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ADP Pilot Test Viewed For AMC Application

Managers and officials from the Army Materiel Command (AMC), Department of the Army (DA), and the Department of Defense (DoD) are watching closely a pilot test of an ADP processing system which may lead to the standardization and computerization of major AMC business systems.

The program will entail the development of standard systems operating via standard programs on standard ADP equipment in each organizational level of the command acquired within the National ADP Program for AMC Logistics Management (NAPALM).

IBM equipment (Systems/360 configurations) was selected for pilot testing a variety of standard systems at the AMC, ADP, Test Centers, St. Louis, Mo., beginning Aug. 15. With Army approval of a successful test, ADP equipment will be installed on a phased basis at other Commodity Commands, National Inventory Control Points (NICPs), and Commodity Centers.

These locations will be the U.S. Army Mobility Equipment Command (MECOM); the U.S. Army Aviation Materiel Command (AVCOM); the U.S. Army Tank-Automotive Command (ATAC); the U.S. Army Missile Command (MICOM); the U.S. Army Weapons

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AMC Notes 5th Anniversary Progress

Entrusted with a mission of unprecedented magnitude when created in the Army-wide reorganization of 1962, the Army Materiel Command received acclaim of Army Chief of Staff General Harold K. Johnson for significant achievements on its fifth anniversary Aug. 1. General Johnson stated:

"To all members of the U.S. Army Materiel Command, it is a distinct pleasure to extend heartiest congratulations and best wishes to members of the USAMC on its fifth anniversary.

"During the five years since its organization, members of the Army Materiel Command have continually distinguished themselves by their contributions to national security. No Army can successfully function in the field without proper tools and equipment with which to do the job. The successes of our fighting men in Vietnam attest to your ability to innovate and to produce and provide them with high quality materiel. Your achievement in fulfilling this added responsibility while at the same time streamling your organization to reduce costs is a superior achievement.

"I join with all members of the United States Army in expressing pride in the accomplishments of the Army Materiel Command and in voicing confidence that its future service to our Nation will be

(Continued on page 4)

Kinnard Commands CDC; Gribble Named DACSFOR

(See story on page 8)

Lt Gen Harry W. O. Kinnard

TORQUE Presents System Of Balancing R&D Program

An analytical procedure for achieving balance in the allocation of exploratory development funds has been formulated by an ad hoc triservice committee, created by request of Dr. John S. Foster Jr., Director of Defense Research and Engineering.

Assistant Secretaries for Research and Development of the Army, Air Force and Navy are preparing comments on the proposed methodology. Dr. Foster has said he considers the procedure worthy of a limited field test.

The test would involve applying the technique to a comparable area of exploratory development in each of the three

(Continued on page 5)

AVCOM Plans New Engine Tests in LOH

U. S. Army aviation will venture with a "first in the world" test of a new regenerative-type engine of potentially major significance when a light observation helicopter (LOH) is flight tested in September.

Preparations for the possibly epochal flight are being completed by the U.S. Army Aviation Materiel Laboratories (AVLABS), Fort Eustis, Va., under the direction of Nicholas Kailos as project engineer.

"After these tests," stated John W. White, chief of AVLABS Propulsion Division, "we should have an assessment of the major installation and operational problems as well as the advantages of the regenerative engine."

In a regenerative-cycle turbine engine the heat energy in the exhaust, which is normally lost, is reintroduced back into the cycle after the compression process by means of a heat exchanger, thereby saving fuel.

The T63 regenerative gas turbine engine completed the 50-hour flight worthiness tests in February 1967 with "highly satisfactory results." Upcoming tests will be the first ever made in which the sole

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T63 Regenerative Engine

Featured in This Issue . . .

Army R&D Newsmagazine

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Dr. Foster Contends R&D Programing Soundly Based In Addressing Aviation Space Writers Association

Contentions that Vietnam war funding is tending to deemphasize the level of R&D necessary to produce superior future weapon systems drew a recent vigorous rebuttal by Dr. John S. Foster Jr., Director of Defense Research and Engineering.

National security prevents public disclosure of much of the research and development in progress, Dr. Foster told those attending the 29th annual meeting of the Aviation Space Writers Association at Las Vegas, Nev. Most of Dr. Foster's address follows:

Dr. John S. Foster Jr.

* * *

"I turn now to my major purpose today; to explore a few areas of defense R&D which show the relationships between our work and yours.

"I suppose it is now regarded as a transparently obvious axiom in any national policy discussion that national security — understood deeply — is a subtle balance of military, political, economic and technical factors. The significance of R&D in the strength and security of nations is unmistakably great. Further, the pace of modern technology — both ours and that of others — will continue increasingly to complicate all considerations of U.S. national security strategy.

"In assessing the broadest implications of new technology and advanced weapons systems, there is, as I see it, a coincidence of our viewpoints. We in the Department of Defense are as committed as you are to contributing to an accurate public discussion of the choices in national security.

"Surely there was no question in the 50s about the vital service to the country when journalists, scholars and governmental spokesmen explored — sometimes heatedly — the impact of the intercontinental ballistic missile on the choice of strategic courses open to the U.S. and the Soviet Union. Surely there is no question today, for example, about the value of an informed, broadly based public analysis of antiballistic missile systems or of the spread of nuclear weapons.

"The vital importance of national security demands that our country have continuing, intense debate on the critical issues. This is, in fact, an international imperative as well. As you realize, the recent U.S. efforts to extend discussions of missile defense with the Soviet Union are based upon the premise that greater international understanding of these issues is necessary in the path of peace.

"But again, make no mistake about the nature of these issues. They involve technical as well as political and economic elements. Too often, the technical facts, and particularly the range of uncertainties, are not treated adequately in publications. I suggest this inadequacy is not primarily the result of excessive secrecy but rather of our mutual failure to complete the discussion. All of us must contribute more here.

"Let me turn to our continuing, most critical area: R&D on our strategic systems. The overriding operational objective of our strategic programs is the deterrence of nuclear war. Mutual deterrence is, in fact, the only meaningful way a nuclear war now can be 'won' by both sides. Deterrence rests on the capability for assured destruction of the enemy's military, industrial and civilian base. A deterrent capability is characterized by three essential factors — assured survivability, penetration and control.

"Our strategic offensive forces must be able to survive a surprise attack and still be capable of inflicting unacceptable damage. This assured survivability is achieved, in part, by a mixture of systems and techniques, land-based bombers, land-based missiles and sea-based missiles.

"Surviving would not be sufficient if, after arriving at targets, our weapons were rendered impotent by defensive systems in the terminal area. They must be able to 'penetrate' the defense, to strike the target. Penetration is achieved in essentially two ways — by brute force, through using overwhelming numbers to exhaust the defense; and by deception, such as through the use of decoys.

"Finally, our strategic systems must be flexible and remain under our reliable, positive control. We cannot risk a response triggered by accident or false alarm.

"Our record in achieving an adequate deterrent has been impressive, in quantity and quality. Our ability to deliver an overwhelming retaliatory strike, even after absorbing a surprise attack intended to paralyze our strength, is unquestionably convinving.

"Now, you are saying to yourselves, we have heard all this before. But let us pause here a moment. I have emphasized the word 'assurance' in reviewing our strategic objectives: assured destruction of any attacker, assured survivability, assured penetration, assured command and control.

"This is a crucial concept. It is crucial that we devote the highest priority to our thinking about assurance — and we do. It is crucial that we assign all necessary

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Aviation Command Plans Regenerative Cycle Turbo Engine Test in LOH

(Continued from page 1)

power of a helicopter in flight is provided by a regenerative engine, Kailos stated.

Significance of these tests is focused on the possibility of very substantial fuel economy and consequently extended range of Army helicopters. The T63 engine is expected to achieve a reduction of 20 percent or more in fuel consumption. AVLABS engineers believe that an increase of up to 75 percent in aircraft ferry range is possible with future improvement in regenerative engine capability.

Still cautious about predicting the performance of the regenerative aircraft engine, engineers are encouraged greatly by results to date, Kailos said. The current research program was initiated by AVLABS in October 1965.

The T63 engine to be tested is a conventional model modified for regenerative operation. Consequently, the results will be only indicative of what may ultimately be accomplished through specially designed regenerative engines of advanced efficiency.

Estimates of the fuel economy that eventually may be achieved range up to 50 percent, depending upon the level of heat-exchanger (regenerator) effectiveness and the specific mission involved, it was explained. The September tests will be used to compare performance directly with a conventional engine installation.

Principles of regenerative engine design were explored by the British more than 20 years ago. In the late 1940s, they installed an experimental regenerative engine in the nose of a 4-engine (conventional) aircraft for limited flight tests.

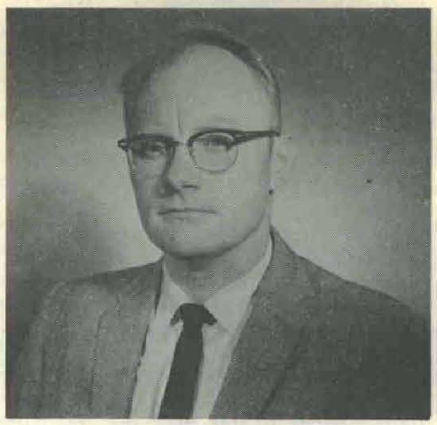
The forthcoming AVLABS tests, however, are believed the first in which a regenerative engine has been installed as the sole power source for any aircraft. The experimental engine will be installed in a YOH-6A helicopter designed and built by Hughes Aircraft Co. as the winner of an elimination competition with other major helicopter manufacturers.

Development of the heat-exchanger principle of regenerative engines has been of interest to the U. S. Army since 1959, and since 1964 has been actively investigated by AVLABS. White and Kailos collaborated on a technical paper presented at the Society of Automotive Engineers annual conference in 1964, and White reported to the SAE again in 1965.

In May, 1967, Kailos presented a technical paper to the American Helicopter Society at its annual conference in Washington, D.C. It was titled "Increased Helicopter Capabilities through Advanced Power Plant Technology."

Lower specific fuel consumption can be achieved by higher cycle efficiency through higher compressor pressure ratios and increasing turbine inlet temperatures, or by the use of a regenerative cycle.

The heat exchanger (regenerator) removes waste heat from exhaust gases and returns it to the cycle of the engine, which reduces the fuel required to reach the necessary turbine inlet temperature at all power settings. The optimum regenerative cycle will show a specific fuel consumption advantage over the simple cycle turbo shaft/prop engine, it was stated.



Nicholas C. Kailos

John W. White

Under contract with AVLABS, the Allison Division of General Motors Corp. ran tests with the first set of regenerators in a small helicopter engine in 1966. Results provided the basis for effective redesign of the engine.

Garrett-AiResearch Corp., Allison subcontractor, also contributed substantially to the series of successes of this program. Test-cell evaluation simulating altitude and temperature conditions has been conducted. Low-hover tests in August will set the stage for flight tests scheduled in September.

Among the extremely important advantages forseen by Army researchers through development of the gas turbine regenerative engine are:

- Reduced aircraft gross and empty weights.
- Reduced fuel logistical requirements to overseas theaters.
- Increased aircraft range capability.
- Increased payload capability.

Army Accepts Floating Nuclear Plant MH-1A

Final testing and training operations prior to deployment of the United States Army's floating nuclear power plant, the MH-1A *Sturgis*, began June 26 immediately following acceptance by the federal government from Martin Marietta Corp.

The MH-1A power plant is the first of its kind in the world. At full power, it produces 10,000 kilowatts, which could provide electricity for a community of 10,000 to 20,000 population. It is installed in a converted Liberty Ship hull, renamed *Sturgis* for the late former Army Chief of Engineers, Lt Gen Samuel D. Sturgis Jr.

Since the *Sturgis* was towed from its construction dock at Mobile, Ala., a year ago, the power plant has been undergoing component testing. Martin-Marietta Corp. contract personnel have been working with soldiers trained at the Nuclear Power Field Office (NPFO), U. S. Army Corps of Engineers, Fort Belvoir, Va.

The core of uranium fuel was loaded Jan. 18 and the plant "went critical" (nuclear reaction began) Jan. 25. Ship-to-shore electrical power was first delivered to the Virginia Electric Power Co (VEPCO) distribution system Apr. 23 and full power was achieved Apr. 26. Power from the MH-1A is fed to the power company under a reciprocal contract.

The plant is assigned to the NPFO for further tests and training of operational personnel prior to deployment. It is intended for remote-area military operations or emergencies such as disaster relief to communities near navigable ports.

The MH-1A is the most recent development in the Army Nuclear Power Program, which started in the mid-1950s. The SM-1 at Belvoir is used primarily as a training facility and the SM-1A, sister facility at Fort Greely, Alaska, began producing power for Army facilities in March 1962.

The *Sturgis* hull is 441 feet long. The special midsection containing the reactor includes a 15-foot-thick collision barrier on each side of the hull for protection of the primary system. Systems approved by the U. S. Atomic Energy Commission have been built into the plant for maximum protection against nuclear contamination.

Four shifts of five Army nuclear specialists plus supervisory and maintenance personnel are required to operate the MH-1A on a 24-hour day, 7-day week, 52-week year basis.

AMC Notes 5th Anniversary Progress

(Continued from page 1)

marked with the same excellence that has characterized its efforts during its first five years."

General Frank S. Besson Jr., who has commanded the AMC since its inception, and his staff received numerous other congratulatory messages for outstanding accomplishments in streamlining AMC organization, improvements in procurement procedures, and research and development of materiel to advance combat capabilities.

Magnitude of AMC responsibilities is indicated by its current annual budget of more than $14 billion. In striving continually to modernize its operational structure, the AMC since 1962 has steadily reduced the number of its facilities taken over from the seven Technical Services. Of the original 278 facilities, only 177 remain.

Fourteen elements were phased out in the past year, including the Army Mobility Command. The Army Tank-Automotive Command, Warren, Mich., and the Army Mobility Equipment Command and Army Aviation Materiel Command, both headquartered in St. Louis, Mo., were designated major commands.

In line with economy and reliability of materiel objectives, the AMC has placed heavy emphasis on its Zero Defects Program. In the past year, employes encouraged to identify potential causes for error submitted more than 6,900 corrective suggestions. Over 5,000 were adopted by management.

To achieve greater mission effectiveness, the AMC held its first Customer Assistance Conference in Washington, D.C., May 3-5. AMC made presentations pertinent to assistance in all logistic fields and the latest developments in organization, missions and materiel. Customers worldwide were provided a forum to present their views.

AMC Customer Assistance Offices are in operation at U.S. Army Headquarters in the European, Pacific and Vietnam Commands. The latter office has a suboffice in Okinawa. The purpose is to assure effective working relationships on all logistic matters.

Another innovation in supply management was the transmission of data to the field by the use of microfilm, a new concept. Selected logistics management data, taken from the Army Master Data File, covering the total 1,181,354 Federal Stock Numbers, were placed on 13 microfilm cartridges.

The film and required readers were provided to selected Seventh Army units in Europe early in March 1967 for user feasibility tests. The tests were expanded to several Continental U.S. installations, including Fort Hood, Tex., and to activities at Cam Ranh Bay, Qui Nhon and Saigon, Vietnam.

Procurement capabilities have been improved through techniques which save time and manpower. Simplified procurements up to $10,000 have been authorized, reducing by 30 to 45 days the lead time for procurement of repair parts for Southeast Asia.

In response to a request from the Defense Supply Agency, the AMC provided a total of 1,319,000 square feet of storage space at four Army depots to facilitate support of supply operations for Southeast Asia.

Numerous items of new materiel were furnished to forces in Vietnam, including a spike-resistant 10-inch-high combat boot to provide protection against a variety of antipersonnel foot-penetrating devices. Another item is a lightweight rucksack (four pounds lighter than the standard item) to permit a soldier to carry either a full marching load or a lighter combat load.

Other developmental projects on which AMC reports progress include:

- A new ground-based surveillance radar set, the AN/PPS-5, which will greatly increase the capability for battlefield detection of hostile vehicular and foot-troop movement in periods of darkness or low visibility caused by inclement weather. The set can locate vehicles at ranges up to 10,000 meters and foot-troop movement at ranges exceeding 4,000 meters. A limited quantity of sets is in production for early delivery.
- More combat units were equipped past year, including the AN/PRC-25 walkie-talkie and the AN/VRC-12, its vehicular counterpart. With 920 channels, these high-performance sets offer advantages in weight reduction, reliability, reduced size and complexity, and power requirements. The first Single Sideband sets also were fielded in Vietnam.
- A vehicle-launched bridge 30 feet long for use with the M113 tracked vehicle was advanced through the engineer development testing phase and it is being pushed for early delivery to Vietnam.
- An airborne acoustical ground-fire detector, capable of warning an aircraft pilot that he is being fired upon, was developed and type classified in a 5-month period. The device weighs about three pounds.
- Water needs of troops in jungle warfare will be served by a 420-gallon-per-hour lightweight water-purification unit. Weighing about 1,000 pounds, it can be sling-loaded under a helicopter. Action is being expedited to provide these units for use in Vietnam.

Army aviation capabilities were improved significantly with numerous advances during the past year. Quantity production started near the end of FY 1967 on the AH-1G Huey Cobra, featuring greater firepower, speed, range and endurance than armed UH-1s. During April, the first units of the OH-6A helicopter were deployed to units at Fort Knox, Ky.

In May, the first production model of the CH-47B Chinook was delivered to the Army, providing increased speed, payload and longer ferry range.

In May, also, the Army formally accepted the first U-21A, a twin turboprop fixed-wing airplane. The U-21A is capable of taking off and landing on an unsurfaced minimum-of-preparation airfield 1,000 feet long.

It is designed to meet a requirement for a utility aircraft for command transportation, combat unit support and special activities from battalion to theater army level.

Additional highlight achievement came in May when the Army unveiled its radically new armed combat aircraft, the AH-56A "Cheyenne." Formally the Advanced Aerial Fire Support System (AAFSS), it will take off and land vertically like a helicopter but fly forward with the speed, ease and maneuverability of a fixed-wing airplane.

The first prototype model of the Cheyenne recently was rolled out ahead of schedule. A series of extensive ground tests is in progress and the first flights are planned later this year.

Five world aviation records were claimed for the Mohawk, the Army's standard aerial surveillance and target acquisition aircraft system. One record, for straight-line distance, was set when the Mohawk was flown nonstop from Fort Lewis, Wash., to Sherbrooke, Canada, a distance of 2,422 miles, at almost 255 miles an hour.

Report Covers Research On Arthropods in Africa

"Arthropods of Medical Importance in Africa" is the first published result of a 15-year study of the worldwide distribution of arthropods being sponsored by the Office of the Chief of Research and Development, Department of the Army.

The 800-page technical report was prepared by Cornell University under contract with the U. S. Army Natick (Mass.) Laboratories. A similar report on Asia is being printed.

Dr. B. V. Travis, Cornell professor of entomology and parasitology, heads the research group. Search of entomological literature in many languages is involved. Reports contain tabulations of occurrence, habitat and biological data concerning arthropods that transmit disease or annoy man.

Similar studies are scheduled for Latin America, Australasia, North America and Europe.

The Department of Geography at the University of Pittsburgh is compiling topical maps showing the distribution of the most important arthropods for the continents mentioned above. An "Atlas of Medically Important Arthropods" will be published when this project is completed in 1968.

Other Mohawk records included an average speed of 292 m.p.h. over a closed-circuit course, an altitude climb mark from 3,000 to 6,000 meters, and sustained altitude in horizontal flight above 32,000 feet.

Another meaningful advance came when evaluation was completed of conceptual design studies for a composite research aircraft. This program is designed to provide an aircraft combining the hovering capability of the helicopter with the cruise efficiency of the conventional fixed-wing airplane.

Two proposed configurations — the "tilting rotor" concept and the "stopped stowed rotor" — have been selected for further analysis and component studies.

Many times the cost of the original investment in the Army's CH-54A Flying Crane aircraft was realized when it was deployed to Vietnam, where it recovered downed aircraft having a valuation in excess of $90 million.

Six Flying Cranes, the largest helicopter used by the Army, were procured in the FY 1966 program and deliveries were completed in May 1967. Maintenance training has been established at Fort Eustis, Va., and pilot training at Fort Rucker, Ala., to support requirements in Vietnam.

Several armament systems for the AH-1G Huey Cobra helicopter were bought, including the XM-28, a rotating turret mounted on the nose which can fire at angles up to 110 degrees to the right or left. The twin-gun turret mounts either two 7.62mm machine guns, two 40mm grenade launchers, or one of each.

A production contract was awarded for the XM129 40mm grenade launcher, a much improved successor to the launcher currently used in the M-5 helicopter armament system. Electrically driven, the XM 129 fires grenades at a rate of 425 shots per minute.

Joint development by the U.S. and the Federal Republic of Germany of the Main Battle Tank 1970s moved ahead through highly effective teamwork. The first of eight prototypes will be delivered the latter part of this year. Engineering

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TORQUE Presents System of Balancing R&D Program

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services. If approved for use following the experiment, the technique would supplement the manager's intuition, knowledge and professional background as another tool in the decision-making process.

Emphasized, however, is that the technique is not under any circumstances designed to supplant the manager.

TORQUE is the somewhat intriguingly descriptive acronymn (considering the mental gyrations involved in the decision process) that has been applied to the technique. It stands for Technology or Research Quantitative Utility Evaluation. Consideration of research programs must follow a demonstration of feasibility for exploratory development.

Essentially, TORQUE is a framework for quantitatively converting statements about desired future military operational capabilities into system descriptions, which then can be translated into technological criteria.

The methodology is based on the premise that the relative amounts of money spent in various areas of science and technology should reflect the varying degrees of interest in those areas. Because total resources are limited, some project proposals must be denied.

The problem of allocation of funds or of achieving balance, therefore, becomes a matter of determining how much an additional advance in one field is worth to the Department of Defense, or the individual agency concerned, as opposed to an advance in some other field which might cost the same money.

TORQUE methodology is based on the premise that the factors to be considered are the relative worth, date needed, and cost of each achievement.

Answers to these questions, combined into a quantified measure of usefulness of money spent in each area, can aid the evaluation of the importance of a budget change in one area as compared with an equivalent budget change in another area.

The quantitative measure is referred to as the *utility* of a funding level. The utility which can be applied to all programs in competition with each other for funding.

As a first step in constructing a utility measure, each military service must define a set of Operational Capability Objectives (OCOs), stating what functions the service thinks it will be required to carry out in each of several time frames. The agency must then assign to the OCOs a set of numerical weights reflecting the relative importance.

An interdisciplinary team of users, technologists, intelligence specialists and systems analysts then analyzes each of the OCOs to determine ways in which they can be accomplished. The team states the level of technological capability required to meet needs of each subsystem component and technology.

The next step is to assign a number representing the criticality of the technological capability to the OCO. This may range from a low number, representing a capability that contributes only minimally, to a high number implying that the OCO cannot be attained without this technological achievement.

Finally, the interdisciplinary team must assign to each level of technological capability the earliest date needed and the latest date by which the achievement can still be used with full effectiveness.

The technological capabilities desired are collected into packages representing single areas of technology. In many cases these will cut across OCO lines. A team of specialists in a given technology then arranges the technologies in order of increasing levels of difficulty and estimates the cost of achieving each capability by the required date.

An example of increasing levels of difficulty could be the problem of sighting and identifying under the same conditions in successive years an object about the size of a basketball, baseball and ping pong ball in outer space.

The cost for a given Level of Difficulty (LOD) reflects but does not include LODs which have to be achieved first. The current year's budget represents a fraction of the total cost of achieving the highest LOD.

Provided the technology leading to accomplishment of the LOD is funded at the level specified by the technology team, the LOD under the TORQUE procedure is expected to be achieved when needed. Worth of the LOD presumably will be decreased if the achievement date is retarded by budget reductions.

Under the TORQUE system, a computer will determine the worth of having each LOD achieved by multiplying its OCO weight by its criticality number, which will then be modified by a timeliness factor, and the LOD cost fraction. The utility of a budget level allocated to a technology is the sum of the worths of each of the LODs in that technology.

Utility can be computed separately for several possible budget levels for the current year. The computer selects the combination of allocation levels in each of the various categories that, with a given budget, will buy the maximum utility. The budget will be allocated so that each technology will be advancing at the maximum rate consistent with the worth of its products and funds available.

For example, the computer could tell in which technology an increase in the budget by $5,000 could buy the most utility units, and also how many utility units each specific increase in the budget would add.

TORQUE developers point out that the system offers no panacea to the ever-changing problem of achieving the most effective balance in the allocation of exploratory development funds. One complicating factor is that it does not take into account the effects of non-Department of Defense research and development on the defense posture. Neither does it recognize the relative cost of doing R&D in different science and technology areas.

Another factor is that TORQUE does not account for the inability to work in some area of science or technology due to lack of qualified personnel or ceiling limitations, problems of technical risk, and problems of one service doing work of benefit to another.

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Army Completes High Elevation Field Maneuver Appraisal

Scientific appraisal of the first field maneuvers conducted by the U. S. Army above the critical 10,000-foot terrestrial-elevation level is nearing completion.

A movie of the 1966 combat-simulated operation is being produced as part of the orientation program for Army medical officers and scientists. Reports on the accompanying studies are being prepared for publication in the scientific literature.

Some 200 troops of the 3d Special Forces Group, Fort Bragg, N. C., participated from July 29 to Aug. 26 in a special sea-level and high-elevation scenario planned by Fort Bragg personnel and the U. S. Army Research Institute of Environmental Medicine (ARIEM), Natick, Mass.

ARIEM Commander Col James E. Hansen headed the research team of 32 scientists and technicians operating with the soldiers near Fort Bragg and on Mt. Evans, Colo., west of Denver. Mt. Evans provided the desired terrain at 11,500 to 13,500 feet, the minimal elevation considered essential to evaluate effects of "thin atmosphere" on performance and health.

Hypoxia, or lack of an adequate supply of oxygen, causes mountain sickness and the serious disorder called high-altitude pulmonary edema.

Earlier studies in the laboratory environment also were conducted by personnel of the U. S. Army Medical Research and Nutritional Laboratory and ARIEM associates from 1964 to 1966 with specially selected pretested soldier volunteers and animals at the 11,400-foot level of Climax, Colo., and from the 14,000-foot summit of Pikes Peak, Colo. (See June 1964 edition of the *Army R&D Newsmagazine*, page 32.)

The first study under simulated-combat conditions at Mt. Evans was part of the Army–ARPA High Terrestrial Altitude Research Program in Life Sciences started in 1963. The Army Medical Service Research and Development Command, Office of The Surgeon General, has underwritten this program in cooperation with the Advanced Research Projects Agency (ARPA), Department of Defense.

Goal of the Army-ARPA program is the "orderly sequential development of human and animal research on the magnitude, cause and prevention of performance impairment at high altitudes, supported by tasks in clinical and basic biological research."

Severe physical and mental stresses are placed upon a soldier by rapid transport to high-elevation environments. In view of the likelihood that the enemy may be fully acclimatized, researchers wish to insure a functional U. S. soldier properly adjusted, trained, equipped and supported to engage in combat at high elevations.

Research objectives during the Mt. Evans maneuvers were:

- Maneuvers held under combat-simulated conditions were designed to enable researchers to begin to understand the decreases in performance capabilities, operational limitations, increases in illness, severity of acute mountain sickness, and the extent of medical evacuation and logistical requirements.
- A carefully controlled drug study was performed on 45 aggressor and umpire volunteers to evaluate the usefulness of acetazolamide in reducing the severity of acute mountain sickness. Ostensibly, all of the troops were given the drug, but a drugless placebo was administered to some. Neither investigators nor the subjects knew which subjects had received the placebo until the code was broken after the maneuvers.

The maneuver study was in four phases. Batteries of physical fitness tests, various biomedical meansurements and intellectual tests were used for later observations of individual soldier reactions to abrupt exposure to high elevation.

Secondly, the sea-level maneuver was staged to obtain baseline measurements on the same troops who were to be maneuvering as "friendly" forces on Mt. Evans. Another phase permitted the drug study while the medical observers, aggressors and umpires acclimatize to 12,000 feet before maneuvering.

The final phase involved partially acclimatized "aggressor" troops and totally unacclimatized friendly soldiers performing strenuous maneuvers at 11,500 to 13,500 feet.

General conclusions include:

- Valuable training experience was gained by the participants and realistic evaluation of equipment, food and clothing was accomplished.
- Movement by foot of troops newly arrived at 11,500 to 13,500 feet is strikingly limited for at least several days. In some individuals higher intellectual functions may be affected at these elevations.
- A field exercise or maneuver at even higher elevations is necessary to define more clearly the problems to be expected. As the elevation increases linearly above 10,000 feet, medical problems can be expected to increase at a greater rate.
- Although acclimatization to high elevations is quickly lost upon return to sea level, the experience is invaluable to the soldier.
- The drug acetazolamide is of benefit in decreasing the severity of acute mountain sickness.

MICOM Team Builds World's Longest Laser

Stretching 178 feet — well over half the length of a football field — the longest continuous-wave laser in existence has been put into operation by the U. S. Army Missile Command, R&D Directorate at Redstone Arsenal, Ala.

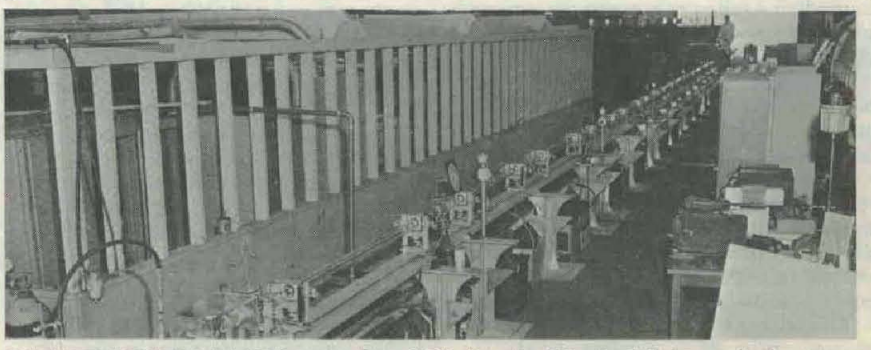
Built by a research team in the Plasma Physics Branch of the Physical Sciences Laboratory, the nitrogen-carbon dioxide-helium laser generates an output power of 2.3 kilowatts. With slight modifications, the laser could generate 4.5 kilowatts.

The present system operates with an efficiency of 10 to 14 percent. When the modifications are completed, it is expected to operate with an efficiency of 20 to 28 percent.

The laser is being used to study scaling laws, various discharge configurations, gas mixtures, optical components and spectra of the output radiation. Investigations seek to determine the optimum operating characteristics and to produce a better understanding of the mechanisms which make these molecular lasers so efficient.

This research, which began in the summer of 1965, provided the necessary information for the extension of smaller laser systems to the present 178-foot laser in modular form. Each module is a duplicate of a smaller laser that was studied.

Dr. Thomas A. Barr Jr., chief of the Plasma Physics Branch, heads the research team that developed this laser. Principal investigators are Dr. T. G. Roberts, J. J. Ehrlich, G. J. Hutcheson, and W. L. Hales. Dr. J. P. Hollowes Jr. is director of the Physical Sciences Laboratory.



LONGEST KNOWN LASER stretches 178 feet in Physical Science Laboratory, Redstone Arsenal, Ala. Researcher at top right is standing at the midpoint.

New Communications Agency Supports DCS Projects

More rapid and effective Army response in the expansion and modernization of the Defense Communications System (DCS) is the responsibility of the newly created U. S. Army Communications Systems Agency (USACSA).

General Frank S. Besson Jr., CG, U. S. Army Materiel Command, and Maj Gen Richard J. Meyer, CG, U. S. Army Strategic Communications Command, announced the establishment of the USACSA as a joint project management agency at Fort Monmouth, N. J.

Col Blaine O. Vogt, backed by 25 years military service, commands the agency and doubles as AMC project manager in coordinating Army efforts for the DCS. Until selected to head the USACSA, he was manager of the Army Materiel Command's Universal Integrated Communications–Strategic Communications (UNICOM-STARCOM) Project. He received a BA degree in 1957 and master's in 1962 from the University of Maryland, and was graduated from the Industrial College of the Armed Forces in 1963.

Under the joint management concept, Col Vogt has full line authority of Generals Besson and Meyer in executing his responsibilities. The USACSA is a subordinate command of STRATCOM. Responsibilities include the development and acquisition of strategic communications systems to meet requirements of a global network.

USACSA will be involved in research, engineering, development, procurement, production, distribution, installation and logistics of DCS projects assigned Generals Besson and Meyer.

Personnel assigned to the agency have been provided from resources of the major field commands. The AMC transferred two of its electronic communications project management offices already at Fort Monmouth, namely the European Tropospheric-Army (ET-A) and the UNICOM-STARCOM offices. The new joint project management office will be known as STARCOM PMO.

The Materiel Readiness Directorate, ECOM, now located in Washington, D.C., also will be transferred to the USACSA. The contribution of STRATCOM will be provided from staff resources associated with engineering and related activities in its headquarters.

Col Blaine O. Vogt

PACSCAT Yields to Gains In Communication Systems

Advances in satellite communications and laying of commercial cables in the Pacific have phased out the Pacific Scatter Communication System (PACSCAT) operated by the U. S. Army Strategic Communications Command (STRATCOM) Pacific since June 8, 1960.

PACSCAT was established to provide military command posts in Hawaii with communications to their subordinate commands in the Western Pacific. The single-voice orderwire channel with 16 teletype channels was terminated May 31 for a combination of commercial and military systems that can carry multivoice channels as well as teletype channels.

These include leased commercial trans-Pacific cable channels, military composite tropospheric scatter and microwave radio systems, military satellite channels of the Initial Defense Communications Satellite Program, commercial satellite, and high-frequency radio systems, all of which are presently in operation in the Pacific Theater.

AFIP Opens Display of Historical Microscopes

Evolution of the microscope — 250 optical pieces dating from the 16th Century — is depicted as part of the 579-piece collection of instruments on display at the Armed Forces Institute of Pathology (AFIP), Walter Reed Army Medical Center, Washington, D. C.

The Billings Microscope Collection, named for Lt Col John Shaw Billings, curator of the old Army Medical Museum from 1883 to 1893, was officially opened to the public June 6. It is the largest known display of microscopes in the U. S. and is recognized as one of the most significant in the world.

AFIP Director Maj Gen Joe M. Blumberg, U. S. Army Medical Corps, termed the collection ". . . an historic insight into the advancement of medical and scientific knowledge brought about by each improvement in instrumentation."

Started in 1874 by Lt Col George A. Otis, early curator of the museum, with several instruments obtained from a Philadelphia manufacturer, the collection was expanded by Col Billings.

Displayed at the Medical Museum are microscopes ranging from a late Sixteenth Century instrument that magnifies objects about six times, to modern electronic devices which enlarge more than 40,000 times.

The exhibit includes a 300-year-old replica of an Antoni Van Leeuwenhoek (discoverer of protozoa and bacteria) microscope one-inch long, three ounces in weight with a lens the size of a pin head in contrast to a 1944 Sieman's one-ton, eight-foot electron microscope.

One of the microscopes is believed to have been used by Dr. Rudolph Virchow, father of modern cellular pathology, and one by Robert Koch, discoverer of causes of anthrax, cholera, and tuberculosis.

One model was used by Maj Walter Reed, the U. S. Army doctor who conquered yellow fever, and another was made especially for the Robert F. Scott National Antarctic Expedition of 1901.

A Wilsun screwbarrel microscope, the type first used at Harvard in 1730, and a Culpepper model, first used at Yale in 1738, are on display with one of the early microscopes used by Dr. James Ewing, famed cancer researcher and discoverer of the Ewing tumor.

John Mayall Jr., London, England, member of the Royal Microscopical Society and private collector, was solicited by Col Billings to help the Army Museum. From 1884 to 1888, Mayall obtained 141 microscopes — some quite rare — for the Washington collection.

The Soviet Union is said to have a collection "of over 500 microscopes and other microscopic instruments" at the Russian Natural Science History Institute of the Academy of Sciences.

Next largest known collection is 350 pieces at the Natural Museum of History of Science, Leyden, the Netherlands. Other smaller collections are at the Royal Microscopical Society, London; the Nachet Collection, Paris; and at the University of Utrecht, Germany.

MEDICAL MUSEUM of the Armed Forces Institute of Pathology curator, Capt Elgin C. Cowart, MC, USN, explains early American microscopes to Debbie Horney (left) and Diane Wilson, George Fox Jr. H.S., Pasadena, Md.

Army, Department of Defense Monitor NAPALM Pilot Test

(Continued from page 1)

Missile Command (MICOM); the U.S. Army Weapons Command (WECOM); the U.S. Army Electronics Command (ECOM); and the U.S. Army Ammunition Procurement and Supply Agency, Picatinny Arsenal, Frankford Arsenal, and Edgewood Arsenal, installations of the Munitions Command (MUCOM).

Along with development of the basic inventory management systems, other systems will be implemented at the various depots, the U.S. Army Test and Evaluation Command (TECOM), arsenals and laboratories. Equipment will be obtained through separate competitive procurement processes for each level.

NAPALM was initiated in 1964 at the direction of the Assistant Secretary of Defense (Installations and Logistics) to develop systems and procedures for materiel management at inventory control points, depots and other affected activities.

The NICPs are an integral part of the commodity commands, however, and the ADP equipment already installed also served the broader areas of operations such as research, engineering, procurement, production, national maintenance point operation, and comptroller functions.

NAPALM was developed, therefore, to include the wider range of commodity command operations as well as the inventory control point operation.

The original title of the program, National ADP Program for AMC Logistics Management (NAPALM), was changed to identify the advanced state of systems development as compared to initial phases of equipment acquisition.

Several major AMC functions will be standardized as applicable. These include quality assurance, provisioning, cataloging, stock control, equipment control, the mutual assistance program, maintenance, supply management, procurement of equipment and missiles, procurement and production, transportation, comptrollership, project management, installation management, manpower and personnel management, the scientific and technical information program, technical logistics data and information, and research, development, test and evaluation (RDT&E).

These functions are categorized into inventory management (which is receiving current priority), scientific and materiel development, and installation management.

NAPALM, as applicable to commodity commands and NICPs, does not include scientific and engineering applications which, however, will be added in the implementation of NAPALM for laboratories and TECOM.

Overall responsibility for NAPALM is assigned to the Director of the AMC Automated Logistics Management Activity at St. Louis, Mo. An ADP Guidance and Coordinating Council (G&CC), a consultative body for resolving problems, assists in planning and coordinating implementation of standard functional and ADP systems throughout the AMC.

Col Richard A. Hansen is chairman of the G&CC. Ellsworth Seitz, NAPALM officer in the ADP Techniques Division, is cochairman.

Functional directors and staff officers at HQ AMC are responsible for the development of appropriate guidelines, working policies, and systems requirements within assigned management areas.

They also are responsible for coordination of functional systems logic with their counterparts in DoD, DA and AMC installations.

Each function is assigned an ADP organization in each participating field installation which is responsible for design and implementation of ADP standard systems and operation.

MICOM, for example, is responsible for specific RDT&E functions which are a part of the Army Research and Development Information System (ARDIS), being implemented to provide essential information for improved management of RDT&E. Included in MICOM's responsibilities are a test operation of the DD Form 1498 (Research and Technology Resume) and the Financial Management Reporting subsystems.

Another RDT&E subsystem, Qualitative Development Requirements Information (QDRI), has been assigned to Frankford Arsenal, Philadelphia, Pa., an installation of the Munitions Command.

The QDRI subsystem provides for the interchange of information on Army requirements for development of materiel or techniques which affect early exploration of new knowledge. Interchange is within Army agencies and between the Army and its contractors, other services and agencies, and scientific community.

The final RDT&E subfunction, the Program Control and Scheduling System, is assigned to the Electronics Command. The system is intended to make available at all times current, accurate and comprehensive data on the status of all projects, tasks and subtasks in the laboratories' RDT&E program.

Subfunctions which will be implemented on standard equipment are the

Kinnard Commands CDC; Gribble Named DACSFOR

(Continued from page 1)

Lt Gen Harry W. O. Kinnard, Deputy Assistant Chief of Staff for Force Development (DACSFOR) since August 1966, achieved 3-star rank July 1 and became CG of the U. S. Army Combat Developments Command (CDC), Fort Belvoir, Va.

Maj Gen William C. Gribble Jr., Deputy Chief of Research and Development under Lt Gen A. W. Betts since April 1966, vacated that position to succeed General Kinnard effective July 17. Maj Gen Richard T. Cassidy, ACSFOR Director of Air Defense, served as DACSFOR during the interim.

General Kinnard has a distinguished World War II combat record. As S-3 of the 501st Parachute Infantry Regiment, he jumped into Normandy the night of June 5-6, 1944, before invading U. S. forces hit the beach.

Six days later, he took command of the 1st Battalion, 501st, and on Sept. 17, 1944, parachuted into Holland. He became G-3 of the 101st Airborne Division and participated in the historic Battle of the Bulge in Ardennes, Belgium, in December.

General Kinnard was Army technical advisor to MGM Studios for the filming of "Battleground," depicting the Battle of the Bulge.

Assigned to the Office of the Director of Defense Research and Engineering, from 1959 to 1961, he then became executive to the Secretary of the Army (1961-1962) and won his first star June 1, 1962, when he became CG of the 101st Airborne Division. Major general rank came as CG of the 11th Air Assault Division in November 1963.

He served a year as CG of the 1st Cavalry Division (Airmobile) in Vietnam before assignment to ACSFOR in 1966.

General Kinnard is a 1939 graduate of the U. S. Military Academy and has attended the Air Command and Staff College, Army War College and National War College.

GENERAL GRIBBLE was U.S. Army Materiel Command Director of Research and Development before he became Deputy CRD when General Betts was promoted from deputy to chief. He has served as chief, Development Division, R&D Directorate, AMC; division engineer, North Central Engineer Division and deputy director, Military Construction, Office of the Chief of Engineers.

From 1953-1956, General Gribble was deputy assistant director, Reactor Development Division of the U. S. Atomic Energy Commission. In 1957 he received the Legion of Merit for developing the Army's first nuclear power plant at Fort Belvoir.

Graduated from the U. S. Military Academy in 1941, he was assigned to the 18th Engineer Regiment and later to the 340th Engineers. He was regimental supply officer and company commander during the construction of the Alaskan Highway. During World War II, he served in engineer assignments in the Pacific Theater.

General Gribble received an MS degree in physical science in 1948 from the University of Chicago. He is a graduate of the Command and General Staff College and the National War College.

AMC responsibility for the Army Technical Library Improvement Studies (ATLIS) project and the Army Chemical Information and Data System (CIDS) project.

Involved also are the Information and Data Exchange Experimental Activities exploratory project, the Engineering Data and Information System (EDIS), the Selective Dissemination of Information project, and the NASA Search System.

Representatives from each organization, for each of the NAPALM functions, comprise the membership of the G&CC.

Implementation of NAPALM has been divided into three phases. Phase I, the acquisition, delivery and prototype installation of standard ADP equipment, began in 1964 with the documentation of specifications.

Each specification was documented by an organization called a "baseline" installation and then circulated to the other NAPALM organizations for "add on" requirements.

Phase II of NAPALM, now underway at most functional levels, consists of the "design, development and implementation of the standard systems presently supported by regulatory documentation and which are basic to the mission and essential to the conversion to new ADP equipment."

Phase III will encompass the development and implementation of additional standard systems to "attain productivity and provide for installation of new, directed systems on a continuing basis."

NAPALM is based on a master file organization utilizing logical integration to avoid data maintenance redundancy. A file structure will be established for operation on standard hardware, using common programs.

Files will be organized so that peculiarities at particular installations can be satisfied by the addition of fields or sectors and still be compatible with programing techniques for file control.

AMC authorities believe the successful implementation of the program will be a giant step for the Army in achieving uniformity in the execution of major logistics functional areas, with optimum automated data processing.

A few of the advantages expected to be realized include:

- With standard equipment, a task need only be programed once and thereafter made available to all other users.
- With standardized equipment (one manufacturer, one family for an organizational grouping), identical languages could be specified, making it possible for a programer at any installation to read and understand any existing program, depending upon the peculiar demands of his location.
- Transfer of functions between installations would not involve files conversion, because data on standard formats could be interchanged between all participating data processing installations.
- Training of programers, systems analysts and operators would be standard and in the long run less expensive than training on individual hardware at each installation.
- A uniform training program would also help alleviate staffing problems. Standard equipment, programing languages, and training concepts would give each installation a vast pool of talent experienced and trained with the same hardware and software.
- Procedures such as tape library, console operation of program maintenance, and scheduling could be standardized, with problems encountered at one installation serving as experience for other installations.
- With standard equipment and 40 to 75 percent of computer programing composed of standard library routines, AMC will be able to estimate the impact of a superimposed system on both hardware and manpower resources.
- Standard costing could be implemented and the time, cost, man/machine requirement and impact on the system could be more accurately evaluated.
- In mobilization planning, any emergency plan could be executed at any installation with less effort.

Time-Lapse Photos Aid Environmental Study

Time-lapse photography has emerged as an important element of environmental research in a report published recently under the In-House Laboratory Independent Research (ILIR) program at the Army Natick (Mass.) Laboratories.

Roland J. Frodigh of Natick's Earth Sciences Division is the author of the photographic and cartographic report, "Seasonal Change Revealed by Time-Lapse Photography."

Covering a 3-year period in the mid-latitude region of the northeastern United States, the report graphically tells the story of how seasonal changes affect vegetation color and density, visibility, trafficability and drainage.

Military applications of the report's findings are in the areas of camouflage, opportunities for cover and concealment, and logistics, including requirements for specialized types of vehicles.

Forty-one landscapes are used for the analysis, each depicting a terrain-vegetation association typical of one of the four major physiographic subdivisions: coastal lowlands, uplands, mountains, and interior lowlands.

Full-color reproduction is used for 16 of the landscapes to show the same site in spring, summer, fall and winter — repeating the identical field-of-view to show the full range of seasonal variation.

Except for the specialized field of aerial photography, the camera has played a relatively minor role in geographic research, the author stated. The report directs attention to the potential of the camera as a research tool for "natural environment" studies.

The 53-page "album" is considered a technical report of considerable merit by Dr. L. W. Trueblood, chief of the Earth Sciences Division. Cost of production, he said, limits distribution, but inquiries are being made into the possibilities of additional printings.

Roland J. Frodigh received an AB degree in 1951 from Clark University where he majored in geography. He later studied geology at the University of Colorado and worked as a cartographer for the magazine *Economic Geography* (1950-52). In 1953, he studied at the New York Institute of Photography, followed by a 2-year period as a self-employed cartographer-photographer.

In 1955, he joined the U. S. Army Natick Laboratories (then the Quartermaster Research and Development Command) as a cartographer. After six years as chief of the Cartographic Office, he transferred in 1962 to the position of research geographer.

Army Mathematicians Hear Geometric Programing Talk

Principles of geometric programing were explained as a highlight of the 13th Army Mathematics Conference at HQ of the U. S. Army Electronics Command, Fort Monmouth, N. J., June 7-8.

Remote access to the B5500 and the TASS simulator was demonstrated at the conference, sponsored by the Office of the Chief of Research and Development. Twenty-four technical papers presented by mathematicians from Army RDT&E activities were acclaimed by participants as being of superior quality, making the conference one of the most successful in the history of the event.

Prof. R. J. Duffin of Carnegie University told some 70 participants that geometric programing is an optimization method for computing simply the minimum of a "posinomial" — an additive function of positive-valued monomial terms occurring with sufficient frequency to make the technique quite useful in applied mathematics.

A "true" minimum results from the technique, he said, as distinguished from the possibility of settling on a "local" minimum, as happens in reponse-surface analysis based on sampling the function space and technique of steepest descent.

Container Shipping Service Begins From West Coast Ports to Vietnam

Direct trans-Pacific container service between West Coast ports and the Port of Danang, Vietnam, was inaugurated with the recent sailing of the *SS Bienville* from Oakland, Calif.

The service is being provided by Sea-Land Service, Inc., Elizabeth, N.J., under a 2-year contract with the Military Sea Transportation Service (MSTS).

Six ships eventually will be full-time carriers of container-packaged military supplies and equipment from Oakland and Seattle, Wash. An additional ship will be in shuttle service between Vietnam ports.

Watervliet Studies Applications of Fluidics to Weapons

Fluidic control systems application to weapon operations and production techniques is being studied at Watervliet (N.Y.) Arsenal by the Automatic Control Group headed by Dr. Rolf E. Wagner.

Watervliet Arsenal is a U. S. Army Weapons Command installation responsible for design and development of all Army cannon, mortars and recoilless rifles. Current studies of fluidics systems are directed toward improving the capability of weapon systems at sizes of 20mm and above.

Automation of weapons has been limited, Dr. Wagner stated, by the fact that they have to operate under various extreme conditions of high shock load, temperatures and environmental factors. The group he leads is concerned mainly with the application of presently available standard components to specific control problems.

One of the group's initial efforts was the building of an automatic breech operating system requiring rapid fire, built-in-safety and reliability, and operation under widely varying recoil conditions. A completely solid-state electronic device meeting these requirements is presently in prototype production.

Experience gained as a result of work with the electronic control system indicated several advantages may be obtained by applying fluidics to weapon control systems — resistance to varying shock, radiation and temperature environments, a possibility of reduced weight and size, and an increase in reliability. Another advantage is the possibility of using recoil energy as a direct power source.

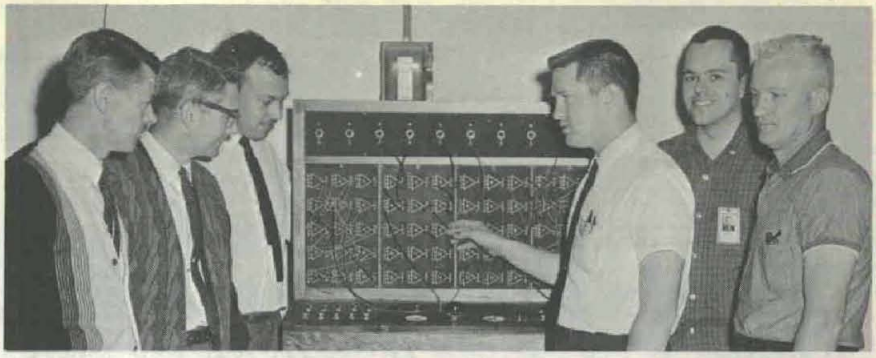
Equipment was obtained to study, build and test fluidic control systems. Because the fluidics control industry is "still in its infancy," Dr. Wagner pointed out, many necessary laboratory tools are unavailable.

To determine static and dynamic characteristics of various fluidic elements quickly and easily, the Watervliet Automatic Control Group developed a test stand that contains various measuring and read-out devices.

Manually operated 3-way valves are incorporated in a network in such a way that all possible combinations of flow and pressure between the inputs and outputs of a fluidic element under test can be realized.

Future plans include incorporating a pneumatic punched-card reader, connected through a logic system to an automatic scanning device and also to control inputs of a 3-way valve network. By these means, the desired characteristics of fluidic elements can be determined automatically.

Feasibility of fluidic logic systems is being studied also with a simulator developed by Dr. Wagner's group. The simulator was designed to simulate logic and sequential functions for weapon operations and for industrial applications.



AUTOMATIC CONTROL GROUP with fluidic logic simulator they designed and built to simulate logic and sequential functions for weapons operations at Watervliet Arsenal. Included (l. to r.) are William Ziegler, technician; John Barrett, physicist; Dr. Rolf Wagner, group director; Ernest Meyer and Brian Pennell, mechanical engineers; Herbert Lewis, toolmaker.

Before experimenting with application of analog control systems to processing methods, it is desirable to simulate the problem on an analog computer. Similarly, theoretically determined logic and sequential systems should be thoroughly tested before adapting them to a process.

Successful testing of a control system for a new weapon with a hydraulically operated mechanism was reported recently by Dr. Wagner's researchers. The advantage of the fluidic control system in this case was the absence of fluid-electric interfaces, because the sensing elements, the logic circuitry and the actuating devices were realized with fluidic components.

An analog 3-mode controller also has been built and tested with fluidic elements. Actually applied to an industrial process, this controller is considered very promising for a position control or stabilization of a weapon system, Dr. Wagner reports.

Present plans of the Watervliet Automatic Control Group include development of integrated fluidic circuits to future weapons. Applications of fluidics to industrial processes also are under investigation.

Hollingsworth Becomes TECOM Deputy CG

Brig Gen James F. Hollingsworth, new deputy commanding general of the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Md., returned recently from Vietnam, where he served since March 1966 as assistant commander, 1st Infantry Division.

Maj Gen Leland G. Cagwin, TECOM CG, has announced that General Hollingsworth will succeed Col John F. Polk, who has served as deputy CG since October 1966 and will retire.

Brig Gen J. F. Hollingsworth

From 1962 to 1965, General Hollingsworth was Deputy Assistant Secretary of Defense (Reserve Affairs), following a year in the Directorate for Reserve Affairs and Readiness Plans, Office of the Assistant Secretary of Defense (Manpower).

Other major assignments have included chief of staff, 2d Armored Division, and deputy commander, Combat Command A, 1st Armored Division, Fort Hood, Tex.; and Chief of the Army Element, U. S. Military Assistance Advisory Group, Pakistan.

He holds a BS degree from Texas A&M College (1940) and an MA degree from George Washington University (1963). He has attended the Command and General Staff College, the Army War College, and the Armed Forces Special Weapons School.

His decorations include the Distinguished Service Cross with two Oak Leaf Clusters (OLC), Distinguished Service Medal with OLC; Silver Star Medal with three OLC; Legion of Merit; Distinguished Flying Cross with two OLC; Bronze Star Medal with "V" Device and three OLC; Air Medal with "V" Device and 25 OLC; and 8 Vietnamese medals.

MICOM Spending $10 Million for BTE

Battery Terminal Equipment (BTE), a new electronic data converter system for control and coordination of Army surface-to-air missile batteries throughout the world, will be produced under a $10 million multiyear contract.

The U. S. Army Missile Command, Redstone Arsenal, Ala., announced that Litton System, Inc., will receive $2,459,175 as a first-year increment to the contract.

The Coordinated Air Defense System AN/GSA-77, designated the Data Converter, was developed under supervision of MICOM's Air Defense Control and Coordination Systems Office, headed by Col Morris W. Pettit.

Designed to integrate Nike Hercules and Hawk missile batteries into Air Defense Control and Coordination Centers, the system will replace two major pieces of current equipment, the Fire Unit Integration Facility and the Coder-Decoder Group.

A significant AN/GSA-77 advantage is its ability to maintain data transfer between batteries in the event of communication loss with the Control and Coordination Centers.

The system will represent the first application of microelectronic technology to this type of equipment. Weight, size and power requirements will be reduced more than 90 percent over currently used equipment.

This results in the elimination of such equipment as a truck, shelter, air conditioner, generator and trailer needed to support the old system.

High reliability is inherent in microelectronic integrated circuits. The system has a built-in self-test capability and utilizes a "throw-away-at-failure" philosophy. A soldier with only basic technical knowledge can easily locate a faulty circuit, replace it, and have the system back in operation within minutes. A full set of spare circuit modules will be packed with the equipment.

Col Pettit commented about the estimated advantages of BTE as follows:

"Substantial savings will be realized for the Army upon fielding of this equipment. The cost of production of new equipment alone is approximately 13 percent of equipment it replaces for the field army and approximately 24 percent of the cost of equipment presently used in the Continental United States (CONUS). Training costs for maintenance people will be only one-fourth of the training costs for equipment it replaces.

"Two enlisted men per battery in CONUS and two to three enlisted men per battery overseas will be eliminated from this maintenance role, since the maintenance for this system (first through fourth echelon) will be performed as an additional duty of missile systems maintenance personnel.

"The current requirement for additional higher echelon maintenance personnel at battalion and air defense levels will be eliminated. The total reduction in maintenance personnel is estimated to result in saving of more than $2 million annually. The reduced power requirement is estimated to result in $1 million annually, once the new equipment is fielded, and about $500,000 will be saved on repair parts for replenishment alone.

"These are but a few of the savings that will be realized which are permitted by the use of microelectronic technology. The Army currently has a program, AN/TSQ-73, waiting initiation to apply the same technology to battalion and higher levels of command so that similar savings will be realized."

Army 'Cubmarine' Retrieves ICBM Nosecones

It's not exactly hush-hush insofar as the U. S. Navy and possible recriminations about encroaching upon its domain are concerned, but the U. S. Army is operating a submarine — a small submarine or "Cubmarine."

Strange though it may seem, the sub belongs to the Army's Nike-X Project Office at Redstone Arsenal, Ala., HQ U.S. Army Missile Command, some 300 miles from the nearest salt water.

As a part of its mission to develop an effective defense against ballistic missiles, however, the Nike-X Project also operates a National Missile Range on Kwajalein Atoll, which is in the middle of the Pacific Ocean. The submarine is based at Kwajalein.

The Nike-X Project uses Kwajalein test site to study American intercontinental ballistic missiles fired westward over the Pacific from Vandenberg Air Force Base, Calif. Missiles are analyzed during their reentries into the earth's atmosphere to gain information which can be used in improving the Nike-X system's ability to intercept and destroy enemy ICBMs.

In support of Air Force and Navy offensive weapon system development, some nosecones are recovered for examination to determine how they withstood the fiery effects of reentry at speeds of 15,000 m.p.h. or more. That's where the submarine comes in. While the ocean surrounding the Test Site is a mile and more deep, the 120-mile-long Kwajalein Lagoon averages only 180 feet to the bottom. Thus the nosecones of Kwajalein-bound ICBMs are targeted to land in the Kwajalein Lagoon so they can be fished out.

To do the fishing, the Nike-X Project purchased an 18-foot Perry Cubmarine from its builder in West Palm Beach, Fla. The 2-man sub has a battery-powered motor that can push it through the water at five knots per hour. It can dive to 300 feet, which means it can operate anywhere in the lagoon.

When a nosecone comes plummeting into the Kwajalein Lagoon, its impact point is marked and the sub is sent out, riding in its cradle on the deck of an LCU (landing craft, utility). The LCU, which has a crane for lowering the sub over the side, as well as quarters and a galley for the sub's operating crew, serves as its mothership and tender.

Painted a bright yellow so it can be seen at depth underwater, the sub carries radio equipment for communication with the mothership. Sixteen portholes ring the sub's sides and bottom. Two operators must watch out not only for the submerged nosecone, but also for pedestals of coral which, if hit, could pierce the sub's hull.

Once the nosecone is spotted, the sub releases a marker buoy to pinpoint its location. Scuba divers from the LCU then dive on the nosecone to attach slings to it and soon the nosecone is started on its 5,000-mile journey back to the States.

TWO-MAN ARMY SUBMARINE is used to recover test-missile nosecones from the Kwajalein Lagoon in the Pacific Ocean. Looking over the berthed sub are Col F. C. Healy, Kwajalein Test Site CO, and A. C. Centrella, Transportation Div. Chief.

ECOM Computer 'Browses' New Literature

Frustration experienced by scientists, engineers and technical personnel endeavoring to breast the flood of research reports related to their specialty fields is being eased by the Army Electronics Command.

Selective Dissemination of Information (SDI), discussed at length in numerous conferences in recent years on problems of achieving more effective utilization of available scientific reports, is being accomplished by ECOM through computer "browsing" of new literature. Users of the system are spared the need of long searches in libraries.

Twice monthly, the computer system at HQ ECOM, Fort Monmouth, N. J., sifts through thousands of new technical reports, articles and translations. An individualized listing of new publications can be provided in any of 7,144 descriptor areas of interest selected by the subscriber.

To enroll in the Fort Monmouth SDI system, the subscriber (about 100 are enrolled out of a potential of 8,000 users) prepares an "interest profile" by selecting a number of terms describing his professional interest from the list of categories, covering the gamut of science and technology. Individual or group-subscriber service will be furnished.

From then on, the computer system takes over, informing him regularly of new documents in all the fields he specifies. The SDI subscriber receives the announcements in the form of a computer-printed booklet. It gives the title, authors, source, date and a descriptive abstract for each document selected by the computer.

The service is performed by special arrangement with the Defense Documentation Center (DDC), which collects and indexes technical documents for Defense Department use. The DDC is one of the world's largest collection points for reports in science and technology.

DDC sends the Electronics Command a special computer tape twice monthly containing a description of each new document acquired. The tape includes for each citation a "document profile" that describes the specific subjects covered. Subjects are selected from the 7,144 descriptors used to prepare the user "interest profile."

A Burroughs 5500 computer matches these thousands of new document profiles against the interest profile of each SDI subscriber to discover all the new documents that have significant material in the user's interest areas. The result is a pre-addressed listing for each subscriber.

The average subscriber selects about 20 subjects for his interest profile, and his semimonthly booklet contains, on the average, about 25 citations of material.

From experience with earlier pilot tests, ECOM estimates that half of the documents referred to a scientist by SDI will be of direct value to him in his present work. Most of the others will be of general interest. On the average, he will order full copies of 15 percent of the cited documents.

About 20 other SDI systems, most of them with relatively small subscribership, are in operation in other U. S. Government agencies and in industry. Expected to serve as a model for an Army-wide SDI service, the ECOM system features low cost, simple ordering of documents, easy self-profiling, and use of the immense document resources of DDC by computer tape exchange.

The ECOM system was conceived and tested over a 2-year period by the Technical Information Division of the ECOM Information Office. The ECOM Computation Agency prepared the computer programs and directs operations.

Maj Gen William B. Latta, ECOM commander, said the main goal of the SDI system is "to increase the productivity of our technical personnel by making sure that each scientist is kept abreast of the latest work in his specialty.

"Our researchers will thus be able to make maximum use of the scientific advances of their coworkers throughout the country, and avoid costly duplication. When this program goes into full gear, we shall see a reduction in the time required to develop a new piece of electronic equipment for our fighting men."

RESEARCH engineer George Sumrall holds a technical report retrieved for him by Selective Dissemination of Informa ion system computer from among 2,500 Defense Department scientific documents published recently. The mound of documents, weighing 1,100 pounds, represents the biweekly scientific report output of the Defense Department and Defense contractors.

Design of Experiments Meet Slated at Belvoir Nov. 1-3

Invited speakers scheduled to address the 13th Army Conference on the Design of Experiments at Fort Belvoir, Va., Nov. 1-3, include three nationally known statisticians and a professor from England.

Prof. Francis J. Anscombe of Yale University will discuss "Regression Analysis" and University of Chicago Prof. K. A. Brownlee is programed for "Some Comments on Matching."

Prof. I. J. Good of the Admiralty Research Laboratory, Middlesex, England, is scheduled for "Some Statistical Methods in Machine Intelligence Research." Dr. Frank Proschan, Boeing Scientific Research Laboratories, will present "Maximum Likelihood Estimation of Reliability."

The U. S. Army Research Office-Durham (ARO-D), N. C., has set Sept. 8 as the deadline for submission of synopses of papers to be presented by Army personnel at technical and clinical sessions on research, development and testing.

The Design of Experiments Conference is sponsored by the Army Mathematics Steering Committee, chaired by Dr. Ivan R. Hershner Jr., chief of the Physical and Engineering Sciences Division, U. S. Army Research Office, Office of the Chief of Research and Development.

The conference chairman will be Dr. Frank E. Grubbs, associate director, U. S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Md. Hosts at Fort Belvoir will be the Engineer Research and Development Laboratories and the Geodesy Intelligence, Mapping Research and Development Agency.

One of the highlights will be the announcement of the 1967 winner of the Samuel S. Wilks Memorial Award, presented by the American Statistical Association. Previous winners are Dr. Grubbs, Princeton Prof. John Tukey and retired Maj Gen Leslie E. Simon.

AFIP Offers Short Course On Pathology of Lab Animals

A course on "Pathology of Laboratory Animals" will be offered at the Armed Forces Institute of Pathology (AFIP), Washington, D. C., Sept. 18-22.

AFIP Director Maj Gen Joe M. Blumberg said the course will include "discussion of etiology, diagnosis, and control of the diseases under consideration."

The course is open to military veterinary, medical and dental officers and, within available space, to qualified civilian personnel in the same fields.

Nurse of Year Assigned to WRGH

Capt Linda A. Bowman, named Army Nurse of the Year for 1966 in February, has been assigned to Walter Reed General Hospital.

Two Department of the Army boards selected the 24-year-old career Army nurse for the annual award. During the same ceremony, she also received the 1967 Dr. Juanita Newcomb McGee Award for "distinguished service to the nation" from the Daughters of the American Revolution.

Both awards recognize Capt Bowman's work as educational coordinator of the 34th General Hospital, Orleans, France.

HumRRO Launches Project IMPACT, Major Computerized Instruction Program

Project IMPACT, a 5-year $4.3 million advanced development effort to provide the U. S. Army with an efficient, economical computer-administered instruction (CAI) system, is involving HumRRO in the largest research venture of its 16-year existence.

HumRRO denotes the Human Resources Research Office of George Washington University, Washington, D. C., the U. S. Army's principal training research agency operating under contract.

Intended to incorporate proven principles of the learning process into a single pattern or model, Project IMPACT is expected to be of vast significance to the education community as well as to its primary beneficiaries — Army personnel seeking advanced skills.

IMPACT is the acronym for Instructional Model Prototypes Attainable in Computerized Training. Objectives of the program are listed as:

- A prototype computer-administered instruction system which the Army can put into operation.
- Several CAI programs of instruction dealing with different subjects of critical importance to the Army.
- A decision model of the instructional process — a set of rules for deciding precisely which learning materials to present next to a particular student, based on his personal characteristics, previous "learning history" and scientifically established principles of learning and teaching.

Dr. Robert Seidel, an experimental psychologist in HumRRO Division No. 1 (Systems Operations), is heading the IMPACT research team with Dr. Felix Kopstein, also a psychologist, as his principal associate. The team will include computer hardware and software experts, instructional programers, applied mathematicians and behavioral scientists.

The initial content will be selected portions of a course in computer programing, with the first course in COBOL, the computer language with a great range of applicability to Army accounting and inventory problems.

In CAI, the computer presents subject matter, asks questions, and provides answers and other information to students at individual instruction stations. The student responds to the computer display by means of a typewriter keyboard or a pen that "writes" with light.

CAI extends the possibilities for individualized instruction beyond those offered by programed instruction. While programed instruction can adapt the instructional presentation to the general characteristics of a specific individual, CAI potentially can adapt the instructional presentation to the detailed characteristics of the trainee and to his precise requirement of the moment.

The decision model of the instructional process to be developed in the 5-year research effort will be a set of rules the computer will use for "deciding" which learning materials to present next to a particular student.

The more capable students progress rapidly through a "short course." Those less capable are given whatever additional information and practice they need.

Dr. Seidel explains that "research in the behavioral sciences provides us with a stock of sound, experimentally established principles of learning and teaching which are clearly relevant to CAI.

"However, most of them were established in laboratory settings and in isolation from each other. Consequently we don't have an understanding of the interactions of the various relevant factors. What is needed — and what we hope to provide through this project — is a synthesis of these factors into a model of the instructional decision process that we can evaluate in terms of effectiveness, efficiency and economy."

As explained by Drs. Seidel and Kopstein, the computer program representing the decision model can be viewed as artificial intelligence that simulates an "ideal" instructor's decision. HumRRO researchers will determine whether or not the same model can be applied to more than one type of learning.

The CAI system to be developed, it was stated, will provide the Army with an automated school stocked with a variety of prototype courses. The "faculty" will be infinitely patient, sensitive and untiring, and can be duplicated at will to meet Army training requirements anywhere.

The project will also provide a laboratory for further study of learning processes and an opportunity for injecting scientific research findings into educational practice.

IMPACT activities will be undertaken in four successive and partially overlapping cycles. Each cycle will include activities concerned with hardware, software, instructional content, and the model of instructional decision process. The project is expected to produce many useful reports, beginning before the end of the first cycle.

Products from the first cycle will include a COBOL course, criterion tests, an administrative information system for recovering information of interest to training administrators, a high-level CAI language for interaction with the computer, a computer program, the instructional decision model, and technical recommendations.

Home Named to Edgewood Post

Lt Col William M. Home has been named deputy director for applied research at the Research Laboratories at Edgewood Arsenal, Md. A 1947 graduate of the University of Washington, he holds a master's degree from the University of California. He is a graduate of the Command and General Staff College, Army Chemical School, and Army Management School.

3 RIA Personnel Receive Postgraduate Fellowships

Postgraduate study fellowships under the U.S. Army Long-Term Training Program have been awarded to mathematician Michael C. Nerdahl and engineers Franklin J. Kozisek and Jimmy H. Williams of Rock Island (Ill.) Arsenal.

The advanced training is part of a continuing program to improve the engineering competence of Rock Island Arsenal's Research and Engineering Division. Each of the three employes will study for two semesters and a summer session.

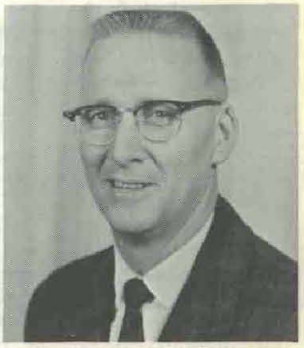
Nerdahl, Product Engineering Branch mathematician for 16 years, is studying theoretical and applied mechanics at the University of Iowa. He received a BA degree in mathematics and education from Augustana College, Rock Island, in 1950. Since then he has completed 12 courses in engineering and advanced mathematics at Augustana and the Universities of Illinois and Iowa.

Michael C. Nerdahl

Kozisek has been in the Development Engineering Branch at the Arsenal since February 1966. Enrolled in the School of Engineering, University of Wisconsin, where he earned an MS degree in mechanical engineering, he is taking courses in high-pressure hydraulics and associated controlling mechanisms. He has a BS degree from the University of North Dakota.

Williams, also in the Development Engineering Branch, has been with the Arsenal since 1954. He received a BS degree in mechanical engineering from the University of Iowa in 1959 and MS in June 1967.

Most of his education has been at his own expense, but he is now taking Army-financed advanced courses at the University of Iowa in gas dynamics, theories of failure in design, engineering analysis, and calculus.



Jimmy H. Williams

SARS Fellowships Enable 2 Army Scientists to Study in England

Secretary of the Army Research and Study Fellowships will enable a chemist and a biochemist to extend their research on specific Army projects through one-year of study in England with international authorities in their respective fields.

DR. BUPENDRA DOCTOR, employed in the Department of Biochemistry at Walter Reed Army Institute of Research since 1960, will work under the direction of Nobel Prize winner Dr. Francis H. C. Crick, originator of the Wobble Hypothesis.

Dr. Doctor's research project will seek to furnish evidence of the genetic code *in vivo* (in a living body), as determined *in vitro* (in glass), and the possible proof of the Wobble Hypothesis.

This hypothesis explains the probable hydrogen bond formation between the anticodon site of t-RNA (transfer-ribonucleic acid) and messenger RNA. This interaction determines the sequence of amino acids in protein, since the position of amino acids in the protein molecule is determined by the t-RNAs. The hypothesis further explains the probable chain initiation and chain termination concept of protein synthesis.

Dr. Doctor's research project is concerned with furnishing data concerning the mechanism of replication of pathogenic bacteria and viruses, since the synthesis of RNA and protein is a prerequisite for the replication of virus and bacteria.

A native of India, Dr. Doctor earned his BS degree from the University of Bombay. In 1955, he received a master's degree in biochemistry and nutrition at Texas A&M University. He earned a PhD from the University of Maryland and from January 1959 to December 1960 was a postdoctoral Fellow at Cornell University.

Author of more than 30 publications, Dr. Doctor will deliver a paper, "The Structure of Nucleic Acid," to members of the 7th International Congress of Biochemistry in Japan in August.

DR. DEREK H. BALL, a chemist at the U.S. Army Natick (Mass.) Laboratories, will conduct a study project on carbohydrates as a member of a group led by Dr. L. Hough, an international authority in the field.

The study is expected to contribute significantly to the development of new materials and to the chemistry of flavor. The long-range aim is to increase the quality and variety of food available to the soldier.

Dr. Ball earned his BSc at Bristol in 1953 and his PhD degree at Queen's University, Kingston, Ontario, Canada, in 1956, both in chemistry. From 1956-58, he held a postdoctoral fellowship, National Research Council of Canada, and in 1959-60 was a research Fellow at Alfred (N.Y.) University.

He is a member of the American Chemical Society, Chemical Society, London, and of the subcommittee on carbohydrates of the committee on biological chemistry, National Academy of Sciences, National Research Council.

Dr. Bupendra Doctor

Dr. Derek H. Ball

Kunkel Succeeds Jones As GPV Project Manager

Col Charles E. Kunkel is the new project manager for General Purpose Vehicles (GPV) at the Michigan Army Missile Plant, Warren, Mich.

Commander of the 8th Logistical Command in Europe until recently, he succeeds Brig Gen Morton McD. Jones Jr. who recently was promoted to that rank and assigned to Vietnam after serving as project manager for two years.

Involving a worldwide asset responsibility of about $1.6 billion and a procurement and production dollar responsibility in excess of $920 million, the GPV is one of the U. S. Army Materiel Command's largest projects.

Ranging from 1/4- to 5-ton trucks, the GPV fleet has many body types and chassis that combine to produce 61 different varieties, plus kits. As project manager, Col Kunkel also will be engaged in the international sale of these vehicle systems to friendly foreign governments.

SCIENTIFIC CALENDAR

3rd Cryopreservation Conference, sponsored by ONR and the Society of Cryobiology, Washington, D.C., Aug. 7-10.

Symposium on Topological Dynamics, sponsored by AFOSR, University of Maryland and Colorado State University, Fort Collins, Colo., Aug. 7-11.

Gordon Research Conference on Inorganic Chemistry, sponsored by AFOSR, New Hampton, N.H., Aug. 7-11.

14th International Spectroscopy Colloquium, Debrecen, Hungary, Aug. 7-12.

Intersociety Energy Conversion Engineering Conference, sponsored by IEEE, Miami Beach, Fla., Aug. 13-17.

14th International Symposium on Microscopy, Cambridge, England, Aug. 14-18.

2nd Symposium on Inequalities, sponsored by ARL, Air Force Academy, Colo., Aug. 14-22.

Meeting of the World Meteorological Organization, Geneva, Switzerland, Aug. 16-23.

7th International Congress of Biochemistry, sponsored by the International Union of Biochemistry, Tokyo, Japan, Aug. 19-25.

Cryogenic Engineering Conference, Palo Alto, Calif., Aug. 21-23.

10th Midwestern Mechanics Conference, sponsored by Colorado State University, Fort Collins, Colo., Aug. 21-23.

14th International Symposium on Microscopy, Cambridge, England, Aug. 21-25.

14th International Meeting of The Institute of Management Sciences, Mexico City, Mexico, Aug. 22-25.

Symposium on Wave Propagation and Dynamic Properties of Earth Materials, sponsored by ASCE, Albuquerque, N. Mex., Aug. 23-25.

7th Biennial Gas Dynamics Symposium, sponsored by ARO-D, AEC, ARPA and NASA, Evanston, Ill., Aug. 23-25.

18th Annual American Institute of Biological Sciences Meetings, College Station, Tex., Aug. 27-Sept. 1.

3rd International Symposium on Organometallic Chemicals, sponsored by ARO-D and others, Munich, Germany, Aug. 28-Sept. 1.

24th Conference of the International Union of Pure and Applied Chemistry, Prague, Czechoslovakia, Aug. 28-Sept. 3.

Conference on High Frequency Generation and Amplification, sponsored by IEEE, ONR and Cornell School of Electrical Engineering, Ithaca, N.Y., Aug. 29-31.

Semi-International Symposium on Mechanical Engineering, Tokyo, Japan, Sept. 4-8.

21st International Congress of Pure and Applied Chemistry, Prague, Czechoslovakia, Sept. 4-10.

Solid State Devices Conference, sponsored by U.K. and Republic of Ireland Section of IEEE, Manchester, England, Sept. 5-8.

22th Annual Symposium on Molecular Structure and Spectroscopy, Columbus, Ohio, Sept. 5-9.

International Hydrology Symposium, sponsored by the International Association of Scientific Hydrology and the American Geophysical Union, Fort Collins, Colo., Sept. 6-8.

International Conference on II-VI Semiconducting Compounds, sponsored by the American Physical Society, Providence, R.I., Sept. 6-8.

ASTM, IES, AIAA National Technical Meeting on Space Simulation, Philadelphia, Pa., Sept. 11-13.

12th Congress of the International Association for Hydraulic Research, Fort Collins, Colo., Sept. 11-14.

6th International Conference on High Energy Accelerators, sponsored by the International Union of Pure and Applied Physics, Cambridge, Mass., Sept. 11-15.

International Symposium on Information Theory, sponsored by AFOSR, IEEE and IRSU, Athens, Greece, Sept. 11-15.

International Congress on Magnetism, sponsored by OAR, AFCRL, AEC, NSF and ONR, Boston-Cambridge, Mass., Sept. 11-16.

Conference on Chemical Vapor Deposition of Refractory Metals, Alloys and Compounds, sponsored by the American Nuclear Society and the Metallurgical Society of AIME, Gatlinburg, Tenn., Sept. 12-13.

International Symposium on Materials—Key to Effective Use of the Sea, sponsored by the Polytechnic Institute of Brooklyn and the Naval Applied Science Laboratory, N.Y.C., Sept. 12-14.

3rd International Symposium on High Temperature Technology, sponsored by SRI, Asilomar, Calif., Sept. 17-20.

Joint Power Generation Conference, sponsored by IEEE and ASME, Detroit, Mich., Sept. 24-28.

International Electronics Conference and Exposition, sponsored by IEEE, Toronto, Canada, Sept. 25-27.

Conference on Magnetic Materials and Their Application, sponsored by the U.K. and Republic of Ireland Sect., IEEE, Institute of Physics and The Physical Society, London, England, Sept. 26-28.

16th Defense Conference on Nondestructive Testing, sponsored by NRL, White Oak, Md., Sept. 26-28.

5th Annual R&D Management Program, sponsored by Ohio University and Battelle Memorial Institute, Athens, Ohio, Sept. 24-Oct. 6.

14th General Assembly of the International Union of Geodesy and Geophysics, Zurich, Switzerland, Sept. 25-Oct. 7.

4th International Conference on Atmospheric and Space Electricity, sponsored by the AFCRL, Army, Navy, NSF and NASA, Lucerne, Switzerland, Sept. 29-Oct. 6.

Report Presents DoD Labs Statistics

One of the most comprehensively informative of the 29 documents published to date by the Office of Laboratory Management, Office of the Director of Defense Research and Engineering, is a recently distributed statistical summary of defense labs.

"Department of Defense In-House RDT&E (Research, Development, Test and Evaluation) Activities" is a 142-page report compiled by Evan Anderson. He is staff assistant to Edward M. Glass, Assistant Director (Laboratory Management) under Dr. Donald M. MacArthur, Deputy Director of Defense Research and Engineering (Research and Technology).

Scheduled to be updated annually, the report is an unclassified version of an earlier classified document bearing the same title. It describes "organizational entities," 25 percent or more of whose work is in any or all phases of RDT&E. Statistics are given for 61 Army labs, 44 Navy and 27 Air Force, a total of 132.

Representative of the detailed type of data contained in the report, for example, is the following: Total annual (FY 1966) laboratory program, $3,396,395,000; total in-house program, $2,083,109,000; total RDT&E program, $2,647,225,000; total in-house RDT&E, $1,458,498,000.

Relative to personnel, the report shows 37,050 military assigned to DoD in-house RDT&E laboratories, with 6,262 classified as professionals and 469 with PhD degrees. The total civilian staff is listed at 94,591, including 31,022 professionals and 1,936 with PhD degrees.

DoD in-house RDT&E labs in FY 1966 were housed on facilities covering 4,212,499 acres with 105,477,617 square feet of floor space. Real property was valued at $2,939,799,000 and equipment at $3,073,583,000.

By studying just five pages of the report, anyone interested can gain statistics on all Army, Navy and Air Force in-house RDT&E labs with respect to funding data, the number of military and civilian employes in each lab, and the breakout of military and civilian employes in each lab, and the percentage of military and civilian professionals with PhD degrees; also, acreage covered by facilities (where pertinent), floor space, value of real property, and value of equipment.

Information on each laboratory includes its mission, past significant accomplishments, current efforts, and planned responsibilities on future military problems and the mailing address.

Selected data from the report appears in shortened form in a separate 7-page management analysis note, "Department of Defense In-House R&D Laboratories" (MAN 66-2), also published by the OLM. The shorter report covers only budgetary, personnel and property data for research and development laboratories.

A third recent ODDR&E publication, "Index of Management Analysis Memoranda, Note, and Reports" (MAM 67-2), by Maxine H. Weyandt, lists titles, dates, and DDC accession numbers for the 29 studies and reports the OLM and its predecessor have published since 1964.

'Dragon' Components Pass Launch Environment Tests

The U.S. Army's recently renamed "Dragon" antitank weapon passed evaluation tests of subsystem components in a launch environment at the Eastern Test Range, Cape Kennedy, Fla.

Component testing, which involved an unguided round, was conducted in June by McDonnell-Douglas Corp., prime contractor for the shoulder-fired tank destroyer. Advanced live warhead testing will be at Redstone (Ala.) Arsenal.

Under development with McDonnell since 1965 as the MAAW system, Dragon is the Army's first missile system to be tested at the Cape since firings of the long-range Pershing terminated in 1964.

Designed to replace the 90mm recoilless rifle at the platoon level, the 27-pound, one-man system is managed by the U.S. Army Missile Command, Redstone Arsenal. Lt Col John Boyes is manager.

White Succeeds Hansen as MUCOM CG

Promotion of Maj Gen Frank G. White to that rank came simultaneously with assumption of command of the U.S. Army Munitions Command (MUCOM), Dover, N.J., June 1. He succeeded Maj Gen Floyd A. Hansen, MUCOM CG for 4½ years, whose retirement ended more than 35 years of service.

General Frank S. Besson Jr., CG of the U.S. Army Materiel Command, and Lt Gen William D. Bunker, his deputy, were among dignitaries present for award of the Distinguished Service Medal to General Hansen.

Maj Gen White served three years as assistant chief of staff, Logistics, Commander-in-Chief, Pacific Command, prior to assignment to MUCOM. He was deputy executive director, Procurement and Production, Defense Supply Agency, Washington, D.C., from 1962 to June 1964.

Graduated from the University of Oklahoma in 1937 with a BS degree and from Harvard University in 1950 with a master's degree in business administration, General White began his military career in July 1937 as a Reservist with the 1st Field Artillery at Fort Sill, Okla.

From 1950 to 1956, he served with the Office of the Chief of Ordnance in Washington, D.C., then attended the National War College at Fort McNair, from which he graduated in 1957.

His later assignments include deputy and ordnance officer, Eighth U.S. Army in Korea (1957-58); deputy and president of the U.S. Army Maintenance Board, Fort Knox, Ky. (1958-60); and commandant of the Army Logistics Management Center, Fort Lee, Va. (1960-62).

Maj Gen Frank G. White

CONGRATULATORY HANDSHAKES with four new members of the U.S. Army Munitions Command Advisory Board were among last duties of Maj Gen Floyd A. Hansen prior to retirement from the Army. The new members (from left) are Dr. Robert G. Shreffler, Los Alamos Scientific Laboratory, University of California, Los Alamos, N. Mex.; Dr. Moshe F. Rubenstein, associate professor of engineering, University of California, Los Angeles; Dr. Alan S. Tetelman, associate professor, Department of Materials, Sciences and Engineering Mechanics, Stanford Univ. and Dr. J. T. Nolen, product manager, E. I. duPont de Nemours and Co.

ASA (R&D) O'Neal Keynotes Industrial Briefing

Helicopters are doing things in Vietnam today "that only the most visionary of our predecessors would have forecast," in the opinion of Dr. Russell D. O'Neal, Assistant Secretary of the Army for Research and Development.

Dr. O'Neal gave the keynote address to some 700 aerospace specialists at the second annual Advanced Planning Briefing for Industry in St. Louis, June 20-21.

Sponsored by the U.S. Army Aviation Materiel Command (AVCOM) and the Army Aviation Association of America (AAAA), the 2-day meeting was classified secret except for the lucheon at which he spoke.

Participants included 20 representatives from Canada, 9 from the United Kingdom Ministry of Defense and 80 from the U.S. Department of Defense.

Director of Army Aviation Maj Gen Robert R. Williams and Maj Gen William B. Latta, CG of the U.S. Army Electronics Command, headed the list of general officers and some 20 military and civilian experts who gave presentations.

Brig Gen John R. Guthrie, Director of Developments, Office of the Chief of Research and Development, outlined the purpose of the briefings for industry at an early session. Retired Brig Gen Glenn Goodhand, AAAA president, introduced AVCOM Commander Col Delbert L. Bristol, who welcomed the conferees.

"When the Bell H-40 was on the drawing board as an aeromedical ambulance in the 1950s," Dr. O'Neal said, "who would have thought that it would have blossomed into a primary tactical transport for airmobile operations as well as a fire-support vehicle?"

He cited also the Army's CH-54A Flying Crane, which evolved as a feasible and "most desirable" logistics vehicle during the air mobility evaluation in 1964. "When exposed to the demands and rigors of combat',, he said, "the CH-54A has more than satisfied our investment by the recovery of downed aircraft alone. In addition, in the operational phase, the Crane is doing yeoman service as an aerial mover for medium artillery.

PODIUM PERSONALITIES at industrial briefing in St. Louis included Assistant Secretary of the Army for R&D Dr. Russell D. O'Neal, at far right of composite picture above, and Director of Army Aviation Maj Gen Robert R. Williams, center, left of photo. Others are (counterclockwise, from top of photo) Maj Gen William B. Latta, Brig Gen Roy L. Atteberry, Brig Gen Howard F. Schiltz, Brig Gen William M. Mantz, Col Leonard M. Orman, Lawrence Hewin and Col L. G. Callahan Jr.

MICOM Briefs 230 Companies On Missile Plans for Future

Invited industrial executives from more than 230 companies attended classified briefings on Army missile blans for the future June 12, 14 and 16 at the U.S. Missile Command (MICOM), Redstone Arsenal, Ala.

MICOM Commander Maj Gen John G. Zierdt welcomed approximately 500 guests from missile-related industry, Army and Department of Defense agencies. John L. McDaniel, technical director of the MICOM Research and Development Directorate, moderated the program.

Dr. O'Neal said he could go further and establish parallel cases with other aircraft. "The point I wish to make," he stressed, "is simply that we should not allow our thoughts to stagnate and get tunnel vision as we concentrate on new aircraft systems. We need to continually exercise a maximum of imagination."

Emphasizing the importance of the "systems approach" early in program formulation, Dr. O'Neal said that a truly integrated system will find many items other than airframe or power plant in its critical path.

"Concurrent with the definition of a new requirement by the Army Combat Developments Command today, the development and technical agencies are busily engaged in establishing or forecasting the technology necessary and available to support the requirement." System integration must begin, he said, in this "embryo stage" of the development.

He called the Advanced Aerial Fire Support System (AAFSS) "our first major step" in the systems approach. (The AH-56A Cheyenne, a new type of fast armed helicopter, was unveiled May 3 and flight testing is scheduled soon.)

Cross fertilization of thoughts and technological advance between the military and industry can lead not only to increased performance to accomplish our known missions, Dr. O'Neal said, but to "grant us increased capabilities to perform missions above and beyond today's tactics, doctrine and techniques."

He cited night operations as a typical goal. With the advent of night vision equipment, he said the Army should develop the capability to conduct all phases of combat operations at night with effectiveness "approaching that of daylight operations."

If we can achieve this capability with our ground and aerial vehicles, he said, we in effect "will be doubling our combat power while decreasing our own vulnerability to enemy actions." Feasibility of night-vision devices — such as infrared equipment and low light level television — is becoming a reality, he said, and "the true integration and application will be accomplished at a quickening pace."

Dr. O'Neal discussed the importance of designing into weapons systems such environmental suitability as armor protection, infrared suppression and maintainability, and reliability "when the castings are made, not after the components are installed."

He emphasized the maintenance function as "critical to sustained combat operations" but said he did not believe that greater sophistication in systems means poor reliability and poor maintainability. "The opposite can and must be the case," he said.

"Because of the basic tenet of Army aviation," he elaborated, "that organic aircraft are located at the user level, immediately available and fully responsive, it is essential that maintenance and ground-support equipment be functional in nature, dependable, simple to operate and common to all Army aircraft systems

wherever possible." He said the dust, heat and humidity of Vietnam have emphasized the importance of maintenance.

Achievements of Army Aviation in the past 25 years are self-evident, he continued, adding that these accomplishments have been made possible only through the collective efforts of an unmatched industrial capacity and a forward-looking Army which operates the equipment.

"Army's Aviation Perspective" was presented by General Williams, who later chaired a panel discussion on fire-support systems. General Latta spoke on "Electronics and Air Mobility."

Presentations of other general officers included: Brig Gen Howard F. Schiltz, special assistant to the Army Materiel Command (AMC) Deputy CG Lt Gen William B. Bunker, "Army Aviation Program: FY 68-73"; Brig Gen Roy L. Atteberry, director of doctrine, Combat Developments Command (CDC), "The Army of the 70s and 80s"; and Brig Gen William M. Mantz, CG U.S. Army Natick (Mass.) Laboratories, "Aerial Delivery Systems and Aircraft Crew Protection System."

Col R. K. Cunningham, chief, CDC Air Support Branch, assisted in General Atteberry's address. Additional presentations in order of position on the agenda included: Col Leonard M. Orman, Army Weapons Command (AWC) R&D Directorate, "Fire Support Systems;" Lawrence Hewin, AVCOM director, "Airframe and Power Plant Technology and Integral Design for Protective System."

Army Electronics Command (ECOM) representatives included Col J. L. Burke, special assistant for avionics to the CG, who discussed "Aviation Electronics Outlook"; Col L. G. Callahan Jr., director of Avionics Laboratories, "Avionics Airborne and Ground Systems"; Dr. Robert Wiseman, director of Surveillance, Night Vision and Target Acquisition Laboratories, "Manned Airborne Combat Surveillance and Target Acquisition Systems"; and Col L. W. Pflanz Jr., chief, Electronic Warfare/Meteorology Commodity Management Office, "Electronic Warfare Systems."

Col John A. Dibble Jr., Office of the Director of Army Aviation, spoke on "Lessons Learned — RVN." Col Gustave A. Peyer, Commander of the CDC Transportation Agency and Christmas Malami, materiel project officer, collaborated to present "Aviation Logistic Support Operations."

Col James O. Townsend, director of instruction, Army Aviation School, discussed "Aircraft Training Mission." Lt Col Charles Peterson, CDC Experimentation Command, spoke on "Determining Aircraft Survival Probabilities," assisted by Richard W. Ferris, Litton Scientific Support Laboratory, Fort Ord, Calif.

Col Warren R. Williams, director, U.S. Army Board for Aviation Accident Research, gave his views on "Human Engineering and Safety." Lt Col Roland H. Shamburek, Medical Corps, chief of the Aviation Branch, Office of the Surgeon General, presented "Medical Evacuation."

WECOM Builds Own 'University' in 10 Years

Increasing interest in a continuing education program for scientists, engineers and technicians at HQ U. S. Army Weapons Command (AWC) and Rock Island (Ill.) Arsenal has resulted in a homegrown "university."

The "University of Army Weapons Command," which is now in its tenth year of using on-post facilities, now has a "faculty" of six, including three Army officers with doctoral degrees, a civilian employe of the Arsenal and two voluntary PhDs from the Rock Island area.

Approximately 100 students enroll each semester in the non-credit courses held during off-duty hours. AWC opens the courses to qualified persons in the Quad-City (Rock Island, Moline and East Moline, Ill., and Davenport, Iowa) metropolitan area.

Charged with the management of research, design, development, procurement and worldwide logistic support of nearly all Army weapons except missiles, AWC has found the continuing education program an important adjunct to keep employes up to date on latest developments.

A second program of graduate courses for credits is conducted on Arsenal Island under auspices of the Quad-Cities Technical Advisory Council, Inc. (QCTAC), a nonprofit organization fostering advanced education. QCTAC is sponsored by AWC and local industry in cooperation with educational institutions in neighboring communities.

During the past semester, the Council scheduled eight graduate credit courses. They included "Foundations of Structures," "Seminar in Advanced Mechanics," "Production Management," "Legal Environment of Industry and Unions," "Managerial Economic Theory." "Quantitative Methods in Business and Economics," "Complex Variables," and "Boolean Algebra with Application of Computer Circuits."

Another innovation during the 1966-1967 scholastic year was Holiday Seminars, which were scheduled during university holiday periods. Instructors were from the faculty of the University of Iowa.

Noncredit, off-duty courses in the current program include:

- "Review of Organic Chemistry," conducted by Capt Robert Frame, who holds a PhD degree from Northwestern University. He is assigned to the Office of the AWC Deputy for Research and Engineering.
- "Introduction to Ordinary Differential Equations" is instructed by 1Lt Edward J. Haug Jr, head of the Mechanical Engineering Section, Research and Engineering Division, Rock Island Arsenal. He holds a PhD degree from Kansas State University.
- "Fluidics," a subject of rapidly rising interest, is conducted by 1Lt R. Thomas Perry, who earned a PhD from the University of Minnesota. Lt Perry is in charge of the Chemical Engineering Section of the Arsenal's Research and Engineering Division.
- "Industrial Design Methods and Practices" is instructed by Alan Galbavy of the Development Branch, Arsenal R&D Division. Galbavy has a baccalaureate degree in Industrial Design from Pratt Institute.
- "Introduction to Laser Science and Technology" is taught by Dr. Robert Frank, head of the Physics Department, Augustana College, Rock Island.
- "Review of Engineering Mathematics" is instructed by Dr. Carl Julian, manager of the Applied Sciences Department, Engineering Research Division, Deer and Co., Rock Island.

Col Sherwood Heads Security Agency Research & Development

Three years of progressively responsible assignments with HQ U.S. Army Security Agency (USASA) reached a high point for Col Robert Sherwood with his recent selection as USASA deputy chief of staff for research and development.

Col Sherwood has served at HQ USASA, Arlington Hall Station, Va., as acting chief, Management and Control Division, then as assistant chief of staff and later deputy for Developments, and recently as commanding officer, Combat Developments Activity.

Prior to assignment to HQ USASA, he was chief, Operations Division, Office of the USASA Operational Control Officer, Fort Meade, Md. From 1953-57, he was assistant S-3, USASA, Far East, followed by a tour of duty as operations officer, 9th USASA Field Stations in the Philippines until 1958. He was chief, Career Field Monitor Section, G-1, HQ USASA, and then chief, Management Branch, Comptroller, HQ USASA from 1952-54.

Col Sherwood attended Bloomsburg (Pa.) State Teachers College (1939-40). Commissioned in the Signal Corps in 1942, he then went on to earn AB and MA degrees from Syracuse University (1946-48). He also graduated from the USASA Advanced Course in 1955 and the U.S. Army Command and General Staff College in 1959.

Col Robert Sherwood

Giant EMCO Camera Shoots Microphotos of Drawings

Microminiaturized photographs of large drawings of electronic circuits are being produced with a new 5½-ton special purpose camera at HQ U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J.

The giant camera has been set up in a new scientific studio. Because a speck of dust would blur the fine details of circuitry on the tiny photographs, a filtering system screens out foreign particles as small as 20-millionths of an inch. Technicians put on lint-free smocks, caps, gloves, and shoe covers before going through a special entry to ultraclean rooms.

The main piece of equipment is a Borrowdale Microminiaturization Camera, 7½ feet high and 32 feet long. Drawings on large plastic sheets are moved back and forth along an overhead railway as the camera is focused with the help of a microscope.

Located in the Hexagon Building, the clean-room facility was built to consolidate and improve accommodations serving ECOM's Electronic Components Laboratory and other activities engaged in advanced research on microsize devices, such as integrated thin-film and thick-film circuits.

Production of the photos of the mite-size electronic devices is a precise job, on which researchers and draftsmen use a number of plastic sheets to lay out the various parts to a scale several hundred times oversize. A page-size multiple-image is made from each drawing to obtain a reduction which can be up to 100 to 1.

In the next phase, the same layout is photographed more than 100 times side by side to form a multiple pattern on the single negative. This is repeated with each drawing.

These first negatives, each imprinted with its own grid of identical miniature pictures, are still much too large. To get the final size reduction, each multiple picture is put on the focusing easel and rephotographed on high-resolution, photo sensitized glass plates to reduce the design to extremely sharp micro-size images.

The result reduces each original giant partial layout of the circuit to a photo the size of a trade stamp, containing the same multiple array of the first negatives.

To make the actual circuitry, each of the trade-stamp-size negatives is used to expose the circuit patterns on a "doped" silicon wafer. The wafer undergoes an etching process similar to, but necessarily more refined than, that used to make engravings of ordinary photographs for publication.

The etching operations are followed by plating and vapor deposits of electronic materials and re-etchings as necessary. The complete sequence of steps forms hundreds of tiny electronic circuits simultaneously.

The wafer, however, is not the end. Its gridded-circuit segments are cut into identical chips, each of which now has the microminiaturized circuit layouts meshed together to form working electronic devices.

Smaller than an infant's fingernail, each tiny chip has its own complete combination of circuit elements and interconnections to perform its electronic function in radios, computers and dozens of kinds of advanced electronic equipment.

As indicated by their name, such integrated-circuit chips can do the work of as many as several dozen wire-connected vacumm tubes or separate transistors. Size and weight reductions are not the only advantages. Microcircuitry is proving to be more reliable, uses much less power, and is becoming more economical.

Picatinny Pumps Ruby Laser With Chemical Detonation

Nondestructive pumping of a ruby laser by detonating a chemical combination has produced brightness temperatures up to 8,000° Kelvin in experiments by scientists at Picatinny Arsenal, Dover, N.J.

Energy is obtained by a cyanogen-oxygen (52 to 48 percent ratio) reaction with inert dopants of argon or xenon, in a specially designed cylindrical cavity. The ruby rod is bathed in intense light without destruction of the crystal, according to physicist Chester L. Smith of the Picatinny Feltman Research Labs.

Assisting Smith in development of the first reported chemical detonation in laser technology were Eugene Homentowski, electronics engineer, and physicists Paul Kisatsky and John Wright. Experiments were conducted at Temple University, Philadelphia, Pa., by Charles Stokes of Temple Research Institute.

The laser pump has achieved one-to 3-millisecond brightness temperature peaks ranging from 6,000° to 8,000° K. Preliminary experiments have indicated that the system may produce temperatures above the 8,000° value for briefer periods.

Prime importance has been placed on the design of the pumping vehicle which produces a cylindrically imploding detonation wave of extreme brightness for a relatively long period close to the ruby rod.

The cyanogen-oxygen combination produces a stable mixture with a flame temperature of 4,850° K. that is "optically thin." Proportions were varied to raise brightness to the desired peak.

PICATINNY physicist Chester L. Smith points to position of laser in specially designed vehicle used in nondestructive pumping experiments.

15th Signal Detachment Uses Miniature 'Card' Circuits

Miniature printed-circuit boards — small enough to hold in the palm of the hand — are replacing bulky tube circuitry of the Hawaiian air defense network of radars, computers and decoding equipment.

The advent of the "playing cards" is said to be making life a bit easier for soldiers of the Army's 15th Signal Detachment at Schofield Barracks who man the system.

With the help of a testing device, technicians can quickly spot the defective portion of an electronic package and easily replace the faulty transistor, resistor or other component.

To speed maintenance of equipment even more, the 15th has a repair shop on wheels. The van has a supply of cards and tests equipment readily available to the operations center, tracking stations and decoder groups.

Threefold advantages of the miniaturized card system are listed by maintenance men of the 15th Signal Detachment as repair speed, economy, and mobility. Changing a card to reactivate an electronic unit takes less time than needed to remove one bolt of older systems, a supply sergeant reports. Card components cost only a few cents compared with several dollars for bulkier items.

COMPARATIVE SIZE of printed card circuits and conventional electronic circuitry is shown by SFC William R. Nelson, 15th Signal Detachment.

AVLABS Computer Program Aids VTOL Development

By William F. Tinsley
Operations Research Analyst
Preliminary Design Division
U.S. Army Aviation Materiel Laboratories
Fort Eustis, Va.

How can you predict the cost of an Army vertical-lift aircraft to be built 10 years hence — when you don't even know what the aircraft will look like, let alone its size and shape?

This perplexing question — and many more equally difficult — must be answered by U.S. Army Aviation Materiel Laboratories engineers and scientists to enable them to carry out successfully our mission of planning today for an aircraft that will take off in 1977. Successful aviation research must continually work 10, 15, or 20 years ahead.

One of the major phases is the planning of the preliminary aircraft design — working for a generation ahead which is literally flooded with unknowns. The trick is to find short cuts that effectively and quickly cancel out those designs with the least promise for success, so that time can be devoted to the development of those that do have potential.

AVCOM researchers believe they have uncovered one of those effective short cuts by employing the computer. About six months ago, AVLABS became the first Army unit to computerize a program for determining relative cost-effectiveness during preliminary design stages of advanced types of vertical-life aircraft.

The program is new, and it is far from perfected, but very encouraging results are being obtained. Use of the computer in the preliminary design stages enables determination of cost-effectiveness early in the game and permits quick answers to the "what if" type questions.

What happens to cost if speed is increased by 10 knots? Suppose gross weight is increased by a thousand pounds to provide more cargo space? How does a design show up on a series of short missions versus a fewer number of long ones when compared to a competing design? These are the kinds of questions that crop up in seeking design optimization.

Once these questions are answered, designers can concentrate on the more promising approaches and drop those with less potential. In other words, we now have a guide. We know where to place our biggest efforts.

Research dollars are always scarce when we are looking at hundreds of design points, any one of which could conceivably involve a mission of critical importance to the Army. It is essential that program planners know as early in the game as possible which design approach shows promise of offering the most in performance for the money spent.

Program planners, when given some firm idea of this best potential design, can concentrate efforts to achieve a considerable saving in manpower, money, and that most critical of all elements — time. To attempt cost-effectiveness studies in the preliminary design stages, it was found, was not practical before the start of the computer program.

Usually this is not attempted until much later in the research cycle, mainly because empirical data for input is virtually nonexistent. This places heavy reliance upon cost estimating relationships (CERs) to furnish meat for the bare bones of the model. Some of ours are good and some are not so good, but we are beginning to get some very encouraging results.

Some of the factors we consider are maintenance requirements as a function of weight, engine weight as a function of horsepower, ratio of maintenance parts to maintenance labor, and labor requirements versity complexity interaction. New CERs are constantly being tried out, but the confidence level is often too low to justify their use.

UNIQUE PROBLEMS. Cost effectiveness problems at this stage are unique because design must involve a whole series of mission profiles, concerned with varying size and performance characteristics. A number of different conceptual design approaches must be considered. This results in from several dozen to as many as several hundred design points, each of which is essentially a different aircraft.

Because the final desired result is optimized design for the series of missions, compromises must be made in the form of performance trade-off. During the very early stages of design, this places considerable importance on cost, cost-effectiveness and sensitivity analysis in narrowing the choices.

Information based on past experience is generally nonexistent at this time. As many as several hundred analyses may be necessary and requirements do not permit using a sophisticated or time-consuming approach.

Aeronautical engineers working with the unique aspects of advanced vertical-lift military aircraft design are concerned with concepts years ahead of the present. About the only things they can count on are predictable aerodynamic principles.

Aspects of the AVLABS program that make it unusual are its simplicity and adaptability to the many different concepts which are advanced for making a military aircraft go straight up-and-down.

Changes can be made rapidly in the mathematical computer model which simulates these changes in real-life size, weight, horsepower, speed, range, complexity and other variables, all of which affect research costs and final acquisition cost of the aircraft.

Our cost effectiveness program still has a long way to go for full effectiveness, but we are constantly refining and expanding it. There is no magic formula yet for determining what a highly complicated mechanism is going to cost and do 10 years from now. Exact shape and structure are still largely conjectural. About the best we can hope to do is achieve fairly accurate results from a comparative standpoint.

The cost side of the AVLABS program is already fairly comprehensive and complete. The simulation model and formulas are flexible. We can insert as much as or little detail breakdown of data as desired, according to what is available, without affecting the validity of the simulation.

A great advantage is to be able to enter the model at various levels and still have it work, because that is the way input date are obtained. Sometimes costs can be broken down in great detail, and sometimes all we can do is look into the crystal ball and make a calculated guess.

The effectiveness side of the AVLABS computer program still needs lots of developing. So far it only gauges productivity as a measure of effectiveness. The answer comes out as dollar cost per ton-mile or person-mile.

Many more ways of measuring the effectiveness of a military vehicle all are based upon what it is supposed to do. Some day, I hope to have all of the important ones in our computer program, but developing simulation models, testing them and finding the errors is a slow process.

My enthusiasm is centered on the fact that use of the computer enables us to do things we formerly would not even attempt. Cost-effectiveness in the preliminary design stage previously was made by intuition more than by analysis.

Simply by turning to the computer at AVLABS, we are getting the right answeres quicker. In effect, we are using a rifle instead of a shotgun. We can go through a dozen preliminary designs now in a fraction of the time it took under the old system.

Eventually, this means that AVLABS may be able to come up with the best possible design in the quickest possible time. Savings in cost and man-hours — not to mention the greatly increased accuracy of design selection — is certain to be reflected in a better and more quickly produced military vertical-lift aircraft.

Army RDT&E, Procurement Contracts Exceed $705 Million

Army contracts exceeding $1 million each for research, development, test, evaluation and procurement since reported in the previous issue of this publication through June 19 total $705,075,621.

Kaiser Jeep Corp. received $43,734,654 for the third increment of a 3-year contract for 5-ton trucks. Bell Helicopter Co. received three contracts and a modification totaling $38,987,859 for helicopters, rotary wing blades, quill assemblies and crash-damage kits.

Contracts with the Chrysler Corp. for engineering services and trucks totaled $38,899,390, including an $8,351,616 first increment to a $21,467,936 2-year contract for forklift trucks.

Six contracts with the Continental Motors Corp. will procure engines for tanks and trucks for $35,266,581. This includes a $10,313,235 third increment to a 3-year contract and an $8,483,358 second-year increment to a $19,319,853 contract.

AVCO Corp. is receiving $25,714,383 in contracts and modifications for helicopter engines. Day and Zimmerman, Inc., will load, assemble, and pack medium caliber ammunition components on two modifications totaling $24,481, 355. Southern Airways of Texas received a $23,041,998 modification for helicopter pilot training and maintenance of aircraft.

Six contracts totaling $22,220,574 with General Electric Co. will procure vehicle-mounted radar sets, aircraft machine-guns, a van-mounted digital computer for war games field experimentation, and self-propelled antiaircraft artillery weapons system. U.S. Rubber Co. was awarded a $21,890,855 modification for manufacturing explosives and loading ammunition.

Metal parts and cartridge cases for 105mm smoke projectiles will be supplied by the Chamberlain Manufacturing Corp. for $16,579,370. Harvey Aluminum Sales, Inc., will provide metal projectile parts and ammunition for $16,191,466. The A. O. Smith Corp. will supply metal bomb parts for $15,221,731.

LTV Aerospace Corp. will receive $14,023,198 for research and development and ground support equipment for the Lance missile system. Modifications totaling $13,936,452 will procure bombs and medium-caliber ammunition from Mason and Hangar, Silas Mason and Co.

General Dynamics Corp. received modifications totaling $13,734,480 for radio sets, transmitters and other communications equipment. General Motors Corp. gained contracts and modifications totaling $12,569,134 for projectile parts, parts, trucks, transmissions and diesel engines for self-propelled guns, howitzers and recovery vehicles.

White Motor Corp. was awarded contracts totaling $11,061,984 for trucks and engineering services. United Aircraft Corp. will furnish engines, rotary wings and transmission assemblies for CH-54A helicopters for $10,732,789.

General Time Corp. will supply fuzes for mortars and illuminating shells for $10,615,840, and Atlas Chemical Industries, Inc., will furnish TNT for $10,409, 525. Contracts totaling $10,355,503 with Honeywell, Inc., will procure bomb fuzes and dispensers and microwave relay components.

Blade assemblies for helicopters will be supplied by the Boeing Co. for $9,607, 000. Raytheon Co. received four contracts totaling $9,581,773 for bomb fuzes, advanced development of the SAM-D missile program, and ground support and maintenance equipment for the Hawk missile system.

Contracts totaling $9,536,201 with Bowen-McLaughlin-York, Inc., will procure guns, howitzers, recovery vehicles, drive assemblies for guns and howitzers, and retrofit of M48A3 tanks. Emerson Electric Co. will furnish helicopter armament subsystems for $8,727,500.

For $8,499,684, Radio Corp. of America will supply tactical satellite communication terminals, portable man-pack radio sets, and other electronic equipment.

Hercules Engine Corp. will provide truck engine assemblies for $7,879,067. The Sperry Rand Corp. received contracts totaling $6,845,163 for aircraft compasses, Sergeant missile engineering services for FY 1968, and ammunition. Harnischfeger Corp. received a $6,787,338 contract for cranes and shovels.

The Thiokol Chemical Corp. received a $6,380,011 modification for ordnance. The Grumman Aircraft Engineering Corp. will modernize OV-1B and OV-1C aircraft for $5,982,500, and the Martin Marietta Corp. will furnish Shillelagh missiles on a $5,818,578 modification.

The Holston Defense Corp. of Eastman Kodak Co. will receive $5,750,296 for propellant and explosives. The FMC Corp. will supply 105mm projectiles, and retrofit and reinspect armored recovery vehicles for modifications totaling $5,733,710. Mack Trucks won a $5,434, 800 contract for axle assemblies for 10-ton trucks.

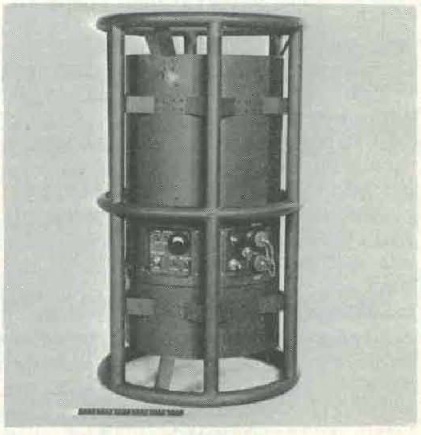
The Collins Radio Co. will supply avionic kits for UH-1 helicopters, and

ECOM Tests Silent Thermoelectric Generator

Performance, endurance and environmental tests of a silent 25-pound thermoelectric generator that uses gasoline and other liquid hydrocarbon fuels to convert heat directly into electricity are being conducted by the U.S. Army Electronics Command (ECOM).

Designed for use as a vehicle-mounted battery charger, the generator is being tested in the Power Sources Division of the ECOM Electronic Components Laboratory at Fort Monmouth, N.J. Developmental work is being done jointly by ECOM and the Rome Air Development Center, Griffiss AFB, N.Y.

Silent operation of the thermoelectric generator is of particular value to ground forces during certain tactical situations. Ordinarily, the engine of a vehicle has to be operated to recharge electronic equipment linked to its battery during stationary operations.



Thermoelectric Generator

The generator is 23 inches high, 13 inches in diameter, and can produce 300-watt, 28-volt direct current. It operates on ordinary gas, No. 2 fuel oil, and a variety of other hydrocarbon liquids with little difference in performance.

Semiconductor elements are heated by the combustion products of the fuel and air to a temperature of 1,100° F. Forced air cooling of the finned heat exchangers keep the ends of the elements furthest from the combustion chamber heat transfer surface at a temperature of 250° F. This temperature difference produces a flow of electrical current in the elements.

The basic principle underlying the ultrasonic burner involves atomization of liquid fuels by vibrating a thin film of fuel. The fuel flows over the surface of a transducer vibrating at 65 kHz.

This vibration causes a wave pattern in the fuel over the entire surface area. With sufficient amplitude, these waves throw off droplets from their crests. The droplet size is a function of the atomizer frequency and fuel density, viscosity and surface tension. Active elements of the atomizer are two piezoelectric disks of lead-zirconate-titanate material. The generator has an overall efficiency of 3.5 percent (net electrical output divided by the heat content of the fuel).

The generator was produced under government contract by Minnesota Mining and Manufacturing Co. ECOM project engineer for development is Joseph P. Angello, and Frank J. Mollura is project engineer for the Air Force.

modification kits for communication sets for $5,363,239. The International Business Machines Corp. won a $5,036,261 contract for five automatic data processing subsystems. Bucyrus Erie Co. received a $4,876,349 contract for 12½-ton crane shovels.

Shipping and storage cartridge containers and electronic equipment will be bought from Lear Siegler, Inc., for $4,387,038. The Anthony Co. received a $4,249,872 first-year increment of a 2-year $10,926,271 contract, for forklift trucks.

Three contracts totaling $3,815,224 with the Lockheed Aircraft Corp. will provide equipment and services in connection with underground nuclear testing at the Nevada Test Site. The Atlantic Research Corp. received a $3,699,000 contract for mines.

Eaton, Yale and Towne Manufacturing Co. won a $3,636,780 contract for diesel engine scoop loaders. Southwest Truck Body Co. will furnish semitrailer repair parts for $3,467,800 and Midvale-Heppenstall Co. will receive $3,452,200 for tube forgings for 175mm guns.

Scovill Manufacturing Co. will supply grenade fuzes and metal parts for $3,423,272. A $3,412,866 modification with the Bulova Watch Co. will procure ammunition fuzes. Highland Industries, Inc., received a $3,383,072 first-year increment to a $6,989,505 2-year contract for truck-mounted liquid-dispensing units.

Muncie Gear Works, Inc., gained a $3,329,299 contract for rocket fin and nozzle assemblies. Norris Industries, Inc., will furnish projectiles and cartridge cases for $3,309,194. Cummins Engine Co. will receive $3,277,074 for diesel engine assemblies for 10-ton trucks.

Kanarr Corp. will supply 40mm grenade launchers on a $3,252,506 modification and Dynamics Corp. of America modifications totaling $3,241,274 are for 60-cycle generator sets. A $3,233,808 contract with Standard Products Co. will procure rubber track shoe assemblies for M13 personnel carriers.

E. I. duPont de Nemours and Co., Inc., won a $3,157,000 contract for the design and development of an ammunition facility at the Kansas Ammunition Plant, Parsons, Kans. Intercontinental Manufacturing Co. received a $3,027,970 first-year increment to a $9,211,563 3-year contract for cases and adapters for Nike Hercules motors. Varo, Inc., received a $3,000,000 modification for image-intensifier assemblies.

A $2,977,779 modification with Cutler-Hammer, Inc., will procure radar sets, battery chargers and test facility kits for lightweight miniaturized combat surveillance radar sets. Colt's, Inc., will supply M16 rifles for $2,943,592 and the System Development Corp. will get $2,835,350 for advanced development work on a prototype data management system.

Eidal International Division of S. W. Factory, Inc., won a $2,731,831 contract for trailer-mounted laundry units and Z. D. Products will supply ordnance components for $2,551,648.

A $2,459,175 first-year increment to a $10,904,460 contract with Litton Systems, Inc., will buy data converter coordinated air defense systems. Canadian Commercial Corp. received a $2,266,046 modification for aircraft engines.

Ford Motor Co. will supply tractor trucks for $2,261,176, and two contracts totaling $2,237,369 with Caterpillar Tractor Co. will buy 41 tractors.

TEMCO, Inc., won a $2,074,500 contract for 106mm projectiles. Whirlpool Corp. was awarded a $2,059,693 modification for 105mm projectiles and Kisco Co., Inc., gained a $2,049,494 modification for 105mm cartridge cases.

Other contracts and modifications are: Western Electric Co., Inc., $1,986,360 for R&D on the Nike-X antiballistic missile system; Westclox Division of General Time Corp., $1,927,893 for projectile fuzes; Brunswick Corp., $1,898,657 for 35mm cartridge launchers; and

Remington Arms Co., Inc., $1,893,234 for 38mm cartridges; Corning Glass Works, $1,818,887 for ceramic containers for munition dispensing systems on aircraft; Carter Carburetor Division of ACF Industries, Inc., $1,808,930 for metal ammunition parts; Uneco, Inc., $1,768,469 for delay plungers for the M48A3 fuze; and

U.M.C. Industries, Inc., $1,728,000 for loading and assembling 81mm projectiles; Sargent-Fletcher Co., $1,716,965 for spray tanks; Fabricators, Inc., $1,659,170 for 1,385 floodlight sets; General Precision, Inc., $1,651,425 for design and development of a prototype liquid propellant rocket motor for the 105mm howitzer; Firestone Tire and Rubber Co., $1,634,400 for track shoe assemblies for tanks; and

Infrared Industries, Inc., $1,629,230 for telescopes for signing units in M102 towed howitzers; G. W. Galloway Co., $1,608,418 for containers for Shillelagh missiles; Wells Marine, Inc., $1,606,893 for 20mm projectiles; Electro-Optical Systems, Inc., $1,554,000 for a night-vision program; and

Consolidated Box Co., Inc., $1,544,187 for fiber containers for ammunition; Eureka Williams Co., $1,513,365 for metal parts for bombs; Sylvania Electric Products Co., a $1,500,000 first-year increment to a $2,000,000 3-year contract for electronic equipment; and

Pacific Car and Foundry Co., $1,500,000 for overhaul of M107 vehicles and conversion of M110 vehicles to M107s; Link Belt Speeder Co., Inc., $1,478,805 for self-powered diesel hammers; Union Carbide Corp., $1,462,504 for dry batteries; Maremont Corp., $1,461,747 for 7.62mm machineguns with spare barrel and bipod assemblies; and

Heil Co., $1,458,222 for semitrailer, tank and aircraft fuel servicing; Standard Container, Inc., $1,434,162 for ammunition boxes; Philco-Ford Corp., $1,400,757 for 40mm grenade launchers and barrels; Stewart Warner Corp., $1,274,209 for reciprocating compressors; Zenith Radio Corp., $1,253,385 for 2.75-inch rocket fuzes; and

Bell Aerospace Corp., $1,253,322 for armament subsystems on helicopters; Consolidated Diesel Electric Co., $1,251,100 for 10-ton tractor trucks; Albion Malleable Iron Co., $1,246,800 for metal rocket parts; Strong Electric Corp., $1,215,886 for 70 searchlights; and

American Manufacturing Co., $1,190,000 for metal rocket parts; Stevens Manufacturing Co., $1,140,493 for trailer chassis; M. Sloane Manufacturing Co., $1,117,200 for cotton cleaning swabs packs; MacLeod Co., $1,082,904 for truck-mounted water distributor tanks; and

United Ammunition Container, Inc., $1,077,250 for fiber containers for ammunition; Polan Industries, Inc., $1,072,156 first-increment to a $3,262,898 contract for truck-mounted mine detecting sets; Motor Wheel Corp., $1,057,103 for tires for self-propelled artillery guns; and

Gibbs Manufacturing and Research Corp., $1,047,797 for metal parts for rocket fuzes; Garsite Products, Inc., $1,030,110 for bridge components; Barnes Manufacturing Co., $1,014,117 for gasoline pump assemblies; and

Olin Mathieson Chemical Corp., $1,012,423 for loading and assembling 81mm illuminating projectiles; and Duffers Associates, Inc., a $413,193 first-year increment to a $3,419,613 2-year contract for battery chargers.

Edgewood Arsenal Recognizes 9 Scientists for Tech Papers

Nine Army scientists received cash awards or certificates of achievement for presenting outstanding technical papers during the recent 2-day biennial science conference at Edgewood Arsenal, Md.

First prize went to J. Stanley Melching, research plant pathologist from Fort Detrick, for a paper titled "A Turntable Tower Method for Predictable and Uniform Deposition of Airborne Spores on Paint Surfaces, Glass Slides and Cylindrical Metal Rods."

Second place awards honored Capt James A. Vick and Joseph S. Wiles, Edgewood Arsenal, for "The Mechanism of Action and Treatment of a Natural Toxin" and Dr. Bulusa Suryanarayana, R.Y. Graybush and J. R. Autera, coauthors of "A Study of the Thermal Decomposition of Cyclic Nitramine Explosives."

Honorable mention awards recognized Leonard Zimmerman, microbiologist from Fort Detrick, and Floyd B. Brinkley and Maj Samuel A. Tisdale Jr., biomedical researchers at Edgewood.

Computer Instruction Studied

Feasibility of computer-assisted instruction (CAI) in electronics will be studied by the International Business Machines Corp. on a contract with the U.S. Army Signal Center and School, Fort Monmouth, N.J.

The study will determine for the U.S. Continental Army Command the feasibility of developing and implementing CAI as it applies to basic training.

OCE—AMS—GIMRADA R&D Program

RESEARCH & DEVELOPMENT IN THE CORPS OF ENGINEERS

By Gilford G. Quarles
Chief Scientific Adviser

EDITOR'S NOTE: Five years ago the major reorganization of the Department of the Army merged R&D materiel functions of the seven Technical Services, except for the Corps of Engineers and the Surgeon General, in the newly created U.S. Army Materiel Command. This is the first of a series of feature articles this publication will carry to explain the magnitude and the broad variety of R&D activities in which the Corps is engaged. A similar series on OTSG activities is in progress.

* * *

The Chief of Engineers has a multiple role. First, he has U.S. Army staff responsibility for monitoring all Engineers matters and advising the Chief of Staff and the Secretary of the Army. Second, he has direct operating responsibility for Civil Works, Military Construction, and Mapping and Geodesy. Third, he is charged with a wide range of research and development.

The Civil Works Program includes navigation, flood control and coastal engineering as major areas of effort. Research in support of this program is financed in part by funds appropriated by Congress as a line item for R&D and in part from specific project funds. Research in support of Military Construction is financed by direct project funds, by Operations and Maintenance Funds, and by research, development, test and evaluation funds.

R&D in Civil Works are concerned with hydraulics, soil mechanics, coastal effects, and properties of lakes and navigable waters. Military Construction is aided by R&D on design and construction techniques, soil dynamics and concrete technology.

The Corps of Engineers' general research, development, test and evaluation (RDT&E) activities include mapping and geodesy, military geographic intelligence, nuclear power, permanent construction and lunar base investigations. Work is done also for the Army Materiel Command, the Defense Atomic Support Agency (DASA), the Air Force, the Navy, the National Aeronautics and Space Administration (NASA), Atomic Energy Commission, and the Office of Civil Defense.

Most of the activities and personnel of the Research and Development Directorate of the Office of the Chief of Engineers were transferred to the Army Materiel Command in the 1962 Army-wide reorganization. The Corps of Engineers retained responsibility for mapping and geodesy and for nuclear-power research. No specific R&D element now exists in the Office of the Chief of Engineers; instead, each directorate has complete responsibility not only for its operating program but also for its R&D.

Lt Gen William F. Cassidy
Chief of Engineers

Increasing concern has been evidenced by the Chief of Engineers during recent years regarding the adequacy of his R&D program and its management for supporting his assigned missions. Several ad hoc committees have reviewed specific portions of this program and have developed recommendations for improving its technical content and its management.

In 1966, as the result of the recommendations of such an ad hoc committee on R&D management, the Chief of Engineers assigned to the Chief Scientific Adviser complete responsibility for coordination of all aspects of the R&D program, and established under him the new position of Research Coordinator.

The procedure used in determining the research and development requirements relevant to Corps missions is not established as a formal operational procedure, but is gradually evolving as a very effective process. A committee of experts, either in-house or extramural, is established to study and evaluate needs in a specific area or in support of a specific mission.

The first step is to project the operating needs several years (10-20) into the future to determine the nature of the work the Corps will have to perform. The second step is to identify the technology that will be required to perform this work.

The third step is to determine the research needed to provide that technology. The fourth is to determine which of this research is now being done, or planned, and which is properly done by others. The remainder represents that which should be done by the Corps of Engineers.

Basically, this process was used in the mapping and geodesy field three years ago. Some of the recommendations have been incorporated into the program, and others are now being implemented. The procedure was used to assess the needs in the Military Construction area first in 1962 and again in 1966-67.

This latter review was performed by a committee assembled by the Building Research Advisory Board of the National Research Council. A long-range program has been generated and the establishment of a Construction Engineering Laboratory at the University of Illinois is proposed.

A slight variation of this process is being used in connection with military engineering problems in Vietnam. Rather than a formal committee, we have teams visiting Vietnam on a continual basis to identify problems.

About a year ago, the Military Engineering Division of the Topography and Military Engineering Directorate compiled a list of Vietnam problems as a basis for developing an appropriate research program. Since that time we have been evaluating these needs and have now proposed an appropriate program to the Office of the Chief of Research and Development.

In addition to these semiformal procedures at the Office of the Chief of Engineers level, there is a continual process within the laboratories and operating divisions of the Corps aimed at identifying research needs.

Procedures for periodic evaluation to assure that the research objectives are being met are comparable to those discussed above for determining research needs. Until last year, the program was reviewed by an OCE coordinating committee, and this is being continued by the new Research Coordinator and the Chief Scientific Adviser.

Individual directorates review their programs in annual planning and review meetings and the laboratories undergo annual technical and management inspections. Each program is reviewed periodically by a board of consultants.

To assure maximum coordination and information exchange, we maintain various types of formal and informal liaison, both within the Corps and with other activities. Through the Chief Scientific Adviser, the Research Coordinator, the

(Continued on page 24)

* * *

Dr. Gilford G. Quarles has served since 1961 as chief scientific adviser of the U.S. Army Corps of Engineers. His reputation as one of the most broadly knowledgeable of Army scientific administrators was enhanced in March 1967 when he was elected chairman of The Army Research Council (TARC).

RESEARCH & DEVELOPMENT IN THE CORPS OF ENGINEERS

(Continued from page 23)

staffs of the directorates and of the laboratories, the program is closely coordinated with other elements of the Army; also with the Air Force, the Navy, NASA, other Federal Agencies and private industry.

In support of his assigned missions, the Chief of Engineers maintains two types of laboratories. The first is the specific R&D laboratory. The second is a test and quality control laboratory in support of the construction missions.

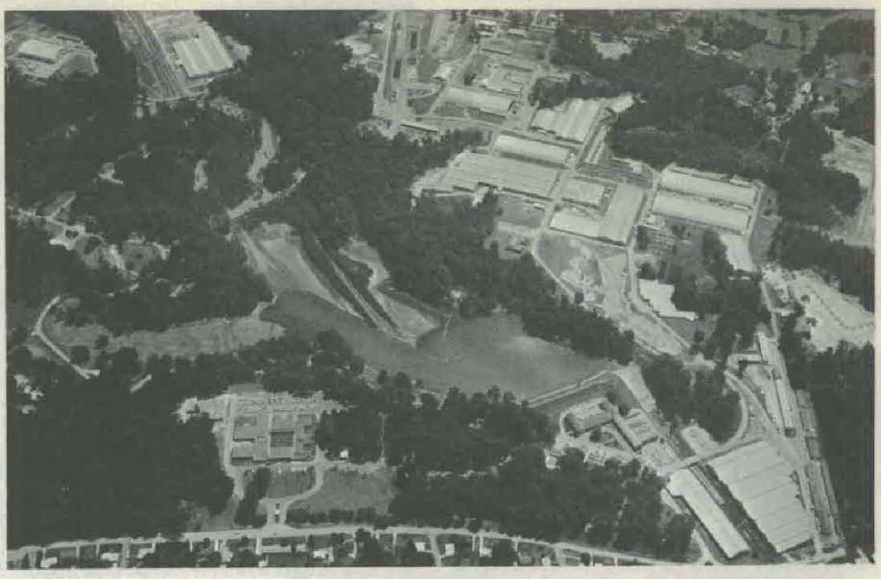
For purposes of construction management, the world is divided into 12 geographical areas, referred to as Engineer Divisions. Nine of these maintain small laboratories for analysis of soil and concrete samples and testing of specific designs. Because of their peculiar capabilities, several of these also conduct small amounts of R&D.

The Waterways Experiment Station (WES), Vicksburg, Miss., is the Corps' principal R&D facility in the fields of hydraulics, soil mechanics, concrete, mobility of military vehicles, nuclear weapons effects, and flexible pavement.

Through basic and applied research, the development of methods and techniques, and testing of materials and equipment, WES supports both the civil works and military missions of the Corps.

WES provides consulting and scientific reference in its specialized fields. Hydraulics studies are made for development, improvement, and maintenance of waterways and harbors. Hydraulic modeling has been carried to a high level of development. Research is conducted on cavitation, turbulence, sedimentation, density currents, and wave and tidal action.

Work in soil mechanics includes geological and soil investigations, studies of structures and foundations, development of criteria and methods of design of flexible pavements, and development of expedient surfacings (landing mats, membranes, and soil stabilizers) for roads and airfields.



AERIAL VIEW of U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss. The complex is the largest and most diverse research, testing, and development facility operated by the Army Corps of Engineers.

Research of a general nature is conducted at WES on concrete as a construction material. Nuclear weapons effects research is conducted by mathematical analyses, small-scale high-explosive tests, special laboratory tests, and full-scale nuclear tests. Efforts are concerned chiefly with blast-resistant structures and underwater shock effects.

U.S. LAKE SURVEY technicians aboard the *Shenehon* floating research laboratory collect water samples from the Great Lakes and their overflow rivers for studies of the hydraulics and hydrology of the waters.

Research for the Army Materiel Command concerning cross-country mobility involves the impact of the environment on military operations. Studies are also conducted on remote sensing of terrain conditions by means of electromagnetic radiation. About 80 percent of the WES program is performed in-house.

The Army Engineer Geodesy Intelligence, Mapping Research and Development Agency (GIMRADA), Fort Belvoir, Va., is the Corps' principal laboratory for R&D related to surveying, geodesy, engineer intelligence, photogrammetry and graphics.

Basic research at GIMRADA includes such subjects as atmospheric refraction, the effects of gravity and other factors on inertial positioning systems, and geodetic applications of satellite orbit theory.

Applied R&D projects include surveying and geodetic systems and topographic mapping systems utilizing aircraft-, missile-, or satellite-borne data and ground-based data reduction subsystems.

Photogrammetric R&D includes techniques and equipment for the automatic compilation of contour orthophotomaps and methods for rapid display and reproduction of maps.

The Coastal Engineering Research Center (formerly the Beach Erosion Board Laboratories), Washington, D.C., conducts research on erosion of shores by waves and currents, and develops techniques for protecting, restoring and maintaining beaches.

CERC makes studies of specific localities in cooperation with state governments, and detailed reports are submitted to Congress. The effects of various types of man-made structures, and the generation of waves and surges by storm winds and

hurricanes are also studied.

The Construction Engineering Laboratory, collocated with the Ohio River Division Laboratory, Cincinnati, Ohio, specializes in research for improvement of design criteria and maintenance procedures for military structures and for rigid and composite pavements and on materials and techniques for Military Construction.

The laboratory tests soils and concrete materials, investigates thermal effects on airfield pavements, and conducts model studies to develop design criteria for concrete beams, culverts and flood walls. It also conducts research in soil and rock mechanics under DASA and NASA-sponsored programs.

The research program at the Construction Engineering Laboratory has outgrown the present facility. To meet current and future needs it is proposed to replace it with a new laboratory at the University of Illinois. This will be designated the Construction Engineering Research Laboratory.

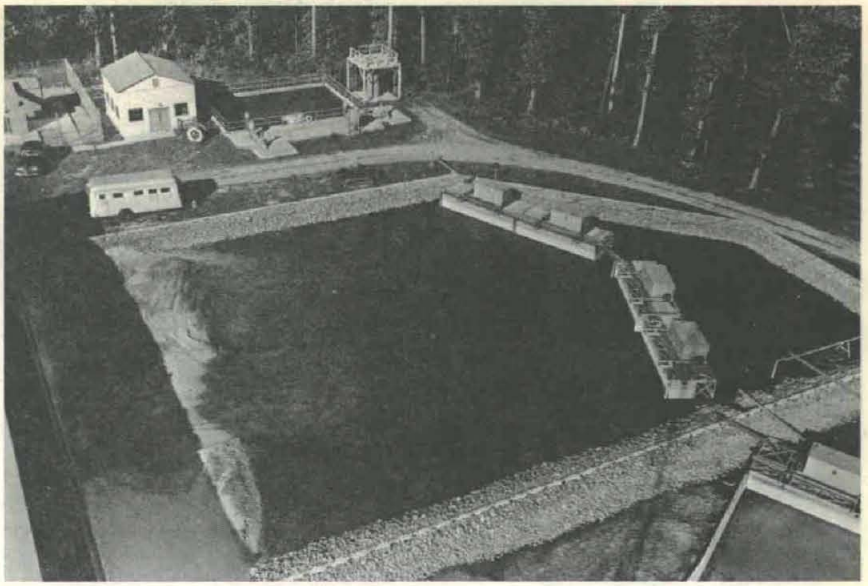
The Engineer Reactors Group, Fort Belvoir, Va., is a joint Department of Defense-Atomic Energy Commission activity under the management of the Corps of Engineers. It is responsible for the Army Nuclear Power Program, designed to meet the nuclear-power requirements (except propulsion) of all three Military Services. Facilities at AEC headquarters, Germantown, Md., are used for the development of reactor systems and subsystems, while Army facilities at Fort Belvoir are used for power conversion and other nonnuclear equipment.

The Engineer Nuclear Cratering Group is a joint operation of the Corps and the AEC at Livermore, Calif. The Group participates in technical planning, management and execution of a nuclear excavation research program to determine the feasibility, cost and other factors involved in nuclear excavation.

Studies are made of craters formed by both nuclear and chemical explosions to determine basic scale relations and engineering feasibility of application to large-scale excavation projects.

The Rock Island Paint Laboratory, Rock Island, Ill., is the Corps' principal facility for investigating protective coatings. It evaluates experimental equipment and industrial materials, conducts research on protective coatings and cathodic protection, and tests paints and paint materials for compliance with military standards.

The Lake Survey District, Detroit, Mich., conducts surveys of the Great Lakes and their outflow rivers, Lake Champlain, New York State barge canals, and the Minnesota-Ontario border lakes, and publishes navigation charts. Studies of the hydraulics and hydrology of the Great Lakes are used principally in the maintenance and control of water levels. An expanding research program involves water quantity, characteristics, and motion, ice, and snow, and shore processes.



SHORE-PROCESSES TEST BASIN at the Coastal Engineering Research Center, Washington, D.C., is used for research on erosion of shores by waves and currents. The two sets of wave generators, shown at the right of the basin, produce either crossing or uniform waves up to 8 inches. The basin is 100 by 150 feet, 3 feet deep.

The Protective Structures Development Center at Fort Belvoir, Va., is a joint element of the Corps of Engineers, the Naval Facilities Engineering Command, and the Office of Civil Defense for research on fallout protection.

Facilities for these studies consist of three experimental shelter structures and a radiation test facility. Radioactive fallout is simulated for testing empirical mathematical relations for estimating gamma radiation attenuation in various buildings or facilities.

In addition to these specific R&D activities, several small laboratories perform investigations and model studies to meet special needs of the Corps. The North Pacific Division Hydraulic Laboratory, Bonneville, Ore., makes model studies in support of power, navigation, flood control and multipurpose projects in the Pacific Northwest.

The Los Angeles Hydraulic Model Laboratory performs model studies of high-velocity flood control channels in the Los Angeles District, and the San Francisco Bay Model Hydraulics Laboratory performs laboratory investigations and model studies for planning, design and construction.

The Hilo Harbor Model Hydraulics Laboratory, Honolulu, Hawaii performs laboratory investigations and model studies in support of planning, design and construction.

Subsequent articles in this series will cover the technical aspects of the Corps of Engineers R&D programs in specific technical fields. These will include hydraulic modeling, coastal engineering, the Great Lakes research, nuclear weapons effects, mapping and geodesy, terrain analysis and construction.

Col Beaudry Named to Head Vandenberg AFB Field Office

Command of the U.S. Army Field Office, Western Test Range, Vandenberg Air Force Base, Calif., was assumed recently by Col Charles L. Beaudry, following a 4-year tour as commander, U.S. Army Research and Development Group (Europe), Frankfurt, Germany.

Col Beaudry was director of operations at White Sands (N. Mex.) Missile Range before he was assigned to Europe, where his successor is Col Robert B. Bennett, former chief of the Studies and Analyses Division, Office of the Chief of Research and Development, Department of the Army.

A 1940 graduate of the U.S. Military Academy, Col Beaudry served four years in the Coast Artillery before transferring to the Ordnance Corps. He earned an MS degree in metallurgical engineering from Stanford University in 1950 and is a graduate of the Army Command and General Staff College.

ARO Polar Specialist Attends Geography School in Canada

Civil Engineer Donald C. Hilton, polar specialist in the Environmental Sciences Division, Office of the Chief of Research and Development (OCRD), is attending the McGill University Geography Summer School at Stanstead College, Quebec, Canada, June 28-Aug. 10.

A Rensselaer Polytechnic Institute graduate and member of the 1939-41 U. S. Antarctic Expedition, he is taking an advanced professional course, The Circumpolar Lands, conducted by McGill Prof. J. Brian Bird. He also is studying the geography of Canada under Prof. F. C. Innes of McGill.

Col R. P. Campbell Jr.

Col W. J. Lynch

Col N. W. Tobey

Col T. C. Rohan

OCRD Adds 3 New, 4 Former Staffers

Seven new staff members assigned recently to the Office of the Chief of Research and Development, Department of the Army, include three officers who served formerly with OCRD and a civilian psychologist with the U.S. Army Personnel Research Office from 1959 to 1963.

COL RAYMOND P. CAMPBELL Jr., successor to Col S. C. Mayer as deputy director of Plans and Programs, OCRD, returned recently from Vietnam where he commanded the 12th Combat Aviation Group. From 1963-66, he served with Tactical Warfare Programs, Office of the Deputy Director for Research and Engineering, Office of the Secretary of Defense.

Other recent assignments have included director of instruction, Army Aviation School, Fort Rucker, Ala., 1960-63, and instructor at the U.S. Military Academy (USMA), 1956-59.

He holds a BS degree from the USMA (1941), an MS degree in electrical engineering from the University of Pennsylvania (1948), and has attended the Naval War College (1944) and the Army War College (1960).

COL WILLIAM J. LYNCH returned to OCRD as new chief of the Technical and Industrial Liaison Office after serving as deputy chief of staff, U.S. Army Hawaii. He succeeds Col Arthur B. White, assigned to the Combat Developments Command Institute of Strategic Studies.

Col Lynch was with the Plans Division, OCRD (1959-60), before going to the Advanced Research Projects Agency as Army assistant to the director. From 1961 to 1964, he was project manager of the Remote Area Conflicts Office, ARPA/Department of Defense, and from 1964-66 was assistant chief of staff, G2/G3, U.S. Army Hawaii.

He received a BS degree in mechanical engineering from the Tufts School of Engineering in 1941 and an MS in aeronautical engineering from New York University in 1948. He has attended the Command and General Staff College.

COL THOMAS C. ROHAN has returned to OCRD as chief of the International Office, the position he held from 1958-61 when it was the International Division. From 1962 to 1965, he served as U.S. Army attache, Stockholm, Sweden and until recently was executive officer of the 35th Artillery Brigade, Fort Meade, Md.

Prior assignments include CO, 514th AAA Missile Battalion (NIKE), Boston Defense, 1956-57, and assistant U.S. Army attache, New Delhi, India, 1954-56.

Recipient of a BS degree in business administration from Fordham University (1937), Col Rohan has attended the Command and General Staff College and the Strategic Intelligence School.

COL NELSON W. TOBEY, the new chief of the Air Defense and Missile Division, served in OCRD from 1957-60 with the Tactical Missiles Branch.

Interim assignments were deputy commander, III Corps Artillery (1966-67) and commander, 9th Field Artillery Missile Group (1965-66), Fort Sill, Okla.; chief, Army Section, U.S. Military Advisory Mission to Saudi Arabia, 1964-65; test officer (Pershing) and chief, Missile Division, The Artillery Board, Fort Sill, 1961-64.

Col Tobey has a BS degree in chemistry from the Virginia Military Institute (1939), an MS degree in mechanical engineering from the University of Southern California (1950), and has attended the Command and General Staff College and the Army War College.

LT COL ROBERT A. BONIFACIO, a staff officer in the Air Mobility Division, was until recently an action officer at HQ U.S. Army Vietnam. He was executive officer of the 228th Aviation Battalion, 1st Cavalry Division, for seven months following three years as assistant corps aviation officer, Fort Hood, Tex. From 1960-61, he was commanding officer, 17th Aviation Company, Fort Ord, Calif.

Lt Col Bonifacio received a bachelor's degree from the University of Omaha in 1966 and has attended the Command and General Staff College.

LT COL LYNN R. RAYBOULD also returned recently from Vietnam as plans and operations officer, Psychology Operations Group, Military Advisory Command. He is assigned as a staff officer in the Programs and Budget Division.

From 1962-63, he was a manpower survey officer at HQ U.S. Continental Army Command, Fort Monroe, Va., following three years as an assistant professor of military science at Central Michigan University.

He received a BS degree in military science from the University of Utah in 1950 and an MPA degree in public administration from the University of Pittsburgh in 1967. He has attended the Command and General Staff College.

DR. DELANEY A. DOBBINS is a research psychologist in the Behavioral Sciences Division, U.S. Army Research Office, Arlington, Va. One of the original staff members assigned to the U.S. Army Tropic Test Center, Panama Canal Zone, he has worked there since 1963 with jungle sounds, vision and anthropometric studies and designed tropic tests for new materiel items.

From 1959 to 1963, he was a senior task leader at the U.S. Army Personnel Research Office (now the Behavioral Sciences Research Laboratory) in Washington, D.C., following four years as a research analyst with the Louisiana Department of Institutions.

Dr. Dobbins earned BA, MA, and PhD degrees from Louisiana State University with a major in psychology and a minor in industrial engineering.

Dr. D. A. Dobbins

Lt Col L. R. Raybould

Lt Col R. A. Bonifacio

Pershing 1A Changes From Tracks to Wheels

Developmental improvements in the Army's Pershing missile system, featuring a changeover from tracks to wheels for ground-support vehicles, will provide more road mobility, higher reliability and lower maintenance costs.

Advanced refinements in the proved effectiveness of the 400-mile-range ballistic missile system, redesignated the Pershing 1A, are being made under guidance of the U.S. Army Missile Command at Redstone (Ala) Arsenal.

New ground support equipment features an erector-launcher which carries the complete missile on a single carrier towed by a 5-ton M-656 truck. The system now in the hands of troops is transported in sections on separate tracked vehicles.

The P1-A erector-launcher, engineered for rapid movement from one firing position to the next, is capable of fast erection and firing. It can also be transported in C-130 aircraft. Built-in hydraulic lifts raise the missile from the horizontal traveling cradle to the vertical firing position in a matter of seconds.

An improved programer-test station provides for rapid missile checkout and countdown. Equipped with computer control devices, it is capable of automatic self-test and malfunction isolation. Electronic packaging, featuring plug-in micromodules, allows the operator to perform repairs at the firing site. The power station at the rear of the vehicle provides energy for the entire system.

An innovation in ground-support equipment is the battery control center (BCC) being developed under the P1-A program. Designed to give the battery commander better control and monitoring of firing-site activities, the BCC is mounted in an expando-van atop an M-656 and is linked by radio with higher headquarters.

Another M-656 will carry the radio terminal set which provides voice and teletype networks for the battery. It is topped by an inflatable parabolic antenna which can be stored in a recessed space during road travel.

The system and components test station (SCTS) is mounted on an air-conditioned van. Designed for field testing of electronic assemblies and pneumatic equipment, the SCTS also can house two missile guidance sections for test and repair.

Other missile sections, still packed in shipping containers, can be tested through electronic connections with the van. Also inside the test station is a computer-controlled checkout facility similar to the one used to fire a Pershing missile.

There is no change to the basic 34-foot inertial-guided missile under the new Pershing 1-A program.

PERSHING 1-A SYSTEM features a changeover from tracks to wheels and an erector-launcher that carries the complete missile on a single carrier towed by a 5-ton M656 truck.

ATAC Honors Winners of Student VE Contest

Ten winners in the U.S. Army Tank-Automotive Command (ATAC) annuel value engineering contest for college students were honored recently at a dinner where Maj Gen William W. Lapsley, ATAC CG, presented cash awards and wall plaques.

Sponsored by ATAC in conjunction with the Detroit Chapter of the Association of the United States Army, the contest was open to all undergraduate engineering students below the age of 25 in schools east of the Rocky Mountains, provided they had previously indicated interest in research.

The purpose of the contest is to publicize the importance of value engineering to the national defense effort. The contest problem was concerned with simplifying design of a dome light in combat vehicles — in line with the VE purpose of achieving the required function at the lowest overall cost.

Two students at Rose Polytechnic Institute, Terre Haute, Ind., James B. Morehouse of Evansville and Raymond E. Mendenhall Jr. of Union City, won first and second-place awards of $150 and $100, respectively. George F. Manska, Fayetteville, N.C., a student at N.C. State University, won the third-place award of $50. Each winner also received a plaque.

Honorable mention went to Rodger L. Casey, Indianapolis, Ind., Rose Polytechnic Institute; John H. Lasley, Cincinnati, Ohio, and Ernest W. O'Neill Jr., Burlington, N.C., North Carolina State University;

Also, to Joseph W. Neibert Jr., Cheltenham, Pa., and Louis W. Reichart Jr., Rochester, N.Y., Drexel Institute of Technology; Michael T. Hadbavny, Allegany, N.Y., University of Toledo, and Carl M. Romack, Flat Rock, Mich., Lawrence Institute of Technology.

Dignitaries present at the dinner included Dr. John E. Gibson, dean of engineering, Oakland University, Rochester, Mich.; Sam Fuller, director, Advanced Vehicle Systems Laboratory, ATAC; Col G. L. Barnhill, director, Development and Engineering Directorate, ATAC; Dale B. McCormick, president, Detroit Chapter, Association of the United States Army; and Col Harold B. Gibson Jr., chief of staff, ATAC, master of ceremonies.

Additional Supplier Produces Shillelagh That Meets Tests

Fourteen months after award of a $1.5 million contract to establish a second producer for the U.S. Army Shillelagh antitank missile, successful firing of a test missile was announced by the U.S. Army Missile Command.

The missile fired at White Sands Missile Range, N. Mex., was produced by Martin Marietta Corp., which began work in March 1966 to set up production facilities for a number of missiles to qualify for large-scale production. Aeronutronic Division of Philco Corp. is the Shillelagh prime contractor.

First application of the Shillelagh system is on the General Sheridan, a lightweight, armored reconnaissance assault vehicle which incorporates a new 152mm dual-purpose cannon that fires either conventional rounds or Shillelagh missiles.

Shillelagh also will be the armament for the Army's M-60A1E1 tank, replacing the present 105mm gun. In addition, it will be the primary armament system for the main battle tank being developed jointly by the United States and Federal Republic of Germany.

Col Spencer R. Baen is project manager for the Shillelagh program.

O'Brien Named Assistant Chief Of Medical Specialist Corps

Currently chief of the Psychiatric Occupational Therapy Section at the Walter Reed General Hospital (WRGH), Maj Eileen F. O'Brien will assume Oct. 1 the duties of assistant chief of the Army Medical Specialist Corps and the chief of the Occupational Therapy Section, Office of The Surgeon General. Maj O'Brien has been assigned to WRGH since 1965.

She has served as chief of occupational therapy at the 2d General Hospital, Landstuhl, Germany; Womack Army Hospital, Fort Bragg, N.C.; Walson Army Hospital, Fort Dix, N.J.; and Irwin Army Hospital, Fort Riley, Kans. She was assistant chief of occupational therapy at Fitzsimons General Hospital in Denver.

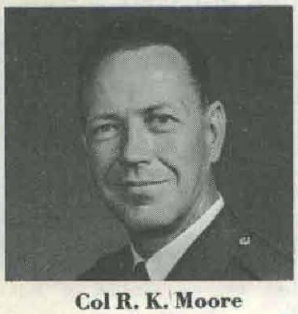
Maj O'Brien received a BS degree in occupational therapy from the University of Pennsylvania and a certificate in occupational therapy from the Philadelphia School of Occupational Therapy.

9 Depart OCRD for New Assignments

Promotions and rotational reassignments account for several key people recently departing the Office of the Chief of Research and Development.

Col Robert K. Moore, chief of the Air Mobility Division, has been assigned to the Office of the Assistant Secretary of the Army (R&D). Before his OCRD assignment a year ago, he was assistant chief of staff for personnel with HQ Seventh Army Support Command.

Col Moore completed studies in safety



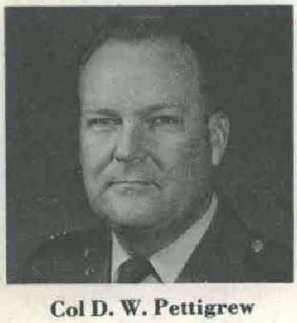
Col R. K. Moore

engineering at New York University (1949) and has studied international relations at the University of Maryland and George Washington University. He has also attended the Army War College.

Col Dee W. Pettigrew, who was assigned to the Air Defense and Missiles Division in 1966 and was named division chief in the recent reorganization, will be studying at the Spanish Escuela Superior del Ejercito, Madrid, Spain, following six months at the Defense Language Institute, East Coast.

Col Pettigrew was chief, U. S. Military Mission to Mali, 1964-66, and a branch and division chief in the Systems Development Directorate, North Atlantic Air Defense HQ, 1962-64.

Graduated from the U. S. Military Academy in 1944, he earned a degree in



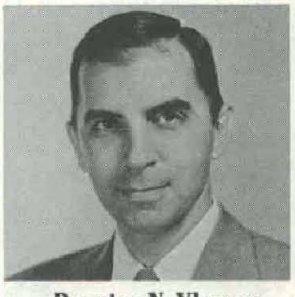
Col D. W. Pettigrew

business administration from Hendrix College (1940) and an MS degree in aeronautics and guided missiles from the University of Southern California (1949).

Peppino N. Vlannes, since August 1962 the deputy chief of the Scientific and Technical Information Division, U. S. Army Research Office, resigned June 30 to become deputy chief of the S&TI Division, National Aeronautics and Space Administration under John F. Stearns.

Honored with a Department of the Army Certificate of Achievement in 1964 for his work in establishing and organizing the Army S&TI program, he launched this effort within two months after he reported to OCRD by setting up a conference of representatives of all Army agencies. This resulted in the creation of 23 task groups to formulate program plans.

Prior to assignment to OCRD, Vlannes



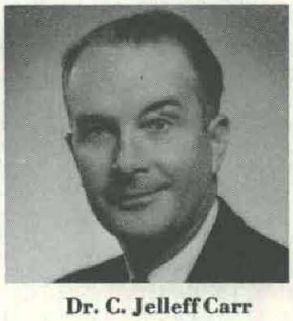
Peppino N. Vlannes

was a physical science administrator, Advanced Planning Division, HQ U. S. Army Chemical Corps R&D Command, earning a Certificate of Achievement in 1962. Earlier he was a chemist with the U. S. Naval Research Laboratories, Washington, D. C.

Vlannes has a BS degree from Centenary College, an MS degree in chemistry from Xavier University and has done graduate work at Georgetown University.

Dr. C. Jelleff Carr left the Life Sciences Division of the Army Research Office, where he was chief of the Scientific Analysis Branch since 1963, to take over July 3 as head of the Life Sciences Division, Federation of American Societies for Experimental Biology, Bethesda, Md.

Dr. Carr came to OCRD from the



Dr. C. Jelleff Carr

National Institutes of Health, where he was chief of the Pharmacology Unit of the National Institute of Mental Health. He has served as head of the Department of Pharmacology, Purdue University, and has taught at the University of Maryland.

He earned BS, MS and PhD degrees from the University of Maryland and has written more than 100 publications on neuro- and psycho-pharmacology.

Lt Col Allan T. Sylvester, Lt Col Thomas E. Marriott and *David L. McKain* ended their OCRD assignments in June to accept positions of increased responsibility in the Office of the Assistant Vice Chief of Staff, Department of the Army, at the Pentagon.

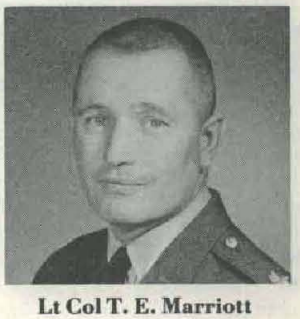
Lt Col Sylvester is assigned to the Weapons Systems Analysis Directorate, OAVCS. His most recent OCRD assignment was with the newly established Systems Analysis Division. Previously he was executive to the Director of Army Research for more than a year, following a tour with the Human Factors and

Lt Col A. T. Sylvester

Operations Research Division, U. S. Army Research Office. He has a BS degree from Virginia Military Institute and an MS degree from Stanford University.

Lt Col Marriott has been a staff officer in the Physical Sciences and Engineering Division for 18 months, following duty as battalion CO, 44th Artillery, Fort Sill, Okla. He has an MSEE degree in communications engineering from the Georgia Institute of Technology and has attended the Command and General Staff College.

David McKain has been with OCRD since 1962, when he completed the Army Management Intern Training Program. He was a management analyst for four years before transferring to the Research Programs Office, Army Research Office, in 1966 as a program analyst and in



Lt Col T. E. Marriott

recent months has been acting chief of the Programs Branch. He has a degree in political science from West Virginia University.

Sumner Meiselman, a retired Army officer and since March 1963 a physical scientist in the Research Plans Office, Army Research Office, accepted a position with the National Highway Safety Bureau

David L. McKain

of the U. S. Department of Transportation effective July 3.

Before coming to OCRD in 1962, Meiselman was a branch chief in the Research and Development Division, Office of the Chief of Transportation, Department of the Army. He holds a BS degree from Worcester Polytechnic Institute and an MS degree from the University of Michigan. He has completed special studies under a Secretary of the Army Research and Study (SARS) Fellowship.

Capt Robert L. Dilworth, Army Research Office adjutant since 1965 and

Sumner Meiselman

assistant executive officer March to December 1966, will go to Vietnam in November. Scheduled for promotion to major prior to departure, he will be adjutant general of the 199th Light Infantry Brigade (Separate). He was chief of the Administrative Services Division and Military Personnel Division, HQ U. S. Army Security Agency, Pacific, prior to his present assignment.

He holds a BS in advertising from the University of Florida (1959) and has taken the basic and associate career course at the Adjutant General's School.

Capt R. L. Dilworth

Report Outlines Technological Forecasting Methodology

Technological forecasting methodology employed by defense industry and military organizations in the U. S. and Europe is outlined in a report recently approved by the Joint Commanders' Meeting for interservice use.

Intended to serve also as a guide, the report was signed by General Frank S. Besson Jr, CG of the U. S. Army Materiel Command; General James Ferguson, CG of the U. S. Air Force Systems Command; and Vice Admiral I. J. Galantin, Chief of Naval Material.

Along with Maj Gen Paul R. Tyler, U.S. Marine Corps Quartermaster General representing the USMC commandant, these officers conduct the Joint Commanders' Meetings (JCM), established early in 1966 as quarterly conferences to further interservice logistical standardization.

The JCM Secretariat chartered the interservice ad hoc study group Nov. 9, 1966, to assess the state-of-the-art and to synthesize available information in the field of technological forecasting. A series of working sessions included a seminar with invited technological forecasting practitioners to discuss advantages and disadvantages of various methods.

Since the late 1950s, technological forecasting has been developing as a discipline mainly through efforts of the military services, aerospace firms and a few specialized consulting organizations.

Interest is growing, as evidenced by the subject, "Technological Forecasting for Industry," assigned to the first annual Technology and Management Conference, May 22-25, 1967, at Lake Placid, N.Y.

Military planners of the Department of Defense, Army, Navy and Air Force attended the conference, sponsored by the Industrial Management Center, a private educational institution headed by Prof. James Bright of Harvard University.

The newly approved interservice guide is directed toward scientific and engineering specialists who may be asked to contribute inputs to forecasts, although they have only limited understanding of technological forecasting and its possible approaches and problems.

The authors consulted numerous Army, Navy, Air Force and nonservice documents and conducted personal interviews with established forecasters. The report contains a bibliography of 161 references.

In attempting to clarify a complex, controversial subject, the report recommends increased use of a number of analytical techniques. Thirteen categories of forecasting methods are described.

The current technology race places a high premium on the ability to assess developing technological trends correctly, it states. The pace of this race and the increasing complexity of the problem have outdistanced the ability of military forecasters to assess these trends by intuitive methods alone.

The authors feel that the report will "reduce the number of intuitive 'guesses' in the field of technological forecasting and will lead to more acceptable forecasting." The report was prepared by the steering committee and study group which included:

James W. Sterling, executive secretary, Office of the Chief of Research and Development, Department of the Army; Donald B. Keckler, Army Weapons Command; Edward Mackiewicz, Army Tank Automotive Command; Halvor T. Darracott, Army Materiel Command; Marvin J. Cetron, Naval Material Command; William A. McKenney, Naval Weapons Laboratory; Thomas I. Monahan, Naval Applied Science Laboratory; Howard A. Wells and Miss Elma Henderson, Air Force Systems Command.

TECOM Plans Second Meet On Test Instrumentation

Progressive results of the first U. S. Army Test and Evaluation Command conference on test instrumentation held in May at Aberdeen Proving Ground, Md., have led TECOM officials to plan a second meeting in December.

Some 50 representatives of HQ TECOM and 15 subordinate installations and activities spent four days reviewing new developments and techniques in the field of test instrumentation and attempting to define current and anticipated problems. The conference was sponsored by the Instrumentation Division of the TECOM Logistics Directorate.

TECOM Director of Logistics Col Harry L. Yerby said a firm date for the second conferences of the series will soon be set. It will be held at one of TECOM's large installations such as Fort Huachuca, Ariz., or White Sands Missile Range.

Lee E. Davidson, chief of the TECOM Instrumentation Division, said that the instrumentation program is currently operating with an inventory of approximately $300 million and an annual budget of $75 million.

Instrumentation is one of the technical areas that is not covered by existing professional societies, Davidson said. Forthcoming conferences will provide instrumentation engineers with a "central point" for exchange of technical information, guidance and advice.

Technical range of the conferences is typified by the Aberdeen meeting. Presentations included instrumentation and test methodology, automatic film reader, telemetry UHF conversion, optical determination of miss-distance, range data control system, procurement of instrumentation supplies and services, cradle-to-grave instrumentation, powerline voltage transient monitor, data processing systems, instrumentation for ballistic measurements and quality of data as a function of calibration.

USAMRUE Evolves From Research on Nuclear Fallout

This is the ninth in a series of articles on U. S. Army Medical Service laboratories. Five features were published in 1966. Since then, missions of the following activities were summarized: January — U. S. Army Research Institute of Environmental Medicine, Natick, Mass. March — U. S. Army Medical Equipment Research and Development Laboratory, Fort Totten, N. Y. May — U. S. Army Aeromedical Research Unit, Fort Rucker, Ala.

* * *

Discovery and development of medical skills and equipment to conserve and protect the strength of soldiers, the prime mission of major elements of the U. S. Army Medical R&D Command, were not the major goal of establishment of the U.S. Army Medical Research Unit, Europe (USAMRUE), in October 1958.

USAMRUE is unique in the true sense of the word and was created as an aftermath of the Second Conference on the Peaceful Use of Atomic Energy, held in Geneva, Switzerland, in 1958. Its original mission (broadened substantially in recent years) fell into that part of the U. S. Army Medical Corps program concerned with scientific information of academic and international interest.

Located in Landstuhl, Germany, USAMRUE is a separate Class II facility under The Surgeon General. Originally, its job was to determine the quantity of nuclear fission products incorporated within the European population, but this responsibility has broadened in recent years.

Cause-and-effect background of the unit dates back to the early 1950s, when interest developed in determining the effect on the world population of nuclear fallout from devices tested in the atmosphere.

The first endeavor of investigators interested in this problem was that of building low-level radiation counters capable of measuring by qualitative and quantitative methods low concentration of nuclear fission products within a human body.

One of the first whole-body radiation detectors designed expressly for this purpose was developed by a group working at the Los Alamos Scientific Laboratory, University of California at Los Alamos, under contract with the U. S. Atomic Energy Commission. Human Counter 1 (HUMCO 1) permitted accurate determination of the body burden of fission products and naturally occurring radioisotopes.

The Los Alamos group then designed, built and displayed a similar radiation detector to demonstrate the principles of the counter at the Second Conference for the Peaceful Use of Atomic Energy in Geneva.

When the conference ended, the Geneva Counter (GENCO) was transferred to

Lt. Col F. C. Leitnaker
CO, USAMRU, Europe

the U. S. Army and placed in operation at Landstuhl, Germany, where the U. S. A. Medical Research Unit No. 1 was established in October 1958.

The Surgeon General assigned to the U.S. Army Medical Research and Development Command the mission of determining the quantity of nuclear fission products presenting a hazard to the European population, and USAMRUE was charged with this responsibility.

Uniqueness was a quality of GENCO when it was installed at the U. S. Army Medical Center at Landstuhl, in that instead of lying or sitting in a standard position, as in comparable counters, persons are counted while standing in the detector. Of the liquid scintillator type, having a 2-pi counting geometry, it accomplishes within a short period of time accurate determinations of gamma radiation emanated from the body.

Large numbers of persons can be counted in a brief period. For a counting time of 200 seconds, the threshhold sensitivity (one percent probable error) for cesium-137 and potassium of a standard man is 0.6 nanocuries and 3 grams, respectively.

Experience has shown that the stability of GENCO is excellent. Background count rates and efficiencies of four energy channels usually remain within plus or minus two percent of the mean during 3-month intervals. GENCO characteristics give USAMRUE the enviable capability to carry on research concerning low-level radiation as well as studies utilizing radioisotopes.

From the time GENCO became operational in June 1959, through 1962, more than 13,000 individuals were counted. Civil associations, schools and individuals throughout West Germany and France participated in the study.

The biological half-life of cesium-137, as well as the mean body burden of nuclear fission debris, was calculated from the counting data obtained during GENCO's first three years of operation. Since 1963, the study has continued but passively due to a change of USAMRUE's mission.

The total amount of potassium in the human body was determined with the whole-body counter in all persons participating in the cesium-137 study. Simultaneously, radiation from potassium-40 was quantified.

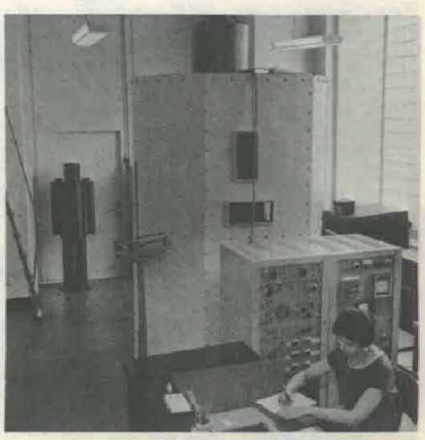
In view of importance of potassium in biological systems, the whole-body counter findings are accepted as a significant contribution to medical knowledge. Data categorized according to age and sex represent a firm baseline for studies on the metabolism of potassium by the human body under various conditions.

Several groups engaged in physical conditioning programs have been studied by USAMRUE to define the effect of such programs on whole-body potassium levels. Data collected to date by counting subjects before, during and after participation suggest that body potassium expressed as grams potassium per body weight and percent lean body mass are increased, due to loss of fat, and/or an increment in the potassium-rich intracellular fluid of muscle tissue.

To obtain additional data, the unit is studying the effects of strenuous physical training on the whole-body potassium burden and lean body mass of 465 males inducted into the Army of the Federal Republic of Germany. Results from similar studies may provide in the future an objective means of evaluating military training programs.

Studies also have been made in the areas of nuclear medicine and environmental radiation. Food used by the U. S. Forces in Europe was systematically sampled and evaluated for radioisotope contamination during the early 1960s, when nuclear devices were tested frequently.

A milk surveillance program is in progress. Samples from each of the six European contractors supplying milk to the U. S. Forces are received weekly and



WHOLE BODY radiation counter with accessories in use at U.S. Army Medical Center, Landstuhl, Germany.

analyzed for content of fresh fission products. In past years, after nuclear testing in the atmosphere, the concentration of radioiodine in the human thyroid was determined by USAMRUE researchers.

Capability to measure low-level alpha particle radiation emitted from environmental and biological specimens has been developed. USAMRUE is the only U. S. military unit in Europe making such determinations.

Studies reports have been published by the unit on measurements and comparison of the alpha activity in human teeth and bone, in soft tissue and the shell of *Helix pomatio* (European land snail) and in the bone and soft tissue of small laboratory animals.

Supplementing the findings of the whole-body counter is a 4 x 8-inch diameter sodium iodide thallium activated crystal radiation detector used in conjunction with a multichannel analyzer. This instrument can do gamma ray spectroscopy, utilized to monitor military and civilian isotope handlers for possible burdens of radionuclides.

USAMRUE expands the clinical capabilities of the Radioisotope Clinic of the 2d General Hospital at the U. S. Army Medical Center in Landstuhl. The whole-body counter is employed frequently to evaluate persons with a history of thyrocarcinoma.

Use of trace amounts (0.5 — 1.5 microCi) of radioiodine-131 enables determination of the whole-body retention of iodine. Generally, it is possible to measure, over a period of three days, whether the individual has remained athyrotic after therapy for the neoplasm or has recurrent thyrocarcinoma.

A project was started recently to study iron absorption in hyperthyroid patients by using trace amounts of radioiron-59. An isotope technique which is easier and more informative than current procedures for evaluating renal function is being developed.

Researchers at USAMRUE have been engaged for the past three years in a study to evaluate the efficacy of adenine, used as an additive to the standard Acid Citrate Dextrose (ACD) blood donor bag, to extend the acceptable storage life for whole blood. This work is conducted as an extension of a basic study of the U. S. Army Medical Research Laboratory's Blood Transfusion Division at Fort Knox, Ky.

A pilot study has been completed, comparing the survival of red cells in ACD solution with cells stored in ACD with the adenine additive upon transfusion into recipients after storage for 42 days. Results suggest that adenine has the potential to extend the shelf-life of whole blood from the accepted 21 days up to possibly 42 days.

Experiments are in progress to determine the actual fraction of red cells stored in the presence of adenine for three to six weeks that survive and remain in circulation after transfusion. A twofold improvement in the storage life of whole blood would prove useful not only in a combat situation; it also would be valuable in maintaining the stock of rarer blood types in military and civilian banks.

Close working relations have been developed between the USAMRUE staff and the medical faculty of the University of the Saarland in Homburg, Germany. The University's Institute for Biophysics has provided the unit with professional and technical assistance over the years on a consultative basis.

Several joint research efforts have been conducted with the Institute for Biophysics, and the relationship establishes direct liaison with the European scientific community.

One example was the evaluation, using the whole-body counter, of pathogenic body burdens of radiothorium existing in the European population. Such burdens in individuals resulted from the administering of Thorotrast in the late 1920s and 1930s, when this thorium-containing substance was used internationally as a radioopaque dye media.

USAMRUE tasks for the future include participation in a study to correlate pathology, that is, neoplastic disease and chromosomal aberrations with the cumulative doses of ionizing radiation emananated from thorium burdens. GENCO has been made available to scientists of the European community for independent research in specialized fields of study.

USAMRUE also is charged with certain support responsibilities and is available to the USAREUR (U. S. Army Europe) Surgeon for technical and research support. Staff members actively participate in the European medical research community, providing liaison between the U. S. Army and European research contractors, and also teach and lecture in the fields of nuclear effects and nuclear medicine.

To support the U. S. Army medical research program in Europe, USAMRUE encourages medical personnel in USAREUR to engage in basic research. The unit also coordinates approval and financial support from the U. S. Army Medical Research and Development Command, Washington, D. C.

Future USAMRUE plans are centered on further utilization and development of present capabilities, rather than on expanding physical facilities. GENCO and other instrumentation of USAMRUE, therefore, will be used more extensively to develop tracer isotope techniques, to investigate known military radiation problems, and to advance basic knowledge in the area of low-level radiation.

Report Describes Technical Library Services

Army Technical Library Improvement Studies (ATLIS) Report No. 2 is a handy guide for scientists engineers and administrators interested in obtaining maximum advantage of technical library resources.

The 56-page "User's Guide to Technical Library Services" was developed under the ATLIS project sponsored by the U.S. Army Research Office as part of the Army Scientific and Technical Information Program. It outlines technical libraries, their resources and services.

Samples rather than complete listings of reference works and libraries are used for guidance. Examples are specific, with authors and facts given for the books, and addresses and descriptions for the libraries.

The section on library resources describes selected technical books, encyclopedias, handbooks, directories, biographical reference books, general and special subject bibliographies, directories of periodicals, technical reports, pamphlets, standards and specifications and trade catalogs.

The section on use of the library gives a detailed explanation of the classification systems used in various libraries, card catalogs, printed indexes and accession lists. A comparison of the Library of Congress index and the Dewey Decimal System is included.

The section on finding and using other resources is of particular interest to the specialist. Addresses and guides are listed for several libraries, information centers and documentation centers.

Detailed information is included on the various indexes and services of the Defense Documentation Center, the Clearinghouse for Federal Scientific and Technical Information, the NASA Scientific and Technical Information Facility, and the Division of Technical Information Extension, U. S. Atomic Energy Commission.

Information analysis centers, whose primary function is to answer questions, are also covered, with brief descriptions and addresses of 21 such centers sponsored by the Department of Defense.

Library services are described in a final section of the pamphlet, with special attention directed to interlibrary loans, extensive research, literature surveys and announcement services.

Report No. 1 of the ATLIS series, "Technical and Medical Research Libraries and Information Centers of the Department of the Army," is being revised and will be issued in the fall as the "Army Technical Resources Directory."

"User's Guide to Technical Library Services" may be obtained by submitting a DA Form 12-4 to the U. S. Army AG Publications Center, 2800 Eastern Boulevard, Baltimore, Md. 21220, or from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Dr. Foster Lauds R&D Programing

(Continued from page 2)

resources and great talent to maintaining and upgrading these assured capabilities — and we do. And it is crucial to our national security that the press not take this concept lightly.

"We know it is essential to explain — clearly and openly — to any potential enemy the nature of our capability. The whole point of 'assurance' is that everyone must appreciate the certainty and capability of our response to any major attack. Nevertheless, occasionally, there is an oversimplified 'scare story' claiming that our deterrent force is in some way grossly inadequate.

"Such stories cannot be supported — either technologically or operationally. Such stories introduce unwarranted uncertainty, here and abroad. Such stories undermine the credibility of our deterrent. Because such stories cannot be supported, they are a great disservice to the country.

"We go to great lengths to state the general facts about our assured strength. Yet some information must remain classified. Often this is a difficult line to draw — the line between what should be said to maintain credible assurance, and what should be left unsaid to ensure security; the line between what skeptical Americans want and need to know in an open society, and what a potential enemy wants to know to design effective counter-measures.

"For example, nothing is gained by disclosing design details of our penetration aids. Disclosing such data would not support our national purposes. It would only assist any potential enemies.

"I want to clarify an important aspect of our thinking about assurance. The concept of assurance spans a complex interaction of the offense and defense. How does one know, for example, that an offensive capability is 'assured' unless one has great confidence in his understanding of advanced defenses? This is precisely the thrust of our analysis. We develop the technology for the most advanced missile defense — and then we design our offensive missile systems to penetrate that defense. We develop the most advanced air defense technology — and then we design our aircraft systems to penetrate that defense.

"In general, we have been one to two technological generations ahead of any potential enemy in these advanced designs. So we have great confidence that our offensive forces are 'assured.' From this experience, we have found that the offense has dominated the defense, and we expect this trend to continue in the foreseeable future.

"Now I want to discuss a difficult point, raised semiannually in discussions of our strategic capability: the so-called 'technological plateau.' I occasionally hear the argument that we have reached, or have somehow accidentally been trapped in, or have decided to remain on, a 'technological plateau.' The allegation usually is either that we are not really pushing important new developments, or that we are not concerned about possible developments of potential enemies.

"I can say categorically that this argument is not valid in terms of any criterion I think is important. But I must say, before going further, that if you feel a key criterion has escaped our notice, please bring it to my attention. To set the record straight, let's look at this from several points of view.

"First, let me first give you examples refuting the funding fallacy often implied. In Fiscal Year 1968, we are continuing our ballistic missile defense development efforts at the high levels of recent years. We are requesting $440 million for R&D work on the Nike-X system. And there is another, related program in ARPA, Project Defender, for which we have requested another $119 million.

"Our capabilities in this area have changed dramatically in the last ten years. How can we be stagnating technologically in ballistic missile defense while we devote more than a half billion dollars to it in one year?

"Also in Fiscal Year 1968, we are requesting about $350 million for programs on our Minuteman forces and about $433 million for the Polaris/Poseidon developments. These funds support some of the efforts necessary to demonstrate that we know how to penetrate any enemy's missile defenses.

"Overall, let me remind you, the DoD expenditures for R&D have increased almost 300 percent during the last decade. The R&D budget requested for FY 68 is $8.1 billion. It contains requests for over 1,500 projects. The real argument here, I suspect, is not about the total. Most people seem to agree we're spending the right amount.

"The real arguments are about specific items, each of which always — always — has its advocates. So the problem is to achieve some balance, some sorting out of priorities and prospects. This requires judgment, and I would be the last to claim we have attained perfect balance. I think we do have about the right total.

"So much for the charge that we are not really investing the required money. But how about the argument that we are not aggressively pursuing the frontier fields of defense technology? I don't think this is true. Here, too, are the difficult questions of balance.

"For example, how does one know whether $1.4 billion this year for the DoD research and technology base is adequate? And how does one know whether we have the right balance between this base and our development projects which are funded at about $4.8 billion?

"Actually, these totals and ratios are merely the sum of thousands of numbers, each examined and set on its own merits. I know of no clearly needed improvement and no clear technological opportunity that does not receive adequate support.

"Probably more important, we are not content with our past and current success. We continue to press the state-of-the-art in every technical area in which there is a solid case for providing required improvements in our forces.

"Thus I am puzzled by the occasional essay on defense R&D which simply ignores the enormous effort we continue to devote to advanced technology. Perhaps it is understandable that some pockets of misunderstanding will exist, because, as

NEW CHIEF OF STAFF, U.S. Army Materiel Command, Maj Gen Clarence J. Lang (left) pauses during briefing at Harry Diamond Laboratories (HDL) in Washington, D.C. With him are Col Vincent H. Ellis, HDL commanding officer, and Dr. Maurice Apstein, HDL associate technical director. General Lang served since August 1963 as deputy commander, U.S. Army Transportation Center and Fort Eustis, Va.; also, as assistant commandant of the U.S. Army Transportation School at Fort Eustis. He entered the Army in 1940 and is a graduate of the Univ. of Texas, Armed Forces Staff College, and Industrial College of the Armed Forces.

I've said, we have been compressing great clusters of advanced work into a single year's effort.

"This situation is somewhat analagous to that assessed by Tom Lehrer, the mathematician turned singer/satirist, when he cracked: 'I am sobered occasionally to recall that when Mozart was my age, he'd been dead ten years!' I, too, am sobered to read the altogether plausible prediction that half of what a competent engineer will need to know 10 years from now is not available to him today!

"One final aspect of this alleged technological plateau: the argument that we are in some way losing our strategic superiority.

"For many years, the Soviet Union apparently has been following our lead in every important strategic system technical development: the intercontinental bomber, the solid-fueled missile, the Polaris-type submarine, the hardened and dispersed silo, and many other advances. This is still the case. We are following their activities with great care. We see no evidence that our planned strategic capabilities will be endangered by recent Soviet technological actions.

"Our missile force represents a fully operational, reliable, survivable, and again, assured, deterrent. Our missiles are more accurate. We have developed a family of penetration aids. The changes that we have made in our missile forces — Minuteman II, and soon the addition of Minuteman III and Poseidon — are much more than minor modifications and name changes.

"These new capabilities provide major increases in effectiveness. Our bombers are capable of low-altitude penetration over a target area. We will soon have a bomber with enhanced area penetration capability, equipped with stand-off missiles so that it can also avoid terminal defenses.

"I am often asked how long we are going to keep one of these strategic systems. The answer is simple: as long as it can provide assured destruction.

"In advanced technology, we have developed the capability, if required, to move rapidly into operational development and deployment of several new systems such as an AMSA and an Advanced ICBM.

"These new concepts are waiting in the wings, not because we have avoided, or failed to invest in, the advanced technology necessary for strategic advantage. It is because at the moment immediate deployment is not yet clearly in the overall national interest.

"Strangely enough, we sometimes get credit for a breakthrough we haven't made, or get blamed that if we haven't made it, the Soviets have. A number of recent articles 'discovered' X-rays as a kill mechanism at high altitude. Depending upon the point of view of the author, either the U.S. has made this breakthrough, or the U.S. is behind in countering some Soviet threat based upon this X-ray threat. Neither the 'pat on the back' or the 'jab in the ribs' stories are true.

"One could read about these X-ray effects several years ago in unclassified official handbooks on nuclear weapons effects. Anyone working with nuclear weapons exploding above the atmosphere must either exploit, or protect against, such effects.

"We have had, and continue to pursue, major research and development programs designed to minimize the susceptibility of our systems to such kill mechanisms and, at the same time, to maximize their effectiveness in developing ballistic missile defense. The details must remain classified. An isolated speech or a paragraph in congressional testimony does not make this 'new.' I admit it can be 'news,' albeit news with an available background of fact.

"Let me try to summarize my views on the matter of a 'technological plateau.' We know that R&D is 'worth it' — in hard economic terms as well as in strategic terms, and in fulfilling normal military functions as well as in creating entirely new capabilities.

"There is no stagnation in defense R&D. There is no 'technological plateau' now. Nor do I think there will be one created, either accidentally or by design. You can help us by resisting any temptations to reinforce the myth of a technological plateau. There are times when my job and yours may lead to conflict. But a controversy about a technological plateau is simply a false conflict based upon misinterpretations.

"We have looked briefly at R&D related to strategic systems, and a few problems in public discussion of these systems. Let's look now at a rather different topic: the role of R&D to support the conflict in Vietnam. The most important single focus in defense R&D today is on meeting, wherever possible, the R&D needs revealed by that conflict.

"Each spring, as you know, we have opportunities to appear before the Congress to present and explain our budget request. Congressmen, like reporters, have a way of asking direct, penetrating, and important questions.

"One of the most striking questions this year was: Why do we show roughly the same R&D budget request in FY 68 for the manned orbital laboratory and for our total R&D effort for Southeast Asia? An attempt to answer this single question may be helpful to you.

"There are some simple answers. First, we cannot project our Southeast Asia R&D requirements very far in advance because so many of them are quick-reaction projects. In this fiscal year, for example, we initially budgeted about $400 million. Subsequently, the Services reprogramed almost $100 million more, and received approximately $200 million more from emergency and supplemental funding.

"Thus the budget was increased from $400 to almost $700 million during an 18-month period in which urgent R&D needs developed. The same evolution may occur during FY 68.

"Second, some of our research for limited warfare simply isn't expensive. For example, the R&D required to develop a new jungle boot, specially tailored to the hot moist climate of Vietnam, cost less than half a million dollars. The country has spent many times that much for the astronauts' flight wear. Both the soldier and the astronaut have to be properly equipped for their jobs. We need them both, and the dollars fall where they must.

"Third, general purpose forces have been under development for hundreds of years, while the first astronaut flew only four years ago. Hence much of our current tactical warfare R&D is devoted to achieving relatively small improvements to existing hardware. Two years of combat have demonstrated beyond question that our troops were well-trained and excellently equipped from the outset.

(Continued on page 34)

STRATCOM Designates Skinner Chief of Staff

Col William G. Skinner has been assigned as chief of staff of the Army's Strategic Communications Command (STRATCOM), following a tour as STRATCOM comptroller since March 1966 at Fort Huachuca, Ariz. He succeeds Col Lawrence R. Klar, recently retired.

A 1937 graduate of Western Maryland College, Col Skinner is a former commanding officer of the Missile Support Agency at White Sands, N. Mex. A veteran of six campaigns in Korea, he served as deputy signal officer with the IX Corps.

In recent assignments, he served as deputy chief of the Program and Budget Review Division of the Defense Communications Agency in Washington, D. C., and as executive officer with the Comptroller's Office, Office of the Chief Signal Officer in the Pentagon.

Other assignments since entering military service as a second lieutenant in 1941 include Camp Crowder, Mo. (1943-47); U. S. Army Pacific (1947-50); and a previous assignment at Fort Huachuca, Ariz., as deputy and chief, Electronic Warfare Department (1956-59).

Col W. G. Skinner

Dr. Foster Lauds R&D Programing

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"These are a few of the simple reasons why we are not able to spend more. But there are other, more fundamental reasons.

"General Maxwell Taylor has characterized the Vietnam conflict as a limited war with limited objectives, limited resources, and, hopefully, limited risks. I would like to add one more restraint: limited applicable technology. If there is one indisputable feature of the Vietnam war, it is that a 'technology fix' alone will not solve our problems. The hard-core problems are essentially political, social and economic. The solutions to these problems will not be found in the products of R&D. Nor will it help to invoke any mythology about the potential of R&D.

"I must add, of course, that there *are* some key problems in Vietnam which R&D should be able to solve. If solutions can be found to these problems, not only might the war be shortened, but our capability to deter other such limited wars would be greatly strengthened.

"At this point I would like to remind you of a somewhat under-publicized aspect of the war. General Westmoreland has been extremely eager to innovate, to press the concept of 'combat R&D.' To assist this process, I assigned two distinguished defense scientists to act as personal advisers to Admiral Sharp and General Westmoreland. Dr. William McMillan is in Saigon, and Dr. Thomas Cheatham is in Hawaii at CINCPAC Headquarters.

"To provide coordination of all our Vietnam-related R&D, I also established a new office within my staff, the Deputy Director for Southeast Asia Matters, and appointed Mr. Leonard Sullivan to this job. The splendid and critical contributions of these three men are a reflection of the entire R&D community's involvement.

"We have had many R&D successes in Vietnam. But I think I should give you, in the interest of candor, a sampling of the R&D problems emerging from Vietnam which we still don't know how to solve. We are still looking, for example, for a satisfactory way to find tunnels. If we could reliably locate tunnels, we would be well on our way to cracking the Viet Cong's principal resource for command, logistic supply, and escape.

"As another illustration, many of our casualties are caused by primitive mines and booby traps. These are often made from our own dud munitions, sometimes even from our cast-off ammunition boxes. We would like a device that could sense explosives and/or metal wires and fragments about 100 yards away that one man can carry along with other combat gear. This same device might be useful in warning of impending ambushes — another serious and deadly problem.

"The VC are masters at the art of infiltration — not just across the borders into South Vietnam, but into our military bases, local outposts, and villages where they practice the diverse techniques of terrorism.

"To meet this threat, we need much better ways to differentiate friend from foe. And we must find reliable 'burglar alarm' systems to warn of approaching or passing danger. Like the other needs I have mentioned, the successful development of simple 'border security' systems and 'people-detection' devices will have spin-off benefits far beyond the scope of the present war.

"We have not yet solved these problems. Do they sound impossible? How does it sound when I ask you to dig a little trench — on the moon? Do you think these problems are not being solved because of a lack of money? I don't think that's the reason. I think it is because we don't know how to spend more money sensibly. This is a tough answer to give a Congressman and a reporter. But it's true.

"These problems are perhaps best attacked by interdisciplinary teams of physical and social scientists. Any turning point in Vietnam will depend upon careful discrimination and analysis, and then change, in the social and physical environment. Obviously, we need to employ all of our skills to get to the point where, instead of counting killed Viet Cong, we will be counting live, independent, self-governing citizens.

"As pointed out in my Congressional statement, we in R&D must heed Santayana's warning that those who don't understand history are condemned to repeat it. We are trying to learn the lessons applicable to R&D activity. It would be irresponsible not to learn these lessons. You can help us here by reaching for the careful and complete story, distinguishing between the various kinds of R&D problems.

"Let me turn now to two examples of areas in which we clearly need growth over the long-term future. I will sketch our thinking about goals for what is called 'man-in-the-system,' and for our research and technology base.

"A key problem now recognized more clearly as a major direction for future R&D is really a cluster of problems pertaining to people. The Defense Department is many people: pilots, infantrymen, intelligence officers, commanders, raw trainees, computer operators, R&D professionals, managers, and on and on. And all of these people participate in 'the system.' But too often our systems do not really fit the man.

"We are beginning to expand efforts in education and training; in human factors engineering; in manpower analyses for all equipment in advanced R&D; in improved equipment for the individual soldiers' vision, firepower, protection and mobility; and an improved understanding of the environmental conditions affecting man/machine performance. At some point in the future, as this work succeeds, we will have developed really matched capabilities for men, equipment, and the opera-

TORQUE Offers System of Balanced R&D Programing

(Continued from page 5)

Additional considerations for which TORQUE offers no formula include the need of allowing some proportion of the total funds for use in high-risk, high-payoff efforts of low apparent relevance that may lead to significantly improved military capability.

Validity of the TORQUE system's applicability to non-materiel areas, such as the behavioral sciences, also is open to conjecture.

Provided that comments being prepared by the Assistant Secretaries for Research and Development of the three services approve the proposal for a pilot test of TORQUE, results are expected to demonstrate many of the specific values of the system as well as areas for improvement.

Under the guidance of Dr. Donald M. MacArthur, Deputy Director of Defense Research and Engineering (Research and Technology), the ad hoc committee that developed TORQUE consists of two representatives each of the Army, Navy and Air Force and seven expert advisers.

The Army representatives are Harold Davidson, a physical scientist in the Office of the Special Scientific Adviser, U.S. Army Research Office, and Lewis Roepcke, chief, Technical Planning Branch, Scientific and Technical Division, Development Directorate, U.S. Army Materiel Command.

Navy representatives are the committee chairman, Marvin Cetron, head of Technological Forecasting and Appraisal, HQ Naval Materiel Command, and Harold Liebowitz, head of the Structural Mechanics Branch and engineering adviser for the Office of Naval Research.

Air Force members are Lt Col Patrick H. Caulfield, chief, Laboratory Plans Office, Directorate of Laboratory Plans and Programs, Air Force Systems Command, and Maj Joseph P. Martino, assistant executive director, Research Communications, Air Force Office of Scientific Research.

Advisers to the ad hoc group included Col Raymond S. Isenson, special assistant to the Deputy Director of Defense Research and Engineering (Research and Technology); Peter Fishburn, Research Analysis Corp., an Army contract agency; Robert F. Lockman, Center for Naval Analyses; Lyle V. Jones, University of North Carolina; Frederick S. Pardee, RAND Corp.; Harry Kaplan, Behavioral Sciences Research Laboratory, U.S. Army; and Herbert Solomon, Stanford University.

tional environment.

"In each of these areas — so easily listed, so difficult to assess adequately — there are millions of people and man-hours and dollars at stake. These are, in many ways, the most important potential payoff fields of the future. Though our data base is limited, our theory limited, I believe the possible improvements are enormous.

"The second area of significance for one to two decades from now is Project Themis. As you may know, Project Themis is our new university research program. It is designed to create — using the President's phrase — new academic departmental 'centers of excellence.' Our goal is to stimulate the development of new university groups, active in defense-relevant basic research, in geographic areas and institutions which have not previously received substantial DoD support.

"I regard this program — funded at about $20 million this year and, Congress willing, expected to expand by almost 50 percent next year — as an exciting initiative. In a sense, it is an experiment and we are delighted with the reaction so far.

"We received nearly 500 preliminary proposals from almost 200 universities, requesting almost $400 million. Note that the proposal requests amounted to almost 20 times more money than we have available!

"On balance, the proposals were of high technical quality. By July, we will have evaluated the detailed proposals. We then will begin awarding contracts for about 50 centers, funding each at roughly $200,000 per year, with advance funding to permit schools to make commitments for three years.

"Our present plan is to add about 50 new centers each year for the next three years. We will begin another round of solicitations later this year.

"Based on payoffs from the last 20 years of university research, I am convinced that Project Themis can be successful, and that it merits more attention by you and your collegues. For this new program is precisely the kind to ensure against any possible 'technological plateau.'

"Make no mistake — we do not believe that $200,000 per year can create an institutional center of excellence. But we do know — from experience — that consistent support of able leaders of doctoral-level research can create departmental excellence, and that this, in turn, can catalyze the growth of an institution.

"We have no intention of reducing our support of existing academic centers of excellence. What we are doing in Themis is broadening and defining our research and technology base to support our future national security.

"Before concluding, I want to touch again on issues central to the role of the press in defense R&D. I have already mentioned some, but would like to return to the tougher ones.

"I quoted Secretary McNamara's statement on freedom of information earlier. I wholeheartedly support this pledge for maximum disclosure of unclassified information: to inform the American public, to maintain a clarifying public debate on major issues, to reach the rest of the world, and to remove any doubts in the eyes of our adversaries about our strength and our desire for peace with freedom.

"Questions arise, obviously, about the possible release of classified information, and about the classification criteria. It seems to me that a complicating factor is not anyone's failure to appreciate the need for security presautions. It is, in part, the challenge of prying open any kind of secrecy. I believe that all the facts necessary for an informed public discussion are avilable on an unclassified basis.

"The problem, I suppose, as Reston (James Reston of the *New York Times*) put it recently, is that it is easier to get 'a breathless presentation of the news, featuring the flaming lead and the big headline,' if you can tag the news as a 'secret.'

"Some people say there is overclassification. They are right. But be careful. Some of this is caused by a conservation based upon the need to make difficult judgements on national security policy under conditions of uncertainty. Our job is to ensure that the necessary secrecy is maintained. Your job is to educate the public on national security without compromising our security.

"I believe that you can and usually do get adequate information. Discretion need not displace truth. And we are, as a nation, indebted to those reporters and columnists who understand these issues and act in the public interest.

"There is another, perhaps tougher problem in reporting research and development news. Obvious but often underrated, it is simply the technical complexity and uncertainty surrounding most R&D work.

"Frequently one is asked by reporters to give estimates on the performance, costs, schedules of R&D projects. If one hesitates or begs off completely, there is irritation, or criticism about excessive secrecy. In my experience, the difficulty is that there simply isn't a good estimate available.

"Sometimes a complete answer requires a sophisticated set of caveats. However, everybody wants a number which magically resolves their arguments or sells their story. To confess, I do, too. But at times there just isn't a simple answer.

"Ladies and gentlemen, I have touched on limited areas of defense R&D: a few of our objectives, some lessons learned, and common problems. I have tried also to deal squarely with some issues which I thought were sensitive and significant from your perspective.

"I approached this occasion with great care, some anxiety and a good deal of ignorance about your preferences and perceptions. I hope very much that we can maintain a symbiotic rather than a hostile or wary relationship. We have a collective responsibility to analyze some difficult public issues, to serve the public interest, and to report a responsible analysis with integrity. The stakes are very high — national security."

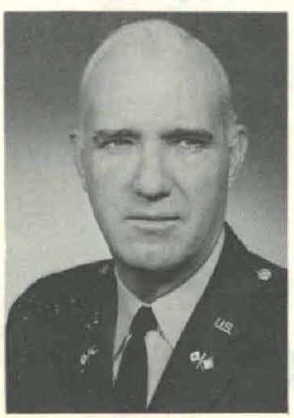
2 Army Scientists Contribute To Communication System Book

Two employes of the U.S. Army Electronics Command (ECOM) are major contributors to the recently-published *Communication System Engineering Handbook*.

Donald H. Hamsher, physicist and technical director of the Commodity Management Office for Test Equipment and Power Services, edited the 972-page volume. Henry R. Burkhard, electronic engineer and branch chief in the Communications and Automatic Data Processing Laboratory, contributed the chapter on "User Equipment and Services."

Published by McGraw-Hill Publishing Co., the book covers communication system engineering, including such areas as principles and standards, practical data and theoretical material.

Col Scales Selected SATCOM Deputy Commander



Col Robert H. Scales

Col Robert H. Scales, director of programs at the U.S. Army Satellite Communications (SATCOM) Agency since July 1964, was assigned recently as deputy commander of the agency at Fort Monmouth, N.J.

Col Eugene B. Datres, who had served as deputy to SATCOM Commander Col Mitchell Goldenthal since August 1966, was reassigned to Vietnam as assistant chief of staff, J-6, HQ MAC-V.

Prior to joining SATCOM, Col Scales served as chief of the Operations Division, U.S. Army Maintenance Board at Fort Knox, Ky., and as deputy for operations at Pirmasens Army Depot, Germany.

He has served in the United States, Philippines, Korea and Japan in various engineering assignments since graduation from Officer Candidate School in 1942. His military schooling includes courses at the Command and General Staff College (1956-57) and the Armed Forces Staff College (1961).

High Army Officials to Address R&D Seminar

Success of the 10th Annual Research and Development Seminar for Reserve Officers, July 30 through Aug. 11 at the Engineer R&D Laboratories, Fort Belvoir, Va., appears assured by the numerous high-ranking dignitaries who have accepted invitations to speak.

The seminar will be focused on the Army R&D life cycle, starting with top management planning down through project and bench level activities, including research, development, test and evaluation. Seminar and panel discussions will be broken down into working groups.

One of the highlights is slated Aug. 1 when General Frank S. Besson Jr., CG of the U. S. Army Materiel Command (AMC), will speak on materiel problems. Maj Gen Julian J. Ewell, Deputy CG and Chief of Staff of the U. S. Army Combat Developments Command, will discuss concepts and doctrine. Maj Gen L. G. Cagwin, CG of the Test and Evaluation Command, and Brig Gen Edwin I. Donley, CG of the Mobility Equipment Command, also will speak.

Army Materiel Command Deputy for Research and Laboratories Dr. Jay Tol Thomas is the featured speaker on the afternoon of Aug. 1, along with Col R. W. McEvoy, commander of the U. S. Army Limited War Laboratory, and Col J. H. Schofield, special assistant for project management, AMC.

Director of Army Research Col Charles D. Y. Ostrom Jr., is programed for a major presentation Aug. 2. Lt Gen William F. Cassidy, Chief of Engineers, and Dr. Gilford Quarles, his chief scientific adviser, are featured Aug. 3. Maj Gen W. J. Sutton, Chief of Army Reserve, is the main speaker Aug. 4.

Assistant Secretary of the Army (R&D) Dr. Russell D. O'Neal will be represented Aug. 7 by Charles F. Woodside, assistant for programs, who will discuss management of Army R&D.

Chief of Research and Development Lt Gen Austin W. Betts is scheduled to give the major address Aug. 11.

Welcoming remarks July 30 will be made by Maj Gen R. F. Seedlock, CG, Fort Belvoir, and Col Frank Milner, commander of the Army Engineer Research and Development Laboratories.

Members of the 1621st Reserve Training Unit at ERDL will serve as the seminar staff under Lt Col Alexander Levin.

AMC Assumes Management Of Generators for Defense

Defense-wide management of all military engine generators, assigned recently to the Department of the Army, has been delegated to the Army Materiel Command (AMC).

Lt Col Joseph J. Rochefort, the new project manager, is a June, 1967 graduate of the Army War College and has been selected for promotion. Col Robert J. Giesen, AMC project manager for generators since August 1965, was awarded the Legion of Merit and reassigned in July as District Engineer, Walla Walla, Wash.

Col Rochefort has the new title of Department of Defense project manager for Mobile Electric Power, and his main office is at Fort Belvoir, Va.

Projected requirements will increase the number of engine generators in the Department of Defense inventory from the present 300,000 to an estimated 400,000. Listed as critical combat items, the generators are needed to support Department of Defense commitments, including operations in Southeast Asia.

Army responsibility is for the selection and design of all mobile (skid or wheel-mounted) diesel and gasoline engine generators. Not included are fixed-permanent electric power installations, nuclear power sources and ship-borne and aircraft-borne generation devices.

Management of engine generators had been divided among the Army, Navy, Air Force, Marine Corps, and other Defense Department agencies. Except for the Defense Supply Agency, each pursued separate research, development and logistical programs.

A major objective of the new project manager will be the establishment of a standard family of electric power generators, ranging from .5 kilowatts to 2,000 kilowatts, within the Department of Defense. The purpose is to satisfy the maximum number of military applications with a minimum number of sizes and types to minimize cost and logistics support.

A 1945 graduate of the U. S. Military Academy, Lt Col Rochefort was CO of the 84th Engineer Battalion (Construction), July 1964- January 1966, and served with the Engineer Command, U. S. Army Vietnam until May 1966.

He received an MS degree in civil engineering from California Institute of Technology in 1953.

Engineers Society Honors 4 Belvoir Men

Several members of the Army Corps of Engineers were honored at the recent annual awards dinner of the Society of American Military Engineers.

The Itschner Award, named for former Chief of Engineers and past society president Lt Gen Emerson C. Itschner, was presented to Company A, 39th Engineer Combat Battalion of the 45th Engineer Construction Group. Offered to the most outstanding company-sized unit of the year, the bronze plaque cited the unit's service in Vietnam under Capt George P. Johnson.

The Wheeler Medal, offered annually for the most outstanding contribution to military engineering through achievement in design, construction, administration, research or development, went to Maj Gen Robert R. Ploger, commander of the Army Engineer Command Vietnam.

He was recognized for his leadership in the operational support to combat units, the provision of military facilities, and intelligence and mapping activities.

The medal is named for Lt Gen R. A. Wheeler, another past president of the society and former Chief of Engineers.

The Ralph A. Tudor Medal for the most outstanding contribution to military engineering in design was offered for the first time to a civilian member of the society, Sherman J. Bollinger.

An engineer in the office of the Army Engineer District, Omaha, Bollinger was recognized for installation of the hydraulic turbines at the Oahe power plant and his improvements in the design of large fixed-blade, propeller-type turbines.

Lt James C. Thomas received the Toulmin Medal, offered to the author of the article judged the best published in the *Military Engineer* during the year. The article was "The Computer Story," a history of the development of calculating devices, computers and applications.

STRATCOM Takes Control Of Fort Huachuca

Command of 90-year-old Fort Huachuca, Ariz., which was selected in December 1966 as HQ of the U. S. Army Strategic Communications Command in a move from Washington, D. C., was transferred to STRATCOM July 1.

Maj Gen Richard J. Meyer, CG of STRATCOM, accepted the transfer from Col Nicholas C. Angel, commander of the U. S. Army Electronics Proving Ground, an element of the Test and Evaluation Command (TECOM), in formal ceremonies. TECOM has exercised command of Fort Huachuca since the 1962 Army reorganization.

General Meyer is now CG of Fort Huachuca as well as CG of STRATCOM. Col Angel continues as commander of the Army Electronics Proving Ground. Col C. A. Mette Jr., former deputy commander and chief of staff for the USAEPG, is the new post commander.

STRATCOM has assumed responsibility for all post support facilities in addition to other normal staff functions.

Included in the transfer are such functions and facilities as offices of civilian personnel, the adjutant general, the staff judge advocate, intelligence and security, logistics, comptroller, plans and operations, information, military construction, post exchanges, finance and accounting, aviation, motor pool, maintenance and repair, and engineering shops.

Army Wins Economy Champion Plaque

Climaxing the U. S. Civil Service Commission (CSC) 6-month Economy Champion Program, CSC Chairman John W. Macy presented to Secretary of the Army Stanley R. Resor a wall plaque honoring the Army for achieving the largest saving of $13,553,034.

In the June 22 ceremony at the CSC office, Washington, D. C., the second-place award went to the Air Force for economies totaling $8,312,912. The Navy was third with $7,603,837. The Air Force had 147 champions, the Navy 133 and the Army 108 out of the government-wide total of 515.

The Army accounted for 32 percent of the total savings of $41 million.

Among non-defense agencies, the Department of Transportation had the largest saving of $2,823,957. With 27, the Post Office had the most champions.

Initiated in January in support of the President's cost-cutting campaign, the Economy Champion Program honored federal employes whose adopted suggestions resulted in first-year savings of $10,000 or more.

Each champion received a commemorative folder containing a citation from the President. Monetary awards were made earlier as part of the local agency's incentive awards program.

Special honors were accorded nine employes whose suggestions each saved over one million dollars. Four are employed at Army installations.

Credited with the most impressive single savings of the 6-month program are two employes of Picatinny Arsenal, Dover, N. J.: Fred G. Ladd, an equipment specialist, and Vincent W. Puleo, a mechanical engineer.

Their suggestion to convert existing stocks of 57mm practice ammunition to high explosive ammunition used in a recoilless rifle in Vietnam saved $4,429,317 and won them a place on the June list. An initial award of $1,000 has been approved, with a supplemental award under review.

The other two Army million-plus savers are William W. Deckert and Frank N. Wilcox, February Economy Champions from the U. S. Satellite Communications Agency, Fort Monmouth, N.J. They shared an initial $1,500 for a $1,429,770 suggestion for modifying surplus Air Force electronics equipment for use in communications satellite systems.

Following are the Army Economy Champions on the May list. Except for the million-plus savers, the June list had not been released at press time.

Rock Island (Ill.) Arsenal boasted a 2-time winner, Herbert A. Hebeler, a production controller, for suggested improvements on the M102 howitzer. This time he received $525 for a $10,848 economy suggestion, a previous award of $1,265 was for a $212,683 saving.

Francis J. Huntowski and Anthony Orefice, U. S. Satellite Communications Agency, Fort Monmouth, N. J., shared a $1,500 award for recommending incorporation of the Marine Corps diesel generator into the design of the power generator AN TSC-54, saving of $505,000.

Victor K. Vincent, Fort Sheridan, Ill., suggested that private line telephone service be provided by the local commercial telephone company for all on-post Class B unofficial telephone subscribers, formerly serviced by a government-owned switchboard. The suggestion saved $203,000. Vincent received an initial award of $1,250, with more pending.

Four champions are from the Aeronautical Depot Maintenance Center, Corpus Christi, Tex. Santos Serna received an initial award of $1,000 for devising a way to restore certain jet engine parts to serviceable condition and saving $551,010. J. C. Yelverton received $840 for a $37,425 suggestion; Calvin F. Seay Jr., $835 for saving $36,627, and George T. Klaus, $800 for a $29,382 saving.

At Aberdeen (Md.) Proving Ground, Charles A. Grace, Robert L. Kessler and Harvey C. Logan divided $934 for a $56,719 suggestion. Retha J. Powell, U.S. Army Engineer Center, Fort Belvoir, received $870 for a $43,732 idea.

Two employes of the Red River Army Depot, Texarkana, Tex., also made the list. They are Reed W. Carder, who received $570 for a $12,637 saving, and David N. Self, $580 for a $13,084 idea.

Other May champions and their awards are Joseph Forestier, Tooele (Utah) Army Depot, $810 for a $31,230 saving; William Fultz Sr., Office of the Secretary of the Army, $715 for a $18,565 saving; Carbin L. Cross, U. S. Army Armor Center, Fort Knox, Ky., $550 for an $11,869 idea; and Daniel Gonzales, White Sands Missile Range, Las Cruces, N. Mex., $535 for a $11,375 suggestion.

SCALE MODEL of the Army's newest aircraft, the AH-56A Cheyenne, is presented to the city of Cheyenne, Wyo., by Army Chief of Research and Development Lt Gen A. W. Betts during Cheyenne's 1967 annual Armed Forces Day banquet. To the right of General Betts are Maj Gen George O. Pearson, adjutant general of the Wyoming National Guard; Governor Stanley K. Hathaway of Wyoming; and Cheyenne Mayor Herbert Kingham. The first AH-56A Cheyenne was rolled out recently at the Lockheed-California Co. plant in Van Nuys and is undergoing tests.

DoD Adds MILSCAP To Logistics Systems

A standard information system known as MILSCAP (Military Standard Contract Administration Procedures) has been developed by the Department of Defense for use by the Military Departments, Defense Supply Agency, and the Defense Contract Administration Services.

Purpose of MILSCAP, designed for high-speed digital data transmission and automatic data processing, is to standardize information data in the functional areas of procurement, contract administration, inventory control, storage, and financial accounting.

The new system will replace a variety of nonstandard procedures currently in use by procurement and contract administration activities throughout the Department of Defense. MILSCAP will be installed progressively because of its impact on existing procedures and may require two or three years for complete implementation.

MILSCAP was developed jointly by the Office of the Secretary of Defense, the Military Departments, and the Defense Supply Agency. It will be an integral part of other DoD standard logistics data systems such as MILSTRIP (Military Standard Requisitioning and Issue Procedures), MILSTRAP (Military Standard Transaction Reporting and Issue Procedures) and MILSTEP (Military Supply and Transportation Evaluation Procedures).

Kudos

DISTINGUISHED SERVICE MEDALS (DSM) were presented recently to two leaders of major commands upon completion of tours of duty. Lt Gen Ben Harrell, CG of the U.S. Army Combat Developments Command (CDC) at Fort Belvoir, Va., since May 1965, is now the CG of the Sixth U.S. Army.

General Harrell was cited for eminently meritorious leadership and judgment in advancing the CDC mission of designing and developing advanced warfare concepts extending 20 to 25 years into the

ARMY CHIEF OF STAFF General Harold K. Johnson (right) presents Distinguished Service Medal (First Oak Leaf Cluster) to Lt Gen Ben Harrell.

future. Before taking command of the CDC, he was Assistant Chief of Staff for Force Development in the Pentagon.

Lt Gen Harry W. O. Kinnard is the new CG of the CDC. Until recently, he was Deputy Assistant Chief of Staff for Force Development in the Pentagon.

Brig Gen Howard F. Schiltz received the DSM upon completing more than three years service as CG of the U. S. Army Aviation Materiel Command, St. Louis, Mo., to accept assignment with HQ, U. S. Army Materiel Command, Washington, D.C.

The citation noted that his "outstanding managerial ability, keen awareness of military requirements, and his untiring efforts contributed greatly to the solution of the many difficult problems incidental to the rapid deployment of many Army aviation units, including the 1st Cavalry Division(Air Mobile).

Col Thomas W. Mellen, Deputy Director of Developments, Office of the Chief of Research and Development (OCRD), Department of the Army, received the Distinguished Service Medal for service in Vietnam from May 1964 to February 1967. His citation states:

"His performance of duties as commanding officer of the 3d Brigade, OIC of the Multibrigade Counterinsurgency Test "Operation Black Night," and as chief of staff of the 225th Infantry Division was outstanding . . . and vastly improved Army-wide counterinsurgency doctrine and techniques. . . ."

MERITORIOUS CIVILIAN SERVICE AWARD. The Army's second highest honor for civilian employes was presented recently to John T. Pennington, U. S. Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency (GIMRADA), and to Henry Handler, U. S. Army Materiel Command (AMC).

Pennington was acting technical director when he retired recently to end 30 years federal service. He was cited for "exceptional leadership and administrative capabilities" while associated with GIMRADA.

The citation continued: "His technical plan for the development of an advanced highly complex geodetic satellite system was approved without change and formed the basis for the success of the Army's Sequential Collation of Range (SECOR) satellite now performing high-priority missions for the Department of Defense. He created an organization of senior research specialists which formed the nucleus of the present Research Institute of Geodetic Sciences of GIMRADA . . ."

Henry Handler, AMC technical relations adviser, was cited for establishing modern industrial management relations in the command. The citation noted that "his broad technical background . . . and unusually comprehensive grasp of the complexities of modern industrial management have underwritten the outstanding success he has achieved in establishing effective and enduring relationships between AMC and the various national . . . societies and associations that represent the civilian industries with which the command is so closely allied."

MCSA medals presented to Mrs. Norah Comer and Mrs. Catherine R. Durkin recognized outstanding performance of

MERITORIOUS Civilian Service Award is presented to John T. Pennington by Col H. W. Fish, GIMRADA commander.

AMC technical relations adviser Henry Handler receives Meritorious Civilian Service Award from General Frank S. Besson Jr., AMC commander.

duties in the Office of the Executive for Administration, OCRD. Mrs. Comer, with OCRD since 1952, is administrative assistant and chief, Management Services Branch. Mrs. Durkin is chief, Military Personnel Branch, and has been in OCRD 11 years.

Mrs. Comer was cited for her "detailed knowledge and understanding of military administration, her extremely sound judgment in the important area of budgetary planning and programing, and her extensive knowledge of manpower procedures and civilian personnel management."

Mrs. Durkin's citation said she has "continuously demonstrated ingenuity, judgment and professional competence to an outstanding degree. . . . Her broad knowledge of the requirements for the availability of officer scientists . . . (have contributed to) obtaining highly qualified officers for key R&D positions. . . ."

LEGION OF MERIT. Col Eugene B. Datres, deputy commander of the U.S. Army Satellite Communications (SATCOM) Agency, Fort Monmouth, N.J., received the LOM for his "exceptionally meritorious performance in critical assignments and for substantial and lasting achievements in satellite communications technology." With SATCOM since 1963, he has been deputy commander since August 1966.

Col Milton M. Berry, chief, Electronics Division, Materiel Directorate, HQ U.S. Army Combat Developments Command, received the LOM for exceptionally meritorious service and forceful leadership decisions on major electronics materiel since July 1964.

Col Richard V. Kissam Jr., now en route to Korea, received the LOM for his service as chief of the Training Division, AMC.

At the U.S. Army Aviation Material Command (AVCOM), Col Eduardo M. Soler, project manager for the Utility Tactical Transport Aircraft System, received the LOM for service in Vietnam.

Col Soler was assigned in 1965-66 to the U.S. Military Assistance Command,

Vietnam, in successive posts as Army Aviation Officer, Office of the Assistant Chief of Staff for Operations, and as chief, Army Aviation Division, Combat Operations Center.

Exceptional service while chief of the Enteric Bacteriology Laboratory, U.S. Army Medical Research Team in Vietnam, November 1965 to January 1967, earned an LOM for Col Sidney Gaines, now assigned to the Walter Reed Army Institute of Research. Cited for establishing and directing the laboratory in a combat zone, he trained Vietnamese citizens to be laboratory technicians.

Lt Col Louis T. Schaner received the LOM upon his retirement from the Doctrine Division, U.S. Army Combat Developments Command Maintenance Agency, Aberdeen (Md.) Proving Ground. He was cited for exceptionally meritorious service from June 1966 to April 1967.

Lt Col Harry F. Smith (USA, Ret.), received the LOM for more than 10 years outstanding service with the Air Defense Board, Fort Bliss, Tex. His last assignment was chief, Electronic Systems Test Division.

BRONZE STAR MEDAL. For his meritorious achievement in ground operations against hostile forces in Vietnam from October 1965 to August 1966, Maj Charles M. Conant, chief of Anatomical Pathology and assistant chief of Laboratory Services, Walter Reed General Hospital (WRGH), received the Bronze Star Medal (BSM).

A first Oak Leaf Cluster (OLC) to the BSM was awarded to Maj Samuel W. Patellos, Materiel Directorate, Combat Developments Command, also for meritorious service in Vietnam.

Capt Wilbur D. Addison, assistant registrar at WRGH, received the BSM for service as executive officer of the medical company, 25th Medical Battalion, 25th Infantry Division, Vietnam, March 1966 to February 1967.

Sp/5 James R. Tipton, U.S. Army Medical Unit, Fort Detrick, Md., won the BSM with "V" Device for heroism in Vietnam. As a medical specialist with the 1st Infantry Division, Tipton dodged enemy fire to assist in evacuating a critically wounded soldier.

VN GALLANTRY CROSS. Lt Col Thomas U. Greer, Combat Materiel Division, OCRD, recently received the Vietnamese Cross of Gallantry. Before assignment to OCRD, Lt Col Greer was G-3 with the 25th Infantry Div., Vietnam.

Maj Frank H. Miller, aviator at Davison U.S. Army Airfield, was presented the Vietnamese Cross of Gallantry with Silver Star for heroic actions on Dec. 27, 1965.

ARMY COMMENDATION MEDAL. The first Oak Leaf Cluster (OLC) to the Army Commendation Medal (ACM) was presented to Lt Col Frank D. Conant Jr., Nuclear, Chemical and Biological Division, Office of the Chief of Research and Development. He was commander of the 72d Armor Battalion, 2d Infantry Division, Korea, before assignment to OCRD.

Lt Col Joseph K. Conant was awarded the first OLC to the ACM for service while an engineer staff officer, Directorate of Installations and Service, AMC.

GOLDEN FLEECE AWARD. Dr. Stephen J. Kennedy, director of the Clothing and Organic Materials Division, U.S. Army Natick (Mass.) Laboratories received the Golden Fleece Award presented annually by the National Association of Wool Manufacturers. He was cited for his outstanding contributions towards insuring that "American soldiers are the best clothed in the world."

Dr. Franken Becomes ARPA Acting Director

Dr. Peter Franken, 1967 winner of the Physical Society Award, assumed duties recently as acting director, Advanced Research Projects Agency (ARPA), Office of the Director of Defense Research and Engineering.

After serving as deputy director of ARPA since January this year, Dr. Franken succeeded Dr. Charles M. Herzfeld, who resigned to become technical director of the Defense-Space Group, International Telephone and Telegraph Corp., at Nutley, N.J. Dr. Herzfeld had served with the U.S. Government for 16 years.

Dr. Franken received the Physical Society Award for his "important and original contributions in the field of spectroscopy, particularly to harmonic generation and rectification, level crossover spectroscopy, and optical pumping."

Before joining the ARPA staff, he served in both academic and research positions with the University of Michigan.

51 Medical Corps Officers Achieve A-Prefix Rating

Medical A-prefix awards signifying the highest level of professional excellence were presented recently to 51 Army Medical Corps officers, in addition to 11 winners of the award at Walter Reed General Hospital (WRGH) announced in the June *Army R&D Newsmagazine*.

Additional WRGH recipients and their speciality field are Lt Col Louis E. Harman Jr., dermatology; Lt Col Alan R. Hopeman, thoracic surgery; and Lt Col John G. Maier, radiology.

Office of The Surgeon General recipients are Col Robert W. Green, Col Marshall E. McCabe, and Col William H. Merony III, internal medicine; Col James K. Pope, general surgery; and Lt Col Maurice Patton, preventive medicine.

Officers at Walter Reed Army Institute of Research who received the award are Col Marcus R. Beck, pathology; Col Paul E. Teschen, internal medicine; and Col Stefano Vivona, preventive medicine.

Letterman General Hospital winners of the award are Col Bruce F. Chandler, internal medicine; Col George B. Hamilton, gastroenterology; Col Thomas B. Hauschild, psychiatry; Col Alfred O. Heldobler, orthopedic surgery; Col Charles A. Moore, urology; Lt Col Leon D. Graybill, radiology; and Lt Col Fred C. Williams, ophthalmology.

At Fitzsimons General Hospital, Denver, Colo., new recipients of the A-prefix are Col Donald J. Joseph, otolaryngology; Col Evan L. Lewis, urology; Col John W. White, general surgery; Lt Robert C. Jones, cardiology; and Lt Col Daniel C. Plunket, pediatrics.

Recipients at Brooke General Hospital and Brooke Army Medical Center, Fort Sam Houston, Tex., are Col Harold F. Hamit, general surgery; Lt Col Darl E. Vander Ploeg, dermatology; Col James P. Perrine, obstetrics and gynecology; Lt Col Jerome H. Greenberg, preventive medicine; and Lt George E. Omer Jr., orthopedic surgery.

Officers recognized at Madigan General Hospital, Tacoma, Wash., are Col William H. Hall, internal medicine; Col John H. Sharp, general surgery; and Lt Col William A. Meriwether, pathology.

Recipients at Tripler General Hospital in Hawaii are Col Robert B. Griffen Jr., pediatrics; and Col Edward J. O'Shaughnessy, urology.

At William Beaumont General Hospital, El Paso, Tex., the new A-prefix recipients are Col William F. MacDonald, orthopedic surgery; Col Robert H. Moser, internal medicine; and Lt Col Joseph A. Hawkins, pulmonary diseases.

Three doctors with the U.S. Army Europe received the award: Col William A. Collins Jr., urology; Col William J. Tiffany Jr., psychiatry; and Lt Col Stephen W. Czarnecki, cardiology.

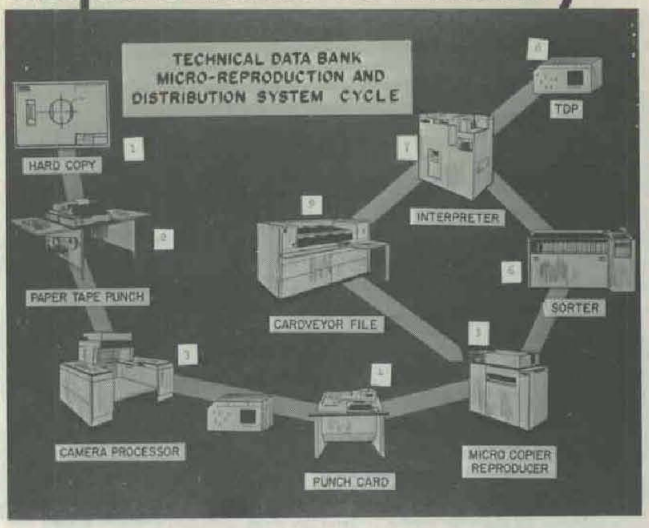
Honored also were Col Irvin C. Plough, internal medicine; and Lt Col Jack C. Fitzpatrick, nuclear medicine; both with the Medical Research and Development Command, Washington, D.C.; Lt Col Nicholas G. Bottiglieri, internal medicine, Medical Research Laboratory, Edgewood (Md.) Arsenal; Col James C. Syner, internal medicine, Medical Research and Nutrition Laboratory, Fitzsimons General Hospital; and

Col Richard R. Taylor, internal medicine, Biological and Medical Sciences Division, Office of the Secretary of Defense; Col Charles W. Kraul, industrial medicine, HQ U.S. Army Materiel Command, Washington, D.C.; Col Roswell G. Daniels, industrial medicine, 9th Hospital Center, Heidelberg, Germany; and

Col Samuel W. Caldwell, preventive medicine, U.S. Army Hospital, Fort Ord, Calif.; Lt Col Pierre A. Finck, forensic pathology, Armed Forces Institute of Pathology, Washington, D.C.; Lt Col Robert I. Bosman, pathology, 10th Medical Laboratory, Landstuhl, Germany; Lt Col Joseph F. Metzger, pathology, 406th Medical Laboratory, Haramachida, Japan; and Col Paul E. Siebert, radiology, HQ U.S. Army Vietnam.

TDP Presents Government Requirements to Industry

By Ralph E. Armbruster
Chief, Electrical Equipment Production Branch, USAERDL



Successful competitive procurement of military equipment depends on clear, concise and unambiguous definition of all U.S. Government requirements for the product to be delivered. The vehicle for the communication of these requirements between the government and industry is the Technical Data Package (TDP).

The TDP, when properly prepared, contains all the design disclosure data, specifications, quality assurance provisions and acceptance criteria necessary for the full and complete item description, procurement and manufacture.

The present world situation has placed vastly increased demands upon operators of data banks responsible for the preparation and distribution of the numerous TDPs. The average package contains some 400 sheets of basic data and about 800 sheets of supporting data.

Timely and accurate distribution of the numerous bid packages required for realistic competitive procurement can be handled only by a well-planned microreproduction and distribution system predicated on current Department of Defense policies. A major step toward this goal has been achieved at the U.S. Army Mobility Equipment Command's (MECOM) Engineer Research and Development Labs. Fort Belvoir, Va.

This system provides automatic and semiautomatic capabilities for the storage, retrieval, reproduction in various forms, and distribution of technical data. The ERDL data bank's capability to meet commitments for TDP distribution for those items of equipment for which ERDL has been assigned responsibility for research, development, procurement and standardization custodianship.

The ERDL system decreases time of preparation and improves the accuracy and the completeness of the data required to support some 500 equipment items. The range is from air conditioners, generators and mine detectors to heavy equipment such as bridges and 20-ton cranes.

Prior to the installation of the new system, all data-calls for drawings were filled by sepias or blue-line copies. These are "hard copy," full-scale documents. As the demand for data increased, reproduction time advanced from one week to two weeks and sometimes longer.

Lack of timely response, increased cost of hard copy, storage requirements and the sheer bulk of data to be shipped provided a real incentive for systematizing the data flow. Added to the problem was the dangerous out-of-file situation, with its attendant document loss potentialities.

Phenomenal growth of data-calls was the real motivating factor for establishing the new system. Growth in distribution in FY65 increased sixfold, from 12,000 to 72,000 units a month. In FY66, distribution approached 115,000 units a month. It now ranges around 150,000 units a month.

Standard 35mm microfilm aperture cards are used in the system for all design disclosure, quality assurance and associated documentation. This means that all drawings, parts lists, data lists, SQAPS, gage manuals and change notices are filmed.

In the near future, all referenced documents such as military standard parts (MS, AN) and military and federal standards and specifications will be available on film. Supporting the film aperture cards is the data processing capability obtained from the punched data entered on each card. This data is standardized through MIL-STD-804 application, mandatory to all Department of Defense users.

The focal point of the total system operation is the Control Office (No. 1) on the accompanying figure showing the reproduction and distribution cycle. All data, new or revised, forwarded to the data bank for processing, and all requests for data are received by the Control Office. Each inquiry for data or submission of data is logged in, priority established, processed and distributed under strict control.

Pertinent data connected to the documentation to be processed is generated directly on paper tape (No. 2) for automatic inventory card punching on a tape-to-card punch (No. 4). This inventory card is used for data processing. It differs from the aperture card in that it has no film and contains some additional digital data. The paper tape also is used for subsequent verifying and data communications system transmission through a direct data link to Headquarters, MECOM, St. Louis, Mo.

A control sheet and the inventory cards just mentioned are simultaneously prepared and maintained as controlled lots for quality assurance. Concurrently, the master documents are grouped in matching lots, and exposed at the rate of 60 per hour through the camera processor (No. 3), using silver-haloid film premounted in aperture cards.

Still in controlled lots, the outputs of the camera processor (No. 3) and the punch card (No. 4) are verified and match-merged in the microcopier (No. 5). This match-merge transfers the punched data from the inventory or slave card to the aperture card.

Documents processed for storage only are sorted (No. 6), if necessary, and are interpreted (No. 7) to provide visual readout at the top of the card of the punched data. Completed cards may then be filed in the rotating file (No. 9).

Data requiring further duplication for distribution is returned to the microcopier reproducer (No. 5) and the number of copies desired are automatically reproduced at the rate of 2,000 per hour. Only the aperture film and punching are accomplished; interpreting (No. 7) is a separate operation. Distribution aperture cards (No. 8) are sorted into separate packages, wrapped securely and mailed as required. Only aperture cards are mailed out. Hard copy is limited for in-house engineering use only.

In general, many engineering requirements can be fulfilled by the use of duplicate sets of aperture cards and an aperture card reader. Certain engineering steps require hard copy. This is accomplished by one of three existing methods, not shown on the accompanying figure. Individual aperture cards are reproduced on a reader-printer on a manual basis. Requests for larger numbers of hard copy are handled on automatic printers.

One of these printers reproduces documents reduced to preselected sizes for facility of transportation. The other reproduces documents to one of two fixed sizes only. The rate is 100 and 300 per hour, respectively, for the two printers.

A microreproduction system similar to the one described is becoming a definite requirement on all military data banks responsible for technical data package documentation. Such a system permits state-of-the-art growth, meets ever increasing data demands and reduces personnel and handling costs.

The potential management benefits in data processing, data manipulation and management controls are still untapped. Accuracy, completeness and inclusion of supporting data to a technical data package are the immediate gains to both government and industry.

Advanced Geometry Glass Fiber-Reinforced Plastic Rotor Blades

By Lt George Zuments

Since major developmental effort began in the U.S. less than 30 years ago, the helicopter has evolved from an underpowered, overweight machine, barely capable of lifting its own weight, into a complex, medium-range aircraft capable of carrying large payloads at high speed.

During this period, the heart of the helicopter — its rotor system — has developed from wooden spars, or wooden spars and ribs built around a central tube, to all-metal construction.

Recent advances in glass fiber-reinforced material design and fabrication technology have indicated potential advantages of fiberglass over contemporary blades similar to those afforded by metal over wooden blades.

To help realize this potential, the U.S. Army Aviation Materiel Laboratories (AVLABS), aviation research center at Fort Eustis, Va., recently awarded Boeing-Vertol Division a $200,000 contract for a 16-hour flight test program of advanced geometry, glass fiber-reinforced plastic rotor blades for the CH-47A helicopter.

Use of wood resulted in rotor blades susceptible to geometric and balance variations, caused by temperature and humidity changes, but it offered the designer a relatively wide latitude in selecting blade geometry. Simple construction methods of wood allowed the designer to taper the planform to obtain greater aerodynamic efficiency without unreasonable increase in manufacturing costs.

The advent of the all-metal blade yielded all-weather suitability and a geometric uniformity. However, the high cost of tooling and manufacturing associated with any attempt to introduce rotor planform or airfoil taper in the metal blades dictated the more economic use of constant chord and uniform airfoil sections — certainly not the most aerodynamically efficient blade geometry.

With the introduction of the gas-turbine engine and its greatly increased power, designers found that all-metal rotor blades were unable to realize the maximum thrust potential available. Also, control load and vibration problems associated with constant chord 0012 airfoils severely limited the pure helicopter forward speeds.

In light of these developments, it became mandatory to develop a high-performance rotor capable of utilizing the advances in engine technology and aerodynamic analysis made in recent years.

1st LT GEORGE ZUMENTS is an aerospace engineer in the Applied Aeronautics Division of the U.S. Army Aviation Materiel Laboratories, Fort Eustis, Va. He received BS and MS degrees in aerospace engineering from Georgia Institute of Technology in 1964 and 1965

In 1965, Boeing-Vertol initiated an extensive in-house program to develop a high-performance rotor blade. Results indicated that use of glass fiber-reinforced materials could possibly offer the all-weather suitability, reliability, and uniformity of metal blades and, at the same time, provide an even greater configuration freedom than previously available with wooden blades.

The glass-fiber structure also would permit maximum flexibility in modification. Small airfoil and local area section property changes could be incorporated, even on completed blades, without excessive cost.

Blades to be flight-tested under the contract are the result of these extensive analytical studies of the aerodynamic, dynamic, and structural environment of the helicopter rotor at high lift, altitudes, and speeds. Test programs evaluating airfoils on model rotors and blade design and material research studies also have been conducted. An extensive materials-testing and fabrication-study program has been completed. Blades currently being fabricated will be subjected to a 50-hour whirl-test program prior to flight tests.

Glass fiber-reinforced materials will be used for the spar, skins, nose and tip fittings. An aluminum honeycomb core and titanium rott-end fitting bonded to the glass spar will be the only metal parts.

The 36-inch root chord tapers to 29.75 inches at the tip (1.22 taper ratio), with the airfoil thickness varying from 12 percent at the root to 10 percent at 55 percent rotor radius to 6 percent at the tip.

Airfoil sections also will be varied to match the average angle of attack over the rotor disk as determined from a new nonuniform inflow velocity-profile analysis developed by Vertol. This variation will enable the blades to be more aerodynamically efficient than contemporary blades.

Combining technological advances in rotary-wing aerodynamics and glass fiber-reinforced plastic material design and fabrication, these rotor blades should prove the feasibility of the advanced geometry blade concept.

This program is the first step in implementing the technological advances in composite materials for rotary-wing applications.

Utilization of some form of advanced composite material should permit the helicopter to perform more efficiently at its maximum capabilities in payload, range and speed.

Battelle Asks Industry to Back Cold-Forging Research

Joint industry backing of a research program to pace technologically the World War II-born cold-forging business that reportedly supports some 70 plants in the U.S. is being proposed by Battelle Memorial Institute.

Scientists at Battelle's Columbus (Ohio) Laboratories have briefed more than 100 representatives of manufacturers and users of the products of cold forging and extrusion. Estimated cost of the proposed 3-year research program is $360,000.

Cold forging and warm forging are used primarily to produce small symmetrical parts used by the automotive industry, such as starter motor couplings and steering control parts.

Future markets, which Battelle forecasters predict will triple in size by 1975, are expected to include lawn mowers, small tractors, pole-line hardware, aircraft ground-service hardware, hand tools, steam fittings and bearing components. The nation's cold-forging plants are expected to require annually 300,000 tons of hot-rolled bars of iron.

The study's eight tasks would provide new fundamental knowledge of the process and materials involved. Such practical problems as lower-cost die design, machinability, effects of processing variables, evaluation of temperature effects and factors affecting shearing effectiveness would be considered.

Proposed tasks are:

- Study of effects of processing variables on workability in cold forging and extrusion.
- Analysis of deformation and stresses in cold forging and extrusion.
- Evaluation of machining properties of cold-forged parts.
- Study of temperature effects on workability and part producibility.
- Study of process controls for achieving specific design strengths in cold-forged products.
- Study of the metallurgy of cold forging.
- Development of useful methods for measuring and analyzing stresses in tooling for cold forging.
- Study of factors influencing shearing effectiveness.

Concurrent with the laboratory investigation would be a continuing effort to monitor all literature on cold forging generated throughout the world. Published data would be brought to the attention of the companies underwriting the research.

AMC Notes 5th Anniversary Progress

(Continued from page 5)

and service tests will follow, and advance production engineering plans are being formulated.

Major contributions were made to the Initial Defense Communications Satellite Project (IDCSP), the U.S. worldwide military satellite communications system. The Army Satellite communications (SATCOM) agency provided the ground terminals and conducted the system evaluation program.

SATCOM exercises AMC action responsibility in the tri-Service tactical satellite-communications (TACSATCOM) program. The agency designed and built in-house small experimental TAGSAT terminals installed in jeeps, ¾-ton trucks and vans.

Progress of Army R&D on lasers was depicted in "Laser —Miracles with light," produced for the AMC Director of Development by the U.S. Army Pictorial Center. The film won the top award, "The Golden Atom," in the International Electronics, Nuclear Telecommunication and Motion Picture Ressegna held annually in Rome, Italy.

Deployment of the AMC-developed Air Defense Control and Coordination System, the AN TSQ-51, was completed during the year. Increasing the capability and flexibility of U. S. Air Defenses with a reduction in manpower requirements, weight, cost of operations and training time, the system performs the functions of an Army command post in controlling and coordinating the fire of Nike Hercules missile batteries.

Advanced development of the SAM-D (Surface-to-Air Missile Development) was initiated with award of a contract in May. Designed for battlefield and continental air defense against aircraft and short-range missiles, the SAM-D is planned to replace eventually the Nike Hercules and a portion of the Hawk air defense systems.

Design of a new perimeter Acquisition Radar (PAR), a major subsystem of the Nike-X missile defense system, also was contracted for as the third phased array radar in the system. Others are the Multifunction Array Radar and the Missile Site Radar. PAR is expected to increase greatly the range at which the Nike-X system can detect targets.

A propulsion concept that may be useful in future missile and space operations was employed in a hybrid rocket which performed well in Army flight tests during April. The 5-foot-long rocket was composed of a solid-propellant boost stage and a hybird stage incorporating solid fuel and a liquid oxidizer. Selectable ranges, up to now, have not been built into a solid-propellant missile because of the problem of controling the burning.

Minimum modification to convert the Lance configuration to an extended range Lance Missile (XRL) will be performed under AMC management. The decision to begin development extends application of the Lance concept, which offers reliability and low cost associated with a free rocket but provides the range and accuracy of a guided missile.

Credit for a pioneering role in the Automatic Digital Network (AUTODIN) system was claimed by the AMC when it installed the first IBM 360-20 Multimedia Terminal at HQ U.S. Army Mobility Command. AMC also added 396 telephone lines to its existing 730 Automatic Voice Network (AUTOVON) lines.

The Automatic Data Field Systems Command (ADFSC) reported substantial progress in the developmental study of its three major systems, the Tactical Fire Direction System (TACFIRE), the Tactical Operations System (TOS) and the Combat Service Support System (CS3). Contract definition contracts were awarded to three companies for TACFIRE.

A contract for the TOS program calls for mobile automatic data processing equipment to be supplied to the Seventh U.S. Army. An equipment contract award under the CS3 program was placed during May and delivery is scheduled during April-June 1968.

Initial delivery of Field Artillery Digital Automatic Computer (FADAC) systems to Southeast Asia is scheduled this year. More than 100 systems have been deployed to the U.S. Army Europe.

The first DIMATE (Depot Installed Multipurpose Automatic Test Equipment), a fully automatic test set directed by a digital computer, was placed in operation as a production tool at the AMC's Tobyhanna Army Depot. Another unit is being installed at the Sacramento Army Depot. DIMATE can diagnose failures in better than 95 percent of Army electronic materiel operating in the DC to 400 MHZ frequency range.

The Army's new Defense-wide management responsibility for engine generators was assigned to the AMC project manager for Mobile Electric Power. A major objective will be the establishment of a DoD standard family of electric generators, ranging from 0.5 to 2,000 kilowatts. About 300,000 engine generators are in the DoD inventory and projected requirements will increase this total to an estimated 400,000.

Analysis of wear metals contained in samples of used oils was stressed as a major area of AMC effort with the establishment of three laboratories. Plans call for creation of three more to become operational in FY 1968. The program will establish a worldwide capability to monitor aircraft components for wear metals in used oils as a basis for corrective action to increase the reliability and life span of components.

AMC installations were encouraged to concentrate effort in Value Engineering. During the first 10 months of FY 1967, AMC contractors submitted 462 Value Engineering Contract Proposals (VECPs) with a potential dollar value estimated at $60 million. Approval was given to 250 VECPs valued at about $15 million.

In commenting upon achievements of the Army Materiel Command since it was established, General Besson said:

"AMC's 5-year record is a creditable one. Man for man and weapon for weapon, the United States Army today is the most effective, versatile and best-supplied in its history. It is a modern, efficient, professional fighting force. The dedicated military and civilian work force — with the help of American industry — is determined to keep it that way."

Aeronautical Research Lab Appoints Airfoil Consultant

Accelerated research to develop improved rotary-wing airfoils, an objective of continuing concern of the aircraft industry and users, is being conducted at the U.S. Army Aeronautical Research Laboratory, Moffett Field, Calif.

Dr. Henry R. Velkoff, associate professor in the Ohio State University Department of Mechanical Engineering and a noted helicopter specialist, is serving 10 weeks as a consultant on air research to Paul F. Yaggy, ARL technical director.

Dr. H. R. Velkoff

Dr. Velkoff also will teach a course in helicopter dynamics for the ARL staff and researchers of the NASA-Ames Research Center at Moffett, with which the ARL conducts a joint program in aeronautical research.

Dr. Velkoff started a survey July 1 of previous efforts in airfoil research. He will assess and analyze the adequacy of all available data and make recommendations for ARL analytical and experimental research programs. Results of this study will be available upon request by government agencies and industrial organizations.

Awarded a BS degree by Purdue University in 1942, he received MS and PhD degrees in 1952 and 1962 from Ohio State University. Dr. Velkoff has held several consultative positions with Department of Defense agencies and from 1944 to 1963 was an engineer in the Propulsion Laboratory of Wright Patterson Air Force Base, Ohio.

Army Library Lists Latest R&D Acquisitions

Recent acquisitions of the Army Library, the Pentagon, Washington, D.C., include the following books of possible interest to research and development personnel.

Accounting Guide for Defense Contracts, 5th ed., Paul M. Trueger, KC 85 .T86 A1 1966.

Administration of Government Supported Research at Universities, The, U. S. Bureau of the Budget, Q 180 .U5 A213 1966.

Aerospace Ordnance Handbook, Frank B. Pollard, UF 563 .P77.

Algorithm for Identifying the Ergodic Subchains and Transient States of a Stochastic Matrix, B. L. Fox (Rand), Q 180 .A1 R18 no. 5269.

Annotated Bibiography on Military Civic Action, Thomas Hall, Z 7164 .C4 H17.

Annotated Bibliography on Systems Cost Analysis, P. A. DonVito (Rand), Q 180 .A1 R18 no. 4848-1.

Attitudes of Troops in the Tropics: An Abridgement of Research Reports, U. S. Army Natick Laboratories, UC 30 .A56 EPT-6.

Automation of a Portion of NCO Leadership Preparation Training, Morris Showel (HumRRO), U15 .G34a 66-21.

Biology of Human Adaptability, Paul T. Baker, ed., QH 546 .B16.

E Brief Notes on the Tahoi, Pacoh, and Phuong of the Republic of Vietnam, Marilou Fromme (CRESS), DS 557 .A6 F93.

COLLECT: A Program for the Retrieval of Grammatical Information from Annotated Text, Martin Kay (Rand), Q 180 .A1 R18 no. 5243.

Compact Statistical Method of Topographic Representation, Barry W. Boehm (Rand) Q 180 .A1 R18 no. 5081.

Computer Systems Analysts: Problems of Education, Selection and Training, Frank Greenwood, HF 5548.2 .G81.

Cost/Benefit Relationship of the M.B.A. Program for the Army, Rodney A. Edge, U 716 .E23.

Criteria for Evaluating the Effectiveness of Library Operations and Services, Phase I: Literature Search and State of the Art, Army Technical Library Improvement Studies, Z 678 .A74 v. 1.

Defense Management, Stephen Enke, UA 23 .E58.

Defense Procurement Handbook, U. S. Dept. of Defense, KC 85 .U5821 D3 1965.

Description and Analytic Discussion of Ten New Concepts for Electronics Maintenance, A, Edgar L. Shriver and Robert C. Trexler, (HumRRO), U15, .G34a 66-23.

Design Engineering: Inventiveness, Analysis, and Decision Making, John R. Dixon, TA 174 .D62.

Department of Defense Incentive Contracting Guide, U. S. Assistant Secretary of Defense (I&L), KC 85 .U5805 D4 1965.

Development of a Potential Defense R&D Complex: A Study of Minneapolis-St. Paul, Kirk Draheim (Stanford), Q 180 .U5 D756.

Dictionary of Military and Naval Quotations, Robert D. Heinl, U 19 .H46.

Differential Games: A Mathematical Theory with Applications to Warfare and Pursuit, Control and Optimization, Rufus P. Isaacs, QA 270 .I73.

Economic Policies Toward Less Developed Countries, Harry G. Johnson, HC 59.7, J67.

Economics Department Publications, 1963-1966: An Author Index of the Open Literature, with Abstracts, Harriet Porch (Rand), Q 180 .A1 R18 2800-2 suppl.

Effect of Programed Instruction Response Conditions on Acquisition and Retention, The, Thomas J. McCrystal and T. O. Jacobs (HumRRO), U 15 .G34a 66-20.

Effective Writing for Engineers, Managers, Scientists, Henrietta J. Tichy, PE 1408 .T55.

Fluid Dynamic Aspects of Ballistics, North Atlantic Treaty Organization, TL 500 .N864 no. 10.

Formal System for the Logical Analysis of Temporal Relationships Between Intervals of Time, Robert Mattison (Rand), Q 180 .A1 R18 no. 5279.

Fundamental Studies of Ions and Plasmas, H. Dean Wilsted, TL 500 .N864 no. 8.

Guide to Reference Material, Vol. 1 — Science and Technology, Albert J. Walford, Z 1035 .W17 1966 v. 1.

Helicopter Developments, North Atlantic Treaty Organization, TL 500 .N864 no. 7.

Implementation and Utilization of the Leader Preparation Program, Paul D. Hood (HumRRO), U 15 .G34a 67-2.

Information, Scientific American, Z 699 .S41.

Input-Output Economics, Wassily W. Leontief, HC 106.5 .L58.

Jungle Acoustics I: Transmission and Audibility of Sounds in the Jungle, D. A. Dobbins, U. S. Army Tropic Test Center, U 167.5 .J8 D628 v. 1.

JOSS: User Scheduling and Resource Allocation, G. E. Bryan (Rand), Q 180 .A1 R18 no. 5216.

LF and VLF Reflection Loss in the Lower Ionosphere: A Theorem on Absorption and its Application, H. G. Booker (Rand), Q 180 .A1 R18 no. 5249.

McGraw-Hill Modern Men of Science, Q 141 .M14.

Minority Groups in the Republic of Vietnam, American University Cultural Information Analysis Center, DA pamphlet 550-105, DS 557 .A5 A558.

MISCOM: An Individual Missile Weapon System Computer Cost Model, R. E. Clapp (Rand), Q 180 .A1 R18 no. 5142.

Multichain Markov Renewal Programs, Eric V. Denardo (Rand), Q 180 .A1 R18 no. 5208.

Multiple-Access Techniques for Communication Satellites: Analog Modulation, Frequency-Division Multiplexing and Related Signal Processing Methods, E. E. Reinhart (Rand), .Q180 .A1 R18 no. 5117.

Nato and Europe, Andre Beaufre, D 845 .B37.

Predicting Material Behavior under Load, Time and Temperature Conditions, H. P. van Leeuwen, TL 500 .N862 no. 513.

Problems of Soviet Defense Policy Under the New Regime, Thomas W. Wolfe (Rand), Q 180 .A1 R16 no. 3098.

Proceedings of the 19th International Management Conference: The Bridge Between Science and Management, Society for Advancement of Management, HD 28 .S673 1964.

Programed Learning in Vietnamese: Construction and Evaluation of a Short Practical Language Course, Alfred I. Fiks and Dinh Van Ban (HumRRO), U 15 .G34a 67-1.

Protein Binding of Small Ions — A Mathematical Model of Serum Albumin, Edward C. DeLand (Rand), Q 180 .A1 R18 no. 5254.

Pursuit Rotor Performance: II. Effects of Reinforcing Successively Longer Intervals of Continuous Tracking over Practice Sessions, Richard W. Sheldon and John F. Bjorklund (HumRRO), U 15 .G34a 66-22.

R&D: Essays on the Economics of Research and Development, Daniel Hamberg, HD 20.3 .H19.

Records, the Systems Memory of Action, from the Systemation Letter, Leslie H. Matthies, HF 5736 .M44.

Role of the University in Defense R&D. The, Albert Shapero (Stanford), Q180 .U5 S52.

Separated Flows, NATO, AGARD, TL 500 .N864 no. 4.

Sino-Soviet Military Relations, Raymond L. Garthoff, DK 68.7 .C5 G24.

Small Arms of the World: A Basic Manual of Military Small Arms, Walter H. B. Smith, UD 380 .S663 1966.

Social Impact of Cybernetics, The, Charles R. Dechert, Q 315 .D29.

Social Psychology of Organization, Daniel Katz, HM 131 .K19.

Social Research: Strategy and Tactics, Bernard S. Phillips, H 62 .P55.

Some Effects of Raised Intrapulmonary Pressure in Man, John Ernsting, TL 500 .A26 no. 106.

Soviet Cybernetics in Technology: IX. ALGEC — Summary and Critique, Niklaus Wirth (Rand), Q 180 .A1 R18 no. 5157.

Space Communications Techniques, Richard F. Filipowsky, TL 3025 .F48.

Structure and Dynamics of Research and Exploratory Development in Defense R&D Industry, Richard P. Howell, Q 180 .U5 H85.

Symposium on the Arctic Heat Budget and Atmospheric Circulation, Lake Arrowhead, Calif., 1966, Proceedings, J. O. Fletcher, ed., (Rand), Q180 .A1 R18 no. 5233.

Exhibit Van Portrays R&D Activities on Tour of U.S.

How research and development activities are providing modern materiel for the soldier of today, and projecting requirements a decade in advance, are depicted in a new van exhibit, "Shaping the Army's Future," which this month began an extended tour.

Viewer-participation displays, technimated panels and colorful photo artwork are used to show how the U. S. combat soldier of today is being equipped to move, see, shoot and communicate better than the enemy — and how long-range R&D planning is preparing to produce superior materiel.

The viewer can simulate firing the Dragon, the newest antitank guided missile, at a moving target, or he can see how objects on a night-time battlefield become visible through an infrared Metascope.

Exhibit highlights also include a working model of the Sheridan/Shillelagh weapons system; a technimated model of orbiting satellites used with ground stations to relay military messages around the world; and a newly developed emergency respirator, shown in operation.

Other action exhibits feature mechanized artwork activated by the viewer to explain the Army's Nike-X Missile System, and a mobile floating assault bridge.

The exhibit is housed in a 12-ton expansible van which is 38 feet long by 15 feet wide by 11 feet high (expanded and accompanied by a team of four men.

The nation-wide tour began in Winona, Minn., July 5-8, and will proceed as follows: July 14-22, Minneapolis, Minn.; July 24-28, St. Cloud, Minn.; July 31-Aug. 6, Chippewa Walls, Wis.; Aug. 9-13, West St. Paul, Minn.; Aug. 18-27, Des Moines, Iowa; Sept. 1-7, Huron, S. Dak.; Sept. 11-16, Texarcana, Tex.; Sept. 18-22, Longview, Tex.; Sept. 25-30, Lubbock, Tex.; Oct. 9-11, Association of the United States Army Annual Meeting, Washington, D.C.; Oct. 26-28, Buffalo, N.Y.

AFMA Expects Conference Aug. 29-31 to Draw 500

"The System Concept — Men, Money, Management" is the theme of the 14th national conference of the Armed Forces Management Association (AFMA) Aug. 29-31 at the Washington Hilton Hotel, Washington, D.C.

More than 500 high-level officials of the Office of the Secretary of Defense, Army, Navy, Air Force and private industry will exchange views on management ideas, techniques and methods. Discussion will cover the establishment and implementation of systems as a keystone of improved management methodology.

Advanced models and the latest developments in computers, optical scanners and information display devices used by management will be exhibited.

CHIEF OF R&D and Nike-X System Manager Lt Gen A. W. Betts cuts the ribbon at recent opening ceremonies for the Department of the Army touring exhibit, "Shaping the Army's Future," at Cameron Station, Alexandria, Va. The mobile exhibit was built by the U.S. Army Exhibit Unit (AEU) and will tour the nation under the auspices of U.S. Army Chief of Information Maj Gen Keith L. Ware, shown at left with Lloyd S. Sullivan, AEU commander. The exhibit will be displayed free to the public during a tour of the U.S.