ARMY RESEARCH AND DEVELOPMENT

MONTHLY NEWSMAGAZINE OF THE OFFICE OF THE CHIEF, RESEARCH AND DEVELOPMENT
Vol. 7, No. 7 July-August 1966 • HEADQUARTERS, DEPARTMENT OF THE ARMY • Washington, D.C.

Army Science Conference Panel Discussion Draws Acclaim

President Johnson Cites Dr. Helwig for Research

Nominated by the Department of the Army in May for a $10,000 1966 Rockefeller Public Service Award, Dr. Elson B. Helwig was presented with The President's Award for Distinguished Federal Civilian Service on June 13.

President Lyndon B. Johnson made the presentation to the renowned chief of the Department of Pathology, Armed Forces Institute of Pathology, during ceremonies at the White House. The award is the highest given for extraordinary achievement in the Federal career service.

Given normally to not more than five individuals each year, the Presidential Award recognizes those in Federal service whose achievements exemplify, to an exceptional degree, imagination, courage and high ability

(Continued on page 5)

PRESIDENT JOHNSON congratulates Dr. Helwig as Secretary of the Army Stanley R. Resor presents the President's Award for Distinguished Federal Civilian Service for AFIP work.

1498 Data System Proving Valuable Management Tool

"Test fired" by its first full year of operation, the Army's system for reporting research and exploratory development at the work-unit level on a current basis, through use of DD Form 1498 (Research and Technology Resume), is proving a valuable research aid and management tool.

Overly optimistic supporters of the system when it was initiated July 1, 1965, are not able to boast that it has proved to be "all things to all people." Conversely, pessimists who contended that the system would not prove a major advance have had to modify that position.

As of July 1, 1966, the Army data bank of research and technology resumes at the Army Research Office, Arlington, Va., contained more than 6,200 reports. The historical file of completed and terminated work units consisted of over 600 reports.

The Army 1498 data bank is for the use of Army and other qualified requestors. The Department of Defense data bank maintained at the Defense Documentation Center serves all DoD organizations.

(Continued on page 39)

Featured in This Issue . . .

Views on Research Programs Share Limelight With Awards For Best of 96 Presentations

Authors of 96 technical papers presented at the fifth Army Science Conference, June 14-17, might be justified in hurling a charge of "stealing the show" at the panel of eight distinguished leaders who exchanged views on the complex and controversial subject of "Basic Research and Practical Relevancy."

As anticipated, the panel headed by Dr. Frederic A. L. Holloway, president of ESSO Research and Engineering Co., scored the most resounding success ever recorded at an Army Science Conference, evidenced by enthusiastic audience response.

The discussion in the United States Military Academy's Thayer Hall—where all of the Army Science Conferences have been held since 1957—was programed from 8:30 a.m. to 12:30 noon June 16. It was still going strong when the cutoff came, somewhat behind schedule. Apparently it could have been extended considerably without making the audience fidgety.

ASC FAREWELL FOR HAWKINS

Not even a ripple of a rumor foretold it, but Assistant Secretary of the Army (R&D) Willis M. Hawkins made his final Army Science Conference appearance in that capacity. (For story, please turn to page 5.)

(Continued on page 28)

WINNERS of top Army Science Conference Award of $1,000, Richard Neil Gottron and Wilmer Gaylord, pose with some of the principal participants. L. to r.: Dr. Harold C. Weber, then Chief Scientific Adviser, DA; Lt Gen Austin W. Betts, Chief of Research and Development; Secretary of the Army Stanley R. Resor; Mr. Gottron; Mr. Gaylord; and Assistant Secretary of the Army for Research and Development Willis M. Hawkins, who resigned June 24.

Army R&D Newsmagazine

Vol. 7, No. 7 July-Aug 1966

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

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

Purpose: To improve informal communication among all segments of the Army scientific community and other Government R&D agencies; to further understanding of Army R&D progress, problem areas and program planning; to stimulate more closely integrated and coordinated effort among Army R&D activities; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

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

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

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

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

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

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

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

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

DDRE Discusses In-House Laboratories

As the featured speaker at the fifth Army Science Conference banquet, June 16 at the United States Military Academy, Director of Defense Research and Engineering Dr. John S. Foster, Jr., emphasized the importance of maintaining a strong in-house laboratories capability for materiel innovations geared to requirements for modern warfare, with particular attention devoted to research and development responsiveness to the war in Southeast Asia. The major portion of his address follows.

By John S. Foster, Jr.

. . . I want to discuss with you the meaning of in-house technical organizations within the context of our overall research and development effort. In particular, I would like to place special emphasis on Southeast Asia on the one hand and "assured destruction" programs at the other end of the spectrum.

The Department of Defense (DoD) mission is national security. It must provide the operational forces with superior weapons, ordnance and techniques which will anticipate any foreseeable threat. This is a reasonably challenging job. It takes all kinds of resources, capability and contributions. This mission is heavily dependent upon science and technology which gives real meaning to both your and my efforts. It also takes the support of all types of organizations—university, industry, nonprofit and in-house laboratories. Each of these organizational types has a relatively unique, although not mutually exclusive, role to play.

We have an array of 143 Defense in-house technical organizations, with coverage of most of the relevant technical areas. They vary widely in strength, ranging as high as 7,000 people. They vary in size from 10,000 square feet to 5,000,000 acres. The total institutional complex represents an investment of $4.1 billion in property, housed in 103 million square feet of building space on 10.6 million acres of land. The total dollar flow from all sources through these organizations was $3.7 billion in FY65, of which $1.7 billion was for in-house programs.

These organizations carry out a wide variety of functions, making it very difficult to generalize meaningfully about their role. Let me try to convey to you what I think is the purpose of our in-house technical organizations.

I see the in-house labs as applied science laboratories—applied *military* science laboratories. This is their unique difference from big university and big industrial laboratories. There tends to be a dearth of good applied scientists. The pure scientist usually doesn't want to get involved directly in our kinds of problems. The in-house laboratories provide the scientific and technical base for the U.S. Military Services.

Our most important asset in the labs are *people*—dedicated professionals whose careers are committed to the development of systems and weapons of the operational forces. The people uniquely provide continuity and integration to what would otherwise be a highly fragmented pattern of discontinuous and heterogenous contributions to the desired end.

The devoted scientists and engineers who man these laboratories as a lifelong career provide the best random access memory to the bottomless data bank into which we are pouring torrents of unrelated facts. . . . These are the people who are our professionals over the years and really carry us through the "lean years." When the "chips are down," they are there to get things done well and in a hurry—minimum reaction time.

Secondly, the DoD laboratories serve as interpreters in translating projected military requirements into technology goals and experimental prototypes. A stated military requirement can frequently be satisfied by three or four alternative technical approaches. It may be necessary to sponsor several exploratory development programs in parallel to make sure that the costly engineering development eggs are placed into one right basket which combines feasibility with cost effectiveness and operational reliability.

Thirdly, a unique characteristic is that the Government laboratories have a powerful lever to magnify their effectiveness. They plan, however, and evaluate that larger portion of our research and technology programs which is contracted to industrial and university laboratories. Intelligent contract definition and project guidance can save many millions of dollars and assure the timely forging of critical links in the weapons systems chain.

(Continued on page 43)

R&D Reservists' Capabilities Typified by 19 Attendees at ASC

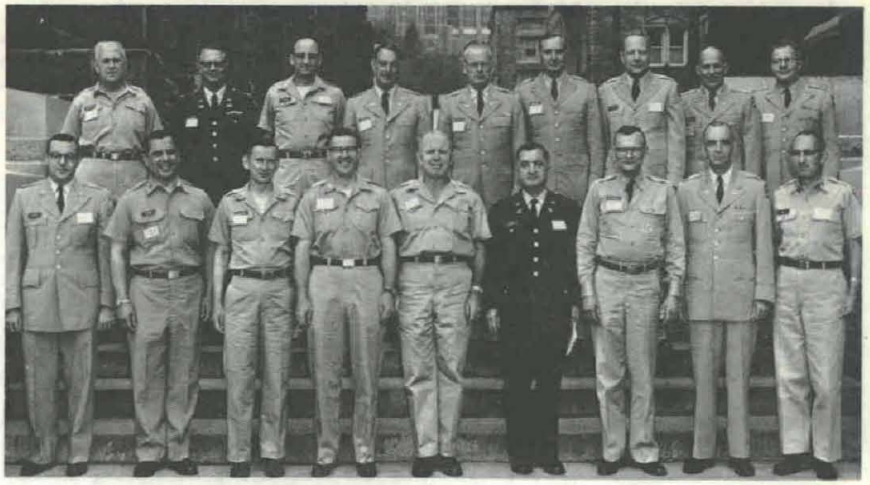
Dedication is a word some folks may use rather freely and injudiciously. But the record establishes that it can be applied deservedly to most members of U.S. Army Reserve Research and Development Units, 19 of whom were 1966 Army Science Conference attendees.

Selected by the Special Assistant for Reserve Affairs, Office of the Chief of Research and Development, the attendees were carefully screened from the 1,050 members currently assigned to some 70 units, representative of virtually every state in the United States.

One of these Reservists, Capt E. F. Allard, a civilian employee of the U.S. Army Engineer Research and Development Laboratories (ERDL), Fort Belvoir, Va., with an assignment in basic research, presented the introductory paper in Session A–II–2 at the conference.

Titled "A Mössbauer Spectrometer," the paper reported on studies of the Mössbauer effect, as a nuclear resonance phenomenon, in military explosives research. The Engineer Laboratories are conducting an intensive research effort in this field.

Another source of particular pride to the USAR R&D Unit members at the conference came two weeks after it ended. On July 1, one of the attendees, Lt Col Adolph H. Humphreys, chief of the Combat Research Division at ERDL, was elected vice president of the Reserve Officers Association at the national meeting in New York City.



U.S. ARMY RESERVE R&D attendees at Army Science Conference included: first row, l. to r.—Col Paul J. Wuest, Capt Andres Llana, Jr., Col Gustav E. Cwalina, Lt Col Howard A. Morris, Lt Col Wilford Gibbs, Dr. Lewis Berner, Lt Col Calvin W. Vriesen, Capt Edmond D. Neuberger, Lt Col Joseph Tobias, 2nd row—Robert Drummond, Lt Col Paul L. Hayes, Lt Col Earnest F. Gloyna, Lt Col Edward B. Williams, Col Walter H. Schaffer, Col Harry L. Willard, Lt Col Harry B. Goodwin, Lt Col Adolph H. Humphreys, Lt Col Conrad A. Blomquist. Milton Mater could not be present for this photograph.

Look into the professional attributes of almost any USAR R&D Unit member you may select at random, and almost invariably you will be impressed with the qualifications he offers to the Army research and development program as a "standby in-depth strength" for a national emergency. The majority of them hold responsible positions in industry, academic institutions or other professional endeavors.

As examples, consider two of the real veterans of the USAR R&D Unit Program, Lt Col Humphreys and Lt Col (Dr.) Lewis Berner. Humphreys is commanding officer of the 2243rd Unit at ERDL and was a member of the 1621st Reserve Training Unit (Research), substantially the same in purpose and in membership, when it was organized at ERDL in 1947. He is also a member and post commander of the Corps of Engineers Mob Des Detachment No. 39 at ERDL.

A man with a rather amazing diversity of interests, Col Humphreys has been active and an officer in civic associations, leader in teenage clubs and recreation groups, educational activities and as a Boy Scout leader for many years. His primary hobby is sculpture, in which he started as a youth under scholarships awarded by the Maryland Institute and Rinehart School of Sculpture (1941 winner of European study competition). He

(Continued on page 48)

Laser Research Risks Weighed at Seminar

Physical dangers inherent in experimentation were considered at a Laser Safety Seminar sponsored recently by the Office of The Surgeon General, Department of the Army, and the Martin Co. at Orlando, Fla.

About 125 Government agency representatives joined with industrial representatives in expressing extreme concern regarding hazards in Laser research. Laser safety, it was stressed, is an inexact science.

Researchers emphasized the lack of absolute answers and the orders-of-magnitude differences in safety factors for Laser experimentation, despite considerable work being done by The Surgeon General's Office and others. Disagreement still exists among experts regarding strict definitions.

A panel of experts associated with programs of the Office of The Surgeon General spearheaded the discussion. The meeting was chaired by Lt Col John Kovaric, chief of the Surgical Research Branch, U.S. Army Medical Research and Development Command.

Principal speakers and panel discussion leaders included Dr. William Ham, Jr., professor and chairman, Department of Biophysics, Medical College of Virginia; Dr. Edmond Klein, chief, Department of Dermatology, Roswell Park Memorial Institute; Dr. Samuel Fine, professor of biomedical engineering, Northeastern University; and Graham W. Flint, senior research scientist, Martin Co.

Discussing ocular effects of Laser radiation, Dr. Ham said that most of the retinal damage observed by his group was analagous to that caused by thermal effects.

As examples, he cited retinal lesions caused by too-close observation of atomic fireballs and that suffered by unprotected observation of the sun during eclipses. Dr. Ham's group, as a matter of fact, uses thermal energy in their studies of effects on rabbits and monkeys. They have observed, however, minor effects apparently caused by photo-chemical action on the retina.

One point stressed was that damaging radiation can be accidentally

(Continued on page 67)

ASAP Chairman Points to Research Needs as ASC Keynoter

In a forthright, hard-hitting keynote address, critical as well as commendatory, Dr. Harold M. Agnew, chairman of the Army Scientific Advisory Panel, directed attention to what he considers areas of weakness as well as those of strength in Army and Department of Defense research and development activities.

One of his listeners at the 1966 Army Science Conference facetiously termed it a "spare the rod and spoil the scientific child approach" to pinpointing matters regarded as meriting immediate and continuing consideration by managers of R&D programs.

Certainly no one who heard the leader of the Weapons Division, Los Alamos (N.Mex.) Scientific Laboratory, could misinterpret his message: that the time to take a good, hard look at the over-all R&D effort is here and now—as bench-level scientists and engineers, as leaders of laboratories, and as top-echelon program directors.

Equally clear was his prideful endorsement of the quality of R&D leadership provided by Assistant Secretary of the Army (R&D) Willis M. Hawkins, who resigned effective June 24, Chief of R&D Lt Gen Austin W. Betts, Deputy CRD Maj Gen William C. Gribble, Jr., and Army Chief Scientific Advisor Dr. Harold C. Weber, who was succeeded June 20 by Dr. Marvin E. Lasser.

Dr. Agnew also had kind words for the capabilities of a number of other high-level Army R&D leaders and for the Army in-house scientists who make contributions to technological advances. He particularly praised the caliber of research reported in technical papers at the conference, saying that much of the work should have "immediate practical applications."

Essentially, he argued strongly for self-appraisal of objectives and results by all who are contributing in any way to Army research and development, through Army in-house laboratories effort as well as in organizations supported to any degree by contracts or grants.

Basic and exploratory or applied research, he contended, when supported by the Federal Government—and thereby having a responsibility to taxpayers for a fair-value return—must be directed in large measure to efforts soundly based in potential practical application, rather than to tasks that hold less prospect of an early payoff in needed results.

Conscientiously, he said, those engaged in Army science must ask:

"Are all the problems that I could work on, all the problems I am considering, those that perhaps should benefit most my country and my colleagues, right now or in the immediate future—problems which are equally challenging to other problems that might not have application or might not further the particular field of knowledge where it could have potential application?"

Dr. Agnew urged that Army scientists and engineers should take more time to learn about some of the more pressing military requirements to insure continued superiority of weapons, equipment, training and techniques. He contended that many of them do not take the time to find out much they should know in order to turn their research efforts to practical results.

"I am not suggesting that the scientists should attempt to guarantee inventions or what they are going to discover," he explained, "but I have been concerned about the large number of research scientists in the United States who have been concentrating their attention on pure science, narrowing their effort too much—who regard it as degrading to work on science that might have practical application. I think this is very bad."

The United States Congress, he emphasized, is concerned about getting a proper return for the research dollar. In support of that statement, he referred to a comment by a congressman before a recent hearing on funding of research, quoting him:

"We are aware that you have developed nuclear weapons, fast aircraft, aircraft carriers, mobile forces of all types, but my big question is, what have you done for us this year?"

Army scientists were charged with having a responsibility not only to focus their attention on practical research problems, but to ask themselves:

"More important, having worked on such a problem, do I go out of my way to make sure that the results of my labor are fully understood by the rest of the scientific and engineering community, with the potential applications of that new knowledge?"

Basic technology in the United States today is second to none, Dr.

(*Continued on page 60*)

ASAP Briefing at Infantry Center Stresses Viet Nam

Army Scientific Advisory Panel members and consultants gained a realistic understanding of problems of supporting troops in Viet Nam when they convened June 21-22 at the Army Infantry Center, Fort Benning, Ga.

Briefings and demonstrations arranged for the Panel gave them information presented by combat veterans recently returned from Viet Nam. Brig Gen Ellis W. Williams, acting CG in the absence of Infantry Center Commander Maj Gen Robert H. York, chaired a panel that presented fresh and graphic accounts of problems.

Assisting in the briefing were Col Robert W. Duke, logistics specialist at Hq 4th U.S. Army Corps, Birmingham, Ala.; 1st Sgt Jack D. Franks, an Infantry veteran; Capt Robert H. Edwards, rifle company commander; Maj George H. Neroutsos, battalion staff officer; and Capt Marvin O. Myers, Army aviation veteran.

One of the highlights was the showing of a special film photographed in Viet Nam and introduced by General Westmoreland, who encouraged the scientific community to increase its effort in improving technological support for Southeast Asia.

More than 80 ASAP members and consultants attended. Dignitaries included ASA (R&D) Willis M. Hawkins, whose resignation came two days later; General Frank S. Besson, Jr., Army Materiel Command CG; and Lt Gen Austin W. Betts, Chief of Research and Development, Department of the Army.

VIET NAM HAMLET mock-up for Infantry Center training

ASA (R&D) Hawkins Draws Plaudits at Farewell

Assistant Secretary of the Army (R&D) Willis M. Hawkins resigned June 24, ending nearly three years of exceptional service to the Army that earned esteem of the highest order from his R&D associates.

The solid basis of that esteem was acknowledged officially by Secretary of the Army Stanley R. Resor when he presented Mr. Hawkins with the Distinguished Service Award (with Laurel Leaf) at a June 29 ceremony in the Pentagon. The accompanying citation for service from July 1965 to June 24, 1966 stated, in part:

"Among his many noteworthy contributions, the US/FRG (United States/Federal Republic of Germany) Main Battle Tank Program stands out as a key accomplishment. His extensive technical knowledge of the entire program, his masterful and skillful demeanor in negotiating with other countries, and the forceful manner in which he pressed forward to keep the program on schedule contributed significantly to its success.

"In reshaping the RDT&E (Research, Development, Test and Evaluation) Program to meet the Army's rapidly expanding requirements, he exhibited unusual managerial ability, incisive insight into complex problems, and sound judgment in resolving those problems; thus instituting and developing one of the Army's major programs and far-reaching achievements. . . ."

In 1961, Mr. Hawkins was awarded the Distinguished Public Service Award from the Department of the Navy for his contributions to the Polaris Missile Program. In June 1965, he received the Distinguished Civilian Service Award for his direction of the Army's R&D program.

When appointed Assistant Secretary of the Army for Research and Development by President Kennedy, Oct. 16, 1963, Mr. Hawkins had served with distinction since 1957 as a member of the Army Scientific Advisory Panel (ASAP).

More than enviable esteem for Mr. Hawkins was manifest when virtually every staff officer and key civilian employee in the Office of the Chief of Research and Development gathered with their wives to honor him at a farewell party at the Fort McNair Officers Club, Washington, D.C.

Former Chief of Research and Development General Dwight E. Beach, now CG of the Eighth U.S. Army in Korea and scheduled to become Commander-in-Chief, U.S. Army Pacific, on Sept. 1, was among the dignitaries.

Tributes and testimonials flowed freely to Mr. Hawkins abilities as a scientist, as one of the Nation's foremost experts in aircraft design, as a man with rare managerial skills, as an astute analyst, and as a constructive idea originator in a broad spectrum of scientific disciplines.

Sentimentality at such times may be a bit expansive, as is quite normal when military men and their ladies say farewell to leaders who have primed affection by their conduct over a period of years. But on this occasion it appeared to have a particularly heart-warming quality. And no one was more moved than the guest of honor, who confined his remarks to a few seconds to lessen the risk of "bawling like a baby."

In that brief time, however, he expressed his high regard for the devoted motivation of the OCRD staff and their forceful momentum to get a difficult job done in minimum time.

With Brig Gen William T. (Bill) Ryder (recently retired from the Army after serving as Deputy Chief of Research and Development for International Programs) presiding as master of ceremonies, the humor was popping abundantly, Mr. Hawkins was the object of the kind of jokes that were perhaps more clearly indicative of devotion than the testimonials.

In addition to achievements in directing the Army effort on the Main Battle Tank Program, Mr. Hawkins was acclaimed for his "vital role" in directing the accelerated study which resulted in the selection of the COBRA as the interim greatly improved armed helicopter; also for guidance that resulted in revitalization and achievement of a "more viable Army Air Mobility Program," and for his leadership on the Advanced Aerial Fire Support System (AAFSS).

(Continued on page 70)

SECRETARY OF THE ARMY Stanley R. Resor presents second decoration for Distinguished Civilian Service to Assistant Secretary of the Army (R&D) Willis M. Hawkins on June 29.

President Johnson Cites Dr. Helwig for Research

(Continued from page 1)

in carrying out the mission of the United States Government.

Dr. Helwig is the fourth physician and the only pathologist to receive the award. The certificate accompanying the award reads:

"A world-renowned pathologist, he has made notable contributions to the diagnosis and treatment of disease through his research, teachings, and interpretations in the field of dermal and gastrointestinal pathology. The influence of his distinguished work extends widely to civilian and military medicine, at home and abroad.

"The Armed Forces Institute of Pathology, reputed for its excellence, bears the imprint of his unique and inexhaustible professional and administrative talents."

Graduated from Indiana University Medical School with an MD degree, Dr. Helwig joined the staff of the Armed Forces Institute of Pathology in 1946 as a senior pathologist and became chief of the Department of Pathology in 1955. Under his leadership, the Department has expanded from 22 to 37 branches.

The May 1966 edition of the *Army R&D Newsmagazine* carried a detailed account of the many notable achievements supporting Dr. Helwig's selection as one of the Department of the Army's seven nominees (three in the administrative and four in the field of science, technology and engineering) for the 1966 Rockefeller Public Service Awards. The $10,000 awards are made annually in each of five categories.

Author or coauthor of more than 100 articles on pathological research in professional journals, Dr. Helwig is the principal investigator in the AFIP Laser Project. He is known for his pioneering studies of Paget's disease, notable findings in Kaposi's sarcoma, research on Boveen's disease and its relationship to systemic cancer, and many other medical research accomplishments.

The concluding paragraph of the citation accompanying Dr. Helwig's Rockefeller Award nomination stated:

"This physician is a medical pioneer. . . . His reported findings are accepted throughout the world. . . . Dr. Helwig symbolizes the mission of the AFIP—Consultation, Education and Research."

RDT&E, Materiel Contracts Hit Year-end Peak of $923.6 Million

Army contracts and modifications totaling $923,634,179, indicative of the rush to obligate funds prior to the close of Fiscal Year 1966, were awarded for research, development, test, evaluation and procurement of materiel since the *Army R&D Newsmagazine* June edition.

The largest amount to a single firm was $87,148,795 to Kaiser Jeep Corp. for trucks, followed by $83,467,232 to the Boeing Co. for helicopters. Chrysler will receive $46,811,169 for tanks, combat vehicles, turret systems, cargo trucks and modification kits.

Contracts and modifications totaling $37,781,476 to Colt's Inc. are for work on M16 and XM16E1 rifle. Remington Arms Co., Inc. will get $33,616,089 for ammunition.

General Electric Co. received contracts totaling $32,877,664, as follows $15,028,797 for aircraft guns, pods, test sets, repair parts and ancillary equipment; $9,058,181 for a multifunctional array radar power plant; $4,777,000 for the XM163 weapons system and repair parts; $1,122,094 for spare parts for the J79-GE10 engines; $1,111,581 for a modification of 2 radar sets; and $1,780,011 for 7.62mm aircraft machineguns and ancillary equipment.

The Olin Mathieson Chemical Corp. was awarded six contracts totaling $30,945,520 for propellant charges, ammunition, M14 rifle shoulder stocks, and 7.62mm, 5.56mm and 20mm cartridges.

U.S. Time Corp. is receiving $21,547,830 for artillery fuzes and $3,526,631 for tooling and special test equipment for production.

General Motors (GM) Corp. will get $5,048,100 for 81mm mortar body assemblies, $1,325,947 for engine and transmission assemblies with containers, $1,856,368 for M113 vehicle engines, $3,176,105 for transmission and power transfer units, $1,475,116 for improvement of the T63-A-5A engine, and $8,427,943 for 155mm howitzer vehicles.

Contracts and modifications totaling $17,157,106 to the Raytheon Co. are for work on the Hawk and Nike Hercules air defense missile systems, another $1,629,417 is for bomb parts.

ABCO Corp. received contracts for aircraft engine assemblies, modification kits and services totaling $9,124,781, $3,901,534 for 750-pound bomb metal parts and 2.75-inch rocket fuzes, and $1,359,300 for AS-1729/VRC fixed-based, vehicle-mounted antennae.

Three contracts totaling $16,134,904 went to Collins Radio Co. for radio sets. FMC Corp. was issued four contracts totaling $13,696,009 for 4.2-inch projectile metal parts, canister assemblies, 90mm projectile parts, and rubber tire wheels for the M113 personnel carrier.

Philco Corp. was awarded $6,415,707 for initial production of Chaparral missile fire units, a $4,000,000 initial increment to a 2-year contract for electronic equipment, and $4,182,270 for Shillelagh support equipment and parts.

A $9,718,199 contract to Bell Helicopter Co. is for UH-1 transmission assemblies and $1,600,550 is for structural components for the same model; $1,142,676 is for UH-1 main rotor blade assemblies and $2,927,394 for the TH-13T.

U.S. Rubber Co. contracts are $9,836,251 for explosives and operation and maintenance activities, $1,818,520 for body armor, and $1,221,966 for collapsible tank assemblies.

Bulova Watch Co. won $4,897,080 modification to an existing contract, two new contracts totaling $5,934,710 for ammunition arming mechanisms and $1,113,961 for the development of the XM552, 30mm high-explosive cartridge.

LTV Aerospace Corp. received $10,709,569 in contracts for advanced production engineering for the Lance missile system and a $1,205,000 modification for system facilities.

Contracts amounting to $11,858,146 went to Radio Corp. of America (RCA) for follow-on research and development, data research, design documentation, fabrication and test of Shillelagh, Lance and TOW missile systems, and for AN/TRC radio sets and spare parts.

Sperry Rand Corp. gained modifications amounting to $11,775,866 for supplies and services to modify Sergeant missile components.

Mason and Hanger, Silas Mason and Co. received a $5,687,000 contract modification for loading, assembling and packing of 500- and 750-pound bombs, and $4,546,100 for 500-and 750-pound bombs. White Motor Co. will get $10,003,237 for 2½-ton trucks.

Laboratory for Electronics Inc. will be paid $8,714,261 for aircraft position-fixing navigation sets. Honeywell Inc. received two contracts totaling $5,592,732 for bomb components and one for $2,781,392 for 40mm cartridge fuzes.

Federal Cartridge Corp. is receiving $8,261,108 for 5.56mm ammunition and for operational and maintenance activities. Hamilton Watch Co. received a $8,215,130 modification to a contract for artillery projectile fuzes. International Harvester Co. is furnishing trucks, tractors and scoop-type loaders under three contracts amounting to $8,091,673.

Hercules Inc. is receiving an $8,225,700 modification for propellants and the American Hoist and Derrick Co., $7,054,985 for rough terrain air-transportable, wheel-mounted cranes.

Contracts totaling $4,701,109 to Whirlpool Corp. are for canister assemblies and $2,159,468 is for metal parts for 105mm projectiles. Aerojet General Corp. will get $6,162,271 for 2.75-inch rocket metal parts, SUU-14A dispensers and cartridge ejection assemblies.

General Dynamics Corp. was awarded contracts totaling $6,196,007 for work on the Redeye missile and components for the Digital Subscriber Terminal.

Contracts within the $5 million range included: Harvey Aluminum, Inc., Torrence, Calif., $3,263,412 contract for 40mm cartridge cases and a $2,620,825 initial increment for 20mm projectiles; Vinnell Corp., Alhambra, Calif., $2,728,708 modification for design, procurement and construction of electrical land distribution systems and a $3,025,000 modification for refitting T-2 tankers as power ships for South Viet Nam;

IBM Corp.: $3,500,000 for electronics equipment and $2,053,036 for design, fabrication, test, delivery and checkout of a complete telemetry data center for White Sands (N.Mex.) Missile Range;

Union Carbide Corp., $5,579,127 for radio batteries; Sylvania Electric Products Co., $5,500,00 for electronics equipment;

United Aircraft Corp. $2,895,576 for T-55 engine fuel controls and $2,458,000 for engine components for the initial outfitting of CH-53A aircraft; and A. O. Smith Corp., $5,393,760 for 750-pound bomb metal parts; Clark Equipment Co. $5,267,532 (definitization of an existing contract) for industrial wheeled tractors.

Zenith Radio Corp., $5,263,073 for ammunition fuzes; Hughes Aircraft, a modification of $2,997,532 for two AN/MSC-46 satellite communication terminals and for $2,232,348 for manpacked radio sets;

Global Associates, Oakland, Calif., $5,161,299 modification for logistic support at the Kwajalein Test Site; Thiokol Chemical Corp., $5,078,178 modification for ordnance items, and for operation and maintenance activities; Allis Chalmers Manufacturing Co. $2,402,013 for 43 tractors with bulldozers, in addition to an initial increment of $2,665,948 for generators.

Eastern Canvas Products Inc., $4,896,536 for protective hoods; Varo Inc., $4,890,698 for 25mm intensifier assemblies and searchlight sets; Eureka Williams Co., $4,719,264 for hand grenade fuzes; R. G. LeTourneau Inc., $1,075,000 for 750-pound bomb assemblies; LeTourneau-Westinghouse Co., $3,671,972 for motorized road graders;

Modification contracts for artillery ammunition fuzes were awarded to: General Time Corp., $9,320,730; Ingraham Co., $4,612,350;

Noris Thermador Corp., was awarded $3,295,527 in contracts for 81mm projectiles and $1,437,653 for bomb-unit tube assemblies.

Hallmark Industries will receive $4,572,960 for 3,000 lightweight aluminum hut kits; Consolidated Diesel Electric Co., $4,377,357 for 10-ton tractor bodies; and Northrop Corp., $4,497,342 (three contracts) for metal parts for 106mm projectiles and 90mm canister assemblies, and $1,391,000 for target missile and tracking exercise flights;

International Telephone and Telegraph Corp., will receive $4,000,000 for image-intensifier assemblies; Pettibone-Bulliken Corp., $4,335,560 for rough terrain forklifts; and Schiller-Pfeiffer Machine Works (Southampton, Pa.) $3,418,700 for 152mm high-explosive, antitank projectile assemblies.

Two contracts totaling $3,204,131 to Dorsey Trailer Inc., Elba, Ala., are for 12-ton semitrailers; $3,164,734 to ARF Products, Inc., Raton, N.Mex., for ground radio-set group components; and $3,130,135 to Amron Corp., Waukesha, Wis., for bomb components.

Contracts under $3 million: Sanders Associates Inc., Bedford, Mass., $2,983,564 for Forward Area Acquisition Radar; Leadcraft, Inc., Denton, Tex., $2,956,460 for semitrailers; Fruehauf Corp., $2,862,604 for 5,000-gallon fuel-servicing semitrailers;

Northrop-Carolina, Inc., $1,094,792 for canisters and smoke rounds and $1,750,375 for chemicals; Firestone Tire and Rubber Co., $2,834,595 for rubber-track shoe assemblies for the M60 series of combat vehicles; Stelma, Inc., Stamford, Conn., $2,790,045 for telephone-telegraph terminals;

Reeves Instrument Co., Garden City, N.Y., $2,612,880 for vehicle gyrocompass systems for installation on naval surface ships; Continental Motors Corp., $2,500,000 for engines; Mine Safety Appliances Co., Pittsburgh, Pa., $2,474,522 for filter elements for protective field masks; Texas Instruments, Inc., $2,408,080 for APQ-116 radar system components for A-7A aircraft; Wilcox Electric Co., $2,350,203 for transponder sets;

Jackes-Evans Manufacturing Co., St. Louis, Mo., $2,343,267 for 7.62mm cartridge-belt links; Hanson Machinery Co., Tiffin, Ohio, $2,320,789 for 5-ton diesel engine cranes;

Litton Systems Inc., $2,150,134 for scientific and technological effort in support of FY67 Combat Developments Command experimentation; URS Corp., Burlingame, Calif., $2,133,534 for technical reports and plans for the combat support system;

Continental Aviation and Engineering Corp., $2,065,411 for production and inspection engineering services for 2½-ton and 5½-ton truck engines; L. T. Industries Inc., Garland Tex., $2,057,591 for 750-pound-bomb fin assemblies.

Western Electric Co., $2,052,570 for additional research and development on the Nike-X system Hayes International Corp., $2,025,000 for 2.75-inch rocket metal parts; Stewart and Stevenson Services Inc., Houston, Tex., $2,787,396 for 400-cycle AC-generator sets.

Contracts of over $1 million: Chamberlain Corp., Waterloo, Iowa, $1,986,207 for 81mm projectiles; Hawthorne Aviation, Fort Sill, Okla., $1,810,027 for aircraft maintenance and related services; Fontaine Reuck Equipment Co., Birmingham, Ala., $1,793,268 for semitrailers; American Fabricated Products Co., Indianapolis, Ind., $1,764,560 for 81mm fin assemblies;

Federal Laboratories Inc., Saltsburg, Pa., $1,675,938 for chemicals; Associated Spring Corp., Plymouth, Mich., $1,658,185 for 20mm cartridge belts; Brunswick Corp., Marion, Va., $1,637,319 for 35mm cartridge launchers; Pace Corp., Memphis, Tenn., $1,627,732 for 105mm canisters; American Fabricating Products Co., Indianapolis, Ind., $1,593,589 for cartridge containers; General Steel Tank Co., Reidsville, N.C., $1,562,654 for portable fuel systems;

Bethlehem Steel Corp., $1,500,000 for forging tubes for 175mm guns; TRW, Inc., Cleveland, Ohio, $1,486,860 for M79 grenade launchers; Bowen-McLaughlin-Hork Corp., York, Pa., $1,481,469 for ½-ton trucks; Maremont Corp., Saco, Maine, $1,471,922 modification for M69 machineguns with barrel and bipod assemblies.

McDonnell Aircraft Corp., $1,470,000 modification for engineering development for the medium antitank assault weapon; Electronic Communications, Inc., St. Petersburg, Fla., $1,455,000 for radio sets and related equipment and services; Marathon Battery Co., Wausau, Wis., $1,447,688 for radio batteries;

Burgess Battery Co., Freeport, Ill., $1,416,780 for radio batteries; Pacific Ventrues, Inc., and West Coast Electric of Washington, Seattle, Wash., $1,400,00 for upgrading and improving Defense Communications power plants in Alaska; Iowa Manufacturing Co., Cedar Rapids, Iowa, $1,388,754 for semitrailer-mounted crushing and screening plants;

Standard Container, Inc., $1,357,987 for M2A1 ammunition boxes; Sundstrand Corp., $1,345,248 for constant-speed drives for A-7A aircraft; Kanarr Corp., Kingston, Pa., $1,322,770 for M79 grenade launchers; Mack Truck Inc., $1,300,035 modification to a contract for axles for 10-ton military tractor-trucks;

Douglas and Lomason Co., Columbus, Ga., $1,291,283 for ordnance items; Universal Match Corp., $1,264,025 for development and test of an aircraft turbine engine; Ford Motor Co., $1,247,807 for stake and platform trucks; Cabot Corp., Pampa, Tex., $1,226,293 for forgings;

Norton Co., Worcester, Mass., $1,207,680 for body armor; Institute for Defense Analyses, Arlington, Va., $1,165,000 modification contract for a 2-month extension for research on economic, technical, political and military studies;

(Continued on page 70)

ECOM, Universities Initiate Program Furthering Research in Avionics

Increasing emphasis on U.S. Army avionics research is evidenced by a multimillion-dollar program initiated recently by the U.S. Army Electronics Command (ECOM) under contract with Princeton University and the University of Pennsylvania.

Program-inaugurating ceremonies at Princeton featured Gaylord P. Harnwell, president of the University of Pennsylvania; Robert F. Goheen, president of Princeton University; and Brig Gen William B. Latta, CG of the Electronics Command.

Termed the Nation's first integrated Government-university effort in avionics (aviation electronics), the program includes aircraft communications, navigation, control and instrumentation.

Dubbed PPAAR (Princeton, Pennsylvania, Army Avionics Research), the program will be monitored by a military-civilian committee comprised of two Army members and two faculty members from each of the universities.

The Army Materiel Command Director of Research and Laboratories, Dr. Jay Tol Thomas, and Lt Col Leslie G. Callahan, head of the ECOM Avionics Laboratory, were named as Army members of the committee.

Prof. Enoch J. Durbin, head of Princeton's Instrumentation and Control Laboratory, and Prof. David B. Smith of Pennsylvania's Moore School of Electrical Engineering, were selected as university members. The second member of each of the universities had not been announced at press time.

The panel's composition gives university members a strong voice in the choice of applied research tasks to be undertaken in support of the Army's avionics mission. The agreement is a new approach in military research that attempts to preserve the university's traditional spirit of free inquiry while focusing on an area of vital concern to future Army aviation.

Signers of the agreement believe it may serve as a model for similar university-military programs elsewhere. They consider that the program gives the Army an opportunity for more direct contact between project engineers and university researchers for solution of practical avionics problems in Viet Nam, and problems that may develop in the future.

The agreement provides for a "civil servants in readiness program." The Avionics Laboratory will be able to send up to 10 Government emloyees to work on special assignments in the academic atmosphere at Princeton or Pennsylvania. These men will be free to attend seminars and use university libraries and other facilities. This will give them the opportunity to discuss scientific problems with members of the faculty and research staff.

PRINCETON President Robert F. Goheen (left), University of Pennsylvania President Gaylord P. Harnwell, and Brig Gen William Latta, U.SC. Army Electroncs Command CG, arrive by "Huey" for inauguration of the Princeton, Pennsylvania, Army Avionics Research (PPAAR) program.

Another stipulation is that an annual symposium on avionics will be held and that leaders both from the participating institutions and other avionics researchers will be invited to present papers. Princeton and Pennsylvania will alternate as host and proceedings will be published to provide milestones in avionics technology and to serve as source volumes for researchers.

The initial agreement has a term of three years. The Army's first-year contract with the two universities provides for a budget of more than half a million dollars.

The principal objective of these contracts is to augment exploratory research efforts in the fields of avionics technology under both contractual and in-house programs during the next three to five years of laboratory growth, staying substantially at current university staff levels.

The association with the universities could aid the Electronics Command in attracting high-caliber civilian employees, it was explained, and provide interesting opportunities for graduate students who might later enter Government service.

Princeton's activity in the program will be centered in its Instrumentation and Control Laboratory, which is part of the Department of Aerospace and Mechanical Sciences. The Pennsylvania portion is in the Moore School of Electrical Engineering, where the first electronic digital computer was built.

PPAAR Committee (l. to r.) Prof. Enoch J. Durbin, Princeton University; Prof. David B. Smith, University of Pennsylvania; Prof. Brainerd, head of Pennsylvania's Moore School of Electrical Engineering; Dr. Jay Tol Thomas, Director of Research and Laboratories, Headquarters U.S. Army Materiel Command; Lt Col Leslie G. Callahan, head of the Avionics Laboratory, Fort Monmouth, N.J.; Prof. Dunstan Graham, of the Princeton University staff.

Army-Industry Team Breaks Barrier to Multielectrode Filters

Nobel Prize winner Dr. William Shockley, a consultant to the Army Scientific Advisory Panel (ASAP), has led an Army-industry applied research team to a history-making breakthrough achievement in microminiaturized radio filters.

Development of multielectrode, thin quartz wafers allows the 50-year-old art of precision filtering to enter the modern age of microminiature electronic circuits. The single-element quartz crystal used in the upper-frequency radio ranges—with a venerable background in communications—is giving way to a newcomer.

The multielectrode wafer is the result of four years of work by the Electronic Components Laboratory (ECL) of the Army Electronics Command (ECOM), Fort Monmouth, N.J., and the Clevite Corp., Cleveland, Ohio.

Sharing honors with Dr. Shockley, coinventor of the transistor and 1956 corecipient of the Nobel Prize in physics, are Clevite physicists Daniel R. Curran and Donald J. Koneval.

Emanuel Gikow, deputy chief of the Circuit Elements and Networks Branch of ECOM's Electronic Parts and Materials Division, traced the new technique from earlier empirical sucesses on multielectrode piezoelectric ceramics. Findings led to development of the "trapped energy concept" governing the discovery.

The filter consists of a quartz disc on which electrodes are applied to form isolated resonators. Electrical interconnections with the resonators are deposited simultaneously, allowing two half-lattice filter sections on a single disc.

The completed wafer is packaged in a standard transistor "can." When connected in cascade, two of these wafers provide a highly selective filter with greater than 80 decibels out-of-band rejection. It occupies ⅛ cubic inch with its package.

Dr. William Shockley

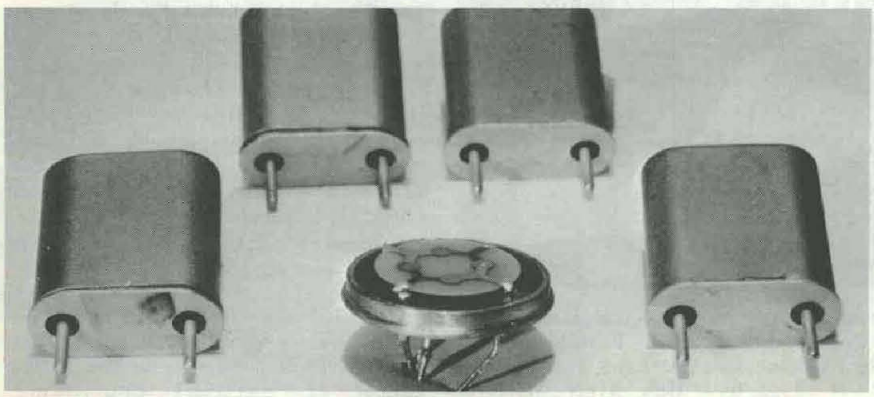
Emanuel Gikow

Practical filters in this new art have been designed to operate in a frequency range of 8 to 30 MHz (megaHertz, or megacycles per second). Band widths which can be attained are compatible with single sideband, amplitude modulation (AM) or frequency modulation (FM) radio.

Physicist Gikow discovered that separate areas within a single piece of piezoelectric material could be made to resonate at different frequencies with negligible interaction of acoustical energy.

The trapped-energy concept has given impetus to the quartz crystal field in the following areas:

- Spurious signal content and insertion loss have been reduced.
- Broad-banding of crystal filters now is possible.
- Optimum geometry and minimum size of multielectrode quartz crystal filters now can be determined.
- Controlled deposition of interconnections opens up the field for simple, precise fabrication of crystal filters in the ultra-high-frequency (UHF) region.



MULTIELECTRODE thin quartz wafer, developed at the Army Electronics Command, is compared with four individually encased quartz resonators.

Because of many uncontrolled variables in conventional filter structures of the past, the advantages of superior designs predicted by computers have not been attainable. Precise fabrication control of these filters has overcome the problem and researchers believe the superior performance of optimal computer design is within reach.

DR. SHOCKLEY, one of the first members of ASAP, received a BS degree in 1932 from the California Institute of Technology and a doctorate in physics from MIT in 1936. He is an Alexander M. Poniatoff Professor of Engineering Science at Stanford (Calif.) University's Electronics Laboratories and has held numerous high academic and technical positions. He is a consultant to the Shockley Laboratory of the Clevite Corp.

Active in numerous scientific organizations, Dr. Shockley has been awarded such high honors as the Comstock Prize of the National Academy of Sciences; Medal of Merit, Office of the Secretary of War; Air Force Association's Citation of Honor; the Liebmann Prize of the Institute of Radio Engineers; Department of the Army Certificate of Appreciation; and the Holley Medal of the American Society of Mechanical Engineers.

He is also a member of the U.S. Air Force Scientific Advisory Board, the Army Electronics Command Science Advisory Group, and the President's Science Advisory Committee Panel on Scientific and Technical Manpower.

EMANUEL GIKOW received a BEE degree from the Polytechnic Institute of Brooklyn in 1955 and is a licensed professional engineer in the State of New Jersey. He joined the Army Electronics Command in 1942.

Former DAR Lotz to Succeed Gibbs as C-E Chief

Former Director of Army Research Maj Gen Walter E. Lotz, Jr., will return from Viet Nam to become Chief of Communications-Electronics, Department of the Army, effective Sept. 1.

General Lotz served as Director of Army Research from October 1963 until reassigned to Viet Nam in September 1965 as Assistant Chief of Staff for Communications-Electronics, U.S. Military Assistance Command.

Deputy CG of the U.S. Army Electronics Command, Fort Monmouth, N.J., from August 1962 until October 1963, he was assigned to the U.S. Army Electronic Proving Ground, Fort Huachuca, Ariz., from 1959–62.

A 1938 graduate of the U.S. Military Academy, he holds an MS degree from the University of Illinois (1947) and a PhD from the University of Virginia (1953). He graduated from the Industrial College of the Armed Forces in 1956 and earned the academic equivalent of the Command and General Staff College.

Other key assignments include signal officer, Eighth Army, Korea, and U.S. Army Pacific, Fort Shafter, Hawaii (1956–59); and tours with the Office of the Chief Signal Officer, Washington, D.C. (1953–55), and the Signal Corps Research and Development Laboratories, Fort Monmouth, N.J.

Early assignments in his career include Headquarters, Ninth Air Force, European Theater of Operations and XII Tactical Air Command, Germany (1944–46); Aircraft Warning Co., Task Force 4, Iceland (1941–42); and three consecutive assignments at Fort Monmouth, N.J. (1938–41) with the 51st Signal Battalion, the Signal School and 1st Signal Operations Co.

Maj Gen Walter E. Lotz, Jr.

Exhaust Heat to Power Experimental Air Conditioner

Waste heat from gas turbine exhaust will be used to power an advanced air conditioner being developed by the U.S. Army Mobility Equipment Center's Engineer Research and Development Laboratories, Fort Belvoir, Va.

Designed for use with the Army's missile fire-control vans and other mobile shelters requiring controlled environment, the air conditioner will utilize heat normally wasted in the exhaust of generator sets powering electronic and other equipment in the vans.

Fuel savings of 40 percent and a size and weight reduction of 30 percent for combined power and environmental control equipment are anticipated. An experimental model scheduled for completion in late 1966 will operate with the 15-kilowatt military turbine generator set to produce five tons of cooling.

The unit incorporates a "double loop" design, consisting of a power cycle loop and a refrigeration cycle loop, both operating with R–11 fluid with a common condenser circuit.

Heat from the exhaust gases is transferred to the power-cycle fluid by means of a vapor generator heat exchanger. Energy recovered is transferred to the refrigeration loop by expanding the heated power fluid through a turbine which drives the refrigeration loop compressor.

The power loop operates on the Rankine power cycle principle with the fluid circulating through a vapor generator, turbine, condenser and pump. The refrigeration loop is a conventional vapor compression type consisting of a condenser, expansion device, evaporator and compressor.

In the experimental model, which as a military unit must provide complete environmental control, heating and cooling are controlled by fully modulating bypass valves to maintain a constant return-air temperature from full cooling to full heating conditions. Hydrodynamic bearings are used in all components handling the R–11 fluid to eliminate the need for lubricating oils.

The Garrett Corp. AiResearch Manufacturing Co. of Los Angeles, Calif., is fabricating the waste-heat powered unit, under a contract with the Laboratories.

Brig Gen Hebbeler Takes ACSFOR Director Post

One of the original staff leaders of the U.S. Army Research Office, Brig Gen James A. Hebbeler, is the new director of the Chemical-Biological-Radiological and Nuclear Operations in the Office of the Assistant Chief of Staff for Force Development, Department of the Army.

General Hebbeler succeeded Brig Gen Donald G. Grothaus upon his recent retirement. Since November 1963, General Hebbeler had commanded Deseret Test Center, Fort Douglas, Utah. For the preceding 21 months he was commander of the U.S. Army Chemical Research and Development Laboratories at Edgewood Arsenal, Md.

From June 1956 until May 1958 he was chief of the Physical Sciences and Engineering Branch, Office of the Chief of Research and Development. He then became chief, Research Analysis Division, Army Research Office, where he served until July 1959.

Upon completion of the Army War College regular course in 1960, he was assigned to the V Corps Frankfurt, Germany, as Corps chemical officer.

General Hebbeler has a BS degree in chemistry from Purdue University and an MS degree in physics from Columbia University.

In addition to the Army War College, he is a graduate of the Field Artillery School, basic and advanced courses; Chemical Corps Advanced Course; Command and General Staff College (Regular and Special Weapons Courses); U.S. Army Command Management School (Management Course) and the University of Pittsburgh (Management Course).

General Hebbeler was born in Evansville, Ind., Oct. 10, 1918.

Brig Gen James A. Hebbeler

Launching of 8 Satellites Heralds Era Of Global Communications for Defense

Global military communications by satellites moved toward fullscale operational reality June 16 with the experimental launch of eight spacecraft—part of 24 scheduled during 1966–67—from Cape Kennedy.

In the Initial Defense Communications Satellite Program (IDCSP), five U.S. Army ground stations are relaying military test traffic through seven communications satellites orbiting in a circular pattern 18,200 nautical miles above the equator. The eighth satellite is an experimental gravity-gradient spacecraft.

Developed by the Army Satellite Communications Agency (SATCOM), Fort Monmouth, N.J., the network's primary ground stations are at Fort Dix, N.J., and Camp Roberts, Calif. Three transportable communications terminals are in Hawaii, the Philippines and West Germany.

SATCOM's No. 1 station at Fort Dix was the first to pick up signals after the cluster of satellites was injected into space from a Titan III–C developmental booster launched by the U.S. Air Force.

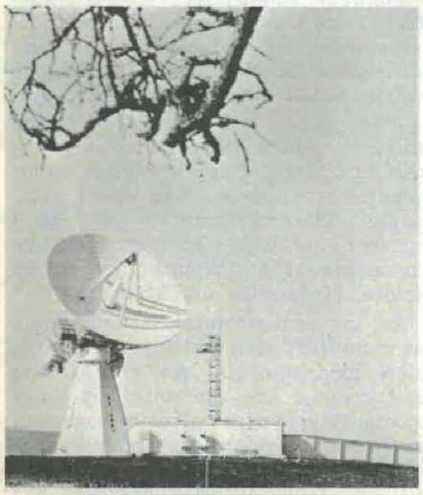
Within six minutes after the experimental craft were in orbit, telemetry signals were received and surface station tracking and communications tests began.

Within two hours, long-distance circuits were established through each of the satellite repeaters. SATCOM and Air Force officials reported the launch "perfect." The dispenser carrying the eight spacecraft was placed into the precise orbit required.

Secretary of the Air Force Harold Brown said there will be at least one more launch this summer to put a sufficient number of satellite repeaters in orbit to insure against failure of any one, or several, of those in orbit.

Designed to meet special Department of Defense communication requirements, the IDCSP satellites will decrease the possibility of an interruption in communications between military installations. The gravity gradient satellite experiment is to determine the feasibility of using the earth's gravitational force for satellite stabilization at high altitudes.

SATCOM Test Operations Center is at Fort Monmouth, N.J., focal point for managing Defense satellite communications experiments in the U.S., overseas and at sea. Seated at the console are Col Eugene B. Datres; Col Mitchel Goldenthal, SATCOM commander; and Maj William W. Weihmiller.



SATCOM STATION No. 2 at Camp Roberts, Calif., serves as the west coast continental U.S., link in the Initial Defense Communications Satellite Program (IDCSP) experimental network. An electronic twin at Fort Dix, N.J., provides identical facilities.

The fixed stations in New Jersey and California, with their 60-foot diameter antennas, are the principle entry points for satellite communication links from the Pacific and Europe. The newly developed overseas terminals are the first to be specifically designed for military use. Each of these terminals, known as AN/MSC–46, has a 40-foot-diameter antenna and can be moved by air wherever needed.

The first portable terminal was delivered late in 1965 and retained by Hughes Aircraft Co. as a training unit for terminal crews. A fifth terminal is on site at Asmara, Ethiopia, and by late summer will begin operations in the research and development test network of the IDCSP.

Location of future terminals being built under the SATCOM Agency contract remains subject to change and will depend on results of the first portion of the test program being conducted by SATCOM for the Defense Communications Agency (DCA).

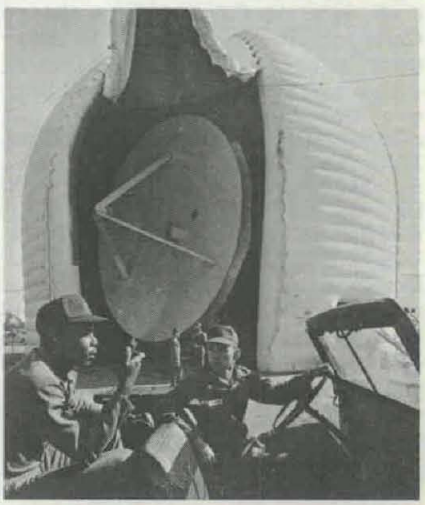
During 1966–67 a total of 15 additional communications satellites and another experimental gravity gradient satellite will be placed in orbit under the present schedule.

The two major ground stations are veterans of military space communications research. Originally built for the U.S. Army ADVENT Program, they were later modified for use in the National Aeronautics and Space Administration's (NASA) SYNCOM Program, since taken over by the Department of Defense.

The latest modification enables both the Fort Dix and Camp Roberts stations to operate in the IDCSP mode while retaining a SYNCOM capability.

Commanded by Col Mitchel Goldenthal, the SATCOM Agency is responsible, as one of its missions, for carrying out the Army's portion of the IDCSP.

The IDCSP is a Department of Defense program under the DCA,



AN/MSC–46 (Mark 1B) satellite communications ground-link terminal is one of a series specifically designed for military use. Each of these terminals has a 40-foot diameter antenna and can be transported by air. The terminals are being built for the Army by Hughes Aircraft Company.

commanded by Lt Gen Alfred E. Starbird. Mission of the DCA is to insure that the defense communications system will be operated to meet the long-haul communications requirements of the Department of Defense.

Rear Adm Francis E. Boyle, U.S. Navy, is head of DCA's Communications Satellite Project Office for the IDCSP.

Each of the Military Services wil carry out certain roles under the direction of DCA. The Air Force develops and launches the communications satellites. The Navy is developing certain shipboard equipment which will enable its ships at sea to use the satellites for specific naval communications requirements. The Army has the mission of developing the ground terminals for the IDCSP and for conducting the communications technical test program.

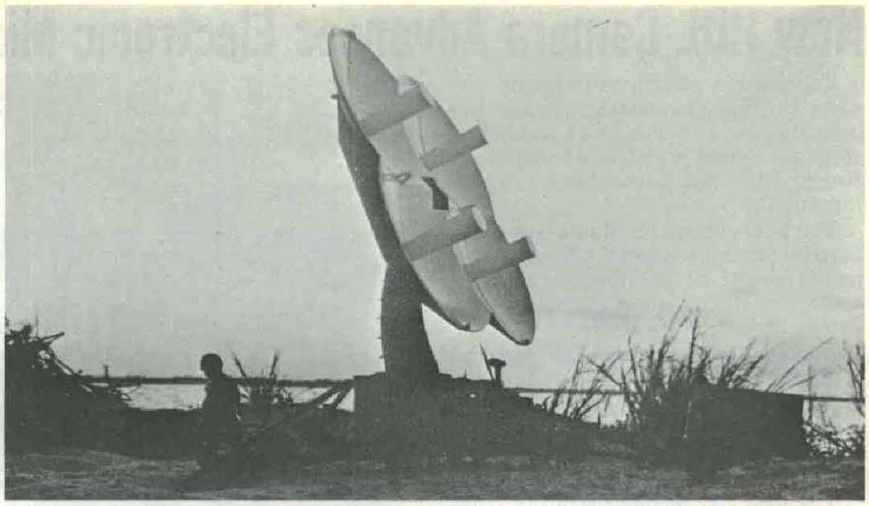
As delivery of the AN/MSC–46 terminals continues, SATCOM will ship them to various overseas locations and tie them together, using the IDCSP satellites to form the world's first global satellite communications network. This network will undergo R&D testing for a period of about one year. Each terminal will receive, amplify and transmit multiple voice and teletype mesages for the Defense Department.

Location of each terminal is determined by the Defense Communications Agency, which makes its decisions based on exhaustive site-survey recommendations accomplished by site-engineering personnel of the SATCOM Agency's Mission Support Directorate.

These highly trained SATCOM specialists have crossed the globe many times in the past several years. Through their search and study, they have developed a specialized capability which is unique because of the newness of the whole field and the absence of previous experience in the state-of-the-art.

Selecting a satellite communications terminal site is influenced by many complex factors, including availability of real estate, frequency interference from other communications equipment in the area, local weather, terrain and accessibility to entry points in the defense communications system.

The ground terminals are being manned by operating personnel of the U.S. Army Strategic Communications Command (STRATCOM) Headquarters in Washington, D.C. Commanded by Maj Gen Richard J. Meyer, STRATCOM operates the Army's long-haul strategic networks within the framework of the defense communications system.



AN/TSC–54 (Mark V) terminal, under development for the Army, can be employed with other IDCSP terminals and also can be tied into a regular telephone exchange or network. Antenna aperture efficiencies of 70 to 75 percent have been recorded in initial tests of the cloverleaf structure. Radiation Inc., contractor, attributes performance to use of DIELGUIDE feeds that use principle of inserting a low dielectric foam material between the feed and the sub-reflector. Designed for tactical, quick-reaction military communications in overseas areas, each terminal, including support materiel and six operational personnel, will be transportable in a single C–130 aircraft.

General Meyer's command is operational. The STRATCOM networks carry actual military traffic while the SATCOM mission is research and development.

After SATCOM Agency development, engineering and procurement of the terminals, STRATCOM personnel operate them and SATCOM carries out the technical test program.

If the system is found satisfactory, at the end of the experimental test period, STRATCOM personnel are trained and ready for any actual operational traffic that might be allocated to the network.

Each AN/MSC–46 station will have a STRATCOM complement of 27 men. For the initial period of the R&D testing, each station has an additional SATCOM test team of seven. These special test teams make up what is known as DAPS—short for Data Acquisition and Processing System, an in-house SATCOM Agency project. Each team works out of a special van located near an AN/MSC–46 terminal, receiving test schedules from the Test Operations Center at SATCOM headquarters.

The SATCOM Agency consists of about 75 military and 132 civilian personnel. Many are pioneers in the field of satellite communications and participated in early Army Signal Corps experiments such as Diana, when radar signals were first bounced from the moon in 1946; Score, 1958; and Courier, 1960.

In 1962, the SATCOM Agency was assigned by the Department of Defense to support NASA in the SYNCOM satellite program.

SATCOM terminals developed for an earlier program were used to make up the experimental SYNCOM network, and the SATCOM Agency conducted the test program from its Test Operations Center at Fort Monmouth, first for NASA, and later for the Department of Defense when the two SYNCOM satellites were transferred by NASA to DoD.

The IDCSP satellites now in orbit are being used primarily for research and development but are capable of providing emergency communications. Interruptions in conventional communication systems caused by natural and man-made interference will not affect the communication satellite system.

Air Force Systems Command's Space Systems Division, Los Angeles, Calif., commanded by Maj Gen Ben I. Funk, is responsible for procurement and launch of the space-borne elements of the Defense Communication Satellite Program.

New HDL Camera Advances Electronic Microminiaturization

Fabrication of microelectronic circuits by the photomask process has been speeded 10 times by an automatic step-and-repeat camera developed at Harry Diamond Laboratories, Washington, D.C.

The new camera produces improved matrix photomasks and allows direct measurement of the image reduction ratio, permitting rapid changes in the ratios used.

Robert Reams, physical science assistant in HDL's Components Laboratory, and Sandie Hargraves, modelmaker in the Developmental Division, collaborated in the design and fabrication of the camera.

The first circuit incorporating transistors and diodes as integral parts by photoengraving and photomechanical techniques was pioneered by the Harry Diamond Laboratories in 1957, then the Diamond Ordnance Fuze Laboratories (DOFL).

(The Pinhole Array Camera System developed by the Army Electronics Command to produce similar microminiaturized circuitry was discussed in the November 1965 edition of the *Army R&D Newsmagazine*, page 13.)

The HDL step-and-repeat camera retains features of the early designs, such as precise focusing on the emulsion. Completely automatic control of matrix exposures along both horizontal and vertical axes is possible.

The exposure procedure, which formerly required several hours of tedious work by two experienced technicians, is carried out in 15 minutes with one operator monitoring the process.

The improved camera has built-in micrometer alignment fixtures, including rotation, which reduces the handling of delicate photographic masters. Incorporated into the design are a large range of reduction ratios and the ability to form a matrix from a relatively large master. This gives the operator a number of variables which he can adjust to have a perfect step-and-repeat process.

HDL Automatic Step-and-Repeat Camera

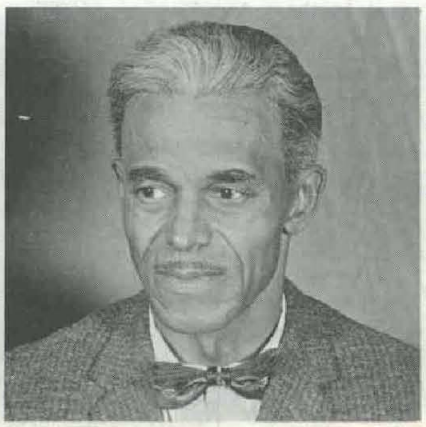
Fabrication of a solid circuit entails the exact placing of a number of circuit elements on a series of plates, all of which have to be in precise register with each other. Because of their asymmetrical shape, the placement of these figures relative to each other is even more critical than for the diode matrix.

In this case, the pattern to be exposed on the spectroscopic plate is placed in the object slot at the front end of the camera. By using a microscope mounted at the other end of the camera, the orientation of the pattern may be checked. When it is set in its predetermined position, the red filter is removed and the film is exposed.

The second pattern is then placed in the object slot and the plate holder is moved in its plane to the new position. The pattern is then exposed. This procedure is repeated for as many patterns as required.

The original step-and-repeat camera was designed to take patterns and locate them in precise position with maximum resolution. The new Harry Diamond Laboratories version is considerably more sophisticated and considered a great stride in electronics microminiaturization.

Robert Reams



Sandie Hargraves

AMEDS Honors Col Alling With A-Prefix Certificate

The Army Medical Service "A-Prefix" Certificate of Achievement, its highest award for professional excellence, was presented recently to Col Charles C. Alling, chief of the Dental Research Branch, U.S. Army Medical Research and Development Command.

In a ceremony at the Army Surgeon General's Office, Maj Gen Joseph L. Bernier, Chief of the Army Dental Corps, explained the significance of the rating as being equivalent to full professional stature, and as an exclusive honor accorded to a few outstanding individuals.

Col Alling, an ardent researcher and author of some 30 papers in dental publications, is a native of Guthrie, Okla. He earned AB and DDS degrees from the University of Indiana and has a master of science degree in oral surgery from the University of Michigan.

He is a Diplomate of the American Board of Oral Surgery, a Fellow of the American College of Dentists and a member of various national and international professional groups.

In 20 years of Army service, he has practiced dentistry at various Army hospital clinics in the United States and overseas. He was assigned to the U.S. Army Medical Research and Development Command in June 1963.

Gen Williams Elucidates Army's Revised Policy On Cooperative Aircraft Deployment With USAF

Revised Army aviation policy resulting from the recent Army and Air Force Chiefs of Staff agreement was clarified by Director of Army Aviation Brig Gen Robert R. Williams in a speech to industrial and military leaders.

The occasion was an Advanced Planning Briefing for Industry Seminar, May 4–5, at St. Louis, Mo. General Williams said that through this agreement the Army has gained support from the Air Force that "represents a new area of understanding and cooperation in the conduct of operations which has been sought by the Army for 20 years."

The only "substantive change" to previous policy brought about by the Chiefs of Staff agreement, the General said, "is the relinquishment of our claim for CV–2 and CV–7 aircraft and any future fixed-wing aircraft designed for tactical airlift."

Before launching into specifics of the Army's aviation policy, General Williams said that "the Army will continue to exploit the inherent capabilities of aircraft to support the conduct of prompt and sustained combat operations on land."

He said that "just as we will continue to receive aviation support from the other Military Services, so will we continue to provide organic aviation responsive to direct control and planning of the Army commander."

The Army, it was explained, will develop and acquire aircraft and command and control systems which are uniquely capable of fulfilling requirements of immediate availability for sustained operation in a field environment.

General Williams countered with a firm "No" concerning recent press inquiries about the Army "getting out of the flying business." He added that the Caribous (CV–2) transports being transferred to the Air Force represented less than two percent of the Army's aircraft inventory.

"In the field of observation, command and control," he said "we will continue to procure and improve the OH–6 helicopter as a replacement for the OH–13, OH–23 and O–1." The Army will also continue to procure the OV–1 and will "product-improve the aircraft to optimize it for the surveillance mission."

The improved aircraft will be with the Army for an extended period pending the final determination of a Surveillance and Target Acquisition Aircraft System (STAAS) to serve as a replacement. The General said the STAAS may be VTOL (vertical takeoff and landing), V/STOL (vertical short-takeoff and landing) or STOL (short-takeoff and landing), depending on the characteristics defined for future developments.

With respect to transport aircraft, it was explained that Army procurement and R&D programs in the past have been based upon continuing the CH–47 and the CV–2/CV–7 aircraft in the Army inventory as a "team in meeting the tactical airlift requirements."

Development efforts have been focused on product improvement of each of these types of aircraft and on exploration of the practicability of developing a single aircraft to replace both the CV–2/CV–7 and the CH–47.

Expanding on replacement with a V/STOL aircraft, the Director of Army Aviation said major questions remain to be resolved concerning the effect of a high downwash velocity, noise level, maintenance and complexity of V/STOL aircraft in Army field operations.

"The XC–142 was developed on a tri-Service basis," he said, in an effort to obtain answers to these questions for the specific operational environments for all three Armed Services.

Until substantive data from field testing of the XC–14A2 (Army) in the Army environment is produced, it was stated, a determination cannot be made as to the applicability of this or similar V/STOL concepts to the Army mission or to an Air Force mission in support of the Army.

The Army considers that the XC–142 and related projects may provide information on a potential aircraft that could replace the CH–47 for the Army mission, or replace the CV–2/CV–7 type aircraft for the Air Force mission in support of the Army.

In the latter case, the Army would take a firm and knowledgeable stand in establishing the acceptability of the aircraft, since it would be operating in the Army area.

General Williams said that in the event that a tilt-wing is found suitable to replace the CH–47 and the CV–2, a determination could then be made as to proportionate numbers of this aircraft to be assigned to the Army for battlefield mobility and to the Air Force for logistics.

Army development efforts, he observed, "should be placed on full-scale compound/composite helicopters which technical forecasts indicate may be more suitable candidates as eventual CH–47 replacements."

Brig Gen Robert R. Williams

In the Utility Tactical Transport (UH–1D) field, he believes Army requirements are being met but that the Army will continue study and consideration for the development of a replacement of the UH–1D with such improvements as "improved cruise speed and efficiency, longer endurance and improved payload and performance under 'hot day' conditions."

General Williams said that heavy-lift helicopters, such as the CH–54, will continue in development. The Cobra (see May 1966 edition *Army R&D Newsmagazine*, page 14) will remain in the inventory as a supplement to the advanced aerial fire support system (AAFSS) and will continue on the procurement list as the AAFSS develops.

There is "no change" in the status of the Army utility airplane, or the mission support aircraft (administrative). It was emphasized that:

"The Army will continue to obtain the most satisfactory aircraft available in meeting its utility (and administrative-mission support) requirements," the General said. "Aircraft of this type will be procured 'off the shelf' and used on the same principle followed by large corporations and other Services in providing transport for senior staff officers and officials."

General Williams "linked arms" with the military-industry team by summarizing:

"Our need (Army aviation) is greater than ever before. Our research and development program is ever expanding to seek new and effective areas of performing the Army mission. Our expanding procurement and production requirements generated by the needs expressed by commanders in Southeast Asia demonstrate their high regard for the responsiveness of aviation support . . . our charter for the future is clear . . . there are great tasks ahead."

CDC Deputy Commander Ends 30-Year Army Career

Maj Gen Charles Billingslea, deputy CG, U.S. Army Combat Developments Command, Fort Belvoir, Va., retired June 30 to end 30 years service in the U.S. Army.

A native of Chicago, Ill., he was graduated from the United States Military Academy in 1936, and commissioned in the Infantry.

During World War II, he participated in the Tunisian Campaign and was with the 82nd Airborne Division as the Parachute Brigade deputy commander during the Sicily jump. He was chief of the Pathfinders for the Salerno jump and executive officer of the 504th Parachute Regiment during operations in Naples, Volturno, Cassino and Anzio. He next commanded the 325th Glider Regiment in combat during the First Allied Airborne Drops in the Arnhem-Nijmegan, Holland, through the Central European Campaigns, and in the occupation of Berlin.

Following his return to the United States as chief of staff, 82nd Airborne Division, he served in the Plans Section of Army Ground Forces, Fort Monroe, Va., and on the faculty of both the Army Command and General Staff College and the Army War College until assigned to Korea in 1950 with the Operations Research Office.

Graduated from the Army War College in 1953, General Billingslea was assigned as chief of Plans, SHAPE Headquarters, Paris. Following completion of the Harvard Advanced Management Program Course and graduation from the National War College, he was assigned in 1958 to the Department of Defense as deputy director, European Region, International Security Affairs. From 1961 to 1962 he was in Korea as deputy and later as chief of staff, U.S. Eighth Army.

Maj Gen Charles Billingslea

ECOM Personnel Present 5 of 37 Papers at Meet

U.S. Army Electronics Command (ECOM) employees presented five of the 37 papers heard by about 250 scientists and engineers from Great Britain, France, Canada and the United States at the Ninth Modulator Symposium at Fort Monmouth, N.J.

Sponsored jointly by the ECOM Electronic Components Laboratory and the Department of Defense Advisory Group on Electronic Devices, the meeting produced an exchange of information on pulse modulators.

The modulator is the heart of equipment that converts the information carried in electronic form on radio and similar waves into intelligible information, audible or visual and vice versa.

Brig Gen William B. Latta, ECOM commander, welcomed participants, and Nigel S. Nicholls, of Britain's Royal Radar Establishment, made the keynote address. Co-chairmen Sol Schneider and George W. Taylor of ECOM arranged and conducted the program.

Papers presented by members of the ECOM Electronic Components Laboratory, Electron Tubes Division, included: "Plasma Properties of Kiloampere Discharges," John E. Creedon; "Deuterium Cleanup," Sol Schneider and Norman L. Yeamans; "Modulator Performance of One-Kilovolt Thyristors," Frederick Vorkwerk and Thomas Krueger; "Drive Requirements for High-Voltage Low-Grid-Current Tubes," George Taylor; and "Triggering Mode Study of a Series Spark-Gap Array," Schneider and Anthony J. Buffa.

Presentations were made by scientists from Brookhaven National Laboratory, Los Alamos Scientific Laboratory, Stanford University, Massachusetts Institute of Technology, Rome Air Development Center, and a number of U.S. industrial laboratories.

Sanders Succeeds Orman as Latin America DRO Chief

Success as commander of the U.S. Army Research and Development Group Far East, including award of the Legion of Merit and one of the rarest honors of the Japanese medical profession, has carried Col Arvey C. Sanders to a similar assignment in Rio de Janeiro, Brazil.

Effective July 1, Col Sanders succeeded Col Leonard M. Orman as commander of the U.S. Army Element and chief of the Defense Research Office—Latin America. Col Orman had served since the DRO-LA was established in July 1962 and is now assigned as Director of Developments, Army Weapons Command, Rock Island Arsenal, Ill.

The Legion of Merit was awarded to Col Sanders for his work in expanding the Army's research programs in the Far East and establishing "a superb rapport" with the Japanese biomedical research community from 1962–65. He became one of four non-Japanese and the first non-physician to be elected an honorary member of the staff and faculty of the 100-year-old Kitasato Institute, in Tokyo. The U.S. Army R&D Group Far East is in Tokyo.

Since May 1965 Col Sanders had served as special assistant to Col William D. Tigertt, director, Walter Reed Army Institute of Research (WRAIR), Washington, D.C., where he had served previously in top bacteriological research positions.

Col Sanders is a veteran of 29 years in the Army Medical Service. He served as chief of the Department of Bacteriology at WRAIR (1959–62) and as chief, Biological and Medical Sciences Branch, Army Research Office, OCRD (1957–59). Earlier assignments at WRAIR were as assistant chief, Respiratory (Virus) Diseases (1956–57) and chief, Diagnostic Section (Bacteriology),

Awarded The Army Surgeon General's "A" Award in bacteriology for professional excellence as one of the top scientists in the field, Col Sanders has an MS degree in bacteriology and a doctorate in microbiology from the University of Maryland, College Park.

Mission of the Defense Research Office Latin America, like those of the Europe and Far East research offices is to coordinate and facilitate scientific liaison between U.S. Army scientists and foreign scientists, including the exchange of scientific and technical information. The office also coordinates the support of research efforts of interest to the U.S. Army through grants.

Col Arvey C. Sanders

Joint Effort Produces Standards for 1723 Glass, 7940 Fused Silicas

Six permittivity standards for 1723 glass-and 7940 fused-silica are now available as a result of cooperation among the U.S. Department of Commerce National Bureau of Standards (NBS), the National Physical Laboratory (NPL) of England, and the National Research Council (NRC) of Canada.(1)

These standards, announced by the NBS Office of Standard Reference Materials, are intended for use in checking and improving measurement systems for complex permittivity. The 1723 glass and 7940 fused silica have been certified for permittivity (i.e. dielectric constant) in three sizes each as standard reference materials for $87.50 each.(2)

Table 1. 1723 Glass

Frequency Hz	relative permittivity *	loss tangent x 10^4 *
10^3	6.314 ± .38%	8.55 ± .74
10^4	6.305 ± .31%	9.00 ± .74
10^5	6.293 ± .41%	10.03 ± .68
10^6	6.278 ± .35%	11.59 ± .73
10^7	6.265 ± .38%	14.64 ± .83
10^8	6.25 ± .60%	20. ± 1.1
10^{10}	6.207 ± .38%	53.5 ± 1.1

Table 2. 7940 Fused Silica

10^3	3.8350 ± .30%	1.86 ± .84
10^4	3.8317 ± .30%	1.14 ± .79
10^5	3.8265 ± .31%	0.33 ± .69
10^6	3.8255 ± .31%	0.34 ± .74
10^7	3.8258 ± .37%	0.20 ± .86
10^8	3.83 ± .67%	1. ± 1.20
10^{10}	3.8315 ± .37%	1.46 ± .84

The glass standards are certified for relative permittivity of approximately 6.3 in the range of 10^3 to 10^{10} Hertz (see table 1). NBS Standard No. 1501, 1723 glass, is a rough-cut blank, 2¼ × 2¼ × 3 in., for making a 2-in. disk for low-frequency, capacity-type holders. NBS Standard No. 1502, 1723 glass, is a rough-cut blank, 1 × ½ × ½ in., for X-band waveguides. NBS Standard No. 1503, 1723 glass, is a rough-cut blank, 1¼ × ¼ by ⅜ in., for making a nominally 1–in. cylindrical waveguide for dielectrometers.

The fused silica standards are certified for relative permittivity of about 3.83 in the range of 10^3 to 10^{10} Hertz (see table 2). NBS Standard No. 1504, 7940 fused silica, is a rough-cut blank, 2¼ × 2¼ × 0.015 in., for making a 2-in. disk for low-frequency, capacity-type holders. NBS Standard No. 1505, 7940 fused silica, is a rough-cut blank, 1 × ½ × ½ in., for X-band waveguides. NBS Standard No. 1506, 7940 fused silica, is a rough-cut blank, 1¼ × 1¼ × ⅜ in. for making a 1-in. cylindrical waveguide for dielectrometers.

(1) For further information, see International Comparison of Dielectric Measurements, by H. E. Bussey, J. E. Gray, F. C. Bamberger, E. Rushton, G. Russell, B. W. Petley and D. Morris, IEEE Transactions on Instrumentation and Measurements, IM–13, No. 4, 305–311 (Dec. 1964).

(2) For a complete list of NBS standard materials, see Standard Reference Materials: Catalog and Price List of Standard Materials Issued by the National Bureau of Standards, NBS Misc. Publ. 260. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20204, for 45 cents.

The values given in the tables are expressed relative to vacuum, not air. Each value is an average of several measurements made by NBS and, at most frequencies, by NPL and NRC. Each laboratory's result was weighted inversely as the uncertainty quoted by that laboratory.

The uncertainty(*) given in the table represents the uncertainties normally quoted by the several laboratories, suitably combined and then increased to allow for possible inhomogeneity of the material from which this specimen was cut.

Dr. Thomas Addresses BRL On Research Management

Dr. Jay Tol Thomas, Director of Research and Laboratories, U.S. Army Materiel Command, was guest speaker at the semiannual meeting of the Army Ballistic Research Laboratories' Scientific Advisory Committee at Aberdeen Proving Ground, Md.

Dr. Thomas addressed industrial and academic scientists who assist the staff of the Ballistic Research Laboratories in program planning on "Management of Research and Laboratories of the Army Materiel Command."

Members of the committee present were Prof. Walker Bleakney, Princeton University; Dr. Bernard Lewis of the Combustion Institute; Prof. Joseph E. Mayer of the University of California, San Diego; Maj Gen Leslie E. Simon, U.S. Army (Ret.), who served as director of BRL from 1941 to 1949; Dr. H. J. Stewart of the California Institute of Technology; and Dr. L. H. Thomas from the Watson Laboratory of IBM Corp.

Brig Gen Boles Assigned as ATEC Deputy CG

Three consecutive major assignments in research and development over the past seven years are part of the broad background of experience Brig Gen John K. Boles, Jr., takes into his new duties as Deputy CG of the Army Test and Evaluation Command.

Prior to reporting recently at Aberdeen Proving Ground, Md., General Boles was the director, Joint Research and Test Activity, U.S. Military Assistance Command in Viet Nam. From 1962 to 1964 he was assigned as deputy and chief of the Requirements and Development Division, the Joint Staff, J–5, in Washington, D.C. He was executive officer, Office of the Chief of Research and Development under Lt Gen Arthur G. Trudeau from 1960 to 1962, and, Senior Military Adviser, U.S. Army R&D Operations Advisory Group, Research Analysis Corp., from 1959 to 1960.

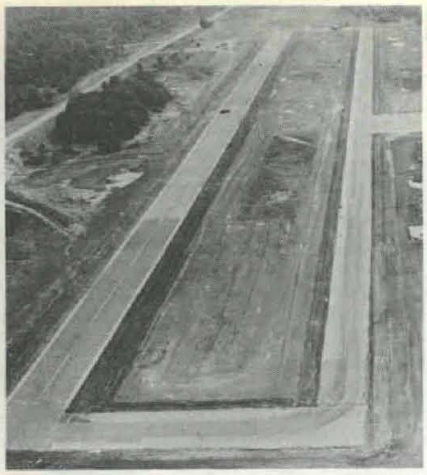
Born in the Philippines in 1916, the general is a member of an Army family and a 1939 graduate of the U.S. Military Academy, West Point, N.Y. He was commissioned in the Cavalry and served with the 3rd Armored Division in Europe during World War II.

An ardent hunter and marksman, General Boles has been a member of the National Rifle Association since 1928. He fired in the National Rifle Matches with Army teams on two occasions and won the Army's Distinguished Marksman Badge.

His decorations include the Silver Star, Soldier's Medal, Bronze Star Medal, Air Medal, Army Commendation Medal and the Purple Heart. With the exception of the Silver Star, all were awarded two or more times. General Boles also holds the French Croix de Guerre and wears the Belgian Fourragere.

Brig Gen John K. Boles, Jr.

Surfacing Membrane Offers 'Short Order' Airfields



Neoprene-coated nylon membrane simplifies construction of a complete assault airfield after the site has been cleared, graded and compacted.

Panels are anchored to the ground with steel "tacks." Edges are then reinforced with two layers of membrane surfacing and cemented in place.

Should damage occur during operations, repairs are simple. A patch is cut from the spare membrane panel and cemented under the damaged area.

Temporary tactical airfields and heliport smay soon go on "short order" lists of the Army and Air Force through use of a newly developed neoprene-coated nylon surfacing membrane.

The material expected to turn the trick has been subjected to extensive field trials in the United States by the two Services and is being tested in Viet Nam under combat conditions.

Integrated engineering/service tests of the T–17 Airfield Surfacing Membrane were completed recently at Fort Campbell, Ky. The Army Test and Evaluation Command (TECOM) Armor-Engineer Board, served as the executive agency for the overall project, and also performed service test portions of the evaluation.

Engineering tests were conducted by the Army General Equipment Test Activity, Fort Lee, Va., another TECOM element, with the support of laboratories and technicians of the Army's Engineer Waterways Experiment Station, Vicksburg, Miss.

Aviation units for the tests were provided by the Army Aviation Test Board, a TECOM command at Fort Rucker, Ala., and the U.S. Air Force Tactical Air Command (TAC). Landings and takeoffs with C–130 cargo aircraft were tested by TAC while the Board flew missions involving Caribou and Mohawk type aircraft (CV–2 and OV–1 aircraft).

Evaluation of the T–17 membrane surfacing involved construction of a complete assault airfield at Fort Campbell by the 27th Engineer Battalion (C). The installation, made entirely from the T–17 material, consisted of a 3,000-foot runway, parallel taxiways and a parking apron. Construction of the airfield conformed to TAC criteria.

The experimental material is intended for use in constructing stable dustproof and waterproof surfaces for temporary airfields. Installation methods and techniques are not complicated or time-consuming.

An Army engineer battalion, for instance, can spread and secure 31 of the experimental membranes (enough for construction of a 3,000-foot runway) in approximately three days. Laying out the surface is a relatively simple task, once a site possessing sufficient soil strength has been cleared of trees and other ground obstacles, and graded.

The accordion-folded panels, packaged in wood crates, are dispensed directly from cargo trucks. Aligned and straightened by hand, each of the 78- by 100-foot panels is anchored to the ground with giant steel "tacks."

Joints are constructed by overlapping adjoining edges and securing them in place with tack anchors and liquid adhesive to form waterproof seams. Side edges are fastened in V-trenches dug at the sides and ends of the emplaced surface. The ditches are then backfilled and compacted to form smooth shoulders.

Surface repairs are made by positioning a piece of membrane under a damaged area and cementing it in place with adhesive.

Before field testing began at Fort Campbell, sections of the surfacing were sent to Fort Lee. There engineering data relative to the physical characteristics of the material were developed by the Army General Equipment Test Activity.

U.S. Air Force C–130 (Hercules) "touches down" successfully on the completed runway during tests conducted at Fort Lee, Va. The runway was constructed entirely of the experimental airfield membrane which is fabricated from nylon.

Special instrumentation equipment and environmental chambers were used on samples of the material evaluated by technicians to determine toughness, resiliency and resistance to flame, abrasion, oil, chemicals, solvents and extreme temperature changes.

During the service test, technologists made studies of the time and manpower requirements involved in constructing and dismantling the temporary airfield. Resistance to wheel stresses imposed by C–130 aircraft in executing landings, making tight turns, preparing for and taking off from the experimental surface, came in for special attention.

After more than 400 landings and takeoffs had been made by Army and Air Force aircraft, membrane from the taxiway and parking apron was picked up and shipped to Viet Nam for further testing. Additional membrane also was procured for this purpose.

A heavier surfacing, called the WX18 membrane, is being tested on the touchdown areas at each end of the Fort Campbell runway to determine if tears resulting from aircraft landings can be eliminated. If the WX18 material proves satisfactory, an airfield constructed with a combination of the two membranes would require virtually no maintenance.

Army Awards DCS to German MBT Chief

Achievements as Federal Republic of Germany (FRG) program managers for the joint U.S./FRG Main Battle Tank (MBT) Program have earned Dr. Fritz Engelmann the U.S. Army's Distinguished Civilian Service Medal.

Secretary of the Army Stanley R. Resor presented the Army's highest civilian award to Dr. Engelmann in mid-June, citing him for outstanding contributions to the success of the recently completed MBT design phase.

Distinguished leadership was demonstrated by Dr. Engelmann, the citation stated, in melding two distinct groups of military and civilian professionals from diverse cultural, linguistic, technical and national backgrounds into one effective working team.

The cost-sharing partnership agreement between the U.S. and FRG to develop a major weapons system was termed "unique in the annals of U.S. Army history." Dr. Engelmann served on the 2-member Program Management Board that implemented the August 1963 agreement.

Promoted recently to chief of Subdivision T-4 (Aviation and Space) Division T, Federal Ministry of Defense, Dr. Engelmann has been succeeded as MBT program manager for the FRG by Col Helmut Schoenefeld, who has a PhD degree in engineering from the Munich Institute of Technology.

Col Chambers Succeeds Wisehart as Picatinny CO

Col John S. Chambers, Jr., became commanding officer at Picatinny Arsenal, Dover, N.J., when Col Henry H. Wishart recently retired after 31 years of military service.

After completing a tour as Ordnance officer, First Corps, Korea, Col Chambers attended the Industrial College of the Armed Forces in Washington, D.C., until assigned as deputy CO at Picatinny in June 1965.

A 1940 graduate of Rice Institute, with BS degrees in both mechanical and electrical engineering, he began active duty in the U.S. Army at the San Antonio Arsenal in 1941, then served in the European Theater of Operations with the First, Third and Sixth Armored Divisions until 1946.

Other Assignments include service with the Military District of Washington (1946–48); Office, Chief of Ordnance (1948–50); Ordnance Board at Aberdeen Proving Ground, Md. (1950–52). During 1952–53 he attended the Command and General Staff College before taking command of the Ordnance Center at Red River Arsenal, Texarkana, Tex.

Following service with the Military Advisory Assistance Group in Athens, Greece (1954–57), Col Chambers attended the Armed Forces Staff College. He served as chief of the Special Weapons Unit Training Division, Field Command, Defense Atomic Support Agency, Sandia Base, N. Mex., from 1957–61, then as commanding officer of North Depot and Seneca Army Depot, Romulus, N.Y., until 1963.

Col J. S. Chambers, Jr.

Army, Interior Dept. Join In Water Purifying Effort

Major contributions to sea water desalting technology and purification of contaminated water are the objectives of an invitation for proposals on engineering studies, design and plans and specifications for new equipment.

Under terms of a recent arrangement, the U.S. Engineer R&D Laboratories at Fort Belvoir, Va., will cooperate with the Department of Interior's Office of Saline Water in studies and testing of the new equipment. The contractor is expected to complete work early in 1967. All proposals were received by the Office of Saline Water by May 31.

The equipment will be a trailer-mounted, vapor-compression, distillation plant, capable of operating without scale formation on sea water, brackish water, or fresh water contaminated with chemical, biological and radiological substances.

Scale prevention will be accomplished by incorporation of a process developed through in-house research at the Engineer R&D Laboratories. The process involves seeding or nucleation of the evaporating brine with crystals of calcium sulfate.

Plans and specifications call for a production capacity of 3,000 gallons an hour, although a capacity of 5,000 gallons an hour is desirable. The unit will be powered by a 300-horsepower gas-turbine engine which is being developed by the Laboratories.

Equipment designed under the contract must be capable of being mounted on a semitrailer, not more than 40-feet long and eight-feet wide, and must not rise more than 91 inches above the trailer bed. Maximum weight will be 40,000 pounds.

AUSA Will Present Truman With Marshall Medal Oct. 12

Former President of the United States Harry S. Truman will be presented the George Catlett Marshall Medal, the highest award of the Association of the U.S. Army (AUSA), on Oct. 12 in Washington, D.C.

Mr. Truman was chosen for his "selfless service to the Nation," by AUSA's Council of Trustees. Selection was based in part on Mr. Truman's "decisive leadership and unusual courage" during the perilous postwar period and the early years of the Cold War which did so much "to establish his place among all the presidents of the United States."

Army Meteorological Teams Cover Continent at 100 Sites

U.S. Army Meteorological Teams are providing specialized meteorological support to about 60 Army research, development, test and evaluation (RDT&E) activities by manning more than 100 sites, located in the U.S. from Alaska to Panama.

Headquarters for the teams is at Fort Huachuca, Ariz., where they are assigned to the Army Electronics R&D Activity. Their mission is to provide specialized support services to aid in planning RDT&E activities. Meteorological data thus can be correlated with test projects data.

Meteorological service to Army RDT&E activities was initiated in 1951 by the Meteorological Branch of the Signal Corps Engineering Laboratories (since redesignated), Fort Monmouth, N.J. As a result of demands by Army agencies for meteorological assistance, the first Army Meteorological Team was established at Yuma (Ariz.) Test Station and Fort Huachuca became the headquarters in 1954.

Lt Col E. H. Pickett

As requests for meteorological support came from various Army activities, other teams were organized. By 1957, the number of teams had increased to seven and currently 10 teams are operating.

Army Met Teams have, in the past, manned sites as remote as Northwest Greenland. The sites encompass all types of climatic environment: polar, arctic, temperate, desert and tropical.

Varying in size from the 4-man team at Hanover, N.H., to 72-man operations at Dugway Proving Ground, Utah, and Yuma, Ariz., the 10 teams are comprised of 10 officers, two warrant officers, 360 enlisted men and 13 civilians. They are under Lt Col E. H. Pickett, commanding officer of the U.S. Army Electronics Research and Development Activity at Fort Huachuca, Ariz.

Among the organizations being supported are: Electronics Command, Test and Evaluation Command, Mobility Command, Munitions Command, Combat Developments Command, Cold Regions Research and Engineering Laboratory, U.S. Army Natick Laboratories, Missile Command, Ballistics Research Laboratory and the Deseret Test Center.

Meteorological support is tailored to fit particular needs of using agencies. Operations of some of the teams are limited while others provide a broad gamut of services, including hourly surface and upper-air observations.

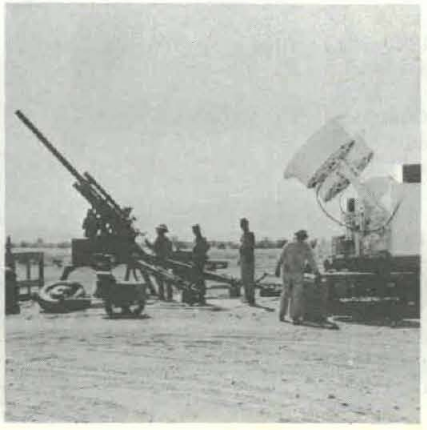
Most of the teams take nonstandard observations and measurements, such as solar radiation, ozone, dust, temperature and wind profiles, wind chill, and wet-bulb globe temperature index.

Some of the meteorological data obtained by the observations are given directly to the user and some are returned to Fort Huachuca for processing. More than 15,000,000 data points per year are put into final useful form by a data-control group.

Data processing and distribution are normally accomplished in 30-45 days from date of receipt at Fort Huachuca.

In Fiscal Year 1965, the Met Teams participated in 280 RDT&E projects, in support of 60 separate activities. Examples of projects include the firing of missiles, artillery projectiles and rockets; the functioning of chemical and biological warfare weapons systems; the aerial delivery of vehicles and equipment; the effects of climatic environment and extremes of climate on the long-term storage of various kinds of equipment, materials and munitions; and the mobility of vehicles in jungle and arctic environments.

In RDT&E programs, it is imperative that all of the recorded meterological data, visual observations and weather forecasts be extremely accurate. The success or failure of many Army tests and experiments depends upon accurate information provided by the Army Meteorological Teams.



VARIETY of tasks performed by U.S. Army meteorological teams is illustrated by collection of wind and atmosphere data in the Arctic (shown at left), rainfall in the tropics (below left), and artillery ballistics factors in the desert (below right). The 10 teams are located at Fort Greely, Alaska; Hunter-Liggett Military Reservation, Calif.; Yuma, Ariz.; Dugway, Utah; Fort Huachuca, Ariz.; Fort Monmouth, N.J.; Aberdeen Proving Ground, Md.; Hanover, Mass.; Maynard, Mass.; and the Canal Zone. Meteorological units are at Ft. Wainwright, Alaska; Deseret Test Center, Utah; Avon Park, Fla.

Army Builds Up Last Brigade

Activation of the 11th Infantry Brigade—the last of the three new independent brigades in the Army buildup—began in July at Schofield Barracks, Hawaii.

The brigade will have an authorized strength of 3,558, comprising three infantry battalions, one cavalry troop and one support battalion. Other Army unit activations announced as part of the buildup are the 9th Infantry Division, February 1966, at Fort Riley, Kans.; 196th Infantry Brigade, September 1965, at Fort Devens, Mass.; and the 199th Infantry Brigade, June 1966, at Fort Benning, Ga.

ECOM Meteorological Balloon Sets 30-Mile Record

Soaring to an altitude of nearly 30 miles, a new type of weather balloon launched by the Army Electronics Command (ECOM) has claimed a world record.

Rising at an average speed of more than 1,500 feet a minute the hydrogen-filled meterological balloon carried aloft an advanced kind of radiosonde, a hypsometer. It transmits precise readings on atmospheric pressure and measurements of temperature and humidity.

The launching site for the record of 156,000 feet was the ECOM Evans Area, 10 miles from Fort Monmouth, N.J., headquarters, two miles from the Atlantic coastline.

Accurate altitude figures were computed from the pressure and temperature data; wind speed and direction were obtained by tracking the balloon from a ground station.

The previously known altitude record for a meteorological balloon is 146,000 feet, almost 28 miles, established at Fort Monmouth in 1959.

The research is being conducted by ECOM's Atmospheric Sciences Laboratory under the direction of Col N. M. Swomley, Jr. Supervisor of the project is J. M. LeBedda, chief of the laboratory's Meteorological Systems Development Division. Moe Sharenow is project engineer.

The U.S. Air Force also contributes to the support of the program. Providing the balloons is the contractor, Kaysam Corp. of America.

ECOM experiments are aimed at development of new highly elastic materials and design features for radiosonde balloons that will reliably sound out very high levels of the atmosphere before reaching the bursting point in rarefied air.

Improved balloon performance would, among other purposes, aid in continuing atmospheric research in support of missile firings, and would contribute to new information on high-altitude wind circulation.

To achieve the 30-mile mark, ECOM researchers used a "balloon carrier" technique, in which an outer balloon with a streamlined skirt encases a high-altitude spherical balloon.

The streamlined outer balloon serves two main purposes. First, it cuts down flight time by rising more rapidly to the 50,000-foot mark than would the inner balloon alone.

At that approximate level, the outer balloon—continuing to expand as the air becomes thinner—bursts and falls away; the inner balloon, freed of the extra weight, continues to rise until it expands to its bursting point.

Second advantage of the balloon-in-a-balloon technique is the casing which protects the inner balloon from the especially adverse atmospheric conditions encountered during the first 50,000 feet, particularly the low temperatures encountered near the level of the tropopause.

NEW TYPE meteorological balloon that recently set an altitude record of nearly 30 miles emerges from the shroud which is part of a newly designed portable launcher. Really a balloon within a balloon, the inner unit bursts free of its streamlined skirted covering at the 50,000-foot mark. It continues to rise until it bursts in the increasingly thin atmosphere.

Together the two balloons weigh just over 13 pounds; the inner balloon weighs less than nine pounds. For inflation, 300 cubic feet of hydrogen is used. Total diameter is slightly over eight feet at the start of an ascension.

In 1928, a hydrogen-filled balloon carrying weather instruments and a radio transmitter made a pioneering flight that led to development of the highly refined data-gathering radiosondes now used worldwide. In 1948, a meteorological balloon reached what was then the record altitude of 140,000 feet, followed by the 1959 altitude mark.

FAAR Defense System Ordered For Early Detection of Aircraft

Intended for early detection of low-flying enemy aircraft, a Forward Area Alerting Radar (FAAR) has been ordered by the Army for use with the Chaparral/Vulcan and other battlefield air defense systems.

The new radar will be provided by Sanders Associates, Inc., through a $2,983,564 fixed-price contract covering design, development and fabrication of initial units.

The FAAR will consist of a highly mobile radar and a prime power source, identification equipment, vehicle and communication equipment, and a channel that will transmit information to various weapons systems fire units.

Brig Gen Clarence C. Harvey, Jr., U.S. Army Missile Command (MICOM) deputy commanding general, Air Defense Systems, Redstone Arsenal, Ala., has overall cognizance of the FAAR program.

The program is under Lt Col William Smith, MICOM Chaparral Management Office, and Lt Col John T. Peterson, Vulcan/Chaparral project manager for the Army Materiel Command, Washington, D.C.

ERDL Designs Equipment Armor for Viet Nam

Special armor kits developed on a crash basis are protecting operators of slow-moving construction and earth-moving equipment in Viet Nam combat zones from enemy guerrilla fire.

In less than six weeks the U.S. Engineer Research and Development Laboratories, Fort Belvoir, Va., designed special configurations for protective cabs on crawler-tractors, graders and loaders by utilizing four basic sizes of modular armor panels now used on military trucks. In this period, 21 cab-kits were shipped, together with installation manuals.

Configurations for the earth-moving equipment required no modification to the existing armor plates, which are fitted together and joined by bolting, somewhat like an erector set.

The modular plate is composed of dual-hardness steel in four basic sizes: 1 x 2 feet; 1½ x 3 feet; 2 x 3 feet; and 3 x 4 feet. Weight of the protective cab varies from 1,250 pounds for the grader to 1,530 pounds for the tractor.

To date, kits have been developed for the International TD–24 crawler-tractor, the Hough H90CM 2½-cubic-yard loader, and the Caterpillar 12 and Huber WARCO 4D graders.

The modular armor was originally developed by the Army Material Research Agency, Watertown, Mass., and adopted by the Army Tank Automotive Command, Detroit, for use on military vehicles.

XV-5A in hovering position, with exit louvers vertical and fan inlet door open in wings and nose. Basic components of the reseach aircraft's propulsion system are two J85 engines, two 5-foot wing fans and a smaller fan in the nose.

U.S. Army Aviation Test Activity Program Serves As Army-Industry Link for Combat-Ready Aircraft

Army aviators staking out their claim to an expanded role for Army aviation on the modern battlefield are not alone in their efforts.

Contributing to their success is a huge military-industry team which delivers the battle-ready aircraft needed in forward areas. The U.S. Army Aviation Test Activity, a field element of the Army's Test and Evaluation Command (TECOM), is an important link in the total logistics chain.

That helicopters and light airplanes have a place among the fighting elements of U.S. ground forces goes without question. How well they stack up is proudly attested by Army aviation's combat record in Korea and Viet Nam.

Helicopters alone have flown more than a million sorties in the past four years in Southeast Asia, transporting upwards of 1.6-million troops and other passengers, and carrying some 84-million pounds of military cargoes.

Almost infinite in variety, combat missions of these aircraft included the movement of troop units into defended areas, delivery and rapid displacement of artillery, and armed-helicopter escort, a brand new role for the erstwhile "workhorses" of Army logistics.

Indications of what the immediate future holds for Army aviation and its agile aircraft are beginning to appear at the proving grounds and test sites of the Test and Evaluation Command. In the offing are increased airlift, more speed, armor, fixed-wing and "compound" aircraft capable of short and vertical takeoffs and landings, armament systems and weapons designed specifically for the engagement of ground targets.

Col Karl H. Zornig
Army Aviation Test Activity CO

TECOM test programs for aircraft and allied equipment are funneled through several of the command's 16 field elements. They differ in some respects from the procedures prescribed for other materiel entering the Army inventory.

Engineering aspects of aircraft tests conducted by TECOM are normally handled by the Aviation Test Activity located at Edward Air Force Base, Calif. Service tests and logistical evaluation tests usually go to TECOM's Aviation Test Board at Fort Rucker, Ala.

Investigations concerned with airborne equipment and aircraft designed for air-drop or air-transport of troops and cargo are referred to the Airborne, Electronics and Special Warfare Board at Fort Bragg, N.C. Aerial delivery equipment is routed through Yuma Proving Ground, Ariz., for engineering tests.

The Army Aviation Test Activity was organized in March 1960 as a staff agency of the former Transportation Materiel Command. With four officers and 26 civilian personnel, the Army Test Office, as it was known, was assigned the mission of participating in engineering flight tests conducted by the Air Force and Navy on Army air items.

The unit received its present designation in March 1963, when it became a Class II activity of the Army Materiel Command (AMC). It was assigned to the Test and Evaluation Command with an authorized strength of 14 officers and 79 civilian employees.

Highlights of this period included engineering flight tests of the Hiller 12E and 12E4 helicopters, the Bell 47G-3, 47G-3B, and J-2 helicopters, the Vertol CH-46 and CH-47 helicopters, and of a number of research aircraft. The specially configured Martin TBM and the North American B-25 airplanes were tested for the U.S. Forest Service. In addition, various aircraft armaments and a higher payload capability for UH-1 helicopters also came under study.

Now under command of Col Karl H. Zornig, a Transportation Corps pilot, the Aviation Test Activity is authorized a complement of 35 officers, 54 enlisted men, and 100 civilian personnel.

While the basic mission of the group has not changed materially since its establishment, its workload has grown in keeping with the accelerated materiel requirements of the Army.

As a TECOM activity, the unit performs the engineering phases of confirmatory tests, service tests, acceptance tests, and renovation tests on in-service air items. It participates in engineering flight tests on research aircraft to define performance and flying qualities and to determine the suitability of test items or concepts for Army purposes.

The unit is particularly concerned with airworthiness and performance tests. These are conducted to obtain and compile detailed information on stability, control, performance and handling characteristics for inclusion in pilot handbooks, technical manuals and other publications.

Studies of test aircraft are usually made in all possible configurations, since the addition or elimination of specific items—guns, bombs, rocket and grenade launchers and similar appendages—exert a measurable influence on flying and performance characteristics.

While most of Army Aviation Test Activity work involves prototype and production aircraft testing, research aircraft engage much of the attention. Current projects form an important link in the joint effort of industry

and the services to meet combat requirements for aircraft capable of operating from dispersed, unprepared sites in forward battle areas.

The Army Materiel Command considers the helicopter a partial answer to this demanding requirement, but it finds the present family of rotary-wing aircraft lacking in both speed and range for the purpose. Some of the things being done to boost these capabilities were described recently by Lt Gen William Bunker, AMC deputy commander, at an XV–5A flight demonstration at Edwards Air Force Base.

"In the last 15 years," he said, "the Army has conducted research in at least 14 different types of V/STOL (vertical/short takeoff and landing) aircraft. The XV–5A is one of three jet models under current study and management by the Army, and one of six V/STOL aircraft in which the Army has a joint interest.

"The lift fan XV–5A was built under Army contract by General Electric and the Ryan Aeronautical Co., and in its present configuration was built specifically to test the fan-in-wing principle of vertical lift.

"I should also mention the extent to which other Government agencies have participated in the XV–5A program; participation which is also evident in many of our other research projects. The General Electric J–85 gas-generator engines used on the XV–5A were developed by the U.S. Air Force.

"The diverter valves, which the Army is also using on its XV–9A hot-cycle research helicopter, were developed by the U.S. Navy and the Air Force, and the National Aeronautics and Space Administration has generated data on various lift-fan concepts. Also, the Federal Aviation Agency has provided certain engineering services for the Army in this area."

ARMY TEST PILOT Maj William L. Welter, Jr., examines one of the 5-foot lifting fans mounted in the wings of the XV–5A. The 33-year-old West Pointer won the Distinguished Flying Cross for setting the world record for 9,000-meter Class E–1 'copter Climb.

Aircraft based on the XV–5A concept offer a blend of the battlefield mobility of the helicopter and the high-speed performance of jet aircraft. The research items flight tested last year were clocked at speeds up to 456 knots, roughly, 525 m.p.h. Landing and taking off vertically, they require limited real estate from which to operate and appear fully capable of assuming military missions such as observation, target acquisition and surveillance.

Two XV–5A research aircraft were delivered to the Army in January 1965 and completed that portion of the flight research program aimed at evaluating the lift-fan propulsions system under flight conditions and generating technical data for further V/STOL research. A continuation program covering somewhat similar ground got under way in November and is expected to continue through September 1966.

The U.S. Army Aviation Materiel Laboratories at Fort Eustis, Va., an agency of the Aviation Materiel Command in St. Louis, Mo., are responsible for conducting the XV–5A research program.

Of equal importance to Army aviation are the trials of other research aircraft now being run at Edwards AFB by a Tri-Service Test Team. Eight officers and 42 enlisted men of the Aviation Test Activity are serving with the test team. Highlights of the current test program are the XC–142 V/STOL transport and the X–22 V/STOL research vehicle.

Flight tests of production-prototype and production aircraft and allied equipment, however, form the bulk of the mission assigned to the TECOM unit at Muroc Dry Lake. The quest for a light observation helicopter to replace the fixed-wing O–1 Bird Dog, the OH–13 Sioux and the OH–23 Raven helicopters was a case in point.

A development program, based on Federal Aviation Agency certification of Bell, Hughes and Hiller helicopters, was adopted in June 1961. The original engineering flight tests of competing aircraft were conducted at the California base during the spring and summer of 1964 when two prototypes supplied by each of the competing manufacturers were subjected to intensive and thorough testing.

Although the tests followed the classic performance-stability-control pattern, the nature of the competition and the requirements for protecting proprietary rights of contractors were such that personnel of one test team were constrained from discussing results with personnel assigned to the other test aircraft.

Eight members of the Aviation Test Activity participated in the activities of the LOH evaluation group. Their recommendations were considered in the deliberations of the LOH Selection Board which finally settled on the Hughes Tool Co.'s OH–6A in May 1965.

Pending arrival of the first production models under a contract calling for delivery of 714 aircraft over a 3-year period, the Aviation Test Activity continued its tests. Investigations included climatic hangar, desert, dirt ingestion and pilot handbook tests. Tests of production models, the first of which are scheduled to arrive in mid 1966, will include armaments, handbook, desert, tropic, climatic hangar and vibration studies.

Just a few of the more important projects under consideration at this time by the Aviation Test Activity are covered in this article. All are critical and, in some measure, can be expected to influence the future of Army aviation. They undoubtedly will help provide some of the answers the Army must find as it grapples with the twin riddle of mobility and firepower posed by 3-dimensional land combat.

Civil Service Programs Course In ADP for Training Directors

"Implications of ADP for Training Directors," a 3-day Civil Service course, is being offered to Government employees concerned with providing training and guidance in the ADP field, Aug. 24–26.

The course to be conducted at the 1900 E Street U.S. Civil Service Commission offices in Washington, D.C., is designed to assist training directors, employee development officers and others to meet the challenge posed by the actual or anticipated introduction of automatic data processing in their agencies.

It has been estimated that by the close of Fiscal Year 1966 over two-thirds of the departments and agencies in the Federal Government executive branch will be using ADP. More than 80,800 man-years will be utilized in ADP operations in 1,963 ADP organizational units at a cost of over $1 billion.

ARO Civilian Selected to Attend Army War College

Jacob L. Barber, U.S. Army Research Office, Human Factors and Operations Research Division, is the first civilian selected from the Office of the Chief of Research and Development to attend the Army War College at Carlisle Barracks, Pa.

Granted a 10-month leave of absence, he will begin studies Aug. 8 with seven other civilians selected from U.S. Government agencies and about 192 officers of the Army and other Military Services.

The Army War College stands at the apex of the Army educational system and is regarded at the same level as the National War College and the Industrial College of the Armed Forces. The AWC provides the final stage of Army professional education for selected officers and civilians within the Department of Defense.

Barber was first assigned to the Human Factors and Operations Research Division as assistant chief of the Human Engineering Branch in September 1961 and received the Meritorious Civilian Service Award in 1964.

In 1950 he began his Federal Civil Service career with the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va., as an experimental psychologist. He was promoted to successively more responsible supervisory positions in camouflage materiel development.

In 1959, he was appointed human factors engineering coordinator for the Laboratories. He holds a BS degree with honors from Dickinson College and an MA in physics and psychology from Lehigh University.

Oberbeck Becomes CG Of Joint Task Force-8

Maj Gen Arthur W. Oberbeck, director of operations, U.S. European Command, reported for duty July 1 as commander of Joint Task Force EIGHT (JTF–8). He succeeded Maj Gen John D. Stevenson, U.S. Air Force.

The JFT–8 is a subordinate command of the Defense Atomic Support Agency (DASA) which plans and coordinates DoD nuclear weapons programs. Responsible for maintaining nuclear test readiness, the task force is comprised of Department of Defense and Atomic Energy Commission personnel.

General Oberbeck will be serving his fourth assignment in the nuclear weapons field. In the 1940s, he worked for the Manhattan Project and from 1951–54 he commanded two of the atomic weapons storage sites under the Armed Forces Special Weapons Project (AFSWP), military successor to the Manhattan Project. The AFSWP was redesignated DASA in 1959.

General Oberbeck was director of special weapons development in the U.S. Continental Army Command from 1956 to 1960.

Jacob L. Barber

4-Nation Meeting Draws 700 to Assess Infrared

Nearly 700 representatives from four countries attended the recent 14th national meeting of the Infrared Information Symposium (IRIS) to assess achievements and exchange information on new findings and programs based on the use of infrared.

The U.S. Army Electronics Command (ECOM) at Fort Monmouth, N.J., was host to the visiting Government, industry, university and research institute delegations from the United States, Great Britain, Canada and Australia.

Along with presentations on the information-gathering infrared devices, the discussions encompassed operating methods and purposes, including aerial reconnaissance and surveillance, and the atmospheric physics of the operating environment. Emphasis was on feasible equipment and dependable, effective field results.

Dr. Jay Tol Thomas, director of research and laboratories for the Army Materiel Command, addressed the gathering on management and philosophy of Army research at the symposium banquet. Prof. Stanley S. Ballard, chairman of the physics department of the University of Florida, was banquet master of ceremonies.

The conferees were welcomed by Brig Gen Kenneth M. Gonseth, ECOM deputy commanding general for Operations. National chairman of IRIS is Thomas B. Dowd, assistant chief scientist of the Office of Naval Research, Boston, Mass. The symposium chairman was Lucien M. Biberman of the Institute for Defense Analysis, Arlington, Va.

The June 1–3 symposium was managed by the Office of Naval Research for the Defense Department with the support of the Army, Navy and Air Force.

Modifications Seek Doubled Capacity for Chinooks

Extensive improvement in performance of the Army CH–47 Chinook helicopter is planned by the Army Aviation Materiel Command, St. Louis, Mo., at an ultimate estimated cost of $20 million, exclusive of hardware.

An initial letter contract for $8 million was awarded to the Boeing Co. to enhance the Chinook's capabilities for speed, payload, reliability and stability. The program will be in two progressive phases, Configuration 1A Configuration II.

Phase one includes development of new rotor blades and associated strengthened components, forward pylon redesign, increased fuel provisions and other significant modifications. These changes will be incorporated in an interim CH–47B model of the Chinook, with the first delivery scheduled for June 1967.

Changes planned for Configuration II will result in a new CH–47C model. Included in the modifications will be the installation of the more powerful T55/L–11 Lycoming engine to replace the T55/L–7 engine now in use, and design of more effective transmissions and shafting. Cross weight of the aircraft will be reduced to 44,000 pounds and it will provide twice the payload capability of the Chinook now in the Army system.

Under the new production program, first deliveries of the CH–47C model are scheduled for March 1968. The present fleet of Chinooks will not be affected by the improvement program.

Army commanders in Viet Nam report that the Chinook has proven invaluable for a wide variety of requirements, redeployment and evacuation of troops and the movement of heavy equipment and other military cargo.

Key STRATCOM Changes Involve Skinner, Weeks

Cols Eugene L. Weeks and William G. Skinner recently assumed key administrative assignments at Headquarters of the Army Strategic Communications Command (STRATCOM), Washington, D.C.

As the new deputy chief of staff, Logistics, Col Weeks succeeds Col R. H. Folts, now STRATCOM's inspector general. Col Skinner is deputy chief of staff, Comptroller.

Graduated from the U.S. Military Academy in 1942, Col Weeks earned an MBA degree from the Harvard Business School in 1949. After a 3-year tour with the Department of the Army DCS for Logistics, he was with U.S. Army Europe headquarters in Heidelberg prior to joining STRATCOM early this year.

Col Skinner succeeds the recently retired Col J. R. Lamar, position following a 2-year tour as deputy chief of the Program and Budget Review Division, Defense Communications Agency.

Col Eugene L. Weeks

Col William G. Skinner

A graduate of Western Maryland College, he is the former commanding officer of the Missile Support Agency at White Sands, N. Mex., and is a veteran of six campaigns in Korea. There he served as deputy signal officer with the IX Corps.

In other recent staff changes at STRATCOM, Col Lawrence R. Klar, former head of Equipment Applications (now Test and Evaluation Department) became director of the Communications Engineering Department. Lt Comdr William Burnett, a Navy Exchange officer, will direct STRATCOM's Command and Control Division, DCS for Operations.

Lt Col Howard Hall, former head of the Command and Control Unit, has been reassigned to Suitland, Md., as commanding officer of the Headquarters Company.

Reservists Given Training On Active Duty OCRD Tours

Brig Gen John E. Vance, Army Chief Scientist from 1953 to 1955, was among six Reserve officers assigned to the Office of the Chief of Research and Development for two weeks active duty during June.

Presently with the Chemistry Department, New York University Graduate School, Dr. Vance served in research and development assignments before the title Chief of Research and Development was added to the Army General Staff on Oct. 10, 1955.

Appointed to the Army Scientific Advisory Panel (ASAP) in May 1956, he has been serving as a consultant to the Panel since 1965. He was an assistant to Lt Gen Austin W. Betts, Chief of Research and Development, during his recent active duty training.

Col John Sterner, vice president of Cordia Corp., Miami, Fla., was assigned to the office of the Assistant for Reserve Affairs. Col Sterner was director of Flight Test Operations at Cape Canaveral from 1955 to 1959.

Lt Cols Robert G. Demaree and Mungo F. Miller were assigned to the U.S. Army Personnel Research Office and Lt Col Deuster to the Nuclear, Chemical and Biological Division. Capt Michael L. Lehrman joined the Technical and Industrial Liaison Office for his active duty training.

Army Missile Command Announces Key Personnel

Col William F. Kaiser has been assigned Chief of Staff of the U.S. Army Missile Command, Redstone Arsenal, Ala., replacing Col E. J. McGinnis, who has been Acting Chief of Staff and is the new director of the Procurement and Production Directorate.

Col Kaiser has served at White Sands (N. Mex.) Missile Range, as acting deputy commander since April 1966. Most of his military career has been in Army Ordnance and for the past 11 years has been largely in missile-related work. In 1962 he was assigned as commander of the U.S. Army Ordnance Depot, Korea, until 1963 when he was named chief of staff at White Sands Missile Range.

Col Kaiser served previously at Redstone as deputy chief and then as chief of the Control Office of the Army Ballistic Missile Agency. Then he was chief of Control Office and deputy to the commanding general for Ballistics Missiles of the Army Ordnance Missile Command.

Lt Col Terence F. S. Southgate has been assigned as British liaison officer to the U.S. Army Missile Command. He replaces Lt Col W. E. J. Haywood, the new liaison officer to the Army Materiel Command, Washington, D.C.

Lt Col Southgate went to Redstone from a previous assignment at White Sands Missile Range. He is a graduate of the first post-war Technical Staff Course at the Royal Military College of Science. Most of his post-war assignments have been in development and testing of new weapons.

Col William F. Kaiser

Lt Col William J. Chilcoat has been named the new Staff Judge Advocate at the Army Missile Command. A native of Fort Worth, Tex., he is a member of the Texas Bar Association and has been admitted to practice before the U.S. Supreme Court and the U.S. Court of Military Appeals.

A Viet Nam combat veteran is the new aide-de-camp to Maj Gen John G. Zierdt, CG of the Army Missile Command.

Capt Malcolm P. O'Neill replaced Capt Terry M. Carlton, who will attend the Army Munitions and Missile Center and School. Capt O'Neill went to Viet Nam in 1965 and served as unit adviser in a Reconnaissance Company of the 21st Viet Namese Infantry Division.

NEW TACTICAL RADIOS IN VIET NAM

By Martin Ides

Early in the morning of Saturday, June 12, 1965, the U.S. Army Materiel Command project manager for Selected Tactical Radios was called from his quarters to read a message from Tan Son Nhut, Viet Nam.

Field experience with some limited quantities of AN/PRC–25 radios, the message stated, showed them to be superior in the environment of terrain, vegetation and climatic conditions found in Viet Nam.

The Commander-in-Chief, U.S. Army Pacific, said further that the message was to be regarded as an urgent battlefield requirement. In response, within one month 2,500 AN/PRC–25 radios were on their way to Viet Nam for use by U.S. Advisers to the RVN.

Thus began the formal conversion of our troops in Southeast Asia from the standardized series radios (AN/GRC–3 through 8, AN/PRC–8, 9, 10) to the new AN/VRC–12, AN/PRC–25 series radios.

The new series of transistorized, FM, short-range, 2-way radios of modular construction is designed to provide reliable combat-area voice communication among Infantry, Artillery and Armor units. The VRC–12 series, consisting of eight configurations (VRC–12 and VRC–43 through 49), is capable of providing vehicular communication ranges up to 20 miles. These configurations together with appropriate installations make the VRC–12 series operational in all types of wheeled and tracked vehicles.

The PRC–25 series consists of the portable man-pack set, AN/PRC–25, the vehicular set, AN/VRC–53 (includes a PRC–25 receiver-transmitter and an amplifier power supply), and the combined vehicular or man-pack set AN/GRC–125.

Vehicular configurations use the standard VRC–12 intercom and antenna. The PRC–25 series has a rated-power output of 1½ to 2 watts with an operating range of from three to five miles.

The VRC–12/PRC–25 series radios are compatible with the new aircraft radio AN/ARC–54 and the new squad radios AN/PRT–4 and AN/PRR–9. The frequency range of 30 to 76 megacycles is compatible with the old system (ARC–44, GRC–3 through 8, PRC–9 and 10) over the 30 to 55 megacycle range. However, certain limitations on the netting capabilities have been experienced.

The new series has 50-kilocycle channel spacing, and interest has recently developed in Viet Nam for even a 25-kc channel-spacing capability. Providing 920 channels, it offers a single receiver-transmitter which can communicate on Armor, Artillery and Infantry frequencies.

At the time of the June 1965 message from Viet Nam, the improved radios were not new to the U.S. Army; five divisions and three armored cavalry regiments in Europe had just been converted. The series provided many advantages: less weight, more compactness, more channels, improved range, greater reliability and simplified maintenance.

All the "bugs" appeared to have been eliminated in the new series during the extensive proving process for the pilot conversion in Europe. Viet Nam, however, presented a completely different type of tropical environment not experienced since World War II.

Radio Set AN/PRC–25

The new radios had passed all the required field tests as well as controlled-humidity and water-immersion tests. But what would happen under sustained true-combat conditions, coupled with heat, humidity and torrential rains, in a fluid unconventional type of warfare?

The answer was soon forthcoming from Viet Nam—the new radios exceeded all expectations. Batteries held up unusually well under prolonged heat and humidity. Reliability of communications had greatly improved. Maintenance was both reduced and simplified.

In Southeast Asia they were used, in some instances, in place of the AN/PRC–6, the primary squad radio. The PRC–6 "Handy Talkie" was considered too bulky, too heavy and too awkward for a soldier to use when wearing a helmet. Although most of the PRC–6 radios were new or had been totally rebuilt in stateside depots prior to August 1965, they failed at such a high rate that many units were carrying spares on operations to ensure communications. The range of the PRC–6 in dense undergrowth is less than a quarter mile.

Many squads and platoons were equipped with PRC–25s while moving out on important missions. Squad and platoon leaders were more than willing to carry the additional weight of the PRC–25 (still only 22½ pounds) because of its reliability. (The PRC–6s are to be replaced with the new squad radios AN/PRT–4 and AN/PRR–9.)

Martin Ides

Martin Ides joined the Office of the Army Materiel Command Project Manager, Selected Tactical Radios (originally AN/VRC–12, AN/PRC–25), Fort Monmouth, N.J., in August 1962. He served as chief of the Supply and Maintenance Division until May 1966, when he moved to a new position with the Army Electronics Command (ECOM) Communications/Automatic Data Processing Commodity Management Office. In his new position, Ides is program manager for all tactical and marine radio equipment.

He has a BEE degree from Clarkson College of Technology and attended Rutgers University Graduate School of Engineering. He began his U.S. Civil Service career in 1951 as an engineering aide at the ECOM Research and Development Laboratories. In 1952 Ides was an electronic engineer and later entered military service with the Army Signal Corps under the Army Scientific and Professional Program, serving until 1954. He was assigned to the Laboratories at Fort Monmouth and later served as a member of a New Equipment Introductory Team. He taught operation, theory, and maintenance of newly developed electronic equipment to troops in Korea. In 1954 he returned to Fort Monmouth and was an electronic engineer in the Maintenance Engineering Department of ECOM. From 1954 to 1962 he held various positions in maintenance engineering and logistics support for tactical radio, avionics and fixed station systems.

To exploit further the advantages of the PRC–25, Viet Nam requested 560 special PRC–25 hookups that could operate from an AC power source in a fixed mode. A good AC-to-DC-power supply was available, but the commercial AC power in Viet Nam is rather unstable in voltage.

This required the inclusion of a Variac (a commercial variable transformer) between the AC source and the power supply to compensate for variations in voltage.

The final configuration consisted of two PRC–25s (back-to-back for retransmission), mountings, amplifier-power supplies, antenna, AC-to-DC-power supply, and the Variac. Some of these kits are already in use in Viet Nam.

Some new problems were encountered. The H–138 handset, part of the AN/PRC–25 radio, needed additional moisture-proofing, particularly for use in rice-paddy areas. Polyethylene moisture barriers over the receiver and transmitter elements of the handset sometimes were torn. Moisture acquired by complete submersion made it necessary to insure each company spare handsets as packups prior to each major operation.

As a field expedient, handsets also were used while encased in the plastic bags originally issued with batteries as protective covering or they were encased in plastic food-container bags. This retarded moisture but reduced somewhat the volume of reception and transmission.

On many tactical occasions in Viet Nam the operator with radio and handset has been forced to become completely submerged, due to enemy action. On all occasions, the radio worked perfectly and reduced-transmission capability resulted only from the wet handset. Once "baked out" in the sun or by other means, the handsets were again fully functional.

Solution to this problem was simple. A clip was designed to allow the operator to hook the handset on his belt or radio-pack harness when the handset was not being used. The operator could also clip the handset to his shoulder epaulet and monitor reception while keeping both hands free for the job of combat.

To deal directly with the moisture problem, barriers of mylar plastic were fabricated that are no thicker than polyethylene, but many times stronger. After laboratory tests showed no audio-power degradation, the new moisture barriers and clips were sent on their way to Viet Nam.

A man in the field can fix his handset within a few minutes; the only tool he needs is a screwdriver. The effectiveness of this modification should become evident within a few months. The new H–189 handset, which will be the replacement for the H–138, already has incorporated these features.

Radio Set AN/VRC–12

Field camouflage of the set also was successfully accomplished. Operators carrying the PRC–25 were identifiable because they were carrying an outlined pack. To break up the back outline, the radios were camouflaged with burlap sandbags and strips. Burlap-covered PRC–25s quickly became standard in combat units.

Another type of problem required special attention. Conventional shipping and packaging methods would not suffice for Southeast Asia. All shipments of radio sets, spare parts, and associated components are now "Double A" packaged, and placed in special (CONEX) containers. To make sure they are received properly and promptly, a special escort "rides shotgun" with each shipment from the U.S. to the port of entry to Viet Nam.

When the ship docks, another escort is ready to take the equipment to the specified receiving units.

More than 10,000 of the new series radios are serving U.S. units and all troops arriving in Viet Nam will be equipped with the new radios.

For the future, we can look forward to an even better performing AN/PRC–25. A power amplifier, boosting the power-output of the PRC–25 to 25 watts will be made available in Viet Nam after completion of current development and expedited test and production.

For the present, combat troops in Viet Nam can continue to rely on the VRC–12/PRC–25 series radios to provide them with the most reliable FM tactical communications available.

Army Lets Contract for 6 More 'Flying Cranes'

Capability of the CH–54A "Flying Crane" as proved in the Viet Nam War and in the Continental United States resulted in a recent award for six additional aircraft, with the first delivery scheduled in November.

The CH–54 has provided a substantial increase in capability for recovering downed aircraft since its introduction into Viet Nam in September 1965. The four aircraft in the 478th Aviation Company, Heavy Helicopter have recovered 98 downed aircraft in Viet Nam with an acquisition value of $37 million.

LIFT CAPABILITY of CH–54A is demonstrated by transport of a CH–47 "Chinook." The aft line secures a drag chute to stabilize the load.

Last January, one CH–54 was lost in combat operations just west of Mang Yang Pass near An Khe, leaving five in the Army inventory.

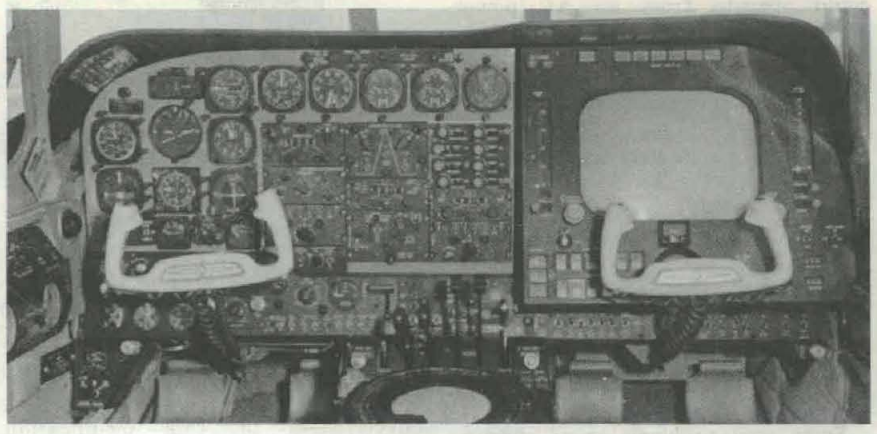
The CH–54A is a twin-turbine, single-main-rotor, six-blade helicopter. A single 4-blade antitorque tail rotor is employed for directional control. Two Pratt and Whitney JFTD12A–1 gas-turbine engines provide propulsive power.

Each engine develops 4,050 horsepower. The engines are located externally, on top of the fuselage, immediately forward of the main rotor. The gross weight of the craft is 38,000 pounds with a useful load of 15,645 pounds for a 20-mile-radius mission.

The Flying Crane, manufactured by the Sikorsky Division of United Aircraft Corp., has lifted everything from the 155mm howitzer to the CH–47 "Chinook" heavy helicopter. Using a cargo net, one CH–54A transported enough "C" rations on a single flight to supply an Army battalion for three days. Another ferried 192 tons of fuel (64,000 gallons) within a 10-mile radius in five hours.

ARMY AIMS TO BE FLY-BY-NIGHT OUTFIT

By Lt Col A. B. Shattuck



Advanced Army Aircraft Instrumentation System

The time: a few years from now. The place: the cockpit of an Army aircraft. The steady hum of the turbine engines is punctuated with the splatter of rain on the windshield. Outside the plexiglass canopy there is darkness and low scud cloud. Even as the aircraft flashes through occasional openings in the clouds, no lights are seen on the ground since complete blackout prevails in the combat zone.

Miserable conditions for flying, you might say, but the pilot seems unconcerned. In front of him on the instrument panel, a screen resembling a television tube shows him a curiously life-like picture of the horizon and the ground moving below the aircraft, as though he were looking through the windshield on a bright, clear day.

Only one Army aircraft—a research vehicle—has this remarkable instrumentation today, but soon many Army aircraft may have it, greatly improving their capabilty to perform tactical missions.

Generally, instrumentation is any or all of the dials, meters and gauges in an airplane or helicopter to help the pilot or other crew member do his job. For purposes of this article, however, let's confine the discussion to "flight" instruments, those on which the pilot depends to fly the aircraft. Involved are instruments to help him keep the aircraft right-side-up, headed in the proper direction and at a chosen altitude; also those showing rate of climb or descent, and where the aircraft is with respect to a navigation facility.

In this sense, instrumentation does not include fuel quantity, oil pressure, cylinder head (or tail pipe) temperature and other so-called "housekeeping" functions. These are important, too, but generally do not require quite as much continuous attention from the pilot as do the flight instruments.

Instrumentation in many aircraft today is of obsolescent technology. The pilot gets separate kinds of information from separate instruments. For instance, height above sea level comes from an altimeter, tilt of the wings or nose comes from the gyro horizon (or flight indicator), heading from a directional gyro, rate of climb from another needle, rate of turn from another, and so on.

The principal problem with this arrangement is that the pilot must glance at each of these gauges separately, interpret them, and decide how to move the controls based on what several of the instruments tell him. It is seldom sufficient from him to make a control movement based on the information he gets from a single instrument.

For example, the altimeter may show that the aircraft is too high. This would ordinarily require the pilot to push forward on the control stick to start a descent. Such a movement would, however, be incorrect if the aircraft were already descending—information the pilot would get from a different gauge, the rate-of-climb instrument.

Difficulties of this type are no problem when the weather is good. On a clear day, the pilot flies by an easy, natural reference to the horizon and the ground below. The problem gets sticky when the weather is foul and visibility poor. If all the pilot can see is gray cloud, with no horizon or earth below, he is said to be "on instruments," since he must depend on his gauges to accomplish the flight.

A number of years ago the Army and Navy teamed up on an exploratory development now known as the Joint Army Navy Aircraft Instrument Research (JANAIR) program. The goal is to improve the state-of-the-art of piloted aircraft instrumentation.

The JANAIR people asked themselves: Wouldn't ideal instrumentation be that which gave the pilot a picture in bad weather just like what he sees when he looks through the windshield on a clear day?

In other words, can the pilot be given a display which is analogous to what he sees when he has visual contact with the ground? Thus was born the concept of the "contact analog." The JANAIR program continues to do exploratory work such as feasibility studies and concept development in support of service requirements.

Instrumentation displays, using some of the same technology as a television set, may be divided roughly into three groups: vertical, horizontal and "heads-up."

Lt Col Amos B. Shattuck, IV, acting chief of the Electronics Branch, Communications-Electronics Division, joined the Office, Chief of Research and Development, in July 1963.

A 1946 graduate of the U.S. Military Academy, Lt Col Shattuck also earned a master's degree in electrical engineering from the University of Illinois (1951) and is a graduate of the Command and General Staff College.

In addition, he completed the Army Parachute, Signal, Aviation and Helicopter Schools and holds airplane, helicopter and FAA glider pilot ratings.

Major assignments include the 11th Airborne Division; the CONARC Board No. 1; Eight U.S. Army; Office, Chief Signal Officer, Washington, D.C. and, for the seven months preceeding his assignment to OCRD, the Test and Evaluation Command, Aberdeen Proving Ground, Md.

As shown in the illustration of the Advanced Army Aircraft Instrumentation System (AAAIS), the vertical display indicates horizon, an imaginary flight path in the sky, and some such additional features as heading, angle of climb and ground speed. The ground may be artificially textured to make it more readily distinguishable from the sky. Obstacles may also be shown, such as mountain tops.

The horizontal display, usually devoted to navigational information, may be either another TV-like display or an optical projection of a map, with the aircraft as a marker, called a "bug," which moves about over the map as the plane moves over the ground. It may also show other aircraft flying in the same formation.

Perhaps the most highly specialized display is the one called "heads-up." Placed between the pilot's eyes and the windsheld, it usually is projected optically to provide for a minimum transitional time from instrument flight to visual flight. Transition is a problem if the pilot's eyes are down in the cockpit at a critical moment, such as just before landing.

The part the pilot looks at is only the visible end of what may be a rather complex subsystem. The display is like the visible part of an iceberg—it 's only one-tenth of the whole thing, but is the part you see. Other items essential to the whole system are the sensors, such as radios, radars and gyros, and a computer. Putting all the pieces together and getting them all to work can be a big job.

Under the Advanced Army Aircraft Instrumentation Program (AAAIP), the Army has just built and is testing its first complete instrumentation system based on the contact analog concept from the JANAIR program. The Douglas Aircraft Co., Long Beach, Calif., was given a contract to provide the system in a Beech J–50 Twin Bonanza airplane, similar to the Army U–8 "Seminole."

Because of the complexity of the program, numerous subcontractors, such as Norden, Texas Instruments, Kearfott, ACF, Bendix, and LFE, were involved. Delivered to the Avionics Laboratories at Fort Monmouth, N.J., the aircraft with its complete instrumentation on board is currently undergoing acceptance tests.

An intensive test program will begin soon, using "guinea pig" Army aviators and covering the spectrum of capabilities from fresh-out-of-twin-engine transition to "old pros." The human factors experts will guide this test program aimed at determining just what our needs are in aircraft instrumentation.

What information must be displayed to the pilot to increase the tactical capabilities of Army aircraft, and what can be eliminated as merely nice to have? Since the same kind of information can be displayed in several ways, we hope to find the best way, eliminate the others, and simplify the machinery.

It should be clearly understood that AAAIS is an advanced development progam; the airplane, though it resembles the Army U–8, is by no means a prototype for new instrumentation for other U–8s. Such new instrumentation is much more likely to find its way into next-generation tactical aircraft, such as the Surveillance and Target Acquisition Aircraft System (STAAS), or the Utility Tactical Transport (UTT).

In fact, the first program expected to produce new instrumentation for use in Army tactical aircraft will be the Integrated Helicopter Avionics System (IHAS), a joint Army-Navy engineering development.

The complete IHAS will include a vertical and a horizontal display, a computer central complex, and a number of sensors such as a station keeping radar, a terrain radar, and a doppler navigator. The Advanced Aerial Fire Support System (AAFSS) will probably be the first Army aircraft to carry the IHAS. Army participation in the IHAS program is the responsibility of the AAFSS project manager in the Army Materiel Command.

Some companies have done development work on their own. Kaiser, a former JANAIR contractor, has built the Flite Path system for the commercial market, shown below.

What advantage will the Army derive from this new instrumentation? Since mentally integrating the old instrument information is hard work, an obvious benefit will be a reduction in pilot fatigue and a corresponding increase in safety. Also, the pilot will have a few brain cells left over to devote to the tactical mission — he won't have to devote all his attention to flying.

Because the new contact analog displays are more natural for the pilot to use, it will be possible for him to make instrument approaches to tactical landing sites in visibility conditions much worse than present minimums. This will greatly enhance the likelihood of mission accomplishment at night or in adverse weather.

Kaiser Flite Path Prototype Installation

ERDL Testing Fuel Cell As Silent Power Supply

Testing of a 300-watt hydrazine fuel cell as a silent auxiliary electric power source for ground vehicles is underway at the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va.

Designed for military operations under a variety of environmental conditions, the compact, lightweight unit is inaudible 100 feet away and is expected to have an operational life minimum of 1,000 hours without major repair or replacement.

Units being tested were built by Union Carbide Co. under contract with the Engineer R&D Laboratories.

When used as an auxiliary power source for ground vehicles, the unit plugs into the vehicle's electrical system to provide 28 volts direct current for operation of radios and other equipment when the vehicle's motor is not running.

Capable of independent operation, the unit consists of hydrazine air fuel cell stack, air blower, electrolyte pump, starting mechanism, output voltage regulator. It weighs 30 pounds and is 1,500 cubic inches in size.

$1,000 Award Technical Paper

TITLE: Flueric Temperature Measurement and Control
AUTHORS: GOTTRON and GAYLORD
Harry Diamond Laboratories

ABSTRACT: A temperature-sensing flueric oscillator and flueric temperature-control system are described.

The oscillator has the capability of sensing the temperature of moving fluid streams. The attractive features of the oscillator are:

1. It has the capability of measuring extremely high temperatures in high velocity streams.
2. Its output is not altered by radiation environments.
3. It has a short time constant to temperature variations.

The flueric temperature-control system utilizes two temperature sensors, digital logic and proportional amplification. The system output is a differential pressure that is proportional to the temperature of the input gas to the sensors. The output was used to control the flow of hydraulic oil (at 6890 kN/m^2) through a servo valve as a function of temperature.

$500 Award Technical Papers

TITLE: A Rechargeable Thin-Film Solid-Electrolyte Battery
AUTHORS: MRGUDICH, BRAMHALL, and SCHWARTZ
Institute for Exploratory Research

ABSTRACT: This paper describes an interesting practical "spin-off" from an originally basic research study of ionic charge transport through solids. It has been found that a dime-size pellet of compressed silver iodide powder carrying vacuum-deposited thin films of silver and platinum on opposite faces behaves like a solid-electrolyte battery working on concentration cell principles. This simple Ag-AgI-Pt battery has several unique advantages over the inherent advantages of conventional solid-electrolyte batteries. The internal resistance is significantly lower, permitting use at higher drains (5-10 uA/cm^2 compared to a previous range of 0.1-0.5 uA). Furthermore, the Ag-AgI-Pt arrays are rechargeable for at least 50 cycles. In addition, the open-circuit voltage (at about 0.6 volt per cell) is a function of the state of charge. This means that a battery using extremely thin films will exhibit a voltage which is quite sensitive to even a minute drain, i.e., it acts as a sensing device. A battery with thicker electrodes will behave more as a power source. Thus it is that a thin-film/thick-film battery pair can be thought of as analogous to a nerve-muscle team, where one element senses and the other reacts. Other advantages of the system are discussed; increasing capacity through overcharge, ease of miniaturization, wide temperature range of operation, simple manufacture, low cost per volt, rugged construction, vacuum operation. An interesting feature of the system is that it may permit eventual development of "printable" batteries for use in integrated microcircuits.

TITLE: The Impact of Acute Infection on Metabolism in Human Subjects
AUTHORS: BEISEL and CROZIER.
Army Medical Unit, Fort Detrick

ABSTRACT: To determine the influence of acute infection on metabolism in the human host, volunteer subjects were studied with balance techniques throughout a pre-exposure control period and the course of illness. Acute tularemia, sandfly fever, and Q fever, instances of mild illness, and responses in vaccinated subjects were studied. Diet, urine and stool aliquots were frozen daily for later automated chemical analysis.

With the onset of fever and symptoms of each infection there developed anorexia and increasing urinary losses of nitrogen. Negative balance became maximal after illness had reached its height and persist-

(Continued on page 29)

Army Science Conference Panel Discussion Lauded

(Continued from page 1)

The complete transcript of the panel discussion will be published in the official proceedings of the Army Science Conference. (For a highly condensed account of some of the high points, see page 52.)

CONSOLIDATED SPECIAL EDITION

Consolidation of the Army R&D Newsmagazine for July and August into a single edition was necessary to give as comprehensive coverage of the Army Science Conference as is possible within the authorized page limitation for two months, without sacrificing variety of material normally carried.

Integrated effort paid off when the first Negro ever to win a major technical paper award at an Army Science Conference, 41-year-old Wilmer Gaylord, teamed with Richard Neil Gottron, 33, to share the $1,000 first-place award—the highest honorarium presented at any of the conferences.

The paper coauthored by the Harry Diamond Laboratories scientists was titled, "Flueric Temperature Measurement and Control." Considered of potentially broad application, their discovery prompted Billy M. Horton, technical director of HDL, to comment:

"This sensor makes possible the accurate and rapid measurement of temperatures so high that other sensors would last but a few seconds. Its direct measurement permits the design of quick-response control systems, and thus helps in achieving system stability. It is particularly applicable to sensing and control in jet engines, rockets and nuclear reactors."

For Gottron, a handsome, personable young man who has been attracting attention for his achievements in

Dr. J. N. Mrgudich receives $500 honorarium for technical paper prepared with P. J. Bramhall and C. M. Schwartz as coauthors.

SECRETARY of the Army Stanley R. Resor presents $1,000 honorarium to Wilmer Gaylord (left) and Richard Gottron for technical paper selected first from 96 presented at the fifth Army Science Conference.

research ever since he joined the HDL as a military scientist in 1960, converting to civilian status in 1964, his presentation of the paper was a "homecoming." He was graduated from the United Military Academy in 1955, and earned an MS degree in mechanical engineering from Purdue University in 1960.

For Gaylord, a thin-faced, intense and reserved man who has labored long years to gain an education, the distinction of sharing the first-place award was a particularly satisfying achievement. Transferred to the HDL when it was established in 1953 with a nucleus of National Bureau of Standards employees, Gaylord has been credited with several meritorious research contributions.

Achievements in research on fleuric controls won Gottron selection as

(Continued on page 30)

Lt Col William R. Beisel receives second-place $500 honorarium for technical paper prepared jointly with Col Dan Crozier at Fort Detrick, Md.

$500 Award Technical Papers

(Continued from page 28)

ed into convalescence. In contrast, an early period of nitrogen retention developed during mild sandfly fever and tularemia and after the exposure of vaccinated subjects. This implied that both anabolic and catabolic changes were stimulated by infection, with catabolism generally predominant.

Other intracellular elements, K, P, and Mg followed patterns of loss similar to nitrogen. Na and Cl were lost as fever and symptoms mounted, but were then retained by the kidney in coincidence with an increase in aldosterone output.

Control studies in noninfected subjects indicated that fever and anorexia were important factors in producing negative nitrogen balances during infection. Adrenocortical overactivity in these illnesses was insufficient to induce appreciable protein catabolism.

$200 Award Technical Papers

TITLE: A Geometric Simultaneous Multistation Determination, with Constraints, Using Data from Geodetic Satellites

AUTHOR: GAMBINO
Research Institute for Geodetic Sciences

ABSTRACT: The observation equations for two types of satellite tracking systems are derived from a purely geometric standpoint. The introduction of these equations into the adjustment is flexible enough to allow for any combination of data to enter into the formation of the normal equations.

Included in the development is the utilization of weight constraints, in which the coordinates of the ground tracking stations and satellite points may be weighted according to how well they are known.

The highly patterned character of the large system of normal equations lends itself to inversion by matrix partitioning in which the largest matrix to be inverted is that involving only the tracking station parameters. Thus, for a fixed number of tracking stations the computations will increase only linearly with the number of satellite points used in the reduction.

TITLE: Stratospheric Tidal Circulations

AUTHOR: WEBB
Atmospheric Sciences Laboratory, WSMR

ABSTRACT: The stratospheric monsoonal circulation is powered principally by ozonospheric absorption of solar ultraviolet energy. A large diurnal oscillation is imposed on the ozonospheric temperature field by the earth's rotation, which in turn results in organized diurnal oscillations in the wind field. The resulting tidal type motions are generally localized in altitude to near the stratopause and are largely meridional at low and middle latitudes. The tidal motion is from equator-to-pole as the crest of the heat wave approaches from sunrise until approximately 2 p.m. and from pole-to-equator the remainder of the day. Separation of these hemispheric tidal motions at the rotational equator results in vertical downward motions in the upper atmosphere, with associated phenomena such as the equatorial electrojet. The tidal circulations become largely zonal at high latitudes as they circle the ends of the heat wave, and in the summer season case the tide circles the polar region, lifts to higher altitudes to form the "Stratospheric Tidal Jet", and gives rise to phenomena such as noctilucent clouds. There is evidence that the tidal circulations exert a controlling influence on the general stratospheric circulation.

TITLE: Ignition Properties of Polyisobutylene - Triethylaluminum Polymer Solutions

AUTHORS: SCHER and GASKINS
Edgewood Arsenal

ABSTRACT: The ignition delays of triethylaluminum, a pyrophoric liquid,

(Continued on page 30)

$200 Award Technical Papers

(Continued from page 29)

and polyisobutylene (PIB) - triethylaluminum (TEA) polymer solutions were studies as a function of the following variables: temperature, relative humidity of air, air flow rate, partial pressure of oxygen, heat capacity of atmosphere, concentration of polymer, dilution with nonpyrophoric hydrocarbon. A novel experimental technique was devised in which a spring loaded plunger impacts a glass vial filled with the PIB-TEA polymer solution, thus exposing the pyrophoric fuel to a controlled atmosphere within an ignition chamber.

A detailed analysis of the pyrophoric ignition process for TEA was proposed. This process was initiated by the formation of unstable peroxides that cleaved to produce free radicals. The steps leading to ignition appeared to be of the thermal variety as opposed to the branched chain type.

As the PIB concentration was increased, keeping all other variables fixed, the surface to volume ratio produced during dissemination decreased and eventually passed through a critical value below which ignition did not occur. These experimental findings led to the realization that the pyrophoric PIB-TEA system could be used as a model to study the relationship between rheological properties of any polymer-liquid system and the surface to volume ratio produced during the dissemination of that system.

TITLE: Observation of Short-Lived Species Produced by X-Ray Pulses

AUTHOR: KLEIN
Army Nuclear Defense Laboratory

ABSTRACT: The recent availability of pulsed accelerators with their inherent high dose rates for very short duration have made possible new techniques for radiation chemistry research. If a transient species in the radiolysis of a particular chemical system has an optical absorption spectrum, then suitable light sources and detection equipmand can be used to study the optical absorbance, i.e., concentration, as a function of time during and after the radiation pulse. Data taken on air-free sodium carbonate solutions at 6328A reveal the presence of at least one species that decays by second-order kinetics. Reaction-rate constants for the disappearance of this species are approximately 3×10^{11} M^{-1} sec^{-1}. This value, higher than any rate constant determined previously, is at least ten times higher than rates possible for simple diffusion-controlled reactions between unchanged species. Theoretical implications based on these results are presented. The use of pulse-radiolysis techniques for the measurement of prompt radiation from a nuclear detonation is also discussed.

TITLE: Waveguide Analog of Tunneling through Quantum Potential Barriers

AUTHOR: CAMPI
Harry Diamond Laboratories

ABSTRACT: Expressions are derived for the electromagnetic fields of guided waves which are analogous to the quantum mechanical equations representing barrier tunneling. This analogy is achieved by comparing the propagation constant of the Schrödinger time-independent wave equation with that of the electromagnetic wave equation in waveguide, and by comparing the de Broglie wavelength of a particle with the wavelength of the propagated energy. This results in an expression relating the form of an arbitrary one-dimensional energy barrier to the physical dimensions of a section of waveguide. The analogy is tested by the propagation of energy in the $TE_{1,0}$ mode at both the 3 and 6 cm bands for the cases of rectangular and hyperbolic barriers. Although evanescent modes are present at the discontinuous regions, the analog for the rectangular barrier, which is considered to be the worse case, is verified when an effective barrier length ℓ_{eff} of about 1.2ℓ is used. This experimental verification demonstrates the possibility of waveguide simulation of quantum mechanical energy barriers and the practicality of utilizing an electromagnetic analog for demonstrating the tunneling phenomenon and provides a method for measurements of the transmission coefficient through an arbitrarily shaped barrier.

(Continued on page 31)

Army Science Conference Panel Discussion Lauded

(Continued from page 29)

"Outstanding Young Professional Engineer for 1966," in the form of the National Capital Award presented by the Washington Academy of Sciences and the District of Columbia Council of Engineering and Architectural Societies.

Gaylord's recognition has been slower coming. When he was graduated from Howard University, Washington, D.C., in 1954, it was the culmination of several years of night school effort while employed as a draftsman at the National Bureau of Standards.

Continued night school studies at Howard University have carried him close to a master's degree in mechanical engineering. Promotion to grade GS–13 at HDL came in June this year.

Secretary of the Army Stanley R. Resor presented awards totaling $3,800 to 23 authors and coauthors of 12 papers, equalling the total of awards at the 1964 Army Science Conference. Twenty-four authors and coauthors of eight additional papers also received Certificates of Outstanding Achievement.

Identical awards of $500 recognized authors of each of the second and third-place papers. One was presented to Dr. J. N. Mrgudich as principal investigator, with P. J. Bramhall and C. M. Schwartz as coauthors, and was titled "A Rechargeable Thin-Film Solid-Electrolyte Battery." All are employees of the Institute for Ex-

Willis L. Webb, Atmospheric Sciences Laboratory, White Sands (N. Mex.) Missile Range, receives $200 award for "Stratospheric Tidal Circulations."

Lawrence A. Gambino receives $200 award for technical paper, "A Geometric Simultaneous Multistation Determination with Constraints, Using Data from Geodetic Satellites."

ploratory Research, U.S. Army Electronics Command, Fort Monmouth, N.J.

Two Army Medical Service career officers, Lt Col William R. Beisel and Col Dan Crozier, both assigned to the U.S. Army Medical Unit at Fort Detrick, Frederick, Md., received a $500 award. Their paper was titled "The Impact of Acute Infection on Metabolism in Human Subjects."

Nine awards of $200 each were presented—which might be termed an easy way for the panel of judges, all members of the Army Scientific Advisory Panel, to solve the problem of competitively evaluating papers considered of superior quality but almost indistinguishable merit.

The Certificates of Outstanding Achievement were signed by the As-

(Continued on page 32)

First Lieutenant Herbert B. Scher accepts $200 award for paper co-authored with Frederick H. Gaskins at Research Labs, Edgewood Arsenal, Md.

$200 Award Technical Papers

(Continued from page 30)

TITLE: Study of Low Frequency Molecular Motions in Explosives by Slow Neutron Inelastic Scattering

AUTHORS: BOUTIN, PRASK, and TREVING
Explosives Laboratory, Picatinny Arsenal

ABSTRACT: The spectra of low energy neutrons inelastically scattered by polycrystalline samples of several explosive materials (β and γ HMX, RDX, lead styphnate and picric acid) have been used to determine the frequencies of intramolecular and intermolecular vibrations in a range (0-600 cm^{-1}) not obtained by optical spectroscopic techniques. A frequency distribution of the phonons in the lattice can be derived from these neutron spectra and values of thermodynamic parameters can in turn be calculated which are compared with experimental values when available. A relationship is presented between the impact sensitivity of an explosive material and the ratio of the internal energy of low-frequency molecular vibrations to the internal energy of the lattice modes. This is the first time that such a direct correlation has been attempted between molecular processes and physical properties of explosive materials.

TITLE: A Comparison of the Impact Behavior in Composites of Single Crystal and Polycrystalline Ceramics

AUTHORS: ALESI, KLIMAN, and THOMAS
Natick Laboratories

ABSTRACT: Single crystal and polycrystalline ceramics were compared as components of composite armor for defeating caliber .30 AP M2 projectiles. With a reinforced plastic backing, the armor with the single crystal required 8 percent less weight than its polycrystalline equivalent.

Combined with a transparent plastic, the single crystal forms an effective transparent armor system substantially lower in weight than "bullet-proof" glass.

Specimen size effects for the single crystal were similar to those previously reported for a different ceramic composition. An expression was developed for approximating the ballistic limit at a larger size from data obtained with smaller specimens.

No significant differences were found in ballistic limit of composites made with single crystals of two different orientations. Tests at other orientations will be required to determine whether orientation and orientation-determined properties have any influence on composite ballistic limit.

Potential uses for single crystal ceramic composites other than transparent armor are suggested; for example, supersonic aircraft glazing and observation windows or parts subjected to erosion by high velocity fluid flow (such as rocket nozzles).

TITLE: Hemodynamic Alterations in Humans and Animals During Chronic High Altitude Exposure

AUTHORS: VOGEL, HANSEN, and HANNON
Fitzsimmons General Hospital

ABSTRACT: Multiple cardiovascular measurements were made at sea level and 14,000 feet on 16 young soldier volunteers during rest and bicycle ergometer exercise. Subjects were divided so that effects of rate of ascent and physycal conditioning could be assessed. The cardiovascular response to hypoxemia during the first four days consisted of: (1) an increase over sea level in cardiac output; (2) no appreciable change in arterial blood pressure; and (3) a fall in total peripheral resistance. The enhanced cardiac output was due primarily to an increased heart rate but included a stroke volume response over that of sea level during moderate and maximal work. All measurements returned to or near sea level values by the third week at 14,000 feet except heart rate. Experiments with exercising dogs at 11,400 foot altitude showed similar results. It is concluded that (a) these cardiovascular responses are an important part of the early acclimatization process to a high altitude environment, (b) there is no indication of any decreased efficiency or deleterious effect on heart action up to 14,000 feet, and (c) gradual ascent to high elevations has the added advantage of reducing the work load on the heart at the period of highest stress.

(Continued on page 32)

Outstanding Achievement Papers

TITLE: The Influence of an Arbovirus Infection on Host-Cell Ribonucleic Acid and Protein Synthesis
AUTHOR: LUST
Army Medical Unit, Fort Detrick

ABSTRACT: The effect of Venezuelan Equine Encephalomyelitis (VEE) virus infection on host protein and nucleic acid metabolism has been investigated in mouse tissues and in cultured mouse fibroblast cells. Although this virus affects the nervous system of mice, protein synthesis in the brain was not altered appreciably. However, in livers of VEE virus infected mice protein synthesis was markedly decreased early during infection and before clinical symptoms of illness were detectable. In tissue culture studies host protein and ribonucleic acid synthesis were depressed rapidly after infection, but returned to normal levels by the time mature virus particles appeared. At the time overall protein synthesis was depressed by the infection a new enzyme, which is involved in the production of new ribonucleic acid, was induced in the infected cells. Properties of this enzyme were studied, since detailed knowledge of its mechanism of action could provide a basis for new methods of rapid detection and therapy of viral diseases.

TITLE: Deposition of Particles in a Turbulent Slot Flow
AUTHORS: DOBBS and WISS
Army Tank Automotive Center

ABSTRACT: The need for research in the dynamics of solid particles flowing in a fluid stream is indicated, with several examples of potential usefulness. A quasi-analytic method of solution is developed for solid particle flow in the boundary layer, using classical techniques modified by particle concentration and velocity deviations and statistical correlations thereof. A novel system of instrumentation has been developed to make the necessary experimental measurements. This instrumentation system, the Dobbs Optical Anemometer, promises to be a powerful tool in fluid dynamics research.

TITLE: Superconducting Thin-Film Nuclear-Particle Detectors
AUTHORS: GREER, SULLIVAN, and VAN ANTWERP
Army Nuclear Defense Laboratory

ABSTRACT: A nuclear-particle detector has been developed that utilize high-speed voltage pulses generated by thermal spikes in current-carrying superconducting thin films. The films used are about 5 mm in length and are equipped with current and voltage terminals at each end; they have widths ranging from 10 μ to 50 μ and a nominal thickness of 1000 Å. The narrow width of the film causes a sharp rise in the current around a thermal-spike region that induces a normal switch of a local section in the film, thus generating an observable voltage drop. The normal region associated with this voltage drop may propagate or collapse depending upon the temperature and thermal properties of the film-substrate combination. Pulses of 10 nsec or less in duration may be recorded showing promise of a very high counting-rate detector. Other factors critical to film characteristics include vacuum deposition and masking techniques. Results are presented to show the relationships between film current, temperature, width, and the observation of propagating or nonpropagating pulses.

TITLE: Investigation of Exchange Effects in Ruby by Line Shape Comparisons
AUTHORS: HARTMAN, MEYER, BENNETT, and DANIEL
Army Missile Command

ABSTRACT: The influence of the exchange interaction in ruby has been investigated by the comparison of resonant line shapes obtained by the

(Continued on page 33)

Army Science Conference Panel Discussion Lauded

(Continued from page 31)

sistant Secretary of the Army (R&D) Willis M. Hawkins and Army Chief of Research and Development Lt Gen Austin W. Betts.

Recipients of the nine awards of $200 for technical papers and the titles of their presentations are: Capt George Lust, U.S. Army Medical Unit, Fort Detrick, Md., "The Influence of an Arbovirus Infection on Host-Cell Ribonucleic Acid and Protein Synthesis";

Also, Dr. James A. Vogel, Lt Col James E. Hansen and Dr. John P. Hannon, Physiology Division, U.S. Army Medical Research and Nutrition Laboratory, Fitzsimons General Hospital, Denver, Colo., "Hemodynamic Alterations in Humans and Animals During Chronic High-Altitude Explosure";

Also, Anthony L. Alesi, Morton I. Kliman and George R. Thomas, U.S. Army Natick Laboratories, Natick, Mass., "A Comparison of the Impact Behavior in Composites of Single Crystal and Polycrystalline Ceramics";

Also, Henri P. Boutin, Henry J. Prask, and Samuel Trevino, Explosives Laboratory, Picatinny Arsenal, Dover, N.J., "Study of Low Frequency Molecular Motions in Explosives by Slow Neutron Inelastic Scattering";

Also, Morris Campi, Harry Diamond Laboratories, "Waveguide Analog of Tunneling Through Quantum Potential Barriers"; Nathan Klein, Edgewood Arsenal, Md., "Observation

Morris Campi receives $200 honorarium for Harry Diamond Labs paper on "Waveguide Analog of Tunneling Through Quantum Potential Barriers."

Nathan Klein, Edgewood Arsenal, Md., receives $200 for paper on "Ignition Properties of Polyisobutylene-Triethylaluminum Polymer Solutions."

of Short-Lived Species Produced by X-Ray Pulses";

Also, 1st Lt Herbert B. Scher and Frederick H. Gaskins, Research Laboratories, Edgewood Arsenal, "Ignition Properties of Polyisobutylene-Triethylaluminum Polymer Solutions"; Willis L. Webb, Atmospheric Sciences Laboratory, U.S. Army Electronics Command, White Sands Missile Range N. Mex., "Stratospheric Tidal Circulations";

Also, Lawrence A. Gambino, Research Institute for Geodetic Sciences, U.S. Army Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va. "A Geometric Simultaneous Multistation Determination with Constraints, Using Data from Geodetic Satellites."

OTHER MERITORIOUS PAPERS. In addition to the 12 papers recognized with cash awards, those

(Continued on page 34)

Henri Boutin accepts $200 award for paper coauthored with Henry J. Prask and Samuel Trevino at the Explosives Laboratory, Picatinny Arsenal, N. J.

Outstanding Achievement Papers

(Continued from page 32)

techniques of ultrasonic paramagnetic resonance (UPR) and the standard electron paramagnetic resonance (EPR). Although theoretical calculations have been made that predict the character of the phonon-induced spin absorption lines in paramagnetic crystals under certain conditions, this technique has thus far not been investigated experimentally. For the EPR induced absorption line it is well known that the exchange interaction does not contribute to the second moment but only to the fourth, giving rise to the phenomenon of exchange narrowing. However, for the UPR induced absorption line, it has been shown that the exchange contributes to both the second and fourth moments and so increases the relative width of the line. Thus, a comparison of the line shapes as observed by these two techniques is, in principle, capable of determining the magnitude of the exchange interaction. Even though this picture is complicated in ruby by the additional interactions arising from the hyperfine structure associated with the aluminum nuclei, an initial qualitative consideration of these ideas has been made on ruby where the chromium concentration varies from 0.05 to 1.2 percent. These measurements have been made on x-band spectrometers utilizing the same samples for comparative measurements.

TITLE: A Laser Device for Use in Clinical Treatment of Malignant Tumors

AUTHORS: DEARMAN, McKNIGHT, and HAWKINS
Electromagnetic Laboratory, Redstone Arsenal

ABSTRACT: Laser experiments on animals with malignant tumors have been conducted during the past thirty months at Redstone Arsenal, Alabama, by Army Missile Command laser scientists and surgeons from the National Cancer Institute, Bethesda, Maryland. These experiments have shown that the laser is a useful therapeutic agent in the treatment of several different types of malignant tumors.

The success of these experiments has resulted in a request by the National Cancer Institute for the design and fabrication of a high energy laser device for clinical use in the operating room.

This device, developed by the Army Missile Command, is capable of delivering variable energy laser outputs at the surgeons demand. In addition, it has the unique feature of utilizing an articulating arm which can be maneuvered to direct the laser beam to normally inaccessible tumor sites.

The problems associated with the development of this clinical laser, the solutions to the problems, and the correlation between the surgeons therapeutic laser requirements and the completed laser device is related.

TITLE: Biological Combinations

AUTHORS: ROBERT L. SCHRICKER and HENRY T. EIGELSBACH
U.S. Army Biological Center (Provisional)
Fort Detrick, Maryland

ABSTRACT: Our objective was to determine if a biological combination would produce effects sequentially without significant change in their overall effect. One of the combinations evaluated was effective in monkeys over wide dose ranges and produced a moderately severe condition. Each disorder was produced sequentially and relatively independent of the others, thus indicating a multiple effect with no significant interference or potentiation. Respiratory exposure of controls resulted in a uniform, acute, moderately severe, self-limiting condition with complete recovery.

TITLE: Nuclear Burst Ionization Effects on Fuzing

AUTHORS: TOMPKINS, McGIBNEY, and ROSADO
Harry Diamond Laboratories

ABSTRACT: The properties of nuclear-burst-induced ionization are examined for their capability of producing false function signals in micro-

(Continued on page 34)

Outstanding Achievement Papers

(Continued from page 33)

wave missile-borne fuzing. Principal phenomena examined are the plasma noise output, clutter and back-scatter, and changes in fuzing antenna impedance and coupling, when the vehicle passes through the ionized fireball or through the extensive x-ray induced transient plasma at high altitudes.

An experimental arrangement for measuring antenna impedance and mutual coupling between antennas located on a cylinder is briefly described. Results for the lossless plasma show that the real parts of the self-impedance R/Z_0 and the mutual admittance Y_{12} both decrease as the plasma density increases, whereas the reactance remains almost constant.

TITLE: Light Attenuation by Photochemical Means Photochromism
AUTHORS: WEINSTEIN, BLUHM, LANGMUIR and STROM
Natick Laboratories

ABSTRACT: It is shown that the photochromism of 2-(2,4-dinitrobenzyl) pyridine, first observed in 1925, is not limited to this compound, but is a common property of aromatic compounds which have a nitro and C-H group ortho to each other. Kinetic data are reported for the dark fading reactions of the colored isomers formed by ultraviolet irradiation of solutions of various o-nitrobenzyl compounds. First-order reactions are observed in a variety of solvents. In these reactions, the rate of fading is faster in nonpolar solvents. Small structural changes also affect the fading rate. Activation energies and entropies of activation are reported for the dark reactions. It is reported that, on irradiation with ultraviolet light, 3,3' -dinitro-4,4'-di(2-pyridylmethyl) azoxybenzene undergoes simultaneously aci-nitro-nitro tautomerization and geometrical isomerization. The discovery of a new class of photochromic nitro compounds is reported.

TITLE: The Elastic Response of Buried Cylinders in Sand
AUTHORS: WALKER, ALBRITTON, and KENNEDY
Engineer Waterways Experiment Station

ABSTRACT: The objectives of this study were to investigate the elastic response of a relatively stiff steel cylinder buried in a dense, dry sand and to compare this response with that predicted by elastic theory. Three series of tests were conducted on a steel cylinder under both static and dynamic loading conditions. The cylinder had a test section length of 12 inches and a diameter of 6 inches. The surface overpressures ranged from 0 to 350 psi, static, and from 100 to 250 psi, dynamic. The depth of cover over the crown ranged from 0 to 12 inches. The results show that the dynamic strains are 0 to 40 percent higher than the strains at an equivalent static load, contradictory to elastic predictions of 10 to 20 percent. The maximum experimental hoop strains were measured on the outside at 180 deg; however, the elastic theory predicted the maximum strain to occur on the inside at 90 deg. Additionally, it was evident that strains (or response) are not a linear function of overpressure. Both the static and dynamic elastic theories compared in the study appear to be inadequate to predict the cylinder response for all overpressure levels

Army Science Conference Technical Papers

TITLE: The Self-Focusing of Intense Beams of Relativistic-Electrons
AUTHOR: ROBERTS
Army Missile Command

ABSTRACT: This paper describes the efforts to produce a very intense beam of high energy electrons which is self-focusing and may reach energy densities of the order of 100,000 Joules/cm^2, or an intensity of 10^{11} watts/cm^2.

A 30 nanosecond, 30,000 ampere pulse of 3.5 Mev electrons has been extracted from the pulsed X-ray machine developed by the Physics International Company of San Leandro, California, and has been projected

(Continued on page 35)

Army Science Conference Panel Discussion Lauded

(Continued from page 33)

that qualified for Certificates of Outstanding Achievement and the authors or coauthors are:

"Deposition of Particles in a Turbulent Slot Flow," Maj Herbert H. Dobbs and Lt Col John W. Wiss, U.S. Army Tank-Automotive Center, Warren, Mich.; "Superconducting Thin-Film Nuclear-Particle Detectors," 1st Lt James B. Greer, 1st Lt Donald B. Sullivan and Walter R. Van Antwerp, U.S. Army Nuclear Defense Laboratory, Edgewood Arsenal, Md.;

Also, "Investigation of Exchange Effects in Ruby by Line Shape Comparisons," Richard L. Hartman, Harry C. Meyer, Jr., Jefferson S. Bennett and Alfred C. Daniel, Physical Sciences Laboratory, U.S. Army Missile Command, Redstone Arsenal, Ala.;

Also, "A Laser Device for Use in Clinical Treatment of Malignant Tumors," James R. Dearman (deceased), W. B. McKnight and R. W. Hawkins, Research and Development Directorate, Redstone Arsenal; "Biological Combinations," Robert L. Schricker and Henry T. Eigelsbach, U.S. Army Biological Center (Provisional), Fort Detrick, Md.;

Also, "Nuclear Burst Ionization Effects on Fuzing," John E. Tompkins, Donald J. McGibney and John A. Rosado, Harry Diamond Laboratories, Washington, D.C.; "Light Attenuation by Photochemical Means: Photochromism," Julius Weinstein, Aron L. Bluhm, Margaret E. Langmuir and E. Thomas Strom,

Dr. James A. Vogel accepts $200 honorarium for paper coauthored with Lt Col James E. Hansen and Dr. John P. Hannon, Fitzsimons General Hospital.

Anthony L. Alesi accepts $200 award for paper coauthored with Morton I. Kliman and George R. Thomas, all employed at the U.S. Army Natick Labs.

U.S. Army Natick Laboratories, Natick, Mass.;

Also, "The Elastic Response of Buried Cylinders in Sand," R. E. Walker, G. E. Albritton, and T. E. Kennedy, Army Engineer Waterways Experiment Station, Vicksburg, Miss.

ABSTRACTS OF PAPERS. For the first time since the Army Science Conference was initiated, the *Army Research and Development Newsmagazine* is devoting a special section in this July-August consolidated edition to publish abstracts of all papers that were presented. They appear on pages 28-59.

PANEL OF JUDGES. The 96 technical papers presented at the fifth Army Science Conference were selected from nearly 450 summary proposals submitted by scientists employed at Army in-house laboratories.

Heading the panel of judges that

(Continued on page 36)

Capt George Lust, U.S. Army Medical Unit, Fort Detrick, Md., receives $200 for technical paper presented at fifth Army Science Conference.

Army Science Conference Technical Papers

(Continued from page 34)

into an ionized medium formed by a 30,000 ampere 7,000 volt pinched discharge in argon. The beam of relativistic electrons traveled 20 centimeters without space charge blow up even though such pulses when projected in vacuum blow up drastically in less than 2 centimeters. Methods are being developed for controlling the extraction of the intense electron beam from the pulsed X-ray machine so that the properties of the relativistic pinch can be studied.

TITLE: Transmission Mode UHF Magneto-Acoustic Delay Line
AUTHORS: SKUDERA, SPROAT, BADY, and GIKOW
Army Electronics Command

ABSTRACT: Results are presented on the investigation of an experimental magnetoacoustic transmission delay line using a single crystal rod of yttrium iron garnet (YIG), over the frequency range of 200 to 1,000 megacycles. A magnetic bias field is applied parallel to the rod axis. Data is given on delay time and insertion loss as a function of magnetic bias field. Both a slow and a fast variation of insertion loss with bias field are noted. The slow variation of insertion loss is quite flat and insertion loss is at a minimum, over the range of 900 to 1,050 oersteds for all frequencies from 200 to 1,000 mc. The separation (in biasing field) of adjacent insertion loss peaks, of this fast variation, is in rough agreement with first order theoretical calculations given by Kohane and Schlomann. A study of the fast variation of insertion loss shows that this variation occurs only over a portion of the pulse and if the pulse is short enough the fast variation is absent. A study of the effects of small permanent magnets that supply a biasing field orthogonal to the primary axial biasing field is presented. Insertion loss and pulse distortion are substantially reduced by these magnets. Two YIG rods bonded together to provide longer delays than what is possible with available single rods were also studied and results presented.

TITLE: A New Microwave Semiconductor Oscillator
AUTHORS: HIGGINS, BRAND, and BARANOWSKI
Electronic Components Laboratory

ABSTRACT: P-N junction diodes, both silicon and gallium arsenide, oscillate at microwave frequencies when reverse biased into avalanche. Principle mechanism of oscillation is the creation of a dynamic ac resistance through avalanche transit time effects.

This paper presents details on the performance characteristics of p-n junction avalanche oscillators including description of a signal substitution measurement technique. This technique permits accurate measurement of closely spaced but distinct oscillations without the use of filters and is used to detect, observe, and characterize avalanche oscillation in the frequency range 6-50 GHz.

Details of experimental results on CW and pulsed oscillations including rf outputs, dc to rf efficiency, tunability, stability, and parametric effects are given for GaAs oscillators. Comparative oscillation performance of some silicon avalanche oscillators is also given. In addition, details of recent avalanche amplifier investigations are presented.

Principal highlights of these avalanche devices are oscillation outputs of over 25 mW at 13 GHz with 5.7% efficiency, 1000 MHz tunable bandwidths for 2:1 power changes; amplifiers give 44 db gain at -60 dbm, and 12 db gain at 0 dbm in the 12-15 GHz frequency range.

TITLE: A New Type of Broadband Low Noise Radio Frequency Amplifier
AUTHOR: BRETT
Electronic Warfare Laboratory

ABSTRACT: Development of high frequency variable capacitor diodes, or as they are known, varactor diodes, has resulted in the expenditure of considerable effort in developing circuits using these devices. Perhaps the greatest emphasis has been on their use for low noise amplification.

This paper will discuss the low noise work with varactor

(Continued on page 36)

Army Science Conference Technical Papers

(Continued from page 35)

diodes, carried on in the Electronic Warfare Laboratory, U.S. Army Electronics Command, Fort Monmouth, where a unique RF amplifier known as the Phase Shift Amplifier has been developed. This amplifier, which uses a technique of phase modulation of a pump frequency by a signal voltage, has exhibited gain bandwidth products in excess of 15,000 mc, dynamic range in excess of 100 db, and extremely low noise at room temperature. Further, in the presence of strong signals, there is little or no spurious output. Data will also be presented on as yet unexplained phenomenon of super sensitivity observed when the phase shift amplifier is used in a receiving system.

Also discussed, will be the use of this amplifier as a crystal video or direct detection type of receiver where sensitivity of 35 to 40 db better than the conventional crystal receiver has been measured.

TITLE: A Mössbauer Spectrometer
AUTHOR: ALLARD
Engineer R&D Laboratories

ABSTRACT: The Mössbauer effect is a nuclear resonance phenomenon. The resonance is affected by the microstructure of the environment of the resonating nucleus. Therefore, it is possible to study the effects on the microstructure of explosives at high pressures and at low and high temperatures. Also, the effects of imperfections in the crystalline structure, of controlled amounts of impurities and of radiation damage can be studied. It is important to understand the behavior of explosives at high pressure because high pressures prevail in the detonation zone of high explosives. An intensive research program has begun on the study of a class of military explosives called picric acid salts. The modern techniques of electron spin resonance, nuclear magnetic resonance, Mössbauer spectroscopy, etc., were not known when picrates were widely used as military explosives. So, a Mössbauer spectrometer was built here to study picrates, among other military explosives, under conditions which prevail during explosions. The spectrometer is an electro-mechanical oscillator which is linear, drift free, vibrationless, synchronized, and capable of operating in constant velocity or constant acceleration modes. Data are obtained from 4°K to a temperature at which resonance vanishes. A high pressure press is used to provide high pressure for the experiments. Data are collected on a punch tape readout system and then programmed into an RCA-301 computer.

TITLE: A New Binder for Composite Solid Rocket Propellants
AUTHOR: ALLEN
Army Missile Command

ABSTRACT: A new binder system was developed for composite solid rocket propellant, consisting of hydroxy-terminated polybutadiene cured with diisocyanates. The polymer was made by reducing carboxy-terminated polybutadiene with lithium aluminum hydride. Gumstock properties of the new binder were excellent, as were the propellant properties down to 0°F. Propellant strain capability was poor at -40°F — a critical area for tactical propulsion units. A study of the basic origins of mechanical failure in composite propellants led to the conclusion that maximum useful strain capability is achieved through maximum adhesive bonding of binder to filler particles. A bonding agent for hydroxy-terminated polybutadiene was developed which makes use of the homopolymerization of aziridine rings which takes place under the influence of catalysis by ammonium perchlorate. A small amount of this agent incorporated into the propellant gave a dramatic increase in strain capability at low temperatures. With this improvement, the new binder system appears to have strain capability exceeding that of other ballistically-similar propellants.

TITLE: Ferrocene Chemistry of Phosphorus and Boron
AUTHORS: SOLLOTT, PETERSON, Jr., and SNEAD
Pitman-Dunn Research Labs, Frankford Arsenal

ABSTRACT: The scope and mechanism of the aluminum chloride-catalyzed

(Continued on page 37)

Army Science Conference

PANEL OF EIGHT top representatives of the institutions and the public discussed controver Relevancy." Left to right are Dr. William O. Ba phone Laboratory; Dr. Edward Gibson, Direct Hopkins University; William Giles, editor of th Lawrence Hafstad, Vice President of General Laboratories; Dr. Frederic Ancrum Lord Holl gineering Co.; Dr. Francis D. Moore, Mosely Pr Peter Bent Brigham Hospital, Harvard Medica Director (Research), National Science Founda Sherwin, Deputy Director of Defense Researcl

(Continued fr

made the final evaluation was Dr. Harold C. Weber, retiring Chief Scientific Adviser, Office of the Chief of Research and Development, Department of the Army. Members: Donald G. Fink, General Manager, Institute of Electrical and Electronics Engineers, Inc., New York, N.Y.; Dr. P. M. Gross, Professor of Chemistry, Duke Univ., Durham, N.C.;

DIRECTOR OF DEFENSE Research and Engi speaker at the Army Science Conference, pos leaders and their wives. From the left are W. lian Embassy, Washington, D.C.; Mrs. and Mr Defense Research Staff; Mrs. Foster and Dr attache, British Embassy; Mrs. and Dr. Deas,

Panel Discussion Lauded

Department of Defense, industry, academic
sial aspects of "Basic Research and Practical
ker, Vice President for Research, Bell Tele-
r of the Applied Physics Laboratory, Johns
e *National Observer*, Washington, D.C.; Dr.
Motors Corp. and Director of GM Research
oway, President of ESSO Research and En-
ofessor of Surgery and Surgeon-in-Chief at
l School; Dr. Randal M. Robertson, Associate
tion, Washington, D.C.; Dr. Chalmers W.
and Engineering (Research and Technology).

om page 35)

Dr. Andrew Longacre, Professor of Engineering Sciences, Syracuse University, Syracuse, N.Y.; Dr. Walter J. Nungester, Chairman of the Department of Bacteriology, University of Michigan Medical School, Ann Arbor, Mich.; and Dr. Edward C. Stevenson, Associate Director, Research Laboratories for the Engineering Sciences, University of Virginia.

neering Dr. John S. Foster, Jr., banquet
ed with Canadian, Australian and British
R. Watson, Defense Science attache, Austra-
B. J. Steuart Johnson, Chief of the Canadian
Foster; Brigadier L. Jubb, assistant military
Munitions Research Officer, British Embassy.

Army Science Conference Technical Papers

(Continued from page 36)

reaction of ferrocene with N,N-(substituted) phosphoramidous dichlorides have been investigated. Reaction conditions, under which ferrocenylphosphonous and -phosphinous chlorides and triferrocenylphosphine were obtained in maximum yield, were determined. Total product yields ranged as high as 95%. In reactions with ferrocene and aluminum chloride, p^{III} amides showed reactivities in the order, $R_2NPCl_2 > (R_2N)_2PCl > (R_3N)_3P$, revealing that cleavage of the P-N bond involves prior coordination of aluminum chloride to nitrogen rather than phosphorus. Further evidence confirming this type of interaction is presented. Phenyl diferrocenylphosphinate and dephenyl ferrocenylphosphonate were obtained by the aluminum chloride-catalyzed reaction of ferrocene with triphenyl phosphite, and are the first known phosphorus esters of ferrocene. Isolation of triferrocenylphosphine oxide when dephenyl phosphite was employed, provided novel evidence for existence of the $P(O)H \rightleftharpoons POH$ tautomerism. Cleavage of the P-O bond (p^{III}-OH and p^{III}-OC_6H_5) is considered to involve prior coordination of aluminum chloride to oxygen. Diferrocenylborinic acid and triferrocenylborane were prepared from boron halides and lithioferrocene. Evolution of ammonia from the borane-ammonia adduct, and lack of formation of isolable adducts of the borane with amines and phosphines were explained in terms of stabilization of the borane by iron-to-boron participation.

TITLE: Development of a Mortar Launched Liquid Rocket
AUTHOR: JABLANSKY
Liquid Rocket Propulsion Laboratory

ABSTRACT: As a result of very exacting requirements of range, accuracy and zoning defined in an Army In-House Exploratory Development effort on a mortar launched rocket assisted projectile (RAP), a liquid rocket engine offered several attractive advantages for achieving the overall program objectives. In order to determine whether a liquid rocket powerplant was feasible for this unusual application, it was decided to conduct an analytical and design analysis, to be followed by an experimental investigation based upon ambient temperature conditions. A propulsion system was developed in nine months, at the Liquid Rocket Propulsion Laboratory (LRPL) of Picatinny Arsenal, that was successfully flight tested at Aberdeen Proving Ground (APG); the first liquid prepackaged system ever flown in such an application. The rocket engine featured solid propellant gas generator, piston positive expulsion, tankage and uncooled thrust chamber assembly matched to deliver the necessary impulse compatible with warhead and system requirements. In connection with this, the engine was designed to accommodate a variable total impulse capability for range zoning, while the components were designed to survive a severe structural environment of 800 g's. This paper discusses the analysis and design details of the prototype as well as the development of the unit and the results of the static and flight tests which verified the accuracy of the concept design study.

TITLE: Determination of Design Parameters for Self-Dispersing Munitions
AUTHORS: CALLAHAN and ZIPFEL
Army Biological Center

ABSTRACT: This paper reports the investigations conducted, and the conclusions reached, by the U.S. Army Biological Center, in determining the design parameters for predictable self-dispersing munitions.

The fusion of the results of both the theoretical and empirical investigations defined the allowable interactions of configuration, mass, and mass distribution to achiefe the predictable dispersion desired.

TITLE: Aircraft Damage and Casualties from Ground Fire in South Vietnam Operations
AUTHORS: BERNIER and SMITH
Ballistic Research Laboratories

ABSTRACT: The sources of combat data, the objectives of its analysis and

(Continued on page 38)

Army Science Conference Technical Papers

(Continued from page 37)

the use of the BRLESC computer for information recall are presented. Significant findings are summarized for the analysis of all U.S. Army combat casualties in aircraft over Vietnam for 1962 through 1965. The major results of the analysis on UH-1 ground fire damage reports through 1964 are also discussed.

TITLE: Determining Aircraft Survival Probabilities
AUTHORS: NABORS
CDC Experimentation Command

ABSTRACT: Described is methodology used by the USACDCEC to conduct an Army Aircraft Survivability experiment.

The probability of aircraft surviving an encounter with visually-aimed weapons* depends on interrelated factors involving threat, aircraft, and environment. These factors cannot be simultaneously examined experimentally in realistic tactical situations. Therefore, experiment examined the following three events single then merged them analytically. (1) Probability that aircraft will be detected, acquired, and engaged. In acquisition phase, time aircraft was in view to tactically deployed weapons was measured..

(2) Probability that, if acquired and engaged, aircraft will be hit. Live fire phase measured frequency of hits against towed drone targets by visually aimed projectiles.

(3) Probability that, if hit, aircraft will be killed. USA BRL terminal effects data were applied to recorded hit data during live fire phase to determine this probability.

Data were integrated with an analytical model to assess results that would have occurred if events had happened simultaneously--if live ammunition had been used against target aircraft when "engaged".

* Experiment specifically excluded radar controlled weapons and all missiles; these are included in other field experiments.

TITLE: Some Studies of Temporary Hearing Losses Resulting from Repeated Exposure to Gunfire Noise
AUTHORS: HODGE and McCOMMONS
Army Human Engineering Laboratories

ABSTRACT: Impulse noise such as gunfire commonly causes diminished auditory acuity measurable as "temporary threshold shifts" (TTS). A comprehensive damage risk criterion (DRC) for impulse-noise exposure is needed and it is desirable to state the DRC in terms of TTS, since TTS is both a valid and convenient indication of noise effects on hearing. This is possible only if TTS is a reliable measure. Reliability of individuals' TTS's may be important, but for the purpose of a DRC, group reliability is paramount.

The results of four studies support the following conclusions: (1) Individual subjects' TTS's are not sufficiently reliable to permit generalization of impulse-noise effects. (2) Group mean TTS varies only slightly across a series of exposures and is considered to be a reliable (consistent; repeatable) measure. This is true for the exposure of normal-hearing subjects to different noise conditions, for the TTS's of subjects to different noise conditions, for the TTS's of subnormal-hearing subjects, and for frequencies representative of the whole range of human hearing. (3) The formulation of an impulse-noise DRC should be based on group data (means, standard deviations, quartiles, etc.). Samples should be as large as possible and representative of the whole Army population to insure generality of results.

TITLE: Gamma-Induced Sensitivity Loss in the Proportional Counters of a Nuclear Power Plant
AUTHOR: McNALLY
Engineer Reactors Group, Fort Belvoir

ABSTRACT: Proportional Counters are widely used to monitor neutron flux during nuclear reactor startup and shutdown. Recently, the proportional

(Continued on page 39)

Dr. Weber Receives DCSA For Role as R&D Adviser

Assistant Secretary of the Army (R&D) Willis M. Hawkins presented to Dr. Harold C. Weber, the retiring Chief Scientific Adviser, Office of the Chief of Research and Development, the Distinguished Civilian Service Award on June 16.

The occasion was the banquet-gathering of about 400 attendees at the 1966 Army Science Conference at the United States Military Academy, West Point, N.Y. Dr. Weber has served as presiding chairman at each of the five Army Science Conferences since they were initiated in 1957.

The citation accompanying the award, signed by Secretary of the Army Stanley R. Resor, stated:

"For distinguished civilian service to the United States Army as Chief Scientific Adviser. From September 1958 until June 1966, Dr. Weber exercised immense influence during the time that the role of research and development was rapidly expanding in the Army and the impact of technological advancement became nationally recognized.

"His rich scientific experience, balanced with rare perception and common sense, provided the Army with uninhibited counsel on activity ranging from research and development organizational effort to technological forecast. His major contributions of a tangible nature were in the fields of chemistry and electronics.

"Through his vigilance and guidance many dollars were saved the Nation, and the image of the Army, as well as its capability, was vastly improved. He has brought great and lasting credit to the civilian scientific community, to the United States Army, and to the Nation he served so well."

1498 Data System Proving Valuable Management Tool

(Continued from page 1)

Late in June 1966 a revised Army Regulation 70–9, "Research and Technology Resume," was distributed to establish policy, responsibility and procedures for reporting technical and management data at the work-unit level. As revised, the AR expands the two program elements in the management and support budget category.

Authority for expansion of the system is contained in a Director of Defense Research and Engineering Memorandum dated Apr. 22, 1966, subject: "Extension of the Work Unit System to Additional Program Categories."

Put into effect July 1, the revised Regulation modifies some reporting procedures and redefines a number of data elements frequently misinterpreted by reporting activities.

The success or failure of the DD Form 1498 reporting system hinges on how completely and accurately the required information is submitted. Properly filled out, inclusive of all on-going effort at work-unit level, the resumes have, in the opinion of most requesters, "proved tremendously useful."

Requests for work-unit data have flowed to the Army data bank at the average rate of about two per work day since operations commenced. About 50 percent of the inquiries have been concerned with the specific scientific and technological effort being conducted by or under the jurisdiction of the Army.

Search criteria for the remainder of the requests were based mainly on the performing activity, responsible organization, and the geographical areas in which Army research, development, testing and evaluation activities are being performed. About 15 percent of the inquiries requested data on RDT&E being performed by Department of Defense elements in addition to the activities of the Army.

Evaluation of the results of response to requests for information has been accomplished by a user questionnaire, the "feedback" of which is used by the Scientific and Technical Information Division, U.S. Army Research Office, to modify procedures and improve system operations.

Among interesting facts brought to light by the evaluation are:

(Continued on page 40)

Army Science Conference Technical Papers

(Continued from page 38)

counters at the Army's SM-1 reactor at Fort Belvoir, Virginia, appeared to lose sensitivity following reactor shutdown. The problem led to an investigation of the effects of gamma radiation on proportional counter operation. Results showed that sensitivity loss occurs because of a reduction in pulse height as gamma flux increases. By choosing a low discrimination level it was possible to minimize sensitivity loss without counting gamma-produced pulses. It was also found that the detector voltage plateau shifts to higher voltages when subjected to gamma radiation.

TITLE: Cohesive Energies in Organic Liquids
AUTHORS: MEYER, WAGNER, and ROSENFELD
Coating and Chemical Laboratory

ABSTRACT: A method which allows quantitative estimation of the dipole-dipole (orientation), dipole-induced dipole (induction), and dispersion energies in polar organic liquids is presented and illustrated with the methyl n-alkyl ketones. Use is made of the temperature variation of density and vapor pressure for homologous series of organic compounds. Data were obtained for the odd-numbered 2-ketones from C_5 to C_{13}.

As an example of the results, it is estimated that the cohesion in liquid 2-butanone at 40°C is comprised of 8% orientation, 14% induction and 78% dispersion energies. The contribution of the dipole to cohesion is much greater than is generally appreciated. In particular, the induction energy, written off as negligible in the past, provides 5% to 10% of the total attraction in the higher, "mostly nonpolar" ketones studied.

This work represents the first evaluation of the three types of attraction among polar molecules in the liquid state, and provides the means to necessary information for a more scientific approach to solvent formulation.

TITLE: The Theory of Operation of an Ammonia Burning Internal Combustion Engine
AUTHORS: GARABEDIAN and JOHNSON
Army Tank-Automotive Center

ABSTRACT: An important candidate in the Army's search to improve fuel logistics is the use of a mobile nuclear power source to provide energy to synthesize chemical fuels with air and water as on-site raw materials. The concept of providing on-site manufacturing of fuels is referred to as the Mobile Energy Depot (MED) concept. Ammonia was chosen as the fuel with the greatest potential.

Important previous work on the combustion of ammonia in internal combustion engines is reviewed. The approach used for burning ammonia in modified spark-ignition engines is discussed. Engine performance data with the L-141 engine are presented.

A discussion of two approaches used for burning ammonia in compression-ignition engines is presented: (1) early liquid ammonia fuel injection followed by spark-ignition in a conventional diesel engine, and (2) the introduction of ammonia vapor at engine inlet temperature into the intake manifold of the engine followed by a small amount of diesel fual injected with a conventional fuel injection system as the pilot charge.

TITLE: Friction Studies of Polymer Solutions
AUTHORS: GISSER and PETRONIO
Pittman-Dunn Research Labs, Frankford Arsenal

ABSTRACT: Friction measurements on steel, glass, and copper with a stainless steel rider on solutions of poly (n-alkyl) methacrylates show that as the length of alkyl group is increased, the coefficient of friction is reduced. The friction values are almost the same as those obtained with a-alkyl acetates having the same alkyl length. Changes in concentration from 0.01 to 10 mg/ml yield at most an insignificant increase in friction. The progressive friction reduction with increasing

(Continued on page 40)

Army Science Conference Technical Papers

(Continued from page 39)

alkyl length is explained in terms of increasing lateral interactions of the adsorbed polymer film with increasing fraction of alkyl lengths having one free end. These lateral interactions lead to progressively increasing rigidity which contributes to friction reduction. Measurements with copolymers of n-hexadecyl methacrylate and methacrylic acid show minimum friction with approximately 50% of the methacrylic acid indicating that strongly polar groups which can interact with the surface and long alkyl groups both contribute to friction reduction. When either are decreased in concentration in the film near the surface, friction increases.

TITLE: Mechanism for Controlling the Reactivity of Lead Azide
AUTHORS: PAI-VERNEKER and FORSYTH
Explosives Laboratory, Picatinny Arsenal

ABSTRACT: In the present investigation it has been found that the reactivity of lead azide can be controlled by introducing solid state defects within the crystal and by changing the particle size of the sample under investigation. Defects have been introduced into the crystal by doping lead azide with iron either as Fe^{3} or as $Fe(N_3)^{2}$. A study of the distribution laws (Berthelot-Nernst and Logarithmic) suggests that Fe^{3} is taken up by lead azide in a substitutional way. The rate of gas evolution during the thermal decomposition of lead azide and the time for lead azide to explode at a fixed temperature are taken as an index of the reactivity of the lead azide.

Results show that when lead azide is doped with Fe^{3}, the reactivity is lessened whereas when it is doped with $Fe(N_3)^{2}$ the reactivity is increased. This is discussed in the light of a possible mechanism involving the role of cationic and anionic vacancies and other electron traps. It is believed that these experiments point the way toward the ultimate control of explosive sensitivity.

TITLE: Influence of Electromagnetic Fields on Liquid Crystals
AUTHOR: MULLER
Night Vision Laboratory

ABSTRACT: Electromagnetic field effects are discussed with special emphasis on cholesteric liquid crystals. A detailed background of information fundamental to the understanding of the liquid crystal state is given.

All experimental effects altering liquid crystals can be classified as either purely electrostatic or magnetostatic, while effects of the liquid crystal upon the electromagnetic field, such as NMR or chromatically selective Bragg Reflection, are primarily considered as probes of the liquid crystalline phase.

For the cholesteric phase, static and dynamic electric field effects first discovered at this laboratory are described in detail. A qualitative analysis is found to be in good agreement with the complicated effects observed.

TITLE: A Correlation of the Base Drag of Bodies-of-Revolution with a Jet Exhausting Through the Base
AUTHORS: BRAZZEL and HENDERSON
Army Missile Command

ABSTRACT: An empirical technique has been formulated for estimating the base drag of bodies-of-revolution with a central jet exhausting through the base. The technique is based on successful correlation of an extensive amount of experimental data covering a wide range of parametric variation. The basis of the correlation is an apparent relationship between the base pressure ratio and the ratio of the momentum flux of the jet to the momentum flux of the equivalent body stream-tube. The elementary form of the derived expression allows solutions with a desk calculator.

(Continued on page 41)

1498 Data System Proving Valuable Management Tool

(Continued from page 39)

- More than four-fifths of the data provided for each inquiry was considered relevant by the requester (range 5 to 100 percent).
- About one-third of the requesters knew of additional ongoing effort in the Army which was not included in the information received.
- About one-fourth of the searches were requested in order to monitor projects, another one-fourth to avoid duplication of effort, about one-tenth to locate capability for performing work, and the remainder for various other reasons.
- One-fifth of the requesters indicated that the results of the search made highly significant contributions to their requirements, about two-thirds a significant contribution, one-tenth a marginally significant contribution, and the remainder an insignificant contribution.
- More than 95 percent of users considered response-time satisfactory.

Results of evaluation of the User Questionnaire include deeper indexing of many resumes, and the development of more explicit instructions to requesters, as prescribed in AR 70–9. The analysis also pointed up several projects in the research and exploratory development fields which were not adequately covered by work-unit reports.

The Army data bank of DD Form 1498 work-unit data has been used to provide a number of responses to congressional and Bureau of the Budget inquiries on the types of organizations performing research and development, and the geographical location of these organizations. In past years, this data was collected by special inquiries to the field, requiring costly unscheduled expenditure of effort.

High-echelon Department of Defense and Department of the Army management personnel have used aggregated DD Form 1498 data to evaluate R&D activities in specific scientific and technological fields, as a means of identifying areas meriting increased interest and those suspect of being over-emphasized. It is expected that this use of 1498 work-unit data will increase.

On the debit side, several basic weaknesses have become apparent in operation of the system to date: (1) Some reporting activities have failed to keep current their submissions with new and revised reports, as required

by AR 70–9; (2) the date of usage is disappointing, especially at laboratory level, and indicates that developing agencies are not availing themselves of the wealth of valuable information readily accessible.

Discussions with several coordinators of the work-unit system at the command/agency level have indicated that the main impediment to time reporting has been the requirement for submission of punched cards and multiple "hard copies."

Updating requirements frequently have resulted frequently in small numbers of reports being sent to local data centers for keypunching. Priority handling of reports often was impossible to obtain, because of previously scheduled workloads. A similar problem was encountered in sending hard copies to the print shop for duplication.

To relieve these problems, the requirements for submitting punched cards and multiple hard copies has been waived in the revised AR 70–9. This action, together with other inducements in the planning stage, is expected to motivate agencies to be more conscientious in reporting.

One of the strongest inducements to timely reporting will come, it is recognized, when the requesters realize the value of knowing what information is available to them, and what is guiding high-echelon management in many major program decisions.

After a full year of operation of the DD Form 1498 reporting system, some activities continue to exhibit a lack of clear understanding as to the meaning of certain data elements. The revised AR 70–9 is intended to clear up many of the deficiencies in definitions.

Examples of errors noted in review of the 1498 submissions include:

- Obligated funds entry in lieu of estimated "level of effort" (funds used) under item 18.
- Vague and too-short narrative portions (Items 24, 25, 26).
- Choice of undescriptive and too general keywords (Item 23).
- Obsolete project and task numbers (Item 10a).

A draft of the Army Thesaurus of Technical Descriptors has been completed and sent to the field for review. After evaluation of the comments and recommendations received, the Thesaurus will be modified and published for distribution in the first quarter of FY 1967.

The Thesaurus will function as a common link between the users and

(Continued on page 42)

Army Science Conference Technical Papers

(Continued from page 41)

TITLE: Helicopter Blade Slap
AUTHORS: TAYLOR and LEVERTON
University of Southampton, England

ABSTRACT: Blade Slap in the sharp increase in helicopter rotor noise, at the blade passing frequency, that is characteristic of certain model helicopters during some regimes of flight. An investigation has been conducted to determine the nature of the phenomenon. This has included flight tests with the type WESSEX and BELVEDERE helicopters and a comprehensive operational survey, military and commercial, in the United States and United Kingdom.

Blade Slap appears to be caused by a blade passing through the tip vortex shed by another blade in its proximity. This has been simulated on a rotor whirl stand under controlled conditions and the effect of various parameters investigated. A theory has been developed to predict the noise generated during a Blade Slap condition.

There is good correlation between the flight tests, model tests and theory. The paper discusses all aspects of the investigation, and its helicopter application.

TITLE: A Hydrocarbon-Air Fuel Cell Using an Acid Electrolyte
AUTHOR: FRYSINGER
Engineer R&D Laboratory

ABSTRACT: The utilization of liquid hydrocarbons in a fuel cell is of high practical interest. The ability to utilize liquid hydrocarbon fractions at efficiencies of 40 to 60% has the effect of greatly increasing the usable energy content of our proven petroleum resources. New fuel cell concepts which utilize a phosphoric acid electrolyte offer a highly compact fuel cell assembly which can be used in a very highly simplified system. Either the hydrocarbon can be reacted directly at the electrode in an anodic oxidation reaction involving several hundred charge transfer steps or the active hydrogen of the hydrocarbon molecule can be liberated by a hydrocarbon-steam reforming reaction and the hydrogen subsequently reacted in a hydrogen-air fuel cell. The reaction steps and the efficiencies which are obtainable by either of these variations of a hydrocarbon air fuel cell using the new acid electrolyte systems are described. The use of the phosphoric acid electrolyte has been greatly facilitated by the availability of new highly corrosion resistant alloys which are capable of long term stability as constructional members or electrode supports in the fuel cell operating environments. The basic considerations for incorporating a multi-cell stack into a complete fuel cell system are described.

TITLE: Acoustical and Visual Attenuation Through Dynamic Regulation of Muzzle Gas Flow
AUTHOR: WATLING
Springfield Armory

ABSTRACT: Objectionable characteristics of modern weapons are their muzzle flash and noise which invite immediate attention and retaliation by enemy forces. Historically, the attachments to conventional weapons have never gained wide acceptance for military use. Their greatest disadvantages are usually weight and bulk. Both of these factors increase with the degree of suppression. After consecutive investigations toward attenuation of muzzle flash and attenuation of sound, it was determined that their commonality is in the field of fluid dynamics and that the work toward one goal can complement that of the other. Desirable characteristics needed in both types of devices are discussed. Experimental data are developed by the use of a unique test fixture and is supported by theoretical gas dynamics. The technique is established on the assumption that mass flow can be retarded by rapid density changes across multi-shock fronts created by a variable volume flow passage. It is believed that this fundamental investigation will provide an analytical background for future design studies.

(Continued on page 43)

Army Science Conference Technical Papers

(Continued from page 41)

TITLE: Ultra High Vacuum Adhesion and Friction
AUTHORS: GALL and HUBBARD
Ohio River Division Laboratories

ABSTRACT: Measurements have been made of adhesion and friction in ultra high vacuum. A maximum adhesion force of 10 grams was measured at a pressure of 5×10^{-10} torr between gold surfaces after a load of 4000 grams had been applied. No adhesion was observed for smaller loads at this pressure. At a pressure of 4×10^{-13} torr a maximum adhesion force of 1.7 grams was observed after a load of 25 grams had been applied. No adhesion at all was observed at pressures of 10^{-9} torr or higher. The friction measurements give an indication that friction increases in ultra high vacuum, but the data is not sufficiently quantitative to establish any definite relationships between pressure and friction at this time.

TITLE: The Effect of Thermal Pollution on River Ice Conditions
AUTHORS: DINGMAN, WEEKS, and YEN
Army Cold Regions R & E Laboratory

ABSTRACT: The addition of large amounts of thermal pollution to a river in the form of power plant cooling water effluent can have important engineering consequences, among which is the maintenance of an ice-free reach during the winter. The present paper discusses a method which allows a large number of meteorological factors to be considered in calculating the downstream water temperature decreases below a thermal pollution site. A differential equation expressing the heat balance of a volume element of the river gives rise to an expression in which the distance x at which water temperature equals T_{wx} is found by integrating the inverse of the heat-loss rate, Q^*, over the limits T_{wo} to T_{wx}, where T_{wo} is the temperature at the pollution site. Q^* is the sum of the heat losses due to evaporation, convection, long- and short-wave radiation, and other processes, each of which is evaluated by means of well established empirical or theoretical expressions. For given hydrometric and meteorological conditions, $1/Q^*$ is a complicated function of water temperature. A computer program numerically evaluates the integral and calculates the distance x for given values of T_{wx}. The value of x where T_{wx} equals 0C is assumed to be the length of the ice-free reach. Results check satisfactorily with observations on the Mississippi River. It is shown that significant portions of the St. Lawrence Seaway can be kept ice-free by the installation of nuclear reactors at appropriate locations.

TITLE: Massive Underground Ice in Northern Regions
AUTHOR: BROWN
Army Cold Regions R & E Laboratory

ABSTRACT: Near-surface, perennially frozen ground contains large quantities of massive ground ice. The formation of ice wedges into nearly vertical foliated bodies is caused by repetitive cracking of the frozen ground from thermal stress and filling in of the resulting crack by water or water vapor to form ice. By this process, geometrically spaced ice wedges may eventually occupy more than 50% by volume of the ground, with individual wedges commonly exceeding 3 meters in width. Below the zone of currently active ice wedges there are found buried ice masses which reflect earlier land surfaces and past thermal disturbances of the frozen ground. Areal distribution of a majority of the wedges can be determined from ground features and estimates of ice volumes approximated from drill records and ice-wedge distribution. The ice at Barrow, Alaska, generally contains only small quantities of soluble salts and a paucity of microbiological life. Tunneling in these ice masses is technologically unique and simple, and can provide easily obtainable space for subterranean facilities such as storage and instrument platforms.

TITLE: Biodegradable Detergents
AUTHORS: LONG, TROTTIER, ROGERS, and KAPLAN
Natick Laboratories

ABSTRACT: Regulation concerning biodegradable detergents have brought about a change from the use of branched-chain alkyl-benzenesulfonates

(Continued on page 43)

1498 Data System Proving Valuable Management Tool

(Continued from page 41)

the operators of the system in the 1498 retrieval. A technique is being devised to keep the Thesaurus current as new technology and changes in vocabulary usage develop.

Based on experience gained in operations to date, the Director of Defense Technical Information, Office of the Director of Defense Research and Engineering, has charged the Defense Documentation Center, in concert with the other participating agencies, to draft a 1498 manual. The purpose is to provide improved guidance in preparing the resumes and submitting more compatible data.

A Department of Defense 1498 Working Group is preparing a draft of the manual and it will be circulated to all participating agencies for comment. Army elements are encouraged to forward recommendations for improving the system to the chief, Scientific and Technical Information Division, Office of the Chief of Research and Development.

As research and development expenditures increase to provide requirements of military security, and to build a strong base of new knowledge and technology for the Nation's sustained economic growth, the need at all echelons of management for basic data on individual units of work will increase geometrically.

The expansion of the system to agencies outside the Department of Defense and the National Aeronautics and Space Administration complex, currently united under a cooperative exchange agreement, is being considered seriously in higher councils of the Government.

MICOM Directs Continued R&D Of Helicopter Version of TOW

Continued research and development of the helicopter version of the TOW (tube-launched, optically-tracked, wire-guided) antitank and heavy armored vehicle weapon has been directed by the Army Missile Command (MICOM), Redstone Arsenal, Ala.

The first increment of a total $15.3 million contract awarded to Hughes Aircraft Co. was for $7.1 million. The XM-26 will replace the M-22 system now deployed with Army troops.

For the TOW helicopter missile, Hughes has developed a stabilized sight that allows the gunner to hold a bead on target even while the pilot maneuvers to evade ground fire.

DDRE Foster Discusses In-House Laboratories

(Continued from page 2)

The in-house laboratories *must* play a key role in shaping and administering the complex research, development, testing and evaluation program on which our defense posture so heavily depends. The role of laboratories in the development and management of large weapon system development and test programs, although quite variable, is another function which assures that the lessons of the past will be reflected in current and future operational equipment.

Up to now I have been talking in the abstract and telling you things that you have heard many times before. Let me add some flesh and blood to the skeleton I have just sketched for you.

When I first arrived, Mr. McNamara told me that he saw two main challenges to the U.S. and wanted me to pay special attention to:

- The maintenance of an "assured destruction" capability.
- The war in Southeast Asia.

I recently visited Southeast Asia for the purpose of seeing how effective the last 10-20 years of R&D has been; what quick fixes are needed; and what the R&D programs for systems are needed in the next 10-20 years.

You know, it was an awesome and inspiring experience, this view of our forces in action half way around the world. What a magnificant job they are doing—a first-rate job with first-rate equipment. I was impressed by the modern thinking amongst the commanders. They realize they are fighting a new and special kind of war. They are anxious to innovate with new tactics and equipment. Both Admiral Sharp and General Westmoreland want personal scientific advisers on their staffs.

But it's a cruel war—a difficult, complicated, awkward war. It is quite different from the way we fought in the past, but yet may be typical of what we can expect during the next 10-20 years.

Because of your interests, I would like to give you my impressions of two areas tonight. (1) Land warfare; (2) Counter infiltration.

LAND WARFARE. There is an enormous imbalance between forces.

(Continued on page 44)

Army Science Conference Technical Papers

(Continued from page 42)

(ABS) to that of linear alkylbenzenesulfonates (LAS). However, LAS may not be adequate to prevent pollution of our waters and a third generation of detergents may be required. Since the United States Army purchases detergents worth millions of dollars each year, research concerning a better biodegradable detergent is pertinent to its interest. A plan to improve the biodegradability of the LAS molecule by the introduction of a heteroatom into its side-chain was therefore initiated.

A series of eleven biodegradable detergents has been synthesized in which the methylene groups of sodium p-(n-dodecyl) benzenesulfonate have been successively replaced by sulfur. Four isomers of sodium p(N-thia-n-dodecyl) benzenesulfonate have proved to be more biodegradable than the commercial standard.

TITLE: Clarification of Potomac River Water with Cationic Polyelectrolytes

AUTHOR: PRESSMAN
Engineer R&D Laboratories

ABSTRACT: A two-part investigation, combining laboratory studies and full-scale plant studies with a standard 3000-gph U.S. Army Mobile Water Purification Unit, was conducted to determine the feasibility of using a cationic polyelectrolyte as sole coagulant to replace ferric chloride and limestone currently used for coagulation in the treatment of natural waters. Eight cationic polyelectrolytes (two poly-quaternary ammonium compounds and six polyamines) and water from five natural sources were used in the laboratory studies. These studies determined optimum dosage requirements, and the effect of pH, hypochlorination, turbidity, color, and mixing on the coagulation process. Large-scale studies with the 3000-gph Army unit, using Potomac River water and a chlorine-resistant poly-quaternary ammonium compound, indicated that a polyelectrolyte of this type could be used as a replacement for ferric chloride and limestone, currently used in standard operating procedures, with a significant reduction in coagulation dosage requirements.

TITLE: Tracer Projectile for SPIW Point Target Ammunition

AUTHORS: CAVELL, DIETSCH, CAVEN, and DI GIROLAMO

ABSTRACT: The Special Purpose Individual Weapon (SPIW) Point Target Tracer is the most unconventional tracer in the small arms ammunition arsenal of the Department of Defense with respect to projectile size, arrangement of major components in the cartridge case, method of launching, and ballistic characteristics. It is the smallest tracer projectile. This presentation describes the SPIW tracer cartridge design features, ballistic and pyrotechnic functioning characteristics and discusses the following eight SPIW pyrotechnic problems:

1. Pyrotechnic Mixture Formulations
2. Initiation of Igniter and Tracer Mixtures
3. Visibility and Flame Color of Pyrotechnic Mixtures Available from Small Diameter Cavity Projectiles
4. Range of Visibility Obtained from One Grain of Pyrotechnic Mixture when fired at High Muzzle Velocity
5. Prevention of Dislodgement of Pyrotechnic Mixtures from Projectiles at High G's Acceleration
6. Loading Problems and Methods for SPIW Tracer Projectiles
7. Overall Temperature and Humidity Ranges and Temperature and Humidity Cycling Limitations on Initial and Surveillance SPIW Tracer Functioning Characteristics
8. Long Range Barrel Corrosion and Erosion Effects of SPIW Primer-Propellant-Pyrotechnic Systems

---

TITLE: The Air Blast Potention of FAX Devices

AUTHORS: HIPPENSTEEL and HOFFMAN
Army Ballistic Research Laboratories

ABSTRACT: The air blast about a device, originally developed by the

(Continued on page 44)

Army Science Conference Technical Papers

(Continued from page 43)

Navy, has been partially evaluated through a number of experimental firings. Measurements include those for determining the optimum heights of burst for maximizing blast effects. This data was used to formulate a rule-of-thumb for establishing heights at which the device should be fired to exploit its possible advantages. A scaling law was also attempted for the air blast from FAX and some analytical predictions made of the blast limitations which might be expected. Based on the magnitude of specific results, the paper concludes with some suggestions as to possible applications of the device.

TITLE: Microchannel Electron Multiplier Arrays
AUTHORS: CARTS and ACCHIONE
Night Vision Laboratory

ABSTRACT: The Army's need to see and operate effectively at night has placed major emphasis on devices for amplifying low light level images. Research directed toward this goal has resulted in the development of a revolutionary new electron image amplifying structure. This device combines high resolution capabilities with very high electron gains. This paper discusses the operating principle of the microchannel electron multiplier array and presents experimental data of its performance characteristics. Electron gain, resolution capabilities, and other electrical and electro-optical properties of state-of-the-art microchannel arrays are presented. Fabrication materials and techniques are briefly covered. Present limitations and approaches for additional improvement are presented relative to microchannel operating theory. The impact of this new type of material on image intensifier tubes and the Army's night vision program is discussed.

TITLE: A Theory of Shock Interactions for Multiple Underground Nuclear Explosions and the Resulting Hypothetical Crater Volumes
AUTHOR: EATON
Engineer R&D Laboratories

ABSTRACT: A theory is developed for predicting the volumes of craters created by the detonation of two underground nuclear explosions. The major hypothesis is the direct proportionality between the crater volume and the "momentum thrust". The "momentum thrust" is the difference between the time derivative of the scaled upward momentum and the scaled gravitational force, calculated at the instant the shock waves strike the soil-air interface. The calculation of the "momentum thrust"is based upon the density, velocity, and pressure fields of Porzels waste heat theory. Using a computer code based upon the theory, parametric plots of two simultaneously detonated and horizontally spaced explosions were calculated. These plots showed that maximum crater volumes resulted from varying separation distances and depths of burial for given yields. By varying the times of detonation between explosions, crater volumes decreased with increasing time lags. Presently the computer codes are being extended to include the effects of the cavity produced by the explosions and the actual expansion path of the shocked materials.

TITLE: Static and Dynamic Tests of Buried Unreinforced Concrete Arches
AUTHORS: FLATHAU and MEYER
Engineer Waterways Experiment Station

ABSTRACT: The objective of this study was to determine the response of semicircular, unreinforced concrete fixed-end arches of varying stiffness buried in dense dry sand when subjected to both static and dynamic loads. Two sets of three arches all having outside diameters of 12 inches were cast with one arch in each set having wall thicknesses of ½, 1, and 2 inches. The maximum static ground surface overpressure applied was 550 psi, and the maximum dynamic overpressure was 270 psi. For most of the tests, the depth of sand over the crown of the arch was 2 inches. The

(Continued on page 45)

DDRE Foster Discusses In-House Laboratories

(Continued on page 43)

We are the best equipped force in the world, fighting one of the worst. We are in the open and operating from concentrated bases and they are spread over the countryside. We are 9,000 miles from home in unfamiliar terrain. The proof of our success is that we are on the offensive—all over Viet Nam. There has been a big change in one year.

The enemy is in hiding. Our one overwhelming problem is finding and fixing the enemy, spread out over huge areas of "guerrilla absorbent" terrain. We just don't have the sensors and detectors to make it easy to find him. We are still using the eyes and ears of foot patrols and FAC (Forward Area Control) aircraft spotters. While he is exploiting nature to work on his behalf, we must find a way to use technology to strip this basic advantage from him.

When we find the enemy, we have overwhelming advantage in mobility, firepower. communications and logistics. The helicopter has virtually revolutionized combat tactics. I am really proud and thankful that we had the 1st Cavalry Division ready when we needed it. Practically everything they use is new since Korea.

In a classic war, a division might fight over an area of 400 square miles. In this war, coverage of 10,000 square miles is possible. They can move battalions of men or artillery anywhere in that area in one day. Thus we have seen a revolution of weapon systems in the field. We are really in the procees of developing tactics which will revolutionize COIN (counterinsurgency) warfare.

While the more densely populated areas are now much safer, we are forcing the enemy back to guerrilla tactics, which make it much more difficult for us. But we are on the prowl, while he has fewer places to consolidate, train, re-equip or marshal supplies in large numbers.

In the time needed, we must be able to cope with big attacks, small hit-and-run attacks, and must help in rebuilding the country. Probably the least recognized contribution of our fighting men is in the rebuilding. In his typical way, the GI is on his own digging ditches, building roads, building churches and doing everything he can to rebuild the community.

COUNTER-INFILTRATION. The second area I want to discuss is

counter-infiltration. The warfare capability of the VC is supported by North Viet Namese infiltration. Our basic aim must be to isolate the country from infiltration, which is a major step toward pacifying the country so that civil action can take over. The level of infiltration determines the level of fighting and of total costs in men, materiel and money.

We are concerned with land trails, rivers and the sea. We have had to resort to an interdiction campaign to cut down the southward flow of supplies from North Viet Nam. Very close coordination is needed between reconnaissance, intelligence interpretation, and prompt-reaction strikes. We know we are hurting him, but so far, not enough to stop him.

Their resupply system is like an enormous group of ants. Individuals, carrying small loads along multiple routes, never seem to stop moving for very long. They show enormous capability to repair routes and bridges and they always seem to be able to find alternate routes readily. We have to hit the supplies and vehicles directly.

Trail interdiction requires all new kinds of systems. We require new concepts in real-time reconnaissance and immediate strike. The weather, terrain, and foliage cover are all against us. New gadgets and systems still hold hope of additional pinching of resupply. Posts along the border can moniter, but not inhibit infiltration at this time. Systems and concepts are beginning to be understood which may be of considerable help.

Stopping infiltration by sea and up rivers is even more difficult, since there is a huge natural flow and water is a prime means of national transport and income. We have to patrol about 400 miles of coastline, 400 miles of main arteries and about 4,000 miles of tributaries.

Again we need sensors and detectors of contraband goods and for distinguishing the good guys from the bad. So counter-infiltration is again the process of fragmenting resupply routes, and attriting supplies, first down through North Viet Nam, then along trails and coastlines, and finally along borders themselves. The basic problem is finding the stuff and the vehicles (or porters) in real-time en route at any time of day or night in any weather.

SUMMARY. Well, what have I really been trying to tell you? The military forces are performing a great job. Where they are limited,

(Continued on page 46)

Army Science Conference Technical Papers

(Continued from page 44)

modes of response for the structures tested statically and dynamically were the same. However, only the ½-inch arch loaded statically collapsed. From strain measurements it was determined that the arches responded in compression. From the results it was possible to write expressions including the effects of soil arching for predicting overpressures to cause failure of the type arches described in this paper.

TITLE: Water Shock Waves from Above-Water Explosions
AUTHORS: PINKSTON and SAKURAI
Engineer Waterways Experiment Station

ABSTRACT: In an effort to determine the amount of energy transmitted into the water when an explosion occurs above a water surface, both experimental and theoretical investigations were conducted. The experimental study involved detonation of 21-lb spheres of TNT above a water surface and measuring induced water shock at spatial positions underwater. To fully incorporate the nonlinear characteristics of the airblast into the study, free-air pressure-time data were used as the water surface loading mechanism and the investigation was divided into two phases--in Phase I, the generating source was at such a height that the induced water shock could be adequately described by acoustic theory, while in Phase II, the generating source was nearer the surface and the resulting disturbance field was of a finite amplitude that had to be considered to accurately determine underwater pressure.

Peak pressures and pressure-time histories derived during Phase I (acoustic theory) compare very well with experimental results for those cases wherein the theory is valid. When the generating source nears the surface, however, the theory becomes inadequate (primarily because of a rigid interface assumption) and theoretical results are adjusted by a correction factor (θ) that modifies the pressure values as θp. Appropriate θ values for each charge position were obtained by comparing theoretical and experimental results for each charge position.

Phase II results (the effect of the finite disturbance) indicated that the disturbance is not as important as originally estimated, and except near the zero point, the acoustic theory can offer a complete description of the pressure phenomena in water. However, near the zero point, the finite disturbance effect is essential to an accurate determination of the underwater pressure.

TITLE: A Study of Sub-Optimal Control Laws
AUTHOR: GRIDER
Army Inertial G & C Laboratory

ABSTRACT: This study is concerned with the general problem of determining sub-optimal control laws which have desirable mathematical structures specified a priori. In general, this is a very difficult problem in control theory and tends to defy analysis with the usual tools of optimization. A direct method of analysis for this type of problem is applied to some low-order examples. The optimal control of a linear, stationary dynamical system is considered where the control law structure is specified a priori as follows:

(1) A constant coefficient linear combination of state variables
(2) The saturation function of (1)
(3) The signum function of (1)

The variable element in each of these control law structures is a special n-dimensional linear gain vector χ, which can be chosen at $t=0$, but must remain constant for all time $t>0$. Each structure is investigated for a performance index consisting of a positive definite quadratic form in the state variables. It is shown that, in general, the optimal linear gain vector χ is a function of the initial state. Several examples are worked out in detail to illustrate application of the method.

TITLE: A Model for Determining Target Location Accuracy Requirements
AUTHOR: SPEARS
Artillery Agency, C.D.C.

ABSTRACT: This paper is an outline of a method for computing target

(Continued on page 46)

Army Science Conference Technical Papers

(Continued from page 45)

location accuracy required of target acquisition systems. Thus the method can be used to assist in the statement of requirements for future target acquisition systems. The essentials of the method are as follows: Target location errors are associated with resultant decrease in weapons capabilities (damage potential). In turn, this decreased capability is associated with corresponding decreased probability of accomplishing the mission, or defeating the enemy. A simplified computing procedure is described.

TITLE: Materials for Use in Mitigating Blast Loads on Deeply Buried Protective Structures

AUTHOR: HOFF
Engineer Waterways Experiment Station

ABSTRACT: The structural design of deeply buried protective structures to resist the effects of nuclear blast loading is somewhat simplfied if the structure can be designed to resist a defined, constant or quasi-constant stress level when shock-loaded. By backpacking a buried structure with certain types of materials, a constant stress level can be obtained when a shock wave is transmitted through the backpacking to the structure. These backpacking materials also act to (a) dissipate a portion of the shock energy, (b) reflect a portion of the shock energy, and (c) absorb flyrock from the containing medium. A program to investigate and develop materials of this nature was initiated at the Waterways Experiment Station and was sponsored by the Defense Atomic Support Agency.

An analysis of the desired behavior of the material accompanied by existing theories and postulates pertaining to the use of backpacking materials resulted in the defining of a variety of materials that could conceivably be used as backpacking materials. Materials that were considered included light-weight concretes, foamed plastics, honeycombs, and natural aggregates. These materials were evaluated as to their physical properties and behavior, availability, and emplacement procedures and costs. Based on the results of these evaluations, three of the materials investigated are receiving further study in an underground nuclear test.

TITLE: Stress-Aging and its Effects on Tensile Properties of Some Stainless and Ultra-High-Strength Steels

AUTHOR: HARRINGTON
Watervliet Arsenal

ABSTRACT: "Stress-Aging" is a new treatment that significantly increases strength properties with no losses in ductility; for some classes of alloys, increases in strength are concurrent with appreciable increases in elongation and reduction of area. For the cited stainless steels, stress-aging may increase the proportional limit by 100%, the elastic capacity to 300%, and 0.1% yield strength by 50,000 psi, with concurrent increases of 20 to 40% in elongation and 50% in reduction of area.

Among the reported ultra-high-strength steels, 4335 Si-Modified and 300 M have their yield strengths increased by 50,000 and by 62,000 psi respectively with no losses in ductility and relative toughness.

300 M becomes the first "low alloy" steel with a yield strength of 300,000 psi.

On a yield strength-to-density basis, these latter two steels, stress-aged, are presently unsurpassed by any other known alloys with useful ductility and toughness. These two steels are also lower in cost than their Be-base and Ti-base alloy competitors, on this basis.

TITLE: Anisotropy and its Relationship to Deep Drawing of a 5% Cr Tool Steel (H-11) for the HAWK Missile

AUTHORS: COLTON and COLGATE
Army Materials Research Agency

ABSTRACT: The drawability of a spheroidized hot rolled H-11 tool steel

(Continued on page 47)

DDRE Foster Discusses In-House Laboratories

(Continued from page 45)

we can generally trace it back to unfinished or ignored research and development.

A major problem is *sensors*. A great deal of understanding and work is needed here. We must develop better means of finding guerrillas, sites, enemy aircraft flying over. We must improve our ordnance to be selective and to work in difficult terrain. We must develop whole new police-and patrol-type systems that can work around the clock every day. We must continue to develop VTOL (vertical takeoff and landing) aircraft for flexibility of movement and rescue. We must remove the power of nature from the guerrilla. And we must continue to develop means of fighting and policing that minimize the number of ground forces permanently committed. The list is almost endless. A major advance in these capabilities, in my opinion, could change the war.

These problems are your problems. The in-house laboratories must lead the way in providing *quickly* new modifications, new systems and new capabilities. I am convinced that solutions tend to evolve when you get a creative group of guys together with common objectives, a lot of flexibility, a high degree of local antonomy and lots of interaction with the operational people.

These problems are a challenge to in-house laboratories, to Army research and development and to Western Science. Under the right conditions and management, answers and solutions will emerge.

I would like to close with a quotation from Admiral Mahan in his *The Influence of Seapower Upon History, 1660–1783*. Because of the impression that it made upon me nine years ago, I have carried it in my pocket since then.

"The battles of the past succeeded or failed according as they were fought in conformity with the principles of war; and the seaman who carefully studies the causes of success or failure will not only detect and gradually assimilate these principles, but will also acquire increased aptitude in applying them to the tactical use of the ships and weapons of his own day. He will observe also that changes of tactics have not only taken place after changes in weapons, which necessarily is the case, but that the interval between such changes has been unduly long.

"This doubtless arises from the fact that an improvement of weapons is due to the energy of one or two men, while changes in tactics have to overcome the inertia of a conservative class; but it is a great evil. It can be remedied only by a candid recognition of each change, by careful study of the powers and limitations of the new ship or weapon, and by a consequent adaptation of the method of using it to the qualities it possesses, which will constitute its tactics.

"History shows that it is vain to hope that military men generally will be at the pains to do this, but that the one who does will go into battle with a great advantage,—a lesson in itself of no mean value."

USAIDR Courses Set For 1966-67 Season

The U.S. Army Institute of Dental Research at Walter Reed Army Medical Center is offering seven postgraduate courses for the 1966–1967 season.

Starting the new series from Sept. 26–30 will be "The Science of Materials in Dentistry." It will cover new aspects in the development of dental materials, and will be geared to the general practitioner as well as to specialists in the field.

The course director Col Peter M. Margetis, director of the U.S. Army Medical Biomechanical Research Laboratory, will be assisted by Lt Col Simon Civjan, chief, Department of Dental Materials, the Dental Institute.

Other fall courses include "Preventive Dentistry," Oct. 24–28, Maj Dale W. Hutchins, course director, and "Prosthodontics," Dec. 5–9, Col Perry W. Bascom, course director.

Subjects in 1967 will be "Oral Surgery," Jan. 9–13, Col Roderick L. Lister, course director; "Periodontics," Feb. 13–17, Lt Col Joe Frisch, course director; "Advanced Pathology of the Oral Regions," Mar. 6–10, Maj Gen Joseph L. Bernier, chief, Army Dental Corps, course director, and "Oral Diagnosis and Therapeutics," Apr. 10–14, Lt Col Surindar N. Bhaskar, course director.

Attendance is open to Dental Corps officers of the Federal Services on active duty, Reserve and National Guard officers not on active duty, and qualified civilians. Officers on active duty must have at least 12 months remaining to serve in order to be considered for "in service" courses.

For further information write to: Director, U.S. Army Institute of Dental Research, Walter Reed Army Medical Center, Washington, D.C.

Army Science Conference Technical Papers

(Continued from page 46)

was shown to be most critically dependent upon hot rolling, finishing temperature, speroidizing treatment and subsequent deep drawing temperature. These processing variables influenced drawability as indicated by their effect upon strain ratio ($R_\theta = \varepsilon_w / \varepsilon_t$) measured at an angle θ to the rolling direction, the average normal anisotropy ($\bar{R}$), the degree of planar anisotropy (ΔR) (susceptibility to "earing"), and the brittle-ductile transition temperature. Drawability was shown to increase as $\bar{R}$ increased. However, $\bar{R}$, ΔR and R45 were shown to be linearly related. Consequently, as drawability increased, that is, $\bar{R} > 1$, susceptibility to earing also increased, that is $/\Delta R/ > 0$. Values of $\bar{R}$, ΔR, R_θ yield strength, ductility and brittle-ductile transition temperatures for optimum drawability are presented.

TITLE: Ductility of Refractory Metals Through Thermal Techniques
AUTHOR: BYNUM
Army Missile Command

ABSTRACT: This paper describes the effects of various vacuum heat treatments on the room-temperature ductility and tensile strength of commercially pure tungsten and molybdenum wires. The four variables considered were heating rate, temperature, time at temperature, and degree of vacuum.

When molybdenum wires were heated to 3600°F and immediately cooled in a vacuum of approximately 5×10^{-3} torr, the resulting room-temperature ductility exhibited dependency on the heating rate for the last heating cycle in a multicycle process. Rapid heating rates yielded the greater ductility. The heating rate-ductility dependence was not evident in a higher vacuum of approximately 2×10^{-5} torr.

TITLE: Hydrodynamic Elastic Plastic Theory and Plane Shock Waves in Metals
AUTHOR: PEARSON
Feltman Research Laboratories

ABSTRACT: It is noted that plastic shock waves with finite shock front thicknesses can occur in metals. The problem of experimentally determining the pressure P and the deviatoric stress S'_{11} behind a shock front in a metal is then considered. First a reasonable model for the strength of a metal which has been shocked is given. Then the experiments necessary to determine both P and S'_{11} are given. And finally it is shown how the information obtained from these experiments can be used to determine both P and S'_{11}. The difficulties inherent in the prediction of the work hardening produced by a plane shock wave and the following plane rarefaction wave are discussed, and alternate methods for calculating the plastic work produced in a shock front are given. The energy dissipation mechanism in powders and heterogeneous materials, which is essentially a geometric dispersion mechanism, is discussed. It is shown that, at least for geometrically simple materials, this geometric dispersion should be amenable to study with hydrodynamic codes. And hence if the equations of state of the constituent material or materials are known, then the Hugoniot of the powder or heterogeneous material can be determined. The invariance of the Hugoniot with respect to the scale of the inhomogeneity for materials in which the forces are essentially strain rate independent is noted. A simple treatment of the thermalization of the turbulent energy which results from the geometric dispersion is given.

TITLE: Large Deflections of Thin Shells of Revolution
AUTHOR: MESCALL
Army Materials Research Agency

ABSTRACT: A numerical procedure has been developed for the solution of the nonlinear differential equations governing the large axisymmetric deflections of thin shells of revolution. The principal advantages of the specific technique are that it makes modest demands upon the memory and speed of a digital computer, while at the same time it permits development of solutions in the so-called post-buckled range of the load-deflec-

(Continued on page 48)

Army Science Conference Technical Papers

(Continued from page 47)

tion curve. These solutions are new and exhibit some interesting and unexpected features.

Large deflection theory and therefore nonlinear equations need to be considered as soon as the deflections are of the same order of magnitude as the shell thickness. Although attention is focused on those problems whose solution may lead to further illumination of the buckling process itself, nonetheless these problems have very definite practical applications in missile and spacecraft design. Among the problem classes discussed in detail are those of concentrated and distributed loads on spherical shells with a variety of boundary conditions.

TITLE: Kinematics of a Tracking Gimbal
AUTHOR: GANNETT
Future Weapons Office, WECOM

ABSTRACT: This paper presents formulas for angular displacements, velocities, accelerations, and torques required about the individual axes of a two-axis gimbal system in which a tracking device swivels universally in error-free tracking of any specified tactic of an unaccelerated target. These formulas apply, for example, to missile and satellite trackers, theodolites, optical sights of weapons, and - by extension - to the weapon itself, displaced through a lead angle.

The target can move in any direction through space, air, water, or on the ground. The gimbal system is carried on an unaccelerated platform and the pintle may be oriented any fixed spatial direction. The effect of target tactics on the choice of gimbal orientation is discussed, particularly in its effects on smoothness and speed of tracking.

TITLE: On a Relationship Between the Errors of Position, Velocity, and Acceleration
AUTHOR: SCHMIDT
Army Research Office - Durham

ABSTRACT: A basic requirement in flight testing is the determination of the position, velocity, and acceleration of an object at discrete points of its trajectory. Very often it is also necessary to obtain these three quantities (position x, velocity $\dot{x}$, and acceleration $\ddot{x}$) with prescribed precisions σ_x, $\sigma_{\dot{x}}$, and $\sigma_{\ddot{x}}$. It will be shown that, for an arbitrary trajectory based on position determination, the dimensionless expression $\sigma_{\dot{x}} / \sqrt{\sigma_x \sigma_{\ddot{x}}}$ must be of the order of one. The important consequences of this observation are:

Desired precisions in all cases, in which the measuring systems determine initially the position, can be prescribed for only two of the three quantities, position, velocity and acceleration. The precision of the third quantity follows then from the above relation. If, from other considerations, the three quantities have to be obtained with precisions for which the above relation does not hold, then it will be necessary to employ auxiliary measuring systems (Doppler or telemetry) to fulfill those requirements.

It should be mentioned that the given dimensionless relation is not only valid for the polynomial moving arc technique, but was found to hold also for approximations by spline-curves or Fourier series.

TITLE: Precision of Measurement, Accuracy and Procedures for Detecting Outlying Observations
AUTHOR: GRUBBS
Ballistic Research Laboratories

ABSTRACT: Precision and accuracy of measurement are defined and discussed in terms of their statistical properties relating to the standard deviation, bias, variable bias and measurement error probability distributions. Precision depends on the reproducibility of the measurements and may be generally characterized by the standard deviation of the errors of measurement. Accuracy, on the other hand, has to do with

(Continued on page 49)

Capabilities of Reservists Typified by ASC Attendees

(Continued from page 3)

also was a 1938 winner of the Kiwanis Gold Medal for Sculpture.

Col Humphreys has patents on designs of medals for the annual Commanding Officer's Awards at ERDL for scientific, technical and leadership achievements, and has had a number of commissions for sculptural design. One of his enthusiastic support efforts is in junior baseball and he had been president of the River Farm Baseball Boys Club for the past 13 years.

Col Humphreys started his Army career at the Engineer R&D Laboratories as an enlisted man in 1941, was commissioned July 7, 1942, and returned to the Laboratories following World War II. Assigned at first as chief, Camouflage Branch, he has remained there continuously for the past 19 years.

The range of Col Humphrey's outside activities might make him suspect of having found the secret of crowding 36 hours into a 24-hour day. Among the honors he has earned are listing in the 1949 supplement of *Who's Who* and in *Who Knows and What*, Corps of Engineers candidate for the William A. Jump Award in 1949, 1960 "Citizen of the Year" award for Mount Vernon and Lee Districts of Fairfax County, Va., ERDL candidate for the Civil Service League Award in 1956, ERDL candidate for Rockefeller Public Service Award in 1958, member of the NATO, Library Panel of Experts, and membership on numerous Army committees.

DR. LEWIS BERNER is a member of the 3355th R&D Unit and has been associated with it ever since it was established in 1948. For the past five years he has been commanding officer of the unit, and it would be hard to find a man more enthusiastically committed to its purpose.

As chairman of the Department of Biological Sciences and professor at the University of Florida, where he has been a member of the faculty continuously since returning in 1946 from World War II, Dr. Berner is fairly typical of other Reserve R&D Unit members who hold responsible positions in academic institutions.

During World War II, Dr. Berner served three years in Africa, most of the time in Ghana. In 1950 he was asked to return there to make a study of medically important insects on the Volta River and the possible effects of impoundment upon them.

The primarily malarial control study was made for the Economic Cooperative Agency under the Marshall Plan.

In 1952, at the request of the British Government, Dr. Berner returned to Africa for another study on medically important insects in Nyasaland.

Presently Dr. Berner's research activities are hampered by the press of his administrative responsibilities. Still he takes time to continue studies on aquatic insects and has been supported for about 10 years by grants from the National Institutes of Health and the U.S. Public Health Service.

An explanation for his 5-year tenure as commander of the 3355th R&D Unit may be found in the esteem he has for its members, most of whom have PhD degrees and are faculty members at the University of Florida. Those who do not have PhD degrees, he explained, are nearing that goal.

The members are representative of a broad spectrum of research interests and scientific disciplines. About half of them are in biochemistry, computer science, nutrition, geography and engineering. Maj Gen Louis O. Graveley is an attorney, one of the few members of the unit not directly in science.

USAR R&D Unit members present at the Army Science Conference indicated that they believe the "standby in depth" program is again on the upswing after a decline in membership partially attributable to the normal attrition of retirements, "too old," deaths, etc.

"What the units need, and we are working hard on it," one of the members said, "is an influx of fresh young blood, the bright young men who are graduating in the science and engineering fields. But we have to be able to offer them something to flag their interest, something more attractive than is currently available, something that will utilize their talents productively and recognize them for achievements."

About one thing those at the conference left little room for doubt. In their opinion, Lt Col Lester is providing the enthusiasm that is giving their interest a "real shot in the arm—he's one of the greatest."

Now let's take a once-over-lightly look at the professional background of other Reservists who participated in the Army Science Conference.

COL PAUL J. WUEST, 2101st R&D Unit, State College, Pa., is a research scientist in the Buckhout Laboratory, Penn State University, where he earned BS and PhD degrees. His primary interest is the study of plant

(Continued on page 50)

Army Science Conference Technical Papers

(Continued from page 48)

closeness of the measurements to the true value, and hence depends on both the standard deviation of the errors of measurement (precision) and the amount of bias. Accuracy requires precision, but precision does not necessarily imply accuracy. An example is given on a procedure for estimating precision of measurement and product variability.

An optimum procedure and a rapid procedure for detecting a single outlying observation in samples are given and discussed, considering the importance of physical grounds for action as compared to statistical criteria. The statistical theory is illustrated with an example on tensile test specimens.

Procedures for detecting two or more outlying observations with necessary tables and illustrative examples are available as indicated in Section 8 of the paper.

TITLE: Examination of the Fatigue Life Characteristics of Large Caliber Gun Tubes

AUTHORS: WEIGLE, DAVIDSON, AUSTIN, and REINER
Benet R & E Laboratories

ABSTRACT: The accepted philosophy of gun tube design has been predicated on the assumption that normal wear and erosion would result in unacceptable accuracy performance long before a catastrophic fatigue failure occurred.

Two current trends in weaponry have necessitated a critical re-evaluation of this hypothesis. First is the trend toward lighter weight, which means operating at higher stress levels than in the past; and second is the introduction of additives to ammunition propellants resulting in a reduction in wear rate.

Concern over the significance of the above developments and their effect upon weapon life limits has resulted in the undertaking of an intensive study of the subject of fatigue characteristics of gun tubes. Described are the techniques utilized, typical results and their implication in terms of current condemnation criteria.

TITLE: Minimum Weight Design for Composite Tubes

AUTHORS: ZWEIG and PASCUAL
Watervliet Arsenal

ABSTRACT: A thick-walled cylindrical tube consisting of a liner and jacket of dissimilar materials is investigated to determine minimum weight for entirely elastic response to any required maximum internal working pressure.

The stresses in both liner and jacket are evaluated for various assumed fabrication techniques. The dimensions of the liner and jacket are then optimized for minimum weight subject to the restriction that these stresses, whether caused by pressurization or by residual strains due to fabrication, not exceed the accepted maximum levels.

The analysis results are evaluated using physical constants appropriate for a steel liner and fiberglass composite jacket. Significant weight savings for this combination of materials are indicated when compared with an all steel tube.

TITLE: Detection and Identification of VT Fuze Shells

AUTHOR: STIBER
Army Electronics Command

ABSTRACT: The VT (variable time) fuze, sometimes called the proximity fuze, was extensively used in World War II and in Korea as a means of increasing the "killing" power of artillery fire.

In order to affect countermeasures, that is, either nullify the ability of the fuzing system to range on its target, or reduce the accuracy of its ranging device, it is first necessary to detect, then identify the use of fuzed shells, and finally to identify the fuze type. The problem is further aggravated by the dense signal environment in which the fuze signals are generally found and also by the VT fuze char-

(Continued on page 50)

Army Science Conference Technical Papers

(Continued from page 49)

acteristics which can be quite similar to some of the signals found in that portion of the radio frequency spectrum.

This paper describes a program conducted by the U.S. Army Electronic Command to determine techniques for detecting, recognizing and identifying by type, proximity fuzed shells fired by opposing artillery. Considerable data was compiled using several different types of sensors. The data from these comprehensive studies and field tests form the basis for the design of an automatic intercept system.

TITLE: Asymptotic Analysis of the Axisymmetric Vibrations of Shells
AUTHOR: ROSS
Army Materials Research Agency

ABSTRACT: Up to the present time little of a general nature has been known about the solutions of the equations of shell vibration. In this paper, an asymptotic analysis is carried out for axisymmetric shell vibrations and clarifies our understanding of these problems in several ways. First, simple approximations are found for all six solutions of equations. Second, certain critical points, called transition points, are seen to play a central part in describing the character of the solutions. Except near the transition points, the six solutions can be classified as four solutions in which bending is the primary mechanism and two in which stretching action dominates. At the transition points, this classification fails, and exchange of energy between bending and stretching action is possible.

TITLE: Ballistic Behavior of Ceramic Composite Armors
AUTHOR: SEMPLE
Army Materials Research Agency

ABSTRACT: The ballistic protection provided by various metallic and ceramic armors against caliber .30 armor-piercing projectiles is reviewed. The influence of ceramic mechanical properties (hardness, elastic constant, and strength) upon the gross ballistic behavior of ceramic armor face plates is presented. Ceramic composite armor design considerations, such as tile size effects, backup materials, stress wave behavior, and the utilization of merit ratings for design estimates, are presented. Preliminary ballistic test results of several new ceramic armors and potentially promising areas of armor materials research are also briefly discussed.

TITLE: A New Concept in Lightweight Armor - Dual-Hardness Steel
AUTHOR: SLINEY
Army Materials Research Agency

ABSTRACT: This paper deals with the original concept leading to the development of a new lightweight, metallurgically bonded, composite steel armor. The mechanism of projectile fracture by the use of a high hardness frontal material, which in turn is restrained from fracturing by a lower hardness backup material, is described. Alloy selection, development of laboratory processing procedures, and the translation of these processing procedures to mill production are presented. The utilization of this material for protection on both ground and air vehicles in Southeast Asia is discussed. Areas of future work on these metal-metal composites are indicated.

TITLE: The Influence of Quality Upon Effectiveness of Shaped Charged Warheads
AUTHORS: EICHELBERGER and VITALI
Ballistic Research Laboratories

ABSTRACT: The variation in effectiveness of shaped charge warheads, against heavily armored vehicles, as a result of changes in quality control during manufacture, has been analyzed. The basis of the study is the computer model of armored vehicle vulnerability developed at the

(Continued on page 51)

Capabilities of Reservists Typified by ASC Attendees

(Continued from page 49)

diseases and he would like support to continue these studies and to branch out into investigation of certain areas of aerospace.

CAPT ANDRES LLANA, Jr., 1001st R&D Unit at Boston, Mass., studied biology and psychology at Temple University in Philadelphia, graduating with a BS degree, and is presently employed by the Univac Corp. As a USAR R&D member, he would like to work on a project using his knowledge of computers.

COL GUSTAV E. CWALINA, 5055th R&D Unit, is assistant dean at Purdue University, where he began as a professor. Graduated from the University of Maryland with BS, MS and PhD degrees, he studied pharmacy, chemistry and medicinal chemistry. He has supervised sanitation projects for the Army while on active duty.

LT COL HOWARD A. MORRIS, 5007th R&D Unit, University of Minnesota, is a professor and research scientist. His primary area of interest at the University of Minnesota is research on food enzymes, the palatability of food, and food preservation. He received a BS degree from Utah State University and MS and PhD from Minnesota.

LT COL WILFORD GIBBS, 4004th R&D Unit, is a professor at Texas A&M College, where he received BS and MS degrees. As a research scientist, he is interested principally in entomology and veterinary medicine.

LT COL CALVIN W. VRIESEN, 2199th R&D Unit, is a research scientist with Dupont de Nemours and has also worked with the Thiokol Chemical Corp. His specialty is investigation of synthetic elastomers and polymers. His BS and MS degrees are from the University of Minnesota and his PhD is from Purdue University.

CAPT EDMOND D. NEUBERGER, 2201st R&D Unit, Pittsburgh, Pa., is a researcher with Calgon Corp. and began his studies on analytical instrumentation at Fisher Scientific Co. following graduation with an ME degree from the school of engineering at Stevens Institute of Technology.

LT COL JOSEPH TOBIAS, 5000th R&D Unit, University of Illinois, is an associate professor and a research scientist in food preservation. His BS degree was earned at the University of Georgia and MS and PhD degrees from the University of

Illinois in dairy husbandry and technology.

LT COL CONARD A. BLOMQUIST, 5008th R&D Unit, University of Illinois, is assistant dean of the University. He obtained his BS, MS and PhD degrees from the University, specializing in zoology, his major research interest.

COL HARRY L. WILLARD, 1332nd R&D Unit, New York City, is Assistant to the Vice President for Research and Development, Union Carbide Corp. A Mellon Institute Fellow, he received a BS degree in chemical engineering from the University of Pittsburgh and did graduate work in chemistry at the University of Pittsburgh and did graduate work in chemistry at the University of Pittsburgh and in law at Fordham and at George Washington Universities.

LT COL EDWARD B. WILLIAMS, 2384th R&D Unit, Dayton, Ohio, received his higher education at Virginia Military Institute. His professional career is concerned with engineering management and control and he is the second senior engineer of the Veterans Administration, currently assigned to Dayton, Ohio.

LT COL EARNEST F. GLOYNA, 4015th R&D Unit, is a professor at the University of Texas, where he is also director of the Environmental Health Engineering Research Laboratories and of the Center for Research in Water Resources, as well as chairman of the Radioisotopes Committee. He earned BSCE and MSCE from Texas U. and his PhD degree in sanitary engineering from Johns Hopkins University. His chief research interest is in this field.

COL WALTER H. SCHAEFFER, 6155th R&D Unit, is a professor in fire control at the University of Washington. He studied forestry at that institution and at Yale University, where he earned his MS degree. His BS and PhD degrees were earned at the University of Washington. His main research interest is combustion and the effect of weather upon fire danger.

LT COL PAUL L. HAYES, 6159th R&D Unit, Pasadena, Calif., is a self-employed geologist and serves as a consultant. Most of his technical publications since he was graduated from the University of California at Los Angeles have reported on his work on earthquakes.

LT COL HARRY B. GOODWIN, 2396th R&D Unit, Columbus, Ohio, is a metallurgical researcher at Battelle Memorial Institute. His degrees in metallurgy are from Massachusetts Institute of Technology.

(Continued on page 59)

Army Science Conference Technical Papers

(Continued from page 50)

Ballistic Research Laboratories. Experimental data representing the penetrations and hole profiles, in infinite steel targets, produced by changes of the same design, but two different sets of tolerances have been obtained. The experimental data are used to synthesize performance data representing the behavior of individual rounds of specified quality, and the effectiveness of these rounds are determined. These data are then used to synthesize performance data representing "production" lots of warheads for a number of tolerance specifications, and an average effectiveness has been determined for each lot.

TITLE: Chemical Laser Pump
AUTHOR: WRIGHT
Feltman Research Laboratories

ABSTRACT: Solid-state lasers are pumped by the light emitted during a chemical reaction. The sharply defined bright zone produced by the detonation of a cyanogen-oxygen mixture in small test vehicles looks promising as a pump with military applications.

This cyanogen-oxygen system is the only one which has directly non-destructively pumped a neodymium-doped glass laser. Recent data show that pump light outputs approaching those necessary for pumping a ruby laser are being attained.

Extensive experimentation with test vehicles to control the detonation wave has improved the brightness and duration of this source. The light-producing reaction can be controlled and perhaps tailored to a particular application. Comparisons are made with other pumping systems such as shock tube techniques and electronic methods.

Possible applications include the development and use of a high energy pump to replace the huge electronic power supplies presently required to pump a high energy laser rod configuration.

TITLE: Novel Laser System Using Very High Magnetic Fields From Superconductors.
AUTHORS: GAULÉ, BUSER, SHAJENKO, and ROSS
Institute for Exploratory Research, ECOM

ABSTRACT: Classified.

TITLE: Development of a Formula for Towing Resistance for a Wheel in Soft Soil
AUTHOR: McRAE
Engineer Waterways Experiment Station

ABSTRACT: The dimensional analysis and the geometry and free-body considerations followed in developing a dimensionally correct formula for approximating the towing resistance for a rigid wheel are first presented. A method, called the moving chord concept, for handling the geometry of the complex phenomenon relating to the configuration of a pneumatic tire in soft soil (based on experimental evidence) is then presented. And finally, a semiempirical formula is developed that satisfies quite effectively a wide range of tire sizes, wheel loads, and tire deflections in two extremes of soil type, namely cohesionless dry Yuma desert sand and highly plastic Louisiana buckshot clay.

The developed formula is $P_T = 3(Wz/\ell)^{0.8}$ where P_T is towing force, W is vertical load, z is sinkage, and ℓ is the horizontal projection of the center line of tire contact area in the direction of travel.

TITLE: Application of Quantified Terrain Data to Vehicle Design Criteria
AUTHOR: ANSTEY
Natick Laboratories

ABSTRACT: Results reported in this paper summarize an extensive analytical study of terrain data from one desert landform type, alluvial fans. The purpose of this study was to develop methods for collecting and using

(Continued on page 52)

Army Science Conference Technical Papers

(Continued from page 51)

significant terrain data for design criteria. Terrain microgeometry was analyzed to determine the nature of critical configuration affecting standard vehicle performance factors. Over 4,000 alluvial fans were measured by photogrammetric means for this study. From the results of this study, a method is suggested for determining the frequency of occurrance of important physical characteristics of representative landform types on a regional basis. Design and experimental performance data are given for several classes of wheel and track vehicles relating to environmental conditions. The lack of agreement between presently published vehicle performance data, standardization objectives, and off-road terrain geometry is described. Field trials of previous designs, based on environmental estimates rather than an assessment of landforms are discussed. The current lack of quantified data for many types of landforms precludes the development of realistic vehicle design criteria. Measurements of alluvial fans, the most common terrain feature in the desert regions of the United States, show that quantified descriptors may be developed for any type of landform. Quantified terrain data may be applied directly to revisions of AR 705-15, Military Standards, and specifications for testing military equipment.

TITLE: Theory of Human Vibration Response
AUTHORS: PRADKO, LEE, and KALUZA
Army Tank-Automotive Center

ABSTRACT: Analytical and experimental studies of whole body human dynamics under random vibration are presented. A previously unreported "absorbed power" is developed through the application of transfer functions. This method is applicable to assess the effects of stationary and non-stationary vibration records. It is equally effective for synthesis or analysis. The linearity of human response to vibration is established on a qualitative basis.

Examination of the "absorbed power" criteria indicates advantages not present in the acceleration measurement. "Absorbed power" is a scaler quantity which may be described by magnitude only. It is additive and may be summed in multi-degree-of-freedom environments.

"Absorbed power" does not require frequency spectrum analysis. Optimization studies involving human dynamics may be conducted conducted continuously without the time lapse that occurs for frequency spectrum analysis. The findings of this research indicate with substantial credence that "absorbed power" and transfer function techniques may provide the basis for a universally usable human vibration measurement method which shall be applicable to air, sea, and land transportation media.

TITLE: Walking Machine Studies
AUTHOR: LISTON
Army Tank-Automotive Center

ABSTRACT: In general, land vehicles developed for operation in off-road conditions represent modifications of highway vehicles. Almost without exception, highway and off-road vehicle designs utilize the wheel as the basic suspension element. Tracked vehicles are nothing more than wheeled vehicles which carry an artificial roadway to modify soil or terrain conditions to fit the requirements of the wheel. Using nature as a guide, it is proposed that the wheel may not be the proper basis for the development of an off-road vehicle form. Nature has produced a highly effective series of "vehicles" that can operate in terrain conditions which are totally inaccessible to man-made vehicles. Nowhere in nature do we find an animal which utilizes the wheel or any derivative of the wheel. Although a wide variety of leg forms and numbers exist in creatures ranging from insects to the human, the leg is the basic natural mechanism for locomotion.

Studies which attempted to develop devices to utilize walking, creeping, crawling, or leaping modes of locomition are discussed. The walking mode has proven to be the most useful and has received primary

(Continued on page 53)

ASC Panel Considers Practical Relevancy of Basic Research Efforts

How much money should be spent for Army basic research in ratio to the total cost of military materiel development? Where can basic research best be conducted? To what degree should it be Army mission-oriented? What truly practicable guidelines can be established to assure a reasonable return for the tax dollar?

These were some of the major questions considered at the 1966 Army Science Conference by the 8-member panel of distinguished leaders during a 4-hour discussion of "Basic Research and Practical Relevancy" at the United States Military Academy, June 14–17.

Dr. Frederic Ancrum Lord Holloway, president of ESSO Research and Engineering Co., chaired the discussion. He suggested at the outset that the topic might perhaps be stated more specifically: "Should the Department of the Army Carry out Basic Research or Should It Leave This to Someone Else?"

Reformulation of the topic, he explained, might be in order in view of the Army being, by necessity, a mission-oriented organization, with a very specific mission aside from the broad advancement of scientific knowledge through its R&D programs. Then Dr. Holloway asked:

"Have members of the panel made any studies of the extent to which research and new scientific knowledge have contributed to weapons development, and if so, what has been the overall contribution of research and science to this development, and how long has it taken the basic research to reach practical relevancy?"

In response, Deputy Director of Defense Research and Engineering (Research and Technology), Dr. Chalmers W. Sherwin, reported on studies of case histories made by the Department of Defense on the chain of events leading to major weapons systems.

An Army team, Dr. Sherwin said, "did an unusually careful job on the Lance missile system. They picked up 111 research and exploratory development events which make it a much higher precision system . . . compared to the Honest John or Sargeant missiles of a previous generation, roughly 10 to 15 years ago."

Dr. Sherwin said that the studies, conducted under the code name of Project Hindsight, have shown that the "events that make weapon systems better come in large bunches. The weapons are not improved by single items but by many, typically 50 or 100, as in the case of the Lance."

In support of the requirement for Department of Defense motivation of research and development leading to new weapon systems, Dr. Sherwin observed that studies of 15 systems showed that 86 percent of the "events" considered responsible for it were financed by the DoD directly, either by contract or done in in-house laboratories.

Nine percent of the events were industrial with a defense need as a clear target, he said, raising the total financed by DoD to 95 percent. Dr. Sherwin continued:

"Just to give a feeling of the fact that the technology which we use is indeed financed by defense money—this is a very important point which we have never been quite sure of—there appears to be little fall-out from non-defense industry in the cases studied. We got only two percent of these events from non-defense industry, general industry.

"I think the reason is that defense industry needs our highly oriented specialized work, and the fall-out is in the other direction, probably. I am sure industry has made more applications of defense discoveries than the reverse. . . ."

Regarding the "target" of events leading to weapons systems, Dr. Sherwin said the studies showed that 58 percent had as the motivation a specific concept of a defense system, and 23 percent were clearly aimed at a generic defense need, such as high-power radars.

In general, Dr. Sherwin was of the opinion that results of undirected research in the U.S. are not feeding rapidly into the improvement of defense systems, except in a few special areas. He added that "recent undirected science appears to have a very slow feed-through." Ninety-five percent of the events leading to new systems were traced to research done before 1930.

The last great undirected event in nuclear weapons, he said, was the discovery of fission in 1939. Since then the progress that has made nuclear weapons better has been almost entirely the result of directed effort, that is, Government-supported.

Two areas of exception to the record of slow feed-through of research,

(Continued on page 54)

Army Science Conference Technical Papers

(Continued from page 52)

attention during the past five years. A review of the walking machine program is presented and future potential of various forms of walking machines is discussed. It is shown that a walking machine may seem a bizarre vehicle but is, in fact, a practical machine having the potential of providing excellent off-road performance.

TITLE: Pattern of Physiological Variables in Slow Blood Loss Shock
AUTHOR: STECHER
Department of Neurophysiology, WRAIR

ABSTRACT: A new method of studying the effects of hemorrhage has been devised in monkeys to induce a progressively developing shock state. In chronic experiments, animals are extensively instrumented, placed in primate chairs, and bled slowly.

A study of the sequential changes in physiological variables reveals that heart rate remains stable early in bleeding, then gradually increases to a peak value with further blood loss, and remains at this level until the animal appears terminal. Arterial blood pressure (ABP) remains essentially at control level as the heart rate increases and then begins to fall as the rate approaches its peak. A graph of ABP fall is not smooth, but is characterized by graded drops with plateaus separating further falls. Late in hypotension (e.g. systolic 60 mm Hg) a "second wind" phenomenon of ABP is found, in which pressure spontaneously rises 20 to 50 mm Hg though the bleeding process continues. Respiratory rate remains at control levels until blood pressure falls, then increases markedly.

Several clinical applications of these findings should be noted: first, the physician cannot follow a patient adequately by blood pressure alone; second, heart rate changes should be watched carefully as another indicator or an approaching shock state; third, respiratory rate is a valuable tool in observation of these patients.

TITLE: *Anopheles* Vectors of Malaria in Southeast Asia
AUTHORS: GOULD, SCANLON, and WARD
SEATO Medical Library

ABSTRACT: In the past year malaria has re-emerged as a vital medical problem for the U.S. Army, due to the appearance of strains of *Plasmodium falciparum* in Southeast Asia which are resistant to some or all of the standard synthetic anti-malarial drugs. Much of this malaria is transmitted by *Anopheles* species in the forested hills of Vietnam. Research in similar habitats in Thailand since 1963 has revealed that a little-known species, *Anopheles balabacensis*, is a highly effective malaria vector in the jungles. It was found to be highly anthropophilic and frequently infected with malaria parasites. This species appeared to be the vector in three episodes where members of the field team were infected with drug-resistant malaria. Three other *Anopheles* appeared to be of actual or potential importance as vectors in various habitats in Thailand and presumably in Vietnam. These are: *Anopheles minimum*, *sundaicus* and *maculatus*.

Strains of simian malaria have now been found in Southeast Asia which can infect man by mosquito bite in the laboratory and in the field. The meaning of this observation for military medicine is still unclear. Human malaria parasites have also been adapted to the gibbon in preliminary attempts to develop an experimental model for study of SE Asian malaria strains.

TITLE: A Mathematical Model for Air Flow in a Vegetative Canopy
AUTHOR: CIONCO
Atmospheric Sciences Research Division, Fort Huachuca

ABSTRACT: The present concepts describing the wind profile and turbulent transfer in the surface layer are inadequate when the underlying surface is vegetated. This is especially true when transfers within the vegetative canopy must be considered. Thus the objective is to investigate the wind flow and the turbulent transfer of momentum within vegeta-

(Continued on page 54)

Army Science Conference Technical Papers

(Continued from page 53)

tive canopies and to develop a mathematical model which expresses the aerodynamic roughness effects in terms of height, density, and drag characteristics of the vegetation. The present model reflects theoretical and empirical aspects of two previous studies and more recent canopy observations. The solutions show that the mixing length is nearly uniform with height throughout the canopy and that it increases linearly with height above the vegetation. The investigation also shows that for semi-rigid canopies of uniform distribution, the wind increases exponentially with height within the canopy and logarithmically above the canopy. The model results compare favorably with observations within a cornfield and a simulated canopy in the wind tunnel. Other investigators have since found exponential profiles in a variety of canopies and it is believed the above findings have an application to a fairly large class of vegetated surfaces.

TITLE: Real-Time Meteorological System for Support of Unguided-Rocket Firings

AUTHOR: DUNCAN
Atmospheric Sciences Office, WSMR

ABSTRACT: A real-time meteorological system used for meteorological support of the Air Force Athena unguided rocket firings is discussed. Both the data collecting equipment and the real-time computer program are discussed.

Four data collecting systems are employed for wind instruments by the real-time system. A meteorological tower is used for measurements in the first five hundred feet; for measurements from 500 to 10,000 feet, a triple optical theodolite system is used to track a pilot balloon; the GMD-1B and the Loki rocket are used for measurements from 10,000 to 250,000 feet. Data from the tower and theodolites are transmitted to the computer via a real-time data link; data from the radio-sonde and rocket are field reduced, transmitted to the computer by telephone, and inserted into the computer through peripheral equipment.

The computer program runs under the supervision of a real-time monitor which determines servicing priorities for the various processors. The processors edit, smooth, reduce, and assess the incoming data and update the wind profile when required. When a new wind profile is acquired, or when instructed by the operator, the required launcher settings are determined by an iterative process using a five-degree-of-freedom simulation model.

TITLE: The Possible Military Significance of Contaminants Found in Tropical Atmospheres

AUTHOR: HUTTON
Tropic Test Center

ABSTRACT: Surfaces exposed to the atmosphere, particularly in forested areas, quickly acquire a visible layer of contamination. The accumulation of contamination is more rapid than one would expect, considering the fact that the measurable dust loading of the tropical atmosphere is relatively light.

Data illustrating this observation, together with quantitative analyses of microbial, chemical, and particulate matter found in tropical atmospheres, are presented. Data presented show how microbial and chemical content of the atmosphere is influenced by region, season, and distance from ground level. The high microbial populations present in air in dry seasons are reduced in numbers when rains begin. Air samples are significantly low in hydrogen sulfide and sulfuric particulates. Gaseous aldehyde levels are high. The data are used to show the possible role of air contamination in the much discussed but little understood phenomenon of accelerated materials deterioration encountered through tropical areas.

TITLE: Advanced Combat Surveillance Radar System

AUTHORS: FISHBEIN and RITTENBACH
Combat Surveillance and Target Acquisition Lab

ABSTRACT: Research efforts at USAECOM have demonstrated that a contin-

(Continued on page 55)

ASC Panel Considers Practical Relevancy of Basic Research Efforts

(Continued from page 53)

as cited by Dr. Sherwin, are in solid-state electronics and in information theory. Solid-state electronics have been applied to "practically every recent system that the Defense Department has."

Information theory, regarded by some as an engineering science, has had "a very large impact on the processing of information in defense—gun-directing, signal-coding, the whole area."

Dr. Sherwin said a possible remedy for solving the problem of more rapid feed-through of research results for application to defense needs is "that the Government, and I think that the Defense Department could properly do it as well, should finance a great deal more of organizing recent science so that engineers can use it."

The next speaker was Dr. Francis Daniels Moore, Moseley Professor of Surgery and Surgeon-in-Chief at Peter Bent Brigham Hospital, Harvard Medical School. He stated that results of research in the biological sciences are, for the most part, given practical application in a relatively short period of time.

As examples, he cited the development of numerous new products to meet the requirements of the Army's "very interesting and very large" biomedical mission, including personnel performance, care of the wounded, prevention of disease, and development of defense and other aspects of biological warfare—"such a big platter of human biology that just about anything that is true is relevant."

Dr. Moore quoted one of his Harvard Medical School associates as perhaps stating the case on behalf of a strong basic research program supported by the Army when he said: "The most practical thing in the world is sound fundamental research."

In support of his contention that the lead time from discovery of new fundamental knowledge to practical application is relatively short in the biological research field, Dr. Moore cited John Enders' research leading to cultivation of the polio virus—hence in "a very short time" the development of the Salk polio vaccine.

Other examples cited by Dr. Moore included a 1959 discovery that led to

the human kidney transplant technique in two years, and the discovery of a bread mold that led to synthesis and the mass production of penicillin in a few years.

Dr. Lawrence Randolph Hafstad, vice president of General Motors Corp. and director of GM Research Laboratories, discussed the policy of GM with regard to trying to program research with the expectation of early payoff. For industry, he said, the problem of wise programing of research is invariably associated with unavoidable uncertainties as to the payoff.

Dr. Hafstad, however, emphasized that for the specialized objectives of industry, the problem of practical programing of research is not usually as complex and difficult of managerial solution as it is in the Army—which necessarily must be concerned with a very broad spectrum of scientific disciplinary areas.

The Army, Dr. Hafstad said, must be continuingly and deeply in support of academic research that is mission-oriented to military materiel requirements. Pointing to the rather large-scale dependence of industry upon academic scientists as consultants, he held that a much more effective interface between basic research at Army in-house laboratories and the general scientific community must be established and maintained.

Prominent in presentation of views on what is "a reasonable amount, a wise amount of effort in basic science," was Dr. William Oliver Baker, vice president for Research of Bell Telephone Laboratories, and selected in 1954 as one of the top scientists in U.S. industry.

In consideration of "What is the right amount to invest in basic research?" Dr. Baker said the hard part is investing wisely "to make available the required technology when it is really needed."

National Science Foundation Associate Director (Research), Dr. Randal M. Robertson, held that consideration of how much should be invested in research, where and how, must be mindful of the question: "Is gross national product (GNP) likely to be adversely affected by inadequacies of basic research programs?" He continued:

"The United States can afford any scientific effort we are willing to make, although the shortage of highly trained scientists is a limiting factor. I don't believe we can afford to do less than move ahead in science as rapidly as we can. . . . I think this policy will pay off in many ways."

(Continued on page 56)

Army Science Conference Technical Papers

(Continued from page 54)

uous wave radar, i.e., a radar which puts out energy continuously rather than in short pulses, is particularly well suited to meet the requirements of combat surveillance. A design for a CW radar was developed and critical components experimentally evaluated.

TITLE: Polarization Sensitivities of Vehicles
AUTHOR: DUNN
Army Electronics Command

ABSTRACT: Experiments were conducted using several fixed linear polarization transmissions and rotational linear receive polarizations to determine if one vehicle could be distinguished from another by measuring the ratio of the single or triple bounced return energy to the double bounced return energy on a statistical basis. The targets used in this investigation were a 2½-ton Van Body Truck, a 3/4 -ton Weapons Carrier, and a civilian automobile. The vehicles were viewed by the radar at 16 aspects and the transmitted polarizations used were 315, 0, 45, 90, and 135 degree vectors. Polaroid photos were made of the polarization display and the amplitude of the returns were evaluated at 315, 0, 45, 90, and 135 degrees for each transmitted vector. The cross to parallel ratios were calculated and the results tabulated. Definite trends are present in the reduced data that indicate that vehicles may be classified by such a technique.

TITLE: A Proximity Fuze with High Immunity to ECM
AUTHOR: PEPERONE
Harry Diamond Laboratories

ABSTRACT: An introduction to the fuze-jammer tactical encounter problem is presented with a brief discussion of the implications concerning fuze CCM doctrine. A proximity fuze implementing this doctrine is described including the coding and decoding procedure, signal processing techniques and decision logic. Examples of the fuze's response to some representative jamming signals are given

---

TITLE: Directions to Advanced ECCM Techniques for Greater Reliabilities of Communications
AUTHOR: FUSCHETTO
Army Electronics Command

ABSTRACT: An Extended Range Phase Lock Demodulator and/or Second Order Frequency Modulation Feedback Demodulator offer one of several directions in the attainment of improved Electronic Counter-Countermeasures performance. These demodulators can be made compatible with modern and future tactical frequency modulation military communications equipment.

For the simulated narrow and wideband voice channels corrupted by thermal or gaussian noise, significant threshold extension was realized over a conventional demodulator. This extension in threshold resulted in a better output signal to noise ratio when compared to a conventional FM receiver employing bandwidth expansion. The threshold extension enables the receiver to remain linear for lower input signal to noise ratios and thereby enable greater reliability of communications in high noise environments which corrupt an FM receiver with unwanted interference.

The extended range threshold demodulators can be implemented with those anti-interference techniques which presently employ conventional demodulators in post anti-interference processing.

A Dead-Zone Weak Signal Processor, when coupled to the extended threshold demodulators was shown to provide high degrees of anti-interference immunity against practical FM jammers.

TITLE: Some Pharmacodynamic Properties of Iris Muscle
AUTHOR: WILSON
Medical Research Laboratory, Edgewood Arsenal

ABSTRACT: The mammalian iris responds to many "autonomic" drugs by dilation or constriction of the pupil. If the experimental conditions are controlled properly, this response can be made highly quantitative

(Continued on page 56)

Army Science Conference Technical Papers

(Continued from page 55)

both "in vivo" and "in vitro". Thus, the passage of volatile anticholinesterases and other drugs through the cornea can be measured.

An "isolated rat iris" preparation is capable of placing a series of cholinolytic agents in ranking order of effectiveness and to distinguish some kinetic differences even between isomers.

Contraction of the sphincter and dilator muscles is uniquely dependent upon cholinesters and sympathomimetics respectively, but acetylcholine definitely relaxes the "dilator pupillae". Sympathomimetics may do the same for the sphincter.

The overall control of pupil size is a direct function of the opposing tension in the two muscles but some differences in the response of "Albino" and "Hooded" rat irides reflect the genetic make-up of the two varieties.

TITLE: The Enzymic Transformation of Secondary Nitrogen Mustards: Implications in Respiration

AUTHORS: WILLIAMSON, KIRBY, SASS, and WITTEN
Chemical Research Laboratory, Edgewood Arsenal

ABSTRACT: Kinetic experiments with N,N-bis(2-chloroethyl)amine(nor-HN2) and related nitrogen mustards in biological media have demonstrated the presence of a hitherto unknown enzyme in human and animal blood serum that catalyzes the reaction between secondary nitrogen mustards and carbon dioxide to form substituted oxazolidinones. After injection into the bloodstream, these agents are rapidly transformed into compounds that cannot perform the alkylating reaction so characteristic of the nitrogen mustards. This phenomenon is of particular interest in the instance of certain secondary nitrogen mustards, such as 1,6-di-(2-chloroethylamino) -1,6-deoxy-D-mannitol (Mannitol Mustard), which an important role in cancer chemotherapy. Since this enzymic effect was previously unrecognized, re-evaluation of the pharmacologic data on such mustards is in order.

Interpretation of the kinetic data obtained indicates that this enzyme catalyzes carbamate formation - a reaction of importance for the transport of carbon dioxide in blood. It is unlikely that the in vivo action of this enzyme is limited to 2-chloroethylamines. More probably, it operates with naturally occurring amines as well, thereby serving an important function of carbon dioxide transport in the body.

TITLE: Persistence of a Pathogenic Microorganism as Affected by Soil Type and Climate

AUTHORS: LEVIN and ORR
Dugway Proving Ground

ABSTRACT: Persistence of certain microorganisms has been investigated with respect to artificially and naturally created aerosols, but little or no work has been done relative to persistence under natural conditions.

The physical and chemical actions exerted by solar radiation, temperature, degree of moisture, components of soil, etc., may be expected to have considerable effects on the survival of microorganisms. The susceptibility of different microorganisms to these effects cannot be predicted, primarily because of the paucity of information relating environmental factors to physiological and biochemical changes of the microorganisms.

As one step toward acquiring information on persistence of a pathogenic microorganism in nature, several soil types were inoculated and seasonal trials were conducted to determine rates of decay of virus. Relative effects of the various soils and conditions were evaluated and will be discussed.

TITLE: Regulation of Metabolism, In Vivo

AUTHORS: SACKTOR and WORMSER-SHAVIT
Medical Research Laboratory, Edgewood Arsenal

ABSTRACT: During the transition of a tissue from a resting to a working

(Continued on page 57)

ASC Panel Considers Practical Relevancy of Basic Research Efforts

(Continued from page 55)

A major role in the discussion was taken by Dr. Edward Gibson, who has served since 1948 as Director, Applied Physics Laboratory, Johns Hopkins University, Baltimore, Md. His major premise was that basic research people cannot live in an ivory tower, they must have an appreciation for the need of mission-oriented research, and that a practical interface between the academic and defense scientific communities is essential.

Dr. Gibson said one of the requirements is more consideration of the "thought to action axis." He explained that those who do a piece of significant basic research should be given more opportunity, when they express a desire, to see the idea put to work usefully and to understand better some of the engineering design and production factors involved in advancing a new concept to practical application.

Representative of the average general public attitude toward basic research was a man whose business is that of keeping a close watch on national developments and the reaction of the man in the street.

As editor of *The National Observer*, a Washington, D.C. newspaper reaching more than a half-million readers, William E. Giles contended that "the man in the street has a large reservoir of faith, of trust, in the knowledge, in the activity, in the experience, in the judgment of the people who are collecting and dispensing his money."

This trust and faith, he said, extends to the capabilities of the Nation's scientific leaders to cope with the problems of defense and the national economy as related to scientific discoveries and inventions.

Whenever Congress begins searching deeply into the question of whether the billions of dollars spent for research and development are being used wisely, Mr. Giles said, "the faith and trust of the man is deeply disturbed . . . and then you are in trouble, real trouble."

A strong and continuing case, based on solid results, must be made, he said, for defense of the money needed for basic research and for mission-oriented research.

Dr. Sherwin said the Department of Defense has planned and prepared for presentation to Congress a $20

million university basic research support program to support President Johnson's goal of establishing scientific "centers of excellence" throughout the Nation.

Dr. Harold C. Weber, presiding Chairman of the Army Science Conference, expressed appreciation to Dr. Holloway and members of the panel for presenting viewpoints of great interest and value to the Army scientific community.

SCIENTIFIC CALENDAR

Electron Spin Resonance Spectroscopy Conference, sponsored by ARO-D, AEC, ACS and Michigan State University, East Lansing, Mich., Aug. 1-3.

1966 Linguistic Institute Conference on Linguistic Method, sponsored by AFOSR, Los Angeles, Calif., Aug. 1-3.

3rd International Heat Transfer Conference, sponsored by AIChE, ASME and IEEE, Chicago, Ill., Aug. 8-12.

Annual Conference on Application of X-Ray Analysis, sponsored by the Denver Research Institute, Denver, Colo. Aug. 10-12.

11th International Symposium on Combustion, sponsored by Ballistic Research Laboratory and The Combustion Institute, Berkeley, Calif., Aug. 14-20.

Guidance and Control Conference, sponsored by AIAA, Seattle, Wash., Aug. 15-17.

Aurora and Airglow Conference, sponsored by OCRD and IIT Research Institute, Frascoti, Italy, Aug. 15-26.

7th Annual Joint Automatic Control Conference, sponsored by ISA, AIAA, AIChE, ASME and IEEE, Seattle, Wash., Aug. 17-19.

2nd Computer and Information Sciences Symposium on Learning, Adaptation and Control in Information Systems, sponsored by ONR, Battelle Memorial Institute and Ohio State University, Columbus, Ohio, Aug. 22-24.

Western Electronic Show and Convention, sponsored by IEEE and WEMA, Los Angeles, Calif., Aug. 23-26.

The Application of Generalized Functions to System Theory Conference, sponsored by AFOSR and Society for Industrial and Applied Mathematics, Stony Brook, N.Y., Aug. 25-26.

4th International Biometeorological Congress, New Brunswick, N.J., Aug. 26-Sept. 2.

2nd International Congress on Instrumentation in Aerospace Simulation Facilities, sponsored by IEEE, Stanford University, Calif., Aug. 29-31.

21st National Association for Computing Machinery Conference, Los Angeles, Calif., Aug. 30-Sept. 1.

Unguided Rocket Ballistics Conference, sponsored by ERDA, El Paso, Tex., Aug. 30-Sept. 1.

6th Western National Meeting of the American Geophysical Union, Los Angeles, Calif., early Sept. (date undetermined).

U.S. National Committee for Pure and Applied Biophysics in connection with 2nd International Biophysics Congress, sponsored by ONR, Virginia, Austria, Sept. 5-9.

Aerospace and Electronics Systems Convention, sponsored by IEEE, Washington, D.C., Sept. 12-14.

13th Annual Petroleum Industrial Technical Conference, sponsored by IEEE, Chicago, Ill., Sept. 12-14.

American Institute of Chemical Engineers Meeting, Atlantic City, N.J., Sept. 18-21.

1st International Conference on Nonconventional Energy Conversion Applications, sponsored by AIAA, ASME, IEEE and AIChE, Los Angeles, Calif., Sept. 25-28.

14th Annual Joint Engineering Meeting, sponsored by IEEE and ASME, Washington, D.C., Sept. 26-27.

Symposium on Galio-Marinide, sponsored by AFSC, Wales and England, Sept. 26-27.

6th Annual National Conference on Environmental Effects on Aircraft and Propulsion Systems, sponsored by Naval Air Turbine Test Station, Princeton, N.J., Sept. 26-28.

3rd Institute for International Engineering, Boulder, Colo., Sept. 27-30.

6th Symposium on Naval Hydrodynamics, Maneuverability, Waves and Physics of Fluids, sponsored by ONR, Washington, D.C., Sept. 29-30 and Oct. 3-4.

Army Science Conference Technical Papers

(Continued from page 56)

state, its metabolic rate in increased many-fold. This shows that tissues can metabolize at the higher rate; in fact, levels of enzymes and substrates suggest that metabolism should occur at maximum rates at all times. This is not the case, however, because biochemical systems in vivo are regulated. Our study was initiated to determine how enzymes become activated or what mechanisms keep energy reserves from being used until needed. The flying insect proved an unique tool to determine factors that control metabolism in the transition from rest to activity. Flight induces an 100-fold increase in glycolytic flux with a rate of energy transformation far in excess of that for any other known biological system. Concentrations of glycogen, trehalose, Embden-Meyerhof and Krebs cycle components, amino acids, adenine nucleotides and phosphate in flight muscle were measured after flights ranging from 5 sec to 1 hour. Changes in titers revealed the energy reserves for muscular contraction and their rates and sequences of utilization. Transient alterations in levels of intermediates show "cross-over" phenomena, indicative of sites of control. These shifts identify 5 enzymatic reactions which become activated, i.e., regulate metabolism, in the transition from a resting muscle to a working muscle. Rapid changes in concentrations of adenine nucleotides and phosphates suggest mechanisms for these facilitations

---

TITLE: Chemiluminescence as a Tool for Biodetection

AUTHORS: NEUFELD, CARLETON and WITZ
Army Biological Center

ABSTRACT: Of particular interest to the military is the development of a system for rapid warning in the event of an attack by biological agents. Basic studies on the nature of the reaction causing the luminescence of luminol, 5-amino-2,3-dihydro-1-4-phthalazinedione, indicated that this substance was one of the most promising reagents suitable for development into an alarm system. The suitability of luminol stems from the fact that its chemiluminescence is catalyzed by hemin either in the free or combined state, so that hemoproteins present in bacteria are efficient catalysts.

Basic studies at Fort Detrick resulted in the establishment of optimal conditions for light production and demonstrated the sensitivity of the reaction. In static systems, as little as 1×10^{-16} mole of catalase, and as few as 5×10^{4} bacterial cells could be determined.

The static system was converted into a continuous-flow system at the Space General Laboratories in El Monte, California. By this technique, as few as 10^{3} to 10^{4} B.globigii vegetative cells have been detected in actual aerosol tests. Current work, both on the conditions of the assay and on the design of the instrument indicates that ultimate sensitivity has not yet been attained.

TITLE: High Energy Synthetic Compounds for Future Compact Combat Rations

AUTHORS: DYMSZA, STOEWSAND, and SWIFT

ABSTRACT: Investigations of high-energy nutrient sources other than fat revealed that certain synthetic compounds may have potential for use in the exceptionally compact rations required for special warfare or space operations. While high-fat, high-energy diets can be fed, prolonged feeding may result in serious metabolic disorders. The problem of the investigation was, therefore, to find and/or to synthesize high-caloric, non-lipid compounds. Three polyols were selected as models for initial study. Animal feeding tests with glycerol, 1,3-butanediol and propylene glycol showed that these compounds supported growth and normal food efficiency. Since there is a demand for additional energy due to accelerated metabolism, studies were conducted at 5°C and -20°C. Glycerol fed rats were comparable to controls in survival time at the severs -20° cold temperature. Dogs fed 1,3-butanediol were capable of sustained physical exercise. Feeding of 1,3-butanediol and propylene glycol produced changes in serum cholesterol, adipose tissue and liver lipids. Preliminary isotope studies indicate that 1,3-butanediol did not adversely affect the cata-

(Continued on page 58)

Army Science Conference Technical Papers

(Continued from page 57)

bolism of glucose-C^{14}. These studies affirm the validity of the concept that certain compounds, not presently considered as foods, can be utilized for energy. However, further studies are needed on the 3 model compounds and on the development of better synthetic energy sources before their use in rations can be recommended.

TITLE: Acetylcholinesterase and Nerve Conduction
AUTHORS: ADAMS, BAY and TOWNS
Chemical R&D Laboratories

ABSTRACT: When cholinesterase is inhibited by a potent anticholinesterase agent the accumulated acetylcholine released by continuous stimulation should theoretically depolarize the excitable membrane and produce a blockade of nerve conduction. Results obtained from *in situ* experiments using the cat sciatic nerve revealed no alteration of the electrically evoked nerve action potential after poisoning anesthetized, atropinized, artificially respired, animals with many LD_{50}'s of either Soman, Sarin, DFP or TEPP. However, the simultaneously recorded action potential of the gastrocnemius muscle were abolished within seconds after the i.v. injection of these agents. The enzyme activity of nerves from Soman and Sarin poisoned animals, as determined by a modified Hestrin colorimetric technique and the histochemical technique of Karnovsky, was reduced to less than 10% of its normal value. Ninety minutes after the injection of Monoisonitrosoacetone, the nerve enzyme activity had increased by 45% in the Sarin poisoned animals. The muscle action potentials began to return within minutes after the injection of the oxime. Curare had no effect on the nerve action potential. The conclusion is reached that in motor nerve fibers *in situ* there is apparently no correlation between the magnitude and amplitude of the action potential and acetylcholinestine activity.

TITLE: Isolation and Identification of Toxic Fractions of Cobra Venom
AUTHORS: VICK, CIUCHTA, BROOMFIELD, CURRIE, and MANTHEI

ABSTRACT: The venom of the cobra, *Naja naja*, is composed of three physiologically identifiable components. The first component appears to produce a loss of cortical electrical activity when injected intravenously into the dog. The second component affects the respiratory system. The third component attacks the cardiovascular system, ultimately producing irreversible hypotension.

TITLE: Red Cell Fragility and Blood Preservation - The Osmogram
AUTHORS: SHIELDS and CAMP
Army Medical Research Lab, Fort Knox

ABSTRACT: A method of testing oxmotic fragility was described based on exposing the same sample to a progressively hypotonic saline concentration. The optical change could be constantly monitored in a continuously recording spectrophotometer commonly available in most laboratories. The constant recording rate permitted timing of the rate of hemolysis. The procedure was simple, rapid, and a measurement system provided points or osmogram that permitted statistical analysis of specimens.

Practical application of this method consisted of measuring blood stored for 6-8 weeks with one set having a new preservative (adenine) added, and another set being air-dropped. An increase of osmotic fragility was demonstrated in all units. This appeared earlier during storage and became more marked in the air-dropped units. Those containing adenine had less of a change compared to controls. Specific correlation was found between the slope value of the osmogram and post-transfusion survival percentage as measured by radioisotope labelled erythrocytes. This correlation would be useful in predicting suitably stored blood yet avoiding some of the risks of *in vivo* testing.

TITLE: Synthesis and Degradation of Poly Alkyl Alpha Cyanoacrylates
AUTHORS: LEONARD, KULKARNI, BRANDES, and NELSON
Medical Biomechanical Research Laboratory

ABSTRACT: In order to study structure-tissue reactivity relationships and ultimately develop a less necrotizing adhesive, this laboratory stud-

(Continued on page 59)

1966 Conference Acclaimed As Notable for Excellence Of Papers, Panel Innovation

In the annals of the five Army Science Conferences held since 1957, the 1966 assembly will be recorded as notable in numerous respects, aside from the high caliber of the 96 papers reporting on significant research at Army in-base laboratories and the panel discussion.

As stated by Dr. Harold M. Agnew in the keynote address, many of the technical presentations reported on work considered promising for application in the near future to technology for materiel development.

For the first time, the Chief of Research and Development, Lt Gen A. W. Betts, presided as toastmaster at the conference banquet in addition to making the welcoming address. Pinch-hitting for Dr. Ralph G. H. Siu, whose wit in that role had enlivened each of the four previous conferences, General Betts kept the humor going at a rapid-fire rate. Dr. Siu was forced to withdraw as toastmaster on the eve of the conference.

Illness and an accident prevented two other celebrities from attending. Dr. Gilford G. Quarles, chief scientific adviser, Office of the Chief of Engineers, Department of the Army, was scheduled to be one of the four session chairmen. Serious illness the day before the conference put him in the hospital for three weeks. Dr. Marvin E. Lasser, who assumed duties in mid-June as chief scientist, U. S. Army, fractured an ankle while preparing to move to Washington, D.C.

Dr. I. R. Hershner, chief, Physical Sciences Division, U. S. Army Research Office, filled in for Dr. Quarles. Other session chairmen were: Dr. Jay Tol Thomas, Army Materiel Command Director of Research and Laboratories; Dr. Craig M. Crenshaw, chief scientist, Army Materiel Command; and Col Tyron E. Huber, chief, Life Sciences Division, Army Research Office.

Dr. Harold C. Weber, presiding chairman at each of the Army Science Conferences, made his last appearance in that capacity. His resignation as chief scientific adviser, U.S. Army, was effective in mid-June. It was also a farewell appearance for Assistant Secretary of the Army (R&D) Willis M. Hawkins and for Dr. Chalmers W. Sherwin, Deputy Director of Defense Research and Engineering (Research & Technology).

Mr. Hawkins has returned to Lock-

heed Aircraft Corp. as general manager and vice president (engineering). Effective July 1, Dr. Sherwin took office as Deputy Assistant Secretary of Commerce (Science and Technology), Dept. of Commerce.

Another "first" at an Army Science Conference was the visit of two gifted science students selected by Army judges at the 17th International Science Fair at Dallas, Tex., in May. Kenneth L. Hurst, 16, Ephrata, Pa., and Steven P. Lund, 16, Bismark, N.D., were greeted by U.S. Military Academy Superintendent, Maj Gen Donald V. Bennett, and they participated in all conference activities. Both termed it "a stimulating experience."

Notable also was the large attendance of ladies who joined their husbands in visiting the Academy. The program arranged for them under the guidance of Capt Martin W. Carey of the USMA kept them enjoyably busy.

Dr. Richard A. Weiss, Deputy and Scientific Director of Army Research, and general chairman of the conference for the fifth time, termed it a "symbol of the complexity of military operations today and the deep involvement of the Army in science and technology" for its defense mission.

Mr. Hawkins, General Betts, Dr. Weiss and John C. Hayes, Army project officer, assisted by Lt Col John J. Walsh, joined in commending the Academy staff, under Lt Col C. A. Mitchell as project officer, for achieving the maximum in successful arrangements for the conference.

Capabilities of Reservists Typified by ASC Attendees

(*Continued from page 51*)

MAJ ROBERT DRUMMOND, 5002nd R&D Unit at Denver, Colo., is a research geologist and is a chief morphologist on a project for the Advanced Research Project Agency on developing methods of terrain evaluation for the Army. He formerly was a Fulbright lecturer at the University of Mandalay in Burma. His BS degree in physical chemistry is from Indiana State University, MS in geography and geology from the University of Illinois, and PhD in geography from Northwestern University.

LT COL MILTON MATER is on the Office of the Chief of Research and Development Mobilization Designation list. Assigned to the 6161st R&D Unit at Corvallis, Ore., he is a large operator of lumber mills in the Pacific Coast area and has mills in Asia, Burma and South America. He earned his BSME degree in mechanical engineering at the School of Technology, City College of New York.

Army Science Conference Technical Papers

(Continued from page 58)

ied the synthesis and degradation of the homologous series of alkyl alpha cyanoacrylate monomers and polymers. A method for synthesizing high purity cyanoacrylates and some of their chemical and physical properties are presented.

In vitro kinetics studies under heterogeneous and homogeneous conditions indicate that cyanoacrylate polymers degrade by hydrolytic scission of the polymer chain. The productes resulting from such a scission are formaldehyde and an alkyl cyanoacetate. As the homologous series is ascended, the rate of degradation under neutral conditions decreases. In homogeneous solution, under alkaline conditions, the rate of degradation is considerably higher than under neutral conditions and the rates obtained with the methyl to buryl derivatives are of the same order. A proposed mechanism of degradation is presented.

Medical evaluation has indicated that as the homologous series is ascended, the greater is the tissue tolerance to the monomers and polymers. The relevance of the results of the in vitro studies to this medical finding is presented.

ISF Winners Participate in Army Science Conference

USMA SUPERINTENDENT Maj Gen Donald V. Bennett welcomes high school science students Steven P. Lund (left) and Kenneth L. Hurst to the 1966 Army Science Conference. Lund and Jurst were selected by a panel of Army judges at the 17th International Science Fair, in May, as the first high school students to participate in the biennial Army Science Conference. Hurst will represent the U.S. Army at the Japan Student Science Awards in Tokyo in November; Lund is the alternate (see June issue, page 18). At right is Dr. John Hayes, Army Research Office, Science Conference project officer.

Beach Assigned as CIC of U.S. Army in Pacific

General Dwight E. Beach, elevated to 4-star rank in 1965 when he succeeded General Hamilton H. Howze as CG of the Eighth U.S. Army in Korea, on Sept. 1 will become Commander-in-Chief, U.S. Army Pacific.

The former Chief of Research and Development (1962–63) went to Korea in May 1965 after serving two years as CG of the Combat Developments Command following the CRD assignment.

Sept. 1 is also the effective date for a sequence of major command assignments touched off by the decision of General John K. Waters, present Commander-in-Chief USARPAC, to retire from the Army on that date.

Lt Gen Charles H. Bonesteel, III, will be promoted to 4-star rank as CG of the Eighth U.S. Army in Korea. Lt Gen John L. Throckmorton will succeed General Bonesteel as Director of Special Studies, Office of the Chief of Staff, DA.

Lt Gen Charles W. G. Rich will take over from General Throckmorton as Chief of Reserve Components, DA. Assigned to succeed General Rich as Deputy CG of the Eighth Army is Lt Gen Vernon P. Mock, presently Deputy Chief of Staff for Operations, DA. Maj Gen Harry J. Lemley, commandant of the Army Command and General Staff College, Fort Leavenworth, Kans., will be promoted to 3-star rank as Gen Mock's successor.

ASAP Chairman Points to Basic Research Needs

(Continued from page 4)

Agnew said, but he expressed concern that "something is very seriously amiss. The thing that appears to be amiss is our ability to put this basic technology into systems that are reliable. This used to be our specialty.

"We used to be very good at putting basic technology into systems that were reliable—which could do what people expected of them. But something has gone wrong. Our systems now seem to be sold on the basis that they are going to do everything, and as a result they sometimes do nothing very well.

". . . There is just something wrong and I think that it behooves the technical community to look very seriously and very deeply into scientific management again to see what has gone wrong. . . .

"Right now, today, we are faced with a large number of problems. All branches of the Military Services are confronted with problems. What I would like to do today is to mention some of these problems and to urge you to find out more about them and what can be done to solve them."

Among the problems he listed are those of adequate ambush detection systems, detectors for hidden or buried explosives, greatly improved aerial and ground reconnaissance, night-vision systems for a 24-hour-day combat capability, devices for detection of SAM (Surface to Air Missile) sites, lightweight packaging of supplies for airlift, counter systems to protect airlift aircraft from destructive weapons, and protection of bases and harbors from surprise attack through infiltration.

Protection of bases and harbors was termed "a rather horrendous and a very serious problem" under conditions of long-haul logistics, requiring "pile-up of tremendous amounts of men and materiel . . . extremely vulnerable."

The blunted-sword tone of most of Dr. Agnew's address was sharpened as he turned to criticism of what he termed policies that discourage dramatic innovations in weaponry and tactics becaues they are "not politically acceptable."

"There is a tremendous gap, almost a complete lack of dialogue, between the technical community and what I am calling the 'State Department' . . . . And I think we need an entry into their community, and I think they very much need us. . . . I believe that in this age of technology, a technical input would be very useful in making many policy decisions. . . ."

The speaker explained that "State Department," in the sense that he was using the term, applied overall to top policy-makers, including what he called "an aversion to innovation" in the Department of Defense research and development community." He explained his position by stating:

"We find ourselves being authorized to build or to consider only those systems which respond to a clearly defined threat. And as a result, we will be reacting on the defensive. The initiative no longer seems to be up to us. The initiative always seems to be in the other fellow's camp.

"Now since we react only to those systems or threats which have been proven to exist, and it takes several years to react, we are continually in danger of coming up with answers to threats which have changed, if indeed we come up with answers in a time scale which is relevant at all.

"In addition, since we seem to be limited to react only to those threats which can be proven, we are completely vulnerable to surprises, to new systems which we have not heard about—which all of a sudden appear.

"Now there seems to be a real hesitancy on our part to innovate, to develop systems as a result of basic technology, which the technical community has come up with, to force the other fellow to react to our initiative. Somehow innovation seems to carry the connotation of provocation, which by definition seems to be ruled out as a tactic.

"Now the maintenance of U.S. technological superiority and its subsequent application to maintain a superior war-waging, and hence deterrent, posture for all levels of conflict clearly demands that this country pursue innovation, not only where it is forced upon us to protect ourselves against innovations of the other person, but wherever these innovations will give us the initiative and hence the decisive advantage. . . .

". . . Obviously, if this country only innovates and modernizes when justified in the light of new threats, that is, in the light of innovations by others, the ultimate result can only be technological enforced inferiority. If we are to maintain the superiority which has guaranteed our dominant power position during the past 20 years, the U.S. must continue to innovate, offensively as well as defensively, and accept the consequences of this policy in terms of any slight provocations which might arise. . . ."

Dr. Agnew said that the Soviet Union has made clear that it recognizes the increased importance of innovation to serve the objective of world domination through Communism. He quoted a recent Soviet Defense Ministry document as stating:

" 'The Soviet government is not limiting itself to those means which the adversary already has. Undoubtedly, this would be insufficient. The creation of new methods of combat which the imperialist aggressors still do not possess is the task of Soviet science and technology. Any pre-empting of the adversary's potential and the creation of the newest means of combat gives undoubted superiority in case of war.' "

Dr. Agnew then stated that "technology is not stagnant, and it will not stand still. I firmly believe that anyone who has a technological advantage and does not use it, does not in any way guarantee that someone else will not soon discover the same phenomenon and develop a similar system, and may even use it.

"This is true whether our technology is kept Secret or not. Geography has no control over man's brains or motivations. Technology is expanding at an ever-increasing rate. If one has an advantage, one has an application, one should use it if one is serious with regard to one's objectives in the first place. And I think that the military should not ask you to devise more 'politically acceptable' methods for achieving identical goals. . . ."

The keynote speaker closed with a quotation of a poem by Ogden Nash, titled "Jack Do-Good-for-Nothing," about a man who befriended a frog about to be devoured by a snake, a little red hen about to be carried away by a hawk, and a rabbit about to be gobbled up by a fox. A little later, the snake, the fox and the hawk joined and "out of him they beat the stuffing."

The poem closes with:

"You see, Jack
Against a cardinal rule of conduct,
Had been a transgressor.
Never befriend the oppressed unless
You are prepared to take on
The aggressor."

25-Year Aviation Veteran Commands AVLABS

An artillery officer and Master Army Aviator with 25 years of military service recently assumed command of the U.S. Army Aviation Materiel Laboratories (AVLABS), Fort Eustis, Va.

Col Harry L. Bush succeeded Col John L. Klingenhagen, reassigned as Director of Materiel Readiness, U.S. Army Materiel Command (AMC) in Washington, D.C. Col Klingenhagen is listed for promotion to brigadier general.

Col Bush served as chief of the Aviation Branch, Directorate of Research and Development, U.S. Army Materiel Command Headquarters, Washington, D. C., from December 1962 until he assumed his new duties.

Born in 1918 in Waverly, Ala., he was graduated from Auburn (Ala.) University in 1940 with a BS degree in engineering and a Reserve officer commission in Field Artillery (ROTC). In 1952 he obtained an MS degree in aeronautical engineering from Princeton University.

Col Bush entered the U.S. Army in August 1941 and served as Division Artillery Aviation Officer, 2nd Infantry Division, in World War II. He was chief, Air Logistics Branch of the National Guard Bureau from 1948 to 1950.

Assigned to the U.S. Army Aviation Board at Fort Bragg, N.C., from 1953 to 1956, he served at Fort Sill, Okla., and Fort Rucker, Ala., as chief, Test Division, until 1957, when he became chief, Army Aircraft Research and Development Branch, Office, Chief of Research and Development, Department of the Army. He remained until 1961 when he was assigned to Korea as commander of the 2nd Howitzer Battalion, 76th Artillery.

In December 1962, he reported to Headquarters, Army Materiel Command, and was designated chief, Air Mobility Section, in the Directorate of Research and Development. He also served as project manager of the CV–7A (Buffalo) Program from February to July 1964. In June 1964, he reorganized the Air Mobility Section to the Aviation Branch and served as chief of the branch until assigned to AVLABS.

Col Harry L. Bush

Col Bush is the holder of the world record in the H–21 helicopter for distance in closed-circuit flight and has received the Distinguished Flying Cross, Air Medal, Bronze Star, Purple Heart, American Defense Service Medal, American Campaign Medal, European-African-Middle Eastern Campaign Medal, World War II Victory Medal, Army Occupation Medal and National Defense Service Medal.

U.S., Canada Conduct Gas-Solids Research

Cooperative research into certain properties of rare gas crystals of interest to the U.S. Army has begun between Frankford Arsenal, Pa., and Canada's Chalk River Nuclear Laboratories.

The joint experiments were authorized by a "memorandum of agreement" entered into by the U.S. Army for the United States and the Atomic Energy of Canada Limited, a Canadian Government Crown Corporation.

Specifically, the research concerns the inelastic scattering of neutrons in rare gas crystals. The Chalk River Nuclear Laboratories (CRNL), in the mountains northwest of Ottawa, have the high neutron flux required for such experiments.

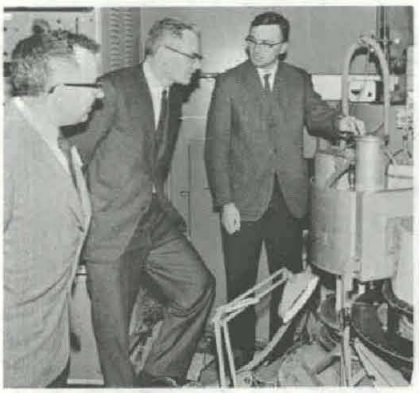
Principal U.S. physicist on the project is Dr. Issia Lefkowitz of Frankford's Physics Research Laboratory. He has been studying properties of rare gas crystals for several years and first reported his early studies last year before the American Physical Society.

Among those assisting Dr. Lefkowitz in the gas-solids experiments are Drs. Roger A. Cowley and Lloyd G. Elliott of the Canadian laboratories.

Edward R. Thilo, director of the Physics Research Laboratory, said that the Army is interested in this project through its program of basic research in physics, and "these experiments will lead to further insight to the fundamentals of materials for future development."

Dr. Lefkowitz holds a doctorate degree from Cambridge University, England (1964) and has had a varied career in physics. He was director of Research Regal Electronics, 1952–53; chief engineer of Haines Industries, 1953–54; research physicist for Gulton Industries and guest scientist at Brookhaven National Laboratories, 1954–60.

Author of numerous classified technical reports, he has been issued several patents. He received an undergraduate degree from Brooklyn College, entered Cambridge in 1960 as a research student, and became a research associate. He joined Frankford Arsenal in 1964.



DISCUSSING USE of Triple Axis Neutron Spectrometer for cooperative research on rare gas crystals between Frankford Arsenal and Chalk River Nuclear Laboratories (CRNL), Canada, are (l. to r.) Dr. Issia Lefkowitz, Frankford; Dr. Lloyd G. Elliott, director CRNL Physics Division; Dr. Roger A. Cowley, CRNL. (Photo by Atomic Energy of Canada Ltd.)

AFMA Convention Focuses On Management by Results

The Armed Forces Management Association's Thirteenth National Conference, scheduled Oct. 11–13 in Washington, D.C., will focus on the theme "Management by Results." From 500 to 700 representatives from military establishments, educational institutions and defense industry are expected to attend.

Cosponsored by the National Capital, Potomac and D.C. Science Chapters, the meeting at the Shoreham Hotel will feature presentations by key officials of Army, Navy, Air Force, and OSD and authoritative speakers from industry and educational institutions.

Selected guest speakers will discuss subjects having a direct impact on Department of Defense management improvement programs which include System Effectiveness, Integrated Logistics, Program Planning and Budgeting, Concept Formulation and Management Ideas from the field.

Radioactive Waste Disposal Challenges NDL Researchers

By Joseph C. Maloney

Project Officer

Contaminated waste or "trash" is an unwanted byproduct of any operation involving radioactive materials.

Confronting the United States Army is the increasing problem of processing and concentration of radioactive materials present in waste resulting from the operation of nuclear power-generating and research-type reactors or from laboratory research.

The Army must be able not only to conduct its research and development programs involving the use of radioactive materials; it must also maintain ability to carry out emergency operations in a nuclear environment.

In direct support of these requirements, the U.S. Army Nuclear Defense Laboratory, Edgewood Arsenal, Md., has undertaken — as one of its many research problems—to establish procedures and apparatus for the processing and concentration of radioactive waste materials.

Although such waste can exist in almost any physical or chemical form, the largest volumes that create final disposal problems are low-level liquids and combustible biological waste.

An important "first" on the disposal research program was the task of separating the minute quantities of dissolved and suspended radioactive substances from the thousands of gallons of contaminated water that were accumulating at the Army's radioactive waste-disposal facility at Edgewood Arsenal in 1960.

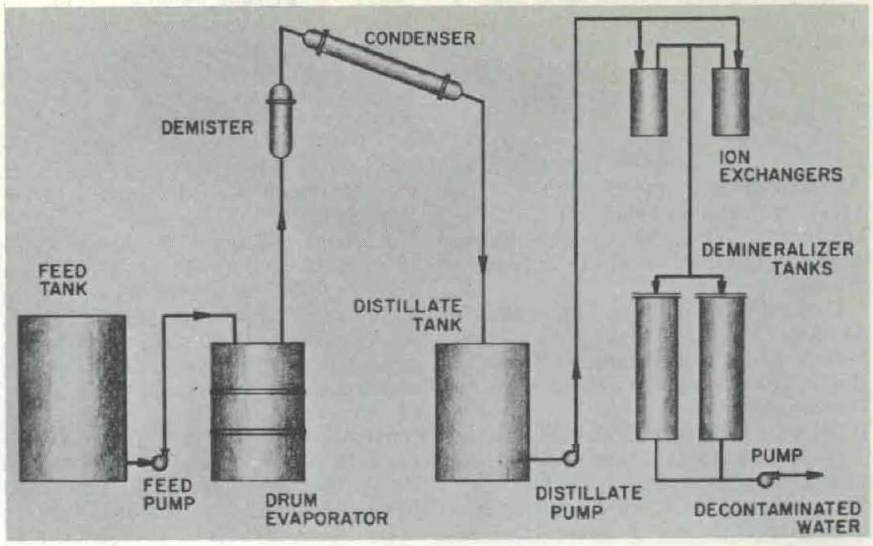


Fig. 1. Disposable Drum Evaporation Process

Laboratory scientists and engineers — in collaboration with defense contractors — designed, constructed and tested a transportable concentration unit consisting of a wiped-film evaporator and mixed-bed demineralizers.

Extensive testing programs conducted by the Laboratory at Edgewood Arsenal and elsewhere proved the unit to be an economical effective apparatus to separate the radioactive material from the water.

In practice, the unit has demonstrated that the volume of contaminated liquid can be reduced by a factor of several hundred, while the pure effluent contains less residual radioactivity than that found in drinking water. The small volume of radioactive sludge resulting from the process is solidified in concrete and buried at an Atomic Energy Commission licensed burial ground.

One of the operating difficulties of the unit results from the necessity to pump and transfer contaminated sludges. Also, problems are sometimes encountered when liquids are pumped containing a very high concentration of suspended radioactive solids.

An improved version of the process (Figure 1) has been designed whereby the concentration is accomplished in the final shipping drum itself. In this procedure, the only pumping of contaminated liquids required is in transferring fresh feed to the evaporation-shipping drum.

An experimental unit, designed and constructed at the U.S. Army Nuclear Defense Laboratory, is being tested by using nonradioactive solutions. Preliminary results show great promise for the unit and tests with radioactive materials will be initiated in the near future.

Another important problem under study is the volume reduction of solid combustible radioactive wastes, particularly biological material that requires refrigeration in addition to other storage considerations.

The use of incinerators with conventional gas-cleaning equipment has not proved radiologically satisfactory in the past. However, the Laboratory and the Atomic Energy Commission have cooperated in a joint project to develop and test a new type of incinerator, which also incorporates a

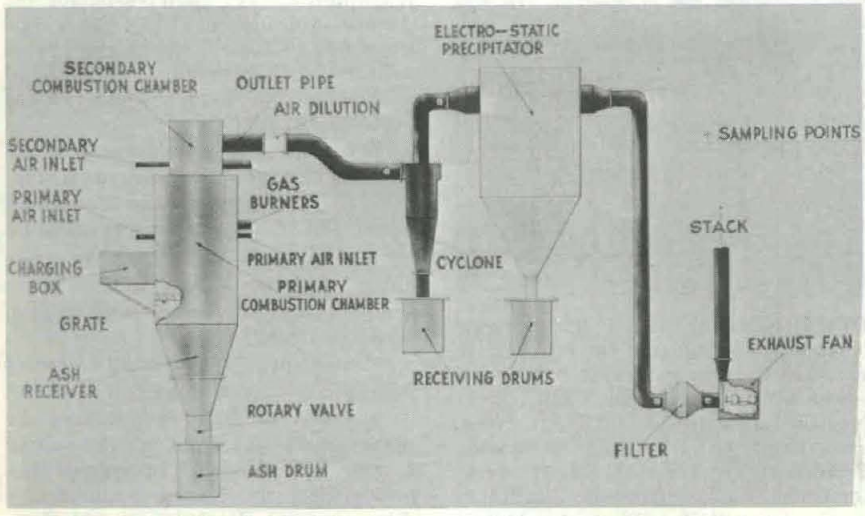


Fig. 2. Incinerator and Dry-Gas-Cleaning Process

novel dry-gas-cleaning concept (Figure 2).

The incinerator has been designed to provide tangential overfire air for combustion, with effluent gas being treated by dilution, inertial particle separation, electrostatic particle separation and filtration.

Extensive tests with nonradioactive charges have been completely successful, and further testing with radioactive materials is under way. The weight-reduction factor between charge and ash approaches 100, and the ash can be easily stabilized in concrete for land burial.

A portable disposal version of this incinerator has been designed for possible use at a radiological incident site where large quantities of slightly contaminated combustibles may have to be concentrated to ash. For this application, a simplified air-cleaning system of dilution and spark-arresting may be adequate.

Tests are programed by the U.S. Nuclear Defense Laboratory for fall 1966 at Camp McCoy, Wis., utilizing facilities and test areas previously established for radiological decontamination experiments.

Future experiments are planned on such newly developed liquid concentration systems as reverse osmosis, where energy and auxiliary apparatus requirements are sharply reduced. This work is conducted under the direction of the Radiation Protection Branch, Nuclear Engineering Division of the Laboratory.

McNamara, Vance Lead DIAC Discussions

Secretary of Defense Robert S. McNamara and Deputy Secretary Cyrus R. Vance led discussions on Defense-industry logistics June 10–11 at the 13th Defense Industry Advisory Council (DIAC) meeting at the Pentagon.

Sessions were chaired by Mr. Vance. Alternate DIAC chairman is Paul R. Ignatius, Assistant Secretary of Defense (Installations and Logistics). Industry is represented on the Council by Industry Vice Chairman Dr. Ruben F. Mettler of Thompson-Ramo-Woolridge Systems Group, Los Angeles, Calif.

Established May 23, 1962 as a forum for discussions by the Secretary of Defense and his principal assistants, the DIAC has 22 non-governmental members, including many of the Nation's top industrial leaders.

In addition to Mr. McNamara and Mr. Vance, officials leading discussions included Robert N. Anthony, Assistant Secretary of Defense (Comptroller); Dr. Finn J. Larsen, Deputy Director of Defense Research and Engineering (DDDRE); Robert H. Charles, Assistant Secretary of the Air Force (Installations and Logistics); Henry J. Kuss, Jr., Deputy Assistant Secretary of Defense (International Security Affairs); and James W. Roach, Assistant Director of Defense Research and Engineering.

Assisting from industry were Joseph Corie of Northrop Corp.; Robert Kirk, Litton Industries; Lawrence Levy, Allied Research Associates Inc.; T. Norman Labash, National Security Industries Association; William M. Allen, The Boeing Co.; and C. J. Breier, International Business Machines Corp.

Discussions of the advisory group ranged in the areas of military export pricing, munitions control, export negotiations, public and industry information, systems acquisition management, standardization and various reports on "task force" activities.

Col Snyder Takes Command of Rock Island Arsenal

Col Harry A. Snyder took command of Rock Island Arsenal, Ill., June 13, when Col Paul A. Nilsson, Arsenal commander since August 1963, was reassigned to Frankford Arsenal, Philadelphia, Pa.

A chemical engineering graduate of Lehigh (Pa.) University, Col Snyder was commissioned as a second lieutenant in 1939. Prior to his new assignment, he was chief of the Firepower Materiel Division of Inventory, Control Point in Hawaii.

During World War II he served in the European and Pacific Theaters of Operations, and later (June 1953–September 1954) as an ordnance officer, Far-East Command Korea. He was awarded the Legon of Merit in 1954 and the Army Commendation Medal in 1965.

Col Harry A. Snyder

Redstone Artists Score 'Zero Defects' on Patents

Two Redstone (Ala.) Arsenal illustrators who specialize in drawings accompanying application for patents have chalked up a very respectable record in "Zero Defects."

William Jennings and Buell Hanners of the U.S. Army Missile Support Command Patent Center, following the very strict rules outlined by the U.S. Bureau of Patents, have turned out 322 sheets of drawings in the past two years without an error.

Every patent must be accompanied by a drawing and since the size of the paper, the shade of the ink and the size of letters and figures are precisely outlined in the instructions, patience and ingenuity are required of the patent design illustrator.

The demand for precision is based on conformity and the need to be able to reduce the illustrations in reproducing them. The draftsman's imagination is taxed to conceive a visual picture of ideas that often are abstract.

Buel Hanners & Wm. Jennings

The U.S. Patent Office requires corrections, or an entire new drawing if the submissions do not meet the requirements. This has not happened to Jennings and Hanners. The Patent Office also requires the cost of the new drawing be absorbed by the applicant, an added incentive to the men for a defect-free drawing on the first go-round.

Jennings, an alumnus of Clemson University, has been at the arsenal for the past eight years and has more than 17 years of Government service.

Hanners gained his knowledge of draftsmanship at the Decatur Trade Center and transferred from the Army Ballistic Missile Agency to the Support Command when the Agency was dissolved.

Trade-Off Studies in Army Missile Research: SAM-D

By Harry F. Vincent

To determine the optimum weapon system concept for the SAM–D (surface-to-air-missile development system, a carefully selected Evaluation Group met last summer at the U.S. Army Missile Command, Redstone Arsenal, Ala.

Considerable interest has been shown in the unique method of conducting trade-off studies on submitted proposals and arriving at this optimum concept.

Quite simply, the Evaluation Group selected the best ideas and innovations from different contractor proposals, and molded these selected ideas into a single SAM–D concept.

In actual practice, the method was not quite so simple; but the results more than justified the extra effort expended. The overall objective of the Evaluation Group was to analyze any proposed system concepts resulting from trade-off studies, considering cost, technical risk, complexity and operational effectiveness. The method used to accomplish this could be of extreme interest for future evaluation groups.

The staffing for the study consisted of about 150 in-house Government personnel, representing the highest degree of professional competence within the Army. Nearly all Army Materiel Command elements and laboratories, plus the Combat Developments Command, were represented.

Private companies also were used for consultation and detailed computation. Well-known authorities from Massachussetts Institute of Technology, Stanford Research Institute, Brooklyn Polytechnic Institute, Johns Hopkins and Purdue Universities, and other research institutions cross-checked the Group's work.

In addition to the Army personnel who served with the Navy ASMS Evaluation, the Navy assigned several people to the Group to insure commonality with that Service's effort in future air defense systems.

To insure that all factors were considered, the Group was organized into five committees: Tactical Suitability, Technical Assessment, Program Estimates, Cost Effectiveness and Executive. The titles define the function of each.

SAM-D Trade-Off Studies started from a reference of Hawk-Hercules capabilities and proceeded to increasingly higher levels of capability. All facets of several SAM-D concepts proposed by contractors were explored.

Several contractors made independent trade-off studies yielding a total of 23 system concepts. They studied a wide range of systems, from relatively straightforward air defense systems, making use of common radar techniques, on up to advanced techniques using high-performance, mobile phased-array systems. The systems ran the gamut of capability. Contractor's studies also paid particular attention to the electronics countermeasures (ECM) and the low-altitude problems.

A checking and sifting operation on the submitted proposals was conducted by the Evaluation Group. Realism of the contractors' assumptions was assessed. Next, the technical claims were verified by use of data available to Army laboratories, by computer runs to establish parameters, and finally by an on-the-spot review of the technical progress actually demonstrated.

The purpose was to determine if the weapon-system concepts were within the proper state of technological art and if the desired characteristics could be achieved in the estimated time frame.

The requirement was that the technology proposed for use could be demonstrated in the laboratory or in a developmental form, and that no technical breakthrough, inventions, or scientific advance would be required.

A final judgment of the weapon concepts was aimed at an optimum balance of total cost, schedule, technical feasibility and tactical capability. Concepts were sifted through a series of requirements: technical adequacy, tactical usability, etc., in order to get further detailed consideration.

Soon it was determined that no one of the contractor concepts by itself would pass all points of the technical scrutiny of Army in-house laboratory people, the consultants and the tactical representatives. To cite one example, it was considered that all contractors were optimistic as to the weight of a missile for a given performance. In addition, it was common for contractors to be strong in some areas and weak in others.

The Group constantly kept in mind Department of Defense prerequisites for the contract definition phase, since a concept was desired that could be recommended for that stage. The net result was that systems had to be modified to satisfy the Group that a particular concept would, in fact, function correctly.

By this continuous sifting and redesign, the number of systems was reduced to four, from whch one could be recommended for the contract definition. These Government-Initiated (GI) Systems are the syntheses of several concepts.

This seemed a logical sequence since a concept was being formed and contractor selection was not under consideration. The Group constantly had to be reminded of its purpose, so that it would not become too enchanted by what it thought it saw in a contractor proposal.

Ideas from all contractor studies were used freely, along with in-house ideas, in developing the four systems. Therefore, no attempt was made to identify a system with a contractor.

Each GI System or concept corresponded to one of the four levels or guidelines. Hence the designations, GI–I–SAM–D, GI–II–SAM–D, GI–III–SAM–D, and GI–IV–SAM–D. The first level started with a combined capability of Hawk and Hercules.

Other levels proceeded upward in capability with respect to factors such as increased numbers of simultaneous engagement, increased single-shot-kill probability, and increased capability in the antitactical ballistic

Harry F. Vincent has been the project director at the Research and Development Directorate, U.S. Army Missile Command at Redstone Arsenal, Ala., since 1951. He was transferred from the U.S. Air Force Long Range Proving Ground at Cocoa, Fla.

Graduated with a BS degree in electrical engineering from Washington University, St. Louis, Mo., he entered the Air Force in 1941. After 4½ years as a pilot and air inspector, he was released from active duty in 1946 as a major. He is a registered engineer in Alabama.

missile role. A relatively sophisticated requirement existed at level four, with concurrent cost increase.

Of the four concepts, the overall technical preference was GI–II–SAM –D. In addition, plus factors were found in all of the other essential facets of a modern weapons system: logistics maintenance, manpower, etc.

A Cost Effectiveness Analysis was performed in three distinct areas:

First, a *tactical* effectiveness analysis utilizing computer simulations was made of the proposed contractor systems. The purpose of this evaluation was to determine the relative effectiveness of the several contractor SAM–D system concepts under realistic tactical conditions. Overall results indicated that any recommended SAM–D system concept should encompass the general technological approaches represented by the GI–II Systems.

Second, an analysis of the *performance* characteristics of each contractor-recommended system concept and the GI Systems was performed by the the Army Missile Command. This included an area-coverage analysis against specific threat parameters, an end-game or warhead-lethality effectiveness simulation, and a performance sensitivity analysis.

Finally, A Field Army *cost* effectiveness was conducted of all contractor-proposed and Government SAM–D concepts was conducted by a combined Missile Command–CDC team. The purpose was to determine the optimum Government SAM–D system as a function of the number and costs of systems deployed in a typical Field Army.

As a comparison analysis, Hercules and Hawk were subjected to a similar treatment and the results were evaluated along with the Sam–D information. Formations of high-performance air-supported targets attacked three target complexes in the Field Army area. These targets flew at two different speeds and at two different altitudes.

War-games techniques were used to calculate the number of targets destroyed for each attack condition and each deployment. Additionally, the deployment cost to achieve a specified number of kills was determined.

The Group does not claim that its approach to trade-off studies using the present state-of-the art technology is a model for all future studies, but it does believe that there were some successful innovations.

One unique aspect to be noted was the key role played by Army in-house laboratories. To select the best parts of the proposals submitted, technical support had to be of the highest quality and had to be continuous. Laboratory specialists in all areas of Army missiles were part of the Group, thus fulfilling the requirements for continuity.

Usefulness of the evaluation in comparing various possible SAM–D configurations attests to the high caliber of their technical contributions, which, incidentally, did not end with the completion of the evaluation. A need for strong and capable in-house technical support will continue even after the development contract has been let.

Because of technical performance incentive contracting, responsibilities of in-house laboratories will increase significantly. Not only will they be expected to monitor the contractor to determine the quality of his technical performance; they also will perform independent evaluations which will be compared with the contractor's analyses to insure that the program is moving in the right direction.

In summary, the whole point of this discussion is this: When all of the ideas are sifted, the infeasible ones eliminated, and the feasible ones combined into concepts, there results a sound basis for cost effectiveness and tactical studies. These studies will almost always point to the direction the Army missile research projects should go to get the maximum return for the defense dollars invested.

ERDL Director Retires After 35 Years Service

One of the Army's nationally known authorities in R&D management, Dr. George W. Howard, retired in June as technical director of the Army Engineer Research and Development Laboratories, ending a 35-year military civilian career.

When he became USAERDL technical director 10 years ago, Dr. Howard was the first civilian to occupy a "super grade" position at the Fort Belvoir, Va., Laboratories.

Oscar P. Cleaver, also a much-honored Federal Civil Service career veteran at USAERDL, became acting technical director when Dr. Howard accepted a position as director of the Engineering Station at the University of Arizona.

Recipient of a Rockerfeller Public Service Award in 1953, Dr. Howard is the author of numerous articles and a book based on his year's study of R&D management at home and abroad. He has lectured extensively on the subject at the university level.

His Federal service career began in 1932 with the Waterways Experiment Station, Vicksburg, Miss. He was chief of the Hydraulics Research Center when he transferred in 1939 to the Civil Works Division of the Office, Chief of Engineers.

In 1941, as an engineer captain, he was assigned to the Engineer Board, the forerunner of the present-day Laboratories. He served at the Yuma (Ariz.) Test Branch until 1949, completing his active Army duty in 1946 with the rank of colonel.

Following a short period as chief of the Laboratories Bridge and Marine Test Branch at Fort Belvoir, he served six years as chief of the Technical Service Department.

During 1951–62 he also served as commanding officer of the Laboratories Reserve Mobilization Unit and is a retired colonel in the Corps of Engineers Reserve.

A native of Vicksburg, Dr. Howard received a BS degree in 1932 and Civil Engineering degree in 1938 from Mississippi State University. He earned a master's degree from George Washington University in 1941 and a PhD from the Technical University of Graz, Austria, in 1954.

Dr. Howard is listed in *Who's in Engineering, Who Knows and What, American Men of Science, Leaders in American Science,* is a member of numerous scientific and technical societies and is a registered professional engineer in Arizona.

Dr. George W. Howard

Kudos

BRIG GEN KENNETH F. DAWALT, Deputy Chief of Research and Development for International Porgrams, OCRD, was awarded the First Oak Leaf Cluster to the Legion of Merit for his achievements as Deputy Director for Operations and Administration, Defense Atomic Support Agency (DASA).

The General was cited for exceptionally meritorious service in matters of great importance to national security. As deputy director, General Dawalt's responsibilities covered all DASA activities pertaining to weapons requirements, stockpile and atomic materiel, safety, training, personnel, logistics and administration. Throughout his DASA assignment, he performed additional duty as chief of the Joint Atomic Information Exchange Group.

General Dawalt's contributions to the field of nuclear safety have been cited as particularly noteworthy. In addition to directing weapons safety studies and operational reviews, he supervised the preparation and presentation of nuclear weapons safety briefings for key members of the Office of the Secretary of Defense. His efforts contributed substantially to improved accident reporting and handling procedures.

The Meritorious Civilian Service Award, the Army's second highest award, was presented recently to Peter H. Haas, a physicist with the Defense Atomic Support Agency (DASA), for outstanding scientific contributions. DASA Director Lt Gen H. C. Donnelly presented the award to Haas in a Pentagon ceremony.

Haas was cited for his work as chief of the Nuclear Vulnerability Branch, Harry Diamond Laboratories, Washington, D.C. In charge of nuclear weapons-effects work at the Laboratories from 1955 to July 1965, he directed construction of the first Department of Defense (DoD) pulse reactor in 1961.

Haas joined DASA in July 1965 and is deputy chief of the DASA Radiation Division. He holds a BS degree in physics from Columbia University and has done graduate work at the University of Maryland.

MRS. MARY KLICKA, ration design specialist at the Army Natick (Mass.) Laboratories, also recently received the Meritorious Civilian Service Award for her work on combat and space feeding.

At the same ceremony, Col C. T. Riordan, Natick deputy commander, awarded the Army Commendation Medal to SFC Mossman Hastings, a veterinary specialist, for technical competence in food inspection.

DR. GEORGE R. THOMAS, associate director of the Natick Clothing and Organic Materials Division, was presented an appointment to attend the National War College this year.

ARTHUR H. MUDGETT, chief of the Instrumentation and Range Development Office at Fort Huachuca, Ariz., was presented the Meritorious Civilian Service Award by Maj Benjamin H. Pochyla, commanding general.

Cited for his work in the comparative evaluation of radar altimeters, Mudget was lauded "for his intense devotion to duty and his immense contributions in the Electromagnetic Environmental Test Facility areas.

"His leadership in improvements to the Range Facilities at the U.S. Army Electronic Proving Ground was largely responsible for the accuracy of measurement . . . attained in the comparative evaluation of radar altimeters. He provided the engineering direction that resulted in consolidation of two major test facilities."

Mudgett is a 1942 graduate of Northeastern University, Boston, Mass., with a BS degree in electrical engineering and has served with the Army for more than 21 years as an electronic engineer.

Lt Col Kermit O. Lindell, chief of the Nuclear Power Field Office (NPFO) at Fort Belvoir, Va., recently presented Army Commendation Medals to two noncommissioned officers.

SFC (E–7) William A. Cozad of the Belvoir Army Engineer Reactors Group received his award for meritorious service as instrumentation supervisor in the Advanced Power Conversion Experimental Facility, NPFO, during the period June 1965 to January 1966. He has served in the Army since 1945.

SFC Samuel A. Harman of the NPFO was commended for his work during the period November 1961 to May 1966 as senior instructor for officer training, training noncommissioned officer and acting training officer. He developed courses of study and training for nuclear plant engineers and nuclear power staff officers to the point where advanced training has become a major activity of the training program.

Harman served as a boatswain's mate in the U.S. Navy from 1943 to 1946, entered the Army in 1949, and completed the nuclear power plant operators course in 1958.

ALBERT T. FINNELL, budget analyst in the Programs and Budget Division, OCRD, is presented the Meritorious Civil Service Award by Lt Gen Austin W. Betts, CRD, at a Pentagon ceremony June 13. In May, Finnell received a Commendation Certificate for Outstanding Performance Rating from Brig Gen Thurston T. Paul, Director of Plans and Programs, OCRD. The two awards covered the period Aug. 1, 1964 through July 31, 1965. He was cited for ". . . exemplary performance in accomplishing reprograming actions."

Col Henry C. Schrader, chief of the Systems Analysis Group, Office of the Chief of Staff, DA, received a Second Oak Leaf Cluster for The Legion of Merit. He was cited for exceptionally meritorious service from September 1964 to February 1966 while serving as chief of the Mobility Branch, Development Division, and as deputy chief, Development Division, Directorate of Research and Development, Headquarters Army Material Command.

The citation stated, in part, ". . . he was responsible for the successful accomplishment of greatly improving Army mobility in remote areas which lead to an enhancement of the combat effectiveness of United States Forces in Viet Nam . . ."

Col Schrader holds BS and MS degrees in civil engineering from the University of Illinois and is a member of several professional societies.

Heart Attack Claims Gregg McClurg

Gregg Harper McClurg, a GS–15 physical scientist since 1959 with the Army Research Office, Chief of Research and Development, died of a heart attack July 9 after mowing the grass at home. He was 56.

Graduated from the University of Maryland with a BS degree in electrical engineering in 1931 and an MS in physics in 1932, he began his Civil Service career in 1935 as a radio engineer at the Aircraft Radio Laboratory, Dayton, O. He transferred to the Army Signal Corps in 1939 and for 20 years was engaged in R&D of electronic equipment with the Corps.

Laser Research Risks Weighed at Seminar

(Continued from page 3)

received by a person without being aware of it. No pain is associated with such an incident, or even noticeable flash-blindness or after-image.

In discussing injurious effect of Laser radiation on mammals, Dr. Klein cited results of two years' work on over 3,000 mice. Much of this work centered on Laser irradiation of tumors.

One of the most important discoveries resulting from these studies was that tumors irradiated by a high-energy pulse tend to "explode" and give off particulate matter. These particles can, in turn, produce other tumors by implantation or through dispersement in the bloodstream.

These secondary tumors, however, undergo a genetic change, producing a wide variety of types of the basic tumor. In other words, injected particles from a specific type of melanoma can produce another melanoma but of a different type.

In addition to the thermal effect of Laser irradiation, a number of other effects observed by Dr. Klein were cited. These include pressure and shock wave effects; photosynthetic, photochemical, and photobiological effects; electromagnetic radiation (which is not necessarily of the same frequency of the basic radiation); particulate matter, mentioned previously, which sometimes contains free radicals; and nonlinear effects such as Raman scattering.

Effects can range from severe to minor and there are many unknowns in the equation. Animal organs irradiated by Lasers show effects other than thermal, he said, describing some of the experiments his group had carried out in this area.

The liver of a living mouse, for example, irradiated by a Laser beam, does not hemorrhage as it would with electrocauterization. Neither does the irradiation necessarily kill the animal or produce a hole in the affected organ.

Graham Flint discussed the derivation of criteria for quantitative evaluation of Laser hazards. He described a series of equations derived to express the level of retinal illumination in terms of Laser parameters and viewing conditions. By use of these equations, the illumination level for a specific set of circumstances can be established and compared with the damage threshold level to determine whether a hazardous condition exists.

A simplified version of these equations has been reduced to a slide rule by Flint, with sliding scales for each of the variable parameters. Solution of a problem produces a "safety factor" reading that indicates the relative safety conditions existing in the particular circumstances.

Dr. Fine described a comprehensive set of procedures and techniques for the safe operation of Lasers. These techniques ranged from assignment of "Laser hazard safety officers" for each operating area, to door interlocks, protective clothing and goggles, nonspecular fittings and accessories, and protective physical barriers. Dr. Fine's presentation emphasized the many unknowns that exist and the very real hazards accompanying Laser experimentation.

The meeting concluded with a tour of Martin Laser laboratories where attendees saw many of the safety devices and procedures in operation. These ranged from power interlocks which automatically shut down Laser operations whenever a laboratory door is inadvertently opened, to an elaborate keyed switchbox that protects workers from high voltages in heavy-duty power supply equipment.

ARO Publishes Guide to Scientific Research Grants

"Scientific Research Grants" is the title of a revised booklet published by the U.S. Army Research Office to provide guidance to universities, colleges and other nonprofit research organizations desiring to seek grants.

Prepared by the Army Research Office Contracts and Grants Branch, the pocket-sized booklet is available gratis to all interested nonprofit research organizations. The revision of the brochure is the first since 1962.

Major changes include a revised listing of where proposals should be submitted, based on the 1962 reorganization of the Army; the institution of cost-sharing, in which it is expected that the grantee will share "a part of the costs of the research"; and a provision for grant payments—lump sum or periodic, based on the size of the total grant and the estimated timing of financial requirements.

Pubilc Law 85–934 authorizes the Department of Defense ". . . where it is deemed to be in furtherance of its objectives, to make grants for support of basic scientific research to nonprofit institutions of higher education and to nonprofit organizations whose primary purpose is the conduct of scientific research . . ."

The Public Law was a product of the foresight of American scientists and the National Science Foundation. The Department of the Army has established policies for the planning and administration of its basic research program consistent with responsibilities as a part of the national scientific community.

The Army's approach to the administration of grants for basic research rests on the belief that institutions and scientists alike wish to share responsibility for the administrative, financial and scientific integrity of the program.

Copies of the new guide may be obtained by writing:

Army Research Office, Office of the Chief of Research and Development, Headquarters Department of the Army, Washington, D.C. 20310.

ERDAA Has New Name With Revised Functions

The U.S. Army Electronics Command Meteorological Support Activity (ECMSA) was adopted recently as the name of the agency responsible for supporting the Army's 10 meteorological teams throughout the Continental United States, Alaska and Panama.

These teams provide meteorological services for all Army research, development, test and evaluation (RDT&E) activities except for the Army missile program. The missile RDT&E support is provided by a separate team based at White Sands (N. Mex.) Missile Range.

The Electronics Research and Development Activity (ERDAA), predecessor to the ECMSA at Fort Huachuca, was comprised of an Electronics Department and a Meteorological Department until Dec 31, 1965. By that time the Electronics Department function had been transferred to Fort Monmouth, N.J.

The meteorological functions have been divided into two units, one of which is the newly titled Support Activity. The micrometeorological research unit of ERDAA is now designated as the Atmospheric Sciences Research Division of the Atmospheric Sciences Laboratory, with headquarters at Fort Monmouth, N.J.

ARO-D Publishes Research in Progress Report

Research in Progress—1965, a 290-page calendar year report on more than 1,200 basic research activities supported through contracts or grants, was distributed recently by the Army Research Office-Durham (N.C.), Office Chief of Research and Development.

Under the supervision of the Director of Army Research, one of the four directorates in the Office of the Chief of Research and Development, the Army Research Office-Durham (ARO-D) is assigned responsibility for conducting that portion of the Army's basic research program in mathematics, and the physical engineering and environmental sciences which is accomplished through contracts and grants with educational institutions, research institutes and industrial laboratories located in the United States.

Included in the report are research activities sponsored through ARO-D by the U.S. Army Materiel Command (AMC), Department of Defense Advanced Research Projects Agency (ARPA), and the Defense Atomic Support Agency (DASA).

Described in the compilation are the scope and the progress on each basic research activity under ARO-D monitorship, including the name of the principal investigator and the academic institution or other organization with which he is associated. Other related reports also are listed.

The book is divided into five sections on scientific areas of investigation and a section of cross-referenced indexes.

The section on Physics, for example, includes astrophysics, atomic and molecular physics, cosmic radiation and elementary particles, cryogenics and liquids, electromagnetic waves and optics, electron and plasma physics, general physics, instrumentation and reactor physics, nuclear physics and solid-state physics.

The section on Chemistry reports on chemical engineering and materials, combustion and propulsion chemistry, photochemistry and radiation chemistry, electrochemistry and corrosion, polymer chemistry, inorganic and analytical chemistry, lubrication and surface phenomena, molecular structure and properties, organic synthesis, organic mechanisms, reaction kinetics and equilibria.

Mathematics research includes algebra and number theory, analysis, foundations, geometry and topology, aplied mathematics, numerical and graphical methods, probability and statistics, operations analysis, and the relatively new field of information sciences.

Listed in the Engineering Sciences section are research activities in materials mechanics, flow mechanics, electronics and systems and power.

Covered in the Metallurgy and Ceramics section are activities in solid-state metallurgy and ceramics, structure of metals and ceramics, physical properties of metals and ceramics, chemical metallurgy and ceramics, process metallurgy and ceramics, and testing of metals and ceramics.

Requests for copies of *Research in Progress—1965* may be addressed to the U.S. Army Research Office-Durham, Box CM, Duke Station, Durham, N.C. 27706, ATTN: CRD-AA-IP.

Increased Prize Money Offered By *U.S. Army Aviation Digest*

The *Army Aviation Digest* has announced that $25 will be awarded each month to the author whose article is judged best for the month, beginning this month.

In addition, the annual prizes are being increased to $250 for "Best of the Year," $150 for second and $100 for third place.

To be eligible for prizes the articles must be within the scope of the magazine's mission and may not have been submitted to other publications or have been previously published. All articles should be mailed to: Editor-in-Chief, U.S. Army Aviation School, Fort Rucker, Ala. 36360.

'Professionalism' Article Earns Lt Col Cleveland $100 Prize

Chief of Research and Development Lt Gen Austin W. Betts presented a $100 prize to Lt Col John G. Cleveland of the OCRD Air Mobility Division on June 30 as the third-place winner in the annual competition for the best article submitted to the *Army Aviation Information Digest*.

Maj Gen John J. Tolson, commandant of the U.S. Army Aviation School, Fort Rucker, Ala., requested General Betts to make the presentation on his behalf. Lt Col Cleveland's article, "Professionalism," appeared in October 1965 edition and was devoted to guidelines for maintaining a highly professional Army.

Bio-Medical Telemetry Course Slated by Smithsonian

Bio-Medical Telemetry will be the subject of an intensive course offered by the Smithsonian Institution at the Museum of Natural History, Aug. 10-13. Dr. R. Stuart Mackay will conduct the course, designed to provide a comprehensive introduction to the field for those engaged in research in the biological and health sciences.

Discussions will include fundamental electronic concepts and circuitry; systems and components; salient research problems; and case studies illustrating the expanding range of applications. Demonstrations, displays, motion pictures and slides will supplement presentations.

Miniature radio transmitters which can be swallowed or implanted in man or animals to reveal otherwise unobtainable information are now used routinely in a number of disciplines. With humans, such devices allow the exploration of clinical conditions in inaccessible regions and help in the testing of drugs. In animals, they permit the simultaneous study of behavior and physiological functioning without interfering with normal patterns of activity.

Recent developments include devices small enough to be placed in the eye; pill-size transmitters capable of operating up to two years; ultrasonic and radio units for free-swimming dolphins; and units for tracking wildlife.

Dr. Mackay currently holds a joint appointment in the University of California's Division of Medical Physics and Space Science Laboratory at Berkeley. In 1964, he served as senior scientist on the Galapagos International Scientific Project, having earlier shared the Apollo Award for "contributions to medical electronics."

Tuition is $125 for professionals; $60 for graduate students. Ten honoraria are available to qualified academic people in the life sciences through the American Institute of Biological Sciences.

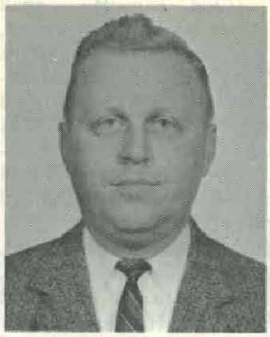
Further information may be obtained by writing: Bio-Medical Telemetry Course, Office of Education and Training, Smithsonian Institution, Washington, D.C. 20560; or calling Area Code 202: 381-5068.

Weapons Command Sets Sept. 27 For Industry Planning Briefing

Long-range R&D plans and programs related to military requirements of the U.S. Army Weapons Command (AWC) will be presented to industry in a one-day advanced planning briefing Sept. 27.

Cosponsored by the Army Weapons Command and the American Ordnance Association, the classified briefing is expected to attract about 400 invited representatives from AWC's R&D selected bidders list.

For the second year, Deere & Co. has invited the group to hold the meeting at its new multimillion-dollar administrative center in Moline, Ill.



Paul V. Dobrow

Lt Col Albert E. Joy

Maj Daniel J. Walsh

OCRD Announces 7 Staff Assignments

Seven key staff assignments announced by the Office of the Chief of Research and Development since the last edition of the *Army R&D Newsmagazine* are as follows:

Lt Col Allan T. Sylvester II, has succeeded Lt Col Frank L. Taylor as executive officer, Office of the Director of Army Research, OCRD. Col Sylvester has served as staff officer in the Human Factors and Operations Research Division, Army Research Office (ARO), since August 1965.

Col Taylor will report for duty in mid-August as commander of the 2nd Reconnaissance Squadron, 10th Armored Cavalry, 7th Infantry Division, Korea. He served as executive officer for the past year and has been assigned to the Research Directorate since January 1963. After a year in the HF&OR Division, he became chief of the Research Programs Office, with additional duty as assistant executive officer.

LT COL ALBERT E. JOY, who recently received a master's degree in business administration from the University of Pennsylvania, has been assigned as chief of the Research Programs Office, ARO.

A 1946 graduate of the U.S. Military Academy, he was chief, Intelligence Branch (G-2) Eighth Army, 1963-64, prior to entering the University of Pennsylvania. He attended the Command and General Staff College, Fort Leavenworth, Kans., from 1958–59 and continued on the staff and faculty of the CGSC until 1963.

He has served as assistant G-3 Operations Officer VII Corps, Assistant Inspector General, Seventh Army and, among early assignments, was Assistant Professor of Military Science and Tactics, University of Vermont.

Col Joy holds the Bronze Star Medal, the Army Commendation Medal with two Oak Leaf Clusters and the Army Combat Infantry Badge.

PAUL V. DOBROW, international planner in the joint U.S.–West Germany Main Battle Tank Program since January 1966, has joined the Policy Branch of the Review and Analysis Division of OCRD. In a newly created position as value engineer (GS–15), he is the principal HQ Department of the Army specialist for the Army Value Engineering Program.

A graduate of Detroit Institute of Technology, 1950, Dobrow holds a BS degree in industrial engineering. He received a bachelor's degree in law from LaSalle University in 1955 and recently completed the Defense Weapons System Management Course at the Air Academy, Dayton, Ohio. He has completed two Value Engineering Courses at Rock Island, Ill., and the Navy Quality Assurance Course.

Previous positions include senior value engineer with HQ, Army Materiel Command and chief operations analyst with the U.S. Army Air Defense Engineering Agency, Fort Meade, Md. Dobrow entered U.S. Civil Service in June 1951 as an ordnance engineer (GS–9) with the Navy Department.

He is a member of the Society of American Value Engineers, American Ordnance Association and the Department of Defense Value Engineering Council.

LT COL HOWARD E. ADAMS, a native of Buffalo, N.Y., is assigned to the Long-Range Plans Branch, OCRD Plans Division, to replace Lt Col Donald F. Bletz, reassigned to the Office of the Chief of Staff, Department of the Army.

(Continued on page 70)

Army Rushes New Helmet to Combat Fliers

U.S. Army pilots and aircrewmen in Viet Nam will soon be using a protective flight helmet termed one of the most significant developments in aviation safety headgear since 1958.

Developed by the Army's Natick (Mass.) Laboratories, the new helmet is constructed of laminated nylon fabric lined with ½-inch crushable foamed polystyrene plastic. In appearance and weight it is similar to the glass-cloth laminated unit it will replace.

MODELING the Army's new nylon flight helmet is Lt Col Edward T. Walker, a Viet Nam veteran now assigned to the Army Natick (Mass.) Laboratories. The helmet gives additional protection against crash and ballistic hazards. A plastic visor, not shown here, provides eye protection.

Scientists estimate that the helmet will sustain four times more impact and provide approximately 50 percent more fragmentation protection than the headgear now in use. Eight years ago the Army adopted the Navy standard flight headgear and has made only minor changes.

Two contracts have been let on an accelerated-production schedule and completion of delivery to Viet Nam in October 1966 is planned.

Eye protection is provided by a shatterproof plastic visor made of polycarbonate resin. It can also be attached to all Army flight helmets now in use or in stock.

Early laboratory tests, conducted under Army contract by the Snell Memorial Foundation, San Francisco, Calif., established that the new helmet material can withstand two successive 145-foot-pound impacts to the same spot without transmitting forces considered injurious. Standard Army ballistic tests confirmed the helmet's superiority.

The helmets are being manufactured by the General Tire and Rubber Co., Akron, Ohio, and Sierra Engineering Co., Sierra Madre, Calif. The Mine Safety Appliances Co. of Pittsburgh, Pa., is producing the visors.

OCRD Announces 7 Staff Assignments

(Continued from page 69)

Previously, Col Adams was Navy action officer in the War Plans Division of the Office of the Deputy Chief of Staff for Military Operations, DA. He is a 1948 U.S. Military Academy graduate, received a masters' degree in international relations from Tulane University in 1965, and has completed the Army Command and General Staff College.

From 1955–58, Col Adams was assistant professor of topography at the U.S. Military Academy. Other assignments include: Assistant G–3 Training, 1st Cavalry Division, Korea and Assistant Plans and Operations Officer, Landing Force Training Unit, Amphibious Training Command, Atlantic.

MAJ DANIEL J. WALSH has been assigned to the Research Plans Branch, Research Plans Office, ARO, to replace Lt Col David M. Monihan. Assigned to the ARO since July 1963, Col Monihan is studying at George Washington University, Washington, D.C., prior to an oversea assignment.

Maj Walsh, a native of Lawrence, Mass., has a BS degree in electrical engineering from the University of New Hampshire (1952) and an MSE from Arizona State University (1966). After attending the Command and General Staff College in 1961, he was with HQ 32nd Artillery Brigade, USAREUR (1961–63) and served in the Operations Division, HQ U.S. Army Europe in 1963–64 and was assistant professor of Military Science and Tactics, Niagara (N.Y.) University, 1958–60.

MAJ RICHARD S. BULLOCK, a staff officer in the Fire Support Missiles Branch, Air Defense and Missiles Division, OCRD, replaced Lt Col William H. Tuttle. With OCRD since July 1963, Col Tuttle is assigned to the Armed Forces Staff College.

Maj Bullock recently received a master's degree in aerospace engineering from the University of Michigan. A 1952 graduate of the U.S. Military Academy, he earlier studied chemical engineering at Alliance College. He completed the Command and General Staff College Course in 1964.

His assignments include: executive officer (S-3), 4th Battalion, 333rd Artillery, and assistant executive officer, 209th Artillery Group, Fort Sill, Okla. From 1960 to 1961, he was training adviser, Military Assistance Advisory Group (MAAG), Viet Nam, and has served as an instructor in the Military Topography and Graphics Department, U.S. Military Academy.

MAJ ROBERT E. BUTLER, a staff officer in the Combat Arms Branch of the Combat Materiel Division, OCRD, succeeded Lt Col Joseph E. Fix III, recently assigned as executive secretary of the Army Scientific Advisory Panel (ASAP).

A 1953 graduate of the U.S. Military Academy, Maj Butler received a BS degree in 1960 and an MS in 1961 in aerospace engineering from the University of Arizona. He is a graduate of the Armor Career Course and Command and General Staff College.

Before joining OCRD, he was executive officer, 1st Battalion, 50th Infantry (Mechanized), 2nd Armored Division, Fort Hood, Tex. He served 1965 in Viet Nam as senior adviser, 3rd Armored Cavalry Squadron (Viet Namese) and earlier was project officer, Combat Development Command Armor Agency, Fort Knox, Ky. Maj Butler served in Germany from 1953–58 as platoon leader, assistant S-3 and company executive officer with the 3rd Armored Cavalry Regiment.

He holds the Bronze Star Medal, Air Medal wtih Oak Leaf Cluster, Army Commendation Medal, Combat Infantry Badge, Viet Namese Armor Badge and the Viet Namese Cross of Gallantry with Silver Star.

ASA (R&D) Hawkins Draws Plaudits at Farewell

(Continued from page 5)

Further tributes came to Mr. Hawkins for "efforts that were instrumental in obtaining recognition for the need and the establishment of a well-rounded Avionics Program responsive to the Army's immediate and future needs."

When the findings of a joint study contributed to consideration of requirements for reorganization of AMC laboratories, with emphasis on effective coordination and integration of effort in interdisciplinary areas, Mr. Hawkins assisted in recruitment of Dr. Jay Tol Thomas, an eminent industrial scientific leader, as AMC Director of Research and Laboratories.

Other areas which earned Mr. Hawkins recognition for outstanding leadership included: improvements to the Pershing missile which materially increase the system's combat capabilities; also, "contributing significantly by sound guidance" to furthering the SAM–D (Surface-to-Air Missile Development) Program; further, work that advanced utilization of the Total Package Procurement Concept in the Army, which results in contracts to provide both development and production of a given item.

As delegated with responsibility by the Secretary of the Army for the unique development concept, Mr. Hawkins was responsible for approving all actions taken in the joint U.S./Federal Republic of Germany Main Battle Tank development program. He made numerous trips to Europe to work with German contractors and the joint engineering agency in directing developmental effort, and also coordinated activities in the United States.

Mr. Hawkins has returned to Lockheed Aircraft Corp. and is Corporate Vice President for Science and Engineering. In his previous assignments with Lockheed, he was instrumental in the creation of a family of military satellite systems and various missiles.

Aviation has been Mr. Hawkins' avocation as well as a major portion of his professional interest. An avid aviator, he has his own plane and on much of his Army business took pleasure in relieving the assigned pilot. He holds a number of patents on complete aircraft designs and five major patents on aircraft component designs.

For the Federal Government, he served in a number of advisory capacities on aircraft problems and was a member of the Government Task Force on Interurban Air Transportation for the Federal Aviation Agency.

The depth and breadth of his knowledge on problems of aircraft development and air transportation is reflected in what the editor considers one of the finest articles the *Army R&d Newsmagazine* has been privileged to publish.

Carried in the November 1964 edition, that article is titled: "The Next 50 Years in Aviation." It is a highly condensed version of the major address given at the Convocation of the Fiftieth Anniversary of Aeronautical Engineering, held Oct. 9, 1964, at Ann Arbor, Mich.

Mr. Hawkins was presented by the University of Michigan with an honorary degree as Doctor of Engineering, in recognition of his many contributions to the aircraft industry. In June of this year, he was recognized by Illinois College with an honorary Doctor of Engineering degree.

Contracts Total $923.6 Million

(Continued from page 6)

Zero Manufacturing Co., Silver Spring, Md., $1,145,400 for expansible shelters for self-contained, transportable medical units; Chemical Compounding Corp., Jersey City, N.J., $1,144,093 as first increment to a 3-year buy contract for decontaminating and impregnating kits; Kentucky Manufacturing Co., Louisville, Ky., $1,127,670 for 12-ton semitrailers;

Rexarc Inc., West Alexandria Ohio $1,109,151 for trailer-mounted acetylene generating and charging plants; B. Jahn Manufacturing Co., New Britain, Conn., $1,079,096 for 30-caliber carbine magazine assemblies; Scoville Manufacturing Co., Waterbury, Conn. $1,072,811 modification for bomb components; and KDI Corp., Cincinnati, Ohio, $1,048,489 for ammunition.

Scenes at 5th Army Science Conference

(1) Dr. Harold C. Weber, retiring Chief Scientific Adviser, OCRD, is shown presiding at 1966 Army Science Conference. Dr. Weber has served as presiding chairman at all Army Science Conferences since 1957. Pictured (l. to r.) on photos below are: (2) Col Charles L. Beaudry, CO, U.S. Army R&D Group, Europe; Col Robert E. Kimball, Director of Army Research, OCRD; Col Charles W. Cook, CO, U.S. Army R&D Group, Far East; R Adm J. K. Leydon, Chief of Naval Research. (3) USMA Chaplain J. D. Ford; Monsignor Joseph P. Moore, USMA Catholic chaplain; ASA (R&D) Willis M. Hawkins; Chief of R&D Lt Gen Austin W. Betts; Lt Gen Arthur G. Trudeau (USA, Ret.) former Army Chief of R&D, new president of Gulf R&D Co.; Col L. G. Callahan, CO, Fort Monmouth, N.J. (4) Frankford Arsenal representative; Frank W. Duetsch, Dr. G. P. Sollott, Dr. W. J. Kroeger, Dr. Henry Gisser, Jonathan Snead, 1st Lt Uicker. (5) Dr. Warren Berning, APG, Md.; Willis Webb, WSMR, N. Mex.; Dr. Ernest N. Petrick, U.S. Army Mobility Command, Mich.; Dr. J. V. R. Kaufman, Picatinny Arsenal, N.J.; Dr. W. W. Carter, Redstone Aresenal, Ala.; Lt Col George A. Nabers, CDC Evaluation Command; Louis Duncan, WSMR.


1


2

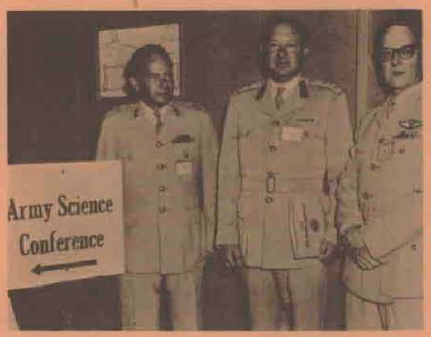

3


4


5

Participating Dignitaries in 1966 Army Science Conference

PRINCIPALS in the 1966 Army Science Conference, shown left to right, include Lt Gen Austin W. Betts, Chief of Research and Development; Dr. Harold M. Agnew, Chairman of the Army Scientific Advisory Panel and keynote speaker; Assistant Secretary of Army for Research and Development Willis M. Hawkins; Superintendent of the U.S. Military Academy Maj Gen D. V. Bennett; and Dr. Harold Weber, presiding chairman of the conference and retiring Chief Scientific Adviser, Office of the Chief of Research and Development.



FOREIGN NATION participants at the conference included (l. to r.) Lt Col J. Caryi, Canadian Armament R&D Establishment, Valcartier, Quebec; Brigadier L. W. Jobb, assistant military attache, British Embassy, Washington, D.C.; and Lt Col K. F. Collins, Engineering Directorate of Armament, Canadian Armament Establishment.

L to R: Brig Gen Colin F. Vorder Bruegge, CG, U.S. Army Medical R&D Command; Brig Gen Wallace L. Clement, director of Personnel Studies and Research, Office of the Deputy Chief of Staff for Personnel; Col Tyron C. Huber, U.S. Army Research Office.

SOCIAL HOUR at the conference gave Army research leaders an opportunity to renew acquaintances. L. to R. are Dr. Richard A. Weiss, Deputy and Scientific Director of Army Research and general chairman of the conference; Billy M. Horton, Technical Director, Harry Diamond Labs, Washington, D.C.; Brig Gen W. A. Latta, CG Electronics Command, Fort Monmouth, N.J.; Col Robert E. Kimball, Director of Army Research; Brig Gen James C. Hebbler, director, CBR Operations, Office of the Assistant Chief of Staff for Forces.

REPRESENTATIVES of several Army overseas research units at Army Science Conference (l. to r.) Dr. Robert S. Hutton, U.S. Army Tropic Test Center, Fort Clayton, C.Z., with Dr. Galan R. Frysinger, Army Engineer R&D Labs, Fort Belvoir, Va.; Col C. W. Cook, Army R&D Group Japan; and B. S. Goodwin, special assistant to the CG, Test and Evaluation Command, Aberdeen Md.

INFORMAL moments at the conference are amusively enjoyed by (l. to r.) Lt Col K. C. Emerson, research assistant to the Assistant Secretary of the Army (R&D); Charles L. Poor, Deputy Assistant Secretary of the Army (R&D); and Dr. Hans K. Ziegler, Chief Scientist, U.S. Army Electronics Command, Fort Monmouth, New Jersey.