and development. An amount up to $2,000 can be expended by project officers to explore the value of a new idea, with a minimum of paperwork and formality.

If the new idea is considered fruitful, it is incorporated into a proposed new task and competes, usually successfully, for a place in the overall LWL program. A number of GNIs have metamorphosed into successful projects. If the idea proves lacking in merit, it is closed out and the file is reviewed periodically, together with other sources, to determine if it can be applied to new requirements, or if the availability of new materials or techniques have enhanced its value.

Under the pressure of getting a job done in a minimum of time to meet the requirement for an item of materiel urgently needed by combat troops, the tempo of activities at the LWL often may become arduous. The reward for the group of seasoned, highly motivated individuals is the satisfaction of seeing the fruits of their labor in operation in 6 to 18 months, rather than the normal R&D cycle of five to seven years.

Another factor that contributes to individual motivation is the GNI Program, in that it permits good ideas to receive recognition, thus stimulating creative initiative. Once a man or group of men becomes engrossed in pushing a novel idea through the development cycle, to produce a new piece of materiel in the minimum time, long hours are accepted without complaint as part of the job.

Back of each of the 24 LWL new materiel items now in use by field troops is a story of dedicated effort to provide quick response to a requirement recognized by a field commander. Take, for example, the "Jungle Canopy Platform," designed to permit the landing of helicopters on top of the trees, perhaps 125 to 150 feet above the ground, in the dense and almost impenetrable jungle.



Captive Balloon-Borne Communications System

The canopy platform system consists of two 20′ x 150′ nets made of stainless steel cable, a dispenser carried as a sling load under a rotary-winged aircraft for transporting and laying the nets, and a hexagonal space-frame 18-foot diameter platform. This system has been tested and thoroughly evaluated. Six units will be delivered shortly for use in Viet Nam.

The nets are laid one across the other, forming a cross (+), with the platform deposited at the vertex. Helicopters can land on the platform for on or off-loading of troops and supplies, evacuation of casualties, or it can be used as an elevated observation post.

A powered hoist and davits are installed for evacuation of casualties by Stokes litter. The vertex (center) of the platform and each strip extending out to 60 feet are constructed of 6-inch steel cable mesh. Extremities of the strips are built of 24-inch mesh.

The Jungle Canopy can be erected quickly and it permits a helicopter to unload troops in seconds. Less than two minutes after leaving the aircraft, the men can be on the ground, ready for action.

The platform can carry up to 4,000 pounds of the aircraft's weight, but it is not intended for aircraft landings—only to unload or pick up troops, or evacuate the wounded.

Descent from the platform is accomplished with a Cargo/Personnel Lowering System. Another LWL development, it permits safe lowering at a rate easily controlled with one hand. Operating on the principle of rope friction (the governor is in the form of a 10-inch long aluminum ladder) the total system weighs 7¾ pounds with 150 feet of ⅜-inch nylon rope.

Project charts in the four divisions of the LWL recently showed a total of 68 experimental or developmental activities. One of the high priority items is a system of detecting small arms fire that will give helicopter pilots the knowledge needed for a decision on whether to land, attack or get out fast.

One of the simple but highly important materiel items provided by the LWL in a matter of months by incorporating on-the-shelf equipment into a lightweight portable unit is a motorized fuel transfer pump.

Until this unit was shipped to Viet Nam in January 1964, transfer of fuel from 55-gallon drums into aircraft was a hand-pumping operation that was laborious and time-consuming. The first 10 units (six 25 gallon-per-minute and four 50 GPM systems) were so effective in relieving the problem, that 90 units were ordered for priority delivery.

Important to the success of combat operations is the time saved in fueling operations through use of the portable pumping unit. Weighing only 68 pounds, it can be moved easily where needed. It permits refueling of a helicopter in one-tenth the time formerly required for the hand-pumping operation. That means the helicopter's operational time can be correspondingly increased.

Density of the jungle in portions of Viet Nam is such that the enemy may be undetectable only a few feet away. That also makes it easy to get lost. Consequently, the LWL is working on a number of sensor and position locator systems critically needed.

One requirement is for a lightweight (10 pounds or less) position locator that can be worn by a soldier, and that will enable counterinsurgency forces in any type of terrain to

(Continued on page 8)

HF Radio for Jungle Use

LWL Providing Vietnam Materiel Requirements

(*Continued from page 7*)

locate themselves geographically to known locations. The device will be self-contained, with no reliance upon an active base station. Tests on prototypes have been encouraging.

Smoke screens and smoke markers released from aircraft are included in the 24 operational items produced to date by LWL scientists. The existing 2.75 rocket launcher for providing firepower protection for the "Huey" helicopters has been adapted by LWL to also dispense M8 smoke grenades from its 24-tube rack.

Using this system, a helicopter can furnish smoke screen protection for troop landings over an area about 4,000 feet long. Two smoke grenade racks are used, one on each side of the helicopter, and the grenades are launched during forward flight.

An aircraft-releasable smoke marker is another of the LWL products. The marker is capable of functioning satisfactorily after landing in trees, swamps, rice paddies, water or on hard ground. The marker will float if landed in water or swamps and will hang up if landed in the jungle canopy. Weighing about 7½ pounds, it can mark targets of opportunity, drop zones, landing zones, etc., for five minutes.

To meet the requirement for a minimum duration smoke signal to serve as a locator for aircraft or to convey information, the LWL has developed a smoke cartridge weighing 1.1 ounces. Ignited by a simple scratch block and pellet, the cartridge provides a large volume of red smoke during its 13 second burning time. Yellow, green and white color smoke cartridges are being developed by the LWL.

Position Indicator

One of the advances in communications capability is a captive balloon-borne system developed by the LWL to overcome the problem of high jungle attenuation of VHF signals. It extends the range of VHF, particularly the AN/PRC-10 radio, by elevating the antenna to an altitude of 500 feet. Five of these systems were shipped to Viet Nam on an urgent priority in August 1964.

The AN/PRC-64 is a lightweight HF radio developed through the LWL and designed for use of long-range infantry patrols in jungle warfare or counterinsurgency operations. Following extensive tests in Hawaii, Viet Nam, Alaska, Panama, the United States and other parts of the world, it became a limited procurement item for field troops.

Mobility of the M113 Armored Personnel Carrier in negotiating canals is augmented by an anchor assembly developed by the LWL. Four anchor kits were shipped to Viet Nam for evaluation and initial use was successful.

Claimed also as LWL achievements are the development of a USOM Scout vehicle armor kit, and of lightweight armor for army trucks of various sizes. LWL has also issued a manual titled "The Use of Field Expedient Armor" which will permit troops to use readily available indigenous materials for making effective armor without relying on industrial sources of supply.

Another requirement to which the LWL responded was for a shot-shell adapter for the M-79 grenade launcher, to permit the firing of standard 12-gauge shotgun ammunition for close-in kill capability in the jungle or heavily vegetated areas in Viet Nam. The adapter is undergoing evaluation tests.

Successfully demonstrated by the LWL, and currently being tested on the M14 rifle, is a compact sight that eliminates the need for the usual combination of rear and front sights. Designed for quick-response situations, and to enable even the novice rifleman to get good accuracy, the reflex-collimator gunsight fixes a cross on the target. The absence of parallax in the eyepiece insures rapid, accurate sighting.

Leeches are among the hosts of animal and insect pests that complicate military operations in the Viet

Fuel Transfer Unit

Nam jungles and swamps. Leeches there grow to prodigious size at maturity and are quick to attach themselves to the human skin. When they drop off the skin, the wound they leave continues to bleed, often leading to severe secondary infection.

To deal with the leeches, the LWL developed an almost odorless repellant that is highly effective and does not wash off easily, even when the user is continually traversing swampy areas. It provides protection for many hours, and a small bottle serves a soldier from three to six days.

A survival kit (hot-wet) is another response of the LWL to the combat soldier's needs in Viet Nam. When supplemented with foraged foods, the compact kit provides a soldier with minimum essential self-aid and survival articles for up to ten days.

Whenever the continually varying, swiftly shifting conditions of the "new kind of war" being waged in Viet Nam demand unusual and unanticipated requirements for materiel items, the U.S. Army Limited War Laboratory is proving that it is serving its purpose.

"Never before in military history," commented one of the Viet Nam commanders, "have highly specialized scientists and engineers gone into the battlefield to study problems, suggest a seemingly feasible approach to solution, and followed up with rapid response through research and development to meet the requirement."

In this approach, Army research and development may be nearing the ultimate in the kind of responsiveness to military users that is critical to victory in modern warfare — when backed by effective overall planning long in advance to meet most basic requirements of conventional combat.

Lowly Guppy Ascends as Enemy of Parasite Causing Schistosomiasis

Seeking a repellant for the microscopic parasite which causes the widespread tropical disease schistosomiasis, an Army researcher in Brazil has made a significant, unexpected and surprising discovery.

Dr. F. W. Morthland, deputy chief of the Defense Research Office (Latin America) at Rio de Janeiro, Brazil, recently sent the *Army R&D Newsmagazine* a special research report on the work of U.S. Army grantee Dr. Jose Pellegrino who is studying the life cycle of *Schistosoma mansoni.*

Schistosoma is the cause of the debilitating disease affecting nearly a tenth of the world's population. The disease reportedly rivals malaria as man's most common plague and the tiny worm that causes schistosomiasis has resisted many attempts to destroy it.

Dr. Pellegrino has found the parasite's predator; the lowly though colorful guppy, common inhabitant of millions of home aquariums, has an avid appetite for the larvae of the parasite.

The South American scientist is chief, Division of Immunology of the Instituto de Biologia, Faculdade de filosofia da Universidade de Minas Gerais. When he made the discovery, Dr. Pellegrino was working in the city of Belo Horizonte, capital of the Brazilian mining state of Minas Gerais.

Following is the substance of Dr. Morthland's special report:

"Schistosomiasis, also known as bilharziasis is found in most tropical regions of the world and has been a military medical problem associated with operations in endemic areas.

"The life cycle begins as eggs are shed by infected animals (or man) by the fecal route. These hatch, and the larvae infect the bodies of certain fresh-water snails. When the larvae mature to a free-swimming stage, called *cercariae*, they leave the snail for the surrounding pond or stream water. In this form they are microscopic and can easily penetrate the skin of animals which contact the water.

"In the animal they mature in the liver and other vital organs. After sexual development is completed, paired schistosomes migrate to the mesenteric vessels where females begin to lay eggs (about 300 each day) to complete the cycle meanwhile ravaging the health of the host.

"Dr. Pellegrino, while studying the activity of various materials for cercarial repellant activity, ran a field test to determine infectivity of "wild" cercariae in their natural environment. He performs this test routinely in his laboratory. It consists of caging individual mice in such a manner that their tails may be immersed in contaminated water. If cercariae are present, they will attack the mice and in six weeks the mouse will show an easily measured load of adult parasites, a load proportional to the number of attacking larvae.

"Anticipating a routine result, mice were exposed to the waters of a stagnant pond in the nearby town of Sabara, known years ago as a gold mining center. This pond was liberally populated with infected snails. The waters around the snails were infested with cercariae. But the mice did *not* become infected at the anticipated level. Several did not develop any adult parasites and the others were only minimally infected!

"Frequently when an experiment such as this goes 'wrong' it is shrugged off and the investigator drops it for more important projects. However, Dr. Pellegrino cannot abide unsolved problems. In carefully reviewing the experiment and studying the pond he also noted it to be well stocked with *Lebistes reticulatus*—the common guppy which many of us have in our tropical fish aquariums. The question arose in his mind: What if the guppy is a predator for cercariae?

"The result of this question was a series of laboratory experiments which quickly showed the guppy to be an enthusiastic devourer of schistosoma cercariae. One guppy plus 1,000 cercariae in 200 ml. of water in a beaker for one hour equals one well-fed happy guppy!

"What about guppy activity in the wild state? Mice were exposed with infected snails in the same pond inside of nylon screen cages. In some cages guppies were included. Those mice in cages from which guppies were excluded showed a high mortality rate and many adult parasites and eggs. Those with guppies added showed little or no infection.

"One final note of interest lies in the rate of infection with changing time of day. The rate at which snails shed cercariae reaches a peak at midday and a minimum at night. Apparently the process is tied to variation in light and temperature. However, in the pond containing guppies, the mice exposed at night showed significantly higher rates of infection than those exposed at noon.

"The explanation is that the guppy sleeps at night.

"So it appears that the tiny guppy is a real aid in limiting schistosoma infection of animals in the natural habitat.

"What is the value of this? First, Dr. Pellegrino solved a puzzling problem and achieved three scientific papers to his credit—both results are highly satisfying to a scientist. We now know another piece in the total puzzle of schistosomiasis. It also is now shown that care must be taken to evaluate the fish killing properties of chemicals developed to clear snails from ponds or streams. It is always dangerous to destroy a natural predator of the pest you are fighting.

"Lastly, if you have guppies in your aquarium, your snails—and you—should be safe from schistosomiasis."

Engineer Labs' Design Lightens Fuel Transfer Pump

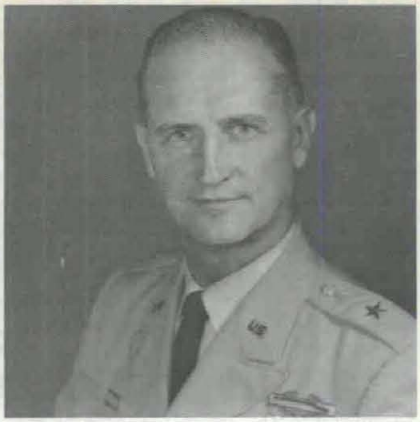
Redesign of a military petroleum transfer pump to decrease its weight and increase performance is announced by the Army Materiel Command Engineer Research and Development Laboratories, Fort Belvoir, Va.

The new unit (shown on the left) weighs 1,100 pounds—150 less than the unit it replaces—and incorporates a standard 20 hp. engine. Aluminum is used extensively in the redesigned wheel-mounted, self-priming pump.

Intended for use primarily on the Army's mobile refueling stations, the pump can supply 500 gallons per minute at a 150-foot head. For unloading petroleum barges and lighters, it can furnish 350 g.p.m. at 190-foot head. It can also be used as a general purpose water distributor. The entire system is air-transportable.

Brig Gen Ware Designated Army CINFO

Brig Gen Keith L. Ware



Brig Gen Lloyd B. Ramsey

Secretary of the Army Stanley R. Resor has appointed Brig Gen Keith L. Ware as U.S. Army Chief of Information and Brig Gen Lloyd B. Ramsey as Deputy Chief.

General Ware, Deputy Chief of Information since September 1964, succeeds Maj Gen George V. Underwood, Jr., who was assigned command of all U.S. Army Air Defense units in Europe in mid-February.

General Ramsey, who had served as Deputy CG, U.S. Army Training Center (Engineer), Fort Leonard Wood, Mo., since October 1964, became Deputy Chief of Information Mar. 1.

GENERAL WARE served a year as assistant division commander, 2nd Armored Division, Fort Hood, Tex., before coming to Washington, D.C., as Deputy CINFO in 1964. He completed Officer Candidate School and was commissioned a second lieutenant in the Regular Army in 1942.

During World War II he participated in a number of campaigns in the European Theater, including the D-Day invasion. After completing the Command and General Staff College in 1946, he served with the Military District of Washington, D.C., and with the War Department General Staff. More recent assignments have included: executive to Chief of Staff, SHAPE, Paris, France, 1962–63; chief, Emergency Plans and Requirements Branch, SHAPE, Paris, France, 1960–62; Congressional Liaison, and Inquiry Division, Office of Chief Legislative Liaison, Washington, D.C., 1957–60.

In addition to C&GSC, he is a graduate of the Armed Forces Staff College and the National War College. His many decorations include the Medal of Honor, Silver Star, Bronze Star Medal (Valor), Purple Heart with OLC and Croix de Guerre with Gold Star.

GENERAL RAMSEY, after receiving a BA degree from the University of Kentucky in 1940, was commissioned a second lieutenant of infantry and served in North Africa during World War II. He was assigned to the Infantry School as an instructor in 1946, then served with the War Department General Staff and in 1954 as deputy then as Secretary of the Joint Staff, United Nations Command and Far East Command.

Transferred to Fort Benning, Ga., in 1957, he commanded the 14th Infantry and later the 1st Infantry Brigade. In 1958 he became G–1 of the U.S. Army Infantry Center. Returned to the Far East in 1959, he served as the U.S. Army Adviser to the Korean National Defense College until 1960. Then he returned to the Department of the Army General Staff, serving first in the Office of the Chief of Legislative Liaison and later as executive officer of the Office, Assistant Chief of Staff for Force Development.

He has completed the Command and General Staff College and the Army War College, the Psychology of Leadership course at Yale University and the Advanced Management Program at Harvard University.

His decorations include the Silver Star with 2 OLCs, Legion of Merit, Bronze Star, Purple Heart with 4 OLCs and the Croix de Guerre with Bronze Star.

First Woman Completes Nuclear Power Course

An attractive mother of five has earned the distinction of being the first woman to complete the Nuclear Power Plant Engineer Course at the U.S. Army Nuclear Power Field Office, Fort Belvoir, Va.

To earn her certificate, Mrs. Wilson M. Scarborough had to keep pace with several male graduate engineers through six weeks of intensive, comprehensive training.

The course included actual work in the Belvoir nuclear power plant, as well as detailed study of its intricacies and simulator operations. Both written and oral examinations are given.

FIRST WOMAN to complete the Nuclear Plant Engineer Course at NPFO, Muriel Scarborough receives certificate of completion from Lt Col Kermit O. Lindell, NPFO chief.

Graduated in 1956 with a BS degree in mechanical engineering from the University of Maine, she has studied advanced engineering mathematics and nuclear engineering at the University of California at Los Angeles.

Mrs. Scarborough completed the course without the usual goal of becoming a nuclear plant engineer. Her purpose was to enlarge her background in the Engineering Department of the Nuclear Power Field Office, where she has been employed since November 1964.

The course is given by NPFO as part of its mission to train Army, Navy and Air Force personnel in the operation and maintenance of nuclear power plants.

IEEE Installs ECOM's Danko

S. F. Danko, deputy director, Electronic Components Laboratory, U.S. Army Electronics Command, Fort Monmouth, N.J., was installed Feb. 16 as a member of the Institute of Electrical and Electronics Engineers.

A Government employee since 1940, he shared with ECOM engineer Moe Abramson in 1956 a $10,000 Secretary of the Army award for inventing the dip-solder printed wiring process.

U.S. Army-NIH Medical Researchers Combat Hemorrhagic Fever

Bolivian hemorrhagic fever — a virus disease that killed 30 percent of its victims during one epidemic in Bolivia—is being intensively combatted through cooperative research by the U.S. Army and the National Institutes of Health (NIH).

Data currently being evaluated were gathered from remote regions in the heart of South America over a recent 6-month period by doctors and medical technicians of U.S. Army Forces Southern Command and the Middle America Research Unit (MARU), jointly staffed by the NIH and the Army.

During the period, United States personnel worked in close cooperation with the health agencies of Bolivia, Brazil, Paraguay and Peru. Research presently being conducted seeks to determine whether the disease might exist in other Latin American areas and, if so, to pinpoint its geographical and environmental distribution.

Bolivian hemorrhagic fever first came to widespread notice when it broke out among rural workers in 1959 in the Beni Department (state) of northeastern Bolivia. Little was known about it but during the first few years it proved fatal to nearly a third of its human victims.

Since then, considerable progress has been reported in caring for patients and in determining how the disease is transmitted. It was learned that a small rat-like rodent is the principal carrier. An extensive and continuing program of rodent control in affected areas has sharply reduced the incidence of the fever.

Although the mortality rate has greatly decreased because of these measures, medical researchers report that the disease still poses a serious threat to human life and to economic development of the isolated regions in which it exists.

Once seemingly limited to the Beni region in the lowlands east of the Andean plateau, more recent reports from other back country areas uncovered a disease with the same internal bleeding and fever characteristics as Bolivian hemorrhagic fever.

The U.S. Army team's job was to help find out whether the disease was related to hemorrhagic fever as originally described in virus of Bolivia and also to seek additional evidence on mammal or insect carriers, how humans become affected and to determine if any geographic boundaries could be established.

Three medical officers and four enlisted medical technicians of the Southern Command, all members of the 8th Special Forces Group (Airborne), Fort Gulick, were involved in the project, which took them into Bolivia, Brazil, Paraguay and Peru. Capt James W. Ryan served the first three months as team chief, succeeded by Capt John R. Hibbs, who also had served on the team during the first three months.

Working with the U.S. Army men were two Bolivian civilian medical technologists and a sergeant major of the Bolivian Air Force who had a background in medical science.

Headquarters for the field work was set up by MARU, the sponsoring agency, in Cochabamba, a city in central Bolivia, where MARU's Dr. Merle Kuns directed activities of the Army medical personnel.

The medical team traveled by plane to widely scattered locations east of the Andes Mountains in vast, sparsely inhabited lowlands drained by tributaries of the Amazon River.

Using a mobile, air-transportable laboratory, they also traveled from village to village, talking with local doctors. They collected animal specimens and examined a cross section of the human population, collecting human blood samples to determine the presence of hemorrhagic fever antibodies.

Additional work involved collecting and processing small mammals, arthopods such as mites and insects and other small creatures. The medical men conducted autopsies on these creatures, taking samples of blood, tissue and organs. They placed vials of these samples in tanks of liquid nitrogen for preservation by almost instantaneous freezing. The tanks were flown to MARU's laboratories in the Canal Zone for more intensive study of the specimens.

The findings are expected to help lay the groundwork for further studies of the fever and how it is transmitted and will be used in the search for an effective immunization method.

DoD Adds Year to Most Civilian Oversea Duty Tours

New Department of Defense regulations have increased the tour of duty for civilian employees serving overseas from 24 months to three years in most areas, such as throughout Europe and in Japan.

Prescribed in DoD Instruction 1404.3, the policy change will not affect present tours of oversea employees, but will apply to subsequent tours. New oversea employees will serve three years initially, then two years if they desire to remain.

In certain less desirable areas for which it is difficult to recruit personnel, the tours have been 12 or 18 months. The new policy increases these tours to 18 and 24 months on new agreements.

Civilian employees recruited from the United States or transferred from positions in the United States to oversea areas are required to sign an agreement that they will serve for a specified period of time. Satisfactory completion of this period of service entitles the employee to Government transportation in returning to the U.S.

The majority of oversea positions are being filled by the rotation of experienced Civil Service career employees desiring a period of foreign service. The longer tours will provide for greater continuity of employment and, according to a DoD announcement, should result in increased efficiency and in substantial savings.

The new provisions do not apply to experts and consultants, nor to DoD employees whose services are not required for the entire period of standard tours of duty.

FCWG, AFTRCC Hold Joint Meeting in Arizona

Hosts of a joint meeting of the Frequency Coordinating Working Group (FCWG) and the Aerospace Flight Test Radio Coordinating Council (AFTRCC) Jan. 12–14 in Scottsdale, Ariz., were the U.S. Army Electronic Proving Ground and Motorola Co.

Maj Gen Benjamin H. Pochyla, commanding general of USAEPG, Fort Huachuca, Ariz., delivered the welcoming speech to the two groups, and A. L. McIntosh, of Fort Huachuca's Test Directorate, presented a technical address.

The FCWG is a unit of the Inter-Range Instrumentation Group, which is one of the primary agencies for frequency control and assignment techniques. AFTRCC is a council made up of representatives of private corporations engaged in flight testing and was established to share information, resources and efforts to solve mutual problems of frequency assignment and use.

Such joint meetings are considered a primary channel for cooperation between governmental agencies and private industry.

Micom Promotes Pershing Manager to Deputy CG

Col Edwin I. Donley, Pershing Weapon System manager since 1963 and recent nominee for brigadier general, is the new deputy commander for Land Combat Systems at the U.S. Army Missile Command, Redstone Arsenal, Ala.

He replaces Brig Gen Charles W. Eifler, now in Viet Nam, who held the position for 2½ years. General Eifler also has been nominated for promotion by President Johnson. Both officers await U.S. Senate confirmation of promotions when vacancies occur.

Responsibility for management and development of all missile systems for frontline troops now rests with Col Donley, who saw the Pershing Weapon System through test stages. The Pershing, Army's longest-range ballistic missile, is now operational with U.S. and West German troops.

A 1940 graduate of the U.S. Naval Academy with a BS degree in engineering, Col Donley also holds an MBA degree in industrial management from the University of Michigan. He is a graduate of the Command and General Staff College, Fort Leavenworth, Kans., and the Industrial College of the Armed Forces, Fort McNair, Washington, D.C.

During World War II, Col Donley served as ordnance officer in the States and European Theater. He later served in the Caribbean Area, in the Foreign Liquidation Commission office of the Department of State, in the office of the Chief of Ordnance and as executive officer and deputy commander, Picatinny Arsenal, N.J.

Prior to assignment to Redstone he was with the Korean Military Advisory Group as senior supply and maintenance adviser to the deputy chief of staff (logistics), Republic of Korea Army.

General Eifler served two tours of duty at Redstone Arsenal, the first as commandant of the Ordnance Guided Missile School for two years. He then assumed command of Frankford Arsenal, Philadelphia, Pa., before reassignment to MICOM.

The general has served 29 years in the Army. During World War II he was with ground forces in Europe and became ordnance officer of the XVIII Corps (Airborne). He earned a master's degree in electrical engineering in 1948 from Massachusetts Institute of Technology and was then assigned to missile work at White Sands Proving Ground, N. Mex. After a tour of duty in the Office of the Chief of Ordnance, Washington, D.C., General Eifler became CO of the 57th Ordnance Group in Germany before his first assignment to Redstone.

He is a graduate of Pennsylvania State College (BS, civil engineering) and the Industrial College of the Armed Forces.

Col Edwin I. Donley

5001st R&D Reserve Unit Plans July Mobility Seminar

The latest advances and trends in U.S. Army mobility, including vehicles and aircraft, will be presented at a mobility seminar recently approved by Lt Gen William W. Dick, Jr., Chief of Research and Development.

The 2-week seminar, scheduled for late July on the University of Detroit campus, is being planned by the 5001st U.S. Army Research and Development Unit, Detroit, Mich., assigned to the VI U.S. Army Corps, Fifth U.S. Army.

Featured speakers at the seminar will be top military personnel from the Office of the Chief of Research and Development, U.S. Army Materiel Command, U.S. Army Mobility Command and the U.S. Army Tank and Automotive Center, including project managers for tracked and wheeled vehicles.

Executives from the automotive industry and representatives from the University of Michigan also will be featured. Attending the seminar will be 70 USAR R&D Unit Members and 30 active Army personnel selected from service schools and combat support agencies. Also expected to participate are personnel from the U.S. Marine Corps.

Additional information regarding the seminar will be reported when plans have progressed further.

AMC Names Col Crossman 2.75 Aircraft Rocket Manager

Col Raymond S. Crossman, formerly of the Army Munitions Command at Dover, N.J., has been appointed project manager for the 2.75-inch aircraft rocket at the Army Materiel Command, Washington, D.C.

The former project manager for selected ammunition at MUCOM is a graduate of the University of Michigan and the Command and General Staff College. After World War II, when he served as an ordnance officer in the China-India-Burma Theater, he was professor of military science at MIT.

Later he was ordnance battalion commander and chief of offshore procurement at the Ordnance Procurement Center, Europe, and was a member of the U.S. Mission in Saudi Arabia.

Col Crossman's new project is an air-to-ground rocket system for use in Army, Air Force and Navy aircraft, including helicopters. The folding-fin rocket packs a warhead, solid-fuel motor and has two types of nose fuzes available—for high and low-speed aircraft. The 2.75 provides effective fragmentation, blast, demolition, smoke, fire and target-marking capabilities against ground materiel or personnel.

SAGE Phase-out Releases $65 Million in ADP Equipment

Automatic data processing equipment that originally cost about $65 million has been reported to the Defense Supply Agency (DSA) for screening and redistribution, it was announced recently.

The equipment was made excess by the phase-out of certain semi-automatic ground environment (SAGE) facilities in the recent reorganization of the North American Air Defense Command.

On-site inspection of the material was arranged through the Department of Defense ADPE Reutilization Program, management of which is under DSA, for the purpose of giving activities having a use for this equipment a chance to see it in operation. The equipment is available to DoD activities, other Federal Agencies and authorized donees at no cost except for crating and shipping.

The excess equipment is located at Truax Air Force Base, Madison, Wis., Norton AFB, San Bernardino, Calif., Stead AFB, Reno, Nev., McChord AFB, Tacoma, Wash., and Richards-Gebaur AFB, Grandview, Mo.

Copies of the catalog describing excess SAGE ADPE, along with other information, may be obtained from the Defense Supply Agency, Attention: DSAH-LSR, Cameron Station, Alexandria, Va. 22314.

AMRAC Combines Expertise of 21 Scientists Noted for Materials Research

Twenty-one nationally recognized scientists with broad collective expertise in materials have been organized as the Army Materials Research Agency Council (AMRAC) at Watertown Arsenal, Mass.

President of the council is Lt Col Joseph E. Black, commanding officer of the Army Materials Research Agency, a research organization of the Army Materiel Command's R&D Directorate. Council members were chosen for individual statures in metallurgy, ceramics, polymers, solid state of matter, mechanics of materials and related fields.

At the organization meeting of the AMRAC Col Black, assisted by Dr. J. L. Martin, the AMRA technical director, and members of the agency staff gave presentations covering the mission, organization, program, and the coordination and liaison activities of AMRA. An in-depth review of the armor materials program followed briefs presented by the major operating segments of the agency.

Mission of the new council was stated as that of adviser in the broad areas of the AMRA technical function including advice on plans and programs in scientific and engineering materials, and the council would make recommendations with respect to the general direction, emphasis and balance of materials research and engineering effort.

Representing a cross section of the levels of materials study, from fundamental academic science to materials processing and industrial production feasibility studies, members of the AMRA council are:

Dr. John O'M. Bockris, director of the Laboratory for Electro-chemistry, University of Pennsylvania; John J. Chyle, director of welding research of the A. O. Smith Corp., Milwaukee, Wis.; Robert P. Daykin, chief metallurgist of the Ladish Co., Cudahy, Wis.; Albert G. H. Dietz, professor of Building, Engineering and Construction, Massachusetts Institute of Technology; Thomas J. Dolan, professor and head of the Department of Theoretical and Applied Mechanics, University of Illinois; Prof. Daniel C. Drucker of Brown University.

Also, Schuyler A. Herres, vice president of Titanium Metals Corp. of America, New York, N.Y.; Dr. Stephen Jeckovich, director of research for Pittsburgh Plate Glass Co.; John F. McMahon, dean of Alfred College of Ceramics, New York; Dr. Maurice Morton, director of the Institute of Rubber Research, University of Akron, Ohio; Stanislaw W. Mrozowski, professor of physics and director of the Carbon Research Laboratory, University of Buffalo, N.Y.; Prof. Earl R. Parker, chairman of the Department of Mineral Technology, University of California, Berkeley.

Also, Harold W. Paxton, professor of Metallurgical Engineering, Carnegie Institute of Technology; Joseph R. Piselli, vice president of Bell Aerosystems Co., Buffalo; Dr. Edward E. Reynolds, manager of the Basic Research Department of Allegheny Ludlum Steel Corp., Pittsburgh, Pa.; Dr. Henry S. Rothrock, liaison manager of the Central Research Department, E. I. du Pont de Nemours; Arnold S. Rustay, vice president and technical director, Wyman-Gordon Co., Worchester, Mass.

Also, Adolph O. Schaefer, metallurgical consultant of Norristown, Pa.; Robert A. Stauffer, vice president for research of the Norton Co., Worchester; Dr. Wieslaw Z. Stepniewski, director of advanced research, the Boeing Co. (Vertol Division), Morton, Pa.; and Porter R. Wray, general manager of product and service metallurgy, U.S. Steel Corp.

R&D Leaders Witness Lance, Shillelagh Firings

Top research and development officials of the Departments of Defense and Army witnessed this year's first firings of the Army's two newest battlefield missiles, Lance and Shillelagh, at White Sands Missile Range.

Dr. Thomas P. Cheatham, Jr., Deputy Director of Defense Research and Engineering (Tactical Warfare Programs); Assistant Secretary of the Army (R&D) Willis M. Hawkins; and Lt Gen William W. Dick, Jr., Chief of Army Research and Development, were guests of WSMR and the Army Missile Command (Redstone Arsenal, Ala.) for the successful New Mexico range demonstrations.

Lance is the first Army missile to use prepackaged, storable liquid propellant. The system is planned as a divisional support weapon with greater range and accuracy than Honest John which it will replace.

Shillelagh is a gun-launched guided missile system being developed for armored vehicles. The Shillelagh 152mm launcher can fire either missiles or conventional ammunition. The system is planned as the main armament for the General Sheridan assault vehicle, the M60A1E1 main battle tank and the U.S. Federal Republic of Germany Main Battle Tank projected for the 1970s.

Walter Reed Surgeon Wins 1965 Metcalfe Award

Outstanding contributions to the field of surgical research have earned the 1965 Raymond Metcalfe Award for Maj Michael M. Duffy, a resident in plastic surgery at Walter Reed General Hospital, Washington, D.C.

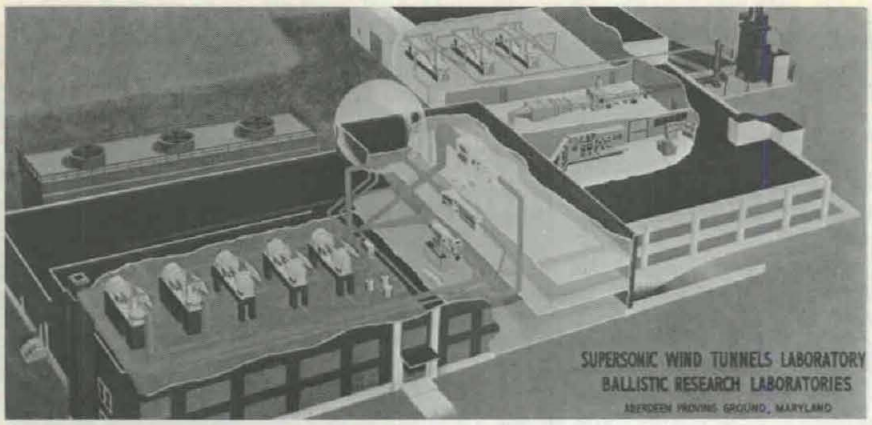
RECIPIENT of 1965 Metcalfe Award, Maj Michael Duffy, is flanked by Army Surgeon General Lt Gen Leonard D. Heaton (right), who presented award, and Maj Gen Douglas Kendrick, CG, Walter Reed Army Medical Center.

Maj Gen Douglas B. Kendrick, CG, Walter Reed Army Medical Center, officiated at the ceremony and Lt Gen Leonard D. Heaton, The Army Surgeon General, presented the award.

Maj Duffy's prize-winning entry was a professional paper on the subject of "Fever Following Palatoplasty: an Evaluation Based on 'Fever Volume.'"

A 1953 graduate of Dartmouth College, where he earned his BA, Maj Duffy received his MD degree from George Washington University School of Medicine in 1957. He entered the Army a year later and has been in the plastic surgery resident program at Walter Reed since July 1964.

This is the fifth annual Metcalfe Award. Carrying an honorarium of $150, it was established by Mrs. Marjorie Metcalfe Nichol in memory of her father, the late Brig Gen Metcalfe, who distinguished himself as a surgeon and later as commanding general of Walter Reed Army Medical Center during World War II.



U.S. ARMY BALLISTICS RESEARCH LABORATORIES wind tunnels, shown in cutaway view, consist of complex of three supersonic wind tunnels, a hypersonic wind tunnel with associated power plants, heating and cooling equipment.

BRL Marks 21st Anniversary of First Wind Tunnel

The U.S. Army Ballistic Research Laboratories (USABRL), Aberdeen Proving Ground, Md., recently noted the 21st anniversary of its supersonic wind tunnel, first of its kind in the United States suitable for research and development testing.

Since the original wind tunnel went into operation in December 1944, USABRL has added several more wind tunnels and a variety of pressurized and atmospheric ranges.

The first tunnel was of the continuous flow, variable density, fixed nozzle type. It was built when the military and scientific need of the Nation was brought to the attention of the Army Ordnance Department.

Such well-known aerodynamicists as Puckett, Emmons, Sternberg and the late T. L. Smith were instrumental in its design and initial performance check.

Since that time USABRL has pioneered in such developments as wind tunnel design and instrumentation.

Because the need for tunnel speeds rapidly changing from one supersonic velocity to another became apparent with the fixed nozzle tunnel, USABRL constructed the first flexible nozzle supersonic wind tunnel in 1948.

In 1954, a second flexible nozzle wind tunnel was constructed to replace the original tunnel. That same year a small research tunnel was put into operation to run concurrently without interfering with the larger tunnels.

In 1961, a hypersonic tunnel was put into operation adding to the three continuous flow supersonic tunnels, all of which are in operation today.

Assigned a 2-fold mission of missile development testing and aerodynamic research, the wind chambers are used extensively for testing missile models for the Army, Navy, Air Force and, more recently, for NASA.

To evaluate aerodynamic design of missiles and missile components, tests include stability and control measurement, pressure distribution, dynamic measurement, temperature measurement and visual boundary layer studies.

Space-age contributions include tests on models of the Jupiter C, Explorer 1, Vanguard, Saturn-Apollo and Saturn V. These studies resulted in many important changes and improvements.

During the past five years the major research and development efforts at the laboratories have been concentrated in three fields—applied aerodynamics, fluid dynamics, and facility and instrumentation development.

In the area of fluid dynamics and aerodynamics basic research, most of the effort is self generated; however, an important aspect of the work is to provide consultation and assistance to other organizations of USABRL and the U.S. Army Materiel Command.

Headed by Robert H. Kreiger, the wind tunnels employ 58 persons and have a normal yearly budget of approximately $1.5 million.

Geologists Select Walker

John W. Walker, geophysicist, Institute of Exploratory Research, U.S. Army Electronics Command, Fort Monmouth, N.J., was elected a member of the Institute of Professional Geologists. Now studying electromagnetic propagation through ice, he has led two polar expeditions.

MICOM Runs Tests on Modified Plasma Jet Facility

Shakedown tests of a recently modified wind tunnel for checking missile nose cones under plasma conditions are underway this month at the Army Missile Command, Redstone Arsenal, Ala.

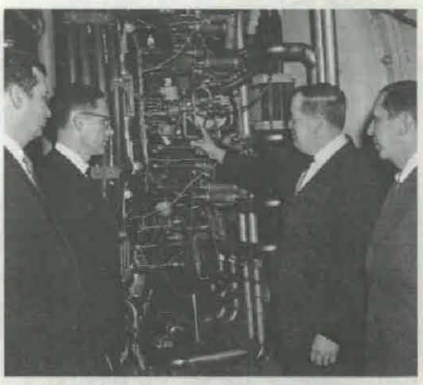
Known as the plasma jet facility, the 150-foot-long steel device at MICOM is unlike similar tunnels in that it can vary conditions during tests according to preplanned requirements, giving more accurate data on what actually is experienced during reentry of missile nose cones into the earth's atmosphere.

MICOM scientists and technicians refurbished the plasma jet facility to "make it a more powerful and effective means for testing model missile nose cones." They contend that the mysteries of what happens to a nose cone upon flaming reentry will be clarified when the plasma jet is placed in full experimental operation.

The facility has cost approximately $1.5 million. One-third of the equipment came from salvage.

In full operation, the plasma jet will heat air with 18 million watts of electrical power. The facility is run by compressed air passed through a nozzle. The air is heated "as hot as the sun" as it passes an electric arc.

Test nose cones are two feet long. During a test, which takes about 12 seconds, the nose cone goes through two orders of magnitude of electrical power and gas-flow rate, simulating an altitude flight change from 300,000 to 150,000 feet.



BUSINESS END of plasma jet facility at the Army Missile Command, Redstone Arsenal, Ala., has been refined to handle complicated problems presented by reentry of missile nose cones into earth's atmosphere. Leaders in developing the facility, pictured above from left, are Charles Cason, Dr. T. A. Barr, Robert Mayo and Dr. Loren Dickerson, MICOM.

Researcher Gets Award Atop Own Canopy Design

Novel approaches in presenting awards reached new heights when Robert L. Woodbury was recognized for superior performance in research at the U.S. Army Limited War Laboratory.

The new "high level" approach was that of setting the presentation stage atop the jungle canopy, 150 feet above ground, in Hilo, Hawaii, by using the unique helicopter landing platform designed by Woodbury.

Proving valuable currently in Viet Nam for deep jungle operations, the device permits rapid deployment of troops and rescue in areas inaccessible except by foot. (See LWL feature story, page 6, for description.)

The award for the jungle canopy platform research and development is one of a number that have honored Woodbury for military materiel achievements. Assigned currently as chief of the LWL Environment and Survival Branch, he began his career with the military when he enlisted in November 1940 and was assigned to the 5th U.S. Infantry Regiment at Camp Paraiso, Canal Zone.

In October 1941 he was placed on detached service as assistant for Research on Jungle Warfare and Development of Specialized Jungle Clothing and Equipment to the Commanding General, Panama Mobile Force. Assignment to the Special Forces Section, Research and Development Branch, Military Planning Division, Office of the Quartermaster General, came in August 1942.

Award of the Legion of Merit recognized his work from November 1940 to September 1945. The citation acclaims Capt Woodbury for his work as an enlisted man and later an officer, stating: "He signally aided the successful prosecution of the war by devising numerous pieces of clothing and equipment especially adapted for jungle combat forces."

That work had taken him to Australia and a number of forward areas in the Southwest Pacific Theater, including Leyte, New Guinea and New Calidonia, working on special requirements for Lt Gen Stillwell's Chinese troops in Burma, Maj Gen Orde C. Wingate's British long-range penetration troops, Merrill's Marauders and other combat units.

Men vociferous in their contention of malassignment in military service take a contrary view, but study of personal histories turns up a large percentage whose duties are logically related to civilian training and experience. In Woodbury's case, his Quartermaster clothing work stemmed from studies of product design and fine arts in six well-known professional schools before he enlisted.

Experience highlights in his civilian career have included service as a designer of mobile carnival equipment and shelters; assistant to the director of the North Miami (Fla.) Zoo; staff assistant to noted explorer and mammalogist Dr. James L. Clark at the American Museum of Natural History; head (two years) of the Design Department of the Institute of Contemporary Arts in Washington, D.C.; and self employment as a designer and printer of silk screen printed textiles.

One of his assignments for General Wingate was that of designing shoes to be worn by his Burma Raiders that would leave an imprint simulating that of Burmese bare-footprints—as he puts it, "just one of many odd and interesting tasks during Quartermaster Corps duties."

JUNGLE CANOPY, 150 feet above ground, acts as stage for presentation of superior performance award for research at the Limited War Laboratory. Robert L. Woodbury accepts the award from Maj David Hayes.

Electric Wheel Motors Drive Test Truck at ATAC

With each wheel independently powered by an electric motor, a 6-wheel 2½-ton experimental Army truck has been successfully driven over 7,000 miles at the Army Tank-Automotive Center (ATAC), Warren, Mich.

It is the first known operational vehicle using frequency-controlled alternating current electric drive, an ATAC concept under development since mid-1960 through a $1 million contract with Lear-Siegler, Inc. of Cleveland, Ohio.

Test driving was performed under a wide range of weather and terrain conditions and ATAC engineers reported performance "surpassed substantially" the predictions made after the first feasibility tests nearly six years ago. The development contract is now in terminal stages.

Heart of the revolutionary drive system is a static frequency converter which provides controlled frequency power. In the experimental truck a conventional 6-cylinder piston engine drives an alternator which generates a high-frequency output proportionate to the engine speed.

The alternator output is fed into frequency converters which control each wheel-drive motor. The converters modify this power into controlled lower frequency which powers the electric motors.

(The alternator operates over a speed range of 2,640 to 7,400 revolutions per minute producing an output frequency range of 704 to 1995 cycles per second).

The frequency-controlled electric drive system is designed to program automatically the most efficient use of engine power to produce the maximum vehicle economy.

In a vehicle designed for such a drive, wheels could be suspended independently with power being transmitted by cable. (The experimental truck's drive system has been adapted to a conventional suspension design.)

Independent motor-drive wheel suspension would eliminate the bulk and weight of drive shafts, transmissions and axles. The system would automatically adjust each wheel to road environment such as grade, depressions, mud or ice. Each wheel would use only the power needed to operate at maximum efficiency, thus allowing the engine to perform at a constant power-producing peak. Ton-mile fuel consumption would be decreased.

Engineers also foresee ease in maintenance through the use of replacement modules instead of the repair of individual parts.

Other features of the electric drive vehicle include safety of electrical braking, capability of one-wheel vehicle mobility should all other wheels lose power, general maintenance-cost reduction through use of fewer moving parts, improved cross-country and grade performance, more flexible vehicle design and minimized driver fatigue.

ATAC is an element of the Army Mobility Command also headquartered in Warren at Detroit Arsenal.

Army Awards $285 Million in RDTE, Production Contracts

Largest aggregation of U.S. Army contracts issued in recent weeks for research, development, testing and production, which totaled $285 million, was awarded to Olin Mathieson Chemical Corp., East Alton, Ill.

Total value of Olin's three contracts was $26,221,318. They called for 7.62 mm ammunition and for partial reactivation of the Badger Army Ammunition Plant, Baraboo, Wis.

Honeywell, Inc., received five contract awards totaling $22,057,608 for automatic assembly and support equipment for 40mm projectiles, ordnance components, batteries for the M532 fuze, ammunition and electronic equipment.

Page Communications Engineers, Inc. was issued a $20 million contract modification for work on Phase II of an Integrated Wide Band Communications System. General Motors Corp. received $18,036,684 under five contracts calling for dump trucks, transmissions for various types of vehicles, delivery trucks and 81mm components.

Philco Corp. was awarded a pair of agreements with total value of $15,200,000 for continued research and development of the Chaparral air defense system and for continued work on Phase II of an Integrated Wide Band Communications System.

Remington Arms Co. will produce 5.56 and 7.62mm ammunition under a $14,980,751 contract. Holston Defense Corp., Division of Eastman Kodak Co. was issued two contracts valued at $14,689,457 for ordnance items, explosives and propellants of various types.

Chrysler Corp., issued a $10,047,537 contract, will produce M60A1E1 turret systems. Federal Cartridge Corp., received a $9,155,900 modification for 5.56mm cartridges. Hercules Powder Co., awarded two contracts totaling $8,694,428, will produce miscellaneous propellants and explosives and continue reactivation of the Sunflower Army Ammunition Plant, Lawrence, Kans. AVCO Corp., awarded three contracts totaling $8,198,180, will produce metal parts for 40mm projectiles and ammunition; the firm also will continue operation, modification and maintenance of missile tracking and instrumentation radars and interfacing equipment at White Sands Missile Range, N. Mex.

Hamilton Watch Co. was issued a $7,865,550 initial increment to a contract for ordnance components. General Time Corp. received two agreements with total value of $7,860,426 to produce ordnance items.

Amron Corp. received $6,962,349 for ammunition. Goodyear Tire and Rubber Co. was issued two contracts totaling $6,353,961 for shoe assemblies for the M578 recovery vehicle and track shoe assemblies and pods for the M108 and M109 combat vehicles.

Global Associates was awarded a $6,285,181 modification to a contract for base logistics support at the Kwajalein Test Site, Marshall Islands, Pacific. International Harvester Co. was issued three contracts totaling $6,131,526 for 91 diesel engine driven loaders, 1,044 pickup trucks and 426 cargo trucks.

Johnson Furnace Co. received $6,102,523 for production of 1½-ton cargo trailers and 1½-ton trailer chassis. General Electric Co. was awarded a $5,089,491 modification to a contract for 7.62mm aircraft machineguns, pods and repair parts to

Defense Department Schedules Industry Briefings

Director of Defense Research and Engineering Dr. John S. Foster and three Assistant Secretaries of Defense headed a team of Department of Defense Civilian and military officials participating in 2-day unclassified briefings for industry.

The top Defense officials spoke at the Advanced Planning Briefings in Boston, Mass., Atlanta, Ga., and St. Louis, Mo., in March and plan to make presentations at two additional briefings in April. They will be held at the Fairmont Hotel, San Francisco, Calif., Apr. 12-13, and the Sheraton-Park Hotel, Washington, D.C., Apr. 27-28.

Accompanying Dr. Foster were Robert N. Anthony, Assistant Secretary of Defense (Comptroller), Dr. Alain Enthoven, Assistant Secretary of Defense (Systems Analysis). Assistant Secretaries of the Military Departments for Installations and Logistics, military leaders concerned with research, development and procurement and business, industry and labor leaders comprise the additional participants.

Sponsored jointly by the Department of Defense and National Security Industrial Association, the briefings are intended to provide management and labor with a broad picture of long-range Defense development needs and to assist industry in planning for and seeking Defense contracts.

Arrangements for the briefings are being handled by NSIA Washington Headquarters, NSIA city chapters and sponsoring industries.

U.S. Army officials making presentations at the briefings include: Assistant Secretary of the Army (I&L) Robert A. Brooks; General Frank S. Besson, Jr., CG, U.S. Army Materiel Command; Maj Gen Roland B. Anderson, CG, U.S. Army Weapons Command; Maj Gen F. A. Hansen, CG, U.S. Army Munitions Command; Maj Gen William W. Lapsley, U.S. Army Mobility Command, Maj Gen John G. Zierdt, CG, U.S. Army Missile Command; and Brig Gen W. B. Latta, CG, U.S. Army Electronics Command.

Subject matter being discussed at the briefings is as follows: major objectives of the Department of Defense and the program designed to implement them; changing patterns in Defense spending and resulting problems and opportunities; the technological challenge of the next 10 years; systems analysis and cost effectiveness; resource management systems; management trends in Defense research and development; procurement management trends; procurement trends and future industry relationships with the Defense Supply Agency; advanced planning requirements of the three Military Services.

Procurement specialists from the Military Departments and DSA are available at each regional briefing to provide counseling services on contract policies and procedures of their organizations.

Invitations for Bid and Requests for Proposal aggregating more than $100,000,000 as well as lists of items for which Department of Defense buyers are seeking additional sources also are available.

Joining with DoD representatives in the counseling are representatives of Defense prime contractors, the Department of Commerce and the Small Business Administration to discuss subcontracting opportunities and services available to the contractors.

Defense Contractor Cost Reduction exhibits are being displayed at each briefing to illustrate the effectiveness of industry's cost reduction ideas and achievements. Participating in the exhibits are about 70 contractors, displaying over 350 effective ideas.

support the Air Force and Army firing program.

Lesser contracts were as follows: Sylvania Electric Products, $4,969,-304, development and production of electronic equipment for the light observation helicopter and electronics equipment; Bell Helicopter Co., $4,-905,000, UH–1 helicopter rotary wing blade and main blade assemblies; Batesville Manufacturing Co., $4,545,-684, ammunition; Collins Radio Co., $3,866,241, radio sets;

Kaiser Jeep Corp., $3,621,654, 5-ton trucks; Medico Industries, Inc., $3,-480,000, metal parts for ordnance components of the 2.75-inch rocket; Ingraham Co., $3,312,650, ordnance items; Fruehauf Corp., $3,200,000 for a 12-month program to supply scientific and operations research support for the Combat Developments Command; Raytheon Co., $3,192,618, design and development on the Hawk Antitactical Ballistic Missile System and electron tubes for the Hawk missile system transmitter;

ITT Corp., $3,170,125, repair parts for the radio network system Tropospheric Army Communication System; Canadian Commercial Corp., $2,660,-567, doppler navigation sets and components and radio sets; Mason and Hanger, Silas Mason Co., $2,637,453, detonators and 90mm cartridges; Radio Corp. of America, $2,611,600 for radio sets; Jayval Co., $2,595,994, cargo parachutes (100-foot canopy); Kentucky Manufacturing Co., $2,540,-979, for 515 semitrailers;

Standard Products Co., $2,482,738, for track shoe assemblies for the M108 and M109 combat vehicles; Emerson Electric Co., $2,362,130, helicopter armament sub-systems; Ford Motor Co., $2,312,588, for 9-passenger station wagons; Eagle Picher Co., $2,-157,840, for ordnance items.

Grand Machine Co., $2,032,200, for 81mm mortar shell assemblies; Continental Motors Corp., $1,839,963, engine assemblies and containers for the M88 recovery vehicle; Studebaker Corp., $1,797,000, for 60-cycle generator sets;

Drillmation, Inc., $1,657,113, bolts and M2 carbines; Eisen Brothers, Inc., $1,619,621, metal parts for hand grenades; Stewart Warner Corp., $1,-541,808, 60mm projectiles; Fairchild Space and Defense Systems division of Fairchild Camera and Instrument Corp., $1,512,115, ordnance items;

Lockley Machine Co., $1,430,739, demolition kits; Hanson Machinery Co., $1,379,918, for truck mounted cranes; Boeing Co., $1,363,476, for CH–47 helicopter components; Connecticut Cartridge Corp., $1,350,000, for 20mm cartridge cases; Trenton Textile Engineering and Manufacturing Co., $1,294,145, for ordnance items; Firestone Tire and Rubber Co., $1,239,427, metal parts for the Shillelagh missile system; Bendix Corp., $1,170,062, stabilizer platforms for the Pershing missile system; Continental Aviation and Engineering Corp., $1,037,277, for continuation of production engineering services for engines applicable to 2½-ton and 5-ton trucks.

Achievement Award Winner for Surgical Laser Dies

One of the Army's outstanding researchers in Laser applications, James R. Dearman, 40, died Feb. 8 of a heart attack as he was leaving work at the Army Missile Command (MICOM), Redstone Arsenal, Ala.

James R. Dearman

He was a group leader in the Missile Command's Applied Physics Branch of the Electromagnetics Laboratory.

Beginning in 1963, Dearman played a major role in a continuing series of medical experiments applying Army laser devices to surgical treatment of cancer, working with medical researchers from the National Institutes of Health in Bethesda, Md. He was one of the Army engineers who designed a unique special Laser device to be used by the National Cancer Institute for the agency's research program. This device is now undergoing tests at Redstone Arsenal.

He was engaged in design and development of infrared instruments used in guided-missile research during the first year at the MICOM laboratory. In 1962, Dearman was named to lead a group responsible for design and operation of the Army's so-called "Bix X Laser System" at Arnold Engineering Development Center, Tullahoma, Tenn.

Dearman received the Army Research and Development Achievement Award and the Army Missile Command Scientific and Engineering Award in 1964.

USARO Holds Operations Research Course

A course designed to provide senior Army staff and action officers with greater understanding of operations research capabilities, limitations, methods and techniques, especially as they apply to Army studies, was held at the U.S. Army Research Office, Arlington, Va., Jan. 31 to Feb. 4.

Attendees at the Operations Research Appreciation Course included 24 military and two civilians from Army General Staff elements and major Army commands. It was the second presentation of the course. The first was held in October 1965 and the third will be presented in late April or early May.

Sponsored by the Chief of Research and Development, Lt Gen William W. Dick, Jr., the course was taught by Eugene E. Newnam of the U.S. Army Management Engineering Training Agency (AMETA), Rock Island, Ill.

With an additional purpose of increasing the overall quality of effort in the initiation, conduct, monitoring, review and use of Army studies, the course covered the following basic areas:

Definition and concept of operations research; the purpose of the Army study system; operations research approach and personnel; statistical inference and the role of statistical design of experiments; common areas of application such as queuing processes, simulation, inventory allocation, competitive strategy; consideration of a case history.

MICOM Dedicates New Lab

Army Missile Command's inertial guidance and control laboratory has a new $2.5 million home at Redstone Arsenal, Ala.

A wing to the Francis J. McMorrow Laboratories building was opened formally recently at ceremonies presided over by MICOM's commanding general, Maj Gen John G. Zeidt.

Named in memory of a former MICOM commander, the building houses five research and development laboratories of the command.

Mrs. McMorrow cut the ceremonial ribbon at the dedication.

Deputy DDRE (TW) Discusses Surveillance Systems

(*Continued from page 2*)

used up until that time. They may affect the men who employ them in ways that are not immediately obvious to the designer or analyst. . . . Tactical weapons research and development ground rules are often quite different from those for strategic systems in terms of cost effectiveness. . . .

In a strategic system, marginal improvements are rather secondary considerations in deciding to go ahead with a new development. In tactical weapons areas, the introduction of a number of marginal improvements that reduce the awkwardness factor to a minimum may offer a payoff which will quickly yield a major battlefield advantage. . . . In this area, even a modest technical advantage may well be worth a full development effort. . . .

The most significant characteristic of tactical warfare is its requirement for an intimate interplay between men and machines, and particularly the overlap and close interrelationship of ground, sea and air operations.

Of all the aspects of tactical warfare, the one that requires the maximum coordination of all of the available sensory and communications means is tactical reconnaissance.

At the same time that it is the most complex aspect of tactical warfare, it is also the most important, because it fuses into the entire system of seeking out the enemy, closing with him and destroying him.

Whether we are talking about antitank operations, antiship operations or locating and destroying enemy troop units, the problem looms up of what and where is the target. If antiballistic missile defense can be said to be the most challenging problem for strategic systems, *target acquisition* can claim the honor in tactical warfare systems.

This is an area where we need to work hard to try to come up with answers far superior and more realistic to any that we have had in the past. Reconnaissance does not stop with finding the enemy, nor does it start and stop with the sorties of the reconnaissance aircraft.

Throughout the period during which we fight the enemy, reconnaissance should be the governing force in determining how we fight him, where we strike him, and how we survive during the fight. Finally, during the phase of destruction, reconnaissance will determine where his forces are and how we can prevent him from escaping to fight us on another occasion.

Historically, most of the approaches to reconnaissance and the studies that have been done on reconnaissance have failed to recognize its full role, requiring the complete integration of all means, starting with the eyes of the forward observers and foot patrols and ranging to the intricate telemetry in satellites.

Because it is such a large and complex job, there has been a tendency to compartment it and break it down into manageable, bite-sized pieces. Even these pieces have not recognized all of the aspects that are inherent within them.

Also, full recognition is not given to the fact that aerial reconnaissance requires a completely articulated system, capable of flexible articulation and responsiveness to match the timing and the requirement of the overall operation. Only a part of the job is done over the target. The biggest job is done before and after the reconnaissance sortie. . . .

Because of the classical approach that we have adopted, our Viet Nam

ASA (R&D) Assistant Gates Reviews SATCOM Progress

Satellite communications systems development for both strategic and tactical use was the subject of a recent special visit to the U.S. Army Satellite Communications (SATCOM) Agency, Fort Monmouth N.J., by Howard P. Gates, Jr., Assistant for Communications and Avionics to the Assistant Secretary of the Army Research and Development.

Discussions with SATCOM Agency commander Col Mitchel Goldenthal centered on two new families of ground terminals developed by the Agency: the AN/MSC–46 now being completed by Hughes Aircraft Co., Fullerton, Calif., and the AN/TSC–54 terminals which will be built by Radiation Inc., Melbourne, Fla.

The air-transportable AN/MSC–46, with 40-foot antennas, will be installed in various overseas locations to provide strategic, long-haul communications for the Initial Defense Communications Satellite Program (IDCSP), scheduled for first testing this year.

The smaller, highly-transportable AN/TSC–54 terminals will augment the IDCSP system later, and will be tested by the SATCOM Agency for possible use in Army tactical communications systems.

The SATCOM Agency, as a Project Manager activity reporting directly to the Army Materiel Command, is responsible for the Army portion of the Defense Communications Satellite Program and for the Army's Tactical Communications Satellite Program.

In addition to the policy and planning discussions with Col Goldenthal, Mr. Gates participated in a SATCOM Agency technical staff meeting, a regular monthly session held to review progress being made on all SATCOM projects.

High-level representatives of the U.S. Army Electronics Command joined in a portion of the meetings to discuss ECOM support to be provided for the tactical satellite communications program.

FUTURE lightweight satellite communications terminal AN/TSC–54 is described by Col Mitchel Goldenthal, U.S. Army Satellite Communications Agency commander, to Howard P. Gates (second from right). On his recent visit to the SATCOM Agency, Mr. Gates, Assistant for Communications and Avionics Systems to the Assistant Secretary of the Army (R&D), was accompanied by Lt Col Boyde W. Allen (left) and Col Jack G. Hines (right) both of the OCRD.

experience has shown that we can expect an unacceptable delay between an aerial identification of the enemy and an aerial strike against him. To improve this situation, we must adopt proper criteria for measuring effectiveness of reconnaissance. These criteria must relate to the whole job and not just to the best technical approach. . . .

Technical perfection, or even the capability to turn out large numbers of images, is not the criterion for excellence. The real criterion is whether we can find the enemy and destroy him.

In Viet Nam it equates to how fast we apply fire power against small, fleeting targets that blend into the local background completely in a matter of minutes, or even seconds, and who disperse, concentrate or move equally well at night or in the daytime.

To cite some history, we seem to have difficulty in being ready for these problems before they occur, although by the end of each war or engagement we have developed systems, procedures and equipment that work reasonably well, and in some cases—beautifully. . . .

We [have] learned that the Viet Namese type of war requires a type of reconnaissance that has worked well since the beginning of time, visual reconnaissance. We rediscovered the efficiency and efficacy of the human eye and the human brain to develop a palm-of-the-hand intimate knowledge of an assigned sector . . . that it could meet requirements for detection of Viet Nam ambushes and construction, that it could provide timely support.

An observer in an 0–1 Birddog, given proper communications, an accurate tactical navigational system and freedom to act, could direct supporting air strikes and artillery, doing a creditable job where photography would have been a complete flop.

However, the Birddog has its limitations. It flies slowly. It is vulnerable, doesn't have the speed and agility to get out of a tight situation, and is limited even in the avionics and communications equipment that it is capable of carrying. . . .

From this experience in Viet Nam . . . we can see that the essence of reconnaissance is flexibility. Reconnaissance is not a classical mission that always dictates the use of the same aircraft with the same combination of sensors. It must be a [united] system . . . [which] differs from integration in that it does not require all of the Services to use common equipment [but] it does require that their individually developed systems be compatible. They must be able to work together. . . .

Speaking of the tendency of the technician to want to build more perfect and complex equipment in order to surmount what seem to be unassailable technological obstacles. Dr. Fubini [former Deputy Director of Defense Research and Engineering] said there is a tendency in America to adopt the approach that "if you can do it, do it regardless of the complexity"—and as an editorial I might add "or the cost" and some times, and most applicable to the aerial reconnaissance problem that we now face—"or the need."

Dr. Fubini also warned against the dangers of seeking extreme solutions to a problem, and I think we have seen the dangers of these extremes in the reconnaissance area. At one end of the spectrum lies the sophisticated RF–4C and at the other end is the completely simple, and perhaps inadequate 0–1 Birddog, or the ground observer in a forward combat outpost. . . .

Operations in Southeast Asia are teaching us some hard lessons. We must capitalize on flexibility and the creative utilization of proper equipment and tactics that are tailored for the real targets rather than a generalized average array.

Army Vice Chief of Staff General Abrams recently stated: "Our flexibility in the use of airborne troops has been increased because we now have the means to extract the troops to shift them rapidly to other sectors in a short time, thus maintaining the initiative, the tempo of the offensive and keeping pressure on the enemy."

Ground surveillance equipment and systems [are needed] that are effective and light in weight for the ground combat units; aerial reconnaissance equipment and systems that can provide target acquisition with accuracy for destruction by firepower or reach out a hundred miles to gather information on an enemy stronghold on which such a unit as the 1st Cavalry Airmobile Division would make an all-out assault. . . .

There is a requirement for a larger and more knowledgeable league of reconnaissance experts with a common understanding of the problem, and it is time that the experts whom we do have were heard from. They can't be heard, nor can a common understanding be developed unless they speak out.

Incidentally, the terms that I use in defining the problem, the terms of finding, closing with and destroying the enemy, came from the Chief of Staff of the Army. It is essentially a land job, imposing our will on a land enemy. However, the entire job is done within a system that includes all Services working in close harmony and cooperation. And we cannot follow a rigid classic peacetime role and mission pattern.

I call on this meeting to examine itself—to evaluate the target acquisition and surveillance capability offered, for example, in Southeast Asia. There are experts in this audience—men whose experience and ingenuity I respect greatly.

Have you allowed a peacetime-geared system to offer up solutions in search of problems OR indeed have you examined the problem and created the expertise, the flexibility and quick reaction needed for a continuous set of "real" solutions? Do you have the full range of sensors, vehicles, subsystems and mental attitude that will allow you to produce practical solutions to real problems as they arise?

If you want my personal opinion—you are on the way but still running at half speed and very much still behind the power curve. My impression today is that you should be the driving force that influences the entire spectrum of finding, closing with, and destroying the enemy for today in Southeast Asia and tomorrow (or some near future time) in yet another but perhaps more sophisticated environment.

New Mobile Image System Undergoes AEPG Tests

Sophisticated mobile image interpretation equipment, revolutionary as a self-contained system, has been undergoing confirmatory engineering tests at the Army Electronic Proving Ground, Fort Huachuca Ariz.

The Tactical Image Interpretation Facility (TIIF), also known as the TSQ–43, is housed in an expansible, truck-mounted shelter. It can travel over paved or unimproved roads and can perform limited cross-country travel. The entire system can be airlifted as one unit.

The TSQ–43 has a trailer-mounted power source and incorporates temperature control within the shelter. Equipment includes high acuity stereoscopic viewers, light tables, imagery measurement instruments, drafting tools, a computer, communications equipment and facilities for storing classified material. It can also accommodate roll imagery and technical references.

Designed to bring image interpretation to the field tactical commander on short notice, the TSQ–43 can be converted from march-order to operational placement in 20 minutes.

Three top civilian officials at the U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J., were presented Army Meritorious Civilian Service Awards by Brig Gen William B. Latta, ECOM commanding general.

Decorated were Alfred W. Rogers, ECOM chief engineer, Dr. Eduard A. Gerber, director of the Electronic Components Laboratory, and Theodore A. Pfeiffer, director of the Technical Programs and Analysis Office of the Research and Development Directorate.

Rogers was cited for having "contributed immeasurably to the successful accomplishments of a number of higher command study groups . . . and . . . without exception the major conclusions or recommendations of the study groups resulted in acceptance by higher command and widespread benefit to the Army."

Dr. Gerber was singled out for "immeasurable leadership and personal scientific contributions in the initiation and implementation of the electronic components research and development program of the Department of the Army. The highly successful accomplishments . . . reflect directly on his technical competence and management capabilities."

Pfeiffer's citation stated: "his exemplary leadership and superior executive abilities contributed to the planning and execution of the total USAECOM RDT&E (Research, Development, Test and Engineering) program. His initiative and accomplishment . . . have contributed to the successful development of the program for Fiscal Year 1965."

J. Gary Nelson, a physical science adviser with the U.S. Army Combat Developments Command Ordnance Agency at Aberdeen Proving Ground, Md., also was presented the Army Meritorious Civilian Service Award.

The decoration recognized his outstanding work in writing the handbook, "Reliability: Theory and Practice." The book is quickly becoming recognized as an invaluable aid to project managers, mathematicians and test engineers in both industry and Government who are concerned with the semantics and mathematics of reliability.

The Army second highest decoration for civilian employees also was awarded to Joseph Kaufman, a physical sciences administrator in the Research and Development Directorate of the U.S. Army Materiel Command, Washington, D.C.

The citation noted his "valuable experience and incisive analysis in direction of the Army Industrial Research program, guidance of the Engineer Design Handbook program, and staff supervision of the AMC basic research projects constituted professional service of a unique character." The period of service cited was August 1962 to October 1965.

The Army Meritorious Award also went to Thomas E. Diggin, deputy personnel director for employment and compensation since December 1962 at the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

The medal recognized his long-term effort to increase public understanding of the civilian personnel programs and policies of the Army and the Department of Defense. He received the Robert D. McMarlin Award in 1963 for outstanding service in personnel administration.

Dr. Bridges Wins Award for Electronics Work

Leadership in U.S. Department of Defense electronics programs credited with pacing worldwide developments is recognized in the recent award of the Meritorious Civilian Service Medal to Dr. James M. Bridges.

Defense Director of Research and Engineering Dr. John S. Foster presented the award to Dr. Bridges when he retired after 23 years of Federal Civil Service. High ranking military and civilian DoD officials attended the ceremony.

Dr. Bridges became director of electronics in the Office of the Assistant Secretary of Defense (Engineering), now the Office of the Director of Defense Research and Engineering (ODDRE), in May 1955. In recent years he has served also as special assistant for command and control to the Director of Defense Research and Engineering.

The award citation commends his "exceptionally distinguished service . . . singularly expert judgment, tireless efforts and enlightened management concepts." These qualities, it continues, "led directly to significant achievement in the fields of reliability, integrated circuits and electromagnetic compatibility.

"His leadership and inspired direction of the Secretary of Defense's Command, Control and Communications program review materially contributed to the realization of a more responsive, better integrated and less costly Department of Defense-wide program."

Dr. Bridges received a BS degree in electrical engineering from the University of Maine in 1928 and the honorary degree of Doctor of Engineering from the University of Maine in 1963.

After 14 years with private industry in New York City, he became associated with weapons control radar research and development in the Navy Bureau of Ordnance as an active officer of the Naval Reserve (1942–46).

From 1946 to 1952, as a Civil Service engineer, he headed radar research and development in the Navy Bureau of Ordnance. Then he was appointed the Bureau's chief engineer for electronics.

As DDRE director of electronics for the past decade, he was responsible for coordination and supervision at OSD level of all research and development activities for the Military Services in the field of electronics. His work gained him acclaim throughout the electronics industry as a leading authority on management of scientific and engineering resources.

Dr. Bridges is a Fellow of the Institute of Radio Engineers and a member of the American Ordnance Association and the Armed Forces Communications and Electronics Association. He is the author of numerous articles and papers in his field.

DECADE OF LEADERSHIP in Defense electronics administration earned Dr. James M. Bridges, former special assistant to the Director of Defense Research and Engineering, the Secretary of Defense Meritorious Civilian Service Medal. DDRE Dr. John S. Foster presents the award.

Harry Fleming Vincent, project director of the Research and Development Directorate at the U.S. Army Missile Command, Redstone Arsenal, Ala., received the Meritorious Award for outstanding contributions to the Army missile program from 1951–65. Maj Gen John G. Zierdt, CG, U.S. Army Missile Command, made the presentation.

In another Missile Command ceremony, General Zierdt presented the Legion of Merit to Col J Mort Loomis Jr., who had retired shortly before the ceremony after 24 years of active Army service. Col Loomis most recently had served as project manager of the Sergeant weapons system.

Capt Heilbron B. Love, Jr., was awarded the Army Commendation Medal in a ceremony at the U.S. Army Materiel Command's Harry Diamond Laboratories, Washington, D.C.

Capt Love was cited for two years of outstanding accomplishment at the Laboratories with the Program and Plans Office. He has been reassigned to Viet Nam after temporary duty at the Ordnance School, Aberdeen Proving Ground, Md.

The Army Commendation Medal also was awarded to Lt Col John M. Reid, assistant secretary of the General Staff, U.S. Army Strategic Communications Command, Washington, D.C.

The veteran Signal Corps officer was cited for outstanding performance of duty during an assignment with STRATCOM in Turkey.

The Joint Service Commendation Medal was presented by Chief of Research and Development Lt Gen William W. Dick, Jr., to three members of the U.S. Army Research Office Staff: Lt Col Louis G. Klinker, Physical Sciences Division; Lt Col Dick R. Markwell, Physical Sciences Division; and Lt Col Charles E. Ramsburg, Social Sciences Research Division.

Ignition Concept Being Tested

A piezoelectric ignition system that enables spark plugs to fire when fouled or wet is being evaluated by the U.S. Army Materiel Command Engineer Research and Development Laboratories, Fort Belvoir, Va.

The extremely rapid voltage rise of the spark produced by the system also decreases erosion of spark plug electrodes, since it requires less energy for ignition than most conventional systems.

A developmental model has been applied experimentally to the 1½-hp. military standard internal combustion engine.

Scientific Calendar

Rubber and Plastics Industries Technical Conference, sponsored by IEEE, Akron, Ohio, Apr. 4–5.

Industry Briefings on ECOM Programs, sponsored by USAECOM and AFCEA, Fort Monmouth, N.J., Apr. 5–6.

2nd Symposium on Marine Bio-Acoustics, sponsored by the U.S. Naval Training Center, N.Y.C., Apr. 6–8.

International Symposium on Animal Toxins, sponsored by Los Angeles County Hospital, AFOSR, Navy and Public Health Service, San Diego, Calif., Apr. 8–11.

Conference on Ground-Based Aeronomic Studies of the Lower Ionosphere, sponsored by AFCRL and DRTE, Ottawa, Canada, Apr. 11–15.

Symposium on the Topic of Generalized Networks, XVI in a Series of International Symposia Organized by PIB, Microwave Research Institute, sponsored by AFOSR, ONR, ARO, SIAM and IEEE, N.Y.C., Apr. 12–14.

4th Quantum Electrical Conference, sponsored by IEEE, Phoenix, Ariz., Apr. 12–15.

Meeting of the American Society of Biological Chemists, Atlantic City, N.J., Apr. 12–16.

Meeting of the Federation of American Society for Experimental Biology, Atlantic City, N.J., Apr. 12–16.

1st National Symposium on Maintenance, sponsored by ISA, Wilmington, Del., Apr. 18–19.

20th Annual Frequency Control Symposium, sponsored by the U.S. Army Electronics Laboratories, Atlantic City, N.J., Apr. 18–20.

37th Annual Scientific Meeting, sponsored by ASMA, Las Vegas, Nev., Apr. 18–21.

ASTME Annual Engineering Conference and Tool Exposition, Detroit, Mich., Apr. 18–22.

Meeting of the American Geophysical Union, Washington, D.C., Apr. 18–22.

Southwestern Conference and Exhibition, sponsored by IEEE, Dallas, Tex., Apr. 20–22.

International Non-Linear Magnetics Conference, Stuttgart, Germany, Apr. 20–22.

Meeting of the American Institute of Chemists, Richmond, Va., Apr. 21–23.

Meeting of the American Society of Mechanical Engineers, Kansas City, Mo., Apr. 24–28.

SAE Aerospace Meeting and Production Forum, N.Y.C., Apr. 25–28.

Spring Joint Computer Conference, sponsored by AFIPS, ACM and IEEE, Boston, Mass., Apr. 26–28.

IEEE Region 6 Annual Conference and Exhibition, Phoenix, Ariz., Apr. 26–28.

NARM 14th Annual National Relay Conference, Stillwater, Okla., Apr. 26–28.

Famed Neurosurgeon Rises to Brigadier General

World-renowned neurosurgeon, Brig Gen George J. Hayes, was promoted to that rank Feb. 3 in ceremonies presided over by Army Surgeon General Leonard D. Heaton.

Pinning on the new stars were Mrs. Hayes and Deputy Secretary of Defense Cyrus R. Vance. Looking on was a group of 100 that included General Frank S. Besson, Jr., CG, U.S. Army Materiel Command, and Adam Yarmolinsky, Deputy Assistant Secretary of Defense for International Security Affairs.

Brig Gen Hayes, chief of Neurosurgery at Walter Reed General Hospital for 11 years, now heads The Surgeon General's Professional Service. He succeeds Brig Gen Frederic J. Hughes, who became CG of William Beaumont General Hospital, El Paso, Tex.

Noted for his signal contributions in the field of neurosurgery at Walter Reed, General Hayes' activities were international in scope. As consultant to The Surgeon General in Neurosurgery, he has been responsible for supervision and staffing of neurosurgery services throughout the entire U.S. Army Medical Service.

General Hayes earned his BS degree from Catholic University in 1940 and received his medical degree and internship at John Hopkins University Medical School. His residency was taken at the Lahey Clinic and Duke University.

He entered military service in 1946 and served with 160th Neurosurgical Detachment and the 46th Surgical Hospital, and headed the Neurosurgical Service at Brooke General Hospital, Texas from 1953 until his assignment to Walter Reed in 1955.

His membership in professional societies and authorship of technical papers has been extensive.

PROMOTION—Army neurosurgeon Brig Gen George J. Hayes received his stars at a Walter Reed Army Medical Center ceremony Feb. 3. Shown, l. to r. are Mrs. Hayes, General Hayes, Cyrus R. Vance, Deputy Secretary of Defense, and Army Surgeon General Lt Gen Leonard D. Heaton.

'Editorial AD 2000' Discusses Polymers for Surgical Repair

By Dr. Fred Leonard

Potentialities of polymers to facilitate surgical repair of an ever-increasing number of serious injuries have prompted Dr. B. McFarland to write, in a 1950 Journal of Bone Surgery article titled "Editorial AD 2000":

"Fortunately, the increase in the frequency of bone fractures has been unimportant because intramedullary fixation with thermostatic hemoplastic agents injected directly into the fracture site, cancellous in their form, setting to the resilience and strength of steel, stimulating callous formation and being resorbed in that process, has permitted weight bearing in nearly every fracture."

The June 1962 edition of *Surgery Gynecology and Obstetrics* published an article by Dr. T. B. Quigley supporting Dr. McFarland's envisioned use of polymers. Dr. Quigley held that the time was ripe for design of an organic substance which would advance bone surgery — provided that "some sort of organized cross-fertilization of prepared minds with adequate facilities for such investigation be developed."

One such facility, comprised of the U.S. Army Medical Biomechanical Research Laboratory (USAMBRL) and the Division of Surgical Research, Walter Reed Army Institute of Research, is operative at the Walter Reed Army Medical Center.

In these units a multidisciplined group of scientists, engineers and surgeons is concerned with the synthesis, design and evaluation of surgical repair polymers and devices which may be utilized in the repair of tissues or organs.

The wide range of mechanical properties available in polymers makes them attractive candidates for surgical applications. However, even though a polymer may possess the desired mechanical properties, there is no assurance that it may be used successfully in the body.

Tissue compatibility is the sine qua non for the long-term utilization of a surgical repair material. Tissue compatibility defines the interaction between the host and the implant: in one instance, by the effect of the tissues and body fluids on the implant, and in the other, by the effect of the implant on the tissues.

Surgical repair polymers may be of two general types: biostable and biodegradable. In the former, the effect of the host on the implant is minimal and the implant is expected to maintain its integrity for a lifetime. In the latter, the implanted polymer is expected to degrade at a desirable rate; products of degradation are eliminated through the normal excretory routes, with none of the products stored in the vital tissues or organs.

What polymers are likely to be stable or unstable in the tissue is dependent upon the structure of the polymer and the nature of the chemical environment in which the polymer is to reside.

A study of the chemical reactions of significance in the organism indicates that the well-known degradation mechanisms for polymer molecules are possible in the biological system, including both hydrolytic and oxidative types.

Nylon, for example, loses up to 50 percent of its tensile strength after a year's implantation, presumably due to hydrolytic scission of the amide linkage. Radioactive entities appear in rats' urine from the subcutaneous implantation of C^{14} tagged polyethylene after approximately 30 days, possibly as a result of oxidative scission of the polyethylene chain.

Several standard methods exist in the polymer chemists armamentarium for slowing down the rate of degradation of implanted polymers. These include the preparation of oriented and/or cross-linked and crystalline polymers, as well as polymers whose chain backbone particularly does not contain labile groups.

Similar criteria, relating to the synthesis of stable high polymeric materials for use in external environments with which the polymer chemist ordinarily deals, may be expected to be applicable to the synthesis of stable polymers for surgical repair materials to be used in the body.

The effect of polymers on the tissues may be divided into two general types. These are local effects surrounding the polymer implant and the more remote or systemic effects. Among the possible local effects of the polymer on the tissues are acute inflammatory responses accompanied by cell and tissue death or injury, exudate formation, vascular response such as redness, as well as more long-term effects such as tumor induction and carcinogenicity.

Among the more remote and systemic polymer effects may be listed antigenicity, hypertension and nephritis, and polymer deposition in various internal organs, resulting in tumors.

The amount of tissue injury and cell necrosis depends on the nature of the irritant. Polymers, such as dacron, silicone, polyethylene and so forth, which are insoluble and "stable" in the body environment elicit minimal response; in general, they show a typically benign foreign body response. A polymer such as methyl alpha cyanoacrylate elicits an inflammatory response and cell necrosis.

(Continued on page 24)

Dr. Fred Leonard has been serving as scientific director of the U.S. Army Medical Biomechanical Research Laboratory, Walter Reed Army Medical Center, since 1961.

He also serves as a plastics consultant to the Committee on Prosthetics R&D and as a representative of The Surgeon General on Government and civilian committees concerned with medical application of materials.

Dr. Leonard received a BS degree from the University of Arkansas (1938), MS (1942) and PhD (1947) from the Polytechnic Institute of Brooklyn. He did post doctorate work at Princeton University from 1946–48.

Joining the U.S. Army Prosthetics Research Laboratory in 1948 as chief of the Resin Section, Dr. Leonard was promoted to chief of the Plastics Development Branch, where he served until his present assignment.

He received the Meritorious Civilian Service Award in 1963 for directing research in materials suitable for a variety of internal body uses, such as vascular prosthesis, and smooth-surfaced porous laminates which have greatly enhanced the comfort of prosthetic devices.

Other awards received by Dr. Leonard are the Superior Accomplishment Award (1954) Outstanding Performance (1956–57), Meritorious Civilian Service, and an award for patent submission (1962). He also has published over 40 articles in the field of materials and devices for biomechanical applications.

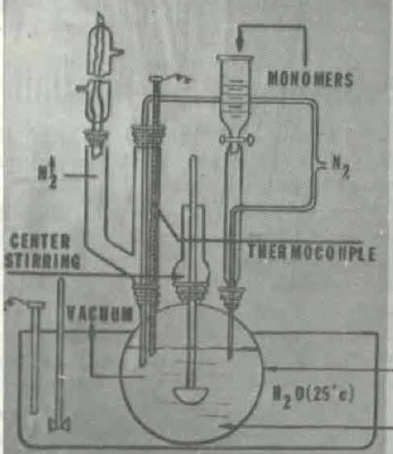
Dr. Fred Leonard

MATERIALS FOR BIOMECHANICAL USE

VASCULAR PROSTHESES

CHEMISTRY

LATEX MANUFACTURE



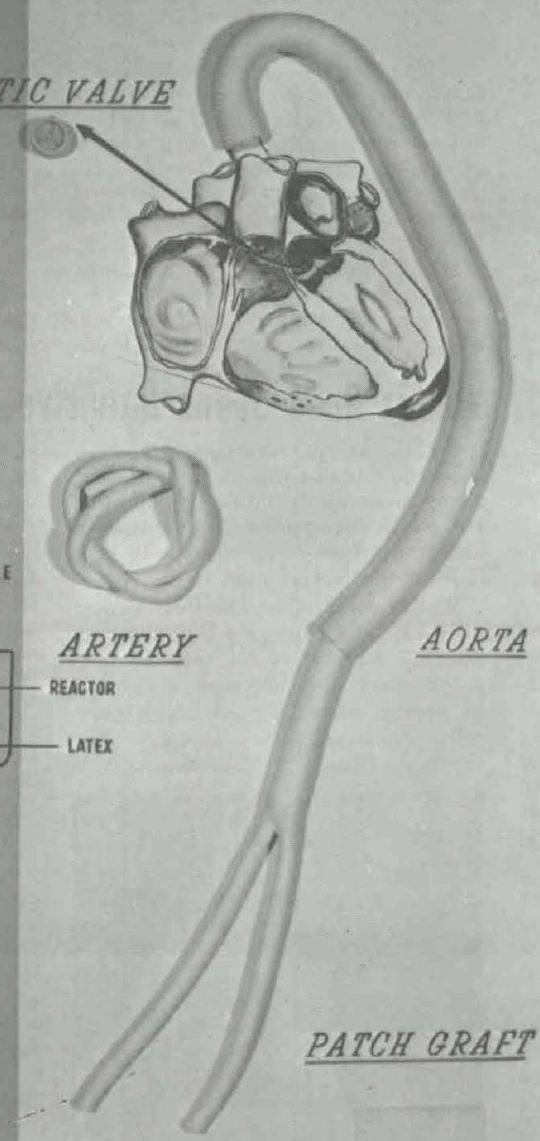
POLYMERIZATION INGREDIENTS

H_2O DEMINERALIZED	155 pts.
SANTOMERSE "SX" (or equal)	2.5 pts.
POTASSIUM CHLORIDE	0.344 pts.
MONOMERS: Butyl Acrylate	90. pts.
Methyl Methacrylate	7.5 pts.
Methacrylamide	2.5 pts.
POTASSIUM PERSULFATE	.04 pts.
SODIUM THIOSULFATE	.04 pts.
SULFURIC ACID	10 MLS. 10%

POLYMERIZATION PROCEDURE

1. CREATE A VACUUM
2. FLUSH N2 THROUGH
3. ADD H_2O (Demineralized) DETERGENT (Santomerse SX) AND POTASSIUM CHLORIDE
4. ADD MONOMERS POTASSIUM PERSULFATE, SODIUM THIOSULFATE AND SULFURIC ACID
5. MAINTAIN CONSTANT TEMPERATURE, 25 c

SURGERY



ENGINEERING

PROSTHESIS FABRICATION

LATEX COMPOUNDING INGREDIENTS	PARTS
ACRYLATE AMIDE LATEX (35-40% SOLIDS)	100
ROHM & HAAS Mc 387 (or equal)	
POLYETHYLMETHACRYLATE (37% SOLIDS)	37
FORMALDEHYDE (37% SOLIDS)	1.765

FOAM COMPOUNDING INGREDIENTS

ACRYLATE-AMIDE LATEX 200.g.

AMMONIUM HYDROXIDE 1-3cc

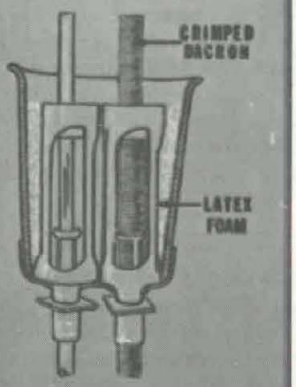
SODIUM POLYACRYLATE SOLUTION 6-9cc

1-N CITRIC ACID 4-8cc — Mixed together and stirred into latex — pH-5.

SANTOMERSE "SX" 1.9 cc

WHIPPED TO FOAM DENSITY DESIRED, THEN ADD SODIUM FLUOSILICATE DISPERSION (50%) 2g. SANTOMERSE "SX" 0.25g.

APPARATUS FOR COATING CRIMPED DACRON TUBING WITH LATEX



INTERACTIONS BETWEEN DISCIPLINES necessary for development of surgical repair materials is illustrated above. Shown at the left of the photo is chemical manufacture; on the right, engineering design and fabrication; and in the center, artificial parts for use in the vascular system including a prosthetic valve for the aorta.

'Editorial' Discusses Polymers for Surgical Repair

(*Continued from page 22*)

Cell injury or death may lead, in turn, to the release and degradation of materials normally contained in cells. These substances then may produce effects on local tissue structure and when absorbed into the blood stream may affect distant organs (the domino theory of polymer implants).

Tumor formation from polymers is the result of long-term residence in the biological environment and may result from polymers which seem to be quite stable in the body. A considerable amount of literature has been produced in this area of research.

Present indications, as a result of studies in a particular type of rat, are that all polymers (or other materials) when implanted in film form elicit malignant tumors whereas polymers of the same molecular structure in powder, textile, or porous form do not.

The concept has arisen that nonporous films cast a "metabolic shadow" which interferes with cellular extracellular exchanges leading to faulty metabolism. To date, however, tumor induction by polymer has been limited to rats, mice and hamsters, and has not been reported for dogs or primates.

What are the parameters involved in preparing tissue compatible materials? What is the relationship between polymer structure and tissue receptivity? What is the effect of the physical and chemical properties of the polymer surfaces and of physical form? What biological end points does one utilize to determine the biological receptivity of a material?

The answers to these questions are not known with certainty at the present time and one cannot predict, a priori, whether a given polymer will be compatible. Each polymeric material considered for a specific application must be tested empirically and, if possible, under conditions of intended use first in laboratory animals and, if salutory results are obtained, eventually in humans.

The Walter Reed Army Medical Center Surgical Repair Polymer Program currently includes investigations in a number of the most promising areas as determined by research in recent years. The program includes work on tissue adhesives, biodegradable polymers, bile ducts, synthetic cartilage, and polymer evaluation.

Tissue Adhesives. The capability of rapidly polymerizing alpha cyanoacrylates to adhere firmly to moist surfaces has evolved considerable medical interest in their potentialities as hemostatic agents and tissue adhesives for closure of wounds in place of, or as adjuncts to, conventional surgical sutures. Requirements for a tissue adhesive are:

- Ability to polymerize rapidly and to effect a bond between relatively wet surfaces.
- Biodegradability, so that the adhesive may be applied as a continuous film for the formation of a seal of optimum strength and then slowly disappear from the site of application, not serve as a barrier to healing, and eventually be replaced by the body's own contiguous tissue.

Medical evaluation of methyl alpha cyanoacrylate has revealed:

- That the adhesive monomer can adhere to tissues of a variety of types and after a time healing occurs at the bonded site.
- Monomer and polymer both are histotoxic and elicit acute inflammatory response.
- The polymer disappears after a time from its initial point of application, indicating that biodegradation was occurring.

Studies were undertaken at USAMBRL to determine the nature of the degradation and the products that were produced. The data indicated that in the presence of distilled water alone, in vitro, polymethyl alpha cyanoacrylate underwent disastrous chain scission, producing formaldehyde, which was positively identified by derivative formation, and ultimately a cyanoacetate, both toxic substances.

In order to elucidate structure-tissue reactivity relationships and ultimately develop a less necrotizing adhesive for use in wound closure, the

Walter Reed Opens Intensive Shock Treatment Unit

Treatment of deadly refractory shock now is possible at Walter Reed Army General Hospital, Washington, D.C., with the opening of an Intensive Treatment Unit—the only one in U.S. military or Government use.

Walter Reed Army Medical Center (WRAMC) officials said that the purpose of the unit is for treatment of shock which does not readily respond to normal attention. Although mortality from refractory shock is "exceedingly high," it is known that if patients can be sustained through it, they may be able to live long and useful lives.

DELICATE NERVE CENTER of Walter Reed's new Intensive Treatment Unit is this 8-channel recorder. The recorder registers arterial blood pressure and that in the large veins near the heart, other pressures and various temperatures. Operator is Capt Jack Herrington, MC, officer in charge of the unit. Capt Marlene Burns is the simulated patient.

The Intensive Treatment Unit will be open 24 hours a day. Special studies will enable doctors, nurses and technicians to determine the exact needs of seriously ill patients. Abnormal shock from any cause will be treated in the unit with emphasis on trauma caused by enemy action.

Without special equipment and skills the exact blood volume required in shock cases is difficult to determine. Too much blood, or too little, may make the difference between life and death.

In addition to equipment which controls the flow of blood, other devices in the new unit enable the staff to correct various defects in the patient's blood composition. Computers at the unit and at the Walter Reed Army Institute of Research speed the necessary information.

Among the medical innovations at the Intensive Treatment Unit are:

- A portable image intensifier enabling immediate fluoroscopy of a patient in a lighted room without shielding equipment;
- A special bed area at the Institute of Research which permits the staff to perform various diagnostic and treatment procedures without moving the patient;
- A special laboratory is an integral part of the unit; it enables specialists to obtain accurate information that is not available from any other laboratory.

synthesis and medical evaluation of the homologous series of alpha cyanoacrylates were undertaken. It was postualated that the higher homologues would degrade at a slower rate because of their more hydrophobic nature.

Results of the studies to date indicate that as the homologous series is ascended, the greater is the tissue tolerance to monomers and polymers. Concomitantly, it has been demonstrated, in accordance with prediction, that as the homologous series is ascended, the rate of degradation decreases.

The butyl derivative seems to be well tolerated and it is being actively applied in animals for wound closure in the oral cavity and in internal organs, particularly in surgically injured livers and intestines. Application as a burn dressing is under study.

Attempts to induce hemostasis with this series of compounds indicate that it is possible to stop capillary and venous bleeding. The results obtained in the case of arterial bleeding are equivocal.

Biodegradable Polymers. USAMBRL is carrying out the synthesis of biodegradable polymers such as L(+) polylactic acid for use in preparing composite artificial arteries and burn dressings. To date, the polymer has been prepared both in radioactive form C^{14} tagged, as well as in nonradioactive form.

The rates of degradation *in vivo* have been studied by implantation of radioactive polymers in rats and measuring the disappearance of radioactivity. Histological studies have indicated that the polymer and its degradation products are well tolerated. In addition, poly L(+) polylactic acid fibers have been made.

Bile Ducts. Salutary results have been achieved with artificial bile ducts prepared from the laboratory's synthetic terpolymer. The terpolymer, a biostable polymer of butyl acrylate methyl methacrylate and methacrylamide, may be reinforced and vulcanized. The polymer satisfies the following criteria for stability: chemically saturated, vulcanizable, and lack of labile groups in the chain backbone.

Stress strain curves of samples of this polymer measured after six months of implantation in dogs were coincident with stress strain curves before implantation. Organic reinforcing agents in polymeric materials can produce a variety of mechanical properties, from stiff and rigid to soft and elastomeric, making use possible in many internal body applications.

Synthetic Cartilage. Efforts are being made to synthesize hydrophillic polymers whose frictional characteristics and mechanical properties simulate that of cartilage for use in replacing diseased cartilage. In this work, polymers prepared from glycol methacrylates are being investigated.

Polymer Evaluation. A program in basic research in pathology is under way to develop quantitative biological endpoints to attempt to delineate the relationship between polymer structure and tissue receptivity, in order to enable the prediction of and structure design of surgical repair polymers of long-term utility.

SUMMARY. Advances in synthetic polymer chemistry have resulted in the production of organic polymers which may have great potential in the repair of damaged tissues or organs. Research in the field of surgical repair polymers is comparatively new and as yet polymer structure-tissue compatibility relationships and quantitative biological testing techniques have not been clearly delineated. It is not possible now to predict, a priori, whether a polymer will be biologically compatible. Each material must be tested empirically.

At Walter Reed Army Medical Center, an interdisciplinary group is engaged in the synthesis, characterization and evaluation of polymers in specific surgical repair applications of important military value as well as in more basic studies designed to elucidate structure activity relationships and to quantitate evaluation techniques. It is hoped through this research to evolve knowledge which will make possible the tailoring of surgical repair polymers of long-term utility.

ERDL Wins 2 Safety Awards

Recognition for the exceptional safety record of the U.S. Army Mobility Equipment Center's Engineer Research and Development Laboratories (ERDL), Fort Belvoir, Va., came in two recent awards.

Brig Gen Thomas B. Simpson, CG, U.S. Army Mobility Equipment Center, St. Louis, Mo., presented the Army Materiel Command Award of Merit for safety to Col Frank Milner, ERDL commander, for calendar year 1965.

The Laboratories also received their second consecutive Award of Merit for "meritorious safety performance" from the National Safety Council. With 1,500 employed in research, development and engineering, the ERDL lost-time injury rate was only 2.07 per million man-hours, despite the amount of hazardous work involved in some areas.

'Keeper of Keys' Walden Controls 18,461 at Redstone

When it comes to having the keys to a weighty problem, the "Keeper of the Keys" at U.S. Army Missile Command Headquarters, Redstone (Ala.) Arsenal, can consider himself without a peer—the man who can turn up 18,461 keys to a $300 million complex.

Billy Walden is only 21 years old but he has held his job as custodian of the keys for two years. From gate guard to commanding general of the Arsenal, no one gets a key without giving Billy his autograph. Billy likes his job because it enables him "to meet the nicest people."

Among the 18,461 keys for which he is responsible, the "patriarch" is the great, great grandmaster key which can open any lock at the Arsenal. This key rests in a most secure steel safe. Its only counterpart is in guarded emergency-only custody of Redstone's duty officer.

Next in line are the great grandmaster, the grandmaster and the master keys—each with successively lesser door-opening powers—and then there are the plain ordinary keys.

Filed in cabinets at Billy's office in the Provost Marshal's building are 14,330 keys; another 4,128 keys are issued to workers, each one signed out to custody of the bearer. A lost key means a changed lock and a new set of keys for it, an expense everyone is urged to avoid through security precautions.

Billy Walden

Optimal Use of Personnel Resources

By Cecil D. Johnson

The technology necessary to achieve optimum use of personnel in a large system includes at least three disciplines: computer science, psychological tests and measurement, and a specialized quantitative methodology which spans psychometrics and operations research.

The necessity for utilizing large, fast, friendly computers and effective predictor variables is acknowledged, but will not be discussed in this review.

The reader is referred to a review by Dr. Julius E. *Uhlaner* in the November 1961 *Army Information Digest*, titled, "Selecting and Utilizing the Right Soldier for the Job"; a second more specific review. "Criteria for Human Performance Research," by Uhlaner and Arthur J. Drucker in the March 1965 issue of *Human Factors;* and to the February, "Research in Review" article by Dr. Samuel H. King in the *Army Research and Development Newsmagazine*, all of which relate to selection instruments.

A worker in the area of optimizing personnel usage relies heavily on linear programing and factor analytic techniques in investigating policies and procedures of selection, training, promotion and reassignment, all elements of the personnel subsystem.

Personnel policies are frequently evaluated for their effects on the average job performance of all personnel in the system. For systems which contain an optimal assignment feature, this criterion of overall performance can be considered in terms of the maximized objective function (criterion of goodness; maximizing average performance of all individuals assigned) of a linear programming model.

Some of the techniques to be discussed here have been developed specifically for optimizing personnel systems, but may be equally useful for the optimal allocation of resources other than personnel, particularly where one or more of the following characteristics are present:

1. Entities are assigned individually (i.e., there are no interchangeable units).

2. Performance criteria scores are predicted rather than obtained by direct measurement.

3. Predictors to be substituted for cost or performance measures in a linear programing model are selected from a larger set of variables.

4. Performance criteria vary qualitatively across the different destinations, and common metrics are difficult to acquire.

Assignment Algorithms. Personnel assignment models are useful both for optimizing assignments operationally and for determining the effects of alternative policies on performance in a system in which optimal assignment policies have already been adopted. The best known personnel assignment procedure is a simplified transportation model. The transportation model classically provides a shipping pattern for minimizing the cost of shipping one or more entities from each source to meet the requirement of a specified number of entities to be delivered at each destination.

The personnel assignment model, however, treats each individual as a separate source and seeks to make assignments so as to maximize performance over the selected destinations or jobs. Requiring a specified number to be delivered at each destination provides constraints that prevent the problem from being trivial.

Computer programs for the transportation model have, with slight modification, been applied to the personnel assignment problem. All rapid solutions require that the entire data matrix be contained in core memory at one time. Since this matrix has dimensions of 5,000 by 150 for the important Army problem of initially assigning enlisted men, more efficient algorithms designed explicitly for the problem are still being sought.

One possible way to surmount this size problem is to section the total personnel pool to be allocated into smaller groups and then to optimize assignments within each group. Simulation studies done at USAPRO indicate that careful random sectioning of pools into groups as small as 150 results in a trivial reduction of the objective function.

A distinctly different approach to allocation is provided by optimal regions algorithms. The transportation model first finds a feasible solution in which all quotas are met. It then moves from one feasible solution to another until the solution which is both feasible and optimal is located.

In contrast, the optimal regions method, proceeds through successive optimal solutions seeking one which is also feasible (i.e., all quotas met). In each intermediate solution every man is assigned to his highest adjusted performance score. The adjustments consist of the addition of a constant to all performance scores for a particular job. The resulting assignment pattern remains optimal.

In theory, if the correct constants are added to each column of performance scores, the assignment of each entity to its highest score will maximize the objective function. The trick is to find the right set of column constants.

Dwyer proposed a method which involves the use of row constants and the separate rank ordering of performance scores for each job after each trial assignment (i.e., after each man is assigned to his highest adjusted score). The column constant for the next iteration is the adjusted score which cuts off, from a rank-ordered continuum, the right number of entities to meet the job quotas.

The real value of the optimal regions model lies in its suitability for use in a decentralized assignment system, as when a recruiter must be able

---

Cecil D. Johnson has been chief of the Statistical Research and Analysis Laboratory of the U.S. Army Personnel Research Office (USAPRO) since 1959. The Laboratory provides consultative, computing, and data processing support for USAPRO research. Within the Laboratory, the Manpower Information and Computerized Systems Research Task uses simulation and model sampling approaches in research to provide solutions for manpower management problems.

Graduated with a BA degree in 1948 from Kansas City University and an MA in 1951 from the George Washington University, both in psychology, he has completed graduate work in psychology and mathematical statistics. In USAPRO he has served as task leader. New Classification Techniques Task (1956-1958), as chief of the Leadership and Personality Research Unit (1956), and currently is the Deputy Chief of Staff (Personnel) representative on the Army Mathematics Steering Committee. During most of 1945 and 1946, he served in China as a Naval Communications Officer in the Sino-American Cooperative Organization.

Cecil D. Johnson

to advise a potential recruit about his eventual assignment. The recruiter would add the appropriate constants, and then make the appropriate occupational assignments on the basis of the highest adjusted performance estimate.

Optimal Weighting. Brogden has shown that the best weights to apply to a set of predictor variables for predicting performance criterion are those weights which separately maximize the prediction of each criterion variable. No other weights will provide composite scores which, when substituted for the criterion scores, can yield a greater objective function in the personnel assignment model.

If the standard deviation of predictions is set to be the product of the multiple correlation coefficient times the standard deviation of the actual performance variables, Brogden has established that from using these predictions in an unbiased estimate of the objective function value which would have been obtained if the actual performance scores had been available.

Predicted performance scores thus can be used instead of the actual criterion scores for evaluating the effects of various policy changes on performance in a personnel subsystem which utilizes an optimal assignment policy.

The above method of computing the "best" weights applies only when the complete set of predictor variables is utilized. Other methods must be used when a researcher wants to use the best subset of predictor variables to accomplish optimal assignment of personnel.

That is true also if he wishes to determine the most differential factors or dimensions in the joint predictor-criterion space to cluster tasks into jobs or jobs into occupations, or to define qualitative manpower requirements.

Factor analytic approaches can be used to solve these kinds of problems.

A procedure which provides a square-root-factor analysis of selected predictor variables, and by extension, the correlation between factors and criterion variables, can also be used to identify "best" predictors. In the following paragraphs, two different definitions of "best" will be considered and a corresponding method described.

The absolute method considers the prediction of each criterion separately and attempts to maximize the average level of prediction. The predictor with the largest sum of squared validity coefficients (i.e., the correlations between predictors and performance criteria) is selected first.

The validities of the orthogonal components of the remaining predictor variables are then surveyed and the variable (i.e., component) yielding the largest increment of explained variance (i.e., largest sum of squared validity coefficients) is next selected.

The selected predictor variables which have the effects of all previously selected variables partialled out are orthogonal components called factors.

A different definition of "best" led Horst to develop a method which chooses predictors, one at a time, so as to maximize the relationship between the selected predictors and the differences among the criterion performance scores. It can be shown that this method is algebraically equivalent to a method which, like the absolute prediction model, provides a square root factorization of the experimental tests extended to the criterion variables.

The absolute and differential methods differ with regard to the basis for selecting a test for defining the next orthogonal component or factor. In the absolute method, the sum of squares of the component-criterion correlation coefficients are maximized; in the Horst differential method, the variance of these coefficients is maximized for each new component (i.e., factor added).

The comparison of these two test selection methods, along with the research method used to make the evaluation, will be discussed in a later paragraph.

In other studies, where there is no requirement to select a smaller number of pertinent prediction variables, the full number of variables on which criterion information is available can be utilized to define factors. As before, the matrix of correlation coefficients among predictor variables would be obtained and the solution extended to the criterion variables.

In USAPRO, the initial solution would be a principal components solution with each factor being a linear function of the total set of predictor variables, and each factor successively maximizing the sums of squares of the correlations between the predictors and the component or factor.

The extended solution would provide correlations between the criterion variables and the same linear function or factor. The initial and extended solutions could be transformed by an orthogonal matrix to provide a comparable solution which has the property that the sums of squares of correlations between the criteria and factors are successively maximized.

The first few factors that provide the maximum explanation of the criterion (job) space in terms of the predictor-defined factors would then be selected. This approach corresponds to the absolute prediction method described above, except that factors are defined in terms of all predictors instead of the orthogonal component of a single variable.

A different orthogonal transformation matrix could be used to transform the initial and extended solution in a manner analogous to the Horst Differential Prediction Method. The variance of the factor coefficients around the mean column values in the extended solution could be maximized. Again, some number of successively best (i.e., most differential) factors could be selected for further analysis.

By these two methods, jobs or tasks can be located in terms of the fewest number of either absolute or differential dimension that can be related to skills, aptitudes, or other predictors of performance.

The extended factors can be further rotated to make them more clearly interpretible from a content point of view without destroying the parsimony of description achieved by the earlier operations.

Model Sampling. Model sampling can provide a means of studying the effect of various system parameter changes on overall performance where the performance of each individual has been maximized by optimal assignment procedures. The numerous predictor variable characteristics related to precision of measurement are usually constrained by such cost considerations as test administration time, scoring difficulties, or administrative and investigative requirements.

A simple example of a model sampling study is the comparison of the Horst differential prediction and absolute prediction methods for selecting the best set of predictor variables.

For this USAPRO study, empirical data on 32 predictors used to predict 12 different jobs was already available. All coefficients were corrected to an input population base, and the best 5, 10, and 20 tests, respectively, were selected by both methods.

Random numbers were generated and appropriate linear transformation matrices used to provide two sets of interdependent data (interdependent to the extent that they were both transformed from the same set of random numbers). The transformed data were, in effect, random samples from multivariate normal universes, with one set having the predictions covariance matrix of variables se-

(Continued on page 28)

Optimal Use of Personnel Resources

(Continued from page 27)

lected by the "absolute" method, and the other having the predictions covariance matrix of the variables selected by the differential method.

Optimal assignments were determined separately on the two sets (using a Hungarian transportation model), and the average performance which would have resulted from each set of assignments was obtained from treating the prediction scores based on all 32 predictors as if they were the criterion measures of performance.

This study indicated that a considerable gain in performance can be expected when tests used for optimal assignment are selected by a method which gives consideration to this eventual use of the measures, an analytical proof of this superiority is not available.

Summary: The differences among people with respect to a number of relatively independent performance-related dimensions must be considered in designing a personnel subsystem. Methodology required to study effects of alternative personnel policies and procedures on overall performance cuts across boundaries of psychometrics and operations research.

Super Battery for Laser Rivals Energy in Dynamite

Energy approaching that of detonating dynamite will be produced by a new super battery being built for the Army Missile Command, Redstone Arsenal, Ala., to provide power for Laser light beams.

Since Lasers (light amplification stimulated emission of radiation) require tremendous amounts of electricity in short bursts, MICOM scientists now face the problem of devising a special split-second on-off switch before the battery's surge of high voltage can be used for tests.

The 25-million-watt rechargeable nickel cadmium battery, about the size of a telephone booth, will replace the huge banks of costly capacitors and related circuits now being used. The battery will be connected directly to the flash lamp which energizes the Laser.

Called "the most powerful battery in the world," the relatively compact unit will be capable of an extended series of 5,000 ampere pulses at 5,000 volts. Although the battery will contain several thousand pounds of active electrode, it will be broken down into smaller, more easily handled modules of several hundred plates.

Pound for pound, MICOM researchers say, the new battery will closely approach dynamite in the amount of electro-chemical energy it can produce. One pound of dynamite gives off about 2-million joules of energy.

The voltage generated by the battery would be capable of lighting one-half million fluorescent lamps simultaneously.

The battery contract has been awarded by MICOM to Gulton Industries, Inc., of Metuchen, N.J. Delivery is expected this year.

Vance Appoints 6 New Members to Advisory Council

Appointment of six new members to the Defense Industry Advisory Council (DIAC) was announced recently by Deputy Secretary of Defense Cyrus R. Vance.

Established in May 1962, the Council provides an important forum for discussions between the Secretary of Defense and his principal assistants and leaders of industry.

The new members are: Fred J. Borch, president, General Electric Co., New York, N.Y.; Kermit Gordon, vice president, Brookings Institution, Washington, D.C.; Daniel J. Haughton, president, Lockheed Aircraft Corp., Burbank, Calif.;

Donald A. Holden, president, Newport News Shipbuilding and Dry Dock Co., Newport News, Va.; Roger Lewis, president, General Dynamics Corp., New York, N.Y.; Noel B. McLean, chairman of the board, EDO Corp., College Point, N.Y.

DIAC members who retired are: Eldon D. Carter, consultant, Glen Burnie, Md.; Charles E. Hastings, president, Hastings-Raydist, Inc.; Hampton, Va.; J. Ed Warren, president, Cities Service Co., New York, N.Y.; Maj Gen James McCormack, USAF (Retired), chairman of the board and chief executive officer, COMSAT Corp., Washington, D.C.

The Council also has a new executive secretary, Clyde Bothmer, who succeeds Samuel W. Crosby. Bothmer, formerly director of the National Aeronautics and Space Administration's Office of Industry Affairs in the Pentagon, has devoted nearly all of his career to Government service.

He holds a BA degree in political science and JD degree in law from the University of Iowa. During the past 14 years, he has served in a series of procurement and logistics management positions with the Air Force, as director of Small Business for the Department of Defense and as director of Management for Manned Space Flight with NASA.

ECOM Names Stangwilo to Head Computer Agency

Zeno Stangwilo, who has risen rapidly in automatic data processing and was one of those who helped develop Army's ADP policy, is now chief of the Army Electronics Command Computation Agency, Fort Monmouth, N.J.

The ECOM agency, with an authorized strength of 466 persons, is responsible for the command's integrated data systems program which includes development of the ADP and electric accounting machine systems.

Zeno Stangwilo

Stangwilo began his ADP career in 1955 with the old Army Chemical Corps at Edgewood Arsenal, Md. He later joined the Data Processing Center at Edgewood and in 1960 went to France as ADP systems analyst with the Army Chemical Supply Control Agency. He was cited for his part in automating much of the agency's workload.

He became chief of ADP programing at Edgewood and in 1964 joined the Office of the Chief of Staff with the special assistant for Army Information Data Systems (AIDS). It was in this latter position that Stangwilo became involved in Army data processing policy.

At Johns Hopkins University, from which he graduated with honors in 1960, Stangwilo won the coveted Wall Street Journal student achievement award and the Delta Sigma Pi scholarship key. He served as an Army bombardier-navigator during World War II and afterward as a U.S. civilian military government officer with occupation troops in Germany.

Engineers Enter Nike-X Power Sources Test Phase

By Perry F. Wendell

Prime power sources development for the Nike-X missile defense system has progressed to the testing phase for "first generation" power plant concepts.

Based on preliminary studies performed in the Office Chief of Engineers (OCE) and by an Advisory Board appointed by the National Academy of Sciences, work was initiated by the Corps early in 1962.

Since then the program has evolved to include major development efforts in energy conversion systems, cooling systems, air handling systems, nuclear electromagnetic pulse effects, reliability, maintainability and performance data analysis.

Current proposed deployment configurations require several sizes of power plants ranging from about 3 to 70 megawatts of installed capacity. In each instance extremely precise power must be provided under severe environmental and load transients with a high degree of reliability.

First generation power plant concepts are based primarily on the ability to accurately determine limiting features and performance of state-of-the-art equipment, plus new approaches to protection from the nuclear weapons environment. Long-range development of new equipment may be expected to provide improved performance and economics for later generation facilities.

Significant advances are being made in blast attenuation concepts and in several areas that will have application to any large electrical-mechanical systems where precise and reliable operation is essential. These areas include nuclear electromagnetic pulse effects and protection, system modeling techniques and reliability analysis.

Performance and repair data on power plant equipment are being collected and analyzed to provide reliability and maintenance information, and as a basis for product improvement.

Extensive use is being made of mathematical modeling techniques for dynamic system analysis and to identify critical performance parameters requiring verification by component and subsystem testing.

The Advanced Technology Branch in the Military Construction Directorate of OCE is managing the program. The Branch has the advice and assistance of the Advisory Board on Hardened Electric Power Systems established by the National Academy of Sciences for this purpose.

Prime power development is part of the overall Nike-X project manager. Funding for this work through FY 66 has totaled about $9,300,000.

A number of contractors and Government elements have been utilized by the Corps. These include the Engineer Research and Development Laboratories, Omaha Engineer District, Arthur D, Little, Inc., Barnes and Reinecke, Inc., Bechtel Corp., Black and Veatch, Booz-Allen Applied Research, Inc., General Electric Corp., Illinois Institute of Technology Research Institute, and Stone and Webster.

Mr. Wendell is chief, Advanced Technology Branch, Engineering Division, Directorate of Military Construction, Office of the Chief of Engineers.

Fort Knox Armor Board Acquires New Name

The U.S. Army Armor and Engineer Board is a name that more closely describes the mission of the former Armor Board at Fort Knox, Ky.

Established in 1938 as the Mechanized Cavalry Board, the organization is assigned responsibility for service testing items of armored and engineer equipment. It consists of approximately 450 military personnel and 90 civilians.

The Board is an element of the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

In addition to the extensive testing facilities located at Fort Knox, the Board also makes use of other installations and activities in the Test and Evaluation Command structure.

Personnel often participate in or monitor tests conducted at Aberdeen Proving Ground; Yuma Proving Ground, Ariz.; the Arctic Test Center, Fort Greely, Alaska; and the Tropic Test Center, Panama Canal Zone.

As a result of service tests conducted by the Armor and Engineer Board and five other similar service test boards, it is determined if a new or modified item of equipment is compatible with the soldier in the field and if it fulfills his requirements.

Based on recommendation of these boards, the tested item is either accepted by the Army for inclusion in its inventory or is returned for further development.

Lt Col Waterman Succeeds Small As Kwajalein Site Exec Officer

Lt Col Joe G. Waterman, former Army Air Defense Command liaison officer at Redstone Arsenal, Ala., has arrived on Kwajalein Island to become executive officer of the Nike-X Project's Kwajalein Test Site.

He succeeds Lt Col M. J. Small, who will become commander of a Nike Hercules battalion at Fort Lawton, Wash. Col Waterman left Redstone last September to attend the Associate Course of the Command and General Staff College at Fort Leavenworth, Kans.

New endurance and payload records have been established at White Sands (N. Mex.) Missile Range by beefed-up Firebee jet target drones. (Shown at right.)

Two 500-pound external fuel pods plus the JATO (jet-assisted-take-off) bottle gave one Firebee a total weight of 3,841 pounds. With the added 1,000 pounds, the remote-controlled drone attained an altitude of 42,500 feet for 45 minutes. It was recovered by parachute.

Another Firebee set an all-time flight-endurance mark of 115 minutes, three minutes longer than a predecessor which was launched at White Sands to evaluate a digital control system. It was in powered flight for 112 minutes and 50 seconds, then glided for 2:40 minutes after fuel exhaustion.

Firebees are built for military target use by Ryan Aeronautical Co., San Diego, Calif.

U.S. Army Reliability, Maintainability Program

By Lt Col Gerald E. Ledford

Reliability (R) and its inseparable partner in military materiel concepts, Maintainability (M), are not among the newer popular terms in the lexicon of U.S. Army research and development terminology. But they are, based upon the mounting emphasis of the past decade, among the most important.

The purpose of this article, therefore, is to provide a synoptic picture of the current status of the overall Army Reliability and Maintainability Program, and the responsibilities of the Office of the Chief of Research and Development for the program.

Recognition of the tremendous and steadily mounting cost involved in the repair, maintenance and down-time of expensive and increasingly sophisticated equipment accounts in part for the current emphasis on the R&M Program. Both *R* and *M* play important roles in Materiel Readiness, which has been demanding progressive attention within the Army.

R and *M* are objectively fundamental characteristics of Army materiel and equipment. *R* is usually defined as the probability that materiel will perform its intended function for a specified period of time under stated conditions. *M* is usually defined as the probability that an item will conform to specified conditions within a given period of time when maintenance is performed in accordance with prescribed procedures and resources.

The layman will probably have more intuitive, qualitative definitions, such as: Materiel which breaks down infrequently has high Reliability; Materiel which can be rapidly restored to operation when a breakdown has occurred has high Maintainability.

BACKGROUND. Concern for the reliability of electronic equipments within the Defense Establishment led to the appointment of the Advisory Group on Reliability of Electronic Equipment (AGREE), as an agency of The Committee of Electronics of the Research and Development Board in 1952. Later it became an agency of other offices within the Office of the Secretary of Defense.

AGREE's purpose was to monitor and stimulate interest in reliability matters and recommend measures which would result in more reliable electronics equipment.

In late 1955, it appeared that sufficient knowledge was available, and sufficient interest aroused, for specific steps to be taken towards quantifying electronic reliability requirements and toward developing suitable tests to verify that such requirements were met.

Consequently, a program of nine tasks in the areas of numerical reliability requirements, tests, design procedures, components, procurement, packaging and transportation, storage, and operation and maintenance was established.

An ad hoc group from the Military Departments and industry was assigned to each of the tasks in January and February 1956. A document consolidating the findings of all of the nine task groups was issued on June 4, 1957, by the Office of the Assistant Secretary of Defense (Research and Engineering), the forerunner of the present Office of the Director of Defense Research and Engineering. The Ordnance Corps and the Signal Corps furnished the bulk of the Army representatives in the task groups.

This Report of the AGREE marked the beginning of a continuing effort by the DoD to advance the state-of-the-art of reliability while at the same time applying known scientific and empirical techniques recognized as adequate within the scientific community.

As a result of the AGREE philosophy and recommendations, MIL–STD–756 Reliability Prediction, MIL–HDBK–217 Reliability Stress and Failure Rate Data for Electronic Equipment, and MIL–STD–781 Test Levels and Accept/Reject Criteria for Reliability of Nonexpendable Electronic Equipment, were published.

OCRD RESPONSIBILITIES. The Office of the Chief of Research and Development has maintained continuing contact with the developments and ongoing efforts in the fields of reliability and maintainability through liaison with DoD and other Government agencies, private industry, Army General Staff and other Army agencies and commands. This liaison permits an exchange of information, awareness of current developments, and assists in the management of *R/M* study projects and working groups.

The OCRD exercises Army General Staff supervision over the Army *R* and *M* Program, and is responsible for the Army Regulations which state Army policy in regards to incorporation of *R* and *M* in materiel and equipment. AR 705–25, Reliability Program for Materiel and Equipment, and AR 705–26, Maintainability Program for Materiel and Equipment, were published Jan. 8, 1963 and Apr. 10, 1963, respectively.

These regulations prescribe specific policies and responsibilities of the General Staff and specific Army commands and agencies considered essential to assure the specification and development of materiel and equipment of known and required *R/M*.

Prescribed in those regulations are how required *R/M* characteristics are to be described in requirements documents, *R/M* information to be in-

---

Lt Col Gerald E. Ledford joined the Office of the Chief of Research and Development (OCRD) in July 1964. Assigned to the Management Analysis Branch, he is serving as OCRD action officer for review of reliability and maintainability in development programs. He has a BME degree from Georgia Tech and MBA degree from the University of Chicago. His military schooling includes the Ordnance Officer's Advanced Course, the Defense Weapons Systems Management Course and the Army Command and General Staff College.

Military experience: Commanding officer, 161st Ordnance Bomb Disposal Unit (1944–45); officer-in-charge (OIC), Guidance and Control Laboratory, Ordnance R&D Sub-office (Rockets), Fort Bliss, Tex. (1948–50); organized industrial activities for guided missiles at Redstone (Ala.) Arsenal (1950) as Chief, National Procurement Division.

In 1954 he was appointed OIC and contract officer representative to establish assembly of Nike missiles at the Charlotte Ordnance Missile Plant. He returned to Redstone in January 1956 during establishment of the Army Ballistic Missile Agency. From 1959–62 he was assigned to the Ordnance Section, Hq., Seventh U.S. Army, as Ordnance supply officer and the assistant materiel officer.

Lt Col G. E. Ledford

cluded in planning documents by the developing agency or command, *R/M* data files to be maintained, and how *R/M* are to be prevented from degrading during production, maintenance, storage, transportation and operational activity.

Responsibility for assuring that the policies set forth in these regulations are implemented rests with OCRD. Management audit has been established to include the review of Qualitative Materiel Requirements (QMRs), Small Development Requirements (SDRs), Technical Development Plans (TDPs) and project reliability status reports for adequacy and conformity to existing policies.

CURRENT STATUS AND PROBLEMS. Until the publication of existing regulations relating to *R/M*, documents such as Military Characteristics or Qualitative Military Requirements relied upon such qualitative expressions as "equipment must be reliable and have ease of maintenance incorporated into its design."

As a consequence, a lack of precision existed during the evolution of requirements and the major stages of development in that *R/M* characteristics often were not quantitatively stated or assessed. Only during the engineering and service tests were attempts made to measure *R/M* and at this point it was too late in the life cycle to influence the *R/M* characteristics appreciably.

Present regulations have corrected this situation. Documents containing *R/M* today must include minimum acceptable levels as well as the desired goals, both expressed *quantitatively*.

Expressing quantitative characteristics, as now required, is not always an easy task. The absence of adequate *R/M* data files is a recognized hindrance to the combat developments QMR writer and to the designer and systems engineer who must consider apportionment and prediction of both *R&M*.

The absence of historical data often frustrates the Department of the Army planners in that yardsticks to evaluate the old versus the new are minimal or nonexistent. Establishment of *R/M* data files by the U.S. Army Combat Developments Command and the U.S. Army Materiel Command and other major development agencies will in time remove much of the present problem in this area.

The Army Equipment Reporting System (TAERS) is expected to assume an increasing role in the furnishing of data for engineering use. Information of a failure rate nature under varying test conditions furnished by the Test and Evaluation Command, as well as contractor and in-house laboratory data generated during the development cycle, plays an important part in the *R/M* data file compilation.

The recent publication of MIL–STD–785, Requirements for Reliability Program for Systems and Equipments, provides the project or commodity manager with uniform criteria for contractor reliability programs and provides guidelines for the preparation of contractor reliability program plans.

Concerted effort being applied to *M* should provide standardization documents on program plans, prediction and demonstration techniques this fiscal year that parallel the reliability documents in concept.

The Army is actively engaged in this tri-service effort, furnishing working group members from the U.S. Army Supply and Maintenance Command, U.S. Army Missile Command and U. S. Army Electronics Command. Members coordinate and staff Army policy and position on the proposed documents.

The OCRD participates in the tri-service steering group which manages these efforts. Publication of these documents should give project and commodity managers tools to insure that contracts adequately adhere to *M* provisions.

Policy establishes that *R/M* will be examined at in-process reviews. These important milestones in the development process permit orderly and objective evaluation of the *R/M* characteristics incorporated into equipments. The Engineering Concept Review (ECR) and the Design Characteristics Review (DCR) are recognized as significant points where review by qualified reliability engineers and maintenance engineers can be the most productive.

AR 70–10, Army Materiel Testing, requires that the service test report will include findings on each characteristic prescribed by the QMR (and amplified by technical characteristics). The report must include a statement on the performance of the equipment and its logistics acceptability to include reliability and maintainability.

R&M TRAINING. Trained technical personnel, together with managers who have an appreciation and understanding of requirements, techniques and products of adequate *R/M* provisions, are necessary if there is to be a meaningful *R/M* Program. The Army Management Engineering Training Agency (AMETA), located at Rock Island Arsenal, Ill., is the Department of Defense executive agency for reliability training.

The present curriculum includes an 80-hour course, Elements of Reliability, for engineers and engineering supervisors. Plans are being made to expand this course to 120 hours with the addition of training in *M* and system effectiveness. A middle management appreciation course of 40 hours, Reliability Program Management, is also offered.

AMETA has developed an 18-month Scientist and Engineer Intern Training Program in quality assurance and reliability engineering. The first class is to start in early 1966. Engineering college graduates will be recruited to receive six months intensive technical training at AMETA and a year of on-the-job training at a commodity command.

The U.S. Army Supply and Maintenance Command (SMC) is actively insuring an adequate *M* training program. A 2-year *M* Engineer Intern Program is being established at Red River Arsenal starting in January 1966. In conjunction with George Washington University, SMC has sponsored a one-week course in *M*, which is to be repeated.

The SMC is now publishing, through Martin-Orlando, a textbook, "Maintainability Engineering," and will shortly publish a handbook, "Maintainability Guide for Design," through the U.S. Army Research Office-Durham and McGraw-Hill.

The Missile Command has published a "Maintainability Engineering Guide" which is now being updated and has joined with the Electronics Command and the other commodity commands in sponsoring related on-site training activities.

The U.S. Air Force is providing three spaces for Army officers at the June 1966 graduate-level course conducted by the Air Force Institute of Technology. Graduates will receive a master of science in reliability engineering and it is intended that they be designated as R&D Specialists under AR 614–135.

The *R* and *M* Program is presently receiving increasing attention within the Army. This increased emphasis is expected to result in better-planned projects which include proper specification, monitoring, and verification of *R* and *M* characteristics. This, in turn, will contribute in the long run to mission accomplishment, to better materiel readiness, and to reduced support costs.

ECOM Aerial Photo Team Uses Electronic Flash for Night Color

High-quality nighttime aerial photographs in color have been made from almost 1,000 feet with fast film and electronic flash by a research team from the Army Electronics Command, Fort Monmouth, N.J.

Photographers and engineers shot the series of chromatic photos with two types of cameras above a stretch of New Jersey coastline. The pictures show such color differences as slight gradations among parked cars, the bold orange and white of a water tank, and the wide range of hues among a cluster of small boats and the color detail of an oceanside boardwalk.

Conducted by the Combat Surveillance, Night Vision and Target Acquisition Laboratories of ECOM, the experiments are seeking improvement of photosurveillance during hours of darkness when reconnaissance flights usually are less hazardous than in daylight.

Members of the team contend that more visual intelligence can be obtained from color photos than from black and white because of the basic fact that people see in color, even in limited light. Slight differences in hues of distant objects or terrain, for example, could be telling factors in the analysis of surveillance photos.

Two major problems in making the pictures were film speed (the American Standards Association, or ASA, rating) and lighting. Film speed was increased several times the normal by prolonged developing in the first bath.

FOUR UNITS of a modified electronic-flash system used to take nighttime aerial color photos were mounted in two wing pods on an Army C–47 MS aircraft. Alvin F. Applegate (right), electronics engineer in charge of the Army Electronics Command experiments and his assistant, Francis Frame, examine one of the wing pods.

BLACK AND WHITE reproduction of a nighttime aerial color photograph taken by an Army Electronics Command research team shows bold pattern of a watertower on the New Jersey coast. In color, the tower is orange and white, resembling a segmented, half-peeled orange. The building (top-center), parking area, roadways are different tones of blue.

The electronic-flash equipment was modified so that output, approximately doubled, was stepped up to 195-million beam-candlepower. One thousandth-of-a-second flashes produced an intensity approaching daylight.

Alvin F. Applegate, ECOM laboratories electronics engineer who heads the photographic experiments, said that the success achieved so far "must not be construed to mean that the Army is now ready for night color photography using electronic flash as the light source."

Aircraft used was the Army C–47 MS (multisensor). Four electronic-flash units were mounted in two wing pods and powered by the plane's electric system using a direct current (d.c. to a.c.) converter.

Cameras were the KA–50, used for commercial and military aerial photography, and a modified P–2 "strike camera," widely used in U.S. Air Force planes for fast combat shots. Both cameras were pointed through a well in the floor of the fuselage and synchronized with the flash system.

The cameras were loaded with Eastman Ektachrome film in 100-foot rolls. The ASA rating of the film was increased to 740 by developing 15–18 minutes instead of the usual ten mintes. Aperture settings of the cameras was *f*2.8.

MICOM Seeking Self-Destructing Rocket Motors

Self-destructing meteorological rockets that can be fired from anywhere into the upper atmosphere without the hazard of falling parts are being sought by the Army Missile Command, Redstone Arsenal, Ala.

Because of the danger of spent rocket hardware tumbling back to earth, weather rockets bearing instrument packages can only be launched from large national ranges. Elimination of this potential danger would give researchers of the stratosphere and troposphere greater latitude to obtain more general coverage of the earth's atmosphere.

Working jointly with the National Aeronautics and Space Administration (NASA), Langley Field, Va., the Army MICOM's small rockets branch is exploring rocket motors that will destruct themselves after separating from the instrument payload, and with motors that will consume themselves by burning.

Under contracts administered by the MICOM R&D Propulsion Lab, one chemical corporation (Thiokol) has developed and fired what the firm's engineers call a "paper" rocket motor which was fragmented by explosives. Another corporation (AMCEL) built and static-fired several nitrocellulose filament-wound motors.

Self-destruction by combustion is a promising theory judging by early tests, according to MICOM scientists. Insulated to prevent ignition of the airframe during the motor burn phase, the rocket would be launched in a near-vertical trajectory. After burnout, the rocket coasts to its highest point and deploys the payload into the upper atmosphere. A time-delay intiator ignites the airframe and the rocket components burn before again descending by parachute to airlane altitude.

Development of a self-destructing rocket would allow launching in any particular area scientists wish to explore. They can study an atmospheric belt from approximately 20 to 100 miles high, and from the instruments deployed can measure wind velocity, temperature, ion density, chemical composition, radiation and magnetic flux.

These data provide meteorologists with upper atmospheric conditions as they would affect vehicles passing through a particular area, in addition to giving them closer insight to the patterns of winds, and temperatures.