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FY 1965 Reports Reflect Successful Results of ILIR Program

AMEDS Reports Progress in 5-Year R&D Program

Announcement of a "far-ranging 5-year Medical Research, Development, Testing and Evaluation Program to meet forecasted requirements for any kind of war in any kind of environment" was made in a feature article in the June 1962 edition of the Army R&D Newsmagazine.

In the 3-year interim, results point to substantial progress. The author of the following article presents it as "an editorial consolidation of the reports prepared by a great many persons who have assisted in summarizing only some of the more important results. Because of space limitations, the report is skeletonized."

* * *

By Lt Col Donald L. Howie

Since the publication of a 5-year proposed research program in FY 1962, the Army Medical Service (AMEDS) has expanded research in support of the ground combat soldier and achieved many of its objectives.

The U.S. Army Medical Research and Development Command provides management, personnel, and research

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Featured in This Issue . . .

SENATE MAJORITY LEADER Mike Mansfield greets another "leader" from Montana, Francis O. Dudas, 15, one of the U.S. Army's 20 top award selectees at the 16th National Science Fair-International. Each of the winners had a choice of a week-long all-expense-paid visit or a summer job at an Army laboratory. Dudas decided on a visit to the Army's Biological Laboratories at Fort Detrick, Md.

Scientific Directors Commend Independent Research Efforts

Complete accord on the merit of any research program among all scientific directors within Army research and development might be considered a goal impossible of achievement, but the Army In-House Laboratories Independent Research Program has indisputably attained that success.

Established under policies prescribed in Army Regulation 705–55, issued in October 1962 and titled "Research and Development of Materiel, Management of U.S. Army R&D Laboratories or Activities," the ILIR Program was conducted at the rate of about $11.2 million annually in FY 1965, reports currently under review indicate.

A committee appointed by the Deputy Assistant Secretary of the Army for Research and Development, was convened Aug. 17-18 to consider the FY 1965 reports. Scientific or technical directors of selected laboratories were invited to attend

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3 Top R&D Leaders Brief Reorganized TARC

Assistant Secretary of the Army (R&D) Willis M. Hawkins, Chief of Research and Development Lt Gen William W. Dick, Jr., and Director of Army Research Brig Gen Walter E. Lotz, Jr., briefed The Army Research Council (TARC) at its initial FY 1966 meeting.

Six new members and a new chairman assumed their duties, including two to serve as TARC additions in the social and behavioral sciences, in order to correspond to the composition of the Department of Defense Joint Discussion Forums. The five Forums are organized into major areas of scientific disciplines.

TARC has made a valuable contribution to the progress of Army research with its studies and recommendations since it was created in January 1964, Mr. Hawkins stated. General Dick joined with him in commending the accomplishments of TARC and in pointing out the importance of focusing research attention on critical gaps impeding advanced development efforts.

General Lotz, TARC coordinator since its inception, discussed the additional important function of TARC in providing Army representation on each of the Forums under the Director of Defense Research and Engineering.

Dr. Richard A. Weiss, Deputy and Scientific Director of Army Research, presided as the new chairman of TARC. Six new members were present for the first time, namely: Dr. Maurice Apstein, Harry Diamond Laboratories; Dr. W. W. Carter, U.S. Army Missile Command; Dr. Hoyt

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Army R&D Newsmagazine

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Purpose: To improve informal communication among all segments of the Army scientific community and other Government R&D agencies; to further understanding of Army R&D progress, problem areas and program planning; to stimulate more closely integrated and coordinated effort among the widely dispersed and diffused Army R&D activities; to maintain a closer link from top management through all levels to scientists, engineers and technicians at the bench level; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

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Engineer Earns Highest Civilian Award

A new concept of ultra-high-speed, high-frequency electrical motors and generators has earned Ralph E. Hopkins, 40, electrical engineer at Fort Belvoir, Va., the Army's highest award for a civilian employee.

It is his third but highest honor for work in this specific field.

Associated with the U.S. Army Materiel Command's Engineer Research and Development Laboratories since 1950, Hopkins was presented the Army Exceptional Civilian Service Medal recently at Fort Belvoir.

Brig Gen Thomas B. Simpson, commanding general of the Army Mobility Equipment Center, St. Louis, Mo., cited him for a "significant contribution" in the electrical propulsion area.

Other honors he has received are the Commanding Officer's Technology Medal in 1963, and the Army Research and Development Award in 1964.

As chief of the Advanced Design Branch in the Electrical Power Division, he was cited for "exceptional qualities of leadership and outstanding technical accomplishment as a research, design and development engineer."

In particular, he was commended for his work in ultra-high-speed and high-frequency motors and generators, and the control techniques for the machines. His advanced concept in electrical propulsion was noted as a tremendous gain in terms of vehicle performance and payload.

Hopkins' concept is based on the use of ultra-high-speed turbine generators, motors and alternators, and automatic digital controls to provide power for various types of military equipment, ranging from earthmovers to mobile weapons.

Test vehicle for this revolutionary system is the huge, ballastable earthmoving sectional tractor (BEST), which has been undergoing Army airborne evaluations this year. Power for the earthmoving giant is provided by a 200 kw. generator operating at 40,000 r.p.m., and a 50 h.p. 30,000 r.p.m. motor in each wheel.

Use of Hopkins' developments would replace the 3,300-pound diesel engine, normally used for the earthmover, with a 500-pound power plant. When not moving earth, the versatile tractor becomes a 200 kw. mobile plant for emergency power.

Hopkins served in the Army during World War II, participating in operations at Normandy and in Northern France. He received his B.S. degree in electrical engineering from Ohio University in 1950.

ELECTRICAL ENGINEER Ralph E. Hopkins receives Army Exceptional Civilian Service Medal from Brig Gen Thomas B. Simpson, CG, U.S. Army Mobility Equipment Center, St. Louis, Mo. At left is Col Frank Milner, CO, U.S. Army Engineer R&D Laboratories located at Fort Belvoir, Va.

3 Top Research Leaders Brief Reorganized TARC

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Lemons, Army Research Office; Kenneth M. Barnett, Fort Huachuca, Ariz.; Dr. John D. Weisz, Aberdeen Proving Ground, Md.; Col William Hausman, Walter Reed Army Institute of Research.

Holdover members of TARC under the 2-year rotation plan are Col Tyron E. Huber, chief, Life Sciences Division, U.S. Army Research Office; Col William D. Tigert, director, Walter Reed Army Institute of Research; Dr. Gilford G. Quarles, chief scientific adviser, Office of the Chief of Engineers, Washington, D.C.; and Dr. J. V. R. Kaufman, chief scientist, U.S. Army Munitions Command, Picatinny Arsenal, Dover, N.J.

KENNETH M. BARNETT, technical director of the Meteorology Department, U.S. Army Electronic Proving Ground, Fort Huachuca, Ariz., is the newest appointee to The Army Research Council.

Dr. Helmut K. Weickmann resigned from TARC before he could attend a session as a new member when he transferred from the Army Electronics Laboratories, Fort Monmouth, N.J., to the U.S. Weather Bureau as head of the Atmospheric Physics and Chemistry Laboratory in Washington, D. C.

Barnett was named to fill the vacancy. Employed at Fort Huachuca since 1954, he has been in meteorological work since 1941.

Graduated from the University of Kansas in 1941 and from the University of Chicago in 1943 with a degree in meteorology, he is working on a Ph.D. at the University of Arizona.

FY 1965 Reports Reflect ILIR Program Success

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and present their views on use and accomplishments of the ILIR Program.

Director of Army Research Brig Gen Walter E. Lotz, Jr., Assistant for Research to the ASA (R&D) Col K. C. Emerson, Dr. Ralph G. H. Siu, Scientific Director of the Research Division of the U.S. Army Materiel Command, Dr. Gilford Quarles, Office of the Chief of Engineers Scientific Advisor, and Dr. Herbert Pollack, Institute of Defense Analysis constituted the committee. All are Ph.D. scientists and Pollack also has a medical doctor's degree.

ILIR Program reports for FY 1965 from 47 Army research and development activities were considered, and the technical directors of 14 of these installations were present at the meeting of the review committee.

Indications from directors present, and as officially stated in the reports from all major R&D activities, are that leaders of the ILIR Program are highly desirous of having it continued at least at the present annual expenditure level.

Paeons of praise is a cliche accurately descriptive of the comments of Army in-house laboratory directors in expressing their views on how well the ILIR Program is achieving the purpose for which it was established.

The stated objective is: "To promote a vigorous internal research program of the highest technical caliber." The intent is to provide individual Army scientists and engineers an additional opportunity to increase their competence by doing original work suited to their research talents.

Emphasis in the ILIR Program is on "new and challenging tasks." As Mr. Poor, Deputy Assistant Secretary of the Army (R&D), explained at last year's Conference for Laboratory Commanders and Technical Directors:

"One of the objectives in establishing the Laboratory Technical Director's Fund was to provide a source of funds to counter 'job-shop' operations in maintaining a balanced R&D program in the scientific and engineering areas of concern to his lab.

". . . Previously he had no source of funds for his laboratory that were not subject to justification, review and approval by other organizations or individuals who were only concerned with parts of his program."

The unique aspect of the ILIR Program is that technical directors of laboratories justify their decisions after, rather than before, they are made on the basis of the results achieved. Directors are given wide latitude in deciding the nature of independent research efforts that will best serve the mission objective of their laboratories.

That latitude is governed by another stated objective of the ILIR Program: "To promote the effective utilization of available resources and to foster an awareness of management policies and principles necessary for the proper utilization of these resources in accomplishing the research and development mission."

The ILIR Program originated when the late President Kennedy, in August 1961, ordered the director of the Bureau of the Budget to determine if the Government was capable of taking over some scientific and technical work then being done under contract. The order called for a determination of "what policies and actions are necessary to increase Government capabilities."

SUMMARY OF ILIR PROGRAM IN FY 1965. Reports reflect a total of 408 research tasks during FY 1965, as compared to 411 in FY 1964. Many of these tasks, as was true also, in 1963 and 1964, have produced results that have led to their incorporation into the regular applied research programs of the laboratories.

To single out from more than 400 tasks the 10 percent considered to have achieved the most significant results, for review in this publication, would be a formidable chore, and would require more space than is here available.

In previous years, technical directors of the laboratories were asked to select the three tasks under their supervision which they believed had produced the most outstanding results. That helped to facilitate the work of the review committee appointed by the Assistant Secretary of the Army (R&D).

The U.S. Army Engineer R&D Laboratories, Fort Belvoir, Va., and the Chemical R&D Laboratories, Edgewood Arsenal, Md. each reported ILIR tasks. The Natick Laboratories, Natick, Mass., and Walter Reed Army Institute of Research, Washington, D. C., each conducted 25 tasks. The Electronics Laboratories, Fort Monmouth, N.J., reported 37 tasks.

In total, the reports covered research performed at 47 laboratories, including a breakout of the new laboratories established at Fort Monmouth, N.J., Picatinny Arsenal, Dover, N.J. and Frankford Arsenal, Philadelphia, Pa.

The scope of the research work units and the diversity of effort, reaching into all the major scientific disciplines, is indicative of the broad range of Army scientific interests when investigators are given latitude in selecting preferred areas of research.

The work at the Natick Labora-

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Heart Attack Claims Distinguished ASAP Consultant

The Army Scientific Advisory Panel lost one of its most eminent consultants when Dr. Alvin C. Graves died recently of a heart attack.

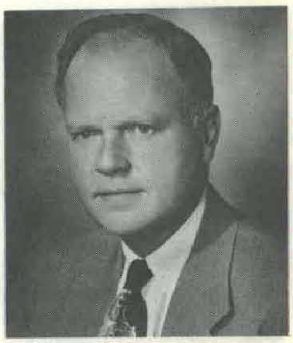
Appointed a member of the ASAP in 1957, Dr. Graves had served as a consultant since 1963, performing "invaluable service" in relation to Army problems of using nuclear energy in research and for electric power plants.

Dr. Graves was renowned for his work on the team that built and tested the world's first chain-reacting nuclear pile under the bleachers at Staff Field, Chicago. In 1943, he joined the Los Alamos Scientific Laboratory at the University of California, where the first atomic bomb was built, and became head of its test division in 1945.

In that capacity, and at various times as test director at the Pacific Proving Grounds, Eniwetok and the Nevada Proving Grounds, he supervised many U.S. atomic and hydrogen bomb tests.

Selected to represent the U.S. Atomic Energy Commission at the 1959-60 Geneva (Switzerland) conference on discontinuing nuclear weapons testing, he also participated in the 1959 Geneva discussions on detecting high-altitude nuclear blasts.

He received the Exceptional Civilian Service Award from the U.S. Air Force, a Certificate of Achievement from the U.S. Army, and the Distinguished Service Award from the Federal Civil Defense Administration.



Dr. Alvin C. Graves

AMEDS Reports Gains in 5-Year R&D Program

(Continued from page 1)

facilities for 20 projects funded under the Army Research, Development, Test and Evaluation Program.

This program is directed toward increasing efficiency of military operations through the reduction of traumatic casualties and losses due to disease, and to raise the performance of the individual soldier.

Research efforts were divided about equally between in-service and extramural programs. Intramural research was conducted primarily at 14 laboratories or units under the management of the Medical Research and Development Command in the United States and overseas.

In addition, investigations were conducted at 14 Army hospitals, at other medical facilities both here and abroad, and through the support efforts of other Government agencies.

The extramural effort consisted of approximately 600 research contracts and grants with universities and other research institutions throughout the United States and in a few overseas locations.

About 5,250 Participants. The total AMEDS research program in FY 1965 involved 1,058 full-time civilian scientists and 1,225 equally highly trained medical officers. In addition, 2,348 civilians were employed full-time on 547 contracts and 64 grants involving the general scientific community. On each of the contracts or grants, one or more supervisors at the professorial level provided their services at no cost to the Government.

During FY 1965, acceleration of studies was promoted in many areas to include increased efforts in newly encountered infectious diseases and drug-resistant strains, particularly Falciparum malaria; medical defense against biological and chemical agents; biological effects of Lasers; disabling skin diseases which afflict combat troops; biological effects of climatic extremes, including high altitudes; and development of more effective, lightweight and readily transportable field medical equipment.

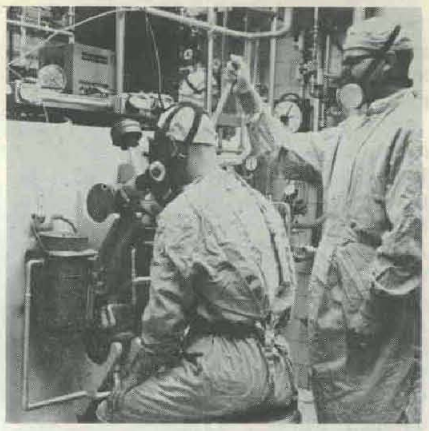
Combat Surgery. Preliminary reports released by the Trauma Unit at the University of Maryland indicate the discovery of an electron transfer system and source of energy for oxygen transport. This system can be reinforced to speed oxygen to damaged cells in patients who are in shock. A wide variety of phenomena associated with trauma and shock have been defined, and effective measures to reduce fatalities are being developed.

Work continued in the use of various methods for suppression of the immune response of the body to homografts, such as attempts to modify the host response by the use of drugs. A combination of drying, freezing and irradiating nerve grafts has been tried and has proved successful in 25 percent of the cases in which these grafts were used. Research has proved that silastic envelopes improve nerve regeneration after injury.

Hydroxyethylated starch has been shown to be equally effective as dextran as a plasma expander, and will be released by the U.S. Food and Drug Administration (FDA) for Phase I (human) investigation. Effects of HES on viscosity and blood coagulation have also been shown to be similar to the effects of dextran.

Work in the preservation of whole blood continues, with the immediate objective of doubling the shelf life of blood by specific additives.

Several synthetics are under study as substitutes for blood vessels, trachea and the bile duct. After prolonged survival in dogs, the first successful synthetic prosthesis has been recorded as a common duct implant in a human.



VIRULENT INFECTIOUS AGENTS are screened and studied in a U.S. Army medical research laboratory. Precise identification of the microorganisms is made from samplings taken on a worldwide basis.

Topical use of sulfamylon (as a "butter") has been extremely effective in controlling infections of burned skin surfaces. The bacterial flora of burns has been shown, clinically and experimentally, to extend deep into the subcutaneous tissues.

The Army Medical Service continues to lead the Nation in studies of the biological effects of Laser irradiation.

Military Internal Medicine. Troop tests conducted at Fort Bragg, N.C., on liquid and solid rations of the patrol or survival type were highly successful. It was found that 2,000 to 2,600 calories were adequate for maintaining physical efficiency, regardless of the form in which they were consumed (liquid, solid or in combination). The major problem for troops, however, appears to be the monotony of rations consumed over prolonged periods of time.

Investigators have reported encouraging progress in the development of a small, economical and efficient blood dialyzer for the treatment of renal insufficiency.

In the area of infectious hepatitis, a new study being conducted at the Delta Regional Primate Center, Covington, La., seeks to explore the experimental potentialities of materials obtained from a chimpanzee that succumbed to this infection.

A conference on Systemic Insect Repellents was held Apr. 8-9, 1965, at Walter Reed Army Institute of Research, Washington, D. C. Most of

Col D. L. Howie

Col Donald L. Howie joined the headquarters staff of the U.S. Army Medical R&D Command, Office of the Surgeon General, in March 1962. He first served as chief of the Medical Research Branch, later as chief, Plans, Programs and Funds Division, and in February 1965 was appointed deputy commander. A diplomate of the American Board of Internal Medicine, Col Howie has served in a wide variety of field, clinical, research and academic assignments. He was previously the deputy director, Division of Medicine, and assistant chief, Department of Hematology, Walter Reed Army Institute of Research, where his principal interests were in clinical and laboratory hematology research.

the basic work has been done with the Aedes aegypti mosquito. Work to date reveals modes of action of repellant agents, new methods to determine probing of mosquitoes, and promising leads in development of systemic repellents.

Military Psychophysiological Studies. Work on acoustic trauma has continued with the use of both human and animal subjects. Studies of middle ear prosthesis in animals exposed to high altitudes have indicated that no untoward effects may be anticipated even in unusually stressful situations.

Research on muscular fatigue and endurance has continued with the self-titrating treadmill, a device developed by the Army Medical Research Laboratory which is useful for research in motor skills and psychopharmacological studies.

Military Psychiatry. The development of language training programs using operant conditioning principles of testing American soldiers in basic vocabulary of Vietnamese is proceed- in collaboration with personnel of the Human Resources Research Office (HumRRO), George Washington University, Washington, D. C.

Milieu therapy has been used as a regimen to develop a method of treatment for patients and for investigating related phenomena of group psychotherapy behavior—the effect of operant conditioning techniques, the use of symptoms to achieve social ends of operant conditioning techniques, and the use of symptoms to achieve social ends and symptom disappearance. Techniques of personal interview, combined with analyses of families and larger social groups, have been demonstrated to be useful and feasible.

Military Environmental Medicine. Decrease in performance due to sudden and chronic exposure to high terrestrial altitudes has been under intense study. Physiological phenomena of mountain sickness and adaptation are being analyzed.

Results of extensive investigations of humans subjected to various types of physical exertion at 14,500 feet in the Colombian Andes indicate that a potassium intake must be provided to lessen the severity and duration of mountain sickness. To achieve a balanced salt intake, careful attention must be given to the diet.

Most processed foods are high in sodium and relatively low in potassium. A satisfactory potassium intake can best be insured from dehydrated fruits and vegetables. Since food intake is likely to be severely limited by anorexia, it has been found advisable to give supplementary potassium in an artificial form.

In investigations of biological responses to cold, emphasis was placed on relationship between lipid metabolism and cold stress. Feeding of high-fat diets prior to cold exposure appeared to predispose rats to a more efficient mobilization and utilization of fat when subsequently exposed to cold.

Chronic cold exposure resulted in a decrease in muscle mass and a corresponding decrease in total muscle fat. A readily available source of neutral lipid seems to exist in, or be closely associated with, striated muscle which can meet the immediate metabolic demands of cold exposure. Cold acclimatization studies revealed that adaptive changes occurring in the liver result in accelerated utilization of fatty acids.

Changes in water balance are among the more obvious responses to changes in environmental temperature. Refractometric methods are being developed for more exact measurement of such changes. Although marked changes in body water occur in exposure to heat, less obvious changes may also be related to cold stress.

Experiments in man and animals indicate that norepinephrine may be the mediator of cold acclimatization (non-shivering thermogenesis). Heat and cold acclimatization may be present at the same time, with no observable effects of one on another. Tolerance levels for certain environments (hot-dry and hot-wet) have been established.

Ionizing Radiation Injury—Prevention and Treatment. A single compound has been reported to provide a dose reduction factor (protection) of 2.6 in mice. No other single compound has evidenced such promise. A combination of compounds has given a dose reduction factor of greater than 3.0 in one strain of mice.

An in-house capability has been established for automated biochemical analyses of body fluids for rapid determinations of biological products resulting from changes in metabolism due to ionizing radiation.

Metabolic products have been shown by gas chromatographic techniques to be present in significant quantities in muscle tissue, formed blood elements and serum of irradiated rats. These

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STUDIES in environmental medicine are a vital part of AMEDS research and development. In aeromedical research (upper left) a Medical Service Corps officer prepares subject for tests in hazardous noise environment in the air as the Army moves further into vertical concepts of battlefield mobility. Peak-level measurement of weapon-firing noise from tank driver's position (upper right) enables scientists to find methods to avoid serious loss of hearing. Research in the many climatic areas of the world (right) allows AMEDS R&D specialists to determine health hazards for closer direction of biological research.

AMEDS Reports Gains in 5-Year R&D Program

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metabolic products are being studied as possible prognosticators of irradiation injury. Two such metabolites seem to have promise in this endeavor.

Certain steroids reportedly have demonstrated a degree of therapeutic effectiveness when administered to irradiated rats.

The synthesis of selected potential antiradiation agents is being continued. When the screening test indicated significant radioprophylaxis, more detailed evaluatory tests were applied to determine the degree of protection as well as toxicity and pharmacological action. Radiation sources in these studies now include X-rays, gamma rays, and neutrons.

Military Preventive Medicine, Communicable Diseases and Immunology. The Armed Forces Epidemiological Board (AFEB) Commission on Influenza reported evidence that there has been further antigenic shifting of 1964 Asian strains away from the 1957 and 1962 prototypes. Recommendations were made concerning the formula for the 1965-66 winter season.

The virus of Venezuelan equine encephalomyelitis (VEE) Trinidad strain and the virus of Bolivian hemorrhagic fever have been isolated from the bone marrow of patients.

Work has progressed on the effects of vaccination and drugs on infections with *P. tularemia.* Attenuated VEE virus vaccine has been given to about 2,500 people with no essential difference in immune response. It has been demonstrated that virus may be isolated from artificially infected mosquitoes five weeks after infection.

ENVIRONMENTAL EXTREMES to which troops may be subjected are under constant study by AMEDS. Physiological effects of heat and cold, high and low altitudes receive intensive research by the medical service. Pictured above is a new concept in U.S. Army "all weather" uniform.

Phase I Q-fever vaccine has been produced, tested for potency and safety, and will receive further development at the University of Maryland and at Walter Reed Army Institute of Research (WRAIR). Typhoid vaccine evaluations have continued over an extended period and it is planned to vaccinate large groups of men using smaller doses of challenging bacteria.

Further epidemiological studies have been carried out on hemorrhagic fever in the Southeast Asia area. It was demonstrated that Bolivian (Machupo) hemorrhagic fever virus can be easily distinguished from Tacaribe and Junin viruses by neutralization tests. It appears probable that the Bolivian disease is transmitted by a house rodent, *Calomys callosus,* and that transmission is either by contamination of food with rodent urine or by aerosolization of dried urine. There is as yet no evidence of transmission by arthropods. A Japanese B virus vaccine has been prepared for volunteer studies.

Working with industry, WRAIR and extramural investigators have been successful in producing Rift-free E strain typhus seed material, and a vaccine may be ready for testing within the next year. Scrub typhus has been found widely distributed in Pakistan, not only in the lowlands, but also as high as 8,000 feet in the Himalayan Mountains. Vivax and falciparum malaria have also been discovered in the Himalayas at altitudes above 10,000 feet.

Further studies on griseofulvin have been carried out. It is a peculiarly selective drug in that it works only against ringworm fungi and has no effect on other dermatological illnesses. Advantage is being taken of this peculiarity in attempts to develop a selective culture technique which would not require a microscope or even the employment of an expert mycologist. Failure to grow on the griseofulvin medium and good growth on Sabouraud's agar, without the need of an incubator, are the anticipated results.

Under the aegis of the AFEB Commission, investigators worked on rhinoviruses, and arrangements have been made for serotyping.

Further projects in malaria research have begun, some under the surveillance of WRAIR and others monitored by the AFEB.

The high national rate of oral impairment due to injuries and diseases keeps AMEDS research in this field always of prime interest. Army dentists, like the one pictured above, work constantly on preventive and more simplified methods of dentistry.

New accurate field methods for detection of radioactivity and of free chlorine residuals in drinking water have been demonstrated.

Mode of action of halogen inactivation of bacteria and viruses in water has been partly elucidated. The utility of a compact foam-separation unit for field treatment of water supplies for small groups has been estabished and design criteria are being developed.

Studies of virus movement in ground water are nearly complete. New methodology to determine the extent of environmental contamination by beryllium from the burning of wastes containing this toxic metal has been developed. The ability of anaerobic liquid waste treatment systems to operate at low temperatures has been demonstrated.

Gamma globulin administration to 25 proven nasal carriers of meningococci completely failed to eradicate the organisms from the nasal cavity.

A study involving over 10,000 recruits showed that gamma globulin administration during the first week of basic training failed to reduce the incidence of both meningitis and pneumonia, although measles and rubella showed a decrease.

Diarrheal disease in American troops continues as a major problem in Southeast Asia. An expert team of civilian consultants in the various fields of gastroentherology is being sent to this area to explore possibilities for research which will ultimately find some answers in this field.

Combat Dentistry. Preventive dentistry studies continue to be most promising in eventually managing

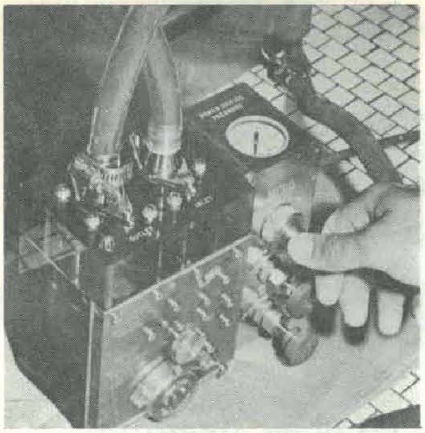
the increasing patient loads of the U.S. Army Dental Corps. New studies include:

- The effects of Lasers on oral tissues and future expansions incorporating studies of Lasers in dental laboratories to simplify welding and cutting techniques.
- Motivation of field troops to maintain effective preventive dentistry measures.
- Definitive study fractures of the subcondylar area of the mandible.
- Advanced studies in periapical pre- and post-surgical inflammatory conditions frequently observed in young adults.

Techniques have been developed which have the possibility of reducing investment and casting times for prosthetic devices from four hours to one hour, and weight of material necessary from 400 to 40 grams.

Several investigators are now studying intra-oral adhesives for rapid closure of lacerations. Different approaches are being followed by research contracts, USAIDR and the Letterman General Hospital oral and maxillofacial science team.

Aeromedical Research. The effect of glare on helicopter operations is a major problem. Proposals have been received and contracts initiated for an assessment of the toxicity of the helicopter environment. Biotelemetry equipment to permit the recording of complex data from pilots during flying maneuvers is partially functional



HEART PUMP developed by AMEDS in coordination with the Harry Diamond Laboratories exemplifies highly efficient and compact mechanical aids that assist or supplement actions of human organs during surgery.

and initial exploratory investigations involving cardiovascular data are in progress.

Longitudinal studies of the effects of high-level noises are progressing, with computer analyses of physical examination data supplemented by extensive examination where possible.

Military Medical Research Program, Southeast Asia. Schistosomiasis—The only recorded area in mainland Southeast Asia where human cases of schistosomiasis occur is in Nakorn-srithamaraj Province in southern Thailand. The morphology of the eggs places this infection in the *Schistosoma japonicum*-like group.

Field studies in this province have shown a heavy schistosomal infection in rodents. Further field studies will be required to ascertain what, if any, relationship exists between the rodent and human infections. It is clear, however, that human schistosomiasis in Thailand is not limited to the previously known focus in Nakorn-srithamaraj.

Cholera. For several years workers at the WRAIR have studied intensively sterile filtrates of broth cultures of *Vibrio cholerae,* using infant rabbits in which the administration of this material produces a cholera-like picture. Recent studies in Thailand (C. Benyajati, Brit. Med. Jour., In press) have shown that similarly prepared sterile filtrates administered orally to a human volunteer produced a temporary cholera-like picture.

Melioidosis. Initial survey data uncovered a high incidence of *Pseudomonas pseudomallei* sero-positivity in members of a small island community off the southwestern coast of Malaysia. Detailed epidemiological studies of this area are now in progress.

Plague. Arrangements have been made to study at WRAIR the EV strain of plague used in Vietnam as a viable vaccine. It is of utmost interest to learn whether this strain is stable in virulence, if it is reproducible on defined media, and whether it retains potency when dried. Its potential usefulness for military personnel will be examined.

Malaria. Drug-resistant strains of malaria have been identified as probably the most serious medical problem facing the military today if global responsibilities are to be required.

Programs in depth are being instituted to make certain that man can conquer the malaria parasite in a changing world. A taxonomic and bionomic study of mosquitoes found in one country of Southeast Asia has been partially completed. The investigator has emphasized studies on those mosquitoes which are vectors of drug-resistant malaria.

Maj Gen Betts Slates Talk At Southeastern Exposition

Deputy Chief of Research and Development Maj Gen Austin W. Betts will make the principal Department of the Army presentation at the Southeastern Science Exposition and Symposium, Oct. 13-17, El Paso, Tex.

General Betts is programed to speak at the opening session Oct. 13 and his report on Army research and development activities will point out the opportunities in Army career service for youthful scientists.

Senator John G. Tower of the Senate Armed Forces Committee will give the keynote address. In addition to the Department of Defense agencies, various other Federal research and development agencies will take part.

Research and development installations under the U. S. Army Materiel Command, the Office of The Surgeon General, the Office of the Chief of Engineers, and the Continental Army Command will display Army materiel.

AFIP Schedules Courses on Laboratory Animals

A short course on the "Pathology of Laboratory Animals" will be conducted Sept. 20-24 at the Armed Forces Institute of Pathology (AFIP). Washington, D.C.

Director Brig Gen Joe M. Blumberg said the course is designed to provide training for professional officers responsible for recognizing and interpreting lesions in experimental animals, or officers responsible for the procurement and maintenance of animal colonies.

"The course is intended particularly to interpret natural diseases which may negate experimental results or their suitability for experimental use," General Blumberg said. "It is aimed especially at the needs of various Army, Navy and Air Force laboratories that have veterinary officers in charge of their animal colonies."

Emphasis will be placed on various conditions which may affect the suitability of laboratory animals for research work or which may alter or interfere with experimental results.

Formerly held annually under the title, "Pathology of Diseases of Laboratory Animals," the course is being resumed on a biennial basis.

It is open to military veterinary, medical and dental officers and to qualified civilian veterinary, medical and dental personnel.

Further information on the course may be obtained by writing: The Director, Armed Forces Institute of Pathology, ATTN: Department of Pathology, Washington, D.C. 20305.

Dr. Eugene Sporn

Dr. L. W. Trueblood

Dr. Leo Alpert

USARO Scientists Receive New Assignments

Scientific personnel changes in the U.S. Army Research Office, Arlington, Va., recently involved Dr. Eugene M. Sporn, Dr. Leo Alpert and Dr. Lester W. Trueblood.

Dr. Sporn, a biochemist (toxicologist) with the Life Sciences Division since August 1962, succeeded Col Thurmond D. Boaz as chief of the Special Projects Branch, Life Sciences Division.

Dr. Alpert, for the past two years chief of the Research Division, U.S. Army Tropic Test Center, Canal Zone, was assigned to the Regional Branch, Environmental Sciences Division, to monitor the Army's humid tropics research programs. He was in this Branch prior to his tour in the Canal Zone.

Dr. Trueblood was chief of the Regional Branch, Environmental Sciences Division, U.S. Army Research Office, until his recent assignment as chief of the Earth Sciences Division, U.S. Army Natick (Mass.) Laboratories, upon Dr. Peveril Meigs' retirement.

DR. SPORN, before joining the USARO staff in 1963, was associated with the Army Chemical Corps for 15 years, including six years at the Biological Laboratories, Fort Detrick, Md., and four years at the Chemical R&D Laboratories, Edgewood (Md.) Arsenal. From 1960-62, he was chief of the Research Division until promoted to chief of the Biological Division, Chemical Corps Research and Development Command, Washington, D. C.

He holds a B.S. degree in chemistry-biology from the City College of New York, an M.S. degree from the University of Wisconsin and Ph.D. in biochemistry from Georgetown University, Washington, D.C.

Author of a number of publications on skin penetration, nutritional studies and psychotomimetics, Dr. Sporn is a member of the American Chemical Society, American Association for the Advancement of Science, Scientific Research Society of America, New York Academy of Sciences and Phi Sigma.

DR. ALPERT, a consulting meteorologist and geographer since 1946, has served organizations in the United States and Latin America. After a year at the Air Force Cambridge Laboratory, he was with the Army Corps of Engineers for 10 years.

Dr. Alpert holds a B.S. from State College, Bridgewater, Mass., MA and Ph.D. degrees in climatology-geography from Clark University, Worcester, Mass., and has done graduate work in meteorology at the Massachusetts Institute of Technology.

A member of the American Meteorological Society, Association of American Geographers and the American Geophysical Union, he has represented the International Geographical Union at various international meetings.

DR. TRUEBLOOD began service with the Environmental Sciences Division, Office of the Chief of Research and Development, in October 1959. In 1942 he was selected as a geography consultant to the Secretary of War, followed by nearly eight years as a research specialist for Southeast Asia, Geographic Branch, G-2.

Appointed in 1950 as chief of the Military Geography Branch of the Engineering Strategic Intelligence Division, Army Map Service, Corps of Engineers, he became assistant chief of the Division in 1951 and served as chief from 1953 to 1959.

Dr. Trueblood holds a B.S. degree from Indiana State Teachers College and M.A. and Ph.D. degrees in geography and international affairs from Clark University, Worcester, Mass. He is a member of the Association of American Geographers, the American Geographical Society of New York and the Royal Geographical Society of London.

Device Uses Magnetic Field to Seek Weakness in Metal

Missile failures due to weak spots in metal may be prevented if the metal can be subjected to accurate "quality control" testing in manufacturing with a device being developed at Redstone Arsenal, Ala.

The Department of Metallurgical Engineering at the University of Alabama is developing the device under contract with the Ground Support Equipment Laboratory of the U.S. Army Missile Command's Research and Development Directorate.

University faculty members and graduate students are exploring further applications of the device, called an electro-magnetic hardness tester. Tests have shown it can determine the strength of a sample of metal without damage.

A metal sample will react in a certain way when placed in a magnetic field. The device operates on the principle that the voltage generated by a sample under such conditions will reveal information about hardness, stress and alloy composition.

Development of the device was announced by John L. McDaniel, technical director, Directorate of Research and Development. The project to study the device is headed by Prof. L. A. Woodman, director, Bureau of Engineering Research, assisted by Dr. Roman Skorski of the university staff.

UNIVERSITY OF ALABAMA's Dr. Roman Skorski (seated) reviews control of electromagnetic hardness tester with Professor L. A. Woodman (left) and W. K. Patterson, chief, Electrical Design Branch, U.S. Army Missile Command Ground Support Equipment Lab, Redstone Arsenal.

Originator, Director of Army Research Office Retires

One of the men primarily responsible for establishing the U.S. Army Research Office, and who served as its first director, Col John A. Ord, has retired from the Army after 23 years service.

Col Ord was chief of the Research Division, U.S. Army Materiel Command Headquarters, from September 1963 until his recent acceptance of a position with Philco Corp. in the Systems Analysis Center, Arlington, Va.

During his long association with Army research and development, Col Ord gained recognition for his work at laboratory level, General Staff planning and control, and in consolidating the management of research when the Army Materiel Command absorbed Technical Services functions.

While serving as chief of the Research Division, Research and Development, Office of the Chief of Staff, Department of the Army, Col Ord recommended the establishment of the U.S. Army Research Office.

Using primarily the staff of the OCS Research Division, he set up the framework of the Army Research Office at Fort Belvoir, Va. After a short period of planning and organization, the office was formally activated at Arlington Hall (Va.) Station under the Chief of Research and Development.

After a 3-year tour in DA Headquarters, during which the Office of the Chief of Research and Development was established, Col Ord departed in August 1958 to attend the Army War College, later serving as a member of the faculty until July 1962.

From April to October 1961, he was on temporary duty as a member of the Hoelscher Committee whose Project 80 recommendations and findings resulted in the broad-scale reorganization of the Army in 1962. He was chairman of Group A, which prepared the over-all report.

While serving as director of the Army Research Office, he was active in the planning which led to establishment of the Mathematics Research Center, U.S. Army, on the campus of Wisconsin University. He also was Signal Officer on site as adviser to the Army Engineers during construction of the Army's Camp Murphy radar school in Florida during World War II.

Backed by B.S., M.S. and Ph.D. degrees in physics from Carnegie Institute of Technology, Col Ord also is a graduate of the Army Command and General Staff College and the Armed Forces Staff College.

Col John A. Ord

Officer Reports to Medical R&D

The new chief of the Field Equipment Branch in the Medical Materiel Development Division, U.S. Army Medical R&D Command, Washington, D.C., is Lt Col Elmer L. Thompson. Chief of the Supply and Service Division at Dewitt Army Hospital, Fort Belvoir, Va., until his recent assignment, Col Thompson also served at Fort Myer, Va., Tripler General Hospital, Hawaii, Percy Jones Army Hospital, Mich., Brooke General Hospital, Tex., and with medical facilities in Korea and Europe.

Col Sheppard Heads AMC Research Division

Col Harvey E. Sheppard has succeeded Col John A. Ord as chief of the Research Division, U.S. Army Materiel Command, Washington, D.C., after serving nearly 15 months as deputy.

Col Sheppard, who holds B.S. and M.S. degrees from Virginia Polytechnic Institute, was commissioned a second lieutenant in the Chemical Corps Reserve in 1933 and worked with West Virginia Pulp and Paper Co before being called to active duty in 1940.

During World War II, he served in Burma and China and returned to his pre-war employer as superintendent of the Chlorine and Bleach Department in the company's Covington plant.

Integrated into the Regular Army in 1947, Col Sheppard has served as chief of the Development Division, Chemical Corps R&D Command; deputy Chief Chemical Officer, U.S. Army Europe; commanding officer of the Phosphate Development Works at Muscle Shoals, Ala.; on the staffs of the Office of the Chief of Research and Development and Director of Defense Research and Engineering; commanding officer of the 81st Chemical Group and CO of Rocky Mountain Arsenal.

A graduate of the Command and General Staff College and the Army War College, Col Sheppard is a member of the American Institute of Management and the Armed Forces Chemical Association.

Col Harvey E. Sheppard

Maj Mauer, Dr. Tyson Begin Duty at Tropic Test Center

Newly assigned to the U.S. Army Tropic Test Center, Fort Clayton, Canal Zone, are Maj John C. Mauer and Dr. Edwin L. Tyson.

Maj Mauer, chief, Test Division, joined the Tropic Test Center after completing the regular course at the Command and General Staff College, Fort Leavenworth, Kans. He has served with the U.S. Army Combat Developments Command Artillery Agency, Fort Sill, Okla., as a battery commander with the 2nd Batallion, 19th Artillery, Fort Benning, Ga. and was stationed in Japan for two years.

A veteran of the Korean campaign, Maj Mauer graduated from the U.S. Military Academy in the class of 1952 and received his master's degree in aeronautical engineering from Mississippi State University.

DR. TYSON, a biologist in the Research Division, is no stranger to Panama and the Canal Zone. He previously was assigned there with the Middle American Research Unit, the Smithsonian Institution and Florida State University. An ecologist, he received his bachelor's degree from Duke University and his master's and doctorate from Florida State. He is a member of Sigma Xi, honorary society for the promotion of research in science.

Army Improving Miniaturized Respirator

Continued development and evaluation of a pressure-cycled respirator, without moving parts and only slightly larger than a pack of cigarettes, are in progress at the Harry Diamond Laboratories (HDL) and the Walter Reed Army Institute of Research, Washington, D.C.

Developed by Henrik H. Straub, an aeronautical engineer at HDL, the respirator is essentially a bistable fluid amplifier. It consists of a lucite block with machined channels and a cover plate screwed or cemented in place. Reportedly, it performs well on humans and animals.

Breathing gases are supplied to the respirator through the power nozzle, forming a turbulent jet. Uneven-gas entrainment from the two control nozzles, one connected to the face mask and the other open to atmosphere, causes the power jet to attach to one of the walls.

When the jet is exhausting to the left receiver, the breathing gas is forced into the face mask and lungs of the patient. The face mask pressure increases, causing flow through the feedback line to the left control nozzle.

At a predetermined mask pressure, the entrainment of the left side of the power jet is satisfied, and the jet is switched to the right wall. The power jet then exhausts to the atmosphere through the right receiver, allowing the patient to exhale.

The pressure in the feedback line now decreases below atmosphere, due to entrainment of gas from the face mask, until the control pressures are sufficiently unbalanced to switch the jet from the right to left receiver.

The respirator can also assist respiration since the inspiratory effort of the patient reduces the pressure in the left receiver and feedback line below atmosphere, switching the power jet into the left receiver thereby initiating inspiration.

Tanks and airway resistances of various values have been used in the engineering laboratory to simulate the range of pulmonary impedances. Flow rates, cycling pressures, and frequencies are controlled by adjusting the set-screws and the input pressures to the power nozzle.

The respirator has been tested on dogs weighing about 35 pounds. All animals were anesthetized, intubated, and ventilated with oxygen from 1 to 5½ hours. Researchers said the respirator performed well as a controller and as an assistor, depending on the condition of the animal. Average arterial blood samples registered pO_2 of 392mm. Hg. and pCO_2 of 30mm. Hg., indicating good pulmonary ventilation.

The respirator performed well as an assistor and controller when used up to 15 minutes on various patients and was also demonstrated 25 minutes without any ill effects to the user.

Considerable interest in the respirator has been shown by medical doctors, hospitals and emergency rescue personnel, because of the lack of moving parts which makes it inexpensive to manufacture as well as easy to operate.

SECRETARY Stella Moore demonstrates pressure-cycled respirator under development and evaluation at the Harry Diamond Laboratories and Walter Reed Army Institute of Research, located in Washington, D.C.

FY 1965 Reports Reflect ILIR Program Success

(Continued from page 3)

tories, for example, include such tasks as (short descriptive title rather than complete project title given): Mechanical Properties of Organic Materials. High Temperature, High Pressure Reactions. Photographic Research on Military Implications of Climatic Extremes. Terrain Analysis (with emphasis on factors which affect vehicle mobility). Russian-English Glossary of Food Terms, Radiation Biodosimitry; Screening for Protective Compounds. Amino Acid Composition of Proteins and Polypeptides. Endogenous Metabolism of Fungus Spores in Relation to Viability.

A similar partial list of the range of ILIR work at other Army installations would reach deeply into virtually every area of scientific investigation that has potential application to Army requirements.

ILIR FY 1965 reports show a diversified program of exploration of the improvement and utilization of Laser and Maser beams, including applications to medical treatment needs. They reflect an extensive program in the synthesis of materials and in research to improve materials by alloys, as well as to develop new materials specially suited to priority military requirements.

ILIR tasks point to intensive investigation of environmental conditions, engineering design factors, human factors, mobility and communications requirements, and military materiel problems. They penetrate searchingly into problems of improving medical protection and treatment methods. In short, the ILIR work units "cover the waterfront" of Army operational R&D needs.

The Pittman-Dunn Institute for Research at Frankford Arsenal, Philadelphia, Pa., reported a problem encountered by several other directors, that of trying unsuccessfully to give favorable consideration to all meritorious ILIR proposals received. Thirty proposals were received and, after careful consideration, only four were rejected as undeserving of funding support. Available funds, however, necessitated limiting acceptance to 16 proposals.

The Harry Diamond Laboratories, Washington, D.C., reported that ILIR work produced significant results in guidance and acquisition techniques in

(Continued on page 14)

ERDL Studying Diving Sets For Special Forces Missions

Immediate needs of the Army Special Forces have resulted in the current type classification of two new diving sets at the U.S. Army Engineer Research and Development Laboratories (ERDL), Fort Belvoir, Va.

The sets are self-contained, open and closed circuit units, constructed from commercially available components.

The open circuit set can be used at depths of over 200 feet and eliminates the danger of oxygen-rebreathing SCUBA operations. However, its use is limited to situations in which maximum security from detection is not required. The closed circuit set, although limited to depths of 25 feet or less, leaves no tell-tale bubbles.

Further studies are now in progress to determine future Army needs for diving equipment.

Smithsonian Institution Offering Varied Program to Research Students

The Smithsonian Institution in Washington, D. C., widely known for its museums but since its inception in 1846 fundamentally devoted to higher education and research, is offering its first program of financial support for visiting research scholars during academic year 1965-66.

Army R&D personnel, and interested parties generally, who have not yet investigated the Smithsonian's new undergraduate, graduate and professional programs may discover an opportunity to earn a degree, complete a thesis, or conduct research while making valuable contributions to the arts and sciences.

In late 1964, the Smithsonian's chief administrator, Secretary S. Dillon Ripley, established a Division of Education and Training with the Smithsonian to administer programs of higher education and cooperative research. The Division Director is Dr. Charles Blitger and his assistant is Jerrold Roschwalb a former member of the *Army R&D Newsmagazine* editorial staff.

Current programs are expected to support approximately 100 undergraduate and graduate students and professional scientists during the first year. Similar to fellowships, the programs range in duration from several weeks to one year, and are termed "visiting research appointments."

Approximately 40 10-week summer appointments are available to undergraduate students and five to 10 more may be added during the academic year. Stipends for these students may vary but will be near $85 a week.

The National Science Foundation's Undergraduate Research Participation Program has made possible about 15 additional appointments limited to the biological sciences and offering weekly stipends of $60.

Applications for both summer programs should be made to: Director, Division of Education and Training, Smithsonian Institution, Washington, D. C. 20560.

At the graduate level, the Predoctoral Intern Program provides appointments for 20 students who need to complete requirements for Ph.D. or equivalent degrees. The projects may be in any field of research available at the Smithsonian and the appointments will run for whatever time is required to complete the research. However, the appointments will generally run for one year. Stipends will range from $96 to $116 per week.

Being considered also for graduate level students are National Science Foundation and National Defense Education Act fellowships and similar awards. Graduate students should address applications to the address given for undergraduates above.

At the professional level, the Smithsonian and the National Academy of Sciences are conducting the Resident Postdoctoral Research Associates program, offering in its first year appointments as follows:

- History of Science and Engineering: Two appointments in the Museum of History and Technology.
- Physical Sciences: Four appointments in the Smithsonian Astrophysical Observatory.
- Biological Sciences: One appointment in the Division of Radiation and Organisms and five appointments in the Museum of Natural History, Canal Zone Biological Area, and National Zoological Park.

The postdoctoral positions are termed Regular and Senior Associateships. Regular awards are generally for those who are no more than four years beyond the doctorate and are for one year with a vacation allowance and a stipend of $10,250. Senior awards are for those who are five years or more beyond the doctorate and are usually for one year, although other periods will be considered. The stipend is flexible to adjust to salaries and includes a relocation allowance.

Inquiries should be addressed to: Fellowship Office, National Academy of Sciences—National Research Council, 2101 Constitution Avenue, N.W., Washington, D. C. 20560.

In addition to the cooperative postdoctoral research associateships, the Smithsonian offers four non-cooperative appointments of that type. Two are for studies in paleoecology, anthropology, botony or zoology and range from several weeks to a year in duration. The stipend is based on an annual salary of $16,460. These are available through the Office of Assistant Director of Ecology, Museum of Natural History, Smithsonian Institution, Washington, D. C. 20560.

Two appointments are for research in American military, civil or cultural history, or the history of science and technology. These are one-year appointments with stipends ranging from $10,000 to $16,640. An interested person should contact the Smithsonian's staff prior to finalizing a research plan. An initial plan must be submitted with an application to the Director, Division of Education and Training, Smithsonian Institution.

In the area of international programs, the Smithsonian and the Organization of American States offer research assistantships in environmental biology at the Canal Zone Biological Area research station for undergraduate and graduate students from the Western Hemisphere. Information can be obtained from the Office of International Affairs, Smithsonian Institution.

Limitations of space demand that many aspects of the Smithsonian's programs be omitted in this report. Such omissions include the cooperative arrangements between the Smithsonian and universities around the nation; the availability of Smithsonian facilities for scientists and scholars; the River Basin Surveys which annually provide research experience for all levels of students; international programs in addition to those mentioned above, and many other Smithsonian activities.

Because of its extreme importance to researchers, however, there remains one aspect of the Smithsonian which cannot go unmentioned—the Science Information Exchange.

Initially planned to prevent needless duplication in Government-sponsored research, the Exchange has become an asset to research scientists in all fields. The Exchange receives reports from Federal agencies, universities, state and city governments, industry and many private foundations briefly describing current research projects.

Last year more than 100,000 such reports were received. In response to more than 35,000 inquiries, the Exchange sent out about 750,000 research notices. Research scientists may obtain, free of charge, information about current research in their field by writing: Science Information Exchange, 1730 M Street, N.W., Washington, D. C.

Joint Team Tells NATO Group About Main Battle Tank Goals

Five NATO nations were represented at briefings on the United States/Federal Republic of Germany (FRG) Main Battle Tank Development Program held recently in Bonn, Germany.

Representatives of Belgium, Canada, Italy, the Netherlands and the United Kingdom were given details of the tank program, including design objectives, status and scheduling. The joint briefing team was headed by Prof. Hubert Schardin, chief of the Division of Military Technology, FRG Ministry of Defense, and Willis M. Hawkins, U.S. Assistant Secretary of the Army for R&D.

Ellerson Retires as USAEPG Deputy CO, Setting Stage for Angel as Successor

Retirement ceremonies climaxing 35 years of military service for the deputy commander of the U.S. Army Electronic Proving Ground, Fort Huachuca, Ariz., were highlighted by award of the Third Oak Leaf Cluster to the Army Legion of Merit.

USAEPG Commander Maj Gen Benjamin H. Pochyla made the presentation to Col Geoffrey D. Ellerson, who had served as his deputy for three years. Col Nicholas C. Angel, USAEPG chief of staff for the past six months, has been designated the new deputy CO. His replacement is Col Clarence O. Mette.

Col Nicholas C. Angel

Col G. D. Ellerson

Appointed to the United States Military Academy a year after he entered the Army as an enlisted man, Col Ellerson was graduated in 1935. When World War II developed, he was put in command of the 1st Field Artillery Observation Battalion, and served through campaigns in Africa, Sicily, Italy, France and the Rhineland in Germany.

Following return to the States upon the conclusion of hostilities, he served on the Field Artillery Board as chief of the Instrument and Survey Section until assigned to Korea in 1950. There he served with the Korean Military Advisory Group and later as Artillery officer with the Eighth U.S. Army in Korea. A 3-year European tour preceded assignment to USAEPG.

Col Ellerson has been honored with the Bronze Star Medal, Army Commendation Medal, French Croix de Guerre, Italian Medal of Valor and the Uichi Medal of the Republic of Korea.

Three of his sons are carrying on in the Army, two as first lieutenants graduated from the U.S. Military Academy in 1963. Another is scheduled to attend West Point Preparatory School at Fort Belvoir, Va.

COL ANGEL, until his assignment as USAEPG chief of staff, was chief of the Test Operations Department at USAEPG for nine months.

He was graduated from Yale University in 1936 and commissioned a second lieutenant in the Army Reserve, Corps of Engineers. In World War II, he received the Bronze Medal for service in Northern France, Ardennes, Central Europe, Rhineland and the Philippines.

In the postwar years, he attended the Command and General Staff College at Fort Leavenworth, Kans., followed by service as Antilles signal officer at San Juan, P.R. From 1952-55 he was assigned to the Tennessee Polytechnic Institute as a professor of military science.

Colonel Angel also served as assistant director of Communications-Electronics with the Joint Chiefs of Staff in Washington, D.C., and attended the NATO Defense College in Paris.

In 1960 he was assigned as chief, Materiel Management Branch in the Office of the Chief Signal Officer in Washington, D.C., then as assistant director for National Military Command System, Test, Evaluation and Doctrine, Defense Communications Agency.

Secretary Resor, Gen Johnson to Address AUSA

Secretary of the Army Stanley R. Resor and General Harold K. Johnson, Army Chief of Staff, will address an expected 3,500 members and guests of the Association of the United States Army at its annual meeting, Oct. 25-27, in Washington, D.C.

Secretary Resor will deliver the keynote speech at a dinner the first evening and General Johnson will speak at a luncheon Oct. 26.

New to this year's AUSA program are idea-exchange workshops for association chapter delegates. A workshop for ROTC Company representatives will provide a similar exchange among cadet members of the AUSA.

Scientific and technical exhibits showing advances in military hardware and know-how will be displayed by private industry and the Army. Presentations will include air mobility, Army operations in the Dominican Republic, combat developments, and Reserve and ROTC affairs.

Climaxing the AUSA meeting will be the George Catlett Marshall Memorial Dinner on Oct. 27 when the Marshall Medal "for selfless and outstanding service to the United States of America" will be awarded. General of the Army Omar N. Bradley received the award in 1964. This year's recipient has not been announced.

In addition to an exhibitors' reception and luncheons for AUSA's industry members and ROTC cadets, the program will include the Department of the Army's Personnel Conference for sergeants major and chief master sergeants. Senior noncommissioned officers also will be guests of the AUSA at a reception and buffet luncheon Oct. 25.

Lt Col Ayoub Heads USAEPG Directorate

Lt Col William J. Ayoub is the new director of the Plans and Operations Directorate at the U.S. Army Electronic Proving Ground, Fort Huachuca, Ariz. Col Clarence A. Mette, Jr., who held that post, became Chief of Staff.

Colonel Ayoub entered the Army in 1940 and served as an enlisted man with the 9th Infantry Division. Graduated from the Infantry Officers Candidate School, he served during World War II in Cairo, Egypt, the Persian Gulf Command in Iran, the Levant States Command in Palestine, and 9th Infantry Division in the European Theater.

Lt Col W. J. Ayoub

Discharged in 1945, the colonel reenlisted in 1949 with the Corps of Engineers and served as a master sergeant until he was recalled to commissioned duty in 1951 with the 196th Regimental Combat Team in Alaska.

Prior to assignment at USAEPG as deputy to Col Mette, Col Ayoub served at the U.S. Army Training Mission in Saudi Arabia. His awards include the Bronze Star with V device, the Army Commendation Medal and the Combat Infantryman and Parachutist badges.

CRD Addresses Maintainability Experts

Chief of Research and Development Lt Gen William W. Dick, Jr., addressed participants in the first Army Technical Meeting on Quantification of Maintainability During Research and Development of Materiel, held recently at the Pentagon, Washington, D.C.

Participants represented the Office of the Secretary of Defense, Director of Defense Research and Engineering (DDRE), the Assistant Secretary of the Army (Research and Development), Assistant Secretary of the Army (Financial Management), Office of the Army Chief of Staff, Deputy Chief of Staff for Logistics, Assistant Chief of Staff for Force Development, Office of the Chief of Engineers, U.S. Army Materiel Command and its subordinate commands and laboratories, and the U.S. Army Combat Developments Command.

Introduced by Lt Col Gerald E. Ledford, Review and Analysis Division, Office of the Chief of Research and Development, the guest speakers and their subjects included:

DoD Maintainability Program, Albert L. Jackson, Jr., Office of the Assistant Director (Engineering Management), DDRE; Maintainability Measurements, Cmdr Keith N. Sargent, Systems Effectiveness Branch, Office of Naval Material;

Quantification of Maintainability, Maj Richard R. Stanton, Systems Effectiveness Division, Systems Policy Directorate, Air Force Systems Command; Introduction of System Effectiveness Parameters in System Specifications, Leonard Weingarten, Research Analysis Corp.;

Ten New Concepts for Electronic Maintenance, Dr. E. L. Shriver, Human Resources Research Office, George Washington University; Effect of Maintainability on Maintenance and Logistics Support Planning and How to Measure This Effect, Col Elwin T. Knight, Maintenance Readiness Division, U.S. Army Supply and Maintenance Command;

The Army's Maintainability Dilemma—Communication, Charles D. Cox, Research and Development Directorate, U.S. Army Missile Command; Some Problems in Defining Maintainability and Associated Terms, H. Walter Price, Reliability Branch, Harry Diamond Laboratories;

Applications of MIL-M-55214(EL), Maintainability Requirements for Electronic Equipment, Michael I. Bonosevich, Materiel Readiness Directorate, U.S. Army Electronics Command; Operation Woodpile—Development of Techniques for Maintainbility Demonstration, Michael Bialkowski, U.S. Army Electronics R&D Activity, Fort Huachuca, Ariz.;

Human Engineering Relationships to Maintainability Measurement, B. Lawrence Sova, Systems Research Laboratory, Human Engineering Laboratories; Using Maintenance Float to Measure Money Value of Maintainability, Boris Levine, Troops and Material Branch, Military Engineering Division, Office, Chief of Engineers; Scientific and Technical Applications Forecast on Research on Materiel Failures, Sumner Meiselman, Research Plans Office, U.S. Army Research Office.

A discussion period was moderated by Abraham S. Pollack, Review and Analysis Division, OCRD. A panel consisting of those who presented papers responded to questions and recommendations from the 70 attendees. Among them were Brig Gen Raymond B. Marlin, director of Plans and Programs, OCRD, and Elidio J. Nucci, Office of Assistant Director (Engineering Management), DDRE.

OCRD Director of Developments Receives First Star

Director of Developments Brig Gen Alvin E. Cowan was promoted to that rank and Col Frank A. Bates, Jr., was assigned as chief, Nuclear, Chemical and Biological Division, Directorate of Missiles and Space, in recent Office of the Chief of Research and Development actions.

Col Bates relieved Col John W. Ervin when he departed to attend a 10-month course at the Industrial College of the Armed Forces, Fort Leslie J. McNair, Washington, D. C.

Col John D. Erickson was promoted to that rank as chief of the Management Analysis Branch in the Review and Analysis Division, Directorate of Plans and Programs. Maj Arthur E. Dewey also was promoted to that rank as assistant executive secretary of the Army Scientific Advisory Panel.

Additional OCRD personnel actions include the awarding of Certificates of Achievement to Lt Col Leslie H. Gilbert, Combat Support Aircraft Branch, Air Mobility Division, and Maj Stan R. Sheridan, Combat Materiel Division. Mrs. Margaret R. Chewning, Air Mobility Division, received a Commendation Certificate.

Lt Col Charles W. Spann, chief of the Electronics Branch, Communications-Electronics Division, retired from active service. Ceremonies marking the event were held in the Pentagon with Lt Gen William W. Dick, chief of Army R&D, officiating.

CHIEF OF R&D Lt Gen William W. Dick, Jr. (left) congratulates Brig Gen Alvin E. Cowan, Director of Developments, OCRD, on his promotion.

New Method Yields Savings In Casting Partial Dentures

A dental laboratory technique that conserves time and material in making partial metal dentures has been contract-developed for the U.S. Army Medical Research and Development Command.

Dr. Floyd A. Peyton, of the University of Michigan School of Dentistry, Ann Arbor, Mich., devised the method of using a modified sodium silicate shell-casting process to permit casting a partial denture framework in about an hour, using either high- or low-melting chrome-cobalt alloy.

The one hour includes investing (dipping and dusting of the shell), which requires 2½ minutes for an average casting, and a burnout period of 20 to 30 minutes. Approximately 30 grams of refractory material are used per casting to form the mold.

Conventional techniques require one hour for investment, three to four hours for burnout and 400 grams of investment material.

Listed as some of the advantages of the new technique are: 1) less investment needed per casting, 2) reduced storage space and shipment costs for large quantities of investment, 3) lower cost of operating burnout ovens due to a shorter burnout cycle, 4) elimination of the need for flasking or casting rings and crucible formers, and 5) shorter time required to make partial dental castings.

Army Contract Awards Total $482 Million

A listing of the Army's latest research, development and procurement contract awards shows a total of $488.5 million and spotlights two firms which together account for nearly $112 million.

Kaiser Jeep Corp. and Bell Helicopter Co. Division of Bell Aerospace Corp. received, respectively, a $61,745,592 second increment of a 2-year buy of 10,000 trucks and a $50,000,000 award for 255 UH-1B and 465 UH-1D helicopters.

Magnavox Co. received an $18,922,425 second increment to a 3-year buy of radio receivers and the Hupp Corp. was issued a $17,550,000 second increment to a 2-year buy of 10,000 multifuel engines for 2½-ton trucks.

Ford Motor Co. obtained a $15,627,990 second increment to a 3-year buy of 7,000 utility trucks and Remington Arms Co., Inc. signed contract modifications totaling $15,381,001 for small arms ammunition.

FMC Corp. will provide 643 vehicles (M-113) and spare parts under a $12,322,368 second increment to a 3-year buy. Page Aircraft Maintenance, Inc. was awarded a $12,265,837 contract for rotary and fixed-wing aircraft maintenance. Western Electric Co. received two contracts totaling $11,638,032—$9,975,000 for Hercules missile modification kits and $1,663,032 for repair parts.

General Electric Co. signed contracts totaling $8,365,150—$2,305,150 to provide 80-ton meter guages for electric diesel locomotives, and $6,060,000 for modification of four KVA generators. Watertown (Mass.) Arsenal was granted a $6,348,600 order for 360 M127 mounts for the self-propelled Howitzer 155mm-M109 vehicle.

Collins Radio Co. was issued three contracts totaling $4,823,272—$1,200,000 for air-to-ground radio sets (AN/ARC-54), $1,434,440 for automatic direction finder sets (AN/ARN-83) and $2,188,832 for radio receiving sets (AN/ARN-82 M).

General Motors Corp. will get $4,240,700 under a contract modification for production engineering supply and services on the XM551 vehicle. International Business Machines Corp. signed a $4,100,000 contract for classified electronics equipment.

Honeywell, Inc. was awarded a $3,309,726 contract for bomb (HE, BLU-3/B) metal parts and body assemblies and Thiokol Chemical Corp., received a $3,081,524 modification for repair parts for Pershing missiles. Continental Motors Corp. won a $3,008,880 second increment to a 3-year buy of 7,000 utility truck engines.

Weatherhead Co. was granted a $2,945,372 contract for antitank projectiles, Harvey Aluminum Sales a $2,768,742 modification for classified ammunition, and A. O. Smith Corp. $2,705,000 to provide 750-pound bomb parts.

Consolidated Diesel Electric Corp. signed a $2,452,320 3-year buy's second increment for 195 tractor trucks.

SCM Corp., Kleinschmidt Division, will get $2,239,275 under two contracts for teletypewriter sets.

Voron Electronics Corp. was awarded a $1,966,188 contract for radio sets (OA-1387/GRC). Batesville (Ark.) Manufacturing Co. received a $1,958,986 contract for bomb parts.

Southwest Truck and Body Co., Inc. won a modification to build semi trailer shop vans for $1,744,326 and Eureka Williams Co. was granted a $1,347,607 order for ordnance items.

FY 1965 Reports Reflect ILIR Program Success

(Continued from page 10)

missilry, as well as progress in thin-film device studies, rangefinders and fuzes, and various classified tasks.

The Ballistic Research Laboratories at Aberdeen Proving Ground, Md., reported gains through ILIR work on gas explosion kinetics, numerical analysis of chemical reacting flows to non-steady hydronamic flows, novel rocket concepts, man-guided whose missile systems, and an "optimum system" of extracting communications signals from interference noise.

Walter Reed Army Institute of Research reported on studies of respiratory infections, infectious hepatitis causes, RNA studies of the basic genetic factors, definition and evaluation of environmental and personnel factors which contribute to physical and psychological stress of military personnel, and chemical study of dengue hemorrhagic fever, antimalarial protection against drug-resistant malaria, and various other diseases.

Among the 27 ILIR tasks listed by the Chemical Research and Development Laboratories are synthesis of properties of alkylating agents; ion mobility and electron capture; solid-state detectors studies; mechanism of the "ageing" process and methods for reactivation of "aged" cholenesterase; protein denaturation; effect of turbulence on deposition of small particles on cylindrical targets; and mechanism of selected detection reactions.

The 37-work unit ILIR Program at the Electronics Command Laboratories produced a variety of notable results, including the publication of 13 reports and two patent disclosures. The technical director termed the program "an extremely effective catalyst in promoting the growth of our in house competence." E-Command gains were reported also in studies to reduce noise in traveling wave tubes, as well as "a pioneering step forward" in developing an AC battery, and a "100-fold increase" in power output of internally fabricated GCAs and Laser diodes."

Regarding thin-film studies on silver oxide use in batteries, it was reported that the cells are operative at 100°F. and stable at 200°F. Also, that "the new system could be the basis for preparation of 'printable' batteries whose components would be amenable to deposition by conventional evaporation techniques. . . ."

The Engineer R&D Laboratories reported that among the 27 ILIR tasks conducted in FY 1965, that a research on a fuel cell for Army vehicles "offers the most promise of a large-scale return." Progress also was reported on a radiation indicator paint, soil excavation and removal methods, thermal shock cleaning of gas turbine engines, scale prevention in distillation equipment, potable water extraction from exhaust gases from engines, and land mine studies.

Each of the laboratories reporting on ILIR activities pointed to results which, in the opinion of the technical directors, justified the continuation of effort on at least the present level of effort or on an expanded scale.

Selected from the many commendatory statements regarding the impact of the ILIR Program in increasing in-house laboratory competence in basic research activities, and in sharply upgrading the morale of researchers, is the following statement by Dale H. Sieling, scientific director of the Natick Laboratories:

"The critical review of the proposals and the subsequent detailed evaluation of the results by a committee of scientists' peers has had a substantial positive impact on the quality of the work performed under this program. The competitive attitude of the investigators to do outstanding work is very much in evidence, and this creates in turn a more inquisitive committee appraisal.

"The whole system is self-generating and I believe has done more to upgrade research procedures, attitudes and results than any other factor in my experience as scientific director of this Laboratory.

Computerized CPX Development Continues

Development of a Computerized Command Post Exercise (CPX) is continuing, following a recent successful experiment at the U.S. Army Strategy and Tactics Analysis Group (STAG), Bethesda, Md.

The objective of the program of tests by the U.S. Continental Army Command is to "miniaturize" training, thereby reducing requirements for expensive and often unobtainable training space.

The experiment marked the first time that National Guard units have been used to test the CPX concept, now in the development stage. Commanders and staffs of a brigade headquarters, two Infantry and two Armor battalions were furnished by the 28th Infantry Division, Pennsylvania National Guard.

Sponsoring agency was the U.S. Army Participation Group, U.S. Naval Training Device Center, Port Washington, N.Y., assisted by Computer Concepts, Inc., of Silver Spring, Md. Maj Gen Henry K. Fluck, commanding general of the 28th Division, was test director and Lt Col Roger J. Link, Army Participation group, was project officer.

The standard CPX now in use depends upon a large control group to maintain a high level of activity. "Canned," prepared messages reportedly often must be used to substitute for manpower, with a resultant sacrifice of realism.

Controllers in the "manual" type CPX are required to simulate enemy forces and friendly flanking and support units, generate messages and provide intelligence information. Necessarily, they become involved in considerable calculations concerning assessment of casualties, troop movements and consumption of supplies.

U.S. ARMY STAG Electronics Branch chief Edward Nuse briefs Lt Gen William F. Train on operations during recent "Computerized Command Post Exchange Exercise" involving units of the 28th Infantry Division, Pennsylvania National Guard.

Even with large controller staffs, fast and accurate processing of tabular data is often difficult or impossible, due to limited time. Introduction of computers into the CPX holds forth the hope of reducing the size of controller staffs, eliminating vague and conflicting answers and instructions—and providing fast, realistic handling of data.

Facilities, support personnel and the experimental war game model "Centaur" at STAG provided the means to test this concept at minimum expense. "Centaur" is a 2-sided, closed free-play game. A small controller group prepares player orders for processing by the computer. Orders are matched against existing data as to tactical doctrine, "friendly" and "aggressor" dispositions, and firepower, weather and terrain.

Results are printed out in the form of reports to the player headquarters by company-level units simulated by the computer. These were provided in 15-minute cycles, representing, in the case of the recent test, "real time" in which one minute of CPX time was equivalent to one minute of actual operations.

The mechanical nature of the computer-simulated company-level units produced some odd results. Instead of requesting verification of an erroneous coordinate, one "computerized" company simply attempted to "move" to the area designated, which proved beyond the limits of the exercise.

A company reported loss of five tanks in a 15-minute cycle. Since modifying instructions could not be inserted in time to take effect until 15 minutes later, the company continued in a sort of computerized "Charge of the Light Brigade" until it had lost all 17 tanks.

Designers of the war game and the mentors of the Computerized CPX concept expressed confidence that these and similar defects can be overcome by a combination of better programing and detailed briefing of participants.

Despite these and other limitations, they said the experiment demonstrated that a significant reduction in CPX controller groups and standardization of doctrine is possible by use of a computer.

Parallel with additional applications of computers in other aspects of tactical operations and training, development of the "Computerized CPX" is continuing.

Army to Offer 7 Postgraduate Dental Courses

The U.S. Army Institute of Dental Research, Walter Reed Army Medical Center, Washington, D.C., has announced its postgraduate short courses for the 1965-66 academic year.

The first of seven courses scheduled is "Trends in Dental Laboratory Activities," Sept. 27-Oct. 1. This will present the latest developments in dental materials research and their influence on clinical as well as laboratory techniques.

"Preventive Dentistry," Oct. 25-29, will offer a comprehensive review of Army dental health problems, aspects of clinical dental practice, and techniques of personal oral hygiene.

"Prosthodontics," Dec. 6-10, will examine prosthodontic practice as it relates to biomechanical principles and clinical techniques. Stress will be on examination, diagnosis, treatment planning and prognosis for complete and partial dentures.

Problems of exodontia and oral surgery in modern warfare will be considered in "Oral Surgery," Jan. 10-14. Subjects will include traumatic injuries of maxillae, mandible and facial bones, anesthesia and extra-oral roentgenographic techniques for oral surgery, and problems of hemorrhage and shock.

Television will be used to present "Periodontics," Feb. 14-18. Procedures such as scaling, curettage, periodontal surgery, occlusal adjustment, and the histology of the periodontium will be studied.

Clinical and microscopic features of various disease will be correlated in "Advanced Pathology of the Oral Regions," Mar. 7-11, including tumors of the odontogenic apparatus and cysts of the oral regions, and consideration will be given to the pathology of the pulp, periodontium and soft oral tissues.

"Oral Diagnosis and Therapeutics," May 2-6, will review the principles, practice and recent advances in oral medicine in areas of diagnosis and treatment of oral diseases. Emphasis will be on techniques of diagnosis.

Further information may be obtained by writing to: Director, U.S. Army Institute of Dental Research, Walter Reed Army Medical Center, Washington, D.C., 20012.

WSMR Tests New Technique of Target Identification

Identification of unknown targets by combining radar, TV, and a computer is a new technique under test at White Sands (N. Mex.) Missile Range that has drawn two dozen scientists from coast to coast to observe.

Employing the basic techniques used to get the recent pictures of Mars, the system is known as the A-Scope Film Reader for identifying targets in development programs. It is a 5-unit complex installed at the Army's New Mexico range.

The military has a two-fold interest in the system, explained Benjamin Billups, technical manager of the White Sands Data Analysis Directorate.

"Through it, we may learn to devise targets that are unidentifiable by an enemy, and learn to build decoys within our missiles that will mislead and confuse an enemy. Ordinary techniques are used in getting the target imaged from the television film and then the operation becomes a matter of mathematical logic."

The instrument picks up and photographs a radar pulse bounced back from a target. The photographed image is then taken from the film and converted into an electrical signal which is broken down into 10 million "samples."

The samples are classified according to magnitude and fed into a computer whose logic modules convert the numerical pattern to language acceptable for further processing in a large-scale digital computer. The target from which the radar pulse was reflected can be identified from the processed data.

The system has been undergoing intensive acceptance testing for several weeks. It is the second instrument of its kind ever made; the original model, much less sophisticated, was made less than a year ago and is at Holloman Air Force Base, Calif.

The A-Scope Film Reader was designed by Lincoln Laboratory, MIT, as part of an Advanced Research Project Agency (ARPA) project. It was built by Information International Incorporated. Its cost: about $350,000.

A control unit, mobile oscilloscope, electro-optical unit, magnetic tape output unit, and a power supply are the primary elements of the A-Scope. The system is operated from a control console.

The unique potentials of the A-Scope have brought scientists from such research and development centers as Los Alamos, N. Mex.; Rome Air Development Center, N. Y.; Air Technical Application Center, Washington; the University of Michigan; and Norton Air Force Base, Calif., to witness the operation.

ARO-D Announces Publication Of 2 Engineering Handbooks

The Army Research Office-Durham, N. C., (ARO-D) has announced the scheduled publication of two U.S. Army Materiel Command Engineering Design Handbooks.

Expected to be sent to the printer this month, they are: *Military Pyrotechnics, Part One, Theory and Application* (AMC Pamphlet 706-185), and *Military Pyrotechnics, Part Five, Bibliography* (AMC Pamphlet 706-189).

The handbooks are prepared by the Denver (Colo.) Research Institute under contract with the Engineering Handbook Office, Duke University (Durham). They are considered to be of primary value to engineers and designers engaged in pyrotechnic development and for personnel training and orientation programs in pyrotechnic and related types of ammunition design.

Part One includes chapters on the history of the pyrotechnic art, and a general introduction to the application of pyrotechnic devices to military problems. Other chapters are Physical Chemical Relationships, Visibility, Production of Heat, Production of Light, and Production of Smoke. Part Five gives selected references to source material of value in military pyrotechnics.

DoD Gobbledygook Under Fire Of Deputy Defense Secretary

Deputy Secretary of Defense Cyrus Vance has declared war on gobbledygook in an effort to improve communications between Defense Department officials and the public.

Mr. Vance began his battle for plain talk by forming a task force, directed by Solis Horwitz, Assistant Secretary of Defense for Administration, to review attitudes, methods and types of responses being made to the public by all components of the Department of Defense.

Included in the analysis will be written, telephone and person-to-person communications. The task force is to make its report by Nov. 1.

Logistics Center Redesignates 12-Week Management Course

A change in name from Army Supply Management Course to Army Logistics Management Course became effective Sept. 7 for the 12-week senior course at the U.S. Army Logistics Management Center, Fort Lee, Va.

The curriculum has not changed and attendance remains limited to major/lieutenant commanders or above for military personnel and GS-12 or above for civilians.

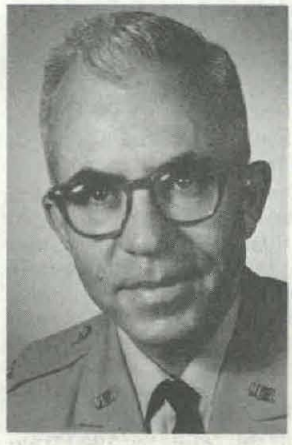
Still offered are the same top-level management courses in initial planning, programing, budgeting and requirements computations through procurement, distribution, maintenance, financial and other controls to the ultimate disposal of surplus stocks.

A major field activity of the Army Materiel Command, the Management Center is headed by Col J. P. Alexander, Jr., and is the only Army agency devoted to training military and civilian logistics managers.

Picatinny Announces Col Chambers as Deputy Commander

Picatinny Arsenal's new deputy commander is Col John S. Chambers, Jr., who succeeded Col Lee S. Kaufman when he was recently assigned as director of Materiel Readiness, U.S. Army Munitions Command.

A 1940 graduate of Rice Institute, with B.S. degrees in mechanical and electrical engineering, Col Chambers began his active Army career at the San Antonio Arsenal in 1941. Later he served in the European Theater of Operations with the First, Third and Sixth Armored Divisions until 1946.



Col J. S. Chambers

Other assignments included service with the Military District of Washington; Office, Chief of Ordnance (1948-50); and the Defense Atomic Support Agency, Sandia Base, N.Mex. (1959-61). He also served as commanding officer of the Ordnance Training Center at Red River Arsenal, Texarkana, Tex. (1953-54); the North Depot and Seneca Army Depot, Romulus, N.Y. (1961-63); and as Ordnance officer with the First Corps in Korea.

Col Chambers attended the Command and General Staff College, Fort Leavenworth, Kans.; Armed Forces Staff College, Norfolk, Va.; and Industrial College of the Armed Forces at Fort McNair, Washington, D.C.

Johns Hopkins Professor Begins Year at BRL

Prof. Robert B. Pond of Johns Hopkins University, Baltimore, Md., recently began a sabbatical year as a staff member of the U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Md.

An associate professor of metallurgy and a Johns Hopkins staff member since 1947, he teaches undergraduate and graduate courses. Over the past four years he has been a consultant to the Ballistics Research Center at the Proving Ground.

Earlier in his career he was a consultant to the Bethlehem Steel Co., the Anglo-American Extrusians in Britain, and to various fundamental research agencies within the U.S. Army and the U.S. Air Force, as well as to public industry nationwide.

A wartime Navy veteran, the 46-year-old professor holds a bachelor of science degree in metallurgy engineering from Virginia Polytechnic Institute.

An inventor and holder of six patents in the field of solidification of wires, filaments, single crystals and others, he is author and coauthor of several publications in the field of metallurgy.

Prof. Pond has conducted recognized research in plastic deformation of metals, mechanical properties in solids, single crystal deformation, casting of artificial hearts and other devices for biomedical problems and related subjects. He is credited with being the first investigator to show the growth mechanism of solid dendrites as they proceed down a liquid solid interface.

Other accomplishments for which he is credited include the growth of a single crystal in a "gang" mold, castings of wires and metal filaments, study of micro-motion pictures of deforming metals which resulted in the discovery of "de-slip" of metals, and delineation of a "cell size" inherent in deformation processes.

Of Prof. Pond's contribution to the Ballistics Research Laboratories, Dr. Robert J. Eichelberger, BRL associate technical director, commented:

"The professor's services will be of tremendous significance to our research programs, and to our younger scientists. As a seasoned scholar and scientific teacher, he will be a distinct asset here. . . . We are happily aware that his being here is in such perfect accord with President Johnson's current program to expedite the training of scientists nationwide."

ODDRE Military Aide Wins Legion of Merit

Col Richard L. Long, military assistant to the director of Aeronautics in the Office of the Director of Defense Research and Engineering (ODDR&E), received the Legion of Merit on his retirement from the Army.

Col Long served in ODDR&E from 1962 until his recent retirement and the award recognized his contributions to several major U.S. research and development programs in aviation, and particularly vertical take-off and landing aircraft.

In addition, he was cited for his ability to obtain agreement among different services and groups on R&D matters. For example, he played a key role in the Tripartite Technical Cooperation Program through which the United States, the United Kingdom and Canada agree to maintain a flow of technical information between them.

A master aviator with over 4,000 hours in the air, Col Long is qualified in both helicopter and fixed-wing aircraft. He is joining Sikorski Aircraft Division, Stratford, Conn., as assistant to the director of Advanced Research, an engineering position.

Col Long entered the Army in 1942 with a commission in the Field Artillery, obtained his pilot's wings in 1943, and transferred to the Transportation Corps in 1954. He served in the office of the Chief of Research and Development in the Pentagon as action officer (1952-54) and became chief of the Airborne and Army Aviation Branch in the Development Division of Army R&D (1954-55).

Col Long adds the Legion of Merit to the French Croix de Guerre, W.W. II Victory Medal, Germany Occupation Medal, Meritorious Service Unit Patch, U.S. Army Commendation Medal, Bronze Star, and Air Medal with Third Oak Leaf Cluster.

Former ARO Officer Heads Major E-Command Project

Lt Col Raymond I. McFadden, a former staff officer in the Physical Sciences Division, U.S. Army Research Office, recently reported to Fort Monmouth, N.J., as project manager of (MQM-58A) OVERSEER.

The OVERSEER Project Management Office, Army Materiel Command element, is delegated the responsibility of providing the Army with the best combat surveillance and target acquisition system at the earliest possible date. It is supported by the U.S. Army Electronics Command.

A 1945 graduate of West Point, Lt Col McFadden earned his M.S. degree in electrical engineering at Ohio State University in 1951. He reported to his new post from Purdue University, where he completed studies toward his doctorate degree in solid-state physics.

In addition to service with the U.S. Army Research Office, one of the four major directorates in the Office of the Chief of Research and Development, Lt Col McFadden has been an instructor and assistant professor in electrical engineering on the staff and faculty of the U.S. Military Academy and an engineer for the U.S. Communications Systems in Taiwan.

Kornet Relieves O'Keefe as CO at Watervliet

Command of Watervliet Arsenal, N.Y., passed from Col Keith T. O'Keefe when he retired July 31 after serving as commander since February 1962, ending 33 years Army service, to Col Fred Kornet, Jr.

Commissioned in 1941, Col Kornet served in the European Theater of Operations during World War II. Following his assignment to Europe, he became coordinator at Watertown Arsenal, Mass., for development of the 280mm. gun, the first artillery weapon capable of firing nuclear rounds.

For four years he was assigned to the office of the Chief of Ordnance in Washington, D.C. Since August 1963, he has been assigned to the Army's Institute of Advanced Studies at Carlisle Barracks, Pa. He has been executive officer of the Institute since July 1964.

Col Kornet is a graduate of both the Command and General Staff College and the Army War College. He was awarded his B.S. degree in chemical engineering from Lehigh University and his M.A. in business administration from the University of Chicago.

Col Fred Kornet, Jr.

E-Command Orders Fuel Cell Test Models

Test models of this country's first air-breathing, lightweight fuel cells to power forward area military electronic equipment will be produced under a $334,891 contract awarded by the U.S. Army Electronics Command, Fort Monmouth, N.J.

The contract with Monsanto Research Corp. calls for exploratory and development models capable of producing 720 watt hours (60 watts for 12 hours) on a single 2-pound fueling. Voltages are to be 28 and 14 volts.

Scheduled for completion in 16 and 28 months, respectively, the models are to have operating lives of 750 hours; they will need refueling at no less than 12-hour intervals under full load.

A final 7-volt model of the system will weigh 10 pounds and occupy less than one cubic foot of space. A comparable rechargeable nickel-cadmium battery (a widely used power source for tactical equipment) would weigh five or six times as much.

The contract also requires operational capability in a temperature range from below 0° to 125° F., for successful power output when the unit is based on as much as a 45-degree angle from the horizontal, and under vibration conditions that may be met in vehicular and manpack radio use; also, operation under as much as 100 percent humidity.

Since large-scale developmental effort began about 10 years ago, the potential of fuel cells has been considered as highly promising for forward tactical use. The cells operate without moving parts and generate electricity silently through the chemical conversion of fuel.

From a military tactical viewpoint, fuel cells have a much higher power-to-weight ratio than other electrical power sources and can operate without attention except for refueling.

Until recently, technical difficulties, including the necessity of handling gaseous fuels such as oxygen and hydrogen in heavy compressed-gas tanks, restricted tactical application.

The new tactical fuel cell will obtain its oxygen from the air and its hydrogen from hydrazine, a liquid fuel that can be handled and transported in the same manner as gasoline.

Army Terminates 5-Year Mauler Development

The Army is terminating the Mauler development program after spending five years and $200 million on a system designed to protect front-line troops against high-speed aircraft and short-range missiles and rockets.

The Mauler was envisioned as an all-weather air-defense weapon system completely contained in one tracked vehicle. Developers found that mounting a fire control radar and a guided missile launcher on the same vehicle posed technical difficulties which caused delay and increased costs. An estimated $180 million in development costs would be needed to complete Mauler.

Technical problems and increased costs were weighed against the need for Mauler in an extensive re-evaluation completed this spring. Recent improvements in the Hawk missile system, and the promise of simpler and cheaper forward-area defense systems involving combinations of automatic guns and the Chaparral (Sidewinder missiles mounted on a self-propelled vehicle), led the Army to question the wisdom of continuing development of the Mauler to deployment.

To insure that the fruits of the Mauler program are not lost, studies are under way to decide which components merit further development. Of potential value to the U.S. and Allied nations are the Infra-red Acquisition Unit, the Acquisition Radar and the fuze.

In addition, it was stated, future compact air-defense weapons systems may benefit from the technology and miniaturization techniques developed during the Mauler program.

Tropic Test Center Adds Two New Key Personnel

A retired Navy offcer and former associate professor at San Jose (Calif.) State College, Robert G. Reed, recently became a research meteorologist at the U.S. Army Tropic Test Center at Fort Clayton, C.Z.

In 1953 he received a BS degree and in 1961 an MS both in meteorology, from the U.S. Navy Postgraduate School, Monterey, Calif.

Retired with the rank of lieutenant commander after 25 years service with the U.S. Navy, Reed is a veteran of the Korean, European, African, Middle Eastern and the Asiatic-Pacific campaigns. He is a member of the American Meteorological Society, the American Geophysical Union, the American Association for Advancement of Science, and has authored several meteorological papers and publications.

MAJ PETER N. LEONE, II, is the new chief of the Electronics and Special Projects Branch, Test Division. A 1954 graduate of the U.S. Military Academy, he was until recently an assistant professor, U.S. Army ROTC Instructor Group at Hofstra University, Hempstead, N.Y. Previously he served with the 10th Infantry Division in Germany.

Self-Propelled Lance Missile Launcher Test Fired

A tactical version of the lightweight launcher for the Army's Lance mobile battlefield missile recently achieved its first successful developmental firing at White Sands Missile Range, N. Mex.

The launcher is an integral part of the Lance missile system, designed to offer greater range and accuracy than the Honest John, which it is expected to supersede.

The Lance and its launcher, mounted on a self-propelled, tracked vehicle, form a self-contained and self-sustaining unit which can be dismounted and transported by helicopter or dropped by parachute. On the ground, the unit can be positioned or towed by any light vehicle.

The first Army missile to use a prepackaged, storeable liquid propellant, the Lance is designed to provide nuclear or nonnuclear support for infantry, armored and mechanized units.

FY '65 Army Cost Reductions Exceed Goal

Intensive effort to improve management and increase efficiency and economy of operations through the Army Cost Reduction Program saved $1.172 billion in FY 1965, about 25 percent above the $934 million goal.

In FY 1963, the first year of the formal program, the Army achieved savings of over $678 million, exceeding a $459 million goal by 50 percent. In FY 1964, the goal was $818 million, which was exceeded by 23 percent with savings of $1.005 billion.

Examples of imagination and ingenuity of military and civilian employees in cost reduction actions that surpassed the goal in FY 65 might be recounted at great length. Selected examples are:

An employee of the U.S. Army Ammunition Procurement and Supply Agency, Joliet, Ill., suggested that M108 cartridge cases considered surplus to Army needs could be reworked and used in lieu of procurement of M108B1 cases needed for the new 90mm. TP-T, M353 cartridge. Resultant savings of over $3 million were released for reprograming to meet other procurement requirements.

A sergeant first class at Fort Knox, Ky., suggested the use of modified football helmets (cost $23.38 each) to replace the standard tanker's helmet (cost $80.95 each) for training purposes. Modification savings totaled more than $123,000.

A group of military and civilian employees at Picatinny Arsenal, Dover, N.J., developed an improved design for the 2.75-inch colored smoke rocket. FY 1965 savings exceeded $627,000.

The 521st Engineer Group, Seventh Army, U.S. Army Europe, fabricated a load center apparatus which provides current to Hawk missile launchers, allowing two generators to perform the work of four. Installed at all Hawk sites throughout the Seventh Army, the apparatus saved $547,000 in FY 1965.

A woman employed by the U.S. Army Missile Command developed a procedure to expedite repair of Nike Hercules solenoid valves, thereby reducing the cycle from six months to three months. The increase in asset availability made it possible to reduce procurement of solenoid valves by 1,402. Over $395,000 was saved.

Involved in the Army Cost Reduction Program are 31 areas of effort. The Office of the Chief of Research and Development monitors two—value engineering (VE) to eliminate "gold-plating," and technical data and reports.

VE contributed $114.1 million to the Army cost reduction goal in FY 1965, or 128 percent over the $50 million anticipated.

Follow-on savings of $9.3 million, for example, resulted from an in-house project at Picatinny Arsenal. Development of a new super-propelling charge (XM119) permitted use of a standard-type projectile (M449-E2) for extended range capability, eliminating the need for a new specialized projectile.

Picatinny VE of the YM169 cartridge case resulted in a reduction of component parts from six to three and saved more than $1 million on FY 1965 production.

Redesign of a biological-chemical sampler at Dugway Proving Ground, Utah, resulted in reduction of its size and in elimination of control valves for a $331,600 initial saving.

In a Quadrant Elevation Study at White Sands Missile Range, N. Mex., the number of missile test firings required was reduced by 28, saving $2,191,500.

Extensive VE modifications in a Microwave Calibration Test Set at Frankford Arsenal, Philadelphia, Pa., saved $1,553,000. Savings of $769,900 resulted from elimination of 14 of the environmental generators in the Electromagnetic Environmental Test Facility at the U.S. Army Electronic Proving Ground, Fort Huachuca, Ariz.

Nuclear Veteran Heads BRL Pulse Reactor Work

Dr. Hubert P. Yockey, a 47-year-old physicist who started his career on the Manhattan Project, will head Ballistic Research Laboratories monitoring of technical and safety aspects of the nuclear pulse reactor under construction at Aberdeen Proving Ground (APG), Md.

Scheduled for completion in mid-1967, the reactor is intended to provide East Coast defense activities and contractors with a means of safely and economically conducting radiation exposure studies on equipment and materials of military interest.

Dr. Yockey was employed on the Manhattan Project as a nuclear physicist at age 24 after receiving a Ph.D. degree from the University of California in 1942.

After five years at Oak Ridge, Tenn., with the Project, he joined North American Aviation's Los Angeles plant. There he helped initiate interest in nuclear reactors, made studies on radiation damage to materials, and pioneered the first use of charged atomic particles in radiation damage studies.

Dr. Hubert P. Yockey

Following a year of research on nuclear powered aircraft for Convair in Fort Worth, Tex., Dr. Yockey became assistant director of the health physics division at Oak Ridge National Laboratory. He initiated work that led to the Oak Ridge Health Physics Research Reactor, the facility after which the APG reactor core will be patterned.

In 1959-62, as manager of research and development for Aerojet General Nucleonics, he directed preliminary design of the APG pulsed reactor. Then he became senior scientist for Hughes Research Laboratories at Malibu, Calif., before accepting his present position.

Areas in which Dr. Yockey has done definitive research include early work in radioactive waste disposal methods, thermoluminescence in biological materials and in ferroelectrics, and the information theory in biology.

The latter is the application of mathematical theory to the storage of genetic information by living organisms; also, to the research field presently producing extensive new data on the influence of genes through isolation of the biochemical DNA.

Dr. Yockey authored a book, *Symposium of Information Theory in Biology*, published in 1960, and is listed in *American Men of Science*, *Who's Who in Atoms*, and *Who's Who in the West*. He is an American Physical Society Fellow and a certified health physicist.

Army HF&OR Program Serves to Enhance Combat Capability

Human factors research and operations research, for which the Chief of Research and Development has Army-wide responsibility, may be described as scientific means of making military manpower, materiel and methodology achieve the utmost in combat capability.

The Human Factors and Operations Research (HF&OR) Division of the U. S. Army Research Office discharges the responsibility of the Chief of Research and Development for planning, programing, coordinating and supervising Department of the Army research, development, testing and evaluation of HF&OR activities.

Primary responsibility of the HF&OR Division is to monitor directly the programs of various in-house and contract agencies for the Chief of Research and Development, as well as exercise General Staff supervision over relevant activities in the U. S. Army Materiel Command. This direct supervision of major research activities is a unique feature in the functioning of the Division.

Col Herald B. Gallinger is chief of the HF&OR Division, consisting of the Human Factors Branch headed by Jacob L. Barber and the Operations Research Branch under Lt Col Joseph P. Lydon. Areas of effort include basic research, human factors engineering, personnel research, determination of the need for training devices and problems of training, motivation and leadership.

Responsibility of the Division in human factors engineering includes fundamental and applied studies on man-machine compatibility. The U.S. Army Materiel Command (AMC) and the Corps of Engineers are responsible for HF engineering of materiel within their assigned areas.

In addition, the AMC is responsible for conducting basic and applied research to produce human factors engineering data required for the design and development of materiel, including training devices. Human engineering of materiel is carried out to varying degrees at numerous AMC laboratories and arsenals.

The mission of performing more fundamental or basic research is conducted almost exclusively at the U.S. Army Human Engineering Laboratories and Natick Laboratories.

The work program in human factors engineering includes research on such subjects as the auditory localization of combat sounds; the effects on human and animal hearing of exposure to impulse noise; the preparation of human engineering guidance and specifications; the application of human engineering data to equipment design; and monitoring of contractors.

AMC research on man-machine compatibility covers a range of research services, anchored at one end in basic research in human performance capabilities and extending to the final application of such knowledge and data to materiel design.

Work on training devices is conducted by the Army Participation Group at the Naval Training Device Center, Port Washington, N.Y. Prior to the 1962 reorganization of the Army, this Group reported to the Continental Army Command, and is now under the cognizance of the AMC.

Research in the fields of personnel measurement and utilization is performed by the U.S. Army Personnel Research Office (USAPRO), an in-house laboratory under the Chief of Research and Development. The mission of USAPRO is essentially "fitting the man to the job."

USAPRO, under various names and at varying levels of effort, has been in almost continuous existence since World War I, fulfilling the Army's requirements for research information on its vital manpower resources. More recently, with the growth of the systems research point of view, USAPRO's research mission has been focused on man-machine interactions in the total work environment.

In its traditional mission area of personnel measurement, USAPRO has produced more than 100 testing instruments which efficiently select and classify candidates for regular and special assignments. USAPRO produced the Armed Forces Qualification Test, which was legislated by Congress as the mental ability test to be used by all the Armed Services. Continuing basic research leading to

COL HERALD B. GALLINGER, chief of the HF&OR Division since May 1965, prepared for that role during a year and a half as deputy chief, after serving two years as military advisor to the Research Analysis Corp., McLean, Va., an Army contract agency. In Korea from 1953-55, he served at Hq 3rd Infantry Division Artillery. Additional assignments have included commander of the 2d Reconnaissance Squadron, 9th Cavalry, 24th Infantry Division, Europe 1958-59, followed by two years duty as G2 of the 24th Infantry Division and a year as acting chief of staff and deputy brigade commander, 24th Infantry Division. He is a graduate of the Command and General Staff College.

LT COL JOSEPH P. LYDON, chief, Operations Research Branch, began service with the U.S. Army Research Office in 1962 as a staff officer with the Research Planning Division and was reassigned to HF&OR Division in 1963. He served from 1960-62 with the U.S. Military Assistance Advisory Group in Cambodia. From 1956-60 he was chief of the Training and Evaluation Branch, Defense Atomic Support Agency, Sandia Base, N. Mex. A veteran of the Korean War and the Metz, Bulge and Ruhr Valley battles of World War II, he is a graduate of the Command and General Staff College.

JACOB L. BARBER, JR., chief of the Human Factors Branch since March 1963, was first assigned to the division as assistant chief of the Human Engineering Branch in September 1961. In 1950 he joined the U.S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va., as an experimental psychologist and 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 B.S. degree with honors from Dickinson College, and an MA in physics and psychology from Lehigh University.

improvement of these screening and classification devices is another vital part of the USAPRO mission.

Research and development in the areas of training, needs for training devices, motivation and leadership, are conducted for the Army by a unique military-civilian effort furnished by a contract organization, the Human Resources Research Office (HumRRO) of the George Washington University.

Products of this research and development consist primarily in more effective principles, techniques, and procedures for training personnel.

Types of training considered range from basic combat training to complex missile electronic maintenance courses, and from elementary leadership training for enlisted personnel to the education of field grade officers. (See HumRRO article, August 1965 issue, page 28.)

HumRRO was established in 1951 as a direct result of an Army staff study which expressed the need for professional assistance in making the best possible use of the human resources entrusted to the Army for the defense of the Nation.

As an integral part of the Army's human factors research program, HumRRO's work is supervised directly by the Human Factors and Operations Research Division. Its research and development activities are conducted through the Training Methods Division and the Language and Area Training Division, both in Alexandria, Va., five field laboratories located at or near Army Training Centers (Fort Benning, Ga., Fort Bliss, Texas, Fort Knox, Kentucky, Fort Rucker, Ala., and the Presidio of Monterey, Cal.) and in Korea.

The guiding principle of the human factors program is that research conducted will provide information useful to the Army in solving its operational problems.

Requirements for research which are accepted by HF&OR Division are forwarded to the research agencies for preparation of appropriate research proposals and incorporation into a proposed research program, which is fully coordinated with the sponsors, with General Staff agencies, and with major commands.

The chief of the HF&OR Division chairs the Army Human Factors Research Advisory Committee (AHFRAC), composed of representatives of each General Staff agency, U.S. Continental Army Command, U.S. Army Materiel Command, U.S. Army Combat Developments Command, U.S. Army Security Agency, and the Chief of the Office Reserve Components.

The AHFRAC reconciles comments regarding the proposed programs and it expedites consideration of the human factors research interest of all Department of the Army agencies.

In monitoring and evaluating ongoing research, the HF&OR Division examines the thoroughness of the coverage of the requirements, striving also to avoid undesirable or unwarranted overlap and duplication through formal and informal written and oral presentations, through review of draft plans and reports, and through the review of the quarterly progress reports.

Sponsors of research receive oral and written presentations on work undertaken for them and suggest changes as appropriate. The usefulness of the research product and the scientific evidence of its value are the final criteria of success, as reviewed by AHFRAC, by the sponsoring agencies, by the research organizations, and by the HF&OR Division.

Aid to sponsoring agencies frequently is given for months or years after completion of the research. Also, each research organization provides technical advisory services as requested on specific problems requiring professional judgment.

The annual Army Human Factors R&D Conference under CRD sponsorship, initiated in 1954, is an acknowledgement of the communality of HF&OR interests of a number of independent Army R&D activities. All of the participating agencies conduct psychological and social science research and exploratory development for the solution of important Army problems. The eleventh conference in the series is slated Oct. 3-6, 1965, at Fort Bragg, N.C.

OPERATIONS RESEARCH in the military fields has been defined as the rigorous application of logic, mathematics, science, and a method of evaluation to achieve a stated goal. The objective is to develop sets of pertinent values and provide the basis for decisions that require a minimum over-all consumption of resources (including time) to achieve that goal.

The Operations Research Branch of the HF&OR Division monitors the Army contract operations research study program funded by research, development, test and evaluation appropriations. The branch also is responsible for U.S. Army participation in Quadripartite and Data Exchange Agreements in the area of operations research.

In addition to research monitored directly by the branch, liaison is maintained with Departments of the Navy and the Air Force and nonmilitary operations research organizations in the scientific community. Emphasis is on an energetic program for coordination and exchange of information with Army in-house operations research activities.

Four of these, the Ballistic Research Laboratories at Aberdeen Proving Ground, Md., the Strategy and Tactics Analysis Group at Bethesda, Md., the Engineer Strategic Studies Group at Fort Belvoir, Va., and the Operations Research Group at Edgewood Arsenal, Md., are considered to have a significant capability for applying operations research techniques to Army-wide problems.

In addition to the in-house activities, the major commands use contract organizations with operations research capabilities to support their missions—such as support of Headquarters, Combat Developments Command, Fort Belvoir, Va., or the Combat Developments Experimentation Center, Fort Ord, Calif.

The two principal contracts monitored by the Operations Research Branch are those with the Research Analysis Corporation (RAC), McLean, Va., and with the Stanford Research Institute, Menlo Park, Calif.

RAC performs scientific and engineering studies and research to support top-level planners and decision-makers in a wide range of problem areas. Its capability extends beyond the purely military field to include economic and political considerations. The annual work program is based on study requirements from Department of the Army agencies and commands.

The SRI contract provides support to the Department of the Army by conducting studies in air and ballistic missile defense. About half the effort is in support of the U.S. Army Air Defense Command. The other half supports air defense of the field Army under the U.S. Army Combat Developments Command.

Advanced technology has increased the sophistication and complexity of weapons, resulting in demands upon the soldier for a great many skills requiring the best in training methods and in simulated training devices. The HF&OR Division monitors research efforts to achieve the utmost in combat capability under these increasingly complex conditions.

To accomplish this demanding objective, scientists trained in many different disciplines, e.g., mathematics, psychology, physics, biology, political science, are called upon to analyze accurately the problem areas and work cooperatively with available resources to solve the problems.

The HF&OR Division mission is to insure that the planning, coordination and integration of effort, and the over-all management of human factors and operations research, effectively serve this objective.

Congressional Unit Approves Army Food Irradiation Program

Federal approval for unlimited public use of certain food items preserved by ionizing radiation—products of the 13-year-old Army Food Irradiation Program—was reported recently to the United States Congress.

Important progress and future plans of the Army in contributing to the National Radiation Preservation of Foods Program were outlined to the Sub-Committee on Research, Development and Radiation of the Joint Committee on Atomic Energy. The hearing resulted in committee approval of the Army's 5-year (1966-70) Food Irradiation Program.

Assistant Secretary of the Army (R&D) Willis M. Hawkins, accompanied by Director of Army Research Brig Gen Walter E. Lotz, Jr., explained that his office and the Army Research Office, Office of the Chief of Research and Development, have overall responsibility for the Army Food Irradiation Program.

Dr. Edward S. Josephson, associate director in the Food Division for Food Radiation, U.S. Army Natick (Mass.) Laboratories, was introduced to make the Army presentation in recognition of his broad experience. Dr. Josephson is internationally known for his work on food problems and methods of preservation.

Introduced also were supporting witnesses Dr. Ralph G. H. Siu, scientific director of the Army Materiel Command and one of six coeditors of *Radiation Preservation of Food*, the initial publication in the Army R&D Monograph Series which has aroused worldwide interest; Col Tyron E. Huber, chief of the Life Sciences Division, Army Research Office; and Lt Col Eugene A. Rosenberger, chief of the Medical Research Branch, Office of The Surgeon General.

Dr. Josephson told the subcommittee that in addition to the U.S. Food and Drug Administration's acceptance of certain foods preserved by radiation for general public use, the Army Medical Service studies on the wholesomeness of 21 major classes of food sterilized by this process have reached a "successful conclusion."

Vegetable parchment paper and other sterilized packaging materials were included in the approvals by the Food and Drug Administration (FDA) as petitioned by the Army, the Atomic Energy Commission (AEC), private industry, and private citizens, Dr. Josephson reported.

Listed as FDA-approved for general use are canned bacon, wheat and wheat products, and white potatoes exposed to varying radiation doses. Four other petitions, including oranges and new flexible packaging materials, are pending.

Other petitions—for enhancements of current processing—are the use of electron beams for deinfestation of wheat and its products, and the commercial use of potatoes with increased gamma doses to inhibit sprouting during storage.

In this first report to the Congressional Subcommittee since the group reviewed the Army food irradiation progress at the Natick Laboratories in May 1963, Dr. Josephson noted that "as far as can be foreseen at present," there will be only minimal needs for future testing of the wholesomeness of the 21 irradiated foods.

Some nutrient loss in approved or petitions pending food items, limited to vitamins, was termed no more than that from conventional food preservation, such as thermal canning and dehydration.

"These FDA approvals achieve the major objective of establishing, in principle, the technical feasibility of sterilizing, or otherwise prolonging shelf-life, of food items by exposure to radiation sources," Dr. Josephson summarized.

The 21 sterilized items successfully tested are ground beef, pork loin, bacon, shrimp, codfish, chicken, tuna, beef stew, chicken stew, carrots, cole slaw, corn, green beans, sweet potatoes, fruit compote, evaporated milk, peaches, jam, flour, white potatoes, and oranges.

Military objectives of the Army Food Irradiation Program are the same today as when research began, Dr. Josephson explained—to eliminate or greatly reduce refrigeration requirements; to introduce irradiated food items closely resembling fresh products; and to develop flexible, lightweight containers for irradiated food as a logistical aid.

Dr. Josephson referred to a lengthy report published late last May by the National Academy of Sciences National Research Council. The report reviews the worldwide import of radiation preservation reports emanating from a September 1964 international conference in Boston, Mass.

Sponsored jointly by the AEC, the Natick Laboratories, and the Advisory Board on Military Personnel Supplies of the National Academy of Sciences, the conference featured 37 technical papers on food irradiation. Represented were West Germany, the Netherlands, Great Britain, Canada, India, Denmark and international atomic energy and food agencies.

Dr. Josephson said the conference demonstrated marked confidence in the future worldwide usefulness of irradiated foods. Canada at that time announced that the world's first commercial processing facility for irradiated potatoes was under construction by Canadian industry.

Exhaustive tests, it was stated, have showed no toxic effects specifically caused by ingestion of irradiated foods; also, no carcinogenic characteristics of irradiated foods have been found in thousands of experimental animals.

Further, long-term feeding studies have established the wholesomeness of foods sterilized by electron radiation at energies up to 10 million electron volts.

Listed among recent achievements in the Army program are:

- Establishing the technical feasibility of the linear accelerator as an alternative to cobalt 60 to achieve irradiation preservation.
- Isolation and identification of three naturally occurring compounds responsible for the irradiation flavor of beef.
- Selection of six classes of flexible plastic packaging materials with markedly improved radiation resistance at sterilizing doses.
- Determination of radiation resistance of a wide variety of *Clostridium botulinum* strains.
- Palatable sterilized beef irradiated at extremely low temperatures.
- Improvement in taste of sterilized meat products by packaging *in vacuo* at high temperature.
- Development of the capability to irradiate foods at controlled temperatures from minus 196° C.
- Improvement in uniformity of radiation dose absorbed by target foods, achieved by varying the placement of individual cobalt slugs in the source rack and mapping of emitted energy.

Outlining future Army plans to the committee, Dr. Josephson said industry is being encouraged to introduce irradiated foods on a commercial basis. One of the research goals of the Army is irradiation sterilization of seven meat items (lamb included) in various forms contained in flexible, lightweight packages. He said it has become more evident in recent years that irradiated meats are particularly needed worldwide for garrison and shipboard feeding.

Industry has been invited to bid on production of 30,000 pounds of irradiation-sterilized bacon (first irradiated food accepted by the FDA in Febru-

ary 1963) to be divided between the Army and Air Force for consumption in the U.S. and overseas.

Other evidence of impetus in the field includes a logistic and economic study by the Department of Commerce (Business and Defense Services Administration) for the Army to determine additional potentials of irradiated food in military feeding.

The Army, the AEC and other Federal agencies are seeking to interest private industry in the need for a pilot plant to process irradiated meats and poultry. This plant would enable the Armed Forces to evaluate, on a larger scale, the acceptability of irradiation-preserved foods under all conditions.

Industrial participation is the key to the future, Dr. Josephson emphasized, pointing out that problems of importance to the military still exist.

Reasons for the Army to continue its irradiation-sterilization research, he said, include accumulation of data required to petition the FDA; need for development of flexible, lightweight packaging; improvement of troop acceptance and adaptation of specific items to fit military needs; further improvement of flavor, color and texture of foods; and successful preservation of completely raw meats, poultry, and marine products for sustained periods in transportation and storage.

Dr. Josephson said the FDS would be asked to clear irradiated chicken, ham and pork in FY 1965 and beef and shrimp in FY 1967. Fourteen additional sterilized products will be submitted for FDA approval during Fiscal Years 1968 through 1970.

Although the FDA-approved vegetable parchment packaging is a step forward, Dr. Josephson said action is pending on six classes of plastic films. Further research is needed, he said, in pliable plastics with improved tolerances to irradiation.

None of the materials produced by private industry has been developed specifically for irradiated food, Dr. Josephson said, making it "wise" for the Army to continue a "substantial level of effort" on packaging improvements.

Army researchers are considering various approaches to minimize the radiation dose required to sterilize food without reducing microbiological safety. Improvements of this type are needed for irradiated food items that will be widely acceptable to consumers and can be processed more economically.

Increased knowledge of the nature of bacterial irradiation resistance is the key to this problem, including the possible use of chemical or biochemical adjuncts to radiation.

Dr. Josephson's report reviewed the 6-year fiscal plan for irradiation which anticipated expenditure of $5.1 million beginning in FY 1961. The Army, however, augmented the plan by $2.3 million to meet additional research costs required by the end of FY 1966. The 1965 level was $1.365 million and is now $1.119 million. Dr. Josephson said that costs from 1967 on will decrease to about $500,000 in 1971 as tasks are completed.

Current estimates indicate, it was stated, that by the end of FY 1970 the technical feasibility of irradiation-sterilized meats, poultry and marine products will have been established by submission of a complete series of satisfactory petitions to the FDA.

Anticipated also is that problems of lightweight flexible packaging will be overcome by 1970, and that major problems of adapting individual items to military needs will be solved.

Subsequent to FY 1970, Dr. Josephson said, the Army plans to maintain its capability to work on the more fundamental aspects of food irradiation. This capability also will allow quick research response to unexpected problems arising from pilot plant processing.

Developmental aspects requiring special attention were cited as:

- Evaluation of the comparative merits of individual irradiation-sterilized food items when introduced into the different rations comprising the combat feeding system.
- Economic, logistic and large-scale acceptability analyses of products produced by the pilot plant currently under discussion with industry.
- Determination of time saved by the combat soldier in field ration preparation as a result of combined irradiation and dehydration processing.

Preliminary estimates, it was stated, suggest that developmental efforts should commence in FY 1968 and thereafter coincide with the production capabilities of an industry-sponsored pilot plant and with completion of the series of Army petitions to the Food and Drug Administration for public use of irradiated food items.

Chronology of Army Food Irradiation Program

1949 (and before) General possibilities of preservation of food by ionizing energy established internationally on a theoretical and laboratory basis . . . prior to 1950, meager U.S. Government support extended in research on preservation process.

1950 U.S. Atomic Energy Commission (AEC) seeks use of waste fission products of nuclear reactor operations; potential in food processing seen, and research contracts are let.

1952 U.S. Army assumes world leadership in developing the process of preserving food by ionizing energy—the Army Food Irradiation Program.

1955 Army research plans presented to Joint Congressional Committee on Atomic Energy (JCAE).

1956 Army plans developed further at Committee Hearings . . . Army Quartermaster Corps studies food sterilization . . . research begins in Canada, Japan, and Europe. . . . Army Medical Service begins studies of irradiated food wholesomeness with Army Quartermaster Corps.

1960 U.S. Atomic Energy Commission joins Army in irradiation research . . . in March, JCAE Hearings delineate responsibilities of Army and AEC in irradiation program.

1962 (June) Army submits irradiated bacon for approval by U.S. Food and Drug Administration (FDA). . . . Army accepts (June 28) $1.8 million Quartermaster Food Radiation Research Facility at Natick, Mass., marking a decade of Army pioneering in the irradiated food field. . . . Army Food Irradiation Program transferred July 1 from Armed Forces Food and Container Institute at Chicago to Food Division, U.S. Army Natick Laboratories, Mass. . . . in November cobalt-60 irradiator (nuclear reactor) becomes operational at Natick.

1963 International Conference on Radiation Research held at Natick Laboratories. . . . The AEC-constructed, Radiation Laboratory becomes operational. . . . (February) Canned bacon, the first irradiated food, is approved by the FDA for unrestricted public use. . . . (May) JCAE Hearings on Army food irradiation held at Natick. . . . (July 1) Army begins serving irradiated meals to troops at Fort Lee, Va., to determine acceptability.

1964 (February) Army-purchased, 24-million electron volt, 18 kw. electron linear accelerator becomes operational at Natick—a second energy source for food preservation; cobalt-60 reactor continues in operation. . . . International Conference on Radiation-Preservation of Foods held in Boston, Mass., Sept. 27-30.

1965 (June 6) JCAE Hearings on Army Food Irradiation Program. . . . FDA approval for unlimited public use of specific food items and packaging materials, the successful end of studies by Army Medical Service on wholesomeness of 21 irradiated food items announced.

OCRD Air Mobility Chief Presents Army V/STOL Aircraft Review

Characteristics of six basic types of aircraft needed by the Army, as determined by peculiarities of the environments in which they must operate, will be discussed by an Army speaker at the Allison Mobility Forum, Indianapolis, Ind., Oct. 6-7.

Col John Dibble, Jr., chief of the Air Mobility Division, Office of the Chief of Research and Development, Department of the Army, will present a technical paper on "Possible Army Applications of V/STOL Aircraft."

V/STOL aircraft are defined as having a capability to accomplish vertical takeoffs and landings at higher, or overload gross weights.

Col Dibble has made available to the Newsmagazine the major portion of his scheduled unclassified presentation, starting with "Environment and Characteristics," as follows:

* * *

By Col John Dibble

As a generalization, Army aircraft operate in the combat zone, under various gradations of primitive conditions, almost completely subject to both seasonal and momentary changes in the weather.

Army aircraft consequently must be independent of any reliance on the fixed-base facilities that would increase their vulnerability and handicap their capability to react to the fluid nature of land combat operations. They must not impose an unacceptable load on the Army's always oversubscribed logistical support organization.

Ideally, Army aircraft should be silent. At worst, their noise level must permit them not only to survive in the face of enemy air defenses, but also to capitalize on the overwhelming advantage of surprise. In varying degrees they must be able to live and operate with the land combat soldiers, and to this extent the soldiers must find them acceptable companions.

To summarize this environmental description, the Army has set these criteria which determine whether an organization should be assigned an aircraft:

- The aircraft must be needed on a full-time basis.
- It must be suitable in performance (and characteristics) for inclusion in the organization and must be compatible with the support capabilities of the organization.
- Its tactical mission must require close integration with the parent organization's activities.
- It must be capable of living in the austere day-to-day environment of its parent organization.

Within these criteria, Army aircraft should be assigned at the lowest level that requires their full-time use, and as their characteristics improve the level of assignment will be lower. This has been proved historically in the cases of the tank and the truck.

Initially, when Army aircraft were considered highly specialized, expensive complex machines they were pooled in specialized units and employed in mass. But as they have become common, accepted members of the Army, they have been increasingly assigned to the smallest forward combat units.

To match this trend in the proximate future, the Army will require V/STOL aircraft that are simple, rugged, quiet and that offer low downwash, superb handling qualities and a broad flight profile, particularly in the lower speed range.

Simplicity is related to maintainability, ease of assembly and disassembly, and ability to service the aircraft without extra ground support equipment. A normal Army mechanic should be able to maintain it using the tools already in the Army's tool kit.

Further, it must be possible to move the aircraft under cover, load ammunition, supplies and fuel and move it back to its takeoff position without special groud support equipment. Maintenance hours per flying hour should be minimal.

To demonstrate the progress being made, fighters built in the mid-1950s required 45 maintenance hours per flight hour. Helicopters in the same time period required up to 60. Some of those coming into the inventory in the early 1960s required as little as 10 hours per flying hour. Now we are looking for less than four maintenance hours per flight hour in future Army aircraft.

Ruggedness, the second characteristic, has several sides. Basically, although the soldiers that maintain, handle, pilot and ride in the Army's aircraft will receive intensive training in their use, there will be many occasions when the pressures of time, darkness, enemy action, terrain and weather will result in rough handling and abuse. The aircraft must be able to withstand the extremes of heat, cold, mud and dirt in an essentially unprotected environment.

Another aspect of ruggedness is survivability. The crew and vital components of the aircraft will be protected by the improved, lightweight armor being developed. But even at its best, armor is heavy and results in a corresponding reduction in the aircraft payload.

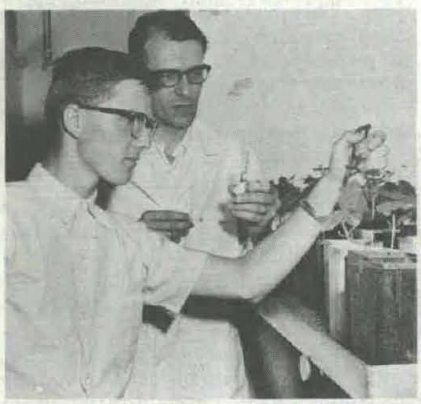
One of the best ways to reduce the requirement for armor is to build survivability into the components themselves. By this, I mean that it is becoming increasingly practicable to build shafts, spars and even gear boxes that can survive reasonable levels of gunfire.

All of the aircraft manufacturers, and particularly the developers of V/STOL aircraft, are aware of the Army's antipathy toward noise in its aircraft. Flight surgeons are concerned with keeping the noise level in the aircraft as far below 100 decibles as possible.

External noise is a different problem and the requirement for quietness is related to the aircraft's mission profile, including its speed, the altitude at which it will fly and the aspect it will present to the enemy.

Some aircraft will have a greater requirement for noise suppression in the forward 60° sector, while others will require noise suppression throughout 270°. Ideally, of course, we would like to have an aircraft that is silent through 360°.

Downwash is related, although not directly, to disc loading, and the amount of downwash the Army can



ONE OF TWENTY top NSF-I winners offered the opportunity of summer employment or a visit to Army Laboratories, Francis Ors Dudas, 15, is shown above during a recent 5-day visit to Fort Detrick, Md. Dr. Fred B. Abeles, a research scientist with the Crops Division, assists the young scientist in the study of a plant growth project at the U.S. Army Biological Laboratories.

tolerate in its aircraft is again a function of the aircraft's mission. As an example, the lowest possible downwash is required of light observation helicopters and utility tactical transports that operate almost continually in the presence of soldiers, supplies, command posts and ground weapons systems.

In these aircraft, downwash blasts the nearby men, blows dirt into supplies and weapons, and gives away their position. Even the relatively gentle downwash of a helicopter can become intolerable on a dusty day.

The weapons aircraft that escort the utility transports face almost the same requirement, but are probably more concerned with the downwash that will give away their position while they are hovering behind a protective terrain mask as a part of their attack maneuver.

The larger transports will not normally operate in constant contact with the assault elements, nor will they be as subject to enemy attack. However, in reinforcing actions and fluid situations they will require the same low downwash characteristics as the lighter utility transports.

The surveillance and target acquisition aircraft can operate from areas further removed from the fighting troops, and will not need to hover in order to do its job. Therefore it should be able to tolerate a higher downwash than the other aircraft in the Army's inventory.

Characteristically, for survival and to fly contact in marginal weather, Army aircraft will fly at low altitudes—sometimes very low. Therefore they require the visibility, smoothness and minimum instrumentation to fly at these low altitudes.

Closely allied to this characteristic is the need for superb handling qualities, both in vertical and in forward flight. To the maximum, the aircraft should fly itself, and as a minimum it must be "forgiving," that is, not subject to sudden or erratic uncontrollable attitude changes.

The Army pilot, concerned with flying in formation, sometimes below the treetops, or finding and attacking a target at low altitude, cannot expend a large proportion of his concentration just flying the aircraft. During night and adverse weather conditions, a simple station-keeping capability is required.

V/STOL Types. The types that I will evaluate against these characteristics are: helicopter, compound, tilt-wing or propeller, direct or deflected jet, and the imbedded fan.

Helicopters are becoming increasingly simple and maintainable after more than 10 years concentration on reducing numbers of linkages, gear boxes, shafts and grease fittings.

Although helicopters appear fragile, field tests and combat have shown that they can withstand considerable rough treatment and that because of the vast areas devoid of vital components, they can withstand considerable small arms fire.

Army V/STOL aircraft generally are more noisy than comparably advanced conventional propeller driven aircraft and have a distinctive noise signature. Their downwash is the lowest of the V/STOL aircraft.

The more advanced helicopters, with ample power and a capability to withstand higher G-loadings, have the agility and visibility for low-level flight in the low-speed spectrum. Handling qualities in this spectrum are excellent. Their ground effects forces are positive. However, a high vibration level is characteristic of helicopters, and at speeds above 160 knots, where they run into problems of advancing blade compression and retreating blade stall, they reach an unacceptable assymetry.

The compound is characteristically more complex than the simple helicopter, although careful engineering should keep it within the same maintainability range. In forward flight, the compound should be quieter than the helicopter, but with its smaller diameter rotor and the interference that wings and the forward flight propulsion system may provide, we may find that its disc loading and downwash are greater.

The compound should have the same relative low-altitude flight characteristics as a helicopter, although it may be so streamlined for higher speed that it cannot translate from forward speed to hovering flight with the same alacrity.

Tilt-wing, and tilt-prop aircraft, because of the requirement for additional shafting and gearboxes, are more complex than helicopters or compounds.

These concepts, since they have not yet been tested operationally, will initially have a tendency to be more difficult to maintain. However, the solution of the maintenance problem should not be a strange one, since it does not involve any radical departure from lessons that we have already learned with fixed-wing aircraft and helicopters.

Tilt-wing and tilt-prop aircraft should be expected to have the same ruggedness as fixed-wing aircraft, and they may perhaps be more rugged than helicopters. Their survivability will depend upon the number of critical vulnerable points designers build into them.

The characteristic H shafting configuration of the tilt-props will provide an increased number of vulnerable points, and although the multiple engines (two or four) in the tilt-wing will provide an increased number of targeting opportunities, will compensate through the use of cross shafting that will permit them to continue flight when not all engines are operating.

The tilt-wings and tilt-props are, to date, noisier than the helicopters in vertical flight, but are about the

(Continued on page 26)

FOUR OF 58 officers who attended the 8th Annual R&D Seminar for Reserve Officers at the Engineer R&D Laboratories, Fort Belvoir, Va., examine a Glide Angle Indicator Light designed to guide pilots to a landing on front-line tactical airstrips. L. to R. are Brig Gen Horace B. Hanson, Jr., Col Roy Moon, Col Donald Vestal and Col Marcus Whitefield, all from Alabama.

Air Mobility Chief Reviews Army V/STOL Program

(Continued from page 25)

equivalent of fixed-wing aircraft in conventional forward flight once they are airborne. Their downwash and disc loading are more severe than helicopters, but whether this severity makes them unacceptable for specific missions has yet to be proved.

For this reason, the Department of Defense is conducting extensive operational suitability testing. For low-altitude flight, it can be expected that tilt-wing and tilt-prop aircraft of appropriate sizes should have the same agility and gust alleviation qualities as comparable fixed-wing aircraft, plus the advantage that they will be able to decelerate from forward speed to the hover.

Right now it appears that this deceleration capability will not be as great as it is in a helicopter, and also that these aircraft will not have the same low-level agility as a helicopter.

Handling qualities of the tilt-wing and tilt-props can be quite good. Within ground effect the opposing downwash flows form fences that may result in positive lift, and variable stability tests have shown that the tilt-wing aircraft is as easy, if not easier, to handle than some helicopters.

Deflected jet aircraft appear to have the least application to the Army's requirements. They are relatively simple, having little more complexity than standard jet aircraft. With careful engineering, they should be maintainable. The experience that the United States, the United Kingdom and Germany are gaining with the Kestrel (P. 1127), using military maintenance personnel, will give better credence to this maintainability.

Apparently there is no reason why the jets should not be rugged, and a comparison has been drawn as to whether the exposed rotor blades of a helicopter are more rugged and less vulnerable than the enclosed compression and turbine blades of the jet engine.

This is an interesting comparison that we have not yet analyzed fully. However, there is no doubt that the jets are much more noisy than either the helicopter, the compound, tilt-wing or the tilt-propeller aircraft. Their downwash and disc loading are quite high, making them unsuitable for use in the close proximity of the ground forces in the forward areas.

Currently, it appears that a great deal of soil preparation, including the use of landing mats, fiber glass and epoxy resins, will be necessary if the deflected jets are to operate in the forward areas at all. Their low-altitude flight characteristics will be essentially the same as those of comparable size jet aircraft.

Since their engines will be oversized for conventional flight their endurance will be greatly reduced, particularly if any considerable amount of vertical flight is required. For the present, it appears that they will not have an extensive hovering capability and their vertical flight capability will have its primary utility in getting them off the ground and back into their landing pad area.

Handling qualities of the deflected jets depend upon the arrangement of lift engines. On some prototypes a single-lift engine results in an efflux that spreads along the ground with such speed that it entrains the surrounding area and by drawing it under the wings results in a negative lift condition. This condition disappears to varying degrees, depending upon the arrangement of multiple-lift engines.

Certain disadvantages of the deflected jet aircraft appear to be overcome by the use of imbedded, vertically oriented fans. Although the fans add to the complexity and weight of the system, this disadvantage is more than compensated for by the smaller power plant that is required.

Deflected jet aircraft so far have been quieter and have exhibited much more tolerable downwash characteristics than the lift jet V/STOLs; also, they will have better endurance and will have handling qualities roughly equivalent to the tilt-propeller and tilt-wing aircraft.

In conclusion, in the future, the Army's entire inventory should consist of V/STOL aircraft. We cannot continue to depend upon large fixed flying operations that are tied to runways or even to unimproved air strips, since these are vulnerable and in many cases unavailable.

Recognizing this, we have for many years accepted the marginal performance of existing helicopters and have been primarily responsible for the improved performance that helicopters have attained in the past decade. Developments of the future, be they helicopters or the other type of aircraft that I have discussed, will couple improved flight performance with this desirable vertical takeoff capability.

However, the Army cannot afford to buy this increased performance at the expense of prohibitive costs that will result in too few aircraft in the Army inventory. Neither can we accept aircraft whose low level and ground operating characteristics make them intolerable to the ground forces, and finally there is no place in the Army for an aircraft that places debilitating demands on our manpower and supply structure.

Many of the aircraft I have discussed are still in the development stages, and their acceptability to the Army will depend upon the extent to which their continuing development overcomes these obstacles.

1957 SARS Fellowship Winner Joins AMS War Plans Division

Operations research specialist Sidney Sobleman, winner of a Secretary of the Army Research and Study Fellowship in 1957, has left Picatinny Arsenal, Dover, N.J., to join the War Plans Division, Engineer Strategic Services Group, Army Map Service, Washington, D.C.

Employed at the Arsenal since 1949, he worked in the Ammunition Engineering Directorate, then with the Management Science and Data Systems Office. He has B.S. and M.A. degrees from City College of New York and a master's degree in industrial engineering and statistics from Stevens Institute.

Col John L. Dibble, chief of the Air Mobility Division, OCRD, since August 1963 is a graduate of the U.S. Military Academy (1940), the Command and General Staff College (1953), the Army War College (1958), Airborne School (1955) and the Aviators Course (1963). His assignments have included command of the 705th and 776th Tank Destroyer Battalions, ETO; instructor Artillery School (1946-49); chief of the Organization Branch, Logistics Division, EUCOM Hq. (1949-52); chief, Foreign Military Training Branch, ODCSOPS (1955-57); General War, Cold War and Areawide planning officer, J-5, CINCPAC (1958-61); assistant commander of the XVIII Airborne Corps Artillery (1961); Exercise Planning and Analysis Branch, J-3, Strike Command (1961-62).

Col John Dibble, Jr.

ICAF Class Includes 3 Formerly With OCRD

Three U.S. Army officers who began the 9-month course at the Industrial College of the Armed Forces Aug. 19 are former staff leaders of the Office of the Chief of Research and Development.

Col Myron T. Johnston was chief of the Long Range Plans Branch, Plans Division, OCRD, from 1960 to 1963. Col Albert G. Lane was chief of the Financial Management Branch, OCRD, from 1957 to 1961. In July Col John W. Ervin completed a year as chief of the Nuclear-Chemical-Biological Division.

Col M. T. Johnston

Three additional enrollees in the ICAF course have R&D MOS designations but have not served in OCRD. They are Lt Col Herbert A. Schulke, who spent the first half of this year as a staff officer in Tactical Warfare Programs, Office of the Director of Defense Research and Engineering; Lt Col Virgil S. Adkins, Jr., for the past year commander of the 299th Engineer Battalion, Fort Gordon, Ga.; and Lt Col Bernard E. Johnsrud, who commanded the 1st Battalion, 75th Artillery in Germany from 1963 to 1965.

The Industrial College of the Armed Forces, located at Fort Lesley J. McNair, Washington, D.C., is a joint educational institution operating under the direction of the Joint Chiefs of Staff. It is considered the capstone of the U.S. military educational system in the management of logistic resources for national security.

The ICAF mission is to conduct courses in the economic and industrial aspects of national security and in the management of resources under all conditions. Due consideration is given to the interrelated military, political and social factors affecting national security in the context of national and world affairs.

Studies are designed to prepare selected military officers and key civilian personnel for important command, staff and policy-making positions in the national and international security structure. During the lecture series at the College, students are addressed by high-level Government and industry executives. There are 180 students in the current class.

COL JOHNSTON is a graduate of the Armored School and the Command and General Staff College and served on the faculty from 1953-1956. Other recent assignments have been nuclear weapons staff officer, Office of Special Weapons Development, U.S. Continental Army Command, Fort Bliss, Tex.; trains commander, Trains Division, 1st Cavalry Division, Korea, 1959; director, Weapon System Safety Division and assistant group chief, Research and Development Group, Field Command, Defense Atomic Support Agency, Sandia Base, N. Mex.

COL LANE is a graduate of the Command and General Staff College and has an MBA degree from Harvard Business School. He was chief of the Fiscal Station Branch, Headquarters, U.S. Army Europe, 1952-55 and, following his OCRD tour and year at the Command and General Staff College, was chief of the Accounting and Financial Policy Division, Headquarters, U.S. Army Korea. From 1963 to 1965, he was chief of the Financial Management Branch, Office of the Chief of Staff, Washington, D.C.

Col J. W. Ervin

COL ERVIN, also a graduate of the Command and General Staff College, earned a BS degree in chemistry from Rutgers University and a BS degree in aeronautical engineering from the University of Michigan. Recent assignments have been: commander, 1st Missile Battalion, 42nd Artillery, U.S. Army Missile Command in Korea, chief of the Divisional Missile Systems Test Branch, Missile Division, U.S. Army Artillery Board, Fort Bliss, Tex.

LT COL SCHULKE, a graduate of the Command and General Staff College and the Armed Forces Staff College, holds a BS degree from the U.S. Military Academy and MS and PhD degrees from the University of Illinois. He was an associate professor in the Department of Electricity and executive officer at the U.S. Military Academy, 1958-61; chief of staff, U.S. Army Electronics Research and Development Laboratory, Fort Monmouth, N.J., 1961-63; communications-electronics project officer, Advanced Research Projects Agency R&D Field Unit in Viet Nam, 1964-65.

Lt Col V. S. Adkins

LT COL ADKINS is a graduate of the Command and General Staff College, the Armored School, and the Engineer School, with a BS degree in mechanical engineering from the University of Tennessee and a master's degree in industrial engineering from New York University. His most recent assignments have been as assistant area engineer for operations and liaison officer, Corps of Engineers Ballistic Missile Construction Office, Minot, N. Dak., and Beale Air Force Base, Calif., 1961-63; logistics staff officer, then chief of the Installations Management Division, and later director, Logistic Services Directorate, Eighth U.S. Army in Korea, 1963-64.

Lt Col B. E. Johnsrud

LT COL JOHNSRUD is a graduate of the U.S. Military Academy, the U.S. Army Artillery and Guided Missile School, U.S. Naval War College, and holds an MS degree in electrical engineering from the Georgia Institute of Technology. Recent assignments have included: electronics instructor, U.S. Army Artillery and Guided Missile School, Fort Sill, Okla., 1956-59; and research and development officer, Defense Atomic Support Agency, Washington, D.C., 1960-63.

Army Standardizes 3 Items of Field Medical Equipment

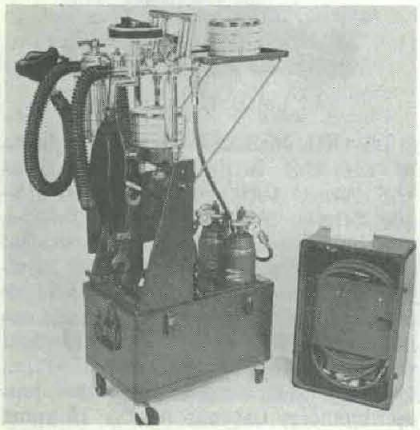
To provide Special Forces and other field medical personnel with improved capability in support of combat operations, the U.S. Army recently standardized three pieces of field medical equipment.

They are a rugged and lightweight portable anesthesia apparatus, a portable medical laboratory combat equipment and supply set, and a lightweight, portable autoclave with vastly improved steam sterilization capabilities. All were developed under the U.S. Army Surgeon General's Medical R&D Command.

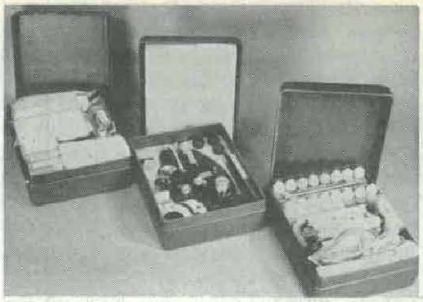
The anesthesia machine and accessories have a case which doubles as a shipping and storage container and as a stand for operation. Packed for transport, it occupies only 2.6 cubic feet and weighs 73 pounds. The former standard field anesthesia unit occupies 4.5 cubic feet and weighs 116 pounds. The new apparatus is compatible for use in current standard field medical units and in the Medical Unit Self-Contained, Transportable (MUST) system of treatment facilities being developed by the Army.

Designed to administer ether, nitrous oxide and oxygen to the patient in the field environment, the apparatus reportedly provides greater versatility in anesthesia techniques. It has improved valves, a patient circuit pressure gauge, a heater to provide proper ether vaporization at lower temperatures, and greater absorber capacity.

Maximum utilization of attachments and accessories already in the supply system was taken into consideration in development of the machine by the Ohio Chemical Co. and the U.S. Army Medical Equipment Research and Development Laboratory, Fort Totten, N.Y. Development was under direction of The Surgeon General as a part



Portable Anaesthesia Apparatus



Combat laboratory set (above) and lightweight portable autoclave (right) are among recent field medical equipment improvements developed by U.S. Army Medical R&D Command.

of the Army's program to provide new and improved field medical equipment for the care of combat casualties.

The other two newly standardized devices are primarily designed for use by Special Forces personnel. The portable medical laboratory is small (10"x14"x16"), light (only 32 pounds), rugged, durable and waterproof.

The unit can fit into a parachutist's adjustable equipment bag and can be man-packed. It gives the medical officer or qualified medical aidman in unconventional warfare or counterinsurgency operations the capability of rapid confirmatory diagnostic procedures.

Special warfare medical personnel are normally required to operate in remote areas far removed from sophisticated medical laboratory facilities. The Department of the Army Small Development Requirement states:

"The highly favorable psychological impact of U.S. forces performing basic medical procedures on indigenous personnel will materially assist in establishing a rapport without which the operational mission may not succeed.

"Many of these basic medical procedures involve environmental and health hazards, necessitating laboratory confirmation of a suspected condition. In numerous instances, much valuable time has been lost because medical personnel in a special warfare operational area were not able to specifically identify local health problems in order to promptly initiate necessary corrective action.

"Adequate confirmatory diagnosis, to permit timely medical treatment, is frequently so far removed that in some instances several weeks transpire before reports are received by the initiating individual. Current field medical laboratory sets are far too heavy and bulky for use by special warfare medical personnel."

The new portable unit provides sufficient medical laboratory equipment and supplies to permit: microscopic examination in all powers up to and including oil immersion; routine urinalysis to include microscopic examination of centrifugal sediment; specific gravity reading of urine; preparation and examination of Gram stain and Wright's stain in suitable biological specimens; determination of hemoglobin; performance of white, red and differential blood counts; basic parasitological procedures.

Planned deployment is one unit for each medical officer or qualified medical aidman in charge of a medical team engaged in unconventional or counterinsurgency operations. It is anticipated that only one hour will be required to inspect, clean and replace or replenish consumed items and only 10 minutes will be required to open the set and prepare for use.

The set will be capable of performing the following before replenishment is necessary: 100 urinalyses; 25 Gram stains; 25 blood differential smears; 60 WB counts; 25 fungus examinations; 50 stool examinations for parasites. The set is designed to operate in all environmental conditions and climates providing ambient temperature exceeds 32 degrees Fahrenheit.

Also type classified recently for limited production is a lightweight field autoclave to provide steam sterilization capabilities for Special Forces elements under rugged field conditions in remote areas. No standard item is currently available for this purpose.

The 28-pound, one-man portable stainless steel autoclave can be fired by any indigenous fuel, such as wood or coal, and will provide a dry, sterile

product. The unit employs a novel "pulsating vacuum" system, developed by the U.S. Army Medical Equipment Research and Development Laboratory, which does not require a heavy vacuum pump.

When broken down for portage, the unit is 20 inches high and 11 inches in diameter and will fit with its removable legs inside the mountain rucksack frame.

The new autoclave is considered to offer a substantial increase in the capability of the medical team in remote areas. Although each Special Forces medical officer and aidman is provided with needed surgical instruments, no suitable sterilization means for remote area use has been furnished.

A boiling pot is available but boiling, according to the U.S. Army Surgeon General, is an unacceptable means of sterilization except as a last resort, because it does not kill the spores of gas gangrene. The smallest and lightest standard item available weighs 480 pounds.

Special Forces units in Viet Nam have been using 21-quart pressure cookers for sterilization purposes. Reportedly these leave much to be desired in that they are fragile and provide a wet product which cannot be stored without air drying.

Engineering tests of the new autoclave were conducted by the U.S. Army Test and Evaluation Command and the sterilization capability was evaluated by the Walter Reed Army Institute of Research. Additional service testing was performed at the U.S. Army John F. Kennedy Center for Special Warfare, Fort Bragg.

Col Klingenhagen Assumes Command of USAAML

Col John L. Klingenhagen recently took command of the U.S. Army Aviation Materiel Laboratories, Fort Eustis, Va., after serving 2½ years as deputy CO of the U.S. Army Support Command in Viet Nam.

Graduated from Officers Candidate School at Fort Belvoir, Va., in 1942, he holds a B.S. degree in military sciences from the University of Maryland and an M.A. in government administration from George Washington University. He is a candidate for a Ph.D. in research and development management at American University, also in Washington, D. C.

Col Klingenhagen began active duty in 1940 with the 138th Infantry Regiment of the Missouri National Guard, rising to sergeant at the age of 18. He participated in five World War II campaigns as a combat engineer and later as a paratrooper when he became assistant chief of staff for Intelligence in the 82nd Airborne Division. He received the Silver Star for heroic action during a hazardous crossing of the Moselle River in Germany.

While commanding an Infantry battalion with the 2nd Infantry Division's 23rd Infantry Regiment during the Korean War, he earned his second Silver Star for his part in holding Old Baldy Mountain.

Six years on the Army General Staff and on the Secretary of Defense's Staff, primarily in aviation research and development, preceded selection in 1959 to attend the National War College, from which he became the youngest Army graduate at that time.

While serving as deputy for Research, Development, Testing and Evaluation Systems at Army Aviation Materiel Command in St. Louis, Mo., he was named to the Howze Board (U.S. Army Tactical Mobility Requirements Board).

Col Klingenhagen also holds the Legion of Merit, Distinguished Flying Cross with two Oak Leaf Clusters, Bronze Star, (valor) with two Oak Leaf Clusters, Soldier's Medal with Oak Leaf Cluster, Air Medal with two Oak Leaf Clusters, the Purple Heart with two Oak Leaf Clusters and the Croix de Guerre from Luxembourg.

Qualified in fixed- and rotary-wing Army aircraft, entitled to wear the Master Parachutist Badge and the Combat Infantryman's Badge, he is a member of the national board of the Army Aviation Association of America, and is active in the Institute of Aerospace Sciences and in the American Helicopter Society.

Col. J. L. Klingenhagen

Math Problems Solved at Rate Of 500,000 in 25 Minutes

A youth setting out to solve a million arithmetic problems by manual methods might not complete the task in his lifetime, but at the Army's White Sands Missile Range (WSMR), N. Mex., the job can be done in less than an hour.

A new computer program put into operation recently at the Range's Data Analysis Directorate makes such speed possible; it processes telemetry data into a final report as much as 20 percent faster than previously was possible.

Lt Col Herbert R. Barker, U.S. Air Force, director of the Data Analysis Directorate at WSMR, pointed out that the program can be applied to almost any computer system because it is machine-independent.

Additional important characteristics of the program are its ability to accommodate most present and foreseeable standard telemetry systems and its offering of an exceptionally wide range of measurements.

Recently, 54,000 data samples taken from one missile flight were processed by a computer in 25 minutes, during which a half-million arithmetical operations were performed. That is equivalent to 21,600 computations in one minute. When that 25-minute output was typed, the report numbered 3,600 pages and required six hours of IBM computer typing time.

ERDL Researchers Perform 'Major Surgery' on Grader

Bisecting a 19,000-pound grader might not normally be considered as "pure research," but the task falls roughly in that category at the Army Engineer Research and Development Laboratories, Fort Belvoir.

The purpose of the feasibility study is to determine methods for helicopter-lift or transport in air-assault operations. The tractor was cut in two at the approximate center of gravity, to make each section light enough for this purpose.

Plates were welded to each face of the disconnected frame and holes were drilled to permit bolting them together at their destination. Quick-disconnect fittings with flexible coupling hoses were inserted in the hydraulic system. Steering the rear, or power half, is accomplished by use of a retractable dolly in conjunction with a "fifth wheel" tandem assembly mounting.

Initial tests show that the two sections can be reunited in 15 minutes by two men using hand tools.

Contractor Reports on Hailstorm Forecasting

Characteristics of hailstorms and techniques for forecasting them are reviewed by Dr. E. M. Frisby in a report prepared for the U.S. Army Research Office (USARO), Arlington, Va.

Issued recently, the report tells of Dr. Frisby's work during the past two years under a USARO contract with Raven Industries, Inc., Sioux Falls, S. Dak. This is part of an atmospheric research program monitored by Mrs. Frances L. Whedon of the Geophysical Sciences Branch, Environmental Sciences Division. The contract has been extended until the end of the year to permit completion of certain aspects of the study.

Dr. Frisby studied in detail hailstorms in South Dakota, Minnesota, Iowa and Nebraska. Forecasts of damaging hail were made daily (excluding weekends and holidays) through June, July and August.

Although nearly every large thunderstorm contains some hail, meteorologists have generally agreed, some of it never reaches the ground. Hail which does comes from relatively small but intense instability showers. Hail has been found to be most frequent in the United States along the slopes of the Rocky Mountains and over the Great Plains of the Midwest.

A widely accepted theory is that hail is formed when a tiny ice pellet falls through sub-freezing cloud layers, picking up super-cooled water drops, which immediately freeze and coat the original ice pellet with additional layers of ice.

Patterns of damage at the ground were related to surface and upper-level atmospheric synoptic data in Dr. Frisby's studies. Hail claim data from insurance records were plotted for June, July and August in 1962, 1963 and 1964 in the northern plains states of the U.S. and southern sections of the prairie provinces of Canada.

Northern Great Plains traveling hailstorms were found to be explainable in terms of instability (the wet bulb potential temperature), shear (wind strength in knots at the 300 millibar level) and triggering (frontal or topographic) analysis.

Dr. Frisby used quantitative relationships between the hailstorm occurrences and the specific meteorological parameters to develop a procedure for forecasting damaging hail. The method developed can be employed manually by two people to cover all stations in the Upper and Lower Great Plains in about half an hour. This is more rapidly accomplished than current procedures using machine techniques.

A climatic study was made to show the relationship of hail incidence to jet stream movement through spring and summer months and the northward movement from the gulf of a zone of high instability during the same period. All three were found to take a similar northward trend.

Dr. Frisby made exploratory efforts to extend the scope of the forecast technique to areas north and south of the area of detailed study and to night-time storms. This research, she states, needs additional depth before results can be discussed with confidence.

For example, many meteorologists have argued that hailstorms do not occur in the tropics, but Dr. Frisby has accumulated documented records of hailstorms in Puerto Rico, Miami, Fla., and Brisbane, Australia. Characteristics of these storms, however, differ from those of the U.S. Great Plains. The investigator recommended further study into the nature of tropical hailstorms.

Dr. Frisby found that hailstorms occur most frequently when the wet bulb potential temperature reaches 66° F. or above and almost never below 60°. A chart plotting storm swaths during July 1963, for example, shows that the preponderance of hailstorms occurred between 62° and 72° and when winds at the 300 millibar level registered between 30 and 50 knots.

Dr. Frisby reported that, depending on the strength and direction of 300 millibar winds in relation to areas of high wet bulb potential temperatures, actual hailswath positions may be forecast or areas in which less well-organized hail is expected to occur may be delineated. It was found that the stronger the upper-level winds are, the better the hailswaths are organized.

UNDERGOING engineer design tests at the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Md., is this "Pony" vehicle produced by DAF (Van Doorne's Automobile Factory) in the Netherlands. The 1,100-pound vehicle has an automatic transmission and can be operated from either front or rear in the interest of battle zone flexibility. It has a maximum cross-country speed of 25 m.p.h., and can ford water up to 18 inches deep.

Canada Buying U.S. CF-5s To Re-equip Armed Forces

An example of cooperative development in aircraft weapons systems is Canada's recent procurement order for 125 Northrup F-5 aircraft from the United States in a 5-year re-equipment program for Canada's armed forces.

Built to Canadian specifications, the aircraft's improvements will include more powerful engines (two J85-15 jets, each with 4,300-pound thrust) and an in-flight refueling capacity. Its primary role will be in tactical support of ground forces.

Redesignated the CF-5, the aircraft's agility, weapons mix (20mm. guns, missiles, rockets and bombs), speed (up to 1,000 m.p.h.), ease of maintenance and versatile conventional (nonnuclear) capability make it well-suited for the "global-mobile" role of the Canadian forces, Minister of Defence Paul Hellyer stated.

Missiles & Bullets . . .

Similarity in Design Due to Aerodynamics

Laymen viewing examples of the missile might of the Nation at Redstone Arsenal, Ala., may look at any one of the deadly array of modern weapons and say, "It looks like a big bullet."

Except for the addition of stabilizing fins and a "mechanical brain" to seek out targets, modern missiles are, in fact, giant bullets. That impels William A. Lewis, chief of the Structures and Mechanics Laboratory of the U.S. Army Missile Command's Research and Development Directorate, to comment: "It's hard to improve on the shape of a bullet as a weapon."

The familiar shape—long cylinder with conical nose—is almost ideal for an airborne projectile, especially a missile, Lewis contends. The Army's newest missile, the Lance, looks a lot like a big "Minie ball," one of the first pointed bullets developed for firing from muzzle-loading guns during the Civil War.

The chief of the Aerodynamics Branch in the Advanced Systems Laboratory, Raymond A. Deep, lists three factors that influence the shape of a missile. They are structure, how it will be powered, and aerodynamics or how air will blow over its body in flight.

The shape of a missile really is established in the preliminary design phase of development. "There is a multitude of conflicting characteristics to be considered," Deep explained. "Depending on the requirements of the missile and their priorities, there is a 'trade-off' of these elements until we achieve the final product."

If the structures man had his way about the shape, the missile probably would be a mass of steel girders. A missile as sleek as a needle would be the end product if aerodynamics was the only element of design considered. The scientist in the propulsion laboratory might decide on a missile in the shape of a sphere. None of these would be of much use by itself, but scientists and engineers have combined features from all these and have come up with missiles that hit their targets.

The cylindrical missile is relatively cheap to produce, it pierces the atmosphere with the least resistance, and is a rigid structure for housing a propulsion system. Deep says he does not foresee any drastic changes in the shape of the missiles and rockets for years to come but adds: "I don't think we can ever standardize it. The different shapes depend on what the missile is supposed to do once it is launched and under what tactical conditions."

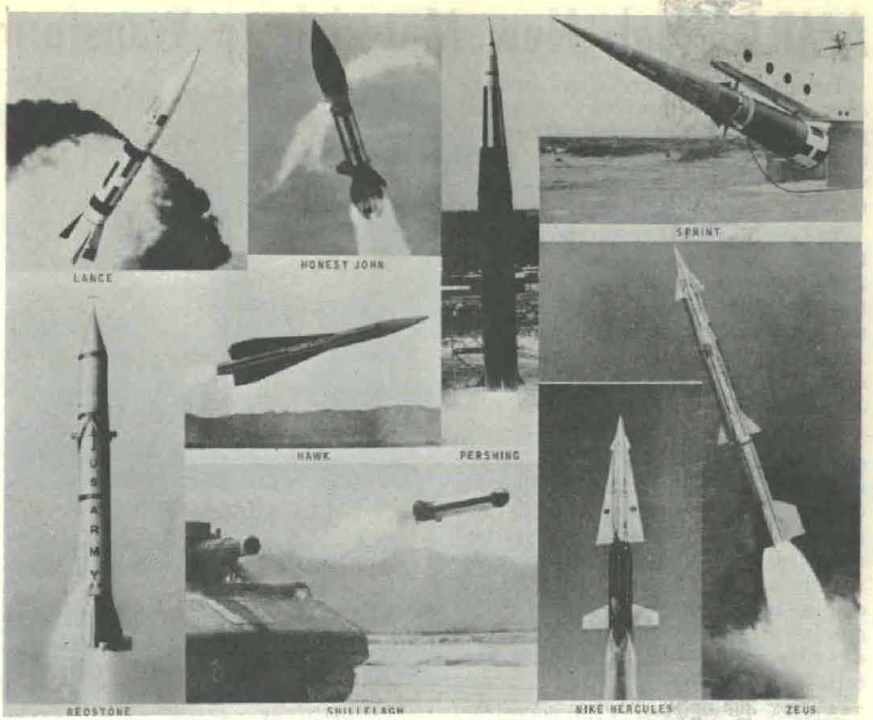
The shape of one of the Army's earliest operational rockets, the Honest John, was dictated by the amount of payload and the availability of a solid-propellant motor already developed. The weight and size of the warhead couldn't be reduced, so a big, bulbous nose was necessary to house it. This shape, which is far from being streamlined, was allowed because of the low drag of the short-range surface-to-surface missile.

Fins are the basic external difference between a bullet and a missile. A bullet spins for gyroscopic stability to keep it flying straight, while a missile depends on its fins for aerodynamic stability as it streaks toward its target.

The first missiles had big fins, because they needed a lot of "lift" and control at their relative slow speeds. As missiles became faster and faster, some at several times the speed of sound, the fins grew smaller. Maneuverable fins serve only to control missiles operating inside the earth's atmosphere. Above 200,000 or 300,000 feet, some reaction device other than fins, such as small jets, is needed to change the direction of a missile.

One of the early air defense missiles, Nike Hercules, had big fins on both of its stages. Sprint, an extremely fast antimissile missile now under development as a major component of the Nike X missile defense system, has only four small, indistinguishable fins.

So closely related are these two different kinds of weapons that people who work in laboratories developing better bullets and better missiles exchange data that grows out of their research. The American soldier using missiles still is firing "bullets" and probably will as long as there are wars and threats of wars.



Army Logistics Center Slates Seminars for Top Management

The U.S. Army Logistics Management Center, Fort Lee, Va., announced two forthcoming seminars designed to acquaint top management personnel with the most modern methodology of wholesale logistics.

Scheduled Sept. 20-24, and Jan. 24-28, the seminars will cover such topics as automatic data processing systems, mathematical background for decision making, operations research and inventory models.

Group workshops and computer-assisted logistics simulations will augment the training already included in the two 5-day seminars. The high level of the program limits attendance to lieutenant colonel or higher for military personnel and GS-13 or above for civilians.

The Computer Simulation Division will conduct the seminars.

AMRA Goal: New Materials to Transform Ideas Into Materiel

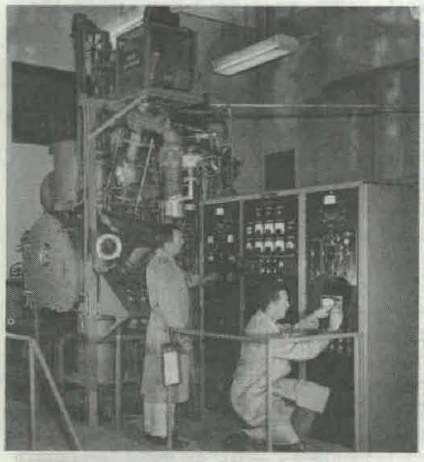
Trends toward increasing sophistication of Army weaponry in recent years have created priority requirements for materials having a broad variety of special characteristics obtainable only through research.

To serve these requirements, the U.S. Army Materials Research Agency (AMRA) was established at Watertown, Mass., July 15, 1962, to function as a major element of the U.S. Army Materiel Command, reporting directly to General Frank S. Besson, Jr., AMC CG.

As described in its official mission statement, AMRA is responsible for managing and directing "that portion of the AMC materials research program within its own laboratories" assigned by the AMC Director of Research and Development. That includes basic scientific research and special investigations of the qualities of metals, ceramics and other materials.

AMRA is charged with coordinating the total materials research program of the Materiel Command to:

- Obtain, evaluate and disseminate scientific information regarding materials for use in Army materiel.
- Adapt, improve and develop materials, including alternatives for strategically scarce materials.
- Provide materials specifications and standards, and demonstrate the practical usability of materials to a point where design engineers are justified in experimental usage.
- Insure the continuance of a trained group of AMC professionals, expert in the development of materials research plans and in the solution of materials problems, capable of understanding and appreciating military objectives and of applying scientific information to achievement of those objectives.
- Keep responsible AMC officials informed of new scientific developments and potential applications in the field of materials, and coordinate a program of testing techniques in conjunction with the quality assurance program; provide technical surveillance over the AMC testing training program.



Electron Beam Melting Furnace

Lt Col Joseph E. Black

Under Lt Col Joseph E. Black as commander and Dr. James L. Martin as technical director, AMRA presently is operating with five military officers and 414 civilians. About one-half of the staff are scientific and technical personnel; others are engaged in administrative and support functions.

The professional staff includes experts in physics, mathematics, metallurgy, chemistry and several other disciplines. This group has historically represented the principal metals laboratory of the Army.

Emphasis is on fundamental materials research, materials engineering, and materials technology, for which AMRA is now organized into three divisions, with functions as follows:

Materials Research Division—Performs theoretical and experimental fundamental research, including all activities directed toward increased knowledge of natural phenomena and environment, and efforts for solution of physical sciences problems.

Materials Engineering Division—Conducts engineering studies, investigations and development efforts in metals, ceramics, and other materials; theoretical and experimental studies in mechanics; applied research studies related to testing of materials; and exploratory and advanced development work directed towards the solution of specific materials and materiel problems.

Materials Technology Division—Performs studies in materials technology pertinent to the development of military equipment; provides materials processing and engineering information for application to materiel; manages assigned portion of the materials standardization program of the Department of Defense; and provides technical support for the research and engineering activities of the other divisions.

AMRA's administrative and support functions are carried on by three offices. The Research Programs Office is responsible for coordinating AMC's total materials research programs. The Comptroller's Office provides executive assistance on business and financial management of AMRA, and the Research Administration Office functions as its name implies.

An important staff element of AMRA is the Materials Advisory Group (MAG), an extension of the Materials Division of AMC located at AMRA and composed of a top echelon R&D representative from each subordinate command. The deputy chairman and secretariat are members of AMRA.

Materials Research Division activities cover various phases of the physical sciences. Prime coverage is being given to solid-state physics, physical chemistry and metallurgy. Scientists search for the microscopic behavior which in turn contributes to the macroscopic properties of materials.

X-ray diffraction, special crystal-growing techniques, nuclear magnetic resonance spectroscopy, neutron diffraction, and electron microscopy are only a few of the tools being employed to study the parameters of the atomic arrangements and relationship of material structures. The nuclear reactor used by this agency also serves a number of other Army agencies.

The preparation and properties of ultra-pure materials, in polycrystalline and single crystal form, are being investigated. The continuing objective is improved methods for preparing materials having impurity levels of the order of parts per billion.

Germanium and silicon are being studied currently because they are available in a high state of purity, and because their unique properties simplify following the progress of the purification process.

Experimental magnetic resonance

studies are being made of nuclear electric quadruple and nuclear magnetic interactions, in single crystals of metals, for the purpose of studying the redistribution of electronic charge when the metals are strained or when substitutional impurities are introduced. This work is made possible by a method devised to allow observation of nuclear magnetic resonance in metallic single crystals.

Physical chemistry of hydrogen-metal systems is being studied by means of an all-metal Sievert's Apparatus designed for precise measurements up to 1,000 atmospheres and permitting exploration of portions of phase diagrams not previously accessible.

Measurement of hydrogen activities and concentration in solutions of hydrogen in metals over wide ranges of temperature and pressure is possible with this apparatus. Such data are of great value in testing theories of interstitial solutions.

Activity at AMRA in the field of electron distributions in metals, determined by both X-ray diffraction and neutron diffraction, has won international recognition for the high quality of the research.

One of the first cold neutron sources for low-energy neutron diffraction studies is currently being installed in the AMRA reactor. Improved methods for examination of solid surfaces are constantly under study in the Research Division.

In the Materials Engineering Division, prime coverage is given to development of fundamental knowledge of behavior of materials, evaluations, and the development of new or improved materials.

A phase of research relating to mechanics of materials is being directed toward understanding the phenomena of fracture and developing quantitative criteria to define fracture. Experimental studies observe the nucleation, growth, and culmination of cracks in engineering materials, in order to formulate concepts underlying the phenomena to the state of stress and strain in the material.

Elasticity studies obtain information on the stress state in the vicinity of cracks of various configurations, through the use of conformal mapping techniques.

Experimental and theoretical studies are devoted to the problems of thin-shell behavior. Investigations cover vibration, buckling (dynamic as well as static), and other nonlinear aspects.

Dr. James L. Martin

Current research concerns vibrations in deep shells having complex curvature; numerical techniques for solving problems of nonlinear deformation of shells, including post-buckling behavior; experimental techniques of time-displacement measurements during snap-through shell buckling; and buckling under dynamic pressure pulses.

Research is also being applied to the examination of material properties and determination of integrity of components. Areas of research activity include ultrasonics, infrared, electro-magnetics, microwave, and other physical phenomena adaptable to material evaluation.

Recent research has resulted in development of nondestructive test techniques—for example, determination of microstructure of metallic components; measurement of elastic constants of metals and ceramic materials; interpretation of ultrasonic test results in terms of defect geometry; and determination of bond defects in laminated materials.

Studies are being conducted to develop new and improved metals, alloys and composite materials for structural service in Army weapons and equipment. Since ferrous alloys and titanium alloys offer special advantages for high-strength, lightweight applications, emphasis is directed at improving strength, ductility, toughness and fracture characteristics.

Investigation of effects of heat treatment and mechanical working on deformation and fracture of these metals at cryogenic, ambient and elevated temperatures is providing new understanding of the mechanisms involved. New and more reliable criteria are evolving for selecting materials for critical highly stressed components of Army missiles and Army aircraft.

Ceramics offer attractive possibilities as structural materials because of high strength-to-weight ratio, high modulus, good corrosion resistance, excellent high-temperature properties, and abundance.

Polycrystalline ceramic materials, however, are characteristically brittle, have low fracture strengths, and seldom possess high standards of uniformity and reliability.

A recently initiated program, aimed at utilization of ceramic structural materials, includes: Microstructure studies of polycrystalline ceramic systems; syntheses of inorganic nonmetallic materials; gas solubility in solid and liquid ceramics; investigation of hot forming techniques; study of strengthening mechanisms in ceramics; densification mechanisms at high pressures; and development of design criteria for ceramics.

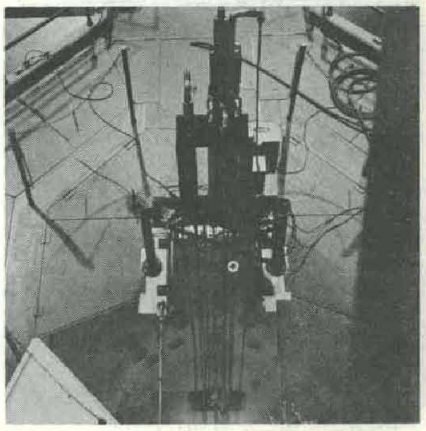
Mechanisms of rocket nozzle erosion, utilizing the Variable Parameter Rocket Engine, are under continuing study. Effects of chamber pressure, burning time, and nozzle size on erosion are being determined for a variety of refractory materials including graphite and titanium boronitride.

Studies are being made of the infrared radiation characteristics of metals at high temperatures and means of control with appropriate coatings. Effects of high-intensity Laser radiation on materials are also under investigation.

Heat-resistant composite materials are being considered for Army aircraft gas turbines and rocket engines to cope with the high operating temperatures. Fiber (whisker) reinforced composites are considered especially promising.

Research in progress seeks to advance the overall state-of-the-art by developing new economical methods

(Continued on page 34)



Nuclear Reactor at AMRA

AMRA: Materials to Transform Ideas Into Materiel

(Continued from page 33)

for growing alumina and other whiskers, measuring their properties, improving the whisker-metal matrix bonding and alignment, and devising improved techniques for fabricating these composites.

Corrosion of Army material is an ever-present problem, requiring continuing research to learn to control it. Current efforts include the investigation of corrosion mechanisms in high-strength steels, titanium alloys, and aluminum alloys in the stressed and unstressed conditions.

Oxidation of the refractory metals —tungsten, tantalum and columbium —remains a serious barrier to their use. Basic studies to develop a unified theory of oxidation for these metals, and to develop oxidation-protective coatings are in progress.

Alloy development studies on high-strength titanium alloys, depleted uranim alloys and beryllium oxide ceramics are aimed at increased tensile properties achieved by compositional changes and by development of new processing techniques.

Powder metallurgy techniques and conventional arc-melting practices are being used in alloy and process development of beryllium, including a vacuum hot press for beryllium. Micro composite, high-strength, ductile beryllium-titanium alloys are under development.

AMRA recently was designated "lead laboratory" for all armor materials and is currently engaged in a first priority effort in this area. Work involves development of lightweight armor materials, including plastics, and development of new and improved materials for ammunition as well as for armor-piercing ammunition.

Prime activities of the Materials Technology Division carry on a continuing program for process technology for advanced materials. This program includes research in melting, casting, shaping, joining and heat treatment of metallic materials. The goal is better understanding of fundamentals influencing the characteristics of these materials during, and as a result of, such processing.

The laboratory facility within the Materials Technology Division responsible for the process technology program includes a well-equipped experimental foundry, with induction melting furnaces ranging in capacity from 30 to 5,000 pounds, a 500-pound vacuum induction furnace, and a 6½-ton electric arc furnace. Apparatus are available for preparation of molds and testing of mold materials. Various types of molds are in use or have been investigated.

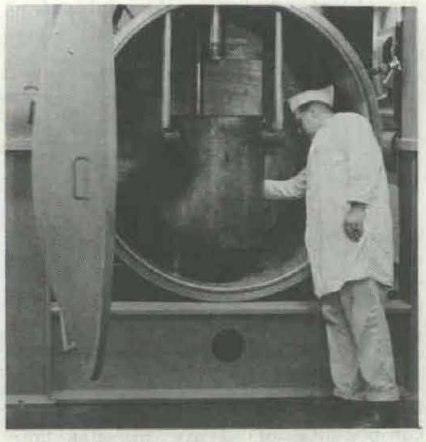
This facility provides a variety of pilot or full-scale equipment for conversion and fabrication of metals, from ingot to semifinished product to prototype item. Equipment includes a 12-inch diameter, 18-inch 2-high rolling mill, a 500-ton extrusion press, an 850-pound pneumatic forging hammer, a 3,500-pound drop hammer, 4,000, 8,000 and 15,000 foot-pound Chambersburg impacters, and a 143,000 foot-pound Dynapak forging apparatus.

Also, an experimental wire and tube draw bench, various hot-swaging machines, a cold-swaging machine capable of handling bar and tube up to three inches in diameter, a 200-ton deep-drawing press, a lathe instrumented for machineability studies, and various accessories.

Another important phase of process technology, because of the complexity of metallurgical problems commonly encountered, is that of joining by welding or brazing. Therefore, this facility also conducts research programs in joining of structural metals.

Effects of various operating factors may be determined through the use of an electronically controlled welding thermal cycle simulating apparatus. Test weldments may be prepared by an automatic feed-back-controlled fusion arc welder or by conventional TIG and MIG welders.

A high-voltage electron beam welder is employed in the study of this new method for joining reactive and refractory metals. A prototype pressure-welding device for joining tubular sections of high-strength alloys is also available.



Vacuum Hot Press for Beryllium

To provide technical support for the research and engineering activities of the other divisions, the Materials Technology Division facilities include analytical chemistry, metallographic, mechanical testing, non-destructive testing, alloy melting, and heat-treating laboratories.

The Analytical Chemistry Laboratory is equipped to identify and measure composition of development materials. A convertible photographic direct-reading spectrometer and apparatus for neutron activation analysis are unusual facilities used for this work.

The Metallographic Laboratory assists in definition of crystal structure or identification of particular compounds. Advanced techniques in metallography and crystallography employ vacuum etching apparatus, an electron microscope, an ultraviolet microscope, an electron probe, low-noise high stability X-ray detection apparatus, and an automatic programing and printout counting device.

The Mechanical Testing Laboratory has an array of testing equipment unique in its completeness. Tensile-compression testing machines range from 1,000 to 2,400,000 pounds capacity and a wide variety of fatigue-testing apparatus is in use. True-stress, true-strain testing and recording are featured. A broad range of testing temperatures may be imposed, notably cryogenic temperatures, in tension and impact testing.

The Nondestructive Testing Laboratory is believed unique within the Army and, with respect to its variety of equipment and range of capabilities, comparable to any within the country. Radiographic, ultrasonic, eddy current effect, magnetic particle, fluorescent oil, infrared sensing, and other techniques are in use and/or are undergoing further development.

The Melting Laboratory aids in preparing experimental alloys from the various metals to exacting specifications. Lower melting and less reactive metals can be prepared in a small induction unit; an enclosed induction furnace allows vacuum or inert gas atmosphere melting of compositions sensitive to contamination. Refractory and reactive alloys may also be melted in a cold-mold arc furnace using either a consumable or an inert electrode. More recently an electron beam melting unit has been installed.

The Heat Treating Laboratory is equipped for operations at normal or extreme temperatures under vacuum

or controlled atmospheres. Excellent quenching facilities, including refrigeration, extend its capabilities.

Another activity of the Materials Technology Division is management of materials standardization and value engineering programs of AMC. Encompassed are standardization studies and providing direction for standardization action, developing and presenting engineering and inspection information on materials, and furnishing engineering support to the Defense Supply Agency.

The Army Materials Research Agency, as provided by results during its 3-year existence, has outstanding staff capabilities and facilities for conducting an integrated program of scientific and engineering investigations pertaining to materials. Proud of this record of achievement, AMRA personnel aim to continue serving the military needs with full capability, resources and energy.

Cruising Classroom Cuts Cost

Scientific personnel at Aberdeen Proving Ground, Md., recently began attending courses in advanced transistor techniques and systems in a tractor-trailer called an electronic mobile training unit.

Savings of approximately $47,000 reportedly resulted from holding the courses at the Proving Ground instead of at Frankford Arsenal, where they originated. Designed to acclimate scientific personnel to the many advances in transistors, the first course will run 80 hours and will be followed by an advanced course later this year.

HumRRO Selects Dr. Abbott For Review and Analysis Post

The Human Resources Research Office (HumRRO) of George Washington University has appointed Dr. Preston S. Abbott assistant director for Review and Analysis. HumRRO is a U.S. Army contract agency in Alexandria, Va.

Formerly director of research programs for the Human Ecology Fund, Dr. Abbott, in his newly created position, will help the Army implement HumRRO research findings and provide consulting services.

Employed with HumRRO for the past 10 years, he has served as a senior research scientist in the Training Methods Division 1955-57; director of research at the Fort Benning, Ga., HumRRO field laboratory 1957-60; and since 1960 as a consultant.

He has a B.A. degree from Bates College, M.A. from the University of Hawaii and a Ph.D. from Brown University.

What Was Beauty Takes New Duty

Runs in Milady's Nylons Aid Missile Research

Milady's nylon hosiery, normally destined for the trash after "runs" take over, now are serving a useful purpose in national defense research.

Chemists at the U.S. Army Missile Command, Redstone Arsenal, Ala., admire the 4-way stretch, the sheerness, the fine-mesh qualities of hosiery, even when not encasing shapely legs, to carry on their research.

MISSILE COMMAND employees stretch a piece of nylon hose, which has been soaked in epoxy resin, across a mould as a step in making a cap for anti-tank missile launch tube. The chemists are Bobby C. Park and Sp/4 Ocke Fruchtniche. The observer is Kay Plemons, one of several "lovely ladies" in the Structures and Mechanics Laboratory, R&D Directorate, who donated hosiery for the project.

With 4½ pairs of hosiery, a batch of sticky epoxy resin, and a mould, researchers have turned out rigid, durable caps for missile launch tubes. Other uses for the worn-out stockings are envisioned by Arsenal scientists.

A major obstacle in the research course has been an adequate supply of hosiery. At first, researchers filched marred-and-scarred nylons from their wives; then feminine lab workers were asked to deposit their trash-bound stockings in a special lab space.

With the research logistics problem temporarily solved, researchers snipped off the foot part, ripped the nylons down the seams, doubled them and dipped the now unrecognizable stockings many times into the gooey, resinous concoction. Stretched tightly over the mould, the once sticky mass had hardened by next morning, into a durable, solid material easily trimmed into Missile Age use.

Still, the limiting factor for mass research purposes remains—an adequate supply of used nylons.

ERDL Contract Calls for Huge Air-Supported Facility

One of the largest air-supported structures in the world will be built for the Engineer Research and Development Laboratories at Fort Belvoir, Va.

A $111,962 contract for the structure was signed recently with Birdair Structures, Inc., Buffalo, N.Y. It will be 210 feet in diameter and 150 feet high to house a simulation facility which the electromagnetic effects of nuclear explosions on Army equipment and systems will be studied. The Defense Atomic Support Agency is sponsoring development of the test facility.

The Laboratories awarded several other contracts recently. Radio Corporation of America, Harrison, N.J., received a $77,015 contract for a tunneling emitter and photoconductor study. Venus Scientific, Inc., Hicksville, N.Y., won a $56,576 contract for the design and study of gating circuits.

Duro-Test Corp., North Bergen, N.J., will investigate radiant high-intensity gaseous discharge arc light sources for $42,372. Ethyl Corp., Ferndale, Mich., was granted a $41,113 contract to study the physical-chemical forces affecting the decontamination of a range of military hydrocarbon fuels having varying characteristics.

Sprague Electric Company, North Adams, Mass., and Erie Technological Products, Inc., Erie, Pa. won $31,019 and $33,992 contracts respectively for the design and fabrication of miniature high-voltage capacitors. Aerojet General Corp. Azusa, Calif., received a $30,000 contract for a Model 1-100-S-1 desalination system.

IBM Corp., Cambridge, Mass.. was granted $29,700 to develop methods of obtaining a geoid representation from satellite-determined gravity coefficients and develop a Fortran IV Computer program.

Army Hygiene Agency $2.76 Million Lab Started

Ground-breaking ceremonies for a $2,762,800 building that will house all operations of the U.S. Army Environmental Hygiene Agency were held recently at Edgewood Arsenal.

The Hygiene Agency, a tenant activity at the Arsenal for the past 20 years, is a direct support unit of The Surgeon General and is concerned chiefly with the Army's preventive medicine program. The 4-story concrete and steel structure will consolidate activities presently scattered throughout more than half a dozen buildings at Edgewood.

Brig Gen James T. McGibony, Deputy Surgeon General, turned the first spade of earth, assisted by Col James H. Batte, CO of Edgewood Arsenal, and Rep. Clarence D. Long.

Also on the platform were Brig Gen Joe M. Blumberg, director of the Armed Forces Institute of Pathology at the Walter Reed Army Medical Center; Brig Gen Frederic J. Hughes, director of Professional Services, Office of The Surgeon General; Col Adam J. Rapalski, chief of the Preventive Medicine Division, Office of The Surgeon General, and Lt Col Richard J. Phillips, commander of the Hygiene Agency.

The modern, windowless facilities, scheduled for completion in February 1967, will rise three floors above the ground floor. Its basic plan calls for central laboratory modules with surrounding office, storage, and special purpose rooms.

EDGEWOOD ARSENAL Commander Col James H. Batte (left), Rep. Clarence D. Long (Md.) and Brig Gen James T. McGibony, Deputy Surgeon General, break ground for $2.7 million building at Edgewood Arsenal, Md., to house operations of Army Environmental Hygiene Agency.

Acknowledging that the "most effective practice of medicine today is through a team effort of a number of specialists working together toward a common goal". Gen McGibony praised the Environmental Hygiene Agency for its significant role in supporting the Army's preventive medicine program by providing services and investigations in the fields of environmental hygiene and sanitation and occupational health.

Col Batte expressed Edgewood Arsenal's pleasure at having this unit of the Surgeon General as a tenant, observing that its presence is another example of the value of cooperative action between separate commands.

Upon completion, the new building will facilitate the expansion of the Occupational Health Program, part of the overall preventive medicine program. It will also accommodate the increasing number of specialized studies and investigations prompted by the new military-industrial activities and products with which the soldier will be in contact or of which he will be the ultimate user.

Among the specialists who staff the Agency are physicians specializing in preventive medicine, sanitary engineers, toxicologists, industrial hygienists, a veterinary officer, and medical entomologists.

Windowless except for end stairwells and front entrance, the new building will be completely air conditioned and will include four separate ventilating systems.

Its 69,000 square feet of floor space will provide the Agency with an increase of 67 percent over the present working area. All air discharged will be filtered to remove any potential dangerous particles, and parking facilities will be provided for more than 80 cars, trailer laboratories and service vehicles.

Temperatures ranging from 60 degrees below zero to 165 degrees above zero are to be generated in the controlled environmental rooms.

Six insectories will be constructed to create temperature, humidity, and varying degrees of light that might exist in any part of the world. A 15,000 volume library is planned.

Deadly Venoms May Benefit Mankind

CRDL Research Could Recast Snakes' Public Image

The man-serpent relationship has not been considered a beneficial one since the Garden of Eden, but venom research at the Army's Chemical Research and Development Laboratories (CRDL), Edgewood Arsenal, Md., may upgrade the public image of snakes as symbols of death and evil.

CRDL and other Army laboratories have been working for many years with poisonous snake venoms. Their primary aim is to develop defenses against these poisons, and current indications are that they are approaching that goal.

In fact, the studies have progressed to the point where therapeutic qualities of snake venoms can be examined, with current attention focused on cobra venom. Future studies of therapeutic applications are planned for other natural poisons such as rattlesnake and black widow spider venoms. Meanwhile, basic research on such poisons will continue.

Capt James Vick, Capt Henry Ciuchta, and Spec 4 James H. Manthei have been conducting much of the CRDL research, assisted by Dr. Clarence Broomfield and Byron Currie, CRDL chemists. Cobra venom has been broken into 12 basic chemical fractions, some deadly and some potentially beneficial.

Certain venom elements have been used to restore physical functions interrupted by polio. Some may help relieve the pain of terminal cancer. Another potential application may be in preventing the human body from rejecting foreign tissue, such as kidney transplants or grafted skin. A cobra antiserum from India is being evaluated for therapeutic effects.

Capt Vick recently presented a report on the "Isolation and Identification of the Toxic Fractions of Cobra Venom" at a meeting of the Federation of American Societies for Experimental Biology.

Dr. Von Braun Climaxes Series Of Summer Employee Lectures

Dr. Wernher von Braun, director of the Marshall Space Flight Center, presented the concluding lecture in a series of 20 lectures for engineering and science summer employees at the Army Missile Command and the Marshall Space Flight Center, Redstone Arsenal, Ala.

Top scientists, engineers and administrators in the Missile Command and the Center presented the lectures, ranging through missile and space technology from "Laser Communications" to "Technical Documents."

Kudos

Lt Col James L. Quinnelly of the Combat Materiel Division, Office of the Chief of Research and Development, received the Joint Service Commendation Medal in recent ceremonies conducted at the Pentagon.

The citation was for service from July 1962 to June 1963 as project officer for the Advanced Research Projects Agency R&D Field Unit, particularly for his work on Project AGILE, and as ordnance advisor to the Combat Developments and Test Center, Saigon, Viet Nam.

He has served in the Artillery and Vehicle Systems Branch, R&D Division Office of the Chief of Ordnance (1957-62) and as a member and chairman of the Tripartite Ordnance Standardization Committee as well as chief of the Technical Branch, U.S. Army Europe Ordnance Division.

Col Quinnelly holds a B.S. degree in chemical engineering from Mississippi State College (1941) and an M.S.E. degree from Michigan University (1948). He coauthored a technical paper entitled "A Theoretical Investigation of Detonation in the Gasoline Internal Combustion Engine."

Lt Col James L. Quinnelly (right) accepts the Joint Service Commendation Medal and congratulations from Lt Gen William W. Dick, Chief of Army Research and Development.

* * *

The Meritorious Civilian Service Award, the Army's second highest civilian service award, was presented recently to John E. Thompson, civilian personnel officer at Fort Detrick, Md.

Signed by Maj Gen Floyd A. Hansen, commanding general of the U.S. Army Munitions Command, the citation, which accompanies a bronze medal and lapel rosette, honored Thompson for his achievements in ". . . piloting new programs and critically evaluating and updating programs of long standing in civilian personnel services."

Thompson joined Fort Detrick in September 1946 and has been serving as civilian personnel officer since February 1952. He is a graduate of Western Maryland College with a B.A. degree (1940) and attended the University of Pennsylvania's Wharton School of Finance and Commerce in 1941.

* * *

Two Fort Detrick scientists, Dr. Norman D. Gary, acting chief, Microbiology Division, and Dr. John D. White, acting chief, Pathology Division, have been certified as Diplomates by the American Board of Microbiology without examination.

To be so honored, candidates must have achieved a position of unquestioned responsibility and eminence in their respective fields. Dr. Gary came to Fort Detrick in January 1952 from Indiana University, where he earned both his M.S. and Ph.D. degrees. During a leave of absence in 1962 and 1963, he was associate professor of biology at Wesleyan University.

Dr. White who holds B.S. and M.A. degrees in biology from the University of Buffalo (N.Y.) and Ph.D. in bacteriology from Vanderbilt University, Nashville, Tenn., has been employed at Fort Detrick since 1956.

* * *

Royal Canadian Air Force Squadron Leader Dr. Robert Forgie has ended a 3-year residency at Walter Reed Army Institute of Research, under the North American Air Defense Training Program, with high praise for the training at the Institute.

"The opthalmology program at Walter Reed is outstanding by the sheer volume and variety of the work," he commented, along with the statement that he would not mind doing the tour all over again.

Hawaiian Cited for Arctic, Antarctic Nuclear Work

Award of a Second Oak Leaf Cluster to the Army Commendation Medal to SFC Takeshi Kumagai recently gave him the distinction of becoming the first man in U.S. Army history to be commended for meritorious service on nuclear power plants in both the Arctic and Antarctic.

"Tak" Kumagai, now with the U.S. Army Engineer Reactors Group, Fort Belvoir, Va., earned his first Oak Leaf Cluster while serving at the Army's PM-2A nuclear power plant in Greenland. The second is for meritorious service from October 1963 to November 1964 at the PM-3A McMurdo Station, Antarctica.

The citation recognized outstanding performance in the operation of the plant, attention to the safety of all personnel assigned to his watch, and the training of all personnel on duty with the Detachment.

A native of the Hawaiian Islands, Kumagai is no stranger to paradox, including survival before a firing squad which left him for dead. He also read reports that he was missing in action as a prisoner on the Korean Death March while serving with the 24th (Taro Leaf) Infantry Division.

Wounded during the North Korean assault on Taejon, "Tak" escaped but was recaptured later and ordered executed. The shot passed through his body below the right collarbone. Left for dead, he escaped only to be recaptured after several attempts to rejoin American troops.

Without medical attention, he began the Korean Death March from Taejon to Seoul and later, as the regrouped American Army advanced north, to Pyongyang. When American prisoners again were herded together for a move further north to the Manchurian border, "Tak" escaped with two other prisoners.

After hiding for six days, the escapees encountered the 2nd Infantry (Indian Head) Division Reconnaissance Unit. "Tak" later was assigned for duty with that unit at Fort Lewis, Wash., where he received his first Army Commendation Medal.

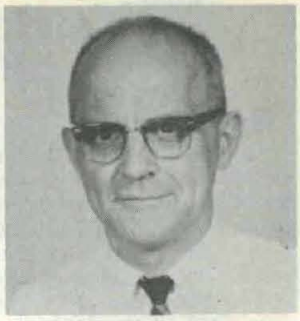
SECOND OAK LEAF CLUSTER to Army Commendation Medal recipient SFC Takeshi Kumagai is congratulated by Col Robert B. Burlin, director of the U.S. Army Engineer Reactors Group located at Fort Belvoir, Va.

Army Night Vision Research Program Objectives Reviewed

Special Technical Series

This is the first in a series of articles more technical in scope than this publication has carried since it was established nearly five years ago. The articles are prepared in response to invitations to scientists or administrators who have achieved eminence in their fields of endeavor.

By Dr. Wilhelm Jorgensen



Dr. Wilhelm Jorgensen

DR. WILHELM JORGENSEN, Internal Research Division, Army Research Office-Durham, since 1957. . . . BS degree, physics and mathematics, 1933; graduate fellow, physics, 1933-37; PhD, physics and mathematics, 1937, University of Washington. . . . research physicist, Battelle, 1937-40. . . . military service 1940-46—antiaircraft artillery, radar fire control and air defense, 1940-43; member, Air Defense Board and chief, Radar-Electronics Branch, 1943; Air Defense and Special Task Force officer, Hawaiian Antiaircraft and Pacific Ocean Area command, 1944-45; member, Navy Technical Mission to Japan, 1945-46; chief, Artillery and Antiaircraft Fire Control and Electronics R&D Division, Ordnance Corps, 1946-57; colonel USAR; chief, Ordnance Branch, USAR School, D.C., 1948-53; commanding officer, USAR R&D Unit, D.C., 1953-57; member, USAR R&D Unit, Chapel Hill, N.C., 1957-63.

"Under cover of night" may be a phrase due for retirement in the next few years as it applies to military operations, because of technology advances in night-vision capabilities.

Broadly interpreted, military night vision encompasses all the techniques and phenomena that can be of service in gaining direct observation of personnel, materiel, terrain, activities, etc., of significance to operations under conditions of darkness; or generally, all these activities when carried on under conditions of limited visibility.

The research program of the Army includes studies covering the ranges of the near infrared (less than 2.0 microns wave-length) and the far infrared (beyond 2.0 microns). This division is somewhat arbitrary. However, it is meaningful with respect to passive detection since it separates the targets into illuminated (near infrared) and self-radiating types (far infrared).

The near infrared region, which extends from the visible up to about 2.0 microns, involves considerable starlight and night sky illumination energy all night long, and hence supports reflected light imaging techniques. It is interesting to note that if the visible light were of the same intensity as that radiated in the near infrared air-glow, there would be perpetual twilight under clear conditions and never a dark sky ("The Upper Atmosphere" by Massey and Boyd-Hutchison).

The far infrared region (nominally 2 to 14 microns, with some gaps) has a relatively low atmospheric absorption. It represents the region of natural black body temperature radiations emitted by living and other warm objects. Passive infrared detection in this region shows remarkably sensitive temperature definition of the scene.

This article attempts to summarize the state-of-the-art of night-vision technology and describe some of the advanced research, particularly that supported by the Army Research Office-Durham (ARO-D), Durham, N.C., under its Night Vision Military Theme. It also reports on certain work carried out at the Night Vision Devices Laboratory, Army Engineer R&D Laboratories at Fort Belvoir, Va.

Discussion will concentrate on fundamental science which supports applied research leading to devices, rather than on applied research. State-of-the-art discussions with applied research personnel at Fort Belvoir, Fort Monmouth, Frankford Arsenal, Harry Diamond Laboratory, and the Institute for Defense Analyses have furnished a sound base for this review.

The ARO-D military theme on night vision is aimed at establishing better understanding of the fundamental techniques involved in the areas of invisible-light image conversion and weakly illuminated picture image intensification. The objective is to discover basic phenomena within the physical sciences which can provide the observer with more perfect night vision, without disclosing his location. Emphasis is on radiation detection and intensification techniques for the eventual use of the individual soldier.

The technical research tasks can be divided into those which support direct-view photoluminescence type techniques and those which support indirect-display photoconductive amplification type techniques; night-vision devices will certainly exploit both. A few words on basic theoretical background may be useful before describing research projects.

Scientists long ago noted that electrons in an atom exist at different discrete energy levels. Given the right energy packet from some outside source, an electron may be displaced to an excited state, at some higher energy level, from which it can decay to its original lower energy state, possibly with the emission of light. This type of phenomenon finds application in many devices, for example, the Laser.

The fact that the energy levels available to the electrons are discrete has important consequences. Such levels are said to be quantized. The energy applied to the electron must be exactly that needed to displace it to a higher available energy state or the electron will remain in its original state.

There is an exception, however, when the energy is sufficient to remove the electron completely from the influence of the atom. The energy of such a free electron is not quantized and the expelled electron carriers its excess energy with it in the form of kinetic energy of motion.

Solid-state and semiconductor materials are made up of many atoms. Atoms in the semiconductor crystal are subjected to the influence of the other atoms in the crystal with cross coupling energy-state effects which modify the simple atomic levels into bands of finely spaced energy levels.

The structure, however, contains unique and discrete energy states. The electrons are constrained to remain in these discrete energy states unless and until activated by discrete amounts of energy. The semibound electrons which become available for movement in semiconducting materials are the valence electrons of the individual atoms. The region of semibound states of electrons is called the valence band (see Figure 1). The electrons are constrained to recrystal which receives an excess of energy, sufficient to be carried free of its original parent atom, arrives in what is called the conduction band. The

conduction band electrons are free to move about in the crystal, almost as if they were an ideal gas made up of electrons. These electrons, however, are free only in the sense that they are not held by the parent atom and are not free to leave the crystal.

The conduction band also is quantized and comprises many closely spaced but discrete energy levels. A minimum of at least one conduction band state, which may be occupied by no more than two electrons (of opposite spin), exists for each atom in the crystal.

The electrons at or near the bottom of the conduction band are in thermal equilibrium with the crystal. Since the number of energy states in the conduction band is very high compared to the number of free electrons in the band, almost all of the conduction band electrons will be found at or near the bottom of the band.

Electrons excited by light or other means to energy well above the bottom of the conduction band normally reach the thermal equilibrium distribution very quickly as compared to the usual lifetime of an electron in the conduction band. The excess energy is given up as heat. Normally, the region between the top of the valence band and the bottom of the conduction band is devoid of states and is identified as the forbidden zone because electrons cannot normally remain there.

By means of imperfections or impurities, however, intermediate states or traps can be introduced into the forbidden zone of the crystal. These traps are very significant in determining the photoconductivity and luminescence properties of solid-state and semiconductive materials.

In general, imperfections and impurities display their most beneficial significance at small concentrations. Since relatively pure crystals contain approximately 10^{15} imperfections per cubic centimeter, fundamental research on the basic nature of the control and characteristics of the various types of imperfections is essential to effect an improved utilization of the basic techniques.

It has been noted that photoconductivity and photoluminescence offer useful night-vision techniques. It may help to look at the basic phenomena in more detail.

A photoconductive material is one in which electrons are filling spaces near the top of the forbidden zone between the valence band and the conduction level. These electrons are higher in energy than those in the valence band and require less energy

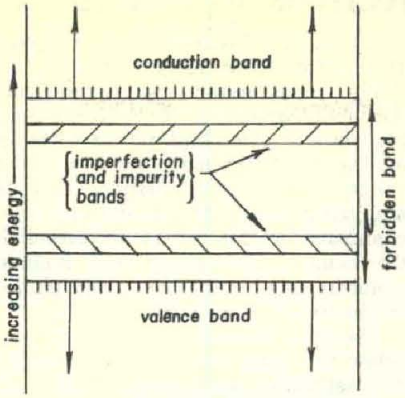


Figure 1. Semiconductor energies.

to lift them to the conduction level. A photon of light striking these electrons does just that. And at the conduction level, the electrons are free to move around in the material. That is to say the electrons, as they accumulate in the conduction band, are available to flow and set up a current in response to an applied electric field; indeed this is what happens.

A photoluminescent material is one in which the electrons are filling spaces sufficiently far down in the forbidden zone that electrons falling from the conduction band to fill the spaces will emit photons of visible light. These states, or traps, are called fluorescent centers since removal of electrons from them is followed almost immediately by a fluorescent response.

The exciting photon of light raises the electron from the fluorescent center state, or trap, to the conduction band where either the same electron or another electron in the conduction band drops down to replace it, re-emitting a photon of visible light in the process. The re-emitted photon may have the same energy as the exciting photon but usually will have less.

The technique, therefore, finds its use limited to the detection of higher energy radiations such as ultraviolet light and X-rays. It does make a very effective and simple detector, however, of the type needed but not presently available for the detection of infrared radiation.

Similar but long-persistence type phosphorescent materials operate on essentially the same principle as fluorescent materials. They require some provision for storage of the activation energy for extended periods of time —much longer than can be accounted for by simple lifetime considerations.

The term phosphorescence is used to identify fluorescence which is delayed by some internal mechanism that stores the excitation energy and releases it slowly over a period of time. Materials for phosphors have the additional feature of a large number of low-energy electron traps in the forbidden zone near the bottom of the conduction band.

Electrons elevated from the fluorescent centers to the conduction band by the activating light photons fall into the traps where they remain until released by a thermal excitation from the crystal. Direct transitions from the traps to the fluorescent centers are forbidden by an exclusion principle, conservation of momentum.

Thermal release, obtained from an occasional lattice vibration excitation, is statistical in nature and believed to account for the exponential decay of phosphorescence with time, as one may observe by activating a phosphor under a bright light and watching it fade with time in the dark.

The persistence characteristic of

(Continued on page 40)

Figure 2. Fall scene taken in daylight approximates best detail obtained by image-intensifier techniques using reflected light during the night.

Figure 3. Fall scene, identical to figure 2, taken at night with a slow-scanning, thermal imaging system operating in the far infrared.

Night Vision R&D Objectives Reviewed

(Continued from page 39)

phosphors finds considerable use in TV picture tubes, X-ray fluoroscopes, etc., to hold the picture between activations.

A promising technique of interest for application of this principle to night vision and infrared detection involves finding an extremely persistent phosphor which shows little if any spontaneous release of the electrons from the traps but which responds to release by infrared light energy.

If made sufficiently effective, this technique would produce an infrared fluorescent detector of the type desired for night vision use. Such a detector would fluoresce when irradiated by infrared light. With suitable optics, the technique could be used as a horizon scanner to locate warm vehicles, infrared equipment, and other heat sources. It would require reactivation from time to time.

Little has been said about such characteristics as holes, carrier lifetimes, compound-type materials, temperature and light-intensity-time effects. All are important and not all are subject to control. Basic research on the reactions, mechanisms and theory can help the applied researcher in selecting useful relationships in which the various interactions can be made to work together.

A research effort at RCA is directed toward establishing the characteristics and parameters for maintaining controlled resistance breakdown of photosensitive insulators under high fields.

Under the proposed technique, an insulator is maintained in a high electric field, literally at the brink of the resistance breaking point. Given a weak infrared irradiation, such as a photon from a distant starlit tank, as the outside source of energy, an electron in the isulator is elevated to the conduction band and immediately moves along under the high field, gaining energy faster than it can lose it to the crystal lattice. Finally, it jars another electron loose in a cascade effect until a detectable current signal results.

If successful, the technique has potential application in the development of wafer-size image intensifiers for miniaturizing infrared night-vision viewing equipment.

A study of trapping parameters in crystalline solids, which includes measurement of photoconductivity rise (superlinearity) curves for CdS and GaAs as a function of temperature and light intensity, is in progress at Stanford University.

The investigator has found that the photocurrent of CdS, for example, rises by some high power (3 to 5) of the light intensity over a short range of light intensities, and is analyzing the photoconductivity mechanisms in this range to establish the cause. The study will include simultaneous luminescence and photoconductivity measurements.

The photoconductivity above and below the transition is near linearity but separated by several orders of magnitude. The superlinearity rise curve locates the transition rise connecting the lower to the upper curve. This superlinearity region moves up and down the light-intensity scale as a function of temperature.

Infrared light has the effect of heating the recombination centers (places where electrons and holes annihilate each other) and can produce strong quenching in the superlinearity region by effectively moving the superlinearity curve.

A means of detecting and amplifying a single infrared photon of light is being investigated at the Johns Hopkins University. An infrared photon of known frequency is used to raise an electron from a heavily occupied ground state (energy level #1) to an unoccupied higher energy level (energy level #2).

The material used is selected or tuned in a manner such that the energy required for this first action is exactly that possessed by some preselected frequency of the infrared light for which the technique is to be used. Once at energy level #2 the electron is optically pumped continuously, by an external source to an energy level three states higher than the ground state (energy level #4).

The material selected is of such nature that the electron decays rapidly through an intermediate energy level (energy level #3) back down to the vacant energy level #2, with the emission of light. The electron is repumped as before and repeats the cycle many times, until lost back to the ground state.

In other words, the device upon receiving the input of a single photon, produces a detectable pulse of light, as indicated. The technique will have application as a detector for use with Laser-type illuminators.

An experimental investigation, at the University of Rochester, of the optical and electronic properties of certain ionic solids is emphasizing luminescence, photoconductivity, photoemission, and related phenomena of alkali halides.

A somewhat similar theoretical and experimental study on the nature and quantitative characteristics of impurities involved in the luminescence of semiconducting phosphors is being conducted at the University of Delaware.

Special emphasis is being placed on donor-accepted and transition metal luminescent centers. Though general in nature, the results of the research will furnish better understanding of infrared technique behavior.

A project being funded by the Army through the European Research Office at the University of Leicester, England, involves the study of "Charge Transport and Carrier Generation in CdS." The chief investigator is making a study of electron transport in doped crystals to determine the dependence of hole mobility upon crystallographic orientation, the generation of holes by light and electrons, carrier diffusion, exciton dif-

Figure 4. Summer scene taken in daylight by reflected light technique.

Figure 5. Summer scene, same as figure 4, made with slow-scanning thermal imaging system in far infrared.

fusion velocity, and carrier transport in recrystallized CdS. This material is a likely candidate for a base material in solid state night vision devices.

A theoretical approach to apply space group theory to solid-state physics and optical Masers, with emphasis on infrared band photoenergies in diamond structure, is being made at New York University. The effects of stacking faults on electronic band structure, vibrational structure, and X-ray scattering, with special considerations for luminescence centers and electro-optic effects are being analyzed.

Research carried out by Dr. Werner Weihe at the Night Vision Devices Research Laboratory at Fort Belvoir is concerned with devices utilizing naturally emitted radiations from warm objects, in the far infrared region.

Figure 2 is a photograph of a scene taken on an overcast autumn day. Taken in daylight, the picture approximates the best detail that can be obtained by image-intensifier techniques using reflected light during the night. Figure 3 is the same scene taken at night, using a slow-scanning, thermal imaging system operating in the far infrared.

Figures 4 and 5 are pictures of the same scene taken in summer by a photographic camera and with the thermal imaging system, respectively. These pictures show that warm targets can be detected by far infrared during either the day or night. It is clear that the man hiding in the bushes, although hidden from reflected light observation, is visible due to his far infrared natural body-temperature radiation.

Unfortunately, such thermal scanning images require exposures of the order of 20 minutes, thus limiting the usefulness of the technique. For this reason, programs have been initiated to develop special detector vidicons, mosaics, and electron circuitry to decrease the exposure time and to provide operational equipment that is more practical and useful.

Solid-state and semiconductor techniques have here been given primary emphasis; the prospects look promising and are far from being exhausted. With new ideas for research, other techniques may be recognized. Basic research is always full of surprises, and almost any good research on photoconductivity and photoluminescence will have night vision significance.

In summary, the research program on night vision devices here described is aimed at exploring and developing techniques for the anticipated future needs of the applied researchers; the knowledge gained will be used in developing very sensitive detectors and analyzers of weak sources of visible and invisible radiations. The objective is to make it possible for the soldier to operate at night with daytime flexibility and facility.

In-House Scientists Invited to Propose ASC Papers

Aspirants to the distinction of being selected to present technical papers at the 1966 Army Science Conference, June 14-17, at the United States Military Academy, must submit narrative summaries of proposed papers by Oct. 15, 1965.

The biennial Army Science Conference will be the fifth sponsored by the Chief of Research and Development and hosted by the superintendent of the U.S. Military Academy.

The call for presentation proposals issued by the Scientific and Technical Information Division, U.S. Army Research Office, allows prospective authors two weeks more time to prepare narrative summaries than was provided for previous Army Science Conferences.

Details concerning channels for the submission of narrative summaries, and poster announcements, and information on attendance quotas for major Army R&D activities will be issued at a later date. For each of the four previous conferences, more than 500 authors submitted summaries.

Only papers concerning original research performed by Army in-house laboratory personnel will be considered. The subject material may be classified through SECRET, but cannot contain restricted or formerly restricted data.

Senior Army scientists making up the ASC Advisory Group will review the summaries and notify selected authors to prepare papers.

A panel of scientists drawn largely from the Army Scientific Advisory Panel will judge the papers for awards patterned after the 1964 procedure, in which Certificates of Outstanding Achievement were granted for 20 papers, nine of which received honorariums totaling $3,800. Five papers won $200 each, two $500 each and two $750 each. Some awards may involve several authors who engage in a team effort.

All papers presented will be published in the widely disseminated Army Science Conference proceedings.

The prime purposes of the Army Science Conference are to provide:

- An opportunity for Army scientists to present the results of their research efforts for constructive comments and discussion by an audience of senior scientists.
- A means by which Army scientists and engineers may exchange information in related fields, in the interest of an appreciation of the scope and depth of the scientific effort of the Army.
- An opportunity for Army scientists to have their work published and disseminated as widely as national security will permit.

Scientific Calendar

Canadian Electronics Conference, Toronto, Ontario, Canada, Oct. 4-6.

11th Annual U.S. Army Human Factors R&D Conference, sponsored by ARO-D, Fort Bragg, N.C., Oct. 4-7.

Meeting of World Meteorological Organization, Geneva, Switzerland, Oct. 4-16.

9th Annual Organic Chemistry Conference, sponsored by AMC and NAS-NRC, Natick, Mass., Oct. 5-6.

6th Annual Symposium on Switching Circuit Theory and Logical Design, sponsored by IEEE and University of Michigan, Ann Arbor, Mich., Oct. 6-8.

Pan-American Congress of Electrical and Mechanical Engineers, sponsored by IEEE, CIME, ASME, ASTM, SAE, AMIME and AMICE, Mexico City, Mexico, Oct. 9-17.

Meeting of Electrochemical Society, Buffalo, N.Y., Oct. 10-14.

Communications Symposium, Utica, N.Y., Oct. 11-13.

International Conference on Safety, Fuels, and Core Design in Large Fast Power Reactors, Argonne, Ill., Oct. 11-13.

Protective Relaying Conference, Minneapolis, Minn., Oct. 12-14.

Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn., Oct. 12-14.

Meeting of Advisory Group for Aeronautical Research and Development, Rome, Italy, Oct. 13-15.

12th Nuclear Science Symposium, sponsored by IEEE, AEC, NASA and OSR, San Francisco, Calif., Oct. 18-20.

Joint Materials Handling Technical Conference, sponsored by IEEE and ASME, Pittsburgh, Pa., Oct. 18-20.

International Symposium on Advances in Gas Chromatography, Houston, Tex., Oct. 18-21.

International Symposium on Economics of ADP, Rome, Italy, Oct. 19-22.

2nd International Symposium on Air-Borne Infection, sponsored by AMC and Johns Hopkins University, Baltimore, Md., Oct. 20-21.

11th Conference on the Design of Experiments in Army Research, Development and Testing, sponsored by ARO-D, Dover, N.J., Oct. 20-22.

Conference on Circuit and System Theory, sponsored by IEEE and University of Illinois, Monticello, Ill., Oct. 20-22.

Electron Devices Meeting, Washington, D.C., Oct. 20-22.

Meeting of the Advisory Group for Aeronautical Research, Paris, France, Oct. 21-22.

Symposium on Microminiaturation in Automatic Control, Munich, Germany, Oct. 21-23.

National Electronics Conference, Chicago, Ill., Oct. 25-27.

4th Symposium on Discrete Adaptive Processes, Chicago, Ill., Oct. 25-27.

3rd Fluid Amplification Symposium, sponsored by AMC, Washington, D.C., Oct. 26-28.

East Coast Conference on Aerospace and Navigational Electronics, Baltimore, Md., Oct. 27-29.

Meeting of Technical Information and Documentation Committee of Advisory Group for Aeronautical Research and Development, Washington, D.C., Oct. (date undetermined).

Spectral Analysis of Metal Colloids in Oil Detects Engine Wear

By Directorate of Research, Development & Engineering
HQ., U.S. Army Aviation Materiel Command

Investigation of aircraft engine and transmission failures resulting from wear while in flight has resulted in a new and apparently reliable means of detecting certain defects in time to avoid serious accidents.

As a result, a whole new concept—appropriately called predictive maintenance by means of spectral analysis—is being explored by the Army Aviation Materiel Command as well as by other military services, with increasing intensity and with steadily encouraging results.

In effect, the purpose of the new approach is to provide a magic eye whereby it will be possible to see what is happening to the hidden components inside an engine and to give warning of incipient engine failure as long as 100 hours before it may occur.

Marking a radical advance in aircraft safety and maintenance, this approach is concerned with the detection and identification of the kinds and concentrations of minute metal particles which slough off into the oil stream, forming the boundary layer of rubbing surfaces of metallic components in relative motion. Approximately the size of molecules, these particles remain in permanent suspension as a colloidal solution.

Under normal operating conditions, the metal contaminants exist only in trace amounts so small that it has been nearly impossible, if not unduly time-consuming, to determine either concentration or identification by traditional wet chemical methods.

Availability of sophisticated optical and electronic instruments, however, has made possible the achievement of a very rapid and exact determination of oil contaminants in concentrations of fractions of parts per million. Coupled with this instrumental development has been the more important one of correlating the test results obtained with wear rates of lubricated metal components.

Pioneered originally by the Navy Laboratory at Pensacola, Fla., research in this area subsequently has been extended to the Army Oil Laboratories at Fort Rucker, Ala., and Corpus Christi, Tex.

Since then, hundreds of Army aircraft and transmissions of all types have been introduced to the analysis program, making possible the accumulation of extensive historical engine and oil contamination data.

One major development from all of this analysis has been the discovery that the rate of increase of specific types of metals is the most important factor in predicting the impending failure of a component. As an example, a steep rate if increase in silver content invariably pointed to rapid bearing wear, a fact which has been invariably confirmed by subsequent tear-down of the engine.

Laboratory analysis and studies of component wear rates eventually will lead to a better understanding of component life and probably will result in more extended use of the component parts which are presently discarded upon overhaul.

In the meantime, however, there remain certain obstacles which must be surmounted. Major among them is the limited number of spectro-chemical laboratory facilities available to the Military Services. Another is the transportation time and delay involved in sending oil samples over considerable distances to basic major laboratories and getting the test information back in time for correction.

With the latter factor particularly in mind, all three services are evaluating various instruments suitable for field use which are less costly, relatively portable, and do not require the rigid environmental control necessary for the massive instruments used at the basic laboratories.

Admittedly lacking the high degree of sensitivity and accuracy characterized by the larger instruments, these prospective field units still are capable of providing a relative wear pattern for each engine which is sufficiently significant in forecasting impending failure.

Still further in the future is the development of an in-flight predicting instrument located in the aircraft itself. Coupled with a computer, it would be capable of monitoring increase in rate of metal concentration and of relating this information to remaining safe flight time. Fulfillment of this ultimate objective remains for future research consideration and subsequent development.

Whatever the type of field instrument that eventually will emerge, it will still possess only the capacity of measuring the rate of wear of lubricated parts. A ripe field for future research will be the development of an instrument that will detect impending catastrophic failures caused by abnormalities not related to wear. These include fatigue failures which, to date, defy scientific solution.

Value Engineering Clause in Contract Pays $20,214

Echoes of an old adage, "A penny saved is a penny earned," were audible recently when a contractor collected a $20,214 bonus on a contract with the Army Aviation Materiel Command (AVCOM).

Spartan Aircraft Co., Tulsa, Okla., collected the award for saving the Government over $50,000 by taking advantage of a value engineering clause in a contract to overhaul R-200 engines used to power the Army's CV-2 Caribou assault transport.

Value engineering clauses allow contractors as much as 50 percent of the Government's savings resulting from that contractor's improvement in equipment or methods. Rights to the ideas become Government property so that savings to the taxpayer continue in future contracts involving those improvements.

An aggregation of ideas earned Spartan the award. The major problem with the R-200 engine was its rear case, which had to be scraped (value: $7) every 9 or 10 months and replaced (cost: $1,267) because of wear in the oil pump bore. Spartan developed a liner for that bore which can be replaced or repaired for $66, and the cases are now expected to survive for six years or more.

Another problem was that the generator driver idler shaft gear admitted too much oil to the rear case when high capacity oil pumps were installed. Old gears were worth 12 cents and new ones cost $81. Spartan simply plugged the holes in the old gears and rebored them to the proper size. (Total cost: $5 per gear.)

A third problem was excessive wear on the cover of the propeller thrust bearing. The covers cost $52 and have a scrap value of 12 cents. Formerly, almost one-third of them had to be rejected. Spartan developed a method of machining the covers which stopped the wear. (Cost: $3 each.)

The $20,214 cost sharing savings awarded to Spartan Aircraft Co. is equivalent to contractor performance of a $400,000 contract at 5 percent profit, without the effort entailed in performance of that contract.

Chief of Staff Extends Zero Defects Program Army-wide

Success of the U.S. Army Materiel Command Zero Defects Program is recognized in Army Chief of Staff General Harold K. Johnson's recent order that it become Army-wide.

Each major command will have a ZD Program but each will decide voluntarily on the precise nature of its activities.

The Comptroller of the Army is now charged with General Staff responsibility for supervision of the ZD Program and its Army-wide development in coordination with major agencies.

Coordination will be accomplished by the Comptroller with the Deputy Chiefs of Staff, Chief of Research and Development, Chief of Engineers, Chief of Communications-Electronics, Chief of Reserve Components, Chief of Information, Assistant Chief of Staff for Force Development, and Assistant Chief of Staff for Intelligence.

Until the Chief of Staff action, the Army's Zero Defects Program had been concentrated within the U.S. Army Materiel Command (AMC) and its installations and various commodity commands. The AMC Director of Quality Assurance (Maj Gen John M. Cone until his recent reassignment as CG, White Sands Missile Range) has directed the AMC Zero Defects Program.

The Chief of Staff memorandum outlined further details of the Army-wide Zero Defects Program as:

- Participation in the program will be voluntary. Commanders will be provided the concept, philosophy, information and publicity packages and pilot models of the program application for various functional activities, but the establishment and actual form of individual ZD programs in the commands and field activities will be a matter for decision by the commanders concerned.
- A detailed reporting system to the Department of the Army will not be required and narrative type progress reports are not desired more frequently than semiannually.
- The program will be established within presently programed manpower resources.
- It will attempt to enhance and complement and not detract from any ZD Program now in effect. In this regard, the use of any appropriate program name or slogan is acceptable.
- Program application will be oriented toward functional activities having a measurable product. Only certain functions in troop units, such as maintenance and records administration, are considered to be suitable for program incorporation. Program regulations, information and publicity will emphasize that ZD techniques are an extension of proven Army leadership methods.
- Decentralization and initiative will be encouraged.
- Pilot models on how to apply a ZD program at the working levels in each selected functional activity will be developed. Pilot models should include product measurement examples.

An Army Regulation establishing the Army Zero Defects Program will be forthcoming and it will be coordinated with the Office of the Assistant Secretary of the Army for Installations and Logistics.

The tone of the wider Army and Department of Defense Zero Defects Programs was set in a statement by Deputy Secretary of Defense Cyrus R. Vance June 1, 1965: "Providing the reliable equipment needed by our military forces is a job requiring highly efficient Defense-industry teamwork. This essential and efficient teamwork can only result from the individual performance and dedication of all involved.

"I believe that the Zero Defects Program will make an important contribution to our joint trusteeship on behalf of the American people for the expenditure of their money in the production of Defense equipment and will thereby greatly assist President Johnson in his efforts to assure our country a dollar's worth of Defense for every dollar spent."

The concept of Zero Defects, which takes exception to the idea that it is only human to err, and challenges each employee to do the job right the first time, began with the Orlando Division of the Martin-Marietta Corp. while performing a contract for the U.S. Army Missile Command.

Since that time, the idea has spread to many Defense contractors and many Army elements, beginning with the Missile Command in 1962. The first anniversary report provides many details on the success of the program, including:

Well over 1,000 industrial companies have adopted or announced firm plans to adopt Zero Defects Programs, bringing over two million employees into active participation.

Sixty AMC in-house activities have adopted or have firm plans for adoption of the program, covering 133,000 employees. A total of nine AMC workshops have been conducted by the Command over the past 10 months to provide comprehensive instruction to 352 key representatives from industry and the Government on the program.

Four additional workshops will be conducted on the West Coast during the month of August for 200 key representatives in conjunction with the Los Angeles Army Procurement District.

Three highly successful seminars for industry representatives were held during the past year to acquaint them with the concept.

To insure that the Zero Defects Program is sustained at optimum effectivity, the Army Missile Command has accomplished the following:

- Prepared a Department of Defense Zero Defects handbook.
- Prepared Zero Defects information kits, pamphlets and brochures and distributed 10,500 of them.
- Prepared three films, which have been shown to 623 industrial and military organizations and viewed by an audience of about 2.5 million people.
- Responded to 2,550 inquiries from industry and Government activities requesting information and assistance.

Some of the results of programs at individual commands or installations are as follows:

Army Aviation Materiel Command—Computer input errors have been reduced 50 percent and actions cancelled due to incorrect calculations or planning have dropped 46 percent since implementation of the ZD program.

Picatinny Arsenal—Typing errors down from three per page to .25 per page since implementation of the program in December 1964; requests for waivers reduced 32 percent; inspection reporting errors decreased 50 percent; during the month of February 1965 two individuals working together published 30,000 EAM cards and processed 700 reports with no errors—special recognition was given.

Edgewood Arsenal—A 50 percent reduction in defects in the rockets production area at Rocky Mountain Arsenal since implementation of the program in February 1965.

Frankford Arsenal—Brazing opertions on 2.75 rocket warheads improved from 89.9 percent acceptance per month production schedule in February 1965 to 99.2 percent acceptance in April 1965.

Results among industrial firms with Defense contracts have been just as impressive.

The Army Missile Command has put into operation a Zero Defects Information Center, which is a clearinghouse for information, education, protion and evolution of new techniques and publication of a ZD bulletin.

3 AMC Personnel Receive Cost Reduction Awards

PRESIDENT JOHNSON awards cost reduction Certificate of Merit to Eugene L. Simpson (above), one of 4 Army personnel to be honored among 17 Department of Defense employees at recent ceremonies in Washington, D.C. At the extreme right is Secretary of Defense Robert S. McNamara. Other Army employees receiving the award included (left, top to bottom) Adolph A. Wronka, Sgt 1st Class John L. LaRue, and Sp/5 B.W.A. Kliem.

President Lyndon B. Johnson awarded citations to 17 Department of Defense employees in recent ceremonies at the Pentagon highlighting the second annual Cost Reduction Week. Three of four awards to Army personnel recognized Army Materiel Command (AMC) employees. The fourth was earned by a Continental Army Command enlisted man.

Eugene L. Simpson was cited for observing that a 90mm. cartridge, scheduled for demilitarization, had a case which could be adapted for use with new cartridges. The procurement contract for cartridge cases was cancelled, saving over $3 million in FY 1965 and an estimated $9-12 million through FY 1969. He received an initial award of $1,000 and has been recommended for an additional award of $2,000.

Formerly a supervisory supply commodity manager assigned to the Munitions Command, Ammunition Procurement and Supply Agency, Joliet, Ill., Simpson is now a general supply officer in the Ammunition Division, Sierra Army Depot, Herlong, Calif.

Mechanical engineering assistant Sp/5 B. W. A. Kliem and industrial engineering technician Adolph A. Wronka, both of Picatinny Arsenal, Dover, N.J., teamed efforts in developing a less expensive and more effective colored marker head for the 2.75-inch rocket. The program brought savings of $627,000.

Sp/5 Kliem was responsible for the coordination, loading, testing and evaluation of the colored marker head. He showed such initiative that he was promoted from Sp/4, given a Letter of Commendation, and is being recommended for the Army Commendation Medal.

Mr. Wronka suggested using an implosion technique in which the explosive is placed around the dye. Formerly, the dye was placed around the explosive. The implosion method permits pelleting the dye instead of melting it and pouring it into the shell. The use of pelleted dye shortens loading time, lessens the hazard of inhaling toxic fumes, and reduces the quantity of dye required by two-thirds.

Sgt 1st Class John L. LaRue, currently serving as communications instructor at the U.S. Army Training Center (Armor), Fort Knox, Ky., discovered that football helmets costing $9.60 each could be modified by adding $13.78 worth of communication equipment and substituted for tankers' helments, which cost $80.95 each. A requirement for 2,139 helmets was thus met at a savings of $123,160.

The 17 awards represent typical alertness to economy and ingenuity of Department of Defense personnel whose ideas saved the Government $4.6 billion in fiscal year 1965.

Large Precise Power Plant Ordered for Nike X System Testing Facility in Pacific

The largest precise power plant ever built in the Free World, capable of delivering intermittent net power of about 26 million watts, is being procured by the U.S. Army Corps of Engineers for testing the Nike X developmental radar on Kwajalein Atoll in the Pacific.

A converted Navy floating drydock section will provide a hull approximately 240 feet long to contain the power plant, which will be designed for precise power under fluctuation loads for the Nike X system. After assembly and testing, the plant will be towed to Kwajalein.

Under a single contract, the designing of the plant will be completed; the drydock converted; the generating and ancillary equipment furnished, installed and tested; the plant prepared for sea tow to Kwajalein; and installation testing and initial operation supervised upon arrival at Kwajalein, scheduled in the fall of 1967.

The plant will be purchased through the 2-step procedure prescribed by the Armed Services Procurement Regulation. Step one, a solicitation of technical proposals, was taken early this month. Step two, the formal invitation for bids, is planned for January 1966 after an evaluation of acceptable technical proposals.