ARMY RESEARCH AND DEVELOPMENT

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

Vol. 10 No. 1 • January 1969 • HEADQUARTERS, DEPARTMENT OF THE ARMY • Washington,.D.C.

Hornig OKs Guidelines To Technical Reports

Presidential Science Adviser Dr. Donald F. Hornig has approved, for voluntary adoption by major agencies concerned, "Guidelines to Format Standards for Scientific and Technical Reports Prepared by or for the Federal Government."

Preparation and coordination of the guidelines over a period of nearly two years of continuing priority effort has been accomplished by a COSATI (Committee on Scientific and Technical Information) Panel 1 Working Group on Report Format Standardization. COSATI functions under the Federal Council for Science and Technology.

Eight major federal agencies are represented on the group, which was recently reconstituted as the Subpanel on Report Standardization. Under a 2-year extension of its mission, the group will continue to coordinate the efforts of the agencies during the implementation period for the new standards.

The preface to the guidelines states

(Continued on page 5)

$5,000 Award Recognizes Night-Vision Progress

Development of night-vision devices over a 14-year period that have "taken the night away from Charlie" in Vietnam combat operations earned Dr. Robert S. Wiseman a $5,000 "Christmas present" and the Army Exceptional Civilian Service Award.

Army Vice Chief of Staff General Bruce Palmer Jr., presented the award to Dr. Wiseman Dec. 19 in a Pentagon ceremony attended by a large group of top Department of Defense officials, assembled to pay tribute to an achievement likened in epochal significance to development of radar devices in World War II.

Dr. Robert S. Wiseman

When Dr. Wiseman joined the staff of the U.S. Army Engineers R&D Laboratories Night-Vision Branch at Fort Belvoir Va. (now an element of the Electronics Command Laboratories at Fort Monmouth, N.J.) in 1954, he was 30 years old and had received a PhD degree in electrical engineering from the University of Illinois only a month earlier. He also earned BS and MS degrees (1948 and 1950) from the same institution.

The U.S. Army research and development image intensification program was initiated in 1954 under his direction. Starting with a nucleus of four researchers, he molded a team of scientists and engineers in an accelerated program for which he justified and obtained in excess of $25 million through 1967.

Benefits of this program are acclaimed as being of tremendous importance, both tangible and intangible. The citation recognizing his exceptional performance as director of Combat Surveillance, Night Vision and Target Acquisition Laboratories of the U. S. Army Electronics Command states in part:

"... His outstanding scientific ability initiative and foresight in planning and directing the Army Night-Vision Program resulted in giving the troops revolutionary new devices enabling them to see in the dark. This passive vision system makes possible military operations as effective by day as by

(Continued on page 3)

MERDC Appoints OCRD Man as Technical Director

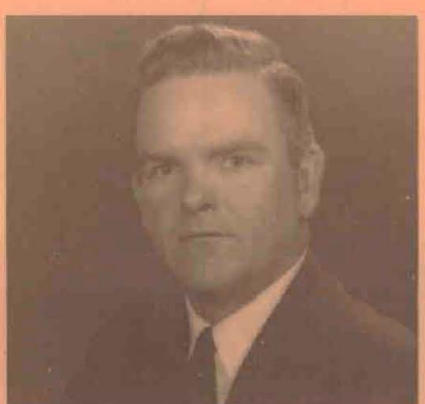
Appointment to a PL–313 position vacant for 18 months came to William B. Taylor, a veteran of Army research and development activities, when he was selected technical director of the U.S. Army Mobility Equipment R&D Center at Fort Belvoir, Va.

Until promoted to the position held by Dr. George W. Howard up to his retirement in 1966, Taylor was scientific adviser to the Missile and Space Directorate, Office of the Chief of Research and Development, HQ Department of the Army, Washington, D.C.

Oscar P. Cleaver, formerly chief of the Mobility Equipment R&D Center Electrotechnology Laboratory, served as acting technical director of the MERDC until he retired in the spring of 1968. Donald J. Looft now with the Night Vision Laboratory at Fort Belvoir, took over when Cleaver ended his long association with the MERDC.

MERDC Commander Col Edwin T.

(Continued on page 4)



William B. Taylor

Featured in This Issue . . .

Eyeglass Innovation Cuts Soldiers' Lost Duty Time

An innovation of sending optometrists to the field has reduced average time away from duty for replacement of a soldier's lost or damaged eyeglasses from about three days to less than 45 minutes.

Phenomenal though this progress might appear, the U.S. Army is looking to the day when a soldier can feed his eyeglass prescription to a computer-linked fabrication machine and have a new pair in about 10 minutes.

Time lost from duty for obtaining

(Continued on page 5)

Army R&D Newsmagazine

Vol 10 No. 1 • January 1969

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

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, U.S. Continental Army Command, Office of the Chief of Engineers, and Office of The Surgeon General. Use of funds for printing of this publication has been approved by Headquarters, Department of the Army June 6, 1967.

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 Special Career Programs. Members of the U.S. Army Reserve R&D Unit Program receive distribution by bulk lot sent to their individual units. Otherwise, distribution is made only to the Army installation, office or organizational element to which the requester is assigned.

CHANGES OF ADDRESS for AE and R&D Officer Special Career Program enrollees should be addressed to: Specialist Branch, OPXC, Department of the Army, Stop 106 Washington, D.C. 20315. 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

Electronics — The Armor of the Eighties

By ASA(R&D) Dr. Russell D. O'Neal

In one of his farewell addresses before departing to accept an appointment as vice president of Bendix Corp., and thus to continue the distinguished industrial career he interrupted to become Assistant Secretary of the Army for Research and Development, Dr. Russell D. O'Neal spoke to the Electronics Industries Association Symposium in Washington, D.C., as follows:

Dr. Russell D. O'Neal

. . . The joint sponsorship of this symposium by the Electronics Industries Association and the Army's Combat Developments Command provides yet one more opportunity to solve that elusive, kinetic and complex boundary-value problem, equating requirements and technology.

That job—matching technology to requirements—is probably the most important one for an Assistant Secretary for Research and Development. As a member of the outgoing administration, the moment for self-evaluation is near at hand. Let me quote from a document I just saw: "The Assistant Secretary might also explain why it is that General Johnson has been able to write that we have not even finally determined on the ultimate design of such tanks, mortars, light cannon, antiaircraft guns, automatic rifles and machineguns as are to be given to our Infantry."

Well, nobody's perfect. Besides, you know and I know that the search for the ultimate design in weapons is likely to continue for a very long time, and if we had attained the ultimate, you would not have asked me here to talk about the future.

Anyway, that critical quotation I just read you is dated 1939. The "General Johnson" referred to is not Harold K. Johnson, former Chief of Staff, but Hugh S. Johnson, a critic of the Roosevelt Adminstration, and the author of the quotation is Oswald Garrison Villard.

There is a special place in purgatory reserved for prognosticators, especially if we are unsuccessful. That very same O. G. Villard is no doubt aware of this special place, for in the same 1939 book he says: "Of all the Defense impostures and delusions, the worst is that a war with Japan is physically possible, that Japan may attack us and we may fight in Japanese waters."

With all these warning lights facing me, I certainly should be wary about indulging in forecasting, but let me plunge on.

The role that electronic technology is playing in fulfilling our Army requirements has expanded quantitatively in an amazing way—from $248 million in Fiscal Year 1965 to $730 million in Fiscal Year 1969. But the mere quantitative growth of electronics is dull compared to its qualitative spread. The use of electronics has diffused, diverged and propagated in amazing ways.

Electronics has infiltrated into the solution of an unbelievable variety of military problems. My theme tonight is "Electronics—The Armor of the Eighties," and, to develop it, let me remind you of some examples of how electronics has already substituted for fuel, for ammunition, for gimbals, push-rods, wires and pipes.

Yes, I said electronics for pipes. That's one of the oldest substitutions of them all; the telephone, which started our era just 92 years ago, replaces the speaking tube. But there's also the replacement of the organ pipe by the transistorized oscillator.

The substitution of electronics for fuel has taken place in at least two ways; as the first example, in the Saturn Launch Vehicle, conservation of fuel requires path adaptive guidance—an iterative technique that continuously finds the minimum propellant trajectory to destination as the vehicle is displaced by unpredictable forces. Thus on-board computational power is traded for propellant weight in Saturn.

Electronics is also substituted for fuel in a perhaps less elegant way in modern military aircraft, through the provision of a fuel management computer that permits the pilot to adjust optimally his trim and throttle settings to minimize fuel consumption.

The Army's FADAC computer and its replacement, the TACFIRE system, are used in control of Artillery fire. By taking into account the details of winds aloft, charge weight, parallax, and shell ballistics in providing aiming instructions to Artillery batteries, computational power provided by electronics is traded for numbers of rounds of ammunition fired and even for numbers of guns,

(Continued on page 14)

$5,000 Award Recognizes ECOM Scientist for Night-Vision Work

(Continued from page 1)

night. Dr. Wiseman's achievements are in the best traditions of the career service, reflecting great credit upon himself and the Department of the Army."

In recommending Dr. Wiseman for the award, the Electronics Command justified the action by saying:

"... We cannot estimate the savings in lives, in the cost of ammunition, or the price of success on the battlefield. The success of night-vision devices is attested to by the fact that CONUS MACV (Continental U.S. Military Assistance Command Vietnam) has submitted an 'urgent operational requirement for all we can produce.'

"A multimillion dollar SEA NITEOPS (Southeast Asia Night Operations) Program has been approved to accelerate research and development efforts. . . ." This program is designed to develop an integrated system of night-vision devices for evaluation for use in Vietnam and worldwide.

Techniques developed through the R&D efforts of Dr. Wiseman and his laboratory associates resulted in night-vision devices such as the small starlight scope, the crew-served weapons sight and the medium-range night-observation device, which permit observation of enemy activities at night "with daylight clarity."

The "technological breakthrough" accounting for production of these devices is described as "development of a unique tube for amplification of light along with the design and development of fiber optic plates through which light is transmitted. An image of light rays is conducted into the tube by a fiber optic plate.

An electron image is emitted in the tube when the light image impinges upon chemical film, which is deposited on the fiber optic plate. These electrons pass through an electric field of 15,000 volts, causing acceleration that gives energy . . . and focuses the image on a phosphorus screen that emits a light image brighter than the input stage.

The light image is further amplified by passing through two additional electron image tube stages coupled together by means of fiber optics, and the result is that the output light image is over 40,000 times the original input level.

Dr. Wiseman called upon the resources of industry and other specialists in the night-vision field, keeping abreast also of related efforts in American universities and by European scientists. He gained cooperative program support from the U.S. Air Force, Navy, National Aeronautics and Space Administration, Atomic Energy Commission, and the Carnegie Institution Committee on Image Tubes and Telescopes.

To probe the state-of-the-art he organized two major technical symposia (1958 and 1961) for the exchange of technological information.

Interest of top officials in the Department of Defense and the Research and Development Subcommittee of the House Committee on the Armed Forces was generated by a series of briefings extending over a 7-year period, starting in 1961 with the then Chief of Research and Development, Lt Gen Arthur G. Trudeau.

Subsequently, briefings were presented to three successive Assistant Secretaries of the Army (R&D), Dr. Finn J. Larsen, Willis Hawkins, and Dr. Russell D. O'Neal; Dr. Eugene Fubini as Deputy Director of Defense Research and Engineering and Dr. John Foster as Director of DR&E; the Army Scientific Advisory Panel (ASAP); subpanels of the Defense Science Board; and the Ground and Air Panels of the President's Scientific Advisory Committee.

Night-vision devices developed by the U. S. Army under the leadership of Dr. Wiseman, in work conducted both at the Fort Monmouth laboratories of ECOM and its Night-Vision Laboratory at Fort Belvoir, Va., are serving to meet critical requirements of a "new kind of war" in Vietnam.

The situation there, and in all of Southeast Asia, however, is characteristic of coping with all insurgency activities—a new element in military tactics and doctrine, involving an enemy "who is here tonight, gone the next day, and somewhere else tomorrow night." Detection of movements of this enemy under the cover of darkness is the problem.

Further, as explained under the heading of "benefits" of the program directed by Dr. Wiseman, "The Army needed a full passive night-time capability to avoid detection by the enemy. It needed it for firepower, for mobility, for support, for observation, and for the psychological advantage it provides to the individual soldier.

"Because of the ultimate isolation of the soldier in the jungle, especially at night, his confidence in himself depends largely upon the capability of the equipment to enable him to accomplish his tasks—to move about, to find the enemy, and to shoot fully and effectively. . . ."

The rifleman, as a result, now can operate with the improved confidence and morale attributable to the new capability of seeing the enemy under the cover of darkness, with a correlated increase in precision of firepower and an over-all improvement in combat effectiveness.

Presented under the Department of Defense Incentive Awards Program, the award to Dr. Wiseman is one of the largest made in recent years. Three $25,000 (the highest possible) awards have been made and two have gone to Army R&D personnel.

In 1959, five employees of the Harry Diamond Laboratories (then the Diamond Ordnance Fuze Laboratories), Dr. J. W. Lathrop, Norman J. Doctor, Thomas A. Prugh, James R. Nall and Mrs. Edith D. Olson, shared $25,000 for their work on microminiaturization of electronic circuits. In 1961, three Picatinny Arsenal scientists shared $25,000 for developing nuclear weapons; $15,000 went to Robert M. Schwartz and $5,000 each to Milton E. Epton and the widow of Irving Mayer.

Donald Belknap of the Harry Diamond Laboratories received $5,000 and the Exceptional Civilian Service Award in 1961 for a microminiaturized lamp—so small it can pass through the eye of a needle, but a valuable tool for computers and other devices. Billy M. Horton, also of HDL and currently the technical director, received $3,000 and the Exceptional Civilian Service Award and Dr. Romald Bowles $2,000 for their work on fluidic controls.

DIGNITARIES and fellow employes who attended the award ceremony to pay their respects to Dr. Wiseman included General Frank S. Besson Jr. and Lt Gen William S. Bunker, CG and deputy CG respectively of the Army Materiel Command (AMC); Lt Gen Austin W. Betts, Chief of R&D, HQ DA; Maj Gen Richard H. Free, head of the AMC Directorate of Research, Development and Engineering; and

Charles L. Poor, acting Assistant Secretary of the Army (R&D); Howard P. Gates, special deputy for Southeast Asia, Office of the Secretary of the Army; Lt Gen A. O. Connor, DCSPER; Charles A. Mallaly, Director of Personnel, HQ DA; Victor L. Friedrich, assistant for electronics, Office of the Assistant Secretary of the Army (R&D); Jerry H. Mason, chief, Incentive Awards, HQ DA; and

Dr. Hans K. Ziegler, deputy for science and chief scientist, ECOM; A.W. Rogers, deputy for engineering and chief engineer, ECOM; William L. Doxey, director of R&D, ECOM; Dr. G.E.H. Ballard, deputy for laboratories, ECOM; Benjamin Goldberg, acting director, and Myron Klein, acting deputy director, Night-Vision Laboratory, ECOM; Isadore Kessler, Edward Sheehan, Stanley Segal, Dr. Werner Wiehe, Dr. George Hass, Jack Hildreth and John Adamitis, all of the ECOM Night-Vision Lab.

Princeton Professor Traces Causes of Vietnam War

Vietnam: The Origins of Revolution (1885-1946), authored by Dr. John T. McAlister, came off the press this past month and is being distributed selectively by the American University Center for Research in Social Systems (CRESS), Washington, D.C. Distribution is unlimited.

Prepared for CRESS under subcontract by The Center of International Studies, Princeton University, the publication explains the fundamental changes in the structure of politics that over the past 40 years provided the essence of revolution in Vietnam.

Dr. McAlister is a lecturer in international affairs at the Woodrow Wilson School of Public and International Affairs, Princeton University.

MERDC Hppoints OCRD Man as Technical Director

(Continued from page 1)

O'Donnell announced Taylor's appointment and stressed that he was chosen after screening of the qualifications of a large number of applicants. Taylor will be responsible for programs encompassing bridge, earthmoving and construction equipment, intrusion detection devices, water purification and advanced electrical power sources.

Taylor, 43, was graduated from the U.S. Military Academy in 1945 with a BS degree, studied radiological engineering at the U.S. Naval Postgraduate School (1948-49) and earned an MS degree in electrical engineering from Johns Hopkins University in Baltimore, Md., in 1951. In more recent years, he has taken courses in civil engineering, political sciences and system analysis at the University of New Mexico, George Washington University and Mathematica, Inc., Princeton University.

In 1955 he entered the Federal Civil Service as a branch chief, Army Reactors, U.S. Atomic Energy Commission (AEC), Washington, D.C. About a year later he became assistant chief, Nuclear Power Field Office at Fort Belvoir, and in 1957 transferred to the Office of the Chief of Engineers as special assistant and executive, Nuclear Power Division.

During two years with the U.S. Army Engineer, Geodesy, Intelligence and Mapping R&D Agency (1960-62), now the Army Engineer Topographic Laboratories, he served as deputy director and then assistant director for Global Systems until 1962.

Five years followed with HQ of the National Aeronautics and Space Administration in Washington, D.C., first as assistant director, Engineering Studies, and then as director, Apollo Applications, Office of Manned Space Flights. His next position, in May 1967, was scientific adviser to the Missiles and Space Directorate, OCRD.

While with the Army Nuclear Power Field Office, he participated in the initiation and development of the joint Army-Atomic Energy Commission Nuclear Power Program. He was directly involved in the design, development and operation of the first Army power reactor, the SM–1, at Fort Belvoir and the follow-on plants at Fort Greely, Alaska, and Camp Century in Greenland.

Later he took part in technical management of experimenal operational Army nuclear power plants in Idaho and Antarctica and in the initial design of the 10,000-kilowatt floating power plant, the *Sturgis*, now serving in the Panama Canal Zone.

During his stay with the Topographic Laboratories, Taylor participated in the design and development of the SECOR (Sequential Collation of Range) geodetic satellite system; also, in development of automatic mapping equipment for processing high-altitude photography.

Achievement credited to him while with NASA included the initiation and management of design studies and program definition of subsystems and flight missions for the Apollo manned lunar landing program. He also took part in planning the U.S. post-Apollo effort in civilian space exploration to provide the technological base for permanent manned earth orbiting space stations, lunar bases or manned planetary exploration.

From September 1946 to June 1948 he served with the Manhattan District and the AFSWP Field Command, Sandia Base, N. Mex., and at the tests on Eniwetok Atoll. He held the rank of major when he retired from the Army in 1954 because of a physical disability.

Taylor is a member of the Institute of Radio Engineers, the Society of Sigma Xi, Society of American Military Engineers, American Institute of Aeronautics and Astronautics, and is a registered professional engineer in the District of Columbia.

Pioneering Army Research Backed Apollo 8 Flight

Epochal success of man's first flight to the moon aboard the Apollo 8 spacecraft, launched by the mighty Saturn 5 rocket, undoubtedly will be recorded in history as the most enduring testimonial to the U.S. Army's pioneering rocket research

National Aeronautics and Space Administration scientists, engineers, technicians and administrators deservedly can claim their "lion's share" of the accolades earned by astronauts Frank Borman, James A. Lovell Jr. and William A. Anders. But that success originated in an Army concept.

Magnified tremendously by NASA as it was developed over more than a decade, the Army concept was the Saturn Project, calling for clustering of eight proven missile engines into one booster rocket to generate 1.5 million pounds of thrust.

Primary developmental work, however, was assigned by the Advanced Research Projects Agency of the Department of Defense to the Army Ballistic Missile Agency (ABMA) at Redstone (Ala.) Arsenal on Aug. 15, 1958.

The order recognized the capability the Army already had acquired under leadership of Dr. Wernher von Braun, now director of NASA and then head of the Developments Operations Division, Army Ordnance Missile Command. Maj Gen John B. Medaris was then the AOMC commanding general.

The Army recruited the German V-1 rocket genius and members of his team as the nucleus of an organization to design, develop, test and launch U. S. space missiles. Much of the work was at White Sands (N. Mex.) Missile Range.

When NASA came into existence, the Army transferred to it the Saturn Project; at that time it had developed the 68.6-foot Jupiter C rocket with 83,000 pounds of thrust, with a proved record of success. The Jupiter C orbited the first U.S. satellite, carrying a 30.8-pound payload of instrumentation, in January 1958.

The Saturn 5 rocket, by way of contrast, generated 7.5 million pounds of thrust and hurled into flight a total weight of *6.2 million* pounds (lift-off weight with fuel).

Moon Voyagers Eat Foods Developed by Natick Labs

Moon voyagers Col Frank Borman, Capt James Lovell Jr. and Lt Col William Anders, whose Apollo 8 spacecraft carried them as the first humans to circle the moon, ate freeze-dried rehydratable foods prepared by the U.S. Army Natick (Mass.) Laboratories.

Many years of research produced the palatable quality of such foods as beef and gravy, spaghetti and meat sauce, chicken salad, beef hash, chicken and gravy, chicken and vegetables, ham and applesauce, fruit cocktail, peaches, tuna salad, corn chowder, potato soup and pea soup the astronauts prepared by adding water and heating if necessary.

In this extensive research program, the Natick Laboratories have been supporting the National Aeronautics and Space Administration by providing sophisticated methods for preservation of food to make it palatable under space-flight conditions.

Patent Granted on Twister, Vehicle for Rough Terrain

Patent protection was accorded recently to the U.S. Army's "Twister," a 2-bodied, rough-terrain vehicle scheduled for delivery in late 1969.

The patent for the 8-wheeled vehicle was granted to the Lockheed Missiles and Space Co., which has developed its concept for meeting the Army's rugged terrain requirements during three years of test operations in rice paddies, snow fields and other environments.

Independent suspension of the front wheels and walking-beam suspension on the rear wheels enables them to flex freely or articulate in the pitch, roll and yaw axes. The Twister has proved capable of high-speed operation over all of the test courses.

Hornig Approves Guidelines to Scientific, Technical Reports

(Continued from page 1)

that they are prepared in a form that can be used without change as a contract or grant specification. Recognized also is that "many agencies will find it necessary to supplement these standards with special instructions providing for security and other special circumstances beyond the scope of this document."

Facing up to the complexities of the problems involved, the preface also states: "It is hoped that these standards will improve both the speed and the effectiveness with which scientific and technical information on federal agencies is communicated."

The Department of Commerce Clearinghouse for Federal Scientific and Technical Information is publishing the 6,000 copies of the guidelines, which are expected to be distributed this month to all federal agencies interested in the standardization program at this time or that may have a future interest. Defense contractors will be able to procure copies from this agency.

Expected to have a potential impact upon more than 100,000 scientific and technical reports produced each year, the standards are envisioned as eventually accounting for savings exceeding $10 million annually in the preparation of these reports.

One of the new and notable features of the guidelines is the use of a standardized title page serving multiple purposes in that it consolidates essential information on one page.

Dr. Hornig, in an introduction, terms the standards a "notable product" and states that "widespread adoption . . . will simplify the preparation, dissemination and utilization of scientific and technical reports, and provide the Federal Government with better reports at less cost."

Jack W. Grewell has chaired the working group as a representative of the Department of Transportation, Federal Aviation Administration. John S. Nigro is another representative of this agency.

Other members are: Dr. John C. Hayes and Parmely C. Daniels, Department of Defense (DoD), representing the Army; H. L. Chadbourne, DoD (Navy); John Marple and Ted Patterson, DoD (Air Force); Mrs. Eleanor J. Aronson, Department of Commerce Clearinghouse for Federal Scientific and Technical Information;

Mrs. Patricia Armentor and Lee R. Zungoli, National Aeronautics and Space Administration; Richard A. Elmendorf, Department of Health, Education and Welfare, Office of Education; Dr. Ben Loeb, U. S. Atomic Energy Commission; Ward W. Konkle and James Turnbull, Department of Agriculture; John T. Simons, Defense Documentation Center; and W. Reeves Tilley, Department of Commerce National Bureau of Standards.

Eyeglass Innovation Cuts Soldiers' Lost Duty Time

(Continued from page 1)

new eyeglasses has been of serious concern to field commanders because one of every three soldiers wears them and about 40 percent require replacement one or more times annually.

In response to the complex problem, the U.S. Army Surgeon General's Office dispatched a team of two officer optometrists and two enlisted opticians to each combat division in Vietnam.

Col Billy C. Greene, optometry consultant to The Surgeon General, reported that "Initial response from the field was almost instantaneous and unanimously enthusiastic. We were able in many instances to cut the manhour loss from three days to between 30 and 45 minutes."

Combat commanders are now the main beneficiaries for this soldier time-saving project. Stateside units also are eligible to requisition these technicians.

"We expect that Stateside commanders will call for optometric teams in the near future," Col Greene said. "When the whistle blows for movement, these teams will pull out with their divisions.

"Fort Hood's 1st and 2d Armored Divisions and the 5th Division (Mech.) at Fort Carson (Colo.) have already assigned optometric officers to their units and we expect all divisions in the Army will soon have functioning optometric sections."

Researchers from the Office of The Surgeon General, in pursuit of even more dramatic progress, have passed new requirements to industry calling for an electronic device that will fill eyeglass prescriptions in 10 minutes.

Linked to a computer, this device would be able to make any lens from a single block of optical glass or plastic. The concept is that a mathematical formula on tape would enable the computer to control the lens-making process. Completed lenses would be inserted automatically into adjustable frames.

ASA(R&D) O'Neal Pays Farewell Tribute to Army

Assistant Secretary of the Army (R&D) Dr. Russell D. O'Neal, in a letter to Army Chief of Staff General William C. Westmoreland following his recent resignation to return to private industry as vice president of Bendix Corp., praised the Army R&D community. Secretary O'Neal had served since Oct. 3, 1966, following a distinguished industrial career. His letter follows:

"Dear General Westmoreland:

"As I leave the Government to return to private industry, I would like to express my great respect and appreciation to the Army, and especially to the Army Staff for its professionalism, dedication, patience and tenacity in the face of the most severe obstacles.

"Since assuming this position in October 1966, I have come to hold the Army and its personnel in the highest esteem, and I return to the civilian sector as one of its greatest admirers and supporters.

"Having enjoyed close personal contact with literally hundreds of officers and men of the Army Staff, I am convinced that the ability of the Army to attract and retain personnel of such outstanding caliber says much about its training, teamwork and esprit, and thus about its leadership.

"I feel honored to have been afforded this opportunity to participate in the activities of such an exceptional organization. I leave with much greater appreciation of the term 'soldier' and with the conviction that the security of our nation is in good hands."

4 New Members Appointed To Defense Science Board

Appointment of four new members to the 28-man Defense Science Board (DSB), the senior technical advisory body in the Department of Defense, was announced recently by the Office of the Assistant Secretary of Defense (Public Affairs).

Composed of academic and industrial leaders and ex-officio members representing major federal agencies, the DSB advises the Secretary of Defense, through the Director of Defense Research and Engineering (DDR&E), on scientific and technical matters.

The new members are Dr. Arthur T. Biehl, associate director for Advanced Study at Lawrence Radiation Laboratory, Livermore, Calif.; Dr. Lewis M. Branscomb, chairman of the Joint Institute for Laboratory Astrophysics, University of Colorado; Daniel J. Fink, general manager for Space Systems, General Electric Corp., Valley Forge, Pa.; and Dr. Charles M. Herzfeld, technical director of the Defense Space Group (R&D) at International Telephone and Telegraph Corp., Nutley, N.J.

Dr. Robert L. Sproull, vice president for Academic Affairs at Cornell University, is chairman of the board.

TECOM Materiel Testing 'College' Grads Exceed 400

Alumni of the U.S. Test and Evaluation Command's intensive training course for test officers topped the 400 mark in mid-December with the graduation of Class No. 13.

What started out on an experimental basis in April 1967 as an "Orientation Course on Materiel Testing"—and was promptly dubbed TECOM College by all hands—is now an important fixture in the training program for military and civilian personnel. Graduates include a liberal representation from other commands and services—and four co-eds.

The academic schedule projected through next June includes plans for six additional classes. Quotas, now limited to 30 students per session, have been over-subscribed consistently in recent months.

The basic 80-hour course reflects just one part of a major continuing effort by TECOM to improve its performance as the Army's principal materiel testing organization.

Primary emphasis during 57 hours of classroom instruction is on application of scientific and technical methodology to test and evaluation activities. The remaining 23 hours are devoted to orientation in testing philosophy, concepts and objectives.

TECOM College was conceived as a 100 percent in-house training program. Classes are conducted at HQ TECOM, Aberdeen Proving (Md.) Ground, where the school is under supervision of the Personnel and Training Directorate and is administered by the Training Division. The arrangement has built-in advantages.

Currently, the course is presented by 25 instructors drafted from the TECOM staff. All are top men in their fields with long years of experience in research, development, test and evaluation (RDT&E). They represent the tier of management immediately concerned with directing and supervising test and evaluation activities conducted in the field by TECOM subordinate elements.

The need for an in-house educational program, such as TECOM College, stems from the unique nature of the command's mission and the increasingly important role played by test and evaluation in the life cycle of Army materiel.

As one of the nine major subordinate elements of the Army Materiel Command, TECOM provides the Army with an independent, unbiased appraisal of its weaponry. From its test reports, TECOM's only product, the Army can determine if an item conforms to specifications, if it is capable of doing the things it was built to do in serving needs of the American soldier in the field.

From the beginning, TECOM has addressed itself to the task of improving its test reports. One way or another, the effort tinctures almost every management improvement action.

One of the first steps taken, for instance, was the establishment of a single, responsive management system to replace the several different systems that existed when TECOM was organized in 1962.

By reducing the number of test titles to manageable proportions—about a score—and insisting on uniform interpretations of definitions of test programs, a common language for use within the command was assured. Communications with developers of Army materiel and other customers were improved, and test documentation became more meaningful.

More recently, experiments with a Test Report Preparation Course produced good initial results. The 32-hour training program, intended to supplement the TECOM College curriculum, was aimed at achieving TECOM uniformity of reporting.

Before it was shelved for lack of funds, the course was presented at six TECOM installations and activities by an Army contractor. The training package is still under consideration for possible use in connection with future TECOM College sessions.

More often than not, the high order of professional competence required by TECOM must be developed within the structure of a work-force exposed to constant personnel fluctuations—a condition particularly critical most of the time in the military specialties during wartime conditons.

A survey of classes conducted to date disclosed that a majority of the students were relative strangers to the materiel development process. With rare exceptions, all had something to do with test reports. But fully 62 percent of the respondents had less than a year of experience in any phase of RDT&E work; only 10 percent are 10-year veterans.

Dr. Nebesky Takes Post as GEPL Director

Appointment of Dr. Edward A. Nebesky as director of the General Equipment and Packaging Laboratory (GEPL) was announced in December by the U.S. Army Natick (Mass.) Laboratories.

Since 1964, he has served at Natick as chief of the Container Division and as acting director of GEPL. He now is responsible for managing military research, development and engineering programs for packaging and containers, food preparation and service equipment, shelters, and individual and organizational field support equipment.

Dr. Nebesky is a native of Amesbury, Mass., and earned BS, MS and PhD degrees from 1943 to 1950 at the University of Massachusetts, all in food science and technology. In 1951 he joined The Cryovac Co., Simpsonville, S.C., as product manager for developing new products, applications and markets for packaging foods, drugs and nonfood items.

In 1956 he became associate professor and head of the Division of Food Technology, Dairy Department, at Cornell University, Ithaca, N.Y. He established an undergraduate teaching program in food preservation, processing and manufacturing methods, and food packaging.

Dr. Nebesky joined the Rutgers University faculty in 1959 as professor and food science extension specialist with responsibility for developing a comprehensive curriculum of teaching, research and extension oriented to consumer packaging of foods and drugs. He was named director of the Rutgers Graduate Packaging Center in November 1963.

Dr. Edward A. Nebesky

CDC Evaluates Feasibility Of 'Pop-in' Command Post

Feasibility of using a "pop-in" command post in an armored riverboat for tactical operations in Vietnam's Mekong Delta is being studied by U.S. Army Combat Developments Command riverine warfare specialists.

The "Commander's Pod" idea was developed by the U.S. Navy. Lt Col Virl E. Haas, Army liaison officer to the Naval Inshore Warfare Project Office in Washington, D.C., is working with Army Combat Developments Command representatives in studies for use in Vietnam.

The 9-by-24 foot portable pod is designed to be lowered into the well-deck of an Armored Troop Carrier (ATC), a principal craft used in riverine warfare flotillas. One of the Navy's ATC's thus becomes the Command Control Boat.

From the U.S. Army's viewpoint, the question to be decided is whether the pod will adequately accommodate all the gear required for a tactical operations center in the inundated areas common to the Mekong Delta.

To prevent the Viet Cong from identifying the command boat and giving it their full sniper and water-mine attention, the Army pod on board will not change the appearance of the boat. It will look like any other ATC in the riverine force.

CDC Conducts GIANT Map Study for 1970-75 Time Frame

Big enough to match its name—GIANT (Geographic Intelligence and Topographic Support System)—is a study for the Army in the field being conducted under the direction of the Engineer Agency, Combat Developments Command, Fort Belvoir, Va.

The first phase of the 2-phase study, which concerns the entire spectrum of maps and topographic units in the Army, will have direct impact on the Army in the 1970–1975 time frame. The second phase is addressed to the Army of a decade later and will extend its effect from the theater Army to the individual field soldier.

The critical aspect of the study is the development of user requirements. The approach is to identify users and establish the nature, quantity and currency of their needs as related to mission, environment, weapon systems and target-acquisition capabilities.

A major source of information for the GIANT study will be derived from the worldwide survey of all aspects of mapping now being conducted. Extending down to company level, the study encompasses every phase of topography.

Included in the study will be such diversified operations as map data-producing equipment and techniques, printing, format and distribution—and asking the man in the field for ideas and opinions.

The first phase is limited only by what equipment and systems will be available in the 1970-1975 time frame. It does not necessarily even think of the conventional map as the ultimate answer. The CDC Engineer Agency plans in terms of "Topographic Data," not of the map. The user is being advised of technological potential so that he can "dream" along with the combat developments personnel.

This CDC view of topographic data that the future could produce is depicted in such situations as a combat commander in his Tactical Operations Center looking at a large screen displaying a large-scale map of the battle area. This map is only hours old. He receives such a real-time portrayal each morning. At his request, graphics indicating current intelligence can be instantly overlayed.

Copies of the map or overlays would then be prepared for distribution to his staff or electronically transmitted to topographic units for production and distribution to combat units.

Another example is a commander looking at a small screen in his tank portraying a large-scale area to his front, including an evaluation of the trafficability of his intended route. It could help a small unit commander placing his defensive weapons. He might be able to call up instantly a terrain profile of the area to be covered by fire. This screen would mount on a lightweight back-pack.

For the long-range patrol leader, the sky is the anticipated limit. By means of a small device on his belt he would query a satellite and instantly receive coordinates of his position.

These are but a few examples of dreaming by CDC GIANT planners.

Once sufficient data has been amassed and evaluated from GIANT's initial phase, the second phase will begin. While the first phase must operate within the confines of what will be on the hardware shelves by 1975, GIANT's final phase will not know such constraints. It may propose concepts and equipment not yet on the drawing and planning board.

In a little over two years, the entire functions of the CDC GIANT support to the Army in the field will have been taken apart, examined and restructured to provide a comprehensive blueprint to guide developmental actions for the next 17 years.

The first phase of the GIANT study is being conducted under contract to the Washington, D.C., Branch, Autonetics Division of North American Rockwell. CDC planners at the Engineer Agency evaluate, monitor, advise and provide guidance in the conduct of GIANT's first phase.

Signal Magazine Publishes Mallard Project History

Anyone interested in the most comprehensive coverage of The Mallard Project given in any periodical to date will find the November 1968 edition of *Signal* Magazine particularly worthwhile. The edition came out too late for publicity in the December *Army R&D Newsmagazine.*

Intended as a modern communications system for the United States, United Kingdom, Australia and Canada in the 1975–77 time frame, The Mallard Project is of concern to Army, Navy, Air Force and Marine elements of participating countries.

An introductory editorial in *Signal* Magazine by W. J. Baird, general manager and editor, states in part:

"The Mallard system represents the largest and most involved communications project for tactical communication purposes seen to date. It represents a break with the historical methods of developing and fielding tactical communications equipments piece by piece. And this is why the Armed Forces Communications and Electronics Association is pleased to present the Mallard story in the following pages."

The special edition carries articles by Maj Gen Paul A. Feyereisen, U.S. program/project manager; Col R. K. Tanner, director, User Requirements Division; Lt Col P. J. Kenny, director, Communications/Automatic, Processing Laboratory, U.S. Army Electronics Command, and George Silverman, chief, Technical Engineering Division, Joint Engineering Agency, Mallard Project; and

Dr. E. M. Pritchard, deputy project manager, U.S. Mallard Project (USMP) and Col J. D. Sinnett, director, Technical Management, USMP; Edward Kovanci, director, Mission and Logistics Support Division, USMP; Col G. W. Engel, director, Configuration Management Division, USMP; Col R. D. Strock, U.S. Army deputy project manager–Washington U.S. Mallard Project; Loren Diedrichsen, director, Systems Engineering Division, USMP.

MICOM Assigns Ridlehoover as Missile Systems Chief

New chief of the U.S. Army Missile Command (MICOM) Future Missile Systems Division is Lt Col Edward Melvin Ridlehoover, who recently returned from a tour of duty in Vietnam with the 29th GS Group.

Col Ridlehoover served in MICOM's Research and Development Directorate from from June 1960 to January 1963. He is a 1967 graduate of the Armed Forces Staff College with an MS degree in engineering science from Purdue University and a BS degree in mechanical engineering from the University of South Carolina.

Among his awards and decorations are the Legion of Merit, Bronze Star, Army Commendation Medal and Belgium Fourraguerre. His campaign ribbons include American Defense, American Theater, European Theater with five battle stars, Army of Occupation, Korean Service, Vietnam Service with three battle stars and the United Nations Medal.

Lt Col E. M. Ridlehoover

Battelle Economists Forecast FY 1969 R&D Trends

How current trends are squeezing the amount of U.S. Government research and development, although federal funding will support about 60 percent of the nation's total R&D effort estimated at $25.9 billion, is reflected in a Fiscal Year 1969 forecast.

Two economists of the Columbus (Ohio) Laboratories of Battelle Memorial Institute, Dr. W. Halder Fisher and Leonard L. Lederman, prepared the forecast that sets federal R&D exependitures at $15.6 billion in FY 1969, about the same level as FY 1968.

Current inflation of costs of doing R&D, however, is variously estimated between 5 and 8 percent annually.

When this trend is compared with an over-all estimated funding increase nationwide of 3.6 percent for FY 1969, the squeeze on R&D total effort is clear. Necessarily, R&D programs will feel the pinch of federal economies.

In this respect, the FY 1969 trend conforms to a continuing pattern traced in recent years. For six of the past 10 years, the growth rate of federal R&D expenditures averaged about 9 percent; however, during the past four years the growth rate has declined to about six percent.

In other words, the federal growth rate has just about equalled the inflationary rate of costs of doing R&D. By way of comparison, estimated FY 1969 funding by industry will increase about $725 million, a rate rise of 8.7 percent. R&D funding by colleges and universities is expected to increase about $98 million, or 11.7 percent; and that by other not-for-profit institutions to increase some $25 million, or 9.3 percent.

Peace in Vietnam, if it comes early this year, is not expected to make any substantial amount of funds available for an increase of R&D activities supported by the U.S. Government. Reductions in total military outlays as a result of peace are not predicted to be rapid, the Battelle report says.

Estimated FY 1969 R&D expenditures by source of funds are predicted as follows: U.S. Government, $15.6 billion; industry, about $9 billion; colleges and universities, $938 million; not-for-profit institutions, about $295 million. This means that industry will support about 35 percent of the nation's total effort; colleges and universities, about 3.6 percent; and not-for-profit institutions, about 1.1 percent.

If inflationary trends in costs of doing R&D taper off, the prospect for an increase in the total volume of federal R&D programs is encouraging. Continuation of the current growth rate of about 6 percent, consequently, would raise the estimated total of federal R&D spending to roughly $28 billion in 1978, a $12 billion jump over the FY 1969 level of $15.9 billion.

Industry is expected to perform nearly $18 billion worth of R&D in FY 1969, with half of this total funded by the U.S. Government. As recently as 1964, industry funded less than 44 percent of its total R&D effort.

The Battelle economists say that "businessmen depend increasingly on deliberate, planned R&D activities as a main source of corporate growth. This widespread awareness of the value of R&D activities is a relatively recent development, but here to stay."

Similarly, not-for-profit R&D funding is increasing, in part, due to money received from foundations and state and local governments. In FY 1969, nonprofit R&D activities are expected to account for 4.8 percent of all funding and to perform about 17 percent of the total R&D, as compared to 4.2 percent and 11 percent 15 years ago. R&D performed by colleges and universities has declined from about 81 to 78 percent of the total not-for-profit effort since 1963.

Sources of information for the Battelle report included the U.S. Bureau of the Budget, National Science Foundation, the McGraw Hill Survey—Business' Plan for R&D Expenditures, and analyses conducted by Battelle socio-economics research groups.

$2.996 Million Funded for WSMR Construction Projects

Construction of a $500,000 addition to the range control building at White Sands (N. Mex.) Missile Range is expected to be completed in mid-January as part of a $2.996 million range improvements program.

About one-third of the cost of the range control building is for special refrigeration and flooring. Army Corps of Engineer district engineer Ray Lunsford terms it a "very sophisticated building."

A $1.1 million Aerobee–350 meteorological rocket launch facility built for the National Aeronautics and Space Administration was completed in October. It will be operated by the WSMR Navy contingent.

Scheduled also for completion in mid-January is a $585,000 project for construction of four satellite range control buildings.

A $709,000 project for repairs to Range Routes 5, 13 and 16 is expected to be finished by August 1969. A $400,000 contract will provide a 1.5-million gallon reservoir and enlarging of the Boles Well Complex near Alamagordo. Two projects funded at $600,000 are for repair and general maintenance of post refrigeration and evaporative cooler systems, scheduled for completion in mid-1969.

VE Proposal Cuts AUTOVON Costs

Operational cost reduction exceeding $1 million will be effected in two years on AUTOVON (Automatic Voice Network) service charges as a result of a Value Engineering idea.

Edgar H. Heald of the Defense Communications Agency AUTOVON Project Management Office, Arlington, Va., recommended that the size of AUTOVON switches rented at four locations be reduced in size because minimum service charges for unused service were being incurred. The sites are at Iron Mountain, Mich.; Medford, Ore.; Cedar Brook, N.J.; and Wyoming, Minn.

Van Lydegraf Takes Command of Atlanta Army Depot

Col Dean Van Lydegraf has taken command of the Atlanta Army Depot at Forest Park, Ga., following a tour of duty as deputy commander/chief of staff, Cam Ranh Bay Support Command in Vietnam.

Col Dean Van Lydegraf

Col Van Lydegraf holds a BS degree in education from the University of Oregon and an MBA degree from Babson (Mass.) Institute. He has completed the Industrial College of the Armed Forces, the Command and General Staff College and the Advanced Management Program for Executives at the University of Pittsburgh.

The Atlanta Army Depot commander entered the Army in 1943, completed Officer Candidate School at Fort Benning, Ga., served in Europe from 1944-46, and in Korea from 1954-55. He has received the Legion of Merit, Bronze Star with V device and Oak Leaf Cluster (OLC), Army Commendation Medal with OLC, and the Purple Heart.

Pittsburgh Picks Army Medic as Grad School Dean

Distinguished service as a U.S. Army medic since 1945 has won Col Herschel E. Griffin an appointment as dean of the University of Pittsburgh Graduate School of Public Health and professor of epidemiology at the university, effective in March.

Since August 1966, he has been chief of the Preventive Medicine Division in the Directorate of Professional Service, Office of The Surgeon General, U.S. Army, Washington, D.C. He entered military service in 1945, following graduation from the University of California Medical School, a year's internship at the UofC Hospital, and surgical residency at San Francisco City and County Hospital.

Commissioned in the Regular Army in 1950, he has since served in Korea, Japan and Europe. Graduated from the first Preventive Medicine Officers Course at Walter Reed Army Medical Center, he was certified in Public Health by the American Board of Preventive Medicine in 1956. He is a graduate of the Command and General Staff College, and National War College.

His military assignments have included a tour as commanding officer at the U.S. Army Hospital, Sasabo, Japan; epidemiologist at the U.S. Army Europe Medical Laboratory and deputy for Professional Service at the 9th Hospital Center Headquarters in Europe; assistant for Professional Service to the Deputy Assistant Secretary of Defense (Health and Medical); and executive officer to The Army Surgeon General.

Col Herschel E. Griffin

Col Griffin is a Fellow of the American College of Preventive Medicine, the American College of Physicians, and the American Public Health Association. He is a member of the American Medical Association, and the Association of Military Surgeons of the United States.

He holds the Bronze Star Medal, the Army Commendation Medal with Oak Leaf Cluster, and the Republic of Korea Presidential Unit Citation.

Services Exchange Views On Tactical Air Systems

Army, Navy, Air Force and Marine Corps representatives convened recently at HQ U.S. Army Electronics Command, Fort Monmouth, N.J., for the 16th meeting of the Working Party on General Support Equipment for Tactical Air Control Systems.

Efforts of this party, one of five in the Joint Technical Coordination Group, are aimed at achieving the maximum inter-service cooperation in development of equipment and systems. The objective is to minimize overlapping of R&D activities insofar as is practicable and to produce end products suitable for all the services.

The Working Party for General Support Equipment is the largest unit within the Joint Technical Coordination Group, chartered in 1965. Other parties are concerned with radar, communications, automatic data processing, and information displays.

Miles H. Abernathy, technical consultant in the Mobility Engineering Branch of the ECOM R&D Directorate, chaired the Fort Monmouth meeting. The host was Louis J. Pilla, deputy chief, Power Sources Systems Branch, Electronic Components Laboratory. William L. Doxey, director, R&D Directorate, gave the welcoming address.

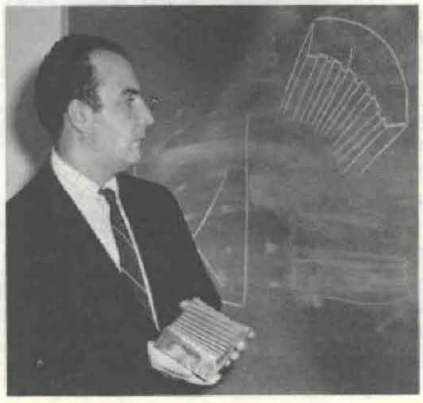
Maj Gen Paul A. Feyereisen, U.S. Project Mallard program-project manager, made one of the major presentations in describing the development of the quadripartite program (U.S., Canada, U.K. and Australia) for a joint tactical communications system.

Subgroups of the Working Party for General Support Equipment are the electrical power sources for tactical air systems, chaired by Frank Mollura of the Rome Air Development Center at Griffiss AFB, N.Y.; equipment shelters and mobility, headed by Conway W. Weikert of the Army's Natick (Mass.) Laboratories; and environmental control, with A.S. Sawyer of the Air Systems Division, Wright-Patterson AFB, as the new chairman.

Watervliet Metallurgist Reports on Surgical Implants

Techniques normally used to investigate causes of corrosion in metal gun tubes are being employed one day a week by a Watervliet Arsenal metallurgist to study stainless steels for surgical implants in humans.

Dr. Vito Colangelo works in the arsenal's process engineering section, studying environmetal effects on the fatigue crack growth rate of steel used in the Army's 175mm gun. About eight hours a week, however, he spends at the Materials Research Center, Rensselaer Polytechnic Institute, Troy, N.Y. Dr. Norbert D. Greene, chief of the RPI corrosion lab, works with him in determining the extent of corrosion on materials used in bone repair and joint replacements, as in the elbow and knee.



Dr. Vito Colangelo

A report on their investigations in the November issue of *Product Engineering* indicates that stainless steel surgical implants are generally inadequate. Dr. Colangelo is quoted as informing the recent Northeastern Regional Meeting of the National Association of Corrosion Engineers in New York City:

"It should be possible to achieve a significant decrease in corrosion incidence by redesigning some of the multi-component surgical implants, with the aim of minimizing the number of metal-to-metal interfaces."

Surgical implant corrosion effects also were discussed recently by Dr. Colangelo at Cornell University's Hospital for Special Surgery, New York City. In April he will address the American Society of Mechanical Engineer's Conference on "Environmental Effects of Failure of Engineering Materials" at Washington, D.C.

Drs. Colangelo and Greene, in collaboration with members of the Department of Orthopedic Surgery, Albany Medical College, have also reported on the problem in the *Journal of Biomedical Material Research.*

Two Chemical Products Play Strategic Role in Vietnam Combat

Two of the chemical products of the U.S. Army's Edgewood (Md.) Arsenal credited with an important role in combat operations in Southeast Asia were reported in a feature article in the November 1968 edition of the Army Digest. Permission has been granted to reproduce the following article.

They don't kill or even wound. They weren't intended for battlefield use. Yet today they are emerging as a major new development in combat support in Vietnam.

What are these agents? One is the newly battle tested (but far from newly developed) riot control powder known as CS—an agent much more effective and much less dangerous than the older CN type. The other is the use of chemical defoliants to deprive the Viet Cong of cover for ambushes and convert movement of their troops and supplies.

CS IS NOT A GAS. Neither is it a toxic chemical agent under the standard definition. It is a white crystalline powder which in finely ground form is disseminated by mechanical dispensers or explosive grenades, or in coarser form by burning type grenades.

Effects of CS on humans are pronounced and instantaneous—coughing, severe burning of the eyes, tightness of the chest, acute discomfort.

These effects are very much the same as CN, which has long been used by civil law enforcement agencies in riot control situations. But CS acts much faster, and has been proven extremely safe. It is temporarily disabling but nonlethal. Those exposed to it quickly lose their aggressiveness and seek only to reach fresh air quickly, where the effects disappear within 10 to 15 minutes, with no after-effects.

CS compound takes its name from two American chemists, B.B. Corson and R.W. Stoughton, who first reported its preparation in 1928. The British further developed the compound and compiled data on its potentialities in riot control. For the scientifically minded, it is known as orthochlorobenzalmalononitrile.

Because it is so effective and fast acting, some people believe that CS must therefore be more dangerous than CN. Actually, CS is much less toxic.

In the many tests using troop volunteers and in actual riots and battle, there has never been a fatality attributed to CS.

USE IN VIETNAM. As a newcomer to the battlefield in Vietnam, CS initially encountered considerable skepticism as to its effectiveness in combat support. This, coupled with unfamiliarity with its use and absence of proven field techniques, posed problems. But these were swiftly overcome as experience was gained. New uses and novel methods of disseminating the agent have rapidly developed. Commanders now find it a valuable weapon in combat situations when it is apparent that explosives are not the sole or best answer.

Viet Cong have frequently forced women and children to accompany them as hostages; they do not hesitate to use them as protective shields against anyone seeking to clear their tunnel hideouts. In such situations, CS quickly proved its value. Labyrinthine tunnels no longer guarantee snug sanctuary to VC snipers. At first, explosive grenades were simply tossed into tunnel openings. These proved ineffective, since some tunnels consist of as many as six levels, covering extensive areas.

A handy solution to the problem was a small, commercially produced blower known as Mity Mite, often used on farms to dispense insecticides. CS grenades are set off in the tunnel opening and the powder-like substance very much like the talcum powder that is used in training to simulate the real thing, is forced in by blower.

In one reported operation, 17 Viet Cong and some 400 noncombatants being held as hostages were forced from a tunnel complex by CS, with nobody wounded on either side. Again, 43 armed Viet Cong were captured with no friendly losses and one enemy killed when he tried to break away.

CS quickly forces those hidden in caves or tunnels to find their way to fresh air. If civilians emerge, they are escorted to VC suspect enclosures. If military emerge without firing, they are captured swiftly. Reports from Vietnam state that greatly increased intelligence, plus more cooperation from both noncombatants and prisoners, have resulted. Lives are frequently saved on both sides.

DELIVERY METHODS. When more tunnels are located than can be destroyed quickly, CS is used to deny use of the complex until supporting

Dr. Fishbein Earns 1968 NYAS Research Paper Award

Authorship of the most acceptable scientific paper on original research by a member of the New York Academy of Sciences (NYAS) earned Dr. William N. Fishbein, chief, Biochemistry Branch, Armed Forces Institute of Pathology (AFIP), the 1968 A. Cressy Morrison Award.

The $500 honorarium was presented Dec. 4 at the NYAS 151st annual banquet at the Waldorf-Astoria Hotel in New York City for a paper titled "The Structural Basis for the Catalytic Complexity of Urease: Interacting and Interconvertible Molecular Species."

The paper embodies results of applying a new sensitive gel strain for urease activity developed by Dr. Fishbein to elucidate the moleclular biology of this enzyme.

By comparing urease prepared from different sources, at different stages of purification, and after treatment with various other separation procedures, he demonstrated that the enzyme may exist in more than a dozen different structural forms.

Many of the forms are interconvertible. Previous investigators obtained varying results in the study of urease, it is believed, because they had different assortments of these molecular forms but were unable to identify them.

The structural variants of urease appear to embrace all of the varieties of protein assembly currently known. Findings suggest several additional types of assembly which may be operative for this and other enzymes.

To be eligible for this award the paper must be an unpublished manuscript submitted by a member of the New York Academy of Sciences, or have been published within the past two years under the sponsorship of the New York Academy of Sciences. The current membership of the Academy is 25,000.

Dr. William N. Fishbein

engineer troops can be brought up to destroy it efficiently. Often, smoke is forced into the tunnel to locate all exits. After an airing, the complex is inspected for intelligence information. Then CS powder is blown into the tunnel.

CS also can be forced in by connecting bags of the powder to an explosive charge, which renders the tunnel uninhabitable for at least a week; a waterproofed CS gives promise of extending this to several weeks. In routing the dug-in enemy, Infantrymen usually lob in a CS grenade, then toss in a fragmentation grenade after the first one has exploded. This dispenses a cloud of CS into the tunnel.

CS has proved extremely effective when delivered by helicopter onto a suspected enemy area. VC scamper out, even from well-camouflaged locations, gasping and seeking fresh air. As a result, U.S. forces often are able to move into large areas totally unopposed.

Dispensing the powder by helicoper effectively clears a village quickly. Inhabitants running for fresh air don't have time to hide weapons and munitions. Reports from Vietnam credit the agent with saving lives in reconnoitering villages, and it also works very well in discouraging sniper fire.

Usually psywar leaflets and loudspeakers are used to warn villagers that CS will be used if sniping persists. In one case, sniping stopped in the entire surrounding area as well as in the village under surveillance.

In one major operation the 1st Cavalry Division used CS to flush VC from fortifications, suppress automatic weapon fire and put down preparatory fires on an objective area and a whole village. Eighty VC suspects were taken with virtually no resistance.

TACTICAL USE. As part of their field tactics, the VC often move in close to U.S. troops in order to escape air and artillery attack. The tear agent is coming into wide use lately to force them to break contact.

In one operation, helicopters dropped CS grenades to blanket a small patch of jungle believed to be a fortified VC headquarters. After the area was blanketed with CS, airmobile troops with protective masks were set down by helicopter and took the area with almost no resistance.

Another use of the agent is in perimeter defense of fixed installations. CS booby traps are placed around the area, to be exploded by unwary VC trying to penetrate the defense.

Sometimes an even simpler method is used; powdered CS is simply sprayed on foliage along trails. Coughing, gasping enemy infiltrators are located easily as they retreat.

Patrols operating some distance from friendly lines spray CS behind them to prevent ambush patrols from following them down a trail. In one reported instance, a CS grenade tossed down the path gave the patrol time to set up a counter ambush.

In still another application to Vietnam, CS is disseminated preceding attack on strongly fortified positions. Entrenched areas that had successfully resisted both aerial and artillery fire have been reduced in an hour or two by combining the use of CS with maneuver and firepower.

BEER CANS AND BASEBALLS. Several methods are used to disseminate the tear agent. One type of grenade bursts. Another burns. The burning grenade (M7) resembles the ordinary 12-ounce beer can. It weighs about a pound, is armed with a quick burning fuse, (one to two seconds) and the contents burn for up to 35 seconds. An alternative fuse is available to give it an 8- to 10-second delay. The grenade can be fired from a grenade-launcher-equipped rifle, or from a grenade projector.

The baseball-size grenade (M25) is three inches in diameter and bursts within two to three seconds after the pin is pulled. It weighs about eight ounces. Its short fuse discourages the enemy from tossing it back. That same short fuse means that a grenadier can toss it high to explode in mid-air over a suspect area.

The Army also has dispersers designed to spray a finely powdered form on a target larger than can be covered by several grenades. One can be man-carried, while another type is designed for mounting on vehicles or aircraft for large area coverage. Additional types of dispersers and munitions, including cluster munitions for delivery from helicopters, have been developed.

HERBICIDES. Along with the use of the tear agent against the enemy in Vietnam, some chemicals in wide use on farms or lawns in the United States are being taken to war. These herbicides or common weed killers are the same chemical compounds that are on sale in this country at your corner grocer, hardware or agricultural support house.

Dense jungle, which is home to the Viet Cong, provides the enemy with effective ambush cover. Wooded areas along trails, roads, railroads, canals and power-lines have been a happy hunting ground for VC units until U.S. Air Force transport planes began to spread their loads of defoliating chemicals. The planes have been flying at such low levels that many are pock-marked with red-metal patches, signs of bullets through wings and bodies.

Defoliants assist our forces in gathering intelligence by permitting a view below the jungle canopy for analysis of trail activity, storage site locations, and targeting. Removal of overhanging foliage exposes the ground area to intensive photographic surveillance and direct fire.

It is obvious, of course, that neither the riot control agents nor the herbicides alone can be expected to win a war. But as an added silent weapon in the Army's arsenal, they are helping to win battles, and to achieve military objectives.

Former Chief Signal Officer Recalled for Mallard Duty

Former Chief Signal Officer (1963-64) Maj Gen David P. Gibbs has been recalled from retirement to active duty as an adviser and consultant to the United States program-project manager for the Mallard Project.

General Gibbs, who served as a captain at Fort Monmouth, N.J., from 1937-41, and retired from active service in July 1966, plans to spend slightly more than seven months of special duty with the Mallard Project. Gibbs Hall at Fort Monmouth, headquarters for the project in the U.S., is named for his father, the late Maj Gen George S. Gibbs, who was Chief Signal Officer from 1928 to 1931.

General David Gibbs graduated from the U.S. Military Academy in 1933, completed an Army Signal School course in 1938, graduated from the Air War College in 1948, the National War College in 1953, and completed studies in the advanced management program at Harvard in 1958.

Maj Gen David P. Gibbs

RDT&E, Procurement Contracts Exceed $389 Million

Army contracts exceeding $1 million each for research, development, test, evaluation and procurement from Nov. 9 through Dec. 8 totaled $389,438,013.

Hughes Aircraft Co. received a $55,371,527 multiyear contract for TOW missiles and related hardware, and a $2,214,952 modification for electronic items for Iroquois helicopters.

AVCO Corp. gained $37,699,165 in two contract modifications for T–53–L13A turbine engines and for parts for general-purpose bomb adapter boosters. Colt's, Inc., was issued a $30,312,469 modification for M16 and M16A1 rifles and Atlas Chemical Industries, Inc., $16,362,194 for TNT and support activities.

Two contracts totaling $11,299,862 with Hercules, Inc., are for 2.75-inch rocket propellant, M6 blasting caps and support services. Norris Industries, Inc., is receiving $11,140,421 for parts for 105mm cartridge cases.

Honeywell, Inc., will be paid $10,945,054 for work on bomb fuzes and 40mm cartridges (two contracts). Kaiser Jeep Corp. was issued a $10,009,217 modification for trucks.

Contracts under $10 million. General Motors Corp., $9,788,625 (three contracts) for parts for 105mm projectiles and modernization and support activities, trucks with repair parts and technical manuals, and for advanced production engineering on the XM–70 combat tank; and

Norris Industries, Inc., $9,410,342 (three contracts) for maintenance of facilities and activation of production lines for 5-inch shells, M374 parts for 81mm projectiles, and for 152mm projectiles; and

Institute for Defense Analyses, $8,600,000 in two contract modifications for basic and applied research studies and evaluations and operational analyses for the Joint Chiefs of Staff, the Director of Defense Research and Engineering, and Advanced Research Projects Agency; and

Philco-Ford Corp., $8,440,007 (four contracts for FY 69 engineering services for the Chaparral missile, 30mm guns (without barrels) for Cheyenne helicopters, continuation of the development/improvement program for the 30mm (XM140), and a counter-countermeasure program; and

Olin Mathieson Chemical Corp., $7,897,867 (two contracts) for 45-caliber cartridges, propellants and support services; Rulon Co., Chicago, Ill., $7,430,500 for parts for artillery shell fuzes; Sanders Associates, Inc., Bedford, Mass. $7,200,000 for Forward Area Alerting Radar (FAAR) and test equipment; and

Eureka-Williams Co., Division of National Union Electric Corp., $6,579,166 for parts for 750-pound-bomb fuzes; Brunswick Corp., $6,212,960 (two contracts) for 35mm launchers and for CS-filled canisters.

Contracts under $5 million. Weatherhead Co., Cleveland, Ohio, $4,930,612 (two contracts) for parts for 4.2-inch and 105mm projectiles; Standard Container Co., Montclair, N.J., $4,845,000 for ammunition boxes; Whittaker Corp., Columbus, Ohio, $4,815,080 (two contracts) for igniters for 2.75-inch rockets and parts for 81mm cartridge fuzes; and

Day and Zimmerman, Inc., $4,701,581 for loading, assembling and packing ammunition items; Bulova Watch Co., $4,492,292 (two contracts) for parts for 81mm mortar fuzes; and

John R. Hollingsworth Co., Phoenixville, Pa., $4,309,944 (two contracts) for generator sets; Chrysler Outboard Corp., Hartford, Conn., $4,127,652 for military engines; and

UNECO, Inc., Bellevue, Neb., $3,932,372 for delay plungers for M557 fuzes; Bethlehem Steel Corp., $3,848,809 (two contracts) for 175mm gun tubes; Raytheon Co., 3,822,000 for telephone signal converters; Rohm and Haas Co., $3,400,000 (two contracts) for a solid-propellant research program; and

Pullman Corp., $3,296,475 for semitrailers with Bogie assemblies; Westinghouse Air Brake Co., $3,263,841 for road graders; Amron Corp.,

OCRD Announces Assignment of 2 Officers

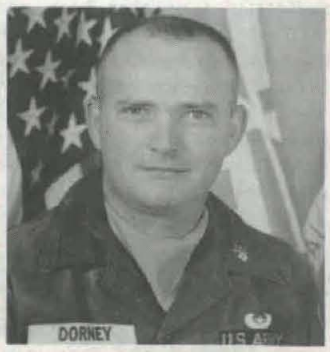
Personnel turnover within the Office of the Chief of Research and Development, Department of the Army, hit the annual low point this past month when only two new assignments were announced.

Col James J. Dorney has been assigned to the U.S. Army R&D Group, Research Analysis Corp. (RAC), McLean, Va., as Army representative to the Joint Service Office (JSO) for Advanced Tactical Command, Control and Communications.

His most recent assignment was chief, Communications Systems Division, Tactical Systems Directorate, Office, Assistant Chief of Staff for Communications-Electronics, Washington, D.C.

Col Dorney served as chief of the Scientific and Engineering Evaluation Division, U.S. Army Computer Systems Evaluation Command, in Washington, D.C., during 1967-68.

In 1966-67 he was assigned to the office of the J–6, North American Air Defense Command (NORAD) at Colorado Springs, Colo. He commanded the 39th Signal Battalion in Vietnam in 1965-66.



Col James J. Dorney

Col Dorney is a graduate from the U.S. Military Academy in 1946, the Command and General Staff College (C&GSC) in 1960, and the Armed Forces Staff College (AFSC) in 1965. He earned an MS degree in communications engineering from the University of Illinois in 1951.

Col Dorney has been awarded the Legion of Merit (LOM), Air Medal (AM) with Oak Leaf Cluster (OLC), and the Meritorious Unit Emblem with OLC.

Lt Col Charles G. F. Wahle is serving as chief of the Combat Arms Branch, Combat Materiel Division, following a tour of duty with the 4th Infantry Division in Germany.

He graduated from the University of California at Berkeley (1950) with a BS degree in civil engineering and earned an MS degree in mechanical engineering from the University of Southern California (1963). He completed the C&GSC (1961) and AFSC (1967).

Recent assignments include a tour with the U.S. Military Assistance Command Vietnam (MACV), service with the U.S. Infantry Board at Fort Benning, Ga. (1963-65), and with the 502d Infantry, 101st Airborne Division at Fort Campbell, Ky. (1958-60).

Lt Col Wahle holds the Bronze Star Medal (BSM), AM with OLC, and the Army Commendation Medal (ARCOM) with two OLC.


Lt Col Charles G. F. Wahle

$3,136,635 for parts for M43A1 grenades; Federal Cartridge Corp., $3,119,397 for 5.56mm cartridges; and

Baldwin Electronics, Inc., $3,101,760 for loading, assembling and packing 2.75-inch rocket motors; Dynalectron Corp., $3,071,879 for data collection services for missiles in flight and other test vehicles; United Aircraft Corp., $3,000,000 for rotor heads and gear boxes for CH–54 helicopters; and

Chrysler Corp., $2,858,948 for combat tanks and armed vehicle launcher bridges; Lockheed Aircraft Corp., $2,810,068 for rotary-wing blades, hydramatic servo cylinders and transmissions for AH–56A helicopters; Bell Aerospace Corp., $2,425,000 for HH–1K search and rescue helicopters; and

Continental Motors Corp., $2,411,330 for engine assemblies for M60 tanks; Caterpillar Tractor Co., $2,396,817 for tractors and repair parts; Philips Broadcase Equipment Corp., Paramus, N.J., $2,375,000 for far infrared target indicators; and

Baifield Industries, Dallas, Tex., $2,354,000 for demountable body vans; Studebaker Corp., $2,338,830 for 60-kw generator sets; Western Electric Co., $2,284,470 (two contracts) for Nike Hercules technical publications and support of the Sentinel System production program; and

Litton Systems, Inc., $2,191,000 for scientific and technical efforts for the Combat Developments Command; Bendix Corp., $2,150,000 for a stabilized platform and power supply for the Pershing missile system.

Contracts under $2 million. ACF Industries, Inc., $1,999,800 for M52 fuze bodies. Steward-Warner Corp., $1,948,991 for 60mm projectile parts; Wilkinson Manufacturing Co., Fort Calhoun, Neb., $1,921,500 for 60mm mortar fin assemblies; and

Associated Spring, Bristol, Conn., $1,862,623 for 5.56mm cartridge clip and filler magazines; Chamberlain Manufacturing Corp., $1,853,747 for 4.2-inch projectile metal parts; Farmers Chemical Association, Inc., Tyner, Tenn., $1,801,800 for production of mixed acids; and

Booz-Allen Applied Research, Inc., $1,796,020 for scientific and technical effort in support of military doctrine programs for the Combat Developments Command; Wire and Metal Specialties Corp., Warren, Pa., $1,749,126 for 5.56mm cartridge clips; Harvey Aluminum, Inc., $1,745,560 for 40mm projectile parts; and

Atlantic Research Corp., $1,655,834 for loading of rocket motors for the Redeye missile system; Garrett Corp., $1,633,470 for repair parts for self-contained transportable medical units; Schlumberger, Ltd., Archbald, Pa., $1,611,000 for computers; and

International Harvester Co., $1,500,000 for loaders; American Bosch Arma Corp., Springfield, Mass., $1,485,367 for metering fuel pumps with compensators for 2½-ton trucks; Cadillac Gage Co., Warren Mich., $1,410,000 for armored cars; and

S. Tepfer and Sons, Inc., Deer Park, N.Y., $1,315,279 for metal parts for Shillelagh missile warhead sections; Hayes International Corp., Birmingham, Ala., $1,275,300 for warheads for 2.75-inch rockets; Philips Broadcast Equipment Corp., Paramus, N.J., $1,214,120 for hand-held night-vision devices; and

Aerojet General Corp., $1,212,855 for bomb dispensers; U.S. Plastic Molding, Inc., Wallingford, Conn., $1,208,840 for 40mm projectile parts; Hughes Tool Co., $1,194,330 for OH–6A helicopter hub assemblies; Pace Corp., $1,193,550 for parachute flares; Collins Radio Co., $1,114,500 for AN/TRC–132 radio sets; General Electric Co., $1,009,281 for parts for the 20mm Vulcan gun.

40mm Grenade Launcher Goes Into ET/ST Phase

Advanced production engineering tests of a weapon intended to give the rifleman a dual capability of point and area fire—a 40mm grenade launcher attached to the underside of the M16 rifle—have started at Aberdeen (Md.) Proving Ground's Materiel Test Directorate (MTD).

The pump-action launcher developed by AAI Corp., Cockeysville, Md., is designed for attachment to both the M16A1 rifle and a submachinegun prototype, the XM177E2, a variation on the M16. If successful during the second phase of the tests, the rifle-launcher combination could replace the Army's standardized M79 grenade launcher, a shoulder-fired weapon resembling a blunderbuss or sawed-off shotgun.

The single shot attachment weighs less than three pounds, comes with sights adjustable up to 400 meters, and fires the standard family of ammunition available for the M79 grenade launcher. Materiel Test Directorate coproject engineers are Eric J. Keele and George Hendricks.

Since last May, the launcher has gone through a battery of subtests to determine performance characteristics and to assess compatability with the M16 rifle and submachinegun now under development.,

Engineer design tests completed in August served to evaluate performance of the weapon under such conditions as dust, mud, rain, salt water immersion and temperature extremes.

In the dust test, the launcher and ammunition were subjected to a dust mixture blown at a rate of five pounds per minute. For the mud test, the launcher was submerged in a mud mixture of red clay, sand and water. The muzzle of the weapon was taped in both dust and mud tests to prevent clogging.

To determine effects of a heavy rainfall on functioning performance, the test item was sprayed from a special shower head positioned three feet above it at an approximate rate of 24 inches per hour.

Corrosion effects and operational reliability were evaluated by immersing in a solution of 20 percent salt to 80 parts water by weight for a minute; they were exposed to high heat and humidity conditions for the duration of the test period. With temperatures ranging from 70 to 150°F., and relative humidity levels from 85 to 97 percent, the weapons were fired on the first, third, fifth, eighth and tenth days without the aid of cleaning or additional lubricant.

In climatic testing, the weapon was subjected to 155°F. above and 65° below zero temperatures for six hours prior to firing.

To evaluate accuracy and velocity, the launcher was fired from 50 meters (just outside hand-throwing range) to 400 meters.

The tests being conducted at MTD are part of a program for the U.S. Army Materiel Command (USAMC), Washington, D.C.

Col Leroy S. Stanley, director, Infantry Materiel Testing, U.S. Army Test and Evaluation Command, is coordinating the over-all test program. Service testing also is under way at USATECOM's Infantry Board, Fort Benning, Ga.

The grenade launcher is a development program of the U.S. Army Weapons Command, Rock Island, Ill.

M16 RIFLE WITH AAI 40MM SINGLE SHOT PUMP LAUNCHER

Electronics — The Armor of the Eighties

(Continued from page 2)

because of increased accuracy and effectiveness.

How can electronics replace gimbals? In inertial guidance, the new "strapdown" systems employ computing for three or four platform formations from the body axis of the missile to which gyros and accelerometers are affixed into a computer-maintained inertial reference frame. The trade is one of electronic computing for three or four platform gimbals and torquers. Strapdown enthusiasts tell us that the trade is a profitable one.

The Army Aviation Materiel Laboratories are currently engaged in making an elegant trade of electronics for bell cranks, push rods, control wires, and the like. In a CH–47 tandem-rotor helicopter, an inertial system, together with a special-purpose computer, will replace the existing mechanical controls, sensors and mechanisms, with an estimated savings in weight of over 500 pounds.

These, then, are some of the trades that one can make of electronics for something that costs more or weighs more. But electronics can be far more useful than that. It can influence—is influencing—battlefield tactics.

There is, I think, a mutually regenerative effect in the coupling between developing tactics and the developing use of electronics. This effect, I believe, has been enhanced by the problems encountered in the pursuit of unconventional wars of the kind in which we have been engaged in Vietnam.

Previous wars have been simplistically described as wars of inventory, of logistics, of masses of forces. Sheer weight and bulk of supplies and ammunition could tip the balance toward victory even with force ratios close to unity.

In Vietnam, mass is clearly not enough. The application of our forces in ratios to enemy force of five to one or ten to one does not, by itself, do the job, even when our forces are totally supported by the world's finest logistic system. What is required to win is the application of force with exquisite precision upon the concealed, fleeting, dispersed bands of enemy. This is where, today, electronics is playing its most important tactical role.

Electronic detection devices and sensors are helping to bring about a tactical revolution, by providing the means for alerting us to the presence and whereabouts of an enemy before he gets within firing range and for pinpointing location when he fires.

The cumbersome radars of World War II have evolved into miniature devices that one or two soldiers can carry and use. Some new ones will penetrate dense jungle foliage and detect a single man long before he can be seen or heard. Several kinds of night-vision devices permit finding an enemy in moonlight, starlight, or in no light at all. The Chemical Sniffer, which is mainly electronic, locates the enemy on the basis of his effluents.

Acoustic, seismic and magnetic sensors, borrowed from developments for antisubmarine warfare, now alert the soldier to the presence of intruders. Infrared detectors can precisely locate the gun muzzles from which the enemy rounds are fired. This array of new sensory devices fashions our operations differently in two important ways: First, in facilitating night operations; and second, in opening the range at which we can fire on the enemy with accuracy and effect.

The defensive options available on the battlefield are few. If a force has adequate warning, it may either maneuver to avoid enemy fire or, if it is able, deliver preemptive fire against the enemy, or it may protect itself by operating from behind a heavy shield-armor.

These tactics may be traded, one for the other; because this trade is possible, electronics can increasingly serve in place of armor.

What can we anticipate in the eighties? I think we derive a clue to one answer by examing two contemporary systems. The counter-mortar radar, in use on the battlefield today, detects and tracks mortar shells in flight in order to compute the positions of the mortars from which they were fired.

The Sentinel radar system detects and tracks ballistic missiles with such precision that defensive missiles can be launched and guided to intercept them. As General Betts, Chief of Research and Development, has put it, the Sentinel System is designed virtually to "shoot down one bullet with another." And in fulfilling its function, the Sentinel System becomes the protective shield—the armor—for our cities.

On the basis of these systems, one is entitled to make a speculative extrapolation. I suggest for your consideration small, fast-scanning, phased-array radars, perhaps aided by infrared, and able to detect and track incoming bombs, artillery shells and mortar rounds. Then counterweapons will be speedily, automatically and precisely directed against the incoming munition, and will destroy or disable it before it arrives within lethal radius of its target.

Today, we encumber personnel carriers and tanks with heavy bottom armor to defeat mines. Our experience with the Chemical Sniffer prompts me to believe that the eighties may bring devices that will literally smell out and point out explosives, sparing us the need for armor.

Armor in yet another sense means, to the Army, tanks. Can electronics of the eighties reduce our dependence on these massive vehicles? It may well do just that. However, I doubt if it does. Rather, I believe that the use of electronics will make the tank a more useful vehicle, and indeed it will be necessary to do this as application of electronics to airborne and man-car-

MERDC Assigns Lt Col Woolaver as Deputy Commander

The U.S. Army Mobility Equipment R&D Center (MERDC), Fort Belvoir, Va., has announced assignment of Lt Col Philip A. Woolaver to succeed Maj Thomas H. Huber as deputy commander. Maj Huber is now chief of the MERDC Systems Engineering Laboratory.

Lt Col Woolaver is a U.S. Army Corps of Engineers career officer who served at the center as executive officer (1966-67) until assigned as post engineer, HQ U.S. Army Vietnam.

Prior to entering the Army in 1953, he earned a BS degree in civil engineering from the University of Toledo and in 1957 did post-graduate work at Ohio State University. He has completed the Engineer Officer Basic and Advanced Courses at Fort Belvoir, the U.S. Army Language School at Monterey, Calif., the Civil Action School at Fort Gordon, Ga., and the School of the Americas in the Panama Canal Zone.

Major assignments have included service with an engineer construction battalion in France (1954-57); Army Intelligence in Washington, D.C. (1959-61); officer-in-charge of a satellite tracking station in Hawaii (1962); project engineer at Cape Canaveral (1963-64); and with the U.S. Army Mission in Ecuador (1964-66).

Lt Col Philip A. Woolaver

ried antitank weapons renders present tanks more vulnerable.

The TOW and Shillelagh missiles are extremely effective; their descendants, especially when equipped with infrared and night-vision sights that permit firing the missiles effectively at night, and with computers that permit their being launched from high-speed platforms like the Cheyenne helicopter, may alter our doctrinaire views on the utility of armor.

The tank itself will have to use electronics to give a detection shield around it in order that the tank commander can know, under varying weather and nighttime conditions, what may be threatening him. He can then take action to defend the tank—to defend it so the tank can carry out its primary function of penetration and disruption through attack.

In my discussion thus far, I have considered primarily the detection, location and guidance aspects of electronics. But there is yet another way in which electronics, in the eighties, will be extensively and directly applied to shield our forces from the enemy—electronic warfare. As the utilization of electronics in detection, location and communication grows, so does the vulnerability to electronic countermeasures.

The future will see, I believe, extensive use of jamming to spoil the enemy's battlefield communication, thus to destroy the synergy of his forces. His radars, his missile guidance systems, even his laser rangefinders, will be attacked and disabled, electronically, by jammers that are logically controlled to deliver the kind of signal to which his devices are most vulnerable.

I would like, now, to return to what I believe to be the fundamental reason that this symposium has assembled—to create an opportunity to improve the match between requirements and technology. Under our Army organization, General Kinnard's Combat Developments Command performs the research and experimentation that leads to the specification of combat organization, doctrine and tactics and then to the determination of the characteristics of the combat equipment needed to support the constantly evolving fighting techniques.

A fundamental difference between the Army and its sister services make General Kinnard's job extraordinarily difficult: The Army is not just a *user* of weapons systems: it *is* one. It is an extraordinarily complex and interlocking one, comprising hosts of those notoriously unpredictable logical and motor elements, human beings.

The subdivisions of the system are those of any weapons system: input sensors for target detection and location; pattern-recognition devices and other means for target identification; facilities for target tracking; and then the computing and mental facilities for threat evaluation, weapon assignment, and weapon release; and finally, the weapons and the means for their guidance and control.

Linking the system is the net of communications and supporting it are the system transport, engineering and logistics. General Kinnard cannot and does not blindly answer the questions: "How should the Army fight? How should it be organized? How should it be equipped?" To restate that, it is not true that Roger Bacon developed gunpowder in response to a CDC requirement.

The requirements-development process is a closed-loop system: CDC tells industry, industry tells CDC, and repeat ad infinitum, as the Army as a fighting weapons system evolves.

In this evolutionary process, industry offers many marvelous ideas. But the improvements to be gained by their adoption are often fragmentary.

The benefits may be lost in the noise unless the other links in the Army weapons system are simultaneously strengthened — if, for example, the new night-vision device is not closely coupled to the gun; or the new gunship tightly linked, communication-wise and navigation-wise, to the patrol leader calling for support. Or if, in the introduction of hosts of new sensory devices, provision is not made for the sifting and correlation of the millions of bits of data obtained from them, so that the field commander is presented with assimilable amounts of information rather than deluged with trivia.

I am convinced that you, in this audience, representing industrial members of the Electronics Industries Association, will contribute enormously to the development of the Army—and the electronic armor—of the eighties. And, with your help, the Combat Developments Command will mold contributions into unsurpassed living, breathing, fighting systems.

Missile Command Evaluating Pershing 1-A Support System

Maintenance evaluation of the Army's Pershing 1-A weapon system's ground support equipment has started at Redstone (Ala.) Arsenal.

The evaluation is being performed by the Command's Supply and Maintenance Directorate and the Arsenal Support Operations Directorate, Test and Procedures Branch, under the direction of Lt Col Edwin A. Rudd, project manager.

The evaluation is scheduled over a 3-month period. Equipment to be evaluated includes the System Components Test Station, Battery Control Central, Improved Erector Launcher, and Improved Programmer Test Station.

The Pershing 1-A program involves a shift from tracked vehicles to wheels for all ground support equipment, including the erector-launcher. The change stems from a continuing search for increased mobility and reliability, decreased maintenance and lower overall costs.

TECOM Designates Col Molloy Director of Testing

Director of Infantry Materiel Testing is the new title of Col Cornelius J. Molloy Jr. at the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

Col Molloy, who succeeds Col LeRoy S. Stanley, was assigned to the Infantry Materiel Testing Directorate after a year of duty as deputy commander of the Army Concept Team in Vietnam. He is responsible for directing all of TECOM's test and evaluation of Infantry weapons, ammunition and equipment at 15 installations in the continental United States, Alaska and Panama.

Graduated from the U.S. Military Academy in 1944, he was commissioned in the Infantry. He served in Europe with the 75th Infantry Division during World War II and was with the 3d Infantry Division in Korea in 1950 and 1951. In all, he took part in nine major campaigns, including the recent Vietnam Counteroffensive, Phase III, and the Tet Counteroffensive.

Col Cornelius J. Molloy Jr.

Other assignments have taken him to Fort Bliss, Tex., where he taught Infantry tactics at the Antiaircraft Artillery and Guided Missile School, and to the Antilles Command in Puerto Rico as the G-3 training officer.

In Washington from 1960 to 1964, he served in the Office of the Chief of Research and Development and was then assigned to the Infantry Training Center at Fort Dix, N.J., until he was ordered to Vietnam in 1967.

The colonel's decorations and awards include the Bronze Star Medal with two Oak Leaf Clusters, Legion of Merit, Army Commendation Medal with Oak Leaf Cluster and the Combat Infantryman Badge.

Kudos

MICOM CG Maj Gen Charles W. Eifler, Edmondson, Lowers, and Black

Maj Gen Charles W. Eifler, CG of the U.S. Army Missile Command (MICOM), recently honored three employes at Redstone Arsenal, Ala., for outstanding contributions to the Army missile and rocket programs.

Exceptional Civilian Service Awards went to *Horace Lowers*, MICOM chief engineer, and to *Robert Black*, chief of the Systems Assessment Division, Quality and Reliability Management Office. *Earl Edmondson*, deputy project manager for the Shillelagh Missile System, received the *Meritorious Civilian Service Award* (MCSA).

All were cited for ". . .dynamic leadership, technical proficiency in areas of engineering and management and exceptional performance of duties."

Marvin B. Schaffer received the MCSA from Col Roger Ray, Picatinny Arsenal CO, for his contributions to development of "Beehive" ammunition while employed at the arsenal in Dover, N.J. Schaffer is now with the Rand Corp., Santa Monica, Calif.

Legion of Merit. *Lt Col James C. McCraw*, chief of the Policy Branch, Management and Evaluation Division, OCRD, received the LOM for service as assistant chief of staff, G2, HQ Second Infantry Division from September 1967 to August 1968.

He was cited for reorganizing the Division Counter Agent Company and reorienting the operations of the G2 Section. The result was "a more efficient, more responsive organization that increased significantly the intelligence and counterintelligence capabilities of the command."

Lt Col Robert Sherman was awarded the LOM for outstanding service as research and development coordinator and as chief, Joint Research and Development Section, Military Assistance Advisory Group, Federal Republic of Germany, from June 1965 to June 1968.

Lt Col Sherman is now serving as a military assistant with the Missile Development Division, U.S. Army Advanced Ballistic Missile Defense Agency, OCRD.

Maj Fred C. Berry Jr., who has been serving with the Behavioral Sciences Division, U.S. Army Research Office, OCRD, since May 1968, received the LOM for service as assistant S3 and S3 with the 196th Light Infantry Brigade in Vietnam.

Bronze Star Medal. *Lt Col Howard F. Stone*, assigned to the Air Mobility Division, Office of the Chief of Research and Development (OCRD), since July 1967, received the BSM for his actions in the successful lodgement of a new Special Forces camp at Tan Rai in a Viet Cong area in Vietnam.

As aviation officer of the 5th Special Forces Group, 1st Special Forces, Lt Col (then a major) Stone was personally responsible for execution of the first C–130 container delivery system airdrop in a combat zone. Delivery of essential equipment was accomplished within 36 hours without the loss of an aircraft.

Lt Col Herbert E. Williams, Programs and Budget Division, OCRD, received the BSM for outstandingly meritorious service in Vietnam from July 1967 to June 1968.

He was cited for "rapid assessment and solution to numerous problems inherent in a counterinsurgency environment. . .energetically applying his sound judgment and extensive knowledge, he has contributed materially to the successful accomplishment of the

MICOM Director Gets Honorary Degree From Auburn U.

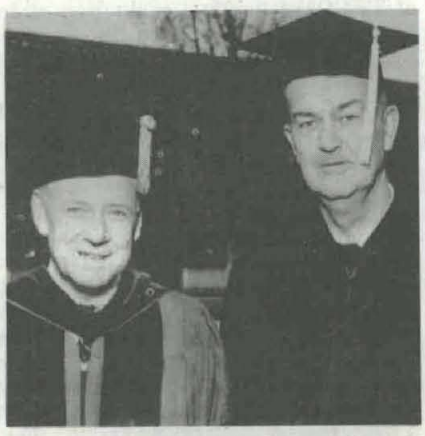
Honorary doctor of science distinction was conferred recently by Auburn University upon John L. McDaniel, technical director of the U.S. Army Missile Command's Research and Development Directorate.

Auburn president Harry M. Philpott presented the award to McDaniel as one of three Alabamians to receive an honorary degree. The others were Dr. Clifton Cox, group vice president of Armour Food, Chicago, and D.K. Caldwell, president of Caldwell Oil Corp., Tyler, Tex. All three were cited for professional accomplishment at the executive level.

McDaniel has served in his present assignment with the Missile Command since January 1962, and has a BS degree in chemistry from Berry College, where he graduated magna cum laude.

His career as an Army civilian employe began in 1942 at Redstone Arsenal when it was known as Huntsville Arsenal, and its mission was loading chemical shells instead of developing missiles. Following military service with the Navy, he became an aeronautical research engineer, later moving into the field of rockets and missiles. He is now responsible for the scientific and technical efforts of laboratories and project divisions which emcompass all phases of missile and rocket development.

In addition to numerous Missile Command awards, McDaniel has received the Army Research and Development Achievement Award, the Meritorious Civilian Service Award, the Decoration for Exceptional Civilian Service, the Presidential Award for Distinguished Civilian Service and the Department of Defense Distinguished Civilian Service Award.



AUBURN PRESIDENT Harry M. Philpott (left) and John L. McDaniel, technical director of the MICOM R&D Directorate, Redstone Arsenal, Ala.

United States mission in the Republic of Vietnam."

Joint Service Commendation Medal. *Col William H. Tucker Jr.*, received the JSCOM for services as an operations staff officer, J–3, Joint Chiefs of Staff (JCS), from June 1967 until his assignment in November 1968 as executive officer, OCRD.

He was commended for planning proficiency that enhanced the readiness of the National Military Command System, JCS, to accomplish necessary actions in emergency conditions. The citation states, in part: "His wide experience, outstanding planning and diligent application of effort produced outstanding results and were of major importance in the development of concepts that bear directly on United States strategic warning capabilities."

Lt Col Clarence L. Williams, assigned recently as chief of the Low Altitude Systems Branch, Air Defense and Missiles Division, OCRD, earned the JSCOM for outstanding service as an operations staff officer, Joint Task Force 2, Washington Liaison Office, from August 1967 to June 1968.

"Using outstanding judgment and insight into mission philosophy and test requirements," the citation states, "he assisted in establishing the necessary structure for the Task Force program actions, including effecting close and mutually beneficial liaison with DoD agencies and with members of the scientific community."

Lt Col Leo P. Hobbs, Southeast Asia Division, OCRD, distinguished himself while serving as a test design officer, Analysis and Reports Directorate, Joint Task Force Two, from September 1967 to June 1968.

The citation lauds Lt Col Hobbs for his performance in "providing technical support and operational expertise in air defense which resulted in obtaining a realistic modeling program on air defense weapon systems against aircraft flown in an extremely low altitude environment."

Army Commendation Medal. *Lt Col Robert L. Russell*, since March 1968, a staff officer with the Space Branch, Nike–X and Space Division, was awarded the ARCOM for meritorious service from 1964 to 1968 with the 10th Artillery Group, U.S. Army Europe.

Capt Anthony J. Graffeo received the ARCOM for his contributions to the research and exploratory development programs in explosives, pyrotechnics and propellants while serving as a staff officer with the Energy Conversion Branch, Physical and Engineering Sciences Division, Army Research Office, OCRD, from 1966–68 until released from active duty.

SCIENTIFIC CALENDAR

American Society for Testing and Materials Winter Meeting, Denver, Colo., Feb. 2-7.

Advanced Airbreathing Propulsion Conference, sponsored by AFAPL and Aerospace Corp., El Segundo, Calif., Feb. 4-6.

Transducer Conference, sponsored by IEEE, Washington, D.C., Feb. 10-11.

Tactical Missile Systems Meeting, sponsored by AMC and AIAA, Huntsville, Ala., Feb. 10-12.

Aerospace and Electronic Systems Winter Convention, sponsored by IEEE, Los Angeles, Calif., Feb. 11-13.

National Meeting on Composite Materials: Testing and Design, sponsored by ASTM, New Orleans, La., Feb. 12-14.

VTOL Systems Conference, sponsored by AIAA, American Helicopter Society and Georgia Institute of Technology, Atlanta, Ga., Feb. 17-19.

International Solid State Circuits Conference, sponsored by IEEE and the University of Pennsylvania, Philadelphia, Pa., Feb. 19-21.

10th Annual West Coast Reliability Symposium, Beverly Hills, Calif., Feb. 21.

Symposium of Differential Thermal Analysis, sponsored by The Chemical Institute of Canada, Toronto, Ontario, Canada, Feb. 25-26.

Air Force and Industry System Safety Conference, Las Vegas, Nev., Feb. 25-28.

MECOM Adds 2 Members to Scientific Advisory Group

Appointment of a professor and a retired industrialist as additional members of its Scientific Advisory Group was announced recently by HQ U.S. Army Mobility Equipment Command, St. Louis, Mo.

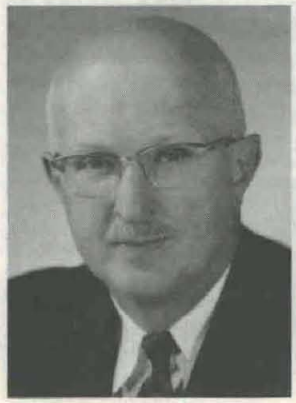
Dr. Theodore J. Wang of American University, Washington, D.C., and Dr. George L. Haller, former vice president of General Electric Co., are the new members of the SAG, now composed of nine industrialists and educators.

SAG was organized in the fall of 1967 to advise the CG of the Mobility Equipment Command (MECOM) on scientific and technical matters. The group meets at the U.S. Army Mobility Equipment Research and Development Center, Fort Belvoir, Va., principal field agency of MECOM, which is a major subcommand of the U.S. Army Materiel Command.

Dr. Wang, a physicist, is professor and director of operations research and director of the Institute for Creative Studies at American University. He received his doctorate from the University of Illinois in 1939 and was a post-doctoral Fellow at the University of Minnesota in 1941-1942.

He has taught at Ohio State University and the University of Massachusetts and was professor and head of the Physics Department at South Dakota School of Mines and Technology. With the National Bureau of Standards he was a physicist, with Research Analysis Corp. an analyst, and with Booz-Allen Applied Research was principal scientist. He was vice president and director, Washington Office of Mathematics.

Dr. Theodore J. Wang



Dr. George L. Haller

Dr. Haller received BS, MS and PhD degrees in physics from Pennsylvania State University. He also has been awarded an LLD degree from Syracuse University, an honorary doctor of science degree from John Stetson University, and an honorary doctor of humane letters degree from Susquehanna University.

Dr. Haller has been a radio engineer with the Westinghouse Electric and Manufacturing Co. and with the War Department at Wright Field. During World War II, he served with the Signal Corps and, later, the Air Corps. He attained the rank of colonel and was awarded the Legion of Merit for development of the Air Force radar countermeasures program.

After the war, he was dean of the College of Chemistry and Physics at Pennsylvania State University and helped found the consulting firm of Haller, Raymond and Brown, Inc., now a division of Singer Manufacturing Co. He joined General Electric Co. in 1954 as manager of its Electronics Laboratory, and, later, was general manager of the firm's Defense Electronics Division.

In 1958, he was elected a vice president and from 1962 until his retirement in 1967 he was general manager of the Advanced Technology Services and a member of the executive office. He is also a member of the Advisory Board, Naval Ordnance Lab, Penn State; board of directors, Chomerics, Boston; board of directors, Geonics, Inc., Toronto, Canada, and consultant for Deering Millikan Corp.

BRL Studying Nonmetallic Bands to Improve Artillery Shells

By E. V. Clarke Jr.

Directing fire for a zoned artillery piece confronts the field battery commander with two problems that at present cannot be handled in a predictable manner. For the close support role, he must be able to deliver accurate fire on target without endangering his own infantry; for certain targets-of-opportunity, he must be assured of a high first-round hit probability, or risk losing his target to protective cover after firing the first round.

Available to him in the field is a variety of ways of accurately determining target range. Through the firing tables, methods also are available for handling variation in muzzle velocity due to variations in projectile weight, leveling of weapon, barrel wear, etc. In some instances, he may have chronographs that allow him to measure directly the muzzle velocity of his weapon.

Unfortunately, these tools are of no help insofar as muzzle velocity error due to unpredictable sources are concerned in certain weapons systems.

Two of the sources are the so-called first-round effect and the "creep effect." First-round effect is variation in muzzle velocity peculiar to the first round fired from a cold gun. The creep effect is a gradual upward trend in muzzle velocity when firing a series of rounds at the same zone or charge level.

These factors directly influence first-round hit probability when firing low-propellant charges. While these effects do not exist across-the-board for all zoned artillery weapons, they are present to a degree large enough to be considered a problem.

The Ballistics Research Laboratories (BRL) of the Aberdeen Research and Development Center, Aberdeen Proving Ground, Md., recently initiated studies into what could be the major contributing factor controling some of the present unpredictable sources of error in computing muzzle velocity.

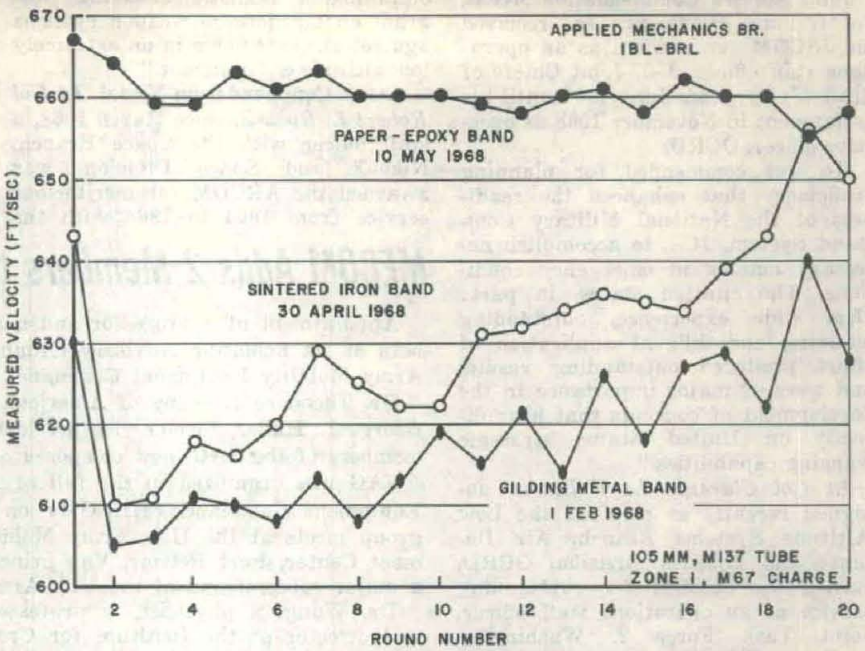


Fig. 2. Velocity Measurements for Three Series of 20 Rounds

Ballisticians in this country and abroad have believed for a number of years that first-round and creep effects could be minimized or eliminated by using nonmetallic rotating bands on artillery shells rather than the gilding metal presently used.

Tests designed to prove this hypothesis have been conducted at the BRL, where a new concept for nonmetallic rotating bands has been developed. This band is applied to the artillery shell after first removing the gilding metal rotating band, machining away the old band seat and knurling the refinished metal.

After thorough cleaning, and drying, the new band is made by wet wrapping concentric layers of epoxy-impregnated paper tape over the band seat, using the simple apparatus shown in Figure 1. Following this operation, the band is oven-cured and machined to the desired shape.

Performance of the gilding metal, sintered iron and the nonmetallic rotating bands was compared by firing three series of rounds in an instrumented 105mm howitzer, light, towed, M102. Barrel strains and temperature were measured at six stations down the length of the gun tube. Chamber pressure and projectile velocity were also recorded.

The gun tube was thoroughly cleaned and dried before each series of rounds was fired and star gauge measurements were made prior to the beginning of the tests. No conditioning or "warmer" rounds were fired before the test rounds so that the gun tube could be considered "cold."

Twenty rounds were fired in each series, with as short a time interval between rounds as instrumentation would permit. Attempts to maintain a 3- to 4-minute interval between rounds were generally successful.

Results of the velocity measurements taken for the three series are

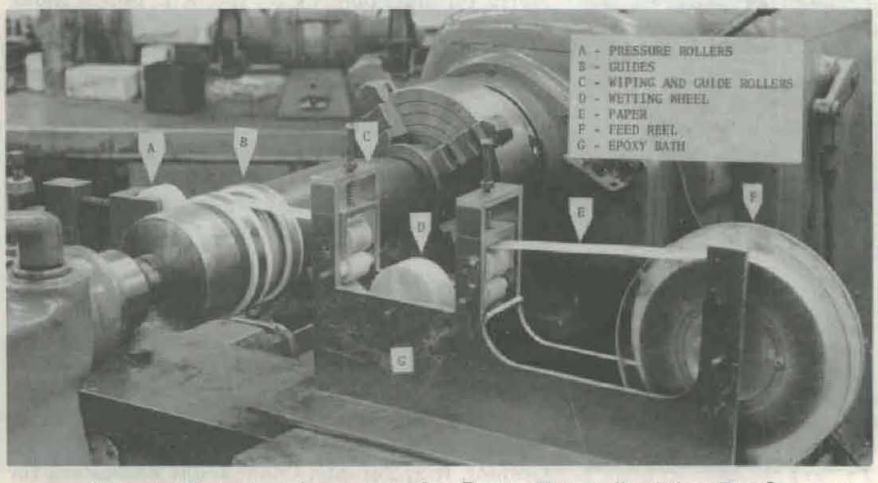


Fig. 1. Wrapping Apparatus for Paper-Epoxy Rotating Bands

shown in Figure 2. The graph shows strong evidence of the first-round effect and the creep effect for both the gilding metal and sintered iron rotating bands. These effects are practically nonexistent for the nonmetallic, composite banding material. This type of band then shows great promise in eliminating at least two of the nonpredictable type errors in muzzle velocity variation.

Additional firing tests have shown that while the particular banding material tested is remarkably successful at the Zone I level, it performs erratically at Zone VII. Efforts, therefore, are being directed toward improving the band material and techniques of application so that the band will behave acceptably at all velocity levels in the present test weapon. A quick answer to this problem is anticipated, since the wrapping technique used here offers a high degree of flexibility in the selection of adhesives and filler materials.

A very important by-product of these tests lies in the results yet to be obtained through the complete analysis of the data recorded during firing. These records should reveal the underlying causes for these ballistic effects, removing them from the realm of the nonpredictable to the predictable.

Emerson V. Clarke Jr. is a physicist assigned to the Applied Mechanics Branch, Interior Ballistics Research Laboratories (BRL), Aberdeen Proving Ground, Md. He received a BS degree in physics from Loyola College in 1950 and joined BRL in October of that year.

Up to 1959 he helped set up and equip the outdoor, large-caliber firing ranges for the laboratory and did exploratory work in determining low-velocity launch techniques for the 105mm howitzer. From 1966, he was chief of the Ballistic Range and Experimental Ballistic Sections.

Clarke is currently investigating sources of inaccuracy of zoned-artillery weapons such as the contribution made by the interaction of the projectile rotating band and the gun tube.

Satellite Communications Marks Decade of Progress

Satellite communications marked a decade of progress Dec. 18 as a dramatic new technology that presents the means of uniting nations everywhere in the conquest of time and space for better understanding.

Significance of the launching on the U.S. Army's SCORE satellite, which a few hours later on Dec. 18, 1958, carried President Eisenhower's Christmas message to the world, was recognized by the *New York Times*. The *Times* included the feat on a list of the most important innovations during the past 100 years.

President Eisenhower's message, the first human voice heard round the world from outer space, stated in part: ". . .Through this unique means, I convey to you and to all mankind America's wish for peace on earth and good will to men everywhere."

Project SCORE was to the U.S. Army Signal Research and Development Laboratories at Fort Monmouth, N.J., and the U.S. Army Ballistic Missile Agency, Redstone (Ala.) Arsenal, the beginning of an enviable record of achievements in the nation's space program. Many of the present Army Satellite Communications Agency personnel are R&D pioneers in the conquest of space. They have also played a major part in such achievements as the launching of TIROS in 1960, the world's first weather satellite and COURIER in 1960, second to SCORE as an active communications satellite; and in 1960–1962, management of the ADVENT satellite communications program.

SATCOM Agency is the Army project manager with responsibility for providing the ground environment for all Department of Defense satellite communications systems. Since 1962, SATCOM has evolved many different classes of satellite communications terminals, ranging from massive fixed stations through smaller and smaller transportable configurations to newly developed jeep installations and still new manpack designs.

In combination with U.S. Air Force efforts on satellites, SATCOM-developed terminals circle the globe as the ground segment of successful, operational satellite communications systems. These systems dependably and with ever-increasing efficiency carry military traffic 24 hours a day—a long way from SCORE's lone satellite and five ground stations in the United States and its 12-day life.

Not so dramatic is the progress toward realization of President Eisenhower's and America's continuing wish for "Peace on Earth and good will to all men everywhere." Each anniversity of Project SCORE, coming appropriately at the Christmas season, serves to reiterate and revitalize that wish—that eternal hope of men of good will.

Mallard Project Review Draws Dignitaries

Department of Defense, Army and Air Force high-level representatives participated Dec. 13 in a progress report and review of the Mallard Project at Fort Monmouth, N.J.

Principal Deputy Director of Defense Research and Engineering Dr. Finn J. Larsen was among dignitaries who heard reports on the joint effort of the United States, United Kingdom, Canada and Australia to develop an automated tactical communications system.

Dr. Larsen, who is the United States representative on all intergovernmental cooperative military programs, was accompanied by Maj Gen Gordon T. Gould Jr., director of Command Control and Communications for the Air Force; Rear Adm Victor A. Dybdal, deputy director, Plans, Defense Communications Agency; Maj Gen Robert E. Coffin, the Army's Deputy Chief, Research and Development; and Brig Gen Harold Rice, Army Deputy Assistant Chief of Staff for Communications-Electronics.

Presentations and discussion indicated that the Mallard Project is moving on schedule toward the goal of putting the unified communications systems into the field in the 1975–77 period.

The Mallard staff included members of the International Program Management Board, each a program-project manager for his country, Maj Gen Paul A. Feyereisen, U.S.; Brigadier Harry Roper, U.K.; Lt Col Douglas C. Coughtry, Canada; and Lt Col Lisle G. Moore, Australia.

Since ratification by the U.S., Canada, and Australia in April 1967 and by the United Kingdom the ensuing September, the Mallard schedule has been advanced over two-thirds of the way through the crucial system study phase in which the participating governments and their contractors are working out the detailed system design.

Although visualized primarily as Army-oriented at the outset, Mallard's scope as an interservice effort has been greatly expanded by the four participant countries. In addition to the Army, the United States has full-time staff members from the Air Force, Navy and Marine Corps at project headquarters.

USATACOM Using Mathematical Models for Mobility Evaluation

By William F. Lins

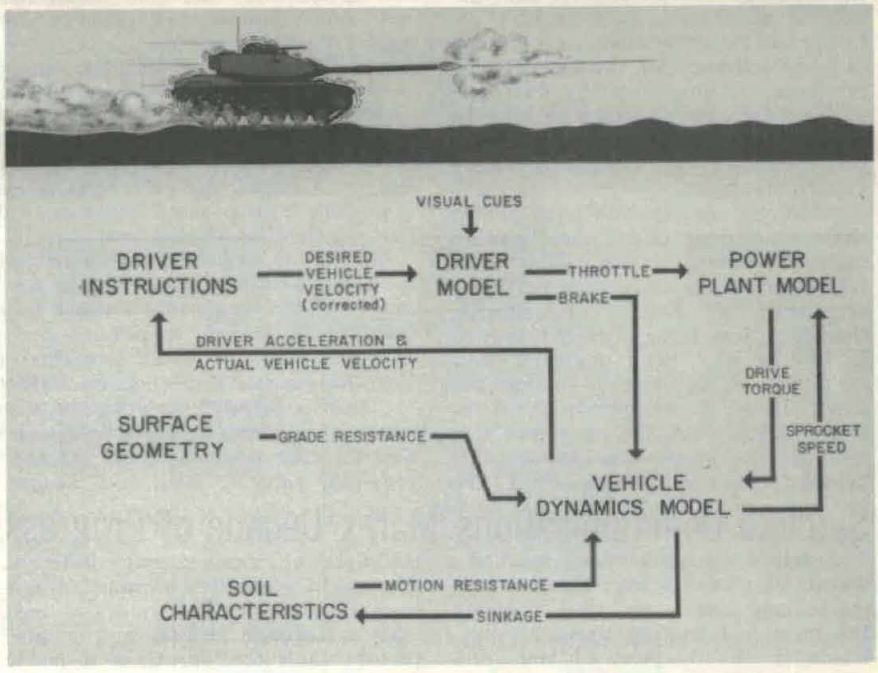
Everything has an Alpha (a beginning) but, contrarily, OMEGA (normally meaning the end) also signifies the early phase of an ambitious project of the U.S. Army Tank-Automotive Command (USATACOM), Warren, Mich.

In this case, OMEGA stands for Off-road Mobility Evaluation and Generalized Analysis. It denotes the task of a study group established by Dr. Ernest N. Petrick, USATACOM chief scientist and director of laboratories, to develop mathematical models and computer programs to describe reliably the performance and mobility of vehicles under a wide variety of terrain and climatic factors.

Under the direction of Richard J. Otto, director of the Mobility Systems Laboratory, and Fred Pradko, chief of the Scientific Computer Division, a group of engineers, mathematicians and computer specialists is assigned to the OMEGA project. The objective is to develop methods of determining guidelines for decisions on investment of research, development, test and evaluation (RDT&E) funds.

Prior to development of the OMEGA computer programs, now less than a year old, a search of existing literature pertinent to the project was conducted. The survey included research conducted by the U.S. Army Waterways Experiment Station (WES), the U.S. Department of Transportation, Cornell Aeronautical Research Laboratory, Booz-Allen Applied Research Inc., General Motors Defense Research Laboratories, Ohio State University Research Group, and other organizations.

Segments of OMEGA programs already have been helpful to the TATAWS (Tank/Antitank Weapons System) and REVAL Wheels (Reevaluation of the Army Tactical Vehicle Program) studies. In the future, it is envisioned that such organizations as the Institute of Land Combat and the Army Materiel Command Systems Analysis Agency may find OMEGA's computer techniques of value.



Mathematical Model of Vehicle/Man System

The technical approach being taken by OMEGA is to describe, by means of mathematical models and computer analysis, vehicle systems in operational environments and to calculate parameters that affect performance and influence design quality. Primary areas of investigation include ride dynamics, crew vibration, automotive performance, soft-soil mechanics, obstacle performance, water egress, firing stability, small unit combat action, and forecasting state-of-the-art design by using linear programing techniques.

To predict and evaluate the over-all performance of the vehicle/man system, each individual system model is combined, as shown by the illustration. This model can be used to predict the vibration and impact effects of the driver and, in turn, the over-all performance of the vehicle/man system. Each section is an integral part of the total system and is included for realistic evaluation. If a change is made in one subsystem, the effects of this change on the total system can be determined.

Two methods of analysis are presently being used in the areas of vehicle ride dynamics and crew vibration. These methods are time and frequency domain analysis. In the time domain, all variables are calculated as a function of time. The frequency domain considers the frequency response of specified variables.

Both methods for analyzing ride dynamics require a mathematical description of the vehicle system and environmental conditions. Environmental conditions considered are terrain profile and soil characteristics. Terrain profiles are broken into two classes: macro and micro profiles. Macro-terrain profiles include such features as vertical and horizontal obstacles, hills, grades and riverbanks.

Micro-terrain profiles represent the "roughness" of a piece of terrain. This roughness may be described in three ways: (1) by a set of measured elevations along a given path, (2) by a properly filtered noise signal generating a randomly varying profile as a function of time, or (3) by a power spectral density (PSD) estimate of a terrain profile.

In the time domain, vehicle systems are modeled by using differential equations to describe the motion of the vehicle in two dimensions along

WILLIAM F. LINS is an electrical engineer in the Scientific Computer Division of the Mobility Systems Laboratory, U.S. Army Tank-Automotive Command, Warren, Mich. In 1963 he earned a BS degree in electrical engineering from Washington University, St. Louis, Mo., and spent the following two years studying for an MS degree in systems and automatic control at Washington University while working for McDonnell-Douglas Corp.

with the motions of various components. Coefficients of these equations represent the various spring rates, damping characteristics and the sprung and unsprung masses of the system.

Such models will accept nonlinear coefficients, allowing realistic simulation of the latest and most sophisticated developments in suspension systems. The solution of the ride dynamics equations may be performed either on an analog or digital computer.

Equations are solved on the analog computer through the use of electronic integrating circuits giving a continuous solution to the problem. On the digital computer, numerical integration techniques are used to generate a time solution of the system equations. To analyze a system in the frequency domain, the system equations are transformed to a set of algebraic frequency response functions using Fourier Transforms. The input to these functions is the PSD estimate of the terrain profile. This type of analysis is limited to linear parameters, but since the equations are algebraic expressions, no integration is necessary; therefore, the speed of solution is greatly increased.

This is the greatest single advantage of frequency domain analysis, which also produces a compact program that is easily solved on low-cost time-sharing computer systems, giving a designer immediate feedback on parameter changes.

Evaluation of vehicle vibration and ride dynamics on the crew can be accomplished by using an analytical model representing the human being. This model is a set of transfer functions describing the effective mass of the seated man. These relations have been created for six modes of motion; for an "average" man in an upright seated position they are vertical (spinal), vertical (feet), longitudinal, transverse, pitch and roll.

For each mode the transfer functions are used to find the force on the subject. This force is then used to compute the rate at which energy is absorbed by the body.

The energy flow takes place as a result of the damped, elastic properties of the human anatomy and the flow rate is designated "absorbed power"—a ride severity measure used to determine the point at which the driver's ability to control the vehicle may be impaired.

The area of automotive performance, not including ride dynamics, is studied by means of a single program capable of simulating the linear performance of a wheeled or tracked vehicle over a course with a specified macro-terrain profile.

The program lends itself to the study of the quantitative effect of major vehicle subsystems on vehicle performance, including velocity-time, distance-time, fuel consumption and gradability. Included in the performance program are separate models representing the engine, transmission, driver and course.

Effects of soil characteristics on performance are being combined with automotive performance, and presently can be analyzed in terms of sinkage, slip, soil thrust and motion resistance for various vehicle configurations. The analytical approach uses the USATACOM Land Locomotion Division procedures, which relate the mechanical deformation properties of soils to a wheel or a track.

To forecast state-of-the-art values for various vehicle and performance parameters, a method has been developed that uses linear programing techniques. Mathematical expressions relating these parameters are synthesized from historical data. Using this data allows physical characteristics of a vehicle to be predicted.

The number of parameters that can be predicted and studied is limited only by the number of mathematical expressions used to describe them. This approach is easily adaptable to trade-off analysis, and is oriented for use in parametric design studies.

The OMEGA working group is expected to complete the first test cases this month. Results of the study will be used to provide guidance to project engineers in components selection; also, to evaluate vehicle systems and predict vehicle/man interactions. This systematic analysis and trade-off evaluation will aid in making engineering improvements to present and future Army vehicles.

U.S. Army Briefs Canadians on 1970-80 R&D Trends

Canadian Department of National Defence and Defence Research Board representatives recently concluded a tour of U.S. Army Munitions Command, Weapons Command and Tank-Automotive Command installations for briefings on R&D trends for the 1970–80 period.

The exchange of information on technological advances in weapons, ammunition and other materiel was a part of U.S.-Canadian cooperation in line with the quadripartite (American, British, Canadian, Australian —ABCA) agreement on weapons standardization and development efforts.

Col J. D. Park, senior standardization representative, U.S. Army Standardization Group-Canada, and Lt Col W. W. Bradley, his associate as weapons and munitions representative, accompanied the Canadian group on tours of U.S. Army Materiel Command facilities.

Briefings on U. S. Army R&D activities were given at the Picatinny (Dover, N.J.) and Frankford (Philadelphia, Pa.) Arsenals, HQ Electronics Command at Fort Monmouth, N.J. and HQ Army Tank-Automotive Command, Warren, Mich. In turn, the visitors reported on Canadian R&D.

Advances in electronics technology were reported during the Defence Research Board visit to the Electronics Command, where briefings were headed by Dr. Hans K. Ziegler, ECOM deputy for science and chief scientist. Dr. G. W. Hull of the Communications Laboratories, Defence Research Telecommunications Establishment, headed the 16-member Canadian delegation.

Emphasis during the tours and briefings at Picatinny and Frankford Arsenals was on progress in development of new weapons systems, ammunition and propellants, and related materiel. Activities and objectives in developing mobility equipment were detailed in briefings by Army Tank-Automotive Command R&D leaders.

Department of National Defence visitors to other AMC installations included Maj Gen D. A. G. Waldock, deputy chief of Engineering; Brig Gen W. K. Lye, director, General Ordnance Systems; Col A. C. Bowes, director, Project Management; Col W. J. Owens, director, Vehicle and Field Engineering (DVFE); Col H. E. Staples, director, Armament Engineering (DARME); and

Lt Col D. C. Badenoch, Canadian liaison officer, U.S. Army Materiel Command; Lt Col D. M. McNaughton, senior staff officer for Equipment, HQ Mobile Command; Cmdr N. T. Malcolm, Directorate of Ammunition (DAMMO); Lt Col J. Adams, commander, Land Engineering Test Establishment; Maj D. H. Clark, Canadian Defence Liaison Staff, Washington, D.C.; Maj D. G. Porter, DARME; Maj D. V. Geary, DVFE; and W. G. MacDonald, DAMMO.

The Defence Research Board was represented by R. P. Blake, deputy for Defence Research with the standardization office in Washington, D.C.

ARO-D Supports Arctic Environmental Changes Mobility Study

Information presented in this article is the result of Prof. Harley J. Walker's work as principal investigator on a research study project titled "Arctic Environmental Changes."

The study was supported by the U.S. Army Research Office-Durham (N.C.) under contract with the Arctic Institute of North America. The purpose was to gather information on an area in Alaska considered analogous to that of the north-flowing Siberian rivers.

U.S. Army environmental sciences research in the cold regions is a part of an over-all program directed to the goal of achieving an all-weather capability for operations in any part of the world when an emergency develops.

Prof. Walker is chairman of the Department of Geography and Anthropology at Louisiana State University, Baton Rouge, La. Presently he is on sabbatical leave for a year with the U.S. Office of Naval Research in London, England.

Transportation in Arctic Deltas During Spring

By Prof. Harley J. Walker

In discussing "Prerequisites of Mobility" in an article in the May 1968 edition of the *Army Research and Development Newsmagazine*, the late Robert R. Philippe said there is an "inherent need in any mobility system to produce a balance between the vehicle and the conditions in nature which will permit it to operate."

Further, he wrote, "as we continue to push into the more remote and undeveloped areas of the world, an understanding of these inherent needs is being thrust upon us." This contention is supported by recent discovery of vast new oil fields on the Brooks Range of the Alaskan mountains. Numerous requests from developers are soliciting critical information on terrain and climatic conditions.

The Arctic, remote and undeveloped, is increasing rapidly in economic, military, political, scientific and social importance. It offers challenges rarely encountered in most other parts of the world.

Some of the most important, yet perplexing and intriguing, of these challenges are those related to transportation. Indeed, in the past, success or failure, more often than not, hinged on transportation. It does not appear that the immediate future will bring any major change in this situation in the Arctic.

Most parts of the earth possess a great number of very different landscapes, some of more importance to man than others. One of the most significant is the delta. Deltas frequently serve as the locale in which settlements are established, despite the fact that they present a greater variety of natural characteristics to which man must adapt than most landscapes.

Deltas are composed of a mixture of rivers, lakes, land (for example, tundra polygons in the case of arctic deltas) and the ocean. It is in the extreme contrasts between seasons that arctic deltas tend to differ most from non-arctic deltas.

During winter, all water bodies (river, lake and ocean) are virtually extensions of the land. During the short summer, water and land are somewhat more distinct. However, because of the thin active layer, low permeability and slow runoff, much of the tundra surface appears only slightly less liquid than the infinite number of lakes which are present.

Although the two extreme seasons provide landscapes that are very distinct, transportation possibilities during them are quite clear-cut. For example, in winter, land vehicles have relatively easy going for the ice of lake, river and sea and the frozen tundra surface provide a firm base. Pilots can land in deltas virtually any place they desire because of the great number of frozen lakes.

In summer, overland vehicles, although able to wend their way around most lakes, are nonetheless confined to limited areas because of the numerous distributaries which block their way. These same distributaries, however, make boat travel feasible. Aircraft landings with wheels on sandbars and mudflats (except after heavy rains or during flood stages), or with boats on lakes and rivers, are easy.

The period of transition, "spring," varies in time (inception, duration, cessation) for the many parts of the arctic deltaic environment — tundra, lakes, river and ocean. For purposes of this discussion, the division of the transitional period between winter and summer that applies to rivers will be used, i.e., (1) prebreakup flooding, (2) breakup, and (3) postbreakup flooding.

In late winter, rivers, lakes and ocean are covered with ice which on the north coast of Alaska and northwest Canada normally averages between 1.5 and 2 meters in thickness. In the shallow portions of water bodies, the ice is bottom-fast whereas over the deeper portions it floats.

Even though there is water beneath the ice in those river channels that are sufficiently deep at time of freeze-up, it does not necessarily follow that there is flow seaward. Large rivers, such as the Mackenzie and the Ob, do flow even in the winter, although at a highly reduced rate. Moderately sized rivers, such as the Colville in Alaska, and smaller rivers, such as the Blow in Canada, do not flow in winter.

Superimposed over this entire surface is a snow cover which varies in depth. Generally on relatively smooth surfaces, such as those of river and lake ice, it is quite thin. However, in areas with rougher surfaces, drifts may form. In deltas, deep drifts are found at riverbanks and sand dunes.

Once the snow begins to melt, the season of surface transition is initiated. The snow melts first from the mudflats and sandbars which, accompanied by some thawing of the surface, become very muddy.

The only flow of melt water at first is toward the middle of the channel on the surface of the ice. As the amount of melt water increases, water will begin to flow downstream on top of the bottom-fast ice and under the floating ice. From the time water begins to flow under the ice until breakup, floating ice fluctuates up and down with discharge.

The most conspicuous feature about the river during the period of prebreakup flooding is the contrast between flooded areas and floating ice. Flooded areas—shallow portions of the distributary channels, shallow portions of those lakes which are connected to the river, and the sea ice just off the front of the delta—vary greatly in extent, the amount depending upon the stage of the river.

Floating ice is an excellent indicator of the deepest channels in a river system. It indicates where water was deeper than ice thickness (about two meters in the Colville River) at time of freeze-up, which is normally the period of lowest stage during the hydrologic year.

The period of breakup in small and medium-sized deltas usually last only a few days though much fluctuation of stage is likely to occur. If the water level is rising during breakup, most of the ice will be carried seaward.

If breakup occurs on a falling stage, however, river ice will be stranded on sandbars and mudflats. The time at which those will become available for use as landing strips will vary greatly depending upon the amount of ice left stranded. Even after this ice has melted, it is usually

some time before the surface of these water-logged bars can be used.

Post-breakup flooding frequently occurs before the summer flow (that flow resulting mainly from rain) begins. Duration of this flooding varies greatly and is dependent mainly on the rate of snow melt in the upper reaches of the river.

The three periods mentioned in this article as separating winter from summer vary greatly in length from one year to the next and, to some extent, from one delta to another. In the case of the Colville, the average duration is about five to six weeks, usually from late May to early July.

The sequence of events especially characterizes the changes occurring in the river and those portions of the delta directly connected with the river. The tundra surface, the lakes and the ocean all have sequences that vary in both type and timing.

Snow melt, which brings about the first surface change, flows lakeward as well as riverward. Lakes tend to have a change similar to that of rivers in the initial stages.

Since lakes are self-contained units, their ice does not break up in the same way as river ice. Lake ice floats in place (although it will shift some because of wind) and gradually melts. Thus, large, deep (over two meters) lakes will have ice in them for a month or so after the river is free of ice. The ice itself may usually be used by aircraft for some time after river ice has broken.

In summary, deltas present an environment during the period of transition in which movement as presently developed is virtually impossible except by helicopter. The various parts of the landscape vary, however, in the time during which use is possible. During the prebreakup flooding of the river, planes (ski and wheel) can still land on lake ice but surface movement is very limited.

After the post-breakup floods have subsided sufficiently, float planes can be used on the rivers even though not on lakes. On the other hand, wheel planes normally cannot be used at this time because river bars and flats are still likely to be covered with water and ice, or at least still too wet for landings of these aircraft.

Army Cold Regions Knowledge Aids Alaskan Oil Field Development

Knowledge of environmetal and terrain factors in the cold regions gained by the U.S. Army through research during the past 25 years, directed fundamentally toward military objectives, is proving essential to development of new Alaskan oil fields.

This time the "spin-off" (side) benefits derived from Army research and development, which over the years have aggregated billions of dollars toward the economic growth of the nation, may lead to one of the biggest payoffs in history. However, development of the recently discovered large oil fields on the north slope of the Brooks Range in Alaska presents many formidable problems. Foremost among these are extreme cold, forbidding terrain and difficult access.

In continuing experiments and tests of materiel and equipment dating back to World War II, the U.S. Army has acquired invaluable information in expanding its capability for military operations "in any environment, in any part of the world." Alaska, because of its proximity to Russia at the far end of the North American Continent, has been a prime area of research.

Developers of the new oil fields are now coming tc the Army for aid in coping with such conditions as sea ice that covers the Arctic Ocean along the northern coast of Alaska much of the year; also, a land mass of permanently frozen ground (permafrost), which shows only shallow thawing during a short summer.

Added to these obstacles are winter temperatures that sometimes go to 80 degrees F. below zero; also, the sun staying below the horizon to cause prolonged darkness each winter at Barrow on the arctic coast of Alaska.

Scientific knowledge of the over-all conditions in the vicinity of the Alaskan oil field discovery and the technical know-how of how to live and work in the environment is concentrated at the U.S. Army Terrestrial Sciences Center (the U.S. Army Cold Regions Research and Engineering Laboratories until redesignated recently) at Hanover, N.H.

CRREL was established in 1961 through relocation and consolidation of the Corps of Engineers' Snow, Ice and Permafrost Research Establishment (SIPRE) at Wilmette, Ill., and the Arctic Construction and Frost Effects Laboratory (ACFEL) at Waltham, Mass. In 1962, jurisdiction of CRREL was transferred to the U.S. Army Materiel Command.

Now, as the Terrestrial Sciences Center, the installation is staffed with scientific and technical personnel who have many years of highly specialized experience in basic and applied research, including exploratory development and engineering related to climatology, meteorology, snow, ice, frozen ground and other operational factors.

Representatives of several companies interested in exploitation of the Alaskan oil field discovery have visited the center for information and guidance. Response to such inquiries is consistent with Public Law 89–487, the "Freedom of Information" statute.

William K. Boyd, chief engineer of the center, explained the Army policy with respect to providing assistance that may eventually contribute to the economic growth of the nation, stating:

"We confer with all who come seeking information on a first-come, first-served basis. Within the confines of our competence and the safeguards of national security, we are glad to help whenever we can. It is our hope that these natural resources will be developed wisely and not exploited ruthlessly, despoiling the terrain."

Questions related to feasible access routes, site selection for living and working areas, foundation design, sources of gravel and stone products, construction techniques, water supply and distribution, sewage disposal, road and airfield construction, ship-to-shore facilities, operational and maintenance problems, and many other related factors are directed to the center. Inquiries are referred to staff specialists in each of these areas.

In most instances, the desired information has been accumulated through U.S. Army research and development activities to learn how to conduct military operations successfully in the arctic areas, and to investigate the effect of the harsh environment on military materiel. Numerous reports have been published and made available to science and industry through the Clearinghouse for Federal Scientific and Technical Information (CFSTI), 5285 Port Royal Road, Springfield, Va. 22151.

Much of the work of the center leading to the preparation of manuals for design and construction criteria has been supported and guided by the Chief of Engineers, U.S. Army. Qualified requesters may obtain these manuals from the Corps of Engineers.

The Terrestrial Sciences Center is constantly seeking to broaden its knowledge of factors related to developmental, operational and materiel problems in the cold regions. "Feedback" of information to the center from other sources having a similar interest will further the center's capability of contributing to various developmental projects linked to the nation's economic growth.

Lt Col John E. Wagner is commanding officer and director of the center.

'Moonlighting' Results in First 'Bug' . . .

Dr. Zahl Explains Electronic Eavesdropping Origin

Permission has been granted to publish excerpts from *Electronics Away,* Dr. Harold A. Zahl's lively account of his 36-year career as an Army scientist credited with a major role in the development of electronics, in response to an urgent World War II need.

The September edition of the *Army Research and Development Newsmagazine* carried a brief review of this book, published by Vantage Press, Inc., New York City. Since the book gives an intimate insight into many of the U.S. Army's contributions to the development of radar and subsequent related inventions, permission to excerpt from it is appreciated.

The first excerpt follows. Future editions will carry other selections.

★ ★ ★

THE ORIGINAL "BUG." Here let me insert a short tale about some early intrigue involving Army communications. Not so long ago considerable publicity was given to an intelligence story concerning a small radio transmitter the size of and looking like an olive, its antenna disguised like a projecting toothpick.

This device in a Martini glass was capable of picking up voice and transmitting it a short distance by radio—an eavesdropper at Washington cocktail parties where there could be some espionage potential. Furthermore, everyone who watches TV knows that from shows like "The Man from U.N.C.L.E.," and from stories written by Ian Fleming, radio "bugs" now seem a part of everyday life. But there had to be a first one.

We go back to 1932 when F.D.R. moved into the presidency, principally on planks to repeal the Eighteenth Amendment and drastic measures on economy in the Federal Government. At Monmouth, because there was no money lying about to be saved, in the interests of economy we were ordered to reduce our personnel by 25 percent, bringing us down to about 45 people while, simultaneously, our work week and pay corresponding were cut down to four days.

"Moonlighting" was officially sanctioned. Of course that meant one had to find something to do which carried a reimbursement, for the Great Depression stalked the country.

Lt H. O. Bixby had an idea. Why not pick some of the best talent in the labs and start a small corporation which in spare time might conceivably develop a commercial product having sales value? Thus under New Jersey law, The General Television Corp. came into being. No salaries were paid; participants only kept track of time they worked for the corporation.

People like H. O. Bixby, Jack Hessel, Harry Trees, Drs. Golay and Hershberger and myself would spend evenings and many long weekends working on things we thought might sell even in the Depression. Our first few ideas weren't too good. And then it dawned on us—the realization that the busiest people in the country seemed to be those in law enforcement agencies. Perhaps, we reasoned, we could sell them something that would help in combating crime.

All of us being electronically oriented, our thoughts naturally gravitated toward something in the radio field. Our financial supporter of that time, Leo Meade, a detective, suggested that if we could only make a very small radio transmitter capable of secretly picking up any voice in a room and transmitting it down the street or elsewhere in the same building we would have something "real hot." Disguising the radio so its presence would be unsuspected, and then by listening to the conversation with a remote receiver,—"Oh my," said Detective Meade, "there would be many applications, some legal, others not so legal . . . but very useful!"

Yes, it was a natural, and under Lt Bixby's drive we all enthusiastically went to work in our little laboratory in Jack Hessel's basement—Hessel being a top Signal Corps radio engineer and Dr. Golay one of the Army's best physicists.

The disguised form factor for the radio was to be an innocent-looking briefcase, not at all conspicuous in any room or office.

Our engineering objectives included a battery capable of 24 hours of continuous operation, and development of a sensitive crystal microphone that could pick up any voice within 40 feet and transmit by radio as far as one mile where a special receiver could make the intercept. We would pick a part of the radio spectrum where the chance of anyone else tuning in would be very small.

The project moved forward rapidly, and with amazing success. Surely for the small weight involved, our effort represented an entirely new level of engineering achievement for lightweight radios. So we built a dozen or so of these sets, contacting offices like that of the U. S. Attorney General, state police organizations, city police chiefs, detective bureaus, and others. Acceptance was instantaneous and very enthusiastic. Under trials, the "bug" responded marvelously in a number of real-life situations where the presence of an old beat-up briefcase in no way restricted a number of very interesting conversations going on in the room or cell "bugged."

But law enforcement agencies of the early 1930's were also pressed for dollars; and although the interest was great, it was soon evident that because of high construction costs our product had to be priced out of range of the legal purchasers of that day.

Of course we could easily have sold the device for unscrupulous and clandestine purposes beyond the pale of the law, but on this course of action our answer was strongly in the negative. We knew, for example, of a few cases where if certain types of people were able to "borrow" sets, the uses to which they were put could have been very embarrassing to us if made public.

So declining questionable profits, as a corporation we went bankrupt, even though very educated in lightweight radio design techniques.

But my story doesn't end here. The requirement for lightweight military radios was ever increasing in its urgency as horses and mules were being replaced by motor vehicle, with combat tactics speeded up accordingly. So, again, with Hessel leading the way, working in the labs at Fort Monmouth, in 1936 the Signal Corps was proudly able to announce the "Walkie-Talkie." Perhaps never in the history of government-supported research has a product moved so quickly through development into procurement and troop issue.

Yes, it was the skills and techniques first learned and used in the "briefcase bug" that did so much to hurry the completion of this most important military communications project, and at bargain rates to the government because the research came for free!

Oakland University Appoints Dr. Petrick to Visitors Board

Dr. Ernest N. Petrick, chief scientist and technical director of laboratories, U.S. Army Tank-Automotive Command, Warren, Mich., was named to an 8-man board of visitors established recently by the Oakland University School of Engineering at Detroit.

Composed of distinguished senior executives from a wide range of industries in southeastern Michigan, the board will assist in making plans for engineering education at the university. The board held its first meeting Dec. 6 to review existing school programs.

Dean John E. Gibson said that establishment of the board coincides with the yearlong dedicatory program planned for the university's new $5 million Dodge Hall and initial expansion efforts under a $570,000 National Science Foundation grant to expand the school's graduate engineering programs.

Trends in Military Vehicle Batteries

By Joseph Reinman

Average users are inclined to regard a storage battery as a "dirty black box," to be recognized and condemned only when it fails to crank an engine. In reality, it is a complicated electrical component which absorbs punishment inflicted by other component malfunctions—often from the vehicle operator's lack of understanding of electrical system principles.

Advanced tremendously in recent years by scientific progress, today's battery is a carefully designed component. Research and development have provided a large variety of innovations, many of which have been incorporated into military vehicle electrical systems.

For example, batteries have been designed to withstand vehicle, engine and gunshot vibration. Research has also revealed the importance of battery location in vehicles to permit easy maintenance, a suitable "living temperature'" range (80° F. plus or minus 20), and engine cranking with a minimum line voltage drop.

Other innovations include hermetically sealed batteries to ensure freshness upon activation; also, improved overcharge capabilities designed into the battery to protect it from effects of malfunction voltage regulators.

In addition to these advances, the battery of the future promises to bring other significant improvements, some aimed at extending its life. One important factor that will determine its life is whether or not it is being provided with the correct charging voltage. Different charging voltages are required for arctic regions than for the tropics—or for other conditions of hot or cold.

An automatic means of providing voltage adjustments over these temperature extremes will soon be employed in military vehicles.

One technique involves a device which constantly measures battery internal temperature. Based on the temperature of the electrolyte, the unit provides an electrical signal to the voltage regulator, causing a related change in charging voltage. This method is currently being evaluated at the Yuma (Ariz.) Proving Ground. Final winter testing is scheduled at Fort Greely, Alaska.

A second method of automatic charge control, currently under study, uses a device to measure rate of battery gassing. This technique appears to be more suitable for sophisticated vehicle electrical systems.

With the advent of the high-impact, thin-wall, plastic containers for standard-sized batteries (external size), more power can be obtained from the same cubic volume. New designs are expected to increase capacity by 15 to 20 percent. See-through walls will permit visual electrolyte level inspection.

Joseph Reinman earned a BS degree in physics from St. Joseph's College in Rensselaer, Ind., and has completed one year of graduate study at the State University of Iowa. He joined the professional staff of the predecessor organization to the U.S. Army Tank Automotive Command in 1950. Reinman is an electrical engineer (equipment) in the Vehicular Components and Materials Laboratory.

The plastic, one-piece battery top and noncorrosive, braided plastic handles are already standard on most military batteries. New SLI (starting, lighting and ignition) batteries have been made part of the standardized military battery group.

For specialized applications and low-temperature operation, U.S. Army Tank-Automotive Command (USATACOM) engineers have developed a standard-sized nickel-cadmium battery. The main interests here are long life under extreme temperature variation, elimination of current leakage of the metal case, maintenance of waterproofness, and provision of an economical means of rebuilding the battery.

The need for a battery state-of-charge indicator for driver information has become increasingly apparent. To be effective, this device must show a vehicle operator the amount of battery capacity remaining under any operational condition.

Obtaining reliable information depends upon numerous variables such as battery temperature, age, history, quality and type of charging system, and storage condition. One promising method involves measuring the dielectric constant of the electrolyte.

One of the basic tools for engineering long, dependable service into a battery is the use of "Application and Installation Standards." These include information concerning proper battery size and number, temperature control, ventilation, cables, connections, hold-down facilities, battery-supporting components, manuals and specifications to promote good field practice. Standards are updated periodically, along with the technical manuals to reflect innovations.

A recent development in the battery field is the dry-charged, water-activated, immobilized electrolyte, lead-acid battery. USATACOM engineers are studying methods of producing immobilized, dry electrolyte that can be carried inside the battery while it is being shipped. Presently, the electrolyte is transported in a separate container along with the battery.

A recent feasibility study and a subsequent contract led to the development of methods of preparing the electrolyte in a dry form. Unlike the conventional sulfuric acid-water type, dry electrolyte will remain in an immobilized state inside the battery. The battery is activated by adding water.

A standard, military 6TN battery requires about two gallons of sulfuric acid electrolyte which is shipped externally. Approximately 30 percent of the package volume is water.

Using the empty spaces within the battery to contain immobilized, dry electrolyte would eliminate the need to ship water and sulfuric acid in a separate container. Benefits would be reduced volume, weight and transportation costs.

A few problems still must be worked out before dry electrolyte can be used successfully in the field. For example, the cells of a 6TN are activated conventionally by adding roughly 1,000 cubic centimeters of sulfuric acid electrolyte, having a specific gravity of 1.280.

More than this amount of the currently available dry electrolyte is needed, however, to meet the military requirement of 100 ampere-hours for this battery. Furthermore, government-imposed regulations preclude making the battery larger to accommodate additional electrolyte.

USATACOM and industry engineers are working on several possible solutions to this problem—by improving organic and inorganic gelling agents, improving electrolyte methods, and developing thin-wall containers to obtain increased internal volume.

Three methods of obtaining water-activated immobilized electrolyte batteries are undergoing evaluation at USATACOM. Each shows considerable promise, and completion of the water-activated battery development program is expected by 1970.

Short Light Pulses

By Dr. Robert J. Lontz

Dr. Robert Lontz, associate director of the Physics Division, Army Research Office-Durham (ARO–D), N.C., directs more than 100 grants and contracts at universities and industrial laboratories concerned with problems of interest to the Army in atomic and molecular, solid-state, low-temperature and optical physics. He graduated from Yale in 1958 and joined the ARO–D staff after receiving a PhD in physics from Duke University in 1962.

Some prominent laser researchers are now focusing much of their time on the subject of extremely short pulses of light, due to excitement stemming from recent discoveries that it is possible to pack megawatts of power into bursts of light that last only picoseconds (one picosecond is a millionth of a millionth of a second).

Proposed scientific and technological applications suggest that the new phenomenon is not destined to remain a laboratory curiosity for long.

The key to producing such unusual light pulses involves a technique of modulating lasers known as "mode locking." Even the laser has a degree of incoherence represented by different modes that oscillate at very nearly the same frequency, but usually with random phase.

If the phases of each of the modes are in some way fixed relative to one another, the laser is said to be mode-locked. The effect on the laser is to make its output pulse-like, with the pulses shorter as more modes are locked together.

The first mode-locking experiments were carried out some time ago at Bell Laboratories, using the helium-neon laser and modulating the laser with an electrically driven diffraction cell in the laser. Since this laser has few modes, the output pulses are relatively long. This is not the case with the typical solid-state laser, as dramatically demonstrated by researchers at United Aircraft when they reported mode-locking of neodymium-doped glass lasers. In this case, the mode locking was achieved automatically by virtue of the amplitude modulation properties of a saturable dye in the laser cavity.

The spectra of these lasers suggested that thousands of modes were being locked together to produce pulses lasting only one-tenth of a picosecond, although there was no way to be sure because the response of conventional detection is orders of magnitude too slow.

The question of just how long mode-locked pulses are was published using a technique publicized by International Business Machines and Bell Laboratories. The most common way of measuring the pulse duration now is to reflect a beam of mode-locked pulses back on itself in a material fluoresced by 2-photon stimulation.

Due to the nonlinear response of such a material to the instantaneous intensity, those regions in which pulses overlap will be outlined by bright fluorescence spots which determine the pulse duration. The early suspicions that extremely short pulses were being produced was confirmed.

In early 1967 it was clear that much more research emphasis would be placed on the generation and measurement of mode-locked pulses. To obtain first-hand knowledge of this field and to promote discussion of the state of affairs, an informal meeting of research workers was organized and held at the Army Research Office-Durham (ARO-D) in the fall of 1967. By that time at least 50 investigators could be identified with this emerging field.

First of its kind on the subject, the meeting proved to be well-timed. Only a few weeks beforehand, several new developments were reported, including a suggestion that high-power Q-switched lasers had been producing picosecond pulses all the time! These and a number of other unpublished results were presented at the meeting.

One of the problems discussed (which is not completely solved today) concerns the precise relationship between the true profile of the pulse and that which is observed by the 2-photon fluorescence technique. On matters more certain, a number of results reported have since appeared in the professional literature.

Additional research is needed to solve a number of problems concerning generation and measurement of short pulses. For example, there is the question of whether the pulse width could be limited to a single optical cycle or about a milli-picosecond.

This experimental objective would require completely mode-locking a laser with a bandwidth greater than presently available. Probably it will be necessary to turn to other techniques to reach the ultimate in pulse duration. Several recent papers propose "chirping," a method that is common in radar pulse compression. At the present time the record seems to be held by United Aircraft Workers, who report pulse widths of 0.4 picosecond using a glass laser at 1.06 microns.

With some work it is possible to attain single picosecond pulses with hundreds of megawatts of peak power. In fact, at the recent Quantum Electronics meeting, the Russian Nobel Laureate Basov and others reported obtaining single mode-locked pulses that had been amplified up to 2,000 gigawatts! (A gigawatt is a thousand million watts.) These pulses were used in experiments to produce neutron emission from a lithium-deuteride surface.

Efforts such as these represent two of the possible applications of short pulse research. For one, it is a way of generating extremely hot plasmas, possibly into thermonuclear fusion. Secondly, it appears that short pulses may be the only way to generate high powers that are otherwise unattainable, due to the damage threshold or the energy capacity of the optical oscillator-amplifier chain.

A number of laboratories have reported results using the mode-locked pulses to observe short-lived optical phenomena. As an example, the fluorescent lifetimes of several dyes important to passive Q-switching have been directly measured.

A variation on these experiments is the use of the pulses for recording high-speed events in a photographic sense. A mode-locked laser has been shown to be an excellent schlieren light source to study the evolution of a laser-induced plasma in its initial stages. Many other photographic applications may use the picosecond exposure times to advantage.

Much of the early stimulus to the study of gas laser mode-locking was provided by the promise of communications applications. The train of short pulses is ideally suited to pulse code modulation. Also, the technique of mode-locking makes available the full power output of very long and intense lasers without being limited to a single mode.

Other applications, perhaps more distant in the future, lie in optical computers and other types of high-speed electronics. As an optical radar, picosecond pulses would yield an unprecedented accuracy and the possibility of resolving small targets.

The list of possible applications could be extended. Some of these may never be realized unless certain basic questions are answered. On the other hand, the degree of activity in this area insures that many of the applicatins will be accomplished. It may well be that the most exciting developments have not yet been imagined.

Newsmagazine Lists Highlight Articles Published in Past Year

Publication of a complete index of all articles published in the Army Research and Development Newsmagazine during the past year admittedly would be desirable. Space available permits a listing of headlines of only the more important highlight articles.

DECEMBER 1967

196 Authors Listed on 96 Papers for Army Science Conference.
Order Clarifies Sentinel, Nike-X Managers' Duties.
Besson Stresses Creativity to Lab Leaders.
Human Factors R&D Meet Draws 250.
Dod Revises Microelectronics Policy.
APG Innovations Cut Test Time.
APG Scientist Probes Heat-Reflecting Paint.
Draft Regulation Outlines Design, Testing Climatic Criteria.
HDL Sponsoring Degree Programs.
ECOM Develops SEA Air Traffic Control.
USMA Professor Compiling Geographic Atlas of USSR.
Army Chiefs Oppose Bill to Shift Civil Works Program.
Terrain Analysis for Military Geographic Intelligence.
550 U.S. Scientists Attend IUGG Meet.
The Atom: Developing Peaceful Uses Through Research.

JANUARY 1968

Ceremonies Jan. 31 Commemorate Explorer I's Decade in Orbit.
Natick Laboratories Celebrate 25th Year.
Cheyenne Performs Capably in First Public Flight.
ASAP Schedules Winter Meet on Missiles.
Army Evaluating Skills of Dogs.
CE Project Aims to Stimulate Appalachia.
DoD, EJC Publish Scientific Thesaurus.
MICOM Uses Moire Patterns in Tests.
Researching Blast Effects of Nuclear Explosions.
Physical Sciences Progress Reviewed.
Center for Research in Social Systems Reports on Projects.
BESRL Details New, Ongoing Programs.
BESRL Report Reviews Military Psychology Progress.
HumRRO Work Program Outlined.

FEBRUARY

Spray Adhesive Saves Lives When Surgical Sutures Fail in Combat Use.
Sentinel Support Command Created.
Radiation Belt Discoverer to Address National JSHS.
New HDL X-Ray Facility Simulates Nuclear Effects.
Apstein Heads TARC; 6 New Members Appointed.
$17.2 Billion Federal R&D Budget Forecast in 1968.
SATCOM Tests Tactical Satellite Communications in Jungle.
USAETL R&D Advancing Global High-Speed Mapping Goals.
Joint Line Islands Experiment Completes First Phase.
Automatic Point Transfer Instrument Speeds Map Production.
University Using AFRRI Ion Accelerator in Cancer Research.
Jungle Acoustics Studies Aid Design of Detection Devices.
Moores' Law for Information Systems Explained.
Microorganism Effects on Missiles Exposed to Tropical Environments.

MARCH

DASA (R&D) Chosen as ABMDA Head.
OCE Establishing Construction Research Laboratory Complex.
AR Redefines Policies for Managing Labs.
CRREL Drillers Hit Antarctic Bedrock.
Composite Torso Armor Classified 'Standard A.'
Inter-American Defense College Educates Officers of 22 Nations.
Mosquitoes Prefer VC Tunnels to Swamps as Dry Weather Retreat.
Combat Service Support System Tests Set for May.
ASAP Studying Reduction of Lead Time.
Engineer Corps Maintains Largest Force of Construction Talent.
Garand Rifle Inventor's 54 Patents Set Goal for Rivals.
Glamour in Cross-Country Mobility.
Patent Processing for Materiel Command Inventors.
HumRRO Unit 7 Copes With Problem of Countering Insurgency.
Army Evaluates Amphibious Troop Carrier.

APRIL

Army Science Conference Centered on Vietnam R&D Goals.
Army Research Office Marks 10th Year.
AR Prescribes Roles of Project Managers.
Army-Sponsored Wind-Tunnel Research.
AFIP Breaks Ground for New Museum Building.
Personnel Management for R&D.
Army ENSURE Program Expedites Urgent Needs for Vietnam.
U.S. Army Medevac Teams' Precise Techniques Set 'Save Rate' Mark.
U.S., Asian Biologists Study Bird Migration Relationship to Diseases.
Unit Commendation Recognizes USAMRT Activities in Vietnam.
New Flat Plasma Panel Viewed as Cathode Ray Tube Successor.
Military Geographic Intelligence R&D.
Heliborne Gear Suppresses Fire, Recovers Crashed Fliers.
CDC Systems Analysis Institute Evaluating Army of 1990s Concepts.
Institute of Land Combat Making Progress.
Communicators for Our Army in Vietnam.
Project Mallard Marks First Year.

MAY

COE Dedicates World's 1st Nuclear Power Plant Built to Serve in Any Emergency.
Army Outlines RDT&E Objectives to Congress in $1.662 Billion Budget Proposal.
Reservations Hint Record Army Science Conference Participation, June 18-21.
ARPA Plans Free Flight for 1-Man Jet-Belt Device.
Army Scientists Study Holography for 3-D Data Storage.
ASL Constructs Laboratory 'Cell' for Advanced Laser Research.
Spartan Passes Firing Tests at Kwajalein.
3 Army Engineers Excel in Fluid Dynamics.
DA Awards 273 Basic Research Grants.
Counterfield Magnetic Joining Coils.
Explosion Welding.
NATO Standardization of MERDC Filter/Coalescer Element.
New IER System Aids WSMR Retrieval.
MARVEL Project Enters New Phase.
Prerequisites of Mobility.

JUNE

1968 R&D Achievement Awards Won by 18 Individuals, 5 Teams.
APG Dedicates Pulse Radiation Facility.
Edgewood Arsenal Marks 50 Years Progress.
AE, R&KD Programs Prove Rewarding.
Fluidics Report Tells of U.S. Role in Growing Technology.
Power Sources Conference Views High-Energy State-of-the-Art.
ATAC Using Ultrasonic Interferometer.
ARIEM-MEND Meet Considers Climatic Stresses on Humans.
Night Operations Experiment 71.4 Nears Completion at CDCEC.
Army Selects Winners in ISF.
OR Meet Centers on 'Systems Analysis.'
WSMR Scientists Collect Jupiter Data.

JULY-AUGUST

Army Science Conference Acclaimed for Excellence of Major Presentations.
SENLOG Slates Move to Alabama; Clifford Asks Sentinel Speedup.
AMC Realigns Headquarters; Reduces Directorates to 11.
General Johnson Gives Farewell Address at Army Science Conference.
24 Reservists at ASC Indicate High Caliber of USAR R&D Units.
Work on Sentinel Shock Tube Test Facility.
ECOM Labs Develop New Generation of Night-Vision Devices.
Pamphlet 70-1 Reports FY 67 Behavioral, Social Science Research.
Clifford Approves THEMIS Contracts.
Chaparral to Undergo Arctic, Tropic Tests.
Environmental Services Agency Nears Full Operational Status.
STRICOM Appoints Concepts Study Unit.
DDC Surveys DoD Interest in COSMIC.
ECOM Evaluates Lightweight Power Source.
ICAF Prepares Text on Defense R&D.
Redstone Arsenal to Test S/D-500 Information System.
MICOM Engineer Designs Infrared Link.
Reservist Compiles Snail Fever Monograph.
Army Research Director Discusses Coupling Need.

SEPTEMBER

ARPA-Sponsored Study Probes Research 'Coupling' Problem.
ABMDA, SENSO, BESRL Plan Relocation.
Besson Keys Manpower in Human Factors R&D.
APG Operating New Weapons Spectrum Generator.
Brig Gen Dawalt Discusses International Military R&D.
Army Materiel Command Cites Vietnam Support on Anniversary.
ATACOM Evaluates Explosive Metal Forming.
HumRRO Experiments With 'Simulated Tutoring.'
President Sends to Senate Nominees for Promotion as Generals.
Medical R&D Command Lists 10th Anniversary Achievements.
Catholic University Studies Cable Design Under THEMIS Grants.
ATACOM Uses Time-Sharing Computer.
New AMC Color-Marking System Traces Origin to World War II.

OCTOBER

Nuclear Defense Laboratory Dedicates $4 Million Accelerator.
AMC Announces Resignation of Top Administrators.
Floating Power Plants Meet Emergency.
LCSS Electronic Equipment Deployed to 17 Installations.
Snead Succeeds Ostrom as Director of Army Research.
Surgeon General Approves Award of 41 'A-Prefix' Certificates.
WRGH Chief's ID Tag Idea Earns Suggestion Award.
World's Largest Balloon Reaches Record Height in Research Probe.
JSO Establishes Tactical Command, Control, Communications Group.
'World's Highest Research Station' Serving Army Interests.
ATLIS Stimulates Publication of Federal Libraries Guide.
USA TACOM Pursues Low-Vulnerability Tire Research.
New Unit Record Concepts Viewed for ADP Applications.
Picatinny Inventors Develop Flare 'Chromacorder.'
Maintaining Reliability During Breakout Procurement.
Trends in Military Vehicle Electrical Generating Systems.
Army Honors Annual Economy Champions for $9 Million Savings.
Secretary of the Army Research and Study Fellowships Recognize Successes of 3.

NOVEMBER

Natick Labs Dedicate $3 Million Institute of Environmental Study.
Advanced Materiel Concepts Agency Links With ILC, ITAG in 'Troika' Relationship.
Edgewood Arsenal Adds $4.1 Million Lab.
Harry Diamond Labs Stage 15th Anniversary Program.
Army Support of Research in Universities.
U.S.-Italy Memo of Understanding Initiates Cooperative Metals Research.
ECOM Engineers Save $4.7 Million.
Watervliet Tests Autofrettage Process on Huge Tubes.
Picatinny Enginers Develop Force Stand to Gauge Footsteps.
Requirements Governing Army Aviation Research.
VPI Study Clarifies Wind Pressures Effects on Shell-Type Structures.
Army Continues EASTT Testing With LES-6 Satellite.
Dust Control in Vietnam.
Electronically Active Ionic Devices.
RAC Ending Study of Tactical Radio Frequency Management.
Top Army Commanders Address 6,000 at 14th Annual AUSA Meet.

HEL Schedules Human Factors Tests for MBT-70

Human factors assessment of a prototype of the Main Battle Tank-1970 (MBT-70) is scheduled to begin early this year at the Human Engineering Laboratories (HEL), U. S. Army Aberdeen Research and Development Center.

The MBT-70, being developed jointly by the United States and the Federal Republic of Germany, is hailed as the fastest, deadliest and most advanced combat vehicle ever devised.

When HEL starts its research on the prototype, part of the work will be done in conjunction with other tests being made at the Proving Grounds Materiel Test Directorate. Prototypes also will be tested at Fort Knox, Ky., in Alaska and the Panama Canal Zone.

HEL Technical Director Dr. John D. Weisz said primary efforts will be addressed to a special program that investigates the effects of equipment design on tank crew task performance. Preliminary studies on full-scale wooden prototypes have been in progress several years. Modified M48 and M60 tanks also have been studied.

"The purpose of our program," Dr. Weisz said, "is to isolate problem areas of the man-machine interaction which limit performance and suggest equipment design change that enhance total system performance."

Conducted jointly with West Germany, the R&D activities included field experiments in target detection and driving from the turret under tactical conditions as well as dynamic studies of manual ammunition handling and loading techniques, emergency escape procedures, and operating control and anthropometric requirements. The wooden mockup has been constantly updated during the development design stages. Design changes are received directly from the MBT Joint Engineering Agency.

Andrew J. Eckles III, a research psychologist in charge of HEL's phase of the work, said that "unlike existing tanks in which the crew occupies both the turret and the hull, the MBT–70 will house its crew of three men in the turret."

In addition to the unique turret compartment, the MBT-70's major technical advantages include a hydropneumatic suspension system that raises and lowers the tank, thereby enabling it to adjust to terrain and lower its silhouette; a 152mm gun missile launcher which fires both a conventional round and the Shillelagh missile with excellent accuracy; a fully automatic ammunition loading system; a transmission capable of operating at four speeds, backward as well as forward; improved armor protection and kits that permit the vehicle to run under water.

The Human Engineering Laboratories, established in 1951, are considered a leader in forming the objectives and expanding the scope of human factors engineering. In addition to applied research on weapons systems and military hardware in general, the laboratories are known for their basic research capability in such areas as audition, central nervous system functioning, psychological and physiological stress, memory, visual perception, and attitude formation.

CDC Tests M551 Sheridan Equipped With Shillelagh

Doctrinal concepts and organization in employment of the Army's new Sheridan Armored Reconnaissance Airborne Assault Vehicle (M551) are being tested by the U.S. Army Combat Developments Command (USACDC).

A light Armor battalion equipped with the vehicle has been testing its long-range antitank knockout capability with the Shillelagh missile. The conventional round with a combustible case also is being evaluated, along with effectiveness of the ammunition's weather-proofing and safety devices.

The combustible cartridge case, if it satisfies requirements during the extensive testing process, will have the advantage of eliminating the usual debris of spent metal cases left over after firing during an engagement.

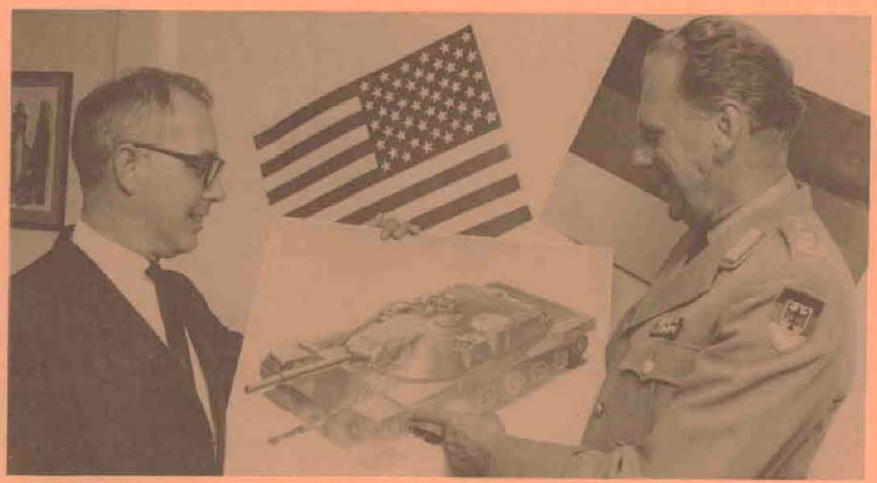
New also in the M551 is a Bore Scavenging System, which uses a compressed air blast to flush residue from the firing tube. A compressor starts automatically to recharge the compressed air containers after a couple of rounds are fired.

Maintainability of the vehicle is being evaluated during the two months of field testing, which began in November.

Versatility of the M551 was demonstrated recently when a company of the test battalion was airlifted with all equipment, including the Sheridan, from Fort Riley, Kans., to Fort Stewart, Ga. The Sheridan system also can be air-dropped.

Commanded by Lt Col Louis C. Wagner, the 1st Battalion (Light), 63d Armor of the 1st Infantry Division attached to the 24th Infantry Division is the test unit. Brig Gen Linton S. Boatwright, commanding general of Fort Riley and of the 24th, is directing the tests, with Col George E. Kimball called in especially from the Armor School at Fort Knox, as deputy director.

The USADC is concurrently participating in intensified confirmatory tests of the M551 in Alaska, where combat developments officers are an integral part of the test group. These tests are providing valuable data on the Sheridan.



UNDER TWO FLAGS, the MBT–70 is discussed by Lt Col Ralf Rodenhauser, chief of the Federal Republic of Germany observer group, and Andrew J. Eckles III, a U.S. Army Human Engineering Laboratories research psychologist in charge of human factors assessment of future main battle tank features.

☆ U.S. GOVERNMENT PRINTING OFFICE : 1969 342-877/6