ARMY
RESEARCH AND DEVELOPMENT
January-February 1978

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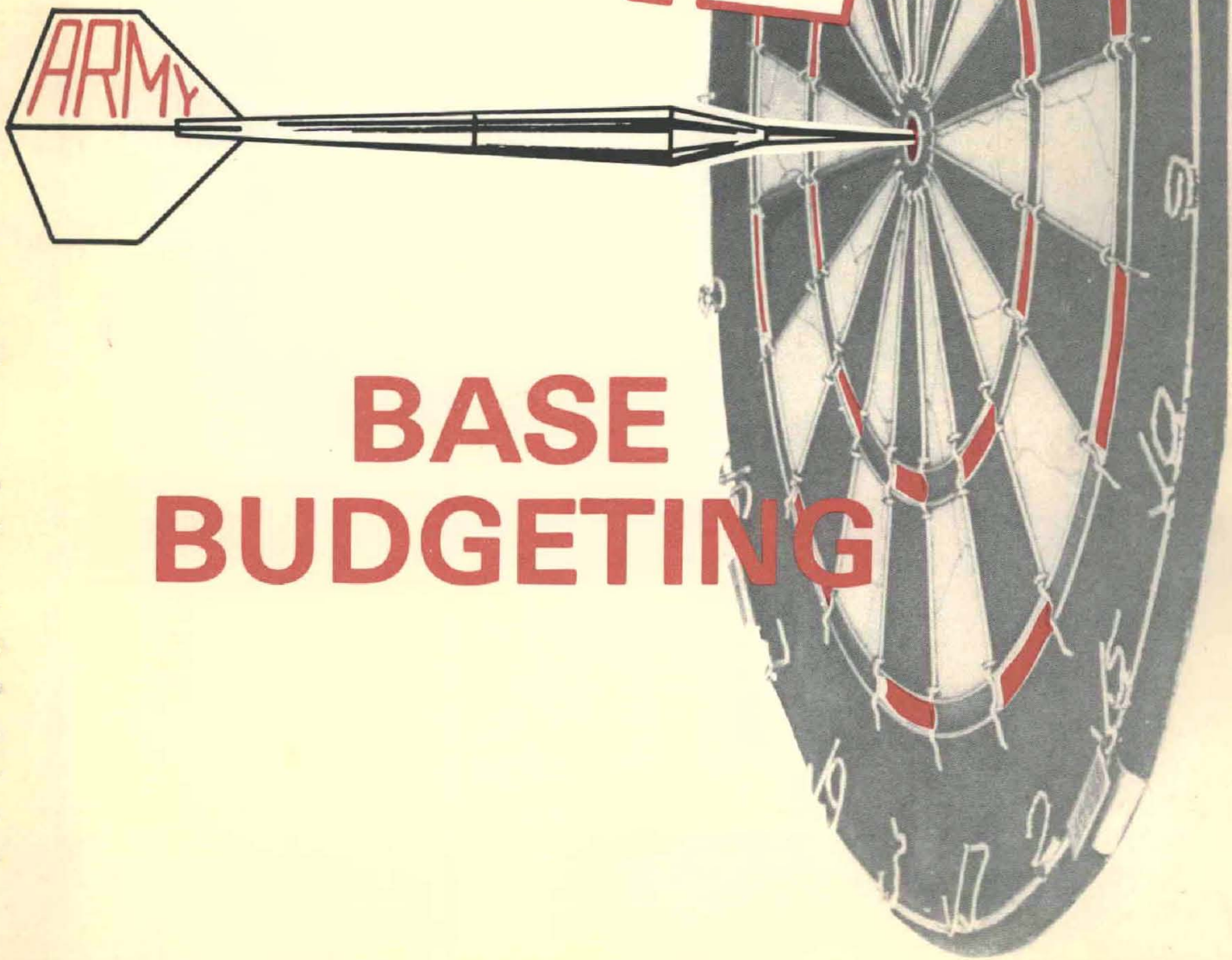


BASE BUDGETING

R&D Newsmagazine Founder-Editor Retires. . .

Clarence T. Smith

For the first time since the inception of this magazine in 1959, the name of Clarence T. Smith is missing from the title of editor. Having retired in July 1977, he was retained as editor until Jan. 3, 1978, to provide the benefit of his vast wealth of knowledge, guidance, and professional experience.

"Clare" or "Smitty," as he is affectionately known to his friends and associates, was selected personally to be the first editor of this embryonic publication by LTG Arthur G. Trudeau in late 1958. GEN Trudeau, then Chief of Research and Development, DA, saw a decided need for a magazine oriented entirely toward the Army's research and development community. Smith's long experience in the military publication field was vital to the successful establishment of the magazine and to its ensuing success. The mission, as it was established at the time, is still carried on the masthead of every issue and it remains the valid objective.

As its first and only editor, since its initial issue in December 1960 and continuing through the December 1977 issue, Smith published a magazine that consistently brought high praise from its readers and compliments from its professional contemporaries. The high standards he set and maintained for the magazine earned him the praise and respect of his superiors and all those connected with the Army R&D community.

Through his insistence on standards of format, content and composition, he provided those who succeed him a magnificant record of accomplishment against which to strive.

Smith's record of association with the journalism field encompasses over 50 years of outstanding accomplishments and performance of duty. He began his career as a sports and city editor for a mid-west daily in 1925, and extended his activities in the ensuing years to directing political campaigns at the state and local level.

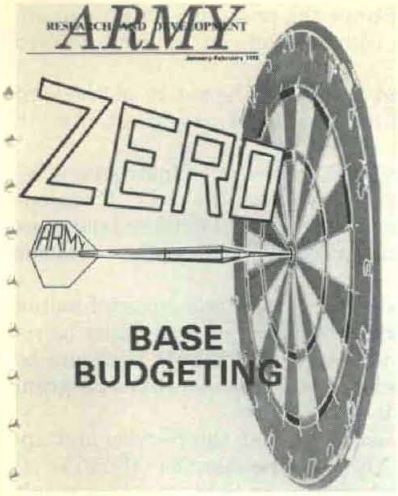
It was during World War II that he first became associated with what was to become his true place in life, an expert in the field of military publications. Service in a military capacity with the editorial staff of **Yank**, beginning in 1943, was followed quickly by his co-founding the publication **Outfit**, directed toward the Army's hospitalized, sick and wounded.

With the coming of peace and the consolidation of many of the military publishing and news activities, Smith became the managing editor of Armed Forces Press Service. After his discharge from the Army, he stayed with the military journalism field by accepting a civilian position with **Stars and Stripes** in Europe.

His stay in Europe would last some ten years, during which time he had the extremely interesting experience of being the editor of **Task Force Times**, the journal of the Combined Airlift Task Force that was supplying blockaded Berlin. While in Europe his professional experience and skills were used in a variety of ways, from Command Information Officer, U.S. Air Forces Europe, to Civil Affairs Officer. In each of his assignments he invariably earned the high praise and commendations of senior officers, his superiors and associates.

Following his decade of overseas duty, Smith returned to the United States in 1957, to become a writer for the Deputy Chief of Staff for Personnel. It was from this position that LTG Trudeau selected him to be editor of this magazine.

Smith has provided a unique service to the Army and its R&D community. We who follow will strive to adhere to the tradition he established in developing an excellent R&D magazine.



ABOUT THE COVER. . .

Zero-Base Budgeting, a new management process, presents a challenge to the R&D community when formulating, submitting and defending programs and budgets. Like the centuries old game of darts, improved over the years by equipment, such as bristol boards, tungsten shafts and synthetic fiber flights - styled to the needs of the user, the strength of our RDTE appropriation may depend largely on how we think, practice and use the latest processes and equipment throughout the RDA community. Cover design by Leslie S. Davis, ODCSRDA.

Editor . . . . . L. VanLoan Naisawald
Associate Editor . . . . George J. Makuta
Assistant Editor . . . . . Harvey Bleicher
Staff Assistant . . . Mrs. Thelma Heisler

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

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FEATURES

DEPARTMENTS

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R&D News...

For about a year now everyone in the Federal Government involved with programing and budgeting has been wrestling with the new process of Zero-Base Budgeting. Since the impact of "ZBB" extends down to the lab bench level, we asked COL Richard L. Nidever, who was intimately involved in preparing the first Army RDTE "ZBB", to compose an article that would explain how the new system works, its differences from the old, and its advantages to the entire R&D community.

ZERO-BASE BUDGETING — WHAT'S DIFFERENT?

By COL Richard L. Nidever

Most of the R&D community has presumably been involved to some degree in zero-base budgeting (ZBB). For the first time, the Armed Services have formulated, submitted, and defended their programs and budgets to the Office, Secretary of Defense (OSD) in ZBB format. This process, overlayed on the traditional planning, programing, and budgeting system (PPBS), has not been easy. We have all come a long way in ZBB since first hearing of it from candidate Jimmy Carter in 1976.

It is necessary to understand what has happened, what this new management process has done to us, and what challenge it presents for the future, for ZBB appears to be a permanent fixture. The strength of our research, development, test and evaluation (RDTE) appropriation may depend largely on how we think, practice, and exercise ZBB throughout the R&D community from the lab to the Army Staff.

We at DA level cannot urge the field to defend the appropriation and support ZBB without assuring that we are all operating from a consistent knowledge base and starting point.

Please don't be misled, the process is not as easy as it may appear. However, I believe that ZBB advantages outweigh disadvantages and its use will improve the management of our RDTE appropriation.

The Defense Department had, through the PPBS, tied planning and budgeting into a single process. Objectives, cost effectiveness, and involvement became the theme of ZBB and, as we'll see, carried throughout ZBB development and implementation.

In April 1977, the Office of Management and Budget (OMB) Bulletin No. 77-9 provided initial ZBB definitions, concepts, and procedures. To start out, OMB defined a decision unit (DU) as a program "for which budgets are prepared and for which a manager makes significant decisions relative to the amount of spending and the scope or quality of work to be performed." Within the Army RDTE appropriation, a DU is a collection of program elements (PE) relating to a specific military mission (e.g., Defense Research, Land Warfare, Test and Evaluation and others).

A funded DU was termed a decision package, and a funded DU at more than one funding level became a decision package set (DPS). DUs and DPSs became the primary ZBB documents throughout the FY79 budget cycle. Figure 1 shows the RDTE program element relationship to decision package set.

RDTE program elements and projects	→	grouped by a related mission area	→	is a decision unit
A decision unit	→	described, justified, and funded at one level	→	is a decision package
A decision package	→	described, justified, and funded at more than one level	→	is a decision package set

Fig. 1. RDTE Program Element to Decision Package Set

OMB further explained that a minimum level (later termed Decremented level) was a "program, activity, or funding level below which it is not feasible to continue the program, activity, or entity because no constructive contribution can be made toward fulfilling its objectives."

OMB also stressed the need to assess alternative methods of accomplishing objectives and to rank programs and activities in order of priority.

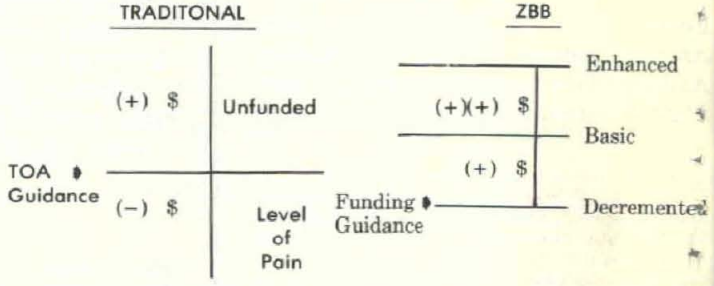
By late April, the Secretary of Defense issued instructions reiterating the above guidance, indicating that the President would play an active role in reviewing critical defense budget issues, and directing the Services to develop management systems that meet objectives of ZBB.

Instructions stated that "clear test of need will govern funding decisions and in all cases, each activity or program must be reviewed from the ground up to determine whether it should be continued at all, and if so, at what level." The fact that a program exists is not justification for its continuance.

Additional implementing instructions at the Service and appropriation levels continued through the summer of 1977, almost to the date of budget submission on Sept. 30. As a result the Army found itself simultaneously developing the FY79-83 Program Objective Memorandum (POM) in traditional terms, pursuing FY79 budget formulation in some kind of ZBB and a traditional mix, and submitting the FY79 budget in formal ZBB format. ZBB was born, and we all moved toward orienting our thinking and procedures to align with ZBB objectives.

If ZBB is not new, it certainly is different. It is important to understand the basic differences between the traditional budget approach and that of ZBB. Conceptually and procedurally there are significant differences. Failure to recognize these differences diminishes the effectiveness of ZBB related to tying programs to mission objectives, prioritizing programs, and identifying the impact of various funding levels which, in fact, is the essence of ZBB.

While perhaps oversimplifying the process, Figure 2 depicts primary differences between traditional and ZBB planning, programing, and budget development.



- Justify and protect TOA
- Describe impact of reduction
- Suggest unfunded requirements

- Mission loss below Decremented level
- Increased capability for increased funds
- Discrete funding levels result in specific capabilities

Fig. 2. Comparison—Traditional to ZBB

Traditionally, each appropriation received Total Obligational Authority (TOA) through the Office of Assistant Secretary of Defense (Comptroller) OASD(C) and the Service Comptroller. Each program or budget was formulated on that specific funding level. Although TOA guidance changed due to inflation, pay raises, cost growth, and appropriation transfers, basically one budget was prepared, submitted, and defended. Anything above TOA was considered beyond reality. Unfunded programs (above TOA) were not seriously pursued.

The traditional decision process was negatively oriented toward levels of pain caused by proposed and actual reductions. Flexibility was limited because the Services could take the position that the TOA figure supported the best possible program within funding constraints. Any funding level below that figure

could have been termed illogical, inefficient, and a threat to national security.

ZBB significantly revises this traditional approach. ZBB does not lose sight of the TOA (the end product remains a POM or budget and is still TOA constrained) but establishes initial planning on funding guidance which is substantially *lower than anticipated* final TOA.

Positioning of the arrows in Figure 2 denotes a critical difference between traditional and ZBB budgeting, which is the starting point, or primary justification level. Traditionally, it is all "downhill" from TOA, while in ZBB it's basically reversed. We begin at a Decremented level and build incrementally upward, adding capability for additional funds.

In traditional budgeting, priority and decrement lists were developed and maintained as "close hold" until the final hour when funding levels were determined and trade-offs were required and exposed.

ZBB demands prioritization. The program is developed and presented from the most important to least important project, program element, or DU. In ZBB, the program manager exposes his "gold watches" at the higher or less protected levels at his own risk. "Untouchable" programs may be reduced through the decision process, depending on the amount of funds allocated to that decision package set.

Also in ZBB, the decision maker, once he allocates funds, knows clearly what capability he has brought and what he has to forego because of funding constraints. Comparability is eased by this prioritization, justification, and decision process.

Alternatives are more clearly identified and easily analyzed as to impact of critical trade-offs. Furthermore, since ZBB builds from a Decremented level up, the creative manager is encouraged to propose additional programs or accelerate current ones.

The traditional stigma of being "unfunded" is reduced with ZBB because ideas become legitimate proposals at Enhanced levels. Senior decision makers have additional alternatives which otherwise may not have appeared. Primary differences between the traditional and ZBB approach then, are the starting point of funding levels and how the program or appropriation is developed, justified, and defended. The traditional approach is more rigid and negatively (level of pain) oriented. ZBB is positively oriented and provides greater flexibility to managers.

By summer 1977, the Army was required to develop an FY79 RDTE budget in ZBB format and submit it to OSD by Sept. 30. Considering we were faced with emerging management concepts, philosophies, and procedures, and with developing a Five Year Defense Program (FYDP) at three different funding levels (Decremented, Basic, Enhanced), meeting the Sept. 30 date became a serious challenge.

We reviewed the ground rules and matched our current programing and budget capabilities. We had to: consider our mission, identify recognizable mission sub-elements, develop mission related decision units, develop minimum effective mission levels, develop funding guidance at three levels, develop incremental capability levels with related funding requirements, create decision package sets, and justify, approve, submit, and defend the whole affair.

This was no easy task since we were dealing with over 500 separate RDTE projects folded into about 230 program elements.

We have activities that research, develop, test, and evaluate things and ideas. We also have an overhead structure of facilities and manpower to perform these activities either through in-house or contractual methods. Of critical value is our ability to define our mission sub-elements in terms of projects and program elements (PEs).

The program element structure and automated support permitted the RDTE appropriation to adapt readily to ZBB DU format. Through negotiation with OSD, all of our PEs were assigned to 14 different DUs.

These DUs are: Defense Research (6.1), Exploratory Development (6.2), Advanced Technology Demonstrations (6.3A), Strategic Defense, Strategic Control, Land Warfare, Air Warfare, Combat Support, Consolidated Defense Intelligence, Global Communications, Other Defense-Wide Programs, Management and Support, and Test and Evaluation.

By the mechanism of the Headquarters, Department of the Army Research, Development, and Acquisition Committee (RDAC) decision process, minimum acceptable program levels and incremental program capabilities and funding requirements were developed.

Each program element was reviewed and prioritized as to mission related requirements and then converted into ZBB decision units through automated means. RDAC prioritization easily converted each DU into the required 3-funding level DPSs.

The DU and its related decision package set (DPS) became the primary format and method of submitting our budget to OSD for review and decision. Our 14 DUs were converted to DPSs by describing program and funding requirements and objectives at Decremented, Basic, and Enhanced levels.

Each DPS was assembled into a 2-4 page summary containing Service Identification, Appropriation, and DU; Long Range Goal which discussed how the DU relates to Army mission and long-term efforts; Major Objectives that related specific R&D programs to individual objectives; Alternatives whereby other means of obtaining objectives were identified (e.g., in-house vs contract research, product improvement vs modernization); and Accomplishment which addressed what had already been done to initiate effort or pursue objectives. Also included was funding information for FY77, FY78, and FY79-83 (three levels for the FYDP years) and end strength and man-years for FY77-80 (manpower data at three levels through budget plus one year).

We had to choose our words carefully. Our $1 billion Land Warfare DPS was presented to OSD in less than 15 pages. Critical to this process is accurate, timely, and *important* information for which the Army Staff relies heavily on data from your developing agencies.

The details given above of the DPS are presented for two reasons: DPS actions will be referred to numerous times in the remaining paragraphs; also, many of the new requirements that people in the field will experience, particularly revised Program Data Sheets, are driven by ZBB procedures in general and the DPS format in particular.

Our RDTE budget in traditional and ZBB formats was submitted to OSD on Sept. 30, 1977. Both were required since the President's budget is given to Congress in January in traditional terms while the OSD/OMB decision process is based on ZBB.

Funding guidance instructed us to use final FY78 Congressional Appropriation funding approval as the starting point for the Decremented level and the FY79 POM as the starting point for the Basic level. The Enhanced level was provided through Comptroller channels based on OSD guidance. In approximate figures, our 14 DPS and budget were submitted as follows for FY79: Enhanced, $2.9 billion; Basic, $2.8 billion (POM 79 was at $2.8B); Decremented, $2.5 billion (included FY78 at $2.43B, plus

(Continued on page 16)

Zero-Base Budgeting Guide Published

Publication of a Zero-Based Budgeting Guide, initially developed for the U.S. Army Corps of Engineers to define and defend its FY79 civil works budget, has been announced by the Corps' Construction Engineering Research Laboratory (CERL).

John Deponai, a CERL civil engineer, was project leader for development of the new document, and was recently presented a Special Achievement Award for his efforts. All federal agencies have been directed to comply with the ZBB process, commencing with their FY79 budgets.

Deponai was assisted in his work by other CERL staff members, the numerous Corps of Engineers Districts, and the Office, Chief of Engineers. Within a 4-month period, their efforts resulted in development of the new guide, required forms, and a ZBB training program.

These materials reportedly provided for submission of a "clear, logical, accurate and exceptionally detailed" budget request to the Office of Management and Budget.

Army's Top Science Advisory Board Reorganized

As part of President Carter's program to bring greater efficiency of operation to all branches of the Federal Government, a number of changes, which affect the Army's R&D and materiel acquisition community, have been made or are underway.

Last June the position of Assistant Secretary of the Army (Research and Development) was retitled Assistant Secretary of the Army (Research, Development, and Acquisition), and the scope of duties and responsibilities expanded. New responsibilities encompass the total acquisition process, which includes procurement policies and procedures, and procurement and materiel acquisition management.

Another significant change was designation of the ASA (RDA) as Scientific Advisor to the Secretary of the Army. In addition, Secretary of the Army Clifford Alexander assigned to the ASA (RDA) responsibility for administration and operation of the Army Scientific Advisory Panel (ASAP), under his guidance.

Secretary Alexander is reorganizing and reorienting the Army Scientific Advisory Panel, which will be called the Army Science Board (ASB), and consist of 30 members and up to 60 associate members. While this is larger than the previous ASAP, the Army-wide number of scientific panels and boards has been reduced.

The ASB will consolidate former duties of the ASAP, the Ballistic Missile Defense Technology Advisory Panel, the Ballistic Research Scientific Advisory Committee, the Tank Automotive R&D Command Scientific Advisory Group, and the Scientific Advisory Group of the Missile Command.

The day-to-day administration of the ASB has been assigned to its Executive Director, Dr. Joseph H. Yang, Principal Deputy Assistant Secretary of the Army (R&D). He will be assisted by the Army Staff and field commands as required.

The working arms of the board will be ad hoc committees. The concept of operation, involves assignment of a problem area or subject to an ad hoc committee. The committee will reach agreement with the ASA (RDA) on a plan of approach addressing the problem, the amounts of time and funds to be expended.

Problem areas for ad hoc committee consideration will originate from all parts of the Army, from laboratory commanders to commanders of major Army units in the field. Topics to be addressed by ad hoc committees can be any matter of Army interest from a narrow technical problem to broad concepts for new systems. It is expected that this willingness to examine a field spectrum of problem areas will encourage members to suggest new and innovative solutions to Army problems.

Membership on the board will be a 2-year term, not to exceed two successive terms. The reorganization will reflect changes in membership to meet changing Army needs, and concepts of operations. The board will be advisory and will not be involved in policy decisions or execution of decisions normally made by Army officials.

Secretary Alexander has said that the board's membership will include representation of the nation's outstanding citizens, from key areas of endeavor. Financial renumeration will not be the motivating factor for acceptance of membership by individuals, as pay will be limited to the daily pay of a GS-15, plus per diem and travel expenses. However, service on the board is to be regarded both as a patriotic privilege as well as a duty, and the Army intends that those who serve the country will be recognized and appreciated.

Those who are selected and accept nomination can be assured that theirs will not only be an honorary assignment, but also a working one. The Army will be asking advice on specific problems from the best talent in the nation.

Present plans include three general meetings of the board a year. One will be held in the Washington area, and the other two rotating at field installations and activities throughout the U.S.

Selection of members and associate members is currently underway.

Shortly before this edition of the *Army R&D Newsmagazine* was sent to press, Secretary of the Army Clifford Alexander announced that the following 29 individuals have been invited to attend the Mar. 2-3 meeting of the Army Science Board:

Dr. J. Ernest Wilkins Jr., associate general manager, EG&G Idaho, Inc., Idaho Falls, ID; *Dr. Harold H. Agnew*, director, Los Alamos Scientific Laboratory, Los Alamos, NM; *Neil A. Armstrong*, College of Aerospace Engineering, University of Cincinnati, OH; *Dr. John Blair*, director of Research, Raytheon Corp., Lexington, MA; *Dr. Joseph V. Braddock*, vice president for Technical Programs, BDM Corp., McLean, VA; *Kenneth E. Clark*, dean, College of Arts and Sciences, University of Rochester, Rochester, NY; *Dr. Nicholas Yaru*, vice president, Hughes Aircraft Co.; and

Dr. Phil E. DePoy, director, Operations Evaluation Group, Center for Naval Analysis, Arlington, VA; *Dr. Ralph E. Fadum*, School of Engineering, North Carolina State University (Raleigh), Raleigh, NC; *Dr. David L. Fried*, president, Optical Science Consultants, Placentia, CA; *Willis M. Hawkins*, president, Lockheed California, Co., Burbank, CA; *Dr. Rhoda Baruch*, private consultant, Washington, DC; *LTG Austin W. Betts* (USA, Ret.), vice president for Planning, Southwest Research Institute, San Antonio, TX; and

Dr. Richard C. Honey, staff scientist, Electromagnetic Sciences Laboratory, Stanford Research Institute, Menlo Park, CA; *Robert L. Johnson*, president, McDonnell-Douglas Astronautics Co., Huntington Beach, CA; *Herbert L. Ley Jr.*, private consultant, Rockville, MD; *Robert M. Lockerd*, manager, ATC Comm/Nav Systems, Texas Instruments, Inc., Dallas, TX; *Dr. Fujio Matsuda*, president, University of Hawaii, Honolulu, HI; *Dr. Richard A. Montgomery*, director of Corporate Development, R&D Associates, Marina del Rey, CA; and

Dr. Russell D. O'Neal, National Science Foundation, Ann Arbor, MI; *Dr. Irene C. Peden*, professor of Electrical Engineering, associate dean, College of Engineering, University of Washington, Seattle, WA; *Dr. Bruce A. Reese*, head, School of Aeronautics and Astronautics, Purdue University, West Lafayette, IN; *Dr. James J. Renier*, Aerospace and Defense Group, vice president, Honeywell, Inc., Minneapolis, MN; *Dr. L. Albert Scipio* II, professor of Space Sciences, Graduate School, Howard University, Washington, DC; *Kent Kresa*, corporate vice president and general manager, Northrop Ventura Division, and

David Shore, division vice president, Advanced Program Development, RCA Government Systems Division, Moorestown, NJ; *Dr. Ralph G. H. Siu*, private consultant, Washington, DC; *Dr. Wilson Kinter Talley*, professor, Department of Applied Science, University of California (Davis), Lawrence Livermore Laboratory, Livermore, CA; and *Dr. Chris J. D. Zarafonetis*, Simpson Memorial Institute, University of Michigan, Ann Arbor, MI.

New Solar Power Generator May Be World's Largest

A Solar Photovoltaic Power Generating Station, believed to be the world's largest, will be designed, assembled and tested by Delta Electronic Control Corp. (DECC), under a contract awarded by the Army Mobility Equipment R&D Command (MERADCOM), Fort Belvoir, VA.

Sponsored by the Division of Technology, U.S. Department of Energy, this work is part of the Military Applications of Photovoltaic Systems (MAPS) program, a joint venture being conducted by MERADCOM for the Department of Energy and Department of Defense.

Special "peak power tracking" circuitry will be used in generating 60 kilowatts of power through a half-acre array of silicon solar cells that produce electric power directly from sunlight. This will properly match the array to the load and insure that maximum power is generated at all levels of sunlight and temperature.

The power will be converted to standard alternating current by circuitry originally developed for DECC's line of uninterruptible power systems. During testing at DECC, the resulting power will be used within their facilities, and any extra power produced will be fed into the Southern California Edison lines.

After undergoing testing at the DECC facility, the power generating station will be permanently installed at Mount Laguna Air Force Station in Southern California to augment diesel engine generating equipment used there for base operations.

The MAPS program is being conducted to demonstrate the feasibility of powering tactical equipment as well as remote installations with solar energy. The program was placed under the general management of MERADCOM on the basis of the command's long-standing work on electric power generation including fuel cells and other energy conversion methods.

Photovoltaic systems developed earlier in the program are providing solar power for mobile communications, remote surveillance, battery charging and water purification equipment.

New Washington-Moscow Hotline Becomes Operational

A new Washington-Moscow hotline, consisting of two independent satellite systems, became operational Jan. 16, to replace the terrestrial system in operation since 1963.

Officially named the Direct Communications Link (DCL), the new satellite hotline was designed by the U.S. Army Communications Command (ACC), Fort Huachuca, AZ, as a direct private communications link between the Presidents of the United States and the Soviet Union during international tension or emergency.

The DCL, like its predecessor system, and contrary to widespread public belief, is designed to exchange printed messages and not telephone calls. Printed messages have the advantage of overcoming language barriers, avoiding possible misinterpretation by translators, and providing a written record of the traffic sent.

Hotline teletype messages from the U.S. to U.S.S.R. are transmitted in the English language, using the Latin alphabet. All messages from the U.S.S.R. are transmitted to the U.S. in the Russian language using Cyrillic characters.

All messages, including test messages, are automatically encoded upon transmission and decoded upon receipt. Circuits are tested hourly, using a variety of sample messages. Normally, items such as nonpolitical passages from magazines and books are used in test messages.

Satellite communications are increasingly being used to supplement terrestrial systems for long-distance communications. The DCL incorporates many technological advances and is less vulnerable than the initial system, since it depends to a lesser degree on extensive terrestrial microwave or cable relays and eliminates dependence upon third country facilities.

Further, the DCL is not susceptible to interruptions caused by atmospheric interference common to high-frequency radio systems.

The two DCL satellite systems employ the Soviet MOLNIYA and the commercial INTELSAT satellites. Both systems operate simultaneously so that if one fails, the other continues to provide communications.

In the MOLNIYA system, there are four satellites that operate in highly elliptical, inclined orbits. Each satellite is used for approximately six hours a day as the satellites sequentially come within view of both the U.S. and U.S.S.R. earth stations. In the INTELSAT system, coverage is obtained from a single satellite positioned in a geostationary orbit 22,304 miles over the mid-Atlantic Ocean at the equator.

Within the U.S., there are two satellite earth stations associated with the DCL. One, located at Fort Detrick, MD, operates twin 60-foot satellite antennas for use with the MOLNIYA satellites. This station was constructed by the Harris Corp., under direction of the U.S. Army Satellite Communications Agency. Operations and maintenance are performed by the Harris Corp., under contract to the U.S. Army Communications Command.

The second U.S. earth station, located at Etam, WV, is a commercial station having a satellite ground terminal for use with the INTELSAT satellite. It is operated by the Communications Satellite Corp. (COMSAT). ITT World Communications Inc., which provided the initial hotline, also is under contract to the U.S. Army and is responsible for providing and maintaining the DCL circuit that uses INTELSAT facilities.

In the Soviet Union, two MOLNIYA earth stations are located near Moscow. Two INTELSAT earth stations, a primary and a backup station, are located at L'vov and Moscow. ITT Space Communications Inc., designed and produced the satellite communications equipment for the L'vov terminal.

TWIN 60-foot satellite antennas track orbiting Soviet MOLNIYA communications satellites and provide a U.S. terminus for the Direct Communications Link.

'Think Tank' Focuses on Improvements for the Soldier

Optimizing the American soldier's ability to win any encounter—by improving existing weapon systems or developing new ones—is the purpose of a small team of engineers and scientists in the Armament Concepts Office (ACO), U.S. Armament R&D Command, Dover, NJ.

Commonly referred to as ARRADCOM's "think tank," the ACO is actually staffed by less than 20 persons, and is headed by COL John J. Cook Jr. Ammunition, fire control, chemical defense and logistics are primary areas of interest.

COL Cook stresses that any idea, regardless of its subject, will be considered as long as it offers potential for strengthening the Army's technology base, Unsolicited ideas and proposals may be submitted by soldiers, industry, academia, or anyone from any walk of life!

Suggestions range from one-page handwritten letters to scientific papers which have been researched and documented. All are given equal consideration and each is acknowledged. Originators are even advised on patent rights.

If an idea is initially rejected, it is still given a final review by a committee of experts to make sure that no valuable contribution is lost.

Suggestions which are ultimately rejected are based on: lack of originality; vagueness of terms which cannot be translated into useful format; violation of a proven scientific principle; or lack of usefulness for battlefield application.

TRANSLATOR operates modified KSR-37 teletype, redesigned to use the Cyrillic alphabet, while a technician monitors two DCL antennas at DCL earth station, Fort Detrick, MD.

90 Technical Papers Programed For 28th Power Sources Symposium

Approximately 90 technical papers devoted to discussions of "Batteries and Portable Power Sources" will be presented during the 28th Power Sources Symposium, June 12-15, at Atlantic City, NJ.

Sponsored by the U.S. Army Electronics R&D Command in conjunction with the U.S. Air Force, Navy, NASA, Department of Energy, and Communications Satellite Laboratories, the meeting is the largest of its kind in the world.

Since 1947 the unclassified symposium has provided a forum for representatives of the sponsoring agencies and their counterparts in industry and academia to discuss mutual interests related to batteries and fuel cells.

Titles of the six discussion sessions programed for this year's meeting are High Temperature/High Energy Systems; Fuel Cells; Alternate Power Sources; Primary Batteries; Secondary Batteries; and Lithium Batteries.

Additional information relative to symposium attendance, registration and accommodations may be obtained from: Doris Yannetta, U.S. Army Electronics Research and Development Command, ATTN: DELET-P, Fort Monmouth, NJ 07703, or commercial phone (201) 544-2662, or Autovon 995-2662.

Conferees Evaluate Responsiveness of DARCOM's Study Program

Making DARCOM's study program effort more responsive to the Army's priority needs and to the goals of the Army Chief of Staff and the DARCOM Commander was the primary theme of the recent DARCOM Study Coordinators Conference.

Meeting at HQ DARCOM on Dec. 15, 1977, the conferees, representing every major Army DARCOM field command and the Department of the Army (DA) staff, heard a number of poignant, sharp presentations, all of which stressed the crucial need to make maximum efficient use of all the Army's strained resources.

DARCOM Deputy Commander for Materiel Readiness LTG Eugene J. D'Ambrosio, in giving the keynote address, told the group that today's demands on DARCOM were exceeding its total resources to respond. The new direct support mission of DARCOM to Army units worldwide, is a new role in the doctrine of the U.S. Army.

As a result, many unanswered questions remain to be solved. "What has to be done, what is expected of DARCOM?," he asked. He noted that the Army's percentage of fill is dropping despite increased dollars. What was the cause, and how could it be corrected, was another point raised by the general.

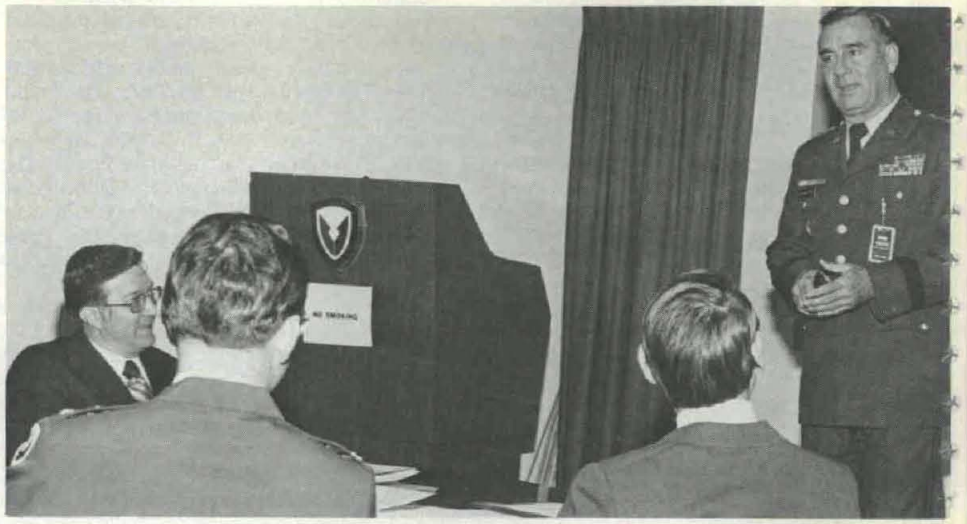
Perhaps a totally new way to present Army budgets must be found, the general continued, so that the true impact of reductions at the shop level on readiness can be made clearly evident. The study program, said LTG D'Ambrosio, can help immensely in finding answers to critical Army problems.

Daniel J. Shearin, DARCOM deputy director for Plans and Analysis, talked to the group about the growing need for a strong HQ focal point to provide help and advice to study coordinators and a better interface with HQ DA.

While Shearin noted that the trend has been sharply downward over the past five years, in terms of the number of studies and in the dollar expenditives and man-years of effort, he expected this to start an upward curve in FY79. However, Congressional criticism of the Defense Department's study program effort should make everyone keenly aware for the need to conduct only those studies the Army believes are critical to its needs and to see that the studies are done well.

The Army Staff view was presented by F. Paul Dunn, Study Management Office, Management Directorate, Office of the Chief of Staff. He noted the changed manner in which the Army's study effort now operates. Rather than relying principally on captive Federally Contract Research Centers (FCRCs) such as RAC, HumRRO and CRESS, the work is being done 80 percent in-house, with the balance being handled by competitive out-of- house bid.

He noted the growing interest, concern and control of OSD in the study programs of the Services and their yearly review of all study programs. Much of the OSD involvement is the result, said Dunn, of the findings of investigations by staff personnel of the House Appropriations Committee (HAC) and of the General Accounting Office (GAO). Both investigations reported numerous weaknesses.



STRESSING A POINT during Study Coordinators Conference, DARCOM Deputy Commander for Materiel Readiness LTG Eugene J. D'Ambrosio speaks with Hollis Bridges, U.S. Army Missile R&D Command; COL Robert Gruen, U.S. Army Missile Materiel Readiness Command; and Dr. Charles Kullman, U.S. Army Aviation R&D Command.

Centralized control of the Army Study Program was desirable, said Dunn, as was decentralized performance, to include study planning. Cautions were needed, he continued, to avoid unnecessary duplication, that proper and adequate use was made of the DoD study bank, that studies be done in-house to the maximum extent possible, that contracts be awarded on a competitive basis rather than sole source where possible, and that very careful deliberate planning for the study results be undertaken early in the concept phase of thinking.

CONFERENCE PARTICIPANTS representing U.S. Army Electronics R&D Command, Oscar J. Mead; Office of the Chief of Staff, DA, F. Paul Dunn; and U.S. Army Communications R&D Command, Douglas Sizelove.

According to Dunn, the specifics of the HAC and GAO criticisms fell in two general categories—managerial and contracting. Under the former, he noted the finding that too often the Army had not formulated the study objective but had bought a contractor's proposal. Not enough questioning had been asked by Army study managers as to whether a particular study was really needed, and if so, what should be done with the findings. Another concern said Dunn, was that results often didn't resemble the original justification. He listed approximately 30 key findings out of over twice the number.

In the contracting area, there were too many sole source contracts; too many budgeted under $100,000 to escape higher echelon review, but were subsequently amended to expand the total amount. In some cases work had been authorized before the contract had been signed.

There was, continued Dunn, a most urgent need to improve the Army administration of its study program. Only by showing the Congress that the Army is capable of proper management can it expect to receive any needed increase in study funds.

Chief of DARCOM's Systems Analysis Division COL Joseph A. Donnan, provided the group with FY78 and FY79 study planning guidance. He stressed that the ability to obtain approval for proposed studies would depend to a great extent on how they support the Army's priority problem areas and goals.

Following in the theme of Dunn's remarks, COL Donnan noted that the ability to point out a return on the investment was a vital necessity to continued support of a good study program. The ability to identify this return has not been readily noticeable, due to inadequate attention to Block 26 on the DD Form 1498.

To try to determine the extent of return on past studies, an analysis was made of those done by the Inventory Research Office (IRO) and by the Logistics Study Office (LSO). When examined in terms of whether the study recommendations had been implemented, partially implemented, under consideration, not implemented, or not ready, the results were highly favorable—about 90 percent of both groups.

Conferees Bernard Rosemman, Inventory Research Office; Clair Weiss, Materiel Development and Readiness Command; and Diane Geweniger, Tank-Automotive R&D Command.

A presentation by Paul A. Robey of the Defense Documentation Center (DDC), covered the useful role his agency could play and the types of data banks available.

F. Hamden, chief, Defense Logistics Studies Information Exchange (DLSIE), Fort Lee, VA, described the unique features of DLSIE and how data should be provided to his agency, the type information desired, and kinds of services available at no cost to the user.

The role of the DD Form 1498 was described by Ms. Marcia Opiela, DARCOM Directorate of Development and Engineering. She covered the use of the form in the study program and the most common sources of errors in the preparation of the forms. She also noted the new data systems changes that will permit more DARCOM installations to have direct access to DDC.

The wrap-up presentation was given by Zohrab H. Tashjian, DARCOM Directorate for Plans and Analysis. He stressed the inconsistencies existing in relating R&D study efforts to the requirements of AR 5-5.

During the discussion period a number of issues were raised, to include the apparent duplicity of study justification, the lack of requirements for studies performed with procurement funds, and the lack of resources available to study coordinators to perform additional functions required of them.

A major conclusion was that an annual meeting of DARCOM study coordinators was desired, but if the committment for such a meeting was not feasible at this time, then a follow-on conference would be requested early in 1979.

Copies of the new publication *DARCOM Study Program—FY 1978*, are available by writing to Chief, Systems Analysis Division, DRCPA-S, HQ DARCOM.

Dr. Emerson Publishes POW Diary Account

Dr. Kary C. Emerson, deputy for Science and Technology, Office of the Assistant Secretary of the Army for Research, Development, and Acquisition, has privately published an account of his experiences during the so-called Bataan Death March, and as a prisoner of war in the Philippines and in Japan, 1942-1945.

The 136-page account is based upon his five notebooks, compiled from small notes concealed from the Japanese during his imprisonment. Many of these notes he had mislaid and their recent recovery in an old footlocker led to the writing of his experiences.

Dr. Emerson explains, in his preface, that he purposely delayed writing "until time had mellowed my interpretation of these experiences." In 1970, however, he began writing on his trials from the fall of 1942 until September 1945.

At the time of the Bataan surrender, Dr. Emerson was an Infantry captain commanding a company of Philippine scouts and serving as assistant G4, II Philippine Corps. His account begins with his experience and observation of the Death March.

Dr. Emerson asks, at the end of the chapter, "Why did it happen?" He answers by saying that the Japanese logistics systems were not programed to handle the situation; the Japanese did not realize the terribly poor health conditions to which the American and Philippine soldiers had fallen; truck transportation was not available; and their policies and methods of operation toward prisoners, human life, discipline, etc., were quite different by experience and practice than those of non-Asiatic armies.

Dr. Emerson's account is interesting and illuminating, not only from the story of events, but from the physiological and psychological observations he made and incorporates in this account. He tells, for example, of ways they detected and sought to cope with "Wet Beriberi" and "Dry Beriberi."

The symptoms of the wet type, in order of their appearance, were swollen ankles, swollen jaws, and swollen eyelids. Some severe cases incurred swollen limbs and abdomen. His observation was that very few severe cases recovered, though milder ones seemed to respond to beans or meat in the diet.

In the case of "Dry Beriberi," Dr. Emerson saw no recoveries from this disease—no cure nor alleviation. Malaria was noted as being of two types: "cerebral" and "ordinary." Limited amounts of smuggled quinine saved a few sufferers of the latter category, of whom CPT Emerson was one.

"How did you survive the ordeal?" is a question that Dr. Emerson says he has been asked many times. "With a lot of luck and the help of God," he writes in the account. However, he says there were certain other factors or conditions that either assisted survival or expedited one's demise.

Physical condition at the time of capture played a major role, he explains. Officers who had a sedentary position had a lower survival than those who had been living in spartan field conditions. Motivation, or the will to live, Dr. Emerson found to be dependent upon a number of background and experience factors.

His observations were that the two types most likely to survive were those who had overcome an unfortunate childhood, and those who were quiet, small to middle-sized in physique who had not been athletic stars. His final chapter, "Survival," treats this subject openly, and perhaps with some eye-opening observations.

Written in a manner that omits the gore and bestiality of his experiences, the book includes references to them in such a way that the reader knows what the prisoner experienced.

Privately printed, in a limited number, copies were donated by Dr. Emerson to former POWs and friends.

Reference copies are available at the Army Library in the Pentagon; the Army Historical Collection at Carlisle, PA; the Technical Library of the Surgeon General of the Army; the Judge Advocate of the Army and the Judge Advocate General School; the Department of the Army Center for Military History; and the Army Research Institute and Army Materiel Development and Readiness Command libraries.

Dr. K. C. Emerson

Dr. Emerson retired from the Regular Army as a colonel in 1966. He is now an internationally known biologist, and author of more than 140 scientific papers and books.

Dr. Emerson has already received a considerable number of letters from readers, and all have been filled with high praise for the story's accuracy of detail and method of presentation. For example, one ex-POW wrote, "I was afraid I would have bad dreams again, it was so good."

Another said, "It is a most moving account of the heavy sacrifices made by so many . . . ." A number of current and retired general officers have commented on the high value of Dr. Emerson's work.

LACV Completes DT II Phase at Camp Pendleton

Completion in January of phase two development testing of the LACV-30 (Lighter, Amphibian Air Cushion Vehicle-30 ton) at Camp Pendleton, CA, has been announced by the U.S. Army's Aberdeen (MD) Proving Ground.

Developed by the U.S. Army Mobility R&D Command, Fort Belvoir, VA, the LACV is designed to transport cargo and conduct search and rescue missions over land, water, snow, and marsh, and carry a crew of three or four.

Its integrated lift system consists of four 1,800 shaft horsepower turbine engines driving two lift fans and two propellers which run off of the same transmission gear box. Speeds in excess of 50 mph have been achieved. Velocity is dependent upon the sea state, winds, air temperature, surf, and terrain.

LACV-30

Selection of Camp Pendleton as a test site was prompted because of the area's surf conditions which often provide waves of six to eight feet high. APG's Materiel Testing Directorate developed "specialized" methodology for measuring the surf in order to evaluate test data.

Former MTD LACV Test Director Byron Hawley termed the new surf measurement method "one of the more significant developments in the latest series of tests." MTD personnel are supervising return of the vehicle to an East Coast facility for additional tests.

Prior to testing at Camp Pendleton, the LACV was at Langley Air Force Base where it was disassembled for air transportability assessments aboard a C130 aircraft. LACV modulars were then loaded onto trucks for shipment to California.

The LACV was also used in support of the joint service Logistics Over the Shore exercise at Fort Story, VA, and was subjected to controlled environmental conditions in temperatures of minus 50 degrees at McKinley Climatic Laboratory, Eglin AFB, FL.

Earlier LACV tests in high waves and strong winds were also conducted at the Naval Coastal Systems Laboratory, located on the Gulf of Mexico. The vehicle was transported there by rail in January 1977.

Battelle Forecasts $44.083 Billion for R&D During 1978

Federal Government funding for R&D development during CY 1978 is estimated at $23.397 billion, up $1.599 billion (7.3 percent) from 1977. This represents 53.1 percent of the total 1978 national projection of $44.083 billion for R&D.

Industrial funding is forecast at $19.052 billion (43.2 percent of total), up $1.544 billion or 8.8 percent from 1977. Funding by academic institutions is estimated at $962 million (2.2 percent of total) and nonprofit organizations $672 million (1.5 percent).

These projections are prepared by Dr. W. Halder Fisher and assistants David G. Dippold and Myrtle Lockard at the Battelle Columbus (OH) Laboratories. Computations are based on data from the National Science Foundation, McGraw-Hill Annual Survey of Business Plans for R&D Expenditures, and analyses from Battelle's Department of Resource Management and Economic Analysis.

A national increase of $3.283 billion (8.0 percent) over the $40.800 billion that the NSF estimates was actually spent for R&D in 1977 is forecast. The increase does not represent any real growth but is attributed largely to continued inflation.

Rate of growth in current dollar R&D activity seems to have drifted below the high rates that characterized the pre-1968 and post-1971 periods. The report notes increasing concern from many sources as to the relative decline in U.S. R&D activity and the danger posed for future economic strength.

Due to the Federal Government's shift to a fiscal year starting in October rather than July, the Carter administration will not have a great deal more impact on R&D funding patterns in 1978 than it did in 1977.

Although the U.S. Government continues to dominate research funding, performance of R&D by industry is expected to total $29.979 billion or 68.0 percent of the national output. This contrasts with 16.0 percent by government, 12.5 percent by academic institutions, and 3.5 percent for nonprofit organizations.

Currently, one-third to one-fourth of government funds support research conducted by the government itself; about half goes to industry; approximately one-sixth goes to colleges and universities; and the remainder, less than one-twentieth, goes to nonprofits.

Four agencies expected to account for almost 87.3 percent of total federal R&D funding in 1978 are: Department of Defense, 44.6 percent; National Aeronautics and Space Administration, 15.4 percent; Department of Energy, 15.4 percent; and the Department of Health, Education and Welfare, 11.9 percent.

The NSF, Department of Transportation, and Environmental Protection Agency will share about 5.7 percent, and all other agencies combined will account for 7.0 percent.

Defense-related R&D continues to receive favorable response from Congress and its share in the administrative budget summaries is now rising. More than half of the estimated dollar gains in total R&D are in the defense area.

Increases, with the exception of strategic programs (held at estimated FY 1977 levels), are slated for tactical, technology base, intelligence and communications, advanced technology development and atomic energy programs.

Energy is the third largest and fastest growing R&D field, following defense and space. Within the energy field, nuclear programs are dominant. However, "geothermal, solar, and advanced energy systems" programs are growing rapidly, along with conservation R&D.

Relative to industry funding of R&D, Battelle anticipates that eight of 16 "broad industry" categories will increase their support of R&D between 1977 and 1978 faster than the average sector rate of 8.8 percent.

These categories are professional and scientific instruments (16 percent), chemicals and allied products (13 percent), nonmanufacturing (13 percent), fabricated metal products (12 percent), primary metals (12 percent), machinery (11 percent), other manufactures (10 percent), and stone, clay, and glass products (9 percent).

More than $2 billion each in R&D funding is expected to be provided by chemical, electrical equipment, machinery, and transportation equipment industries. They will account for about 73 percent of all industrial funding in 1977 and 71 percent in 1978.

Nonmanufacturing industries generally devote slightly more than one percent of their profits to R&D, and this is estimated to grow by 13 percent between 1977 and 1978. Additionally, nonmanufacturing industries support extramural R&D especially well, devoting 15 percent of R&D funds to outside contracts.

Relative to the composition of R&D activity, the expected pattern is one of stability and very slow change. Energy, federal regulations, and science and technology-base problems will provide the major impetus for change. The proportionate composition of R&D funding and performance will change very little.

Business is generally shifting from long-term to shorter-term R&D activities, with growing emphasis on market-related modifications in current products and on immediate payoff.

During 1972-78, average costs of all R&D are estimated to rise by 54.4 percent. Increases by the individual performing sectors are expected to be: government 57.4 percent; industry, 56.0 percent; colleges and universities, 56.0 percent; other nonprofit organizations, 28.5 percent.

HEL Integrated Helicopter Control System Debuts

An experimental Integrated Helicopter Control System, mounted in an OH-58 helicopter, made its official debut in a 17-day swing through seven Army installations, beginning Jan. 20.

Under development at the U.S. Army Human Engineering Laboratory (HEL) at Aberdeen Proving Ground, MD, for the past five years, the experimental system combines "collective" and "cyclic" controls of the helicopter into one integrated unit that permits a pilot to fly the aircraft one-handed.

According to John A. Stephens, coinventor and team leader for development, ramifications of the new system are 4-fold: they will increase the survivability factor for the crew in the event the pilot is wounded or injured; simplify the overall task of helicopter flying; reduce pilot training requirements; and allow a new approach to cockpit design and simplification.

Under the conventional system, the collective, a control resembling the handbrake in a sports car, performs two basic functions: it varies the lift needed for helicopter flight, and, with a throttle control similar to a motorcycle twist grip, modifies the power from the engine in order to maintain a certain RPM reading. The pilot uses his left hand to operate the collective function.

With his right hand, he operates the cyclic, which oversees the aircraft's attitude and thus, direction. The cyclic is a joystick-like control similar to that of a fighter aircraft.

Therefore, prior to this time all helicopter pilots had to simultaneously operate controls with both hands in order to fly the aircraft. However, this is no longer true with this new integrated control system.

The integrated unit is floor mounted and all functions of the collective and cyclic are combined into two pistol-grip type handles located at the top of a control shaft, about chest level with the seated pilot. Using either hand, the pilot can now perform all tasks previously required of both hands.

The research team installed the first developmental prototype in an OH-58 helicopter in late 1975. That system was successfully flight tested in January and February of 1976 at Phillips Army Airfield, Aberdeen Proving Ground (APG), MD. After initial flight testing, the team developed a second prototype that was successfully flight tested at APG late last year.

MAJ Dave Yensan of the HEL research team will pilot the craft, using the conventional controls, and demonstrating the integrated system at planned stops at Fort Eustis, VA; Fort Bragg, NC; Forts Gordon and Benning, GA; Fort Rucker, AL; and Forts Knox and Campbell, KY.

He will be accompanied by project engineer John D. Waugh, crew chief John Allison, and instrumentation technician Robert C. Brucksch.

Yensan said the team will spend 11 days at the U.S. Army Aviation Center and School at Fort Rucker, and three days at Fort Knox, where key people in Army aviation R&D, as well as Army aviators and technicians will be briefed on the system.

Coinventor Stephens said a phase-three development of the system would entail a decision by the Department of the Army to seek a civilian firm or agency to assume further development of the system.

INTEGRATED Helicopter Control System, which permits a pilot to fly his craft one-handed, is checked by project engineer John D. Waugh, during second-phase developmental testing at Aberdeen PG, MD.

FY77 Accomplishments Reviewed . . .

Research and Technology Laboratories Issue Annual Report

Ongoing programs, plans, managerial changes, and technical achievements of the U.S. Army Aviation R&D Command's Research and Technology Laboratories (RTL) are contained in a recent FY77 Annual Report.

During FY77 RTL became the new name of the former U.S. Army Air Mobility R&D Laboratory, NASA Ames Research Center, Moffett Field, CA. Four subordinate directorates were also retitled during the period as follows:

The Ames Directorate is now the Aeromechanics Laboratory, Moffett Field; the Lewis Research Center is now the Propulsion Laboratory, NASA Lewis Research Center, Cleveland, OH; the Eustis Directorate is now the Applied Technology Laboratory, Fort Eustis, VA; and the Langley Directorate has become the Structures Laboratory, NASA Langley Research Center, Hampton, VA.

One of the unique aspects of RTL's management lies in its ability to operate as a single entity despite the coast-to-coast geographical dispersion of its separate laboratories. The labs are managed as a unit under a single director.

During FY77, the In-House Laboratory Independent Research Program sponsored by the Army Deputy Chief of Staff for Research, Development, and Acquisition was expanded. Funds were increased from $90,000 to $150,000.

This increase permitted RTL to initiate a research project to investigate the mechanical properties of elastomeric bearings, as well as to continue earlier successful rotor acoustic research by the Aeromechanics Laboratory.

AIR MOBILITY PROGRAM, Category 6.1, *Aerodynamics*. Significant progress was reported in development of a technology for improving airfoil section aerodynamic characteristics for helicopter applications. Tests included five industry and four government airfoils.

Propulsion. Research in this area is aimed primarily at advancing the technology of propulsion and drive train components and systems. Problems associated with small gas turbines are of particular interest.

Other in-house programs included investigations of combustor liner cooling techniques, effects of wall and boundary layer temperatures on premixing fuel and air, and methods of varying geometry for optimum airflow between primary and dilution zones.

Structures. This effort is generally committed to developing new ways of transmitting loads safely and economically throughout an aircraft with minimum weight penalty. Research is being conducted to determine the feasibility of using minicomputers for graphic support and data base manipulation.

Fatigue and fracture mechanics research during FY77 focused on fatigue of laminated composite materials. An objective was to develop a model to predict composite fatigue behavior and improve composite laminate designs.

Research in advanced materials for helicopters revealed that the bearingless rotor concept offers improvements over conventional rotors in maintainability, reliability, and structural efficiency. This was achieved by eliminating critical bearings in the hub.

Mathematics. Basic research efforts are directed to the general domain of aerodynamics, propulsion, structures, and design analysis. End results contribute to meeting technological requirements of advanced airmobile systems.

A general 2-dimensional alternating direction implicit scheme for solving the unsteady transonic small disturbance equation was developed and used to compute some high speed rotor flows. A good comparison with experimental rotor data was reported.

AERONAUTICAL TECHNOLOGY PROGRAM, Category 6.2, *Aerodynamics Technology*. Exploratory development of aerodynamics follows the 6.1 subdisciplies of fluid mechanics, dynamics, flight control, and acoustics and is conducted by the Aeromechanics, Applied Technology, and Structures Laboratories.

Specific areas of R&D included blade tip planform effects on hover performance; flow separation models for helicopters; interactional aerodynamics for single rotor helicopters; full- scale rotor testing; and high energy rotor systems.

Structures Technology. R&D achievements in structures encompassed improved load prediction and analysis methods, internal and external loads, improved design criteria and manufacturing/testing techniques, and advanced composite materials.

Propulsion Technology. The 6.2 propulsion activities, conducted by the Applied Technology and Propulsion Laboratories, were keyed on inlet protection devices, advanced coupling, engine rotor dynamics, transmission noise and dynamics, combustors and fuels, seals, and small turbine engine research.

Reliability and Maintainability. The 6.2 R&M effort, also conducted by the Applied Technology and Propulsion Laboratories, resulted in design of a Logic Model test set for use as an evaluation tool for advanced trouble shooting and diagnosis.

A scale model helicopter demonstration unit was fabricated and Army aircraft hardware, such as the ARC-51B radio set have been modeled. A joint Army/Air Force evaluation of the test set is underway.

Safety and Survivability. A program to establish test data on the impact of 23mm high explosive incendiary-tracer projectiles on helicopter tail booms aided in selection of a practical design for reducing ballistic vulnerability of UH-1H and AH-1G/S tail booms.

Preliminary design and analysis of the Accident Information Retrieval System (AIRS) was also achieved. The AIRS is a low cost, low weight system.

Mission Support. MS technology development efforts are directed toward the equipment which enhances the effectiveness of military operational capabilities of Army aircraft. FY77 activities included cargo handling methodology, helicopter ground mobility systems, and advanced technology ground power units.

Aircraft Systems Synthesis. Jointly accomplished by the Applied Technology Laboratory and the Advanced Systems Research Office, this effort is aimed at defining a firm technology base to meet projected Army aviation requirements.

This is achieved by improving in-house capabilities; conducting reviews of Army aviation R&D programs; identifying technology voids and risks; assessing potential gains from technological advances; and identifying concepts with high potential.

Aircraft Subsystems. This project provides visibility to technological development efforts of aircraft subsystems which previously were overshadowed by reliability and maintainability programs and/or off-the-shelf equipment.

The objective of this program is to advance the state-of-the-art of Army aircraft subsystems so that improvements in operational effectiveness and/or reduced life cycle costs can be achieved. Projects include the Nickel-Cadmium Battery and Helicopter Ice Protection.

RPV Supporting Technology. Remotely Piloted Vehicle activities conducted by the Applied Technology Laboratory seek to eliminate technological voids in air mobility which hamper development of mini-RPVs for military applications.

The key air mobility disciplines required for development of mini-RPVs are propulsion, launch and recovery, survivability/vulnerability, RPV configuration, structures, and flight control.

Man-Machine Integration. Exploratory development in aviation human engineering methods and technology became a formal part of the RTL 6.2 program during FY77. The goal is to provide advanced methods for performing system integration functions during design, development and testing of air mobility systems.

Aircraft Weapon Technology. The Army aircraft weaponization program provides the capability of delivering ordnance to destroy, neutralize, or suppress those targets jeopardizing ground or airborne forces in the conduct of the land combat role. RTL projects in this category include the Separate Loaded Ammunition Concept, the High Impulse Gun Airborne Demonstration, and the Millimeter Wave Radar.

ADVANCED TECHNOLOGY DEMONSTRATION PROGRAM, Category 6.3, *Tilt-Rotor Research Aircraft*. This is a joint Army-NASA program to demonstrate, in flight, attainment of the technology required to implement the tilt-rotor concept. The concept units the speed and economy of fixed-wing turboprop aircraft with the vertical takeoff and landing capability of the helicopter.

The tilt-rotor XV-15 made its first hover test flight, following several months of integrated systems and ground tiedown tests. It completed three flight hours at speeds up to 40 knots in forward flight, 15 knots lateral, and 10 knots rearward.

Rotor Systems Research Aircraft. The RSRA program, also a joint Army/NASA effort, will provide research capabilities to evaluate promising new rotor concepts, verify supporting research technologies, and test product improvement rotors.

Advanced Rotor Technology. Final evaluation of the bearingless main rotor concept is expected from flight test results on a BO-105 helicopter in 1978. Other investigations in this area are the advancing blade concept, and a second generation comprehensive helicopter analysis system.

Some of the other high priority projects in the 6.3 category include the structural integrity recording system, the shaft horsepower advanced technology demonstrator engine, cargo handling equipment, remotely piloted vehicles, and helicopter ice protection.

Crystalline Hemoglobin Solution Foreseen as Blood Substitute

DR. FRANK DE VENUTO is a research chemist on the staff of the Blood Research Division, Department of Surgery, Letterman Army Institute of Research (LAIR), Presidio of San Francisco, CA. He attended the University of Rome in Rome, Italy, and received a PhD degree in organic-biological chemistry in 1951.

Dr. DeVenuto pursued advanced education at the Oak Ridge Institute of Nuclear Studies at Oak Ridge, TN. He served in the U.S. Army Chemical and Medical Corps from 1953 to 1955. In May 1955, he accepted an appointment as a research chemist at the Army Medical Research Laboratory, Fort Knox, KY, where from 1955 to 1974 he did research in blood components and steroid hormones.

In July 1974, Dr. DeVenuto accepted his present position at LAIR and has been developing and evaluating "Resuscitating Solutions" with emphasis on blood substitutes capable of carrying oxygen and being used in combat situations for massive transfusions in field casualties.

He has authored 60 scientific articles published in national and international journals and is internationally known for his contributions in blood research. Dr. DeVenuto received a U.S. Army Certificate of Outstanding Achievement at the Army Science Conference at West Point in June 1976, and a Department of the Army Research and Development Achievement Award at LAIR in July 1976.

By Dr. Frank DeVenuto

Hemoglobin solution has the potential of becoming an important blood substitute and could provide the basis for an ideal resuscitating fluid for the severely wounded soldier.

The ultimate goal in transfusion therapy is to have "blood" that can be stored for indefinite periods of time, does not require refrigeration, is packaged for compact storage and shipment, does not require typing or crossmatching, and can be transfused easily in combat situations or civilian disasters.

Hemoglobin, in a freeze-dried form and reconstituted into a solution by addition of water at the time needed for transfusion, may prove to satisfy this goal. Hemoglobin is a component of normal blood; it is capable of transporting oxygen to the tissues and maintaining oncotic pressure; it does not appear to cause significant allergenic problems. This combination of features is immensely important and has been missing from other blood substitutes and resuscitating solutions.

The Blood Research Division of the Department of Surgery, Letterman Army Institute of Research (LAIR), Presidio of San Francisco, has obtained preliminary findings which show promise toward attaining the ultimate goal of preparing "blood" meeting the desired criteria stated above.

The group at LAIR has developed a rapid, simple procedure for the preparation of stroma-free hemoglobin (DeVenuto et al: J. Lab. Clin. Med. 89: 509, 1977). This method uses outdated human whole blood and represents a modification of a technique developed in the 1940s by an investigator named Drabkin.

The group at LAIR has isolated hemoglobin by low-speed centrifugation and subsequent crystallization. The crystals obtained are further purified by repeated washings before solubilization and sterilization.

Solubilization is achieved by dissolving the hemoglobin crystals in a standard renal dialysis fluid. Also, through the process of lyophilization (freeze-drying), solutions of hemoglobin have been reduced to a powdered form in the presence of glucose (a stabilizer to prevent formation of methemoglobin).

The hemoglobin solution prepared by the LAIR procedure and maintained at −20 C. does not demonstrate any alteration in methemoglobin content, oxygen affinity, osmolarity, oxygen capacity, sodium, potassium, or pH after two years of storage.

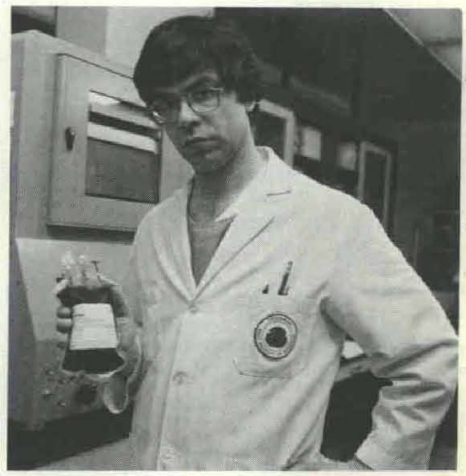
At refrigerator temperature (4 C.), the hemoglobin solution does not show any deterioration for a period of 12 months. The lyophilized hemoglobin kept at room temperature has remained unchanged after three months and may ultimately prove to be the most stable form.

The freeze-dried hemoglobin can be reconstituted into a solution by addition of distilled sterile water. This reconstituted hemoglobin solution has the same biochemical and physiological properties as nonlyophilized hemoglobin solution.

Stroma-free hemoglobin solutions, prepared by Dr. DeVenuto's crystallization procedure, have been tested for their effectiveness as transfusion substitutes for blood in total (91 to 93 percent) and partial (70 to 76 percent) blood replacement studies using experimental animals.

In the total replacement studies, hemoglobin-transfused rats survived for five hours, whereas control rats, transfused with albumin (a plasma expander that does not transport oxygen), survived for only 10 minutes.

The survival of hemoglobin-transfused rats can be extended to approximately 10 hours by a second partial infusion of hemoglobin 3½ hours after the first total transfusion. In the partial replacement studies, one group of rats was transfused with hemoglobin and another with albumin. All animals survived. Both groups were monitored for two weeks.



Assistant Angelo I. Zenga holds bag containing crystalline hemoglobin solution.

There were significant differences in the two groups. For example, at the end of the transfusion, the volume of oxygen in the circulating fluid was three times greater in the hemoglobin infused animals than in the albumin-infused controls. Several physiological and hematological parameters were monitored and they returned to normal pre-transfusion levels within 5-8 days in both groups of rats.

Morphological studies by light and electron microscopic examination showed that sections of liver, kidney, and brain prepared from the tissue of the animals partially transfused with hemoglobin were normal two months after transfusion.

Hemoglobin appears to be an ideal blood substitute, since it has the ability to bind oxygen reversibly and to sustain life in animals subjected to complete blood replacement.

NARADCOM FY77 Posture Report Lists R&D Achievements

Development of a procedure for conducting bench tests of barometric staging devices, and formulation of standard requirements for the DoD Family of Tactical Rigid Wall Shelters are listed among major accomplishments in the FY77 posture report of the U.S. Army Natick (MA) Research and Development Command.

Space limitations do not permit presentation of all ongoing activities that comprise the NARADCOM research, development, engineering, and managerial program. A summary of technical achievements of the four major laboratories and the Operations Research/Systems Analysis Office follows:

Aero-Mechanical Engineering Laboratory (AMEL). AMEL's bench test procedures for barometric staging devices were applied specifically to the Teledyne Electronic Barometric Staging Unit. The new wall shelter requirements are included in development of the Army's one-sided expandable shelters that meet international standards.

The laboratory also completed development of an improved method for heating water for the XM-75 Field Kitchen. Complete automation of the heater eliminated the need for an operator to be present during its operation.

Investigations were conducted to select new canopy designs suitable for use as a steerable reserve parachute for military free-fall applications. Two commercial designs and one in-house design are under evaluation.

During FY77 there was a major effort in engineering support for testing the U.S. Air Force's Advanced Medium STOL Transport and C-141B prototype aircraft. Other significant efforts included development initiation of a 2,000 pound airdrop system which will permit delivery of supplies to any ground force unit where air defense missiles will be encountered.

Redesign and refinement of a test model to permit parachutists to jump with an M-16 rifle; a contract award for development of an all-aluminum airdrop platform; development initiation of a fastening system to replace zippers on MUST shelter components; and participation in a joint service project to standardize airdrop components.

Clothing, Equipment & Materials Engineering Laboratory (CEMEL). Development of a Personnel Armor System for Ground Troops (PASGT) is reportedly nearing completion. Specific items in this category include a protective vest and helmet.

Relative to improving the individual soldier's comfort in cold environments, CEMEL is experimentating with use of reflective layer insulation in various materials. Laboratory results show an average of 40 percent insulation increase over polyester batting materials.

Listed among ongoing activities in the area of camouflage are a computerized technique for the one-constant theory of colorant layers; radar absorbing materials in the form of flexible fabric-like structures; and computerized color matching of fabrics.

The concept of a New Women's Green Shirt is being tested in conjunction with the Men's New Green Shirt. Four designs are under consideration with emphasis placed on the appearance of "oneness" in women's and men's uniforms.

A new treatment has also been developed which improves surface water repellency of full-grain cattlehide glove leather without decreasing permeability or comfort. The process also affords some surface oil repellency and acid resistance.

Food Engineering Laboratory (FEL). Investigative programs of this laboratory are geared primarily toward improved military feeding systems, including rations, food packaging, radiation preservation of foods, and food service equipment.

Logistical advantages and transportation savings were reported as a result of progress in food compaction studies. Dehydrated apple mix was compressed to 20 percent of its volume, and work is proceeding on the compression of flour.

Progress in combating insect infestation of packages was achieved with development of a procedure for determining when initial infestation occurs. Additional studies are underway to assess its value as a laboratory tool.

Animal feeding studies, relative to the Food Irradiation Program, continued during FY77. Primary efforts were directed to establishing wholesomeness of irradiated beef, ham, pork, and chicken. These studies are conducted on a contract basis.

Chicken, pork, and low nitrite-nitrate ham were procured and irradiated with gamma rays from the megacurie cobalt-60 source and 10 MeV electrons from the linear accelerator. Further support was provided by the Federation of American Societies for Experimental Biology.

Contract negotiations have also been initiated to develop radiation preserved frankfurters, to study the effects of irradiation on the flavor of chicken, and to evaluate irradiation effects on myoglobin in cured meats.

Exploitation of a new mechanical flaking or chipping process for meats is reportedly providing the basis for development of an increasing variety of restructured frozen meat products.

Food Sciences Laboratory (FSL). Two Protein Efficiency Ratio determinations were performed to evaluate protein quality of stored and processed beef. No significant quality differences were reported between fresh and 5- year-old irradiated, frozen, or thermally processed beef.

The laboratory initiated a systematic study for preventing or minimizing oxidative rancidity of stored military rations by adjusting their composition without adding antioxidants. Chicken and sauce ingredients showed strong antioxidant activity while brown rice had none.

A study of food habits of remote and nonremote duty Alaskan Air Force personnel was also completed. Conclusions revealed that separate menus are not required for remote stations, although some attention to diet meals may be appropriate.

Operations Research/Systems Analysis Office (OR/SA). Recent studies included a system evaluation of Army garrison feeding, the development of a uniform ration cost system, and establishment of requirements, concepts and characteristics of a complete field feeding system for the Army and Marine Corps.

A new concept of Navy food service aboard carriers was formulated. Improvements include two distinctive food outlets for high-preference menus at the forward galley, and increased seating capacity. Up to four different menus will be provided simultaneously.

Further progress was reported in developing a new method for design of the Food Cost Index. The method uses a computer to design an optimized, nonselective cyclic menu. Considerable work was devoted to compiling a comprehensive data base for this effort.

Concept drawings for modernizing and renovating enlisted dining facilities were completed. These concepts range from "modest" to "moderate" in expense, and are designed to permit initiation of an ala carte food service system.

Analyses were also conducted to determine the feasibility of incorporating a crew feeding system within the M113A1 Personnel Carrier, the Infantry Fighting Vehicle, and the M60A1 Tank. Feasibility was established relative to energy required to heat food, water, stowage of rations, and supporting components.

NARADCOM's FY77 Posture Report also contains a summary of technology transfer achievements relative to federal, state, and local law enforcement agencies, the U.S. Department of State, the National Bureau of Standards, and the U.S. Energy R&D Administration.

Appendices provide information on Natick's participation at professional meetings, on government and non-government committees; technical publications; and a profile of executive personnel.

GSRS Directed Toward U.S., European Team Effort

General Support Rocket System (GSRS) development is being redirected by the U.S. Army Missile R&D Command (MIRADCOM) toward a standard NATO weapon that could be developed and coproduced in both the United States and Europe.

According to COL Barrie P. Masters, GSRS project manager at Redstone Arsenal, AL, the U.S. and the Federal Republic of Germany are putting together a team to plan, develop and share production benefits; and other European allies are being invited to participate. "We anticipate signing a Memorandum of Understanding this August," he said.

Vought Corp. of Dallas and Boeing Aerospace Co. of Seattle are under a 29-month validation program contract to design, build, test and demonstrate free-flight artillery rocket systems of their own design.

"Changes in no way diminish effectiveness of the system to meet U.S. requirements," COL Masters said, "but the program redesign will require about a 3-month extension of the validation program."

He went on to say that the option exists for both countries to opt for something less than full standardization, although " . . . we have set the stage for a standard NATO weapon and . . . a program of common development."

Changes planned to meet requirements of both countries would include bigger rocket motors and development of three warheads—a dual purpose antimateriel/antipersonnel, a scatterable antitank mine capability, and a terminal homing antitank warhead.

Being developed to supplement cannon artillery when targets such as artillery, troops and armor appear on the battlefield rapidly and in great quantities, the free-flight rocket system will utilize conventional target acquisition and fire direction procedures. The Army plans to field the system in the early 1980s.

Commercial By Design—Changing Times and Policy

By COL Justin A. Holmes

During the past year the Department of Defense has made a deliberate effort to buy more DoD materiel requirements from the commercial marketplace. Repeated studies by the Defense Science Board and the Military Services have proven that, by contracting for off-the-shelf products, DoD avoids costly and time consuming research and development, and lowers unit production costs. Equally important has been the capability of the commercial sector to provide alternative logistics support for what it sells.

The idea for acquisition and distribution of commercial products is not new. From General George Washington's time it has always been necessary for the government to rely on the private sector. Today the opportunity exists to do this on an increasing scale, because "the times, they are changing."

Specifically, industry's technological base has been driven at a faster pace than ever before. Today's consumer demands a wide range of choices among competing firms—price being only one factor in the equation. In addition, both large and small businesses have extended their networks of commercial distribution systems, many on a multinational basis. Such developments support the full and active utilization by the Federal Government of every available commercial aspect.

Auspiciously, the government has modified its management structure to permit exploitation of the commercial theme. In May 1976, the Office of Federal Procurement Policy (OFPP) issued the following fundamental direction:

"The government will purchase commercial, off-the-shelf, products when such products will adequately serve the government's requirements, provided such products have an established commercial market acceptability. The government will utilize commercial distribution channels in supplying commercial products to its users."

OFPP guidance was amplified to the Federal Departments in late 1976 to include a planning-analysis phase. DoD responded in January 1977 through a pilot effort under the acronymn CCAP—Commercial Commodity Acquisition Program.

CCAP is not an identifiable program by line item in the defense budget. Rather, it is a "learn by doing" effort among a wide range of service and agency product lines.

Additionally, a CCAP Task Group, composed of representatives from Services and DoD agencies, serves as a forum for discussion of problems and issues encountered by program managers to satisfy requirements through commercial means.

In January 1978, the DoD and National Bureau of Standards cohosted a 3-day workshop to review CCAP efforts to date, develop recommendations for policy inputs and to refine program guidelines.

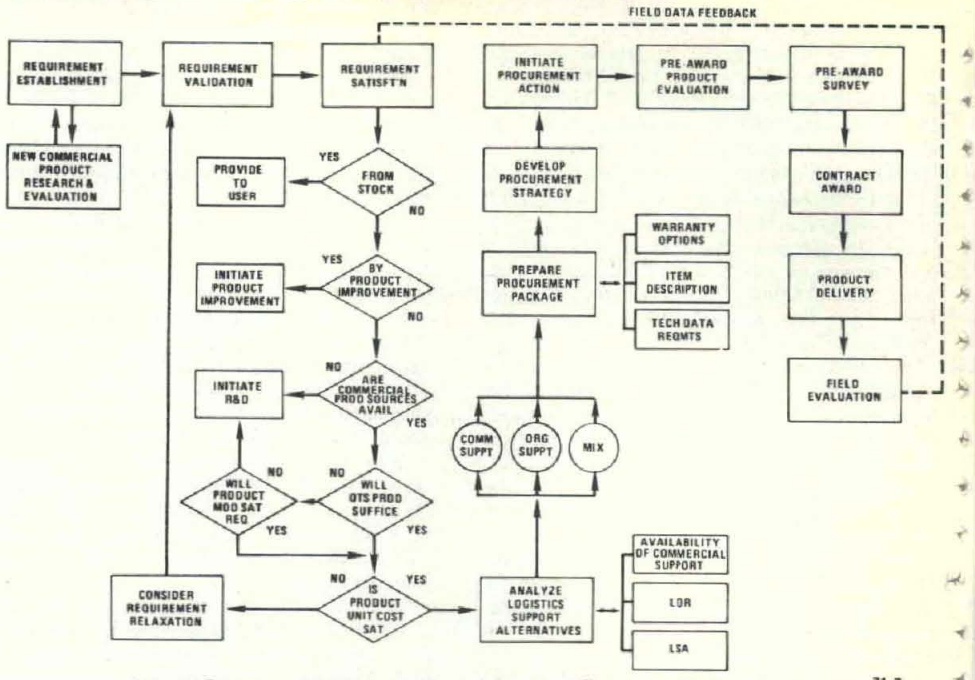


Fig. 1. Commercial Commodity Acquisition Program Methodology

More than 200 government and industry executives shared concerns with top level policy makers from OFPP, DoD and industry. Their conclusions and recommendations will be published in March. 1978.

Coupled with the pilot program, the workshop results will foster long-term acquisition policy and methodology which is more compatible with that employed by the private sector, e.g., Uniform Commercial Codes. The present CCAP methodology is described in figure 1.

The results sought may be broken into five functional areas for DoD policy development and implementation. The five areas are User Needs, Market Research, Acquisition Strategy, Logistics, and Product Assurance.

User Needs. The DoD people that develop requirements may or may not know what is available in the marketplace that will do the job effectively at an affordable price. Far too often, requirements and detailed specifications are developed on an exacting basis, so that the solution is almost frozen into the concept phase.

The DoD 5000-series directives concerning systems acquisition processes are being structured so that orientation will be toward development of the Mission Element Needs Statement (MENS). This will provide the requirements profile, not dictate the solution early on.

If there are competing commercial alternatives available in the requirements development or MENS process, then the user should be aware of them and provide for commercial considerations up front.

DoD can avoid the costs of a lengthy development process and concurrently obtain the advantages of the latest commercial state-of-the-art by sifting through commercial, modified, or off-the-shelf products to meet both system and/or component requirements.

Market Research. It is often difficult to select from the great number and variety of products available in the marketplace those which appear to satisfy DoD's requirements. There is a need, where commercial products are concerned, to conduct market research more intelligently and to constantly assess the trade-offs between the extra capability of a product and the added costs that would be incurred to achieve the capability.

Market research has not been developed as a separate discipline within DoD. Instead, it is achieved from the combination of laboratory centers, contracting activities, and industry's "marketeers" out to sell a product.

Market research criteria must be developed that determines whether a product does have in fact, "commercial market acceptability;" what constitutes that acceptability for that generic class of commodities; and what competing alternatives are available. In the market research area, the objective is to expand on what has been termed "shrinking technological base."

There are limited R&D resources to husband a host of high priority items. It will be necessary to do a better job capitalizing on the R&D accomplished to satisfy the commercial consumer, and at the same time, keep defense-industry research effort strong.

DoD needs to support the conduct of R&D programs in the private sector that show promise and free defense in-house resources to concentrate on the military

R&D effort.

Acquisition Strategy. With the designation of Dr. William Perry as DoD's Acquisition Executive, there are changes taking place in the contracting field within the acquisition process. These changes are required to keep pace with the way industry does business today and of necessity to get the most of DoD's procurement dollar.

The Chiles Bill (or S. 1264) is a good document that DoD fully supports. The alignment of DoD to that bill as it materializes will facilitate the acquisition executive's job and the functioning of the Defense Acquisition Regulatory System (DARS).

In the acquisition area, "the word" must get to the government personnel in the field. Where commercial buys are concerned, the DoD and Service procedures should be there, be simple and be concluded successfully.

There are several schools of thought among government and industry in this regard. One says that there are sufficient latitudes in the acquisition processes and that no changes are necessary to "buy commercial."

Another says that there ought to be a separate "call out" chapter in The Armed Services Procurement Regulation, or its successor, for commercial acquisition. Many commercial firms also point out that government contracting is too complicated and that they wouldn't touch a government contract with a 3-meter pole.

Acquisition experts are addressing many of these issues in order to "institutionalize" the commercial policy within the acquisition process. "Implementers" are planned for the September-October 1978 time frame.

Logistics. The job of professional logisticians is one of the most difficult today. DoD is emphasizing a coordinated logistics effort throughout the R&D or acquisition processes.

In the Commercial Item Support Program (CISP), logistics considerations are "up front" where, in many cases, the total costs of ownership are predominantly influenced by the logistics tradeoffs. It is a known fact that the bulk of dollars in the defense budget go to personnel, operations and support costs.

Can commercial products and distribution/logistics systems help to reduce these costs? The answer is "yes" when dealing with reputable, responsive and responsible firms. The present logistics system is adjusting to this approach through the CISP. Obviously, there is no reason to acquire a commercial product that cannot be logistically supported.

Product Assurance is a daily challenge. DoD directives and program managers strive to write all of the "ilities" into product descriptions, standards and specifications and still, when it gets to the user, fixes are required—oversimplified, to be sure.

The challenge is to promote acceptable quality assurance, reliability and maintainability criteria for the industrial producer, and to be in a position to accept his certifications as valid with a minimum amount of testing by the government.

The DoD wants to gain, through the user and supporter, visibility of performance data in order to control operating and support costs during the products' life. Improved product performance from the commercial sector will do more to convince the user and logistician to favor commercial approach than any other factor.

This is happening in the development of commercial quality assurance standards and specifications. DoD is a "player" in this area and has a strong program to tailor to MilSpecs or adopt those commercial standards that can be applied.

Last, but far from least, there is the increased emphasis on NATO. NATO is not a one-way or even a 2-way street. It's more like the Los Angeles Freeway! NATO standardization, commonality or supportability does not mean "buy all U.S."

There is a shared, mutual responsibility between governments, between governments and their contractors, between Defense Departments and Ministers, and between U.S., international and foreign contractors. While there has been no attempt to extend DoD's commercial product pilot into this complex arena, it is not without potential. Think of these implications where defense and ultimately, National Security are concerned.

In summary, the DoD is embarked on a chartered course to significantly increase the percentage of products acquired "off-the-shelf." Actions and the timetable for 1978 include continued representation at the federal policy level, development and/or modification to existing DoD policy directives and Service regulations, and an effort to address commercial solutions with industry and the private sector.

While potential payoffs are persuasive, the test of the commercial policy will be measured in the results achieved. Rewards will go to those who learn to use commercial products technology and support to their advantage.

COL JUSTIN A. HOLMES, U.S. Army Signal Corps, is the commercial products staff officer, Office, Deputy Director for Standardization and Support, Office, Under Secretary of Defense Research and Engineering (Acquisition Policy). He serves as DoD representative to the Office of Federal Procurement Policy Interagency Steering Group on Commercial Commodities, and is chairman, Office, Secretary of Defense Commercial Commodity Acquisition Program Task Group.

A distinguished graduate of the Industrial College of the Armed Forces (Bicentennial Class of 1976), his academic credentials include a BS degree in industrial production management and a master's degree in business administration from the University of Arizona.

COL Holmes is a member of the Armed Forces Communications Electronics Association, the National Contract Management Association, the Society of Logistics Engineers, and Beta Pi Alpha National Honorary Scholastic Fraternity of Business Management.

WRAIR Probes 'Brain's Opiates' Effect on Behavior

Have you ever wondered why some persons are seemingly unaffected by physical or emotional pain while others pass out at the mere thought of such discomforts? Part of the answer may lie in a medical mystery now under investigation at the Walter Reed Army Institute of Research in Washington, DC.

Dr. John Holaday, a pharmacologist in WRAIR's Division of Neuropsychiatry, believes that a group of body substances termed "endorphins" may answer a lot of questions relative to human and animal behavior.

Described as "the brain's own opiates," endorphins are produced in the brain and stored in the pituitary, a small gland at the base of the brain. Endorphin, Holaday explains, is short for "endogenous morphine."

Endorphins react much like morphine, both chemically and in their effect on the body. Preliminary evidence indicates that endorphins may be related to the body's response to pain and temperature control.

Stress situations, such as severe injury, appear to trigger release of the chemicals from the pituitary. Thus far, animal research has focused on behavioral effects resulting from removal of the gland from the body.

Holaday and associates MAJ Gregory Belenky, CPT Bruce Cuthbert, and Dr. Jean Kant speculate that endorphins may be involved in disorders and mood changes such as schizophrenia. Studies have also been conducted by Holaday, Dr. James Meyerhoff and Ed Mougey to measure individual endorphin levels.

Holaday also speculates that a "high stress" person may built up an immunity to their own endorphins. Similarly, he asks, if a person is removed from stress situations is there a withdraw syndrome?

His work, initially conducted for his doctoral dissertation at the University of California, earned him the American Society of Pharmacology and Experimental Therapeutics 1977 Deane N. Calvert Memorial Award for Scholarship and Commitment to Research in Pharmacology.

The award was accompanied by a $500 honorarium and an expense-paid trip to the Medical College of Wisconsin, where he presented a series of lectures on his research findings.

An ROTC and master's degree graduate of the University of Alabama, Dr. Holaday joined WRAIR in 1968, serving in the Psychiatric and Microwave Research Departments. He became a WRAIR civilian employe following release from active duty.

Some of our readers suggested that from time to time they'd like to see historical type articles covering R&D programs—good & bad. As a trial article of this nature the editors selected the story of the Jeep. If you enjoy this type article let us hear from you. If you have a good story to tell, write it down and send it to us.

20 YEARS TO DEVELOP—THE JEEP

Probably no vehicle with the exception of the tank, so symbolizes the Army as the ubiquitious Jeep. Its use and versatility far transcend its official title as "Truck, Command Reconnaissance, ¼-ton, 4x4." It has become so much a part of the Army that its origins are taken for granted. Many now wearing Army Green have never known an Army without a Jeep. But the birth pangs of this remarkable vehicle were long—almost 20 years, and they were truly messy and agonizing—even at times, embarrassing. There are still lessons to be learned from the development saga of the Jeep.

The idea for a vehicle of this type emerged from the "lessons learned" following World War I. About 1920, the Ordnance Department's Technical Division—the R&D arm of the Corps, considered a ¼-ton tractor to meet requirements for a light reconnaissance vehicle capable of negotiating difficult terrain.

Concurrent with this action was one originating with the Quartermaster Corps' Technical Committee. The QMC at that time had responsibility for general purpose vehicles, whereas the Ordnance Corps' purview was that of combat vehicles. The QMC envisioned a small vehicle capable of hauling limited amounts of supplies and ammunition to front-line positions.

Even in those days there was formal recognition of the need for a low silhouette for such a vehicle—something often forgotten when the later U.S. command and reconnaissance cars and M-3 tanks of the early World War II days provided unmistakable targets to Rommel's gunners in North Africa.

The Ordnance Department, working with very limited R&D funds, began modifying existing trucks with the addition of tracks, and by modifying commercial vehicles. The tracked truck approach ended in utter failure. Trials with a Modified 2-seat, canvassed-topped Ford Model T, stripped down to barely 1100 pounds of dead weight produced better results. The standard 3½-inch tire however, was inadequate; sand and mud defeated it. When wider type aircraft tires salvaged from a junkyard were substituted, the vehicle's performance improved markedly.

What followed is all too familiar. The requirement began to change. Special equipment and weapons were added. The weight of the vehicle started rising and it lost power and maneuverability. However, the concept of a wheeled vehicle rather than a tracked one seemed proven.

But there the program stalled, for these were times of lean military budgets. It would not be revitalized until the early 1930s. At that time the Infantry Board at Fort Benning, the forerunner of today's combat developments element, had become interested in the British Army's use of the tiny Austin car in a reconnaissance role. Authorization was obtained to buy a car from the American Austin Company of Butler, PA, which was done and the car began its trials.

Concurrently, COL Arthur W. Herrington, president of Marmon-Herrington Co. of Indianapolis, began an independent industry approach to the problem. Herrington decided that his company's experience with heavy all-wheel drive vehicles might have a U.S. pay-off. In 1934 Marmon-Herrington modified a 1½-ton Ford truck to an all-wheel drive version.

There was Army interest in the truck but no funds were provided to support the concept. However, the Belgian Government bought one, and its findings confirmed American thinking that the weight was too great for its mission.

COL Herrington thereupon took a ½-ton Ford and converted it to all-wheel drive. Experiments with this vehicle in 1936 looked so promising that the U.S. Army purchased five of the trucks for testing.

The trials, which began in January 1938, indicated that Herrington's modified truck was close to what the Army had in mind. It moved well cross-country, carried supplies and ammunition, traveled 35mph with a 1000-pound cargo load and could even tow a 37mm antitank gun. Drawbacks were still the weight and height. Nonetheless, a contract was awarded to Marmon-Herrington for 64 additional trucks. These remained in service until 1941, when replacement specifications called for the ¾-ton truck. COL Herrington's trucks would not evolve into the Jeep, but did confirm the validity of using an all-wheel drive vehicle for forward area duty.

While COL Herrington's trucks were being developed, personnel at the Infantry School attacked the requirement on their own. A team composed of CPT Robert G. Howie and SGT Melvin C. Wiley had begun to build, often on their own time and expense, a low silhouette, compact reconnaissance vehicle.

CPT Howie had been experimenting on paper with such a concept since 1934. By 1937 the design matured to the point where MG Walter C. Short, assistant commandant of the Infantry School, (later to be the unfortunate Army commander at Pearl Harbor, Dec. 7, 1941), diverted $500 to support their work.

The basic broad requirement had not changed so far as the Infantry people were concerned; they wanted a low silhouette, high mobility vehicle capable of carrying weapons and ammunition to the front lines.

What Howie and Wiley came up with, most of which came from parts salvaged from junk yards, was a low, springless vehicle powered by a 4-cylinder water-cooled Austin engine. It was a 2-man wheeled vehicle wherein the men rode prone on their stomachs. The engine was in the rear and the drive axle at the front. It was essentially a machinegun carrier, called the "Belly Flopper."

The reaction of the Infantry Board was mixed. The low design and excellent mobility in sand drew praise, but there was deep concern regarding the vehicle's bare 33¼ inches of ground clearance, extreme light weight and lack of ruggedness. MG Short sought professional opinion. The president and chief engineer of Willys-Overland of Toledo were invited to view the vehicle in action. The Willys men concluded it was a step in the right direction, but!

Meanwhile, the American Austin Co. had become the American Bantam Co. and in 1938, it had loaned three of its cars to the Pennsylvania National Guard for trials during summer maneuvers. Reaction from the Guardsmen was most positive, and the Bantam Co. felt the ball had bounced into their hands. And indeed it had, for a time.

Bantam officials met with the chiefs of Infantry and Cavalry and suggested they be given a contract to develop the car. General specifications were agreed upon, the proposal sent to the General Staff, and approval granted.

The next step was the assignment of the project to the appropriate technical committee for implementation. In this case the Staff said it was to the Ordnance Department committee. However, that body recommended that before it undertook the work a subcommittee of infantry, cavalry, and quartermaster officers, along with civilian engineers, be set up to formulate

Howie-Willys "Belly Flopper" *Photo—Courtesy of Patton Museum of Cavalry & Armor, Fort Knox, KY*

detailed specifications for the proposed vehicle.

The subcommittee was created, and one of its first acts was to visit the Bantam plant at Butler, PA. They talked with company officials, examined their capabilities and saw existing Bantam cars. Howie accompanied the subcommittee at the Bantam plant.

According to Howie's later statements, he had been ordered to report there along with his plans and drawings, by the Chief of Infantry. Upon doing so, Howie was told by the committee to turn over his drawings and plans to the Bantam Co. He was to state later, that he was advised the contract was to be for 70 vehicles, based upon his prototype. He remained with the company for a week to make recommendations as to Bantam's ability to produce the car.

By the end of June 1940, the subcommittee had formulated the specifications and delivered them to the Ordnance Technical Committee. They called for a weight limit of 1200 pounds, a payload capability of 600 pounds, a wheelbase of no more than 75 inches, a maximum height of 36 inches and a speed range of 3-50 mph. Body design was rectangular, the vehicle would feature a 2-speed transfer case with a 4-wheel drive, a folding windshield, 3 bucket seats, and blackout driving lights.

Since the vehicle was basically a general purpose rather than a combat type, the Secretary of War authorized not more than $175,000 of *Quartermaster* funds for 70 vehicles. Bantam won the contract under a competitive bid arrangement, with Willys being the only other bidder.

At the time of the request for proposals, Bantam had only some 15 people on its payroll, was in shaky financial shape, and had almost no engineering staff. However, between the award and required time of prototype delivery, the staff was expanded considerably.

The vehicle delivered to Camp Holabird, MD, the QMC test center, resembled the eventual Jeep in about every aspect except the fenders, position of lights, motor, hood and front. Bantam engineers concluded however, that there was no way a vehicle could be designed within the revised authorized 1300-pound limit, and still meet the other requirements. Bantam was confident that it had a winner.

Subjected to constant testing, the vehicle's fenders and grill loosened, a generator pulley disintegrated, tail lights fell off, etc. One source reported 20 faults. Nevertheless, the vehicle demonstrated ample power and met all the requirements—excepting weight, which everyone was now beginning to realize had been totally unrealistic. Notified of the recommended changes by the Army, Bantam prepared to deliver the full 70-vehicle order.

The future looked bright for the Bantam Co., but there were ominous omens in the air.

Present at the test site were representatives of Willys and Ford. One Bantam official would later testify seeing Ford technicians make detailed drawings of the Bantam car from under a grease pit at Holabird. The other omen was growing QMC concern relative to Bantam's high-volume manufacturing capability.

Willys had lost out to Bantam, but had not given up the idea of getting a big piece of the growing U.S. military rearmament effort. This objective tied in nicely with Army in-house wishes that the supplier of the truck be capable of producing not hundreds but thousands. Furthermore, some felt a dual source was necessary to offset sabotage, strikes, and to meet surge production.

Using its own money, Willys began its version, and by mid-November 1940, it was on the test tracks at Holabird.

The situation became even more muddled when a Ford prototype arrived at Holabird. There were now three versions at Holabird, all resembling in appearance the original Bantam model. Despite this, Bantam believed it had already won the award for an additional 1500.

Willys had protested, and Ford expressed the desire to bid. What the Army should do became a major concern.

LTC Henry S. Aurand, later to head the Army's post-WW II R&D effort (1946-1947), reportedly suggested an award for 1500 vehicles be given to each. The sub-committee recommended that the 1500 should be divided equally among the three. What followed was a very unfortunate and messy controversy.

The Army was seemingly driven by concern for two reliable sources of volume production. Bantam still had only about 450 employes, while Ford had some 100,000. Willys was much smaller than Ford, but believed to be a more proven quantity than Bantam. The squable went into the halls of Congress.

The Army Staff position, and the one accepted by the Secretary of War, was to award Bantam the 1500 vehicle contract. The QMC questioned Bantam's financial status and ability to mass produce. However, the decision in favor of Bantam stood.

The National Defense Advisory Commission, which favored multiple sources of supply, intervened and recommended that each company be given a 1500 vehicle contract. Contracts were drawn up, initially with Bantam and Willys; Ford's was temporarily delayed because of unfair labor practice charges.

Despite a continuation of anti-Ford publicity, all three companies eventually began production. The QMC claim the Bantam could never exceed a rate of 50 cars per day was voided when that company attained a rate of 52 a day on one 8-hour shift.

However, none of the three companies met their required delivery dates for their respective 1500 vehicles.

Tests of the three prototypes generally proved Willys the best; Bantam followed, with Ford a poor third.

The final award was given to Willys on the basis of its low bid of $738.74 per car and its competency to produce the vehicle. The contract was signed on July 23, 1941, and to all intents and purposes that was the end of the Bantam Co., which never received any further remuneration for the vehicle it had in reality developed.

The model that emerged would carry the label Willys MB, Truck, Command Reconnaissance ¼ ton, 4 x 4. Specifications required it to climb a 60-percent grade or a 7-percent grade if towing a load; an ability to tow a 1000-pound load; an open-road speed of not less than 55 mph and a minimum speed of 3 mph at maximum torque; capability of fording water 1½ feet in depth; and that it be able to operate at gross weight with a towed load over unimproved country and hills.

So great would the vehicle's success and demand be, that a second source was shortly required. For reasons that are still not wholely clear, the Bantam Co. was excluded and the second source became Ford.

A total in excess of 600,000 vehicles were produced during WW II by Ford and Willys, in a wide variety of modifications, and used by all the allied nations.

Despite periodic efforts to have Bantam given a share of the production, it never came to pass. While the company survived a short time on government contracts for trailers, torpedo and aircraft components, it finally went bankrupt in 1956 and was absorbed by American Rolling Mills.

Surviving the company is its prototype vehicle No. 1007, which is in the possession of the Smithsonian Institution, Washington, DC. The grand-daddy of them all—the Howie-Willys "Belly Flopper" rests in the Fort Knox museum.

Less clear is the origin of the now-familiar name "Jeep." One theory is that it emerged from the letters "GP," standing for "General Purpose" truck, which at one time categorized it. Another contends the term came from "Eugene the Jeep" of E. C. Segar's "Popeye" comic strip. A third version says that it was first termed a "Peep" since the earlier fielded ¾ ton command car had been dubbed a "Jeep" by the men of the 34th Division during manuevers in 1940.

Which of these sources is right may never be known, but the Jeep, now in its third version, having moved from the M38 to the M38A1 to the current M151, seems destined to be with the Army, in some form, for a time-span almost comparable to the horse.

World War II Jeep

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(Continued from page 3)

inflation, pay increases, and transfers).

Instructions from Office of the Comptroller of the Army (OCOA) required DPS prioritization. Priority and decrement lists are at best dangerous. They are hard to keep "close hold," and can be disadvantageous if they fall into the hands of a program adversary in a superior budget advisory or decision making position. In traditional budget development, a natural tendency was to protect internal priority and decrement lists. In ZBB, the heart, soul, and softness of the appropriation are exposed. ODCSRDA argued that to maintain a balanced program from basic research to program-wide activities, all DPSs had the same top priority. The instruction to prioritize was repeated.

This was countered by indicating all programs at the Decremented level were Priority 1, Basic level (additional program effort above Decrement to Basic) were Priority 2, and Enhanced Level, Priority 3.

The requirement to prioritize between DPSs disappeared. Guidance then came to prioritize by project/program element, all projects above Decremented level within each DPS. This was done reluctantly for the budget year and then, through strong urging from OSD, for all five FYDP years.

Now the appropriation was totally exposed—a Decremented level program below which there would theoretically be mission failure, topped with a nearly $250 million PE-by-PE prioritized list. This was again, a classic example of ZBB at work.

We were then requested to develop seven banding levels: five from Decremented level to Basic, and two from Basic to Enhanced. This was done by grouping the priority listing into $40-50 million segments of PEs and describing what capability each segment or band bought for so many additional dollars.

During October-November 1977, the appropriation was arrayed in a variety of formats: traditional budget (duplicated final Basic ZBB funding level); 14 DPSs structured in three levels and seven bands above Decremented level; and individual PE prioritization also above Decremented level.

What existed then, was a complicated and somewhat confusing situation. It was not clear whether program and funding decisions would be by band, DPS level, or by individual PE. Eventually, all ZBB formats and a fair share of traditional techniques were used to make initial and final budget decisions.

The Army, OSD, and OMB decision process that followed was complex, and OSD was wrestling with something that looked like that shown in Figure 3.

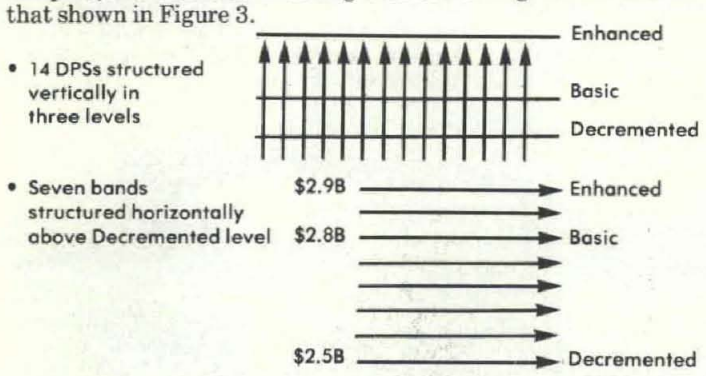

Fig. 3. ZBB Budget Submission

These vertical and horizontal ZBB formats, in addition to the traditional decision process of addressing individual projects/PEs, presented the decision maker with interesting if not complex decision alternatives. One could make: program and budget decisions within a DPS; decisions based on the banding process; or individual program decisions without regard to ZBB packaging.

There appeared no clear-cut solution because the vertical structure of the DPS complicated a simple decision based on bands. Random program decisions would have negated all the work which had gone into arraying the appropriation in ZBB formats.

The initial route taken by OSD was to make decisions by DPS with funding adjustments at all levels if appropriate. This was done by "rolling out" the DPS to PE/project level, make plus/minus/no change decisions, and then "rolling up" the PEs back into the DPS. Funding levels and justification were then created at DPS level, based on individual PE decisions.

An interesting dynamic developed where OSD created its own 3-level DPSs through the "roll out - roll up" process which further provided additional decision alternatives. Figure 4 illustrates this expansion of decision levels. The SECDEF based his initial decisions generally on specific Service or OSD alternative level recommendations.

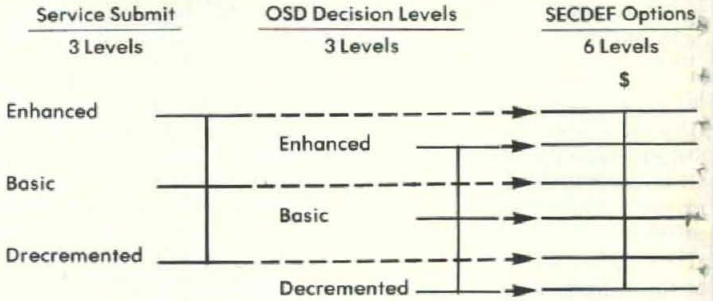

Fig. 4. Expansion of ZBB Decision Levels

Figure 4 indicates where the DPS has been recommended by the SECDEF staff for reduction at all levels. Initial SECDEF decisions, at the DPS level, resulted in no change in five of the Army DPSs, three receiving additional funds, and six being reduced. Critical to the appropriation was that OSD program increases in the RDTE area exceeded reductions, which was unique within the Army.

Major reductions were experienced by Advanced Technology Demonstrations (R&D Category 6.3A), certain communication and missile programs, and program-wide activities including some test and evaluation funds. Major increases were provided in Exploratory Development (6.2), several missile and rocket systems, mine warfare, and some communication efforts. The major increase was related to enhancing our R&D in NATO related activities.

During the decision process there was a close working arrangement with OSD and many mutually acceptable increases/reductions were negotiated. These resulted in a better balanced appropriation and narrowed the differences between the Army and OSD staffs.

The decision process had clearly been based on the DPS "roll out—roll up" approach, with some banding element emerging as related to determining specific program priorities and various funding levels. OSD revised Army priorities by changing individual program or funding levels within the Basic or Decremented categories. For example, a program for which OSD wanted to provide additional protection was shifted from the Basic to the Decremented level, and vice-versa for a program which may have been viewed as less important.

The full force of the banding technique did not appear until the first week of December. At that time, the Army received a listing from OSD of its priority ranking and banding of Army's total budget issues. This represented ZBB in its finest application at the Service level.

All other intra-Army and Army/OSD debate subsided and attention was focused on the SECDEF list, Army-wide program priorities, and the impact of gaining or losing the various bands on the list. An outstanding ZBB-related dynamic of the list was that the Army was directed to create impact statements in a positive, not negative manner. In other words, the list, starting at the total Army level of approximately $30 billion, was increased by banded increments until it totalled about $33 billion.

Each incremental step had to be described in terms of added capability for added funds. However, on Dec. 21 the Army was notified that its RDTE items on the SECDEF list as well as several programs listed to have been protected at the Decremented level had been reduced during final budget decisions.

It was apparent that both ZBB and traditional budget techniques were used. Undoubtedly, ZBB levels, banding, and prioritization efforts had a significant impact on final decisions. Relatively speaking, Army R&D did well.

The final decision reduced our appropriation by about 4.5 percent, while the total Defense Research and Engineering budget was reduced more than 5.0 percent. The final FY79 Army RDTE budget level of slightly more than $2.7 billion represents about 6 percent real growth over FY78. However, the budget is only now before the Congress for authorization and appropriation, and further reductions are anticipated.

Don't despair if you are confused by ZBB and question its practical use and effectiveness. These are logical reactions, particularly considering the extra thousands of man-hours required. Also, as a new process, ZBB was imposed on a time-constrained and extremely complex PPBS system.

Considering that OSD, the Service Comptroller, and the appropriation director basically came down the ZBB track together, problems in receiving timely procedural and funding guidance and exercising smoothly the principal concepts of ZBB were bound to exist.

I strongly believe that familiarity and experience with the system will reduce or eliminate many of the problems experienced during the FY79 budget cycle. I believe there are significant benefits in ZBB. The wise program manager will take advantage of the positive side, and in the long run make the system work to the benefit of his program.

Highlighting some of the ZBB pros and cons during this last budget cycle may help in understanding the system. Major positive aspects of ZBB are as follows:

Relating program to mission. Programs stand or fall based on their recognized need and relation to an agency's mission. The ZBB ground-up review, if done honestly, surfaces the sub-elements of mission and programs and asks repeatedly if a particular program is related to a recognized requirement and, if so, is it funded at a proper level. Failure to substantiate need or level results in program elimination or reduction. Conversely, program gaps and inadequate funding levels can be identified and properly supported through ZBB.

Relating programs to objectives. This directs one's attention to the establishment of objectives and related programs to support mission responsibilities. It asks the question "are these funds needed now?" Again, ground-up review and prioritization prevail. Soft, or less urgent, programs rise to the top and are cut if sufficient funds don't materialize.

Involvement at all levels. A consistency of program and budget development is necessary throughout an appropriation if it is to be strong, well thought out, defended, and successful in a competitive funding environment. Properly executed, ZBB forces everyone to think minimum level and build incremental capability for additional funds. This start low and build up concept, with critical program review at succeeding decision levels, should assure the strongest and best possible program at all levels.

Start low—build up. This concept, by itself, is perhaps the most significant contribution of the ZBB process. It forces the manager to address and identify his primary mission-sustaining needs. It also forces him to consider the impact of different funding levels from the beginning of program or budget cycle. Priorities change, and programs may migrate from Decrement to Basic to Enhanced. At least, under the ZBB process, these migrations are done with eyes open and with the benefit of conscious decisions. The manager knows that the higher the program floats up the ZBB level, the more likely it is to be cut. Offering up "gold watches" to protect his funds can be a risky strategy.

Prioritization. Related to the "start low, build up" process is the discreet prioritization of all programs, identified by PE, in the DPS/budget above the Decremented level. This aids significantly in developing both incremental capabilities and in determining impacts in the hundreds of "what if" exercises associated with budget development and finalization. These prioritized listings, once compiled and approved, represent the staff's position when actual decisions are made. This early development and approval actually saves time and anxiety during critical decision-making periods.

Flexibility. ZBB prepares the appropriation for the decision making process. From the outset, more important programs are clearly identified and protected while critical but less important programs are exposed to management judgment. Banding and prioritization present, in crystal clear terms, options and alternatives—either within DPS, between DPSs, between appropriations, within a Service, and even between Services. The manager knows quickly what he buys and what he doesn't buy at various levels.

This enhanced management ability is not constrained to the budget year but conveys itself thoughout the FYDP. Prioritization and banding expose inconsistencies in program development and increase the manager's flexibility in correcting illogical programs and program funding profiles across more than one year.

There were some major lessons learned in this first ZBB cycle. The following represent some of the more important ones we have identified.

Early procedural guidance. Procedures, formats, and instructions need finalization as early as possible in 1978 if they are to be effective in assisting in POM '80 development. POM '80 represents a *programing* as opposed to budgeting cycle (zero-base programing and budgeting—ZBP/ZBB) and ZBP applied to the POM will have to be carefully thought out to assure the most effective POM submission to OSD.

Early fiscal guidance. Early fiscal guidance, particularly at the Decremented level is critical to the program and budget formulation process. For numerous reasons, we received final guidance late in the FY79 budget cycle. This caused a fair degree of program turbulence and readjustments and will hopefully be avoided during the POM cycle.

Program justification. Classic ZBB requires justifying the hard core program at the Decremented level—below which there is mission failure—and then developing incremental funding with increasing program capabilities. The Army had proceeded accordingly and then, after our DPSs had been submitted to OCOA, we were advised to justify the program at Basic level and discuss impacts of increments and decrements (back to traditional budgeting!). This caused a complete, last minute, revision of all DPS narratives.

All levels—all years. Primary concentration was on three levels for FY79, the budget year. Secondarily we looked to the remainder of the FYDP, FY80-83. This was inefficient in that during final phases of budget submission and initial phases of the decision process we had to retrace one-year decisions and establish funding profiles for three levels, five years.

DPS decision information. OSD was faced with DPS analysis which included PEs from the various Services. DPS decisions were clearly stated from an OSD standpoint but were hard to interpret from the individual Service standpoint. DPSs were written at the OSD level, but our appeals had to be Service oriented. Audit trail and accuracy of PE and DPS math were difficult to maintain. This OSD/Service interface problem should resolve itself as we gain more experience in ZBB.

Mixed traditional and ZBB decision techniques. The ZBB three level, banding, and prioritization decision process held up quite well until final decision actions. It was apparent that certain budget levels had to be maintained and that additional reduc-

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(Continued from page 17)

tions were necessary. The final DPS action distributed many reductions into all levels of the appropriation. This appeared to have voided some of the prioritization effort and to have been based on individual program analysis more along traditional decision lines.

A look to the future. The FY79 budget is now working its way through Congress, and, as noted earlier, we are already moving into the next programing and budgeting cycle, FY80. We started preparing for POM '80 in August/September 1977. This was necessary to provide for ZBB and PPBS complexities described earlier, avoid problems we learned the first time around, and allow time to structure the best possible appropriation program. Some of the major efforts related to preparing for a ZBB oriented POM and budget '80 are as follows:

Program Data Sheets (PDS) revised. In October 1977, HQ U.S. Army Materiel Development and Readiness Command took action to revise PDSs into ZBB format and have programs submitted to HQ DARCOM for review in December 1977, using ZBB concepts and narrative. The new PDS requires each program to be justified at a minimum level with higher levels addressing additional capability, schedule changes, funding requirements, and manpower impact for all FYDP (FY80-84). HQ DA extended these instructions to all Army RDTE developing agencies. PDSs were scheduled to arrive at HQ DA by mid-January for continued review and consideration during POM '80 development.

RDAC revisions. RDAC worksheets and procedures have been revised to accommodate ZBB program formulation and decision processes. Automated systems have been updated to provide for ZBB formats and data and assist in ZBB decision making.

MARDIS. Actions have been initiated to modify the Modernized Army Research and Development Information System to accommodate zero-base budgeting. MARDIS is planned for extension during early 1978 and will be modified through System Change Request procedures to support ZBB requirements by mid-1978.

Army-wide ZBB Conference. In late January/early February 1978, the Director of the Army Budget conducted an Army-wide ZBB Conference. The purpose of this conference was to review lessons learned during the FY79 budget formulation and submission and refine procedures, formats, and training requirements for FY80 program and budget submission. Army Staff and major command representatives participated in seminars addressing all appropriations and all phases of ZBB programing and budgeting.

Clearly, our whole programing and budgeting system is moving toward ZBB.

The mission then, of the Army RDTE community is to support Army and national defense objectives by providing the best possible RDTE program within the constraints of limited resources. Zero-base budgeting is a major management tool developed to assist the decision maker in the critical process of relating objectives and programs, identifying more efficient or effective alternatives, and exposing the impact of budget decisions.

We must take this tool and use it to the benefit of our appropriation. This should be obvious for at least two reasons: first, ZBB, even considering its complexity, makes good business sense; and second, there is no doubt about the requirement to implement the system.

It is hoped this article has been helpful in increasing your understanding of ZBB. With the 15,000 RDTE professionals in the Army pulling together, we can develop and maintain a highly effective appropriation and meet the planning, programing, and budgeting challenge head-on and successfully.

COL RICHARD L. NIDEVER is chief, RDTE Programs and Budget Division, Office, Deputy Chief of Staff for Research, Development, and Acquisition, Department of the Army. He has more than 12 years experience in materiel acquisition, including assignments involving missile R&D, industrial, field service, contracting, and procurement operations with various DARCOM commands and with HQ DARCOM.

His academic credentials include a BA degree in psychology from the University of California (Los Angeles), and a master's degree in business administration from George Washington University. He is a graduate of the Infantry School, Ordnance School, Air Command and Staff College, Army War College, and the Naval War College. He is a member of the National Contract Management Association and is a Certified Professional Contracts Manager.

Commissioned through ROTC in 1954, he served as an Infantry officer with the 82d Airborne and 1st Cavalry Division before transferring to the Ordnance Corps in 1958. He has commanded ordnance direct support companies in Korea, 708th Maintenance Battalion, 8th Infantry, Germany, and the 801st Maintenance Battalion, 101st Airborne Division (Air Mobile), Vietnam. His military decorations include the Legion of Merit, Bronze Star Medal, Meritorious Service Medal with Oak Leaf Cluster (OLC), and the Army Commendation Medal with two OLC.

Lessons Learned From the Past . . .

Military Museums Can Aid Army R&D Planners

Identifying all possible historic examples of the Army's scientific knowledge, collecting hundreds of artifacts showing the development of weapons and equipment, Army museum curators can be of major help to the research and development community.

How were rates of fire increased? How were soldiers better protected in various environments? Which potential hazards to operations were eliminated? Curators ask themselves these and many other questions in planning their acquisition programs.

Technicians and engineers can take a look at approaches that worked, but were not fielded for some reason, and equally valuable, approaches that were tried and found technically wanting.

The combined assets of military museums are immediately available for research and development personnel seeking answers to problems.

The design of the Lewis gun, a World War I light machinegun with a drum magazine mounted on top, provided ideas for improving the rate of fire of current automatic weapons. Museum information made it unnecessary to repeat experiments performed several generations ago.

Because of field modifications, human engineering laboratories found that accurate measurements of armored vehicles turrets could best be obtained from intact museum pieces.

Some 2,000 weapons are at Fort Benning's Infantry Museum. At Aberdeen Proving Ground, the Ordnance Museum has 18,000 items related to the search for reliability in ammunition, light and heavy ordnance, and chemical items. Examples of attempts to reduce weight of vehicles are displayed at the Fort Eustis Transportation Museum.

Development of military engineering equipment can be seen at Fort Belvoir's Engineer Museum, while Fort Sill's Artillery Museum has collected cannon, gunner's tools, and fire control instruments from the 16th to the 20th centuries. Equipment for fighting in fair weather or foul from the 15th century to the present day is preserved at the West Point Museum, plus examples of all major U.S. Army shoulder weapons.

From Fort Monroe to the Presidio of San Francisco, Army-operated museums stock reference material and technical information on their extensive military collections. Basic lessons of technological advances and failures then, are readily available to the R&D engineer and scientist.

Defense contractors have shown no hesitation in visiting Army museums. In the mid- 1970s, one official research group showed renewed interest in World War II's curved gun barrel. A leading American contractor also took another look at the 40mm antiaircraft gun for possible experience transition to a future air defense gun.

Responsible for all Army museums, the U.S. Army Center of Military History can assist in finding a museum that may help with development problems. Whether one is wrestling with ideas on personal gear, uniform items or major equipment pieces, the chances are that somebody has faced a similar problem before. Army museum collections may save countless hours of reinventing the wheel.

By U.S. Army Center of Military History Staff

Problems With Documentation Costs? AEDPS Can Help

By Leland Womack*

The Automated Engineering Document Preparation System (AEDPS), a new concept of using computer technology for preparation of engineering procurement documentation, can reduce parts specification/documentation costs.

In support of the defense mission, numerous programs for weapons system development, acquisition, and maintenance are continuously active. These programs entail procurement of many component items for each of which specifications must be presented to the suppliers. If a requirement for an item can be satisfied within the range of an existing military specification or military standard item class, no unique specification or drawing need be prepared for procurement.

Inherent delays in the manual systems for research, authorization, documentation, and promulgation of both standard and nonstandard specifications lead to the preparation of an immense number of item procurement documents for military applications.

The AEDPS was developed to help reduce proliferation of documentation. Major features and characteristics of most parts of the system are specified in an existing military specification. Generally, special or unique application requirements call for exceptions to the applicable military specification. The AEDPS System takes advantage of this situation.

A description of the AEDPS, as well as instructions for the preparation of specification requirement sheets (SRS) to obtain the desired document are contained in MIL-STD-35 and its dash-numbered parts. The SRS, a computer program, and the data base comprise a system that prepares procurement documents on generic names (resistors, capacitors, etc.) which are included in the data base. The AEDPS currently has 124 generic names.

AEDPS has been designed to prepare a document entitled Military Specification Exception (MSE), which is an exception to an existing military specification. Parts that previously would have been documented by specification control, source control, or selected item drawings, or by program-peculiar specifications can now be documented by AEDPS. A part characteristics "boilerplate" for the generic names has been stored in the computer data base. The AEDPS prints only parameters and requirements that differ from the original military specification.

The basic function of the AEDPS is to replace manual preparation of documentation that falls primarily into control-type drawings and program-peculiar specifications. Instructions and characteristic requirements contained in each MIL-STD-35 part (MIL-STD-35 dash-numbered parts) serve as a checklist helping to insure that all needed requirements, tests and quality assurance provisions for a particular item have been addressed.

The requester for an MSE also has the option, before completing a detailed specification request, to submit a query to the computer system to see if existing documentation, within specified limits, will satisfy his requirement. If not, it will be necessary to complete an SRS. Instructions for completing the SRS are contained in MIL-STD-35 and the dash-numbered parts.

When a request is received by MIRADCOM, it is checked for completeness, keypunched and forwarded to the computer center for processing. The computer then matches the characteristics used to define the item with those used to produce similar documents put into the data base. If a match is found, the computer produces the identifying number of the existing document; otherwise, it prepares a new document which is stored in its data base.

The primary function performed by the computer, after deciding that an existing document will not satisfy the request, is to determine which paragraphs will be used, insert the values, and print out the MSE document.

To be successful, standardization efforts must begin in the early development cycle of a system. In the past, most standardization efforts began long after the documentation functions were started. These efforts can now be initiated in the early design stage. Full benefits of AEDPS can be realized only when it is mandatory that the solicitation package (RFP/RFQ) calls for the AEDPS requirements (MIL-STD-35 and DI-E-1133).

The AEDPS concept was established in 1963, and in 1967 the Office of Assistant Secretary of Defense (Installation and Logistics) forwarded a Standardization Memorandum to the Departments of the Army, Navy and Air Force, and the Defense Logistics Agency, stating there was a need to improve the procurement documentation process, thus, triggering further development of the AEDPS.

Implementation of this system for automatically preparing procurement documents is estimated to reduce costs more than 50 percent. The system also precludes preparation of multiple documentation of parts by screening it's data bank for an identical document.

The AEDPS is being used by Missile R&D Command (MIRADCOM), Missile Materiel Readiness Command (MIRCOM) contractors, and at least one major AVRADCOM (Aviation R&D Command) contractor. Currently, the MIRADCOM engineering point of contact is the Systems Engineering and Product Improvement Directorate, Engineering Laboratory, MIRADCOM, DRDMI-ESD, AV 746-1045.

An average of 10 days is required to process a request for an MSE. MIRADCOM is performing the system development and operation and maintains liaison with user activities. If you have documentation problems and the cost digs into your budget, consider AEDPS.

Leland Womack is chief of the Configuration/Data Management Group, Engineering Standards and Data Systems Division, Systems Engineering and Product Improvement Directorate, Engineering Laboratory, U.S. Army Missile R&D Command (MIRADCOM).

Dual-Rifling Process Enhances Production of 105mm Gun Tubes

A dual-rifling process that increases 105mm M68 gun-tube rifling production 40 percent, is a new innovation of the Machine Processes Unit, Benet Weapons Lab., Watervliet (NY) Arsenal.

The Arsenal machining process used to produce rifling grooves, which initiate spin of the projectile on its axis to provide stability in flight, has changed very little over the years.

Because gun tube specifications require close dimensional control and surface finishing, rifling grooves have always been costly to produce and the process is time consuming.

As an example, when rifling 105mm gun tubes, it is necessary to pass 32 individual cutters or rifling broaches through the bore to attain full groove depth. Each cutter removes an average of .003" on the groove diameter until finish size is reached. Time required to perform this process is 3.06 hours.

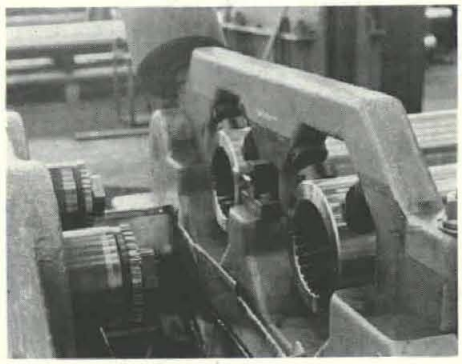
Attempts to reduce manufacturing costs included increasing rifling speeds, introduction of carbides as a cutter material, rifling with more than one cutter on the same head, and reduction of material handling time. These efforts were unsuccessful and a new approach was tried.

With C. H. LaRoss as project leader, the Machine Processes Unit developed the dual rifler process in which one machine could be used to rifle two tubes simultaneously, without undue strain on the equipment.

A machine with a bed wide enough to support two 105mm gun tubes, was refitted with a double-tube holding fixture and a 2-bar drive system designed in a side-by-side fashion. This approach was taken because it did not change basic and proven operating techniques.

Setup for the dual system was completed in May 1977, and a total of 40 tubes was rifled by the new process. All tubes passed Quality Control and were accepted for production.

Successful application of the dual process of rifling to 105mm M68 gun tubes has established the process as highly adaptable to production line quantities, with added advantages that include: reduction of 40 percent in rifling costs; reduction of manpower, setup time and floor space; and improved state-of- the-art.



DUAL RIFLER. Closeup view of rifling heads with cutters mounted and two 105mm M68 gun tubes in the process of being rifled.

Minority Firms Receiving $15 Million For Camouflage Nets Support Systems

U.S. Army contracts totaling more than $15 million for materials and support systems for camouflage nets were recently awarded, through the Small Business Administration, to two minority-owned firms.

Finalized in January, the awards went to A&S Tribal Industries, Poplar, MT, the Devil's Lake Sioux Manufacturing Corp., Fort Totten, ND, and the Brunswick Corp. (a sponsor of the Sioux firm).

The Defense Logistics Agency, in a related development, announced planned publication of a minority firm directory to aid minority enterprises seeking government contracts. The directory will be distributed to all contractors bidding on defense contracts, and to all DoD purchasing agencies.

Low-Maintenance Batteries for the Military

By Joseph Reinman

Automotive batteries have been tagged with many fancy names, splashed with bright colors, and given a connotation of tremendous power forever—without so much as a passing thought required after installation.

The military battery, too, has received increased attention and has been given a new appearance with its change to military colors. However, it is more reserved in its claims for something a little less than eternal life.

After some four years of development and testing, the military has adopted the calcium, alloy-grid, low maintenance storage battery, in a new olive-drab colored plastic container, semi-permanently sealed. Many obstacles had to be overcome and final design did not come easy.

Military batteries, for example, must be hermetically sealed and dry- charged for long-term storage in the supply system prior to usage. They must be capable of performing reliably in extreme temperatures of −65°F. to 190°F., and to supply large amounts of current to crank the biggest tank engine.

Ability to withstand the abuse of cross-country operation and the extreme shock and vibration of gun- carrying combat vehicles is a primary requisite. Batteries are frozen in the Arctic and blasted with high-temperature air from heater kits; also, subjected to the abuse of desert heat in the tropics.

Military batteries must also serve as "those serve who stand and wait"—in motor pools, in a combat readiness condition. During combat, they must give reliable service under the most adverse conditions.

Finally, U.S. military batteries must meet the standards and be directly interchangeable with batteries of the North Atlantic Treaty Organization; also, the Quadripartite Agreement countries, Great Britian, Canada, Australia and the United States.

Rapid increase in public acceptance of the maintenance free battery concept has prompted a scurry among manufacturers to provide what the public wants and what has offered a solution for some of the major causes of battery failures.

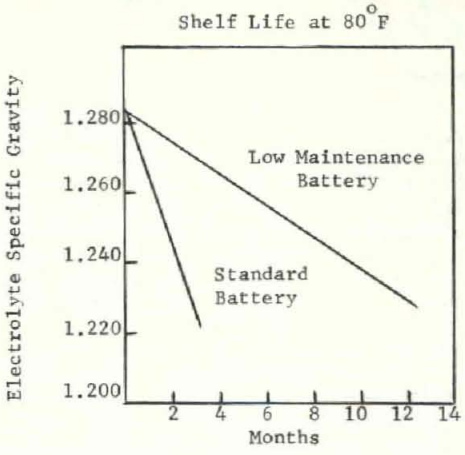
The U.S. Government recognizes the potential of the maintenance-free battery concept, including calcium- alloy grid plates, to improve battery storage life, decrease overcharge failures, increase the overall life cycle, and reduce maintenance.

However, in the military this battery is described as a "low-maintenance battery" rather than a "maintenance-free battery" since it more accurately describes capabilities.

The first approach to low maintenance was to decrease the gas evolution in the battery. This was accomplished by using chemically pure lead with a small quantity of calcium instead of antimony to produce the necessary grid hardness; also, to provide plate stability and desired mold flow characteristics.

With the use of calcium to replace antimony, and by virtue of its location in the chemical Periodic Table with respect to lead, there is a decrease in electrical action within the plates.

In lead antimony batteries, antimony normally is deposited from the positive plate to the negative plate during each battery cycle. The older the battery, the more antimony is deposited. Thus, there is an ever-increasing amount of local chemical reaction with parasitic



currents, reducing the electrical charge and causing short battery shelf-life (see graph).

A high incidence of overcharge failure occurs with standard military batteries when the vehicle system voltage regulation is not reduced or adjusted to requirements. The inherent feature of the calcium alloy grid plates to tolerate this condition and resist overcharge led to further interest in this concept.

Considering, for example, a military vehicle system voltage in excess of 28.5 volts at 80°F. or more, with fully charged batteries, the standard lead antimony battery will suffer serious overcharge, water depletion and grid oxidation.

Conversely, the low-maintenance battery with calcium alloy grids will require a higher over-voltage to produce an equivalent overcharge current. The float current is about one-fifth that of comparable lead antimony batteries at a specified voltage. Battery life is increased and excessive water consumption decreased.

Military vehicle batteries are supplied only in a dry and charged condition—necessary because of the long period of time between manufacturing and usage. Dry-charged military batteries will store indefinitely without deterioration.

Consequently, we can procure batteries by the hundreds of thousands to supply vehicles all over the world, using simple, safe shipment procedures that assure fresh batteries to the field upon activation. Military requirements resulted in the present dry- charging method and to development in 1977 of the new calcium alloy grid low-maintenance battery.

A newly designed high-impact plastic container, olive-drab color, is under development and will be available in FY 79 for the Army's low- maintenance battery. It will outperform the old hard-rubber container in strength, cost and, not to be overlooked, aesthetic appeal.

This new battery will be easy to keep clean because of its flat top surface and plastic rope handles to eliminate rust and corrosion. Cell plugs are gasket-sealed with no vents, avoiding electrical leakage paths.

Cell sealing plugs are to be removed only for the initial activation and for emergency filling thereafter, if electrical equipment failure has caused overcharge or long service has resulted in water depletion.

A built-in indicator shows the battery electrolyte level and it doubles as a state-of-charge indicator. A green ball floats at a specific gravity of 1.250 and higher to show 75 to 100 percent charge. The internal plate and element design provides for individual separator envelopes for each positive plate, reducing the likelihood of plate shorting, especially at the bottom edges.

Since the active material is retained in the envelope, no sediment spaces at the container bottom are required for the normal collection of loose material. A bonus advantage is the lowering of the cell element to allow for increased electrolyte volume above the plates for longer life. It also provides a means of better element anchorage to resist shock and vibration.

Combining of all of these features into one new battery is considered a major breakthrough: calcium alloy grides, dry-charged plates, sealed separators, through-the-wall connectors, high-impact plastic container, flush top, stud terminals, manifold venting, electrolyte level indicator, and state-of-charge indicator.

The battery will be virtually maintenance free. Upon its release into the military system in 1979, battery life should be increased by one year. Performance will be greatly improved and total procurement costs drastically reduced.

JOSEPH REINMAN is an electrical engineer in the Tactical Vehicle Components Laboratory at the U.S. Army Tank-Automotive Research and Development Command (TARADCOM), Warren, MI.

Employed by TARADCOM and its predecessor organizations since 1950, he is a graduate of St. Joseph's College in Rensselaer, IN, with a BS degree in physics, and also has completed a year of graduate work at the State University of Iowa, Iowa City.

Logistics Center Gets Responsibilities For Administering DoD Test Programs

Responsibilities for administering the Department of Defense civilian career knowledge test program have been transferred from the U.S. Air Force to the U.S. Army's Logistics Management Center (ALMC), Fort Lee, VA.

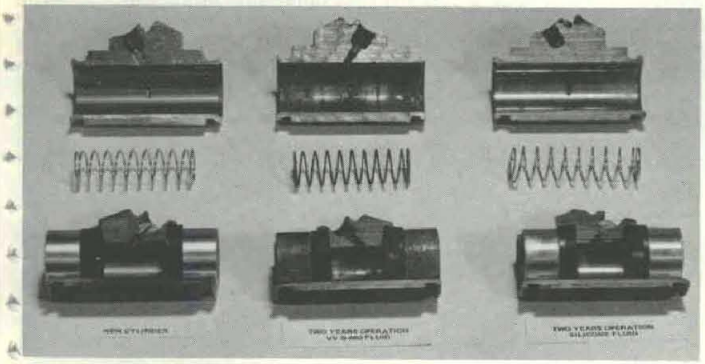
The program permits civilian career program members to take equivalency tests to prove their knowledge of course subjects deemed necessary for normal career progression. Careerists passing the tests can be promoted without further course attendance.

Equivalency tests are currently limited to the 11 procurement career courses, including ALMC's Defense Procurement Management Course and the Wright Patterson Air Force Base Defense Contract Administration Course.

Additional information relative to the program may be obtained from: Commandant, U.S. Army Logistics Management Center, ATTN: DRXMC-ACM-EE, Fort Lee, VA 23801, or Autovon 687-3124.

Army Converts From 3 Brake Fluids To 1

By James H. Conley



SILICONE hydraulic brake fluid developed by MERADCOM, Fort Belvoir, VA, eliminates excessive corrosion of aluminum and cast iron components of a brake system. Comparison above shows components after 2 years of operation on conventional brake fluid (center), and on the silicone fluid, at right.

A major improvement in the combat readiness of Army vehicles is anticipated with the introduction this year of the first single hydraulic brake fluid to meet all the Army's requirements.

Developed by the Energy and Water Resources Laboratory, U.S. Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA, the new silicone brake fluid is described in Military Specification MIL-B-46176, now being published by the Army Materials and Mechanics Research Center (AMMRC), Watertown, MA.

Designed for the lifetime of a vehicle, the all-purpose, all-weather fluid will replace three types used by the Army for more than 30 years. It will permit movement of vehicles from the tropics to the arctic with no preparation of the brake systems, and enable them to be stored for long periods without change of fluid. Reduced maintenance and logistics costs are expected to achieve estimated annual savings of more than $2 million.

The MIL-B-46176 brake fluid consists of a diorgano polysiloxane base with small amounts of additives. Its chemical difference completely eliminates problems associated with the conventional or polyglycol base brake fluids now being phased out.

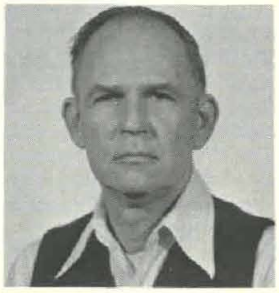
These are the brake fluids, similar to those in the civilian market, used for operations where temperatures do not drop below minus 35 degrees Centigrade; the arctic brake fluid for operations down to minus 55 degrees Centigrade; and the preservative fluid for vehicles in storage.

Polyglycol base brake fluids are hygroscopic, they absorb water. This water enters the brake system in various ways, through rubber hoses, the master cylinder diaphragm, and around the wheel cylinder pistons. Many problems created by absorbed water limit the life of the brake system.

It is not unusual for this type fluid to pick up as much as 15 percent water over a 2-year period in a humid area such as the Panama Canal Zone. Water causes excessive corrosion of the aluminum and cast iron components of a brake system and in a short time will render them inoperable.

Low temperatures viscosity will increase substantially with increased water content, resulting in sluggish brake action at lower temperatures. Increased water content lowers the boiling point and consequently the vapor lock point. When the fluid temperature reaches this point, which is about 290 degrees F. with a water content of about 3 percent, there is a total loss of brake action creating a very unsafe situation.

The new silicone brake fluid is not hygroscopic and in fact actually repels water. A chemical barrier is produced that keeps the water from penetrating the brake system. Silicones exhibit a much flatter temperature-viscosity curve which in turn makes them suitable for use over the entire operating range experienced by Army vehicles. There is no lowering of the boiling point or the vapor lock point.



JAMES H. CONLEY has been employed since 1974 as a chemist in the Fuels and Lubricants Division, Energy and Resources Laboratory, U.S. Army Mobility Equipment R&D Command, Fort Belvoir, VA. He served previously with the Coating and Chemical Laboratory, Aberdeen (MD) Proving Ground.

He has attended the University of Delaware and is a member of several professional societies and organizations.

Army Studies Lightning Effects on Copperhead

How do electric and magnetic fields of lightning affect Army weapon systems? Until recently, answers to this question—at least in a controlled test environment—were but a mere guessing game for the U.S. Army.

However, through the miracles of modern technology, the Army has successfully tested the effects of one of nature's nemesis on the Copperhead antitank projectile. White Sands (NM) Missile Range technicians have subjected the projectile to near misses and direct strikes of artificially generated lightning. The tests, which provided peak currents of 200,000 amperes, were recently conducted at the Lightning and Transit Research Institute facility in Miami Beach, FL. Setting up a similar test environment at WSMR would have reportedly cost more than $750,000.

The Miami facility was also selected because it offers a suitable test bed, and is located within driving distance of the Copperhead contractor plant, and a Nike Hercules battery where the Copperhead could be safely stored.

A primary objective of the tests was to evaluate the effect of lightning on Copperhead's electronic initiators. Commonly termed squibs, these 10 initiators release Copperhead's wings and fins, activate its battery and gyro, and arm and detonate the warhead.

Premature activation of the squibs, by a magnetic or electric field, can render the missile inoperable, or cause a mishap.

During the near miss tests, the Copperhead was rotated in four positions to provide maximum exposure to electrical and magnetic fields. Its squibs were removed, examined and replaced following each of a series of 10 tests.

Identical procedures were used during the direct hit tests, with the exception of heat indicators being used in place of detonators. Direct strikes rendered the Copperhead inoperative but did not arm or detonate its warhead.

ETL Investigates DEFT Devices Applications

Potential of recent advances in acoustic, electronic and integrated optic technologies—for applications such as image analysis, terrain feature extraction and change detection, along with automation of mapping processes—is being investigated by the U.S. Army Engineer Topographic Laboratories, Fort Belvoir, VA.

Further exploration of the potential of these technologies is expected to provide a scientific basis for measuring and evaluating camouflage for the Army. Camouflage is viewed as the inverse of feature extraction.

Among other advances that have matured to a point where potential for exploitation to specific applications is believed to merit investigation are Direct Electronic Fourier Transformation (DEFT) devices, which have been procured from Syracuse University.

No larger than a 35mm camera, the solid-state DEFT device is a new acousto-electro-optical unit that produces an analog alternating current electrical signal containing the Fourier transform of a conventional optical image.

DEFT converts the spatial frequency distribution of a conventional image into an electrical frequency distribution that can be processed and transmitted in the same way as radio and TV signals. ETL researchers say the signal actually is the signature of the image, and that the process is accomplished without computers.

The physical basis for operation of the DEFT device is the coupling interaction of a Surface Acoustic Wave (SAW) with the conductivity of a layer of photoconductive material upon which a conventional image is focused.

When the frequency of the SAW corresponds or matches a spatial frequency in the image, a strong photocurrent is obtained with that electrical frequency. The collection of all such frequencies is the Fourier transform or spatial frequency signature of the image.

ARI Provides Information on Research Programs

Do you know about recent work by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) that might improve your operation? If you don't, perhaps a new ARI method of keeping you informed of "what's happening at ARI" will interest you.

ARI has announced a new program—The Commander's Overview, a 1-page summary of a report, written in understandable terms on a specific research topic.

The first Commander's Overview concerned REALTRAIN and was targeted to Infantry division, brigade, battalion, and company commanders in the U.S. Army. CPT Peter J. Luther, ARI R&D Coordinator for Plans and Operations, has reported that the initial response was "highly favorable."

Interested personnel who are not receiving Commander's Overview should contact: Commander, U.S. Army Research Institute for the Behavioral and Social Sciences, ATTN: PERI-P, 5001 Eisenhower Avenue, Alexandria, VA 22333, AUTOVON 284-8840.

Bearingless Main Rotor System Concept

By Patrick A. Cancro*

Efforts to reduce complexity and costs of Army helicopters are evident in a program designed to evaluate a Bearingless Main Rotor (BMR) concept at the Applied Technology Laboratory, Fort Eustis, VA, of the U.S. Army Research and Technology Laboratories, Moffett Field, CA, AVRADCOM.

This program includes design, fabrication, component and whirl-tower tests, and a 25-hour flight test of the BMR concept (Fig. 1) utilizing a composite hub assembly flexible enough to accommodate normal blade pitch and flapping motions.

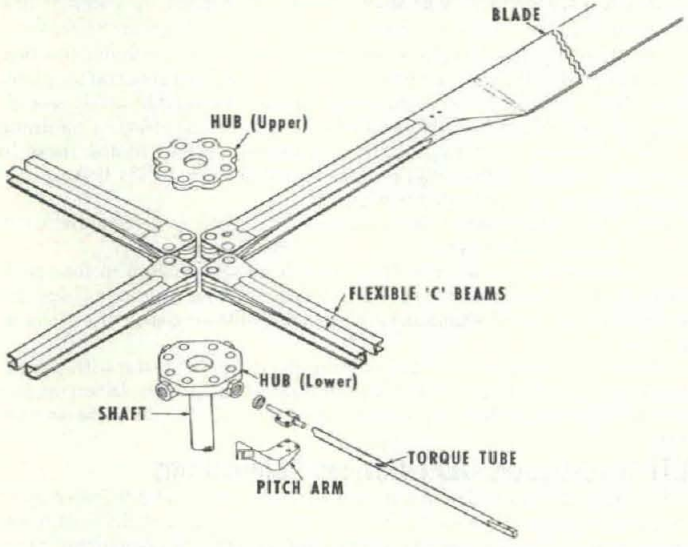


Fig. 1. Bearingless Main Rotor Concept

The BMR system will be installed on a BO-105 helicopter for the flight tests, with no changes planned to the helicopter, other than modifying the blades to maintain a rotor diameter of 32.2 feet. Twenty hours will be flown by Boeing-Vertol (winner of a competitive contract to conduct flight evaluation of loads and stability characteristics of the BMR), and five will be flown by government pilots.

The program also includes updating of the analysis for accurately predicting the dynamics and structural performance for this new concept where hub flexibility is the prime motivating factor. In order to verify or to demonstrate weaknesses in the analysis, some wind tunnel tests on a Froude scale-model of the BMR-BO-105 helicopter were conducted.

Results indicated that the analysis was able to predict the trends reasonably well. However, final evaluation will come from the results and analyses of the flight tests of the BMR on the BO-105 helicopter.

It is anticipated that the BMR concept, utilizing composite materials to permit torsional deflection and bending of the flexible hub structure, will provide major advances in reliability and maintainability.

Other significant advantages of this concept include reduced number of parts (from approximately 400 for an articulated system to 60 parts for the BMR), reduced weight and drag, improved handling qualities and lower life-cycle costs.

An earlier attempt to minimize cost and complexity of the helicopter, through the design and fabrication of a full-scale bearingless main rotor, was made in 1966. This concept eliminated all bearings and hinges in the main rotor blade retention system - pitch bearings, flapping and lead/lag hinges.

In their place, a metal flexure (approximately 30% of the inboard section of the rotor), soft enough to accommodate normal blade pitch and flapping motions, was used. Analysis, ground tests and flight tests of this BMR system demonstrated that the concept was feasible; but, the stage of development at that time limited the system in the range of rotor speed (rpm) in which it could operate safely.

The rotor system appeared to be marginal with respect to air and ground resonance stability. The state-of-the-art analytical approach in that time frame was not capable of predicting, with any accuracy, dynamics and structural performance for this new concept.

In later years, Kaman, Sikorsky and Boeing-Vertol, with improved analysis methods, looked at bearingless tail rotors. As a result, successful bearingless tail rotors were designed. Kaman installed a bearingless tail rotor (the Elastic Pitch Beam Tail Rotor) on a Bell UH-1H helicopter and flight tests were successful. Bearingless tail rotors also were designed and utilized on in both the Boeing-Vertol and Sikorsky UTTAS helicopter.

Improvements in analytical techniques increased the interest in bearingless main rotors and brought about the current BMR program that will enable the Army to develop rotor systems offering substantial improvements in maintainability and reliability, while reducing cost, weight and complexity of helicopters.

Patrick A. Cancro, aerospace engineer, Applied Technology Laboratory, Fort Eustis, VA, RTL, AVRADCOM: senior engineer, Martin Marietta Co. (1962); senior engineer, Fairchild Stratos Corp. (1956-63); electrical/mechanical engineer, NACA (1943-55); BEE degree, Clarkson College of Technology (1942).

Contract Calls for Helicopter Moving System

Moving a helicopter into a position on the ground where maintenance can be carried out in a concealed environment can be a difficult thing, particularly if the ground is broken, sloping, or the soil soft. This condition has led to efforts to field a new helicopter moving device.

Design and production of two prototype systems for transporting Army helicopters through rough terrain is called for in a recent contract announced by the U.S. Army Aviation R&D Command, St. Louis, MO.

Vehicle Systems Development Corp., Upland, CA, is developing the system. It will be designed to operate on slopes, in soft soil conditions with obstacles, and through small ditches. Its readily air mobile capability will permit loading of helicopters onto transport aircraft.

No helicopter modifications will be required and the system will feature rapid attachment and detachment capabilities. An adapter for skid landing aircraft will use existing pickup points to attach a high flotation tire system.

AVRADCOM has also awarded a contract to Bell Helicopter Textron to investigate the behavior of advanced airframe structural materials subjected to crash impact loading. Bell will specifically study the capability of advanced materials to provide impact protection for future airframes.

Sikorsky Aircraft Division and Systems Research Laboratories have also received contracts to conduct wind tunnel evaluations of an aeroelastically conformable rotor blade. Results of this program are expected to have a significant impact on a new breed of high performance helicopters.

Patriot Undergoes First Flight Test of 1978

Despite protection by electronic and tactical countermeasures, one of two jet fighters (PQM-102 drones), flying in close formation, was recently knocked from the sky during the first 1978 flight test of the Patriot air defense missile at White Sands (NM) Missile Range.

Patriot Project Manager MG Oliver D. Street, assigned by the U.S. Army Materiel Development and Readiness Command to Huntsville (AL) Research Park, reported that all test objectives were accomplished. The flight was the 24th fully guided firing in the Patriot program.

Under development to replace Nike Hercules and Hawk air defense systems, Patriot is expected to be the cornerstone of field Army air defense against medium to high altitude targets in the 1980s and beyond.

The mobile, all weather system features a high kill probability and fast reaction time capability. It will be able to handle saturation attacks against highly maneuvering targets in an intense countermeasures environment.

Raytheon Co., is Patriot prime contractor and Martin Marietta Corp., is principal subcontractor for the missile, canister and launcher. Thiokol Co. is subcontractor for the single stage solid propulsion unit.

First GSRS Validation Tests Termed 'Successful'

The first is a planned series of 2-year validation tests of the General Support Rocket System (GSRS) was conducted recently at White Sands (NM) Missile Range and termed "highly successful."

Programed for Army fielding during the early 1980s, the GSRS is expected to complement cannon artillery when targets such as artillery, troops and light materiel appear on the battlefield rapidly and in great quantities.

GSRS projectiles can be fired singly or in rapid ripples and can accommodate several warheads to accomplish a variety of battlefield missions. Intended to provide massive artillery firepower at reduced manpower costs, the GSRS development is managed by COL Barrie P. Masters, who says the Army currently has nothing like it.

Vought Corp and Boeing Aerospace Co. are building, testing and demonstrating rocket systems under contract with the U.S. Army Missile R&D Command. Following the 29-month validation phase, the Army will select one contractor for initial production.

Selective Scanner

XM1 Developmental Testing II Scheduled at APG

Developmental II testing of the XM1 Tank, which begins in February and will continue through July 1979, will reportedly add about $6 million to Aberdeen (MD) Proving Ground's payroll as a result of direct labor charges.

Designated as the Army's future Main Battle Tank, the XM1 is expected to provide significant improvements in offensive ground combat power, mobility, ballistics protection, fire control, and shoot-on-the-move capabilities.

Chrysler Corp., XM1 developmental contractor, completed testing of the tank's fire control system at APG in January and automotive testing in February. The first 2 of 11 models will arrive at APG in March; the remaining 9 vehicles will be delivered over a 5-month period. Two M60A1 Rise-Passive Tanks will be used as a base line comparison for performance of the XM1.

Under contract with XM1 Project Manager BG (P) Donald Babers, Chrysler is conducting operational and maintenance training for personnel from APG, Yuma Proving Ground, AZ; White Sands (NM) Missile Range; U.S. Army Cold Regions Test Center, Fort Greely, AK; Fort Knox, KY; and Fort Bliss, TX.

All training is being conducted at APG in order to centralize and simplify instruction and because of repair facilities and fire system test capabilities of the installation.

Chrysler launched its program of full-scale engineering development at its Detroit facilities and at APG in November 1976, following its selection as prime contractor.

CCE/SMHE Product Manager's Office Established

Receipt of a charter authorizing establishment of a new Product Manager's Office for Commercial Construction and Selected Materials Handling Equipment (CCE/SMHE) has been announced by the U.S. Army Tank-Automotive Materiel Readiness Command, Warren, MI.

Staffed by two military and 22 civilian personnel, including LTC Peter P. Strzok as product manager and LeRoy J. Schnurbusch as his deputy, the new office is located at the Michigan Army Missile Plant, Sterling Heights, MI.

Primary mission of the office is to select and procure commercially proven "off-the-shelf" equipment used for clearing operations and road and airfield construction. Seven handling items such as forklifts and ramps, used to support the Army's Container-Oriented Distribution System, also fall under the office's purview.

Twenty systems such as tractors, cranes, scoop loaders, compressors and compaction equipment are included among commercial equipment items. Acquisition cost of these systems through 1983 will be about $455 million.

Department of Army Convenes PM Selection Board

The Department of the Army Project Manager Selection Board convened in January to consider qualifications of eligible colonels and lieutenant colonels for potential assignments to designated PM position vacancies.

Selections will be made from those officers who are members of the Project Manager's Development Program, are career division nominees, or from personnel who have requested special consideration from the Selection Board. All persons must meet the following requirements:

Be in grade of colonel or lieutenant colonel on a promotion list; have not refused consideration by the Selection Board; have not declined any previously designated command, district engineer, or PM position if selected as a principal; have not declined activation for any designated command, district engineer, or PM position if selected as an alternate; have three or more years of active service remaining as of Oct. 1, 1979.

Selection Board consideration will not be denied to personnel who have previously or are currently serving in command, district engineer, or PM assignments.

Officers now serving in command or district engineer assignments will be eligible for available PM positions following completion of their current tours.

Although eligible officers may be selected by both the annual command and the annual PM Selection Board, they will be assigned to only one category. They cannot be deferred for later consideration to alternate assignments.

Officers on the eligibility list who are not initially selected will still remain eligible for any PM vacancies which might occur during FY78. A new list will be published if the number of eligibles changes significantly during the period.

Chemical Lab Achieves FY77 Savings of 2.2 Million

Fiscal Year 1977 government savings of more than $2.2 million - 157 percent greater than the assigned goal - have been reported as a result of 71 individual Cost Reduction Program actions at the U.S. Army Chemical Systems Laboratory, Aberdeen (MD) Proving Ground.

Three of the largest contributing actions, submitted by nine CSL individuals and representing $960,000, were associated with research and development activities.

William G. Rouse and Charles S. Ferrett of CSL's Munitions Division were credited with savings of $324,000. They provided an innovative approach to filling the Smoke Screening XM259 Warhead, while also eliminating a need for new filling lines.

Savings of $321,000, the second largest reported, were achieved by Munitions Division Chief Dr. Bernard Berger and fellow employes Louis N. Hack, Nicholas S. Capasso, and Joseph W. Lynch. Their work involved the M36 and M33A1 dispersers.

A value engineering study by James E. Norton and Donny W. Bromley, also of the Munitions Divison, accounted for savings of $315,000 and revealed a cost-effective ignition system which deleted a difficult-to-manufacture component in the M1 and M2 Cannister.

TECOM Headquarters Assumes 3 New Missions

Additional mission responsibilities and new manpower and funding ceilings are announced purposes for planned reorganization of HQ U.S. Army Test and Evaluation Command, Aberdeen (MD) Proving Ground.

Focused primarily on the technical portion of HQ TECOM - where seven directorates for testing and five for analysis are being broken down into 12 divisions under three directorates - the reorganization is not expected to entail reductions in either force or civilian grades.

Announced as additional headquarters missions are: International Materiel Evaluation (assessment of foreign hardware for possible acquisition by this country in lieu of independent U.S. development), TEST FACS (maintenance of Army Test Facilities Register and Base), and development testing of Army Security Agency tactical equipment.

Manpower ceilings, which are mandated for completion by Sept. 30, call for 76 military and 341 civilians. Require-

ments for fewer colonels and more lieutenant colonels will be achieved by normal rotation of assignments.

DoD Senior Offices Slated for Reorganization

Reorganization of senior offices within the Department of Defense, which will reduce the number of Assistant Secretaries from 22 to 16, has been announced by Secretary of Defense Harold Brown.

Issued under the Secretary's statutory authority to transfer, consolidate and abolish functions of DoD officials, the order calls for elimination of three of the nine authorized Assistant Secretaries of Defense, and one Assistant Secretary each from the Army, Navy, and Air Force.

Positions of Director and Deputy Director of the Women's Army Corps are also being eliminated, Secretary Brown said, "to recognize the role of women as full partners in our national defense, with full opportunity to progress with their male counterparts."

Secretary Brown also stated, in letters to the Senate and House Chairmen of the Armed Services Committees, "I believe that this reversal of the trend toward ever larger headquarters organizations is a significant step towards more effective management of the DoD, and that the leaner structure will contribute to our continued efforts to streamline."

The order becomes effective 30 days after it is reported to the Congress, unless either of the Armed Services Committees recommends that it be rejected by the House or Senate. Major combatant functions or the Joint Chiefs of Staff are not affected by the order.

NATO Troops Participate in Norway Exercise

Approximately 15,000 troops representing seven NATO nations recently took part in a winter defense of Northern Norway training exercise termed "Arctic Express." Operational scheduling was announced by Supreme Allied Commander Europe GEN Alexander M. Haig Jr.

The Allied Command Europe Mobile Force (AMF) participated with land and air components, in conjunction with U.S., United Kingdom and Netherlands Marine Corps groups, and Army, Air Force, Coast Artillery and Home Guard units of Norway.

The seven nations providing personnel for the exercise were the U.S., Canada, Republics of Germany, Italy, the Netherlands, Norway, and the United Kingdom.

Primary goals of the exercises were to exercise rapid deployment of allied and Norwegian forces, under winter conditions, to Northern Norway; test command and control techniques and coordination between forces of different nationalities; and to exercise and test the host nation's support to the Allied Mobile Force, and exercise AMF's deterrent role.

A command post exercise will follow Arctic Express to further evaluate U.S., Canadian, and Norwegian capabilities for defending North Norway.

Directive Orders Purchase of German Vehicles

U.S. Army purchase of non-tactical, heavy-duty commercial vehicles from the Federal Republic of Germany is ordered in a recent directive issued by the Secretary of Defense. The action was reportedly taken in order to improve standardization of NATO equipment and for monetary purposes.

The directive authorizes the Army to initiate purchase of buses, trucks, tractors and forklifts during 1978. Temporarily excluded, pending Congressional approval, are sedans and station wagons.

The prospect of German-made vehicles for U.S. Armed Forces follows years of American influence in NATO and is in concert with other recent U.S. purchases of European arms. The exact price or quantity of future purchases will be determined later.

However, the Army is expected to begin negotiations soon, on behalf of the Army and the Air Force, for the purchase of more than 20 types of heavy-duty vehicles.

Department of the Army officials have said that no information is available on whether U.S. troops will receive specialized training for operation or maintenance of the vehicles, or if these tasks will be performed by Germans.

Catapult Evaluated for Drone Launching Use

A catapult system of launching aircraft, successfully used by the U.S. Marines during the Vietnam War, is currently being evaluated as a less expensive means of launching drone targets at the U.S. Army's White Sands (NM) Missile Range.

Drones are pilotless, remotely controlled aircraft used for testing various air defense weapon systems. As targets, they are normally launched with the assistance of rockets. Catapults achieve substantial cost savings by eliminating the need for rocket assistance.

A recent cost study conducted by the Naval Air Engineering Center (NAEC), Lakehurst, NJ, indicates that drones could be launched from catapults at 10 percent of the cost of current rocket assisted takeoffs.

NAEC conceived the idea of using the CE1–3 catapult for launching drones, and enlisted the aid of the Army and Air Force in demonstrating the concept's feasibility. White Sands launches more than 100 Firebee drones (MQM–34D) annually.

The U.S. Marines' Short Airfield Tactical System (SATS) catapult is designed to handle aircraft weighing up to 59,000 pounds which fly at 180 knots. It is being used at WSMR to launch drones weighing less than 3,000 pounds.

SATS energy, which is generated by two modified J–79 jet engines, is transmitted to an endless steel launch cable through a reduction gear and capstan. A dolly, which carries the drone, is clamped to the cable and towed to the runway.

ECOM Unveils Mobile Automatic Test System

Improved operational readiness of tactical electronic field equipment is predicted with a new mobile automatic test support system developed by the U.S. Army Electronics Command, headquartered at Fort Monmouth, NJ.

Scheduled for deployment in Europe, the Automatic Test Support System/General Support Facility uses a computer-controlled test station. Included are tools and replacement parts to repair electronic printed-circuit boards.

The system is reportedly the first of its kind to be tested under actual field conditions. It is installed in two semi-trailer vans for mobility under tactical conditions.

Objectives of the test deployment are to study normal day-to-day test and repair capabilities of the system for electronic printed-circuit boards, and to "evaluate effects on readiness in a European Environment."

DARCOM PM LTC Walter J. Gabrysiak is assigned overall management responsibility for design and fielding of the equipment. CPT H. J. Trexler is action officer for European fielding of the system.

Awards...

Outstanding ISEF Winners Return From Tokyo

U.S. Army Japan Chief of Staff BG Edwin L. Kennedy greets "Operation Cherry Blossom" winners Paul M. Embree and Richard A. Sanger during their visit to USARJ HQ at Camp Zama.

Representing the United States at the Japanese Student Science Awards in Tokyo, Paul M. Embree and Richard A. Sanger were introduced to the people, culture and technology of Japan, through awards by the U.S. Army and Navy, for outstanding exhibits of their high school research and development projects.

Embree, a 17-year-old student at Muhlenberg High School, South Temple, PA, was selected by the Army for the "Operation Cherry Blossom" trip for his exhibit "Coherent Detection as a Means of Reducing AM Radio Distortion." Selection was from more than 400 finalists at the 28th International Science & Engineering Fair (ISEF) last year in Cleveland, OH.

Navy winner Richard Sanger, 17, Coronado (CA) High School, was selected by a special Navy selection board for his exhibit "Rhomboid Ripples: Diamonds on the Beach."

Operation Cherry Blossom was initiated by the Armed Services in 1963, under sponsorship of the Yomiuri Shimbun, as a means of rewarding gifted science students and in popularizing science in high schools.

The Association of the U.S. Army contributed $100 checks to the Army winner and to the Army winner of a London International Youth Science Fortnight trip, July 23- Aug. 10, an extension of the ISEF awards.

Sponsored by Science Service, a nonprofit institution whose objective is to stimulate interest in scientific research, the ISEF culminates competition among high school students in more than 200 affiliated local, state and regional fairs, including some in foreign lands, i.e., Canada, Japan, Puerto Rico and Sweden.

U.S. Army participation in the ISEF is arranged by the U.S. Army Research Office (ARO), Reserach Triangle Park, NC. Anne G. Taylor was ARO action officer; Donald C. Rollins, chief of the ARO Conferences and Symposia Office, was the Army escort for the trip to Japan.

In addition to participation in the Japanese Student Science Fair Awards Ceremony, where the Americans met His Royal Highness Prince Hitachi, the itinerary included a visit with BG Edwin L. Kennedy, Chief of Staff, U.S. Army Japan.

At the American Embassy, the visitors were met by Dr. Bruce J. McDonald, scientific director of the Office of Naval Research, and Dr. Francis J. Richards of that command; William C. Sherman, deputy chief of Missions, Embassy of the United States; and Justin L. Bloom, counselor for Scientific and Technological Affairs.

Among highlights of the tour was a visit to the Hakuho Maru, first-class research ship operated by Tokyo University, which was being refitted at Tokyo Harbor for a scientific journey into the Pacific.

The high school representatives traveled by the Hitari 23 Superexpress Bullet Train to Kyoto, where they were introduced to Japanese cuisine and culture at the Inn of the Three Sisters, the Heiam Shrine, Sanjusangendo Hall, and the Kiyomizu Temple.

Other points of interest included the Golden Pavilion, the Nijo Castle, the Old Imperial Palace, Todaiji Temple, Deer Park, the Kasuga Shrine and the Kyoto Cultural Center.

On the journey back home, the group stopped over in Honolulu, where they were met by Richard Rothrock, Public Affairs officer for Pearl Harbor, and received a tour of the Pearl Harbor facilities, as well as a journey to points of interest including Diamond Head and Paradise Gardens.

For further information on the 28th ISEF, which includes Operation Cherry Blossom and Army Superior and Meritorious Award winners, see May-July issue of the *Army R&D Newsmagazine*.

DARCOM Military Personnel Receive Awards

DARCOM Director of Development and Engineering MG Robert J. Lunn, LTC Peter Bizic Jr., and MAJ Robert P. Moore.

Two military personnel assigned to HQ U.S. Army Materiel Development and Readiness Command, Alexandria, VA, were recently recognized for earlier achievements.

LTC Peter Bizic Jr., an R&D coordinator in DARCOM's Foreign Science and Technology Office, received the Meritorious Service Medal for 1976-77 service as chief of the Tunnel Neutralization Team with United Nations Command/U.S. Forces Korea/Eighth U.S. Army.

He was cited specifically for development of a viable tunnel detection program and for devising new procedures for operational employment of tunnel research systems in the Demilitarized Zone.

MAJ Robert P. Moore, assigned to DARCOM's Office of the Director for Development and Engineering, is a recipient of the Joint Service Commendation Medal for 1973-77 service as executive officer, commander, and dual rated aviator with the First Aviation Detachment, HQ U.S. European Command.

MAJ Moore was credited for his excellence in all aspects of command responsibility, international flight operations, and flying expertise. He compiled more than 1,000 flight hours as a command pilot for numerous U.S. and allied government dignitaries.

Suggestion Earns 2 WSMR Scientists $1,900 Award

Adoption of a suggestion for modification of AN-MPS-36 radars for Target Motion Resolution processing, resulting in government savings of $796,754, has earned a $1,900 joint award for two scientists at White Sands (NM) Missile Range.

Raul Real y Vasquez Jr., an electrical engineer, and Elwin Nunn, a physicist, worked for more than two years on an alternative approach to a planned post modification of existing radar equipment. Original WSMR procurement costs were $830,655, but were finally reduced by the two men to about $34,000.

WSMR Commander MG O. L. Tobiason noted that the improvement is clearly based upon an innovative and imaginative application of scientific engineering theory and principles.

Successful modification of the radars has reportedly tripled WSMR capabilities of collecting Target Motion Resolution data; reduced modification time by 22 months; and for the first time permitted extraction of data such as time of occurrence and duration of events, velocity spread of chaff and other clutter, and target motion associated with its center of gravity (spin, precession, nutation, and aspect angle).

Employed at WSMR's National Range for more than 9 years, Vasquez holds a BS degree in electrical engineering from the University of Texas at El Paso. Nunn served in the Instrumentation area for 13 years and has an MS degree in computer science from New Mexico State University.

Raul Real y Vasquez Jr. and Elwin Nunn

New Journal Appoints Kaplan to Editorial Board

Dr. Arthur M. Kaplan

Dr. Arthur M. Kaplan of the U.S. Army Natick (MA) R&D Command was recently appointed to the editorial board of *Petroleum Microbiology*, a new journal scheduled for publication in Great Britain by Applied Science Publishers, Ltd.

Chief of the Biotechnology Group, Food Sciences Laboratory, Dr. Kaplan has served as a NARADCOM research microbiologist since 1953, has published numerous scientific articles, and holds several patents related to microbiological deterioration, materials contamination, and pollution abatement.

He is a graduate of Massachusetts State College and earned his master's degree from the State College of Washington and his PhD from the University of Massachusetts.

Dr. Kaplan has served as a member of the U.S. delegation to the Organization for Economic Cooperation and Development Expert Group on Biodeterioration of Materials, Paris, France, and is a founding member of the International Biodeterioration Research Group.

An adjunct professor in the Plant Pathology and Entomology Department of the University of Rhode Island, he is an associate member of the Commission on Environmental Health, the Armed Forces Epidemiological Board, and on the Board of Governors of the American Institute of Biological Sciences.

Listed among his honors are the Charles Porter Award of Merit and the Charles Thom Award for contributions to industrial microbiology, both presented by the Society for Industrial Microbiology.

2 AMMRC Personnel Receive Meritorious Awards

Dr. Robert W. Lewis and Joseph I. Bluhm of the U.S. Army Materials and Mechanics Research Center, Watertown, MA, are recent recipients of Meritorious Civilian Service Awards, the Army's second highest honor for civilian employes.

Dr. Lewis, who is chief, Composites Division, Organic Materials Laboratory, was cited for 1972-75 significant contributions to in-house plastics and composite materials processing capabilities, and for service on the President's Commission on Personnel Interchange.

Bluhm is assigned to AMMRC's Mechanics Research Laboratory. He was recognized for meritorious contributions to the Army's solid mechanics R&D program. "His technical leadership," the citation states, "provides the basis for continuing Army advances."

MCSA recipients Joseph I. Bluhm and Dr. Robert W. Lewis, flanked by AMMRC Director Dr. Edward S. Wright, and Chief Scientist and Director of Research, DA, Dr. Marvin Lasser.

Reader's Guide...

Study Paper Termed 'Outstanding' . . .

Officer Cites Importance of System Coordinators

Reflections on Being a Department of the Army System Coordinator (DASC) is the title of a study paper selected as "the most outstanding by an Army student" in the 77-2 class of the Defense Systems Management College Program Management Course.

Authored by LTC Alex J. Johnson, former staff officer and DASC in the Office, Deputy Chief of Staff for Research, Development, and Acquisition (DCSRDA), the study details the difficult but vitally important task of being a successful DASC.

The DASC is defined in the Executive Summary (preface) of this study as the person at the forefront of the daily battle for program funding and support in the HQDA, OSD, and Congressional arena. He is referred to as an invaluable member of the management team.

LTC Johnson notes in his introduction that the purpose of his paper is to provide assistance to newly assigned DASCs in understanding their principle mission and the actions required to accomplish this mission effectively and efficiently.

Quoting another authority, he states that "the DASC's job is enormously complicated and difficult . . . [he] is overburdened with obligations, yet he cannot easily delegate his tasks." The new DASC is advised how to minimize job frustration while maximizing productivity.

For example, he stresses the importance of never taking lightly any of the budget exercises a DASC may encounter, for funds once cut are extremely difficult to recover. Justification for one's program must be constantly maintained current, strong, as well as refined and strengthened.

The budget reclama process, LTC Johnson notes, can be a 2-edged sword. A DASC should always negotiate with higher authority to obtain the most favorable compromise, "then use the issue to ensure that direction is complied with."

LTC Johnson's paper contains seven chapters, covering Introduction, Program Funding, Decision Making, Program Expertise, DASC Credibility, Responsibilities of the DASC, and a Summary.

Believed to be the first major comprehensive work on the current DASC system, the study is being reprinted and distributed by DCSRDA for use by all present and future DASCs. It may also be of considerable benefit to anyone involved in the RDTE process.

Copies are available from the U.S. Army (Pentagon) Library, the Defense Systems Management College Library, and HQ U.S. Army Materiel Development and Readiness Command Library.

CDEC Compiles OR Symposia Technical Papers Index

Titles of unclassified technical papers presented at annual U.S. Army Operations Research Symposia (AORS) from 1962-76 are compiled in a new index published by the U.S. Army Combat Developments Experimentation Command.

U.S. Army Operations Research Symposia (AORS) Proceedings 1962-76 contains "Keyword Headings" to identify general subject areas. A cross-reference list (by number) of individual papers provides the author's name, paper title, and annual proceedings year and page.

Persons seeking to read specific papers identified in the index, but who do not have the actual proceedings which contain their text, may obtain them from the Defense Documentation Center (DDS).

Comments, suggestions, and questions regarding the index should contact: Commander, Combat Developments Experimentation Command, Office of the Scientific Adviser, Fort Ord, CA 93941.

ARI Examines WAC's Impact, Leadership Training

Utilization and impact of women in Army operations and effectiveness of leadership training are subjects of two new publications announced by the U.S. Army Research Institute for the Behavioral and Social Sciences.

Women Content in Units Force Development Test (MAX WAC), is designed to provide insight to the Army in evaluating the future role of women. Forty combat support and combat service support companies were tested for this research.

A major finding of this report is that no substantial changes in company performance were found when the content of enlisted women increased. ARI found that women did not impair unit performance during intensive 72-hour field exercises.

Supplemental findings indicated that enlisted women had more academic schooling than enlisted men (in the test); about two thirds of all test personnel reported their company performed "outstanding/very well" and that women dislike their uniforms, and field hygiene is a problem.

Enlisted women appeared to do better in units where they were treated as equals and leadership was supportive. ARI stresses that the 72-hour field test is not really long enough to determine how well women will endure under extended field duty.

Extended field duty is addressed in another research effort entitled Women in the Army-REFORGER 77. The MAX WAC study, ARI emphasizes, is only one of many inputs contributing to policy determinations regarding utilization of women.

Leader Match IV Programmed Instruction in Leadership for the U.S. Army, Technical Report 77-TH3, is a training manual designed to improve effectiveness of potential military leaders.

This training is based on the theory that demonstrates that group or organizational performance and success may depend upon the leader's per-

sonality and the situation in which he must operate. Presumely, most people are effective in some leadership situations and ineffective in others.

Leader Match training has been tested in four civilian organizations and four military settings. ARI comparisons between leaders trained by this method and leaders not trained by this method reveal more effective performance by the LM group.

Each of the 12 chapters contained in the manual begins with a brief discussion of "need-to-know" principles. These discussions are followed by practical exercises (problems) to illustrate basic points in the text.

The book concludes with a bibliography of suggested readings and a final exam to provide students with information relative to where they might need improvement.

Career Programs . . .

R&D Officer OPMS Course to be Offered at ALMC

A new 7-week R&D Officer Personnel Management System (OPMS) course, structured to specialized officer training leading to a primary or secondary SSI 51 (Research and Development), has been approved for resident classes at the Army Logistics Management School, Fort Lee, VA.

Thirty-two spaces have been authorized for captains, majors and a limited number of GS-11, 12 and 13 civilians to attend the first class scheduled for Aug. 20. Starting dates have not been set for three additional classes planned for FY79.

The curriculum includes sessions on life-cycle management model, R&D management, contract management, financial management, quantitative technology, and decision risk analysis and cost estimating.

Inquiries for further details should be addressed to the Commander, U.S. Army Logistics Management School, Fort Lee, VA 23801.

PM TRADE Employe Earns Unique Distinction

Karen D. Lam

Karen D. Lam, an employe in the Office, Project Manager for Training Devices, Orlando, FL, earned distinction as the first woman from an Army PM's Office selected to attend the Defense Systems Management College Program Management Course.

Assigned to PM TRADE's Training Devices Instructional Systems Division, Ms. Lam is a project officer and the senior education specialist responsible for managing procurement of Training Extension Courses.

The 20-week Program Management Course, taught at Fort Belvoir, VA, is designed to provide promising careerists with a professional education in effective defense systems acquisition management.

TRADE Project Manager COL J. J. Leszczynski based his nomination of Ms. Lam on her "extensive knowledge of training and instructional systems, the systems acquisition process, and her potential for increasingly important assignments in the PM arena."

The nomination certificate also credits her Integrated Technical Documentation and Training efforts relative to the PM TRADE MILES Program—a family of direct fire laser simulators designed to improve tactical proficiency training.

Formerly employed by the U.S. Navy Training Analysis and Evaluation Group, Orlando, FL, Ms. Lam has a BA degree in psychology (phi beta kappa) and a master's degree in teaching (psychology) from the University of Florida. She has coauthored technical reports on instructor training and training effectiveness assessment.

USUHS Offers New Graduate Degree Programs

Accredited graduate programs in the basic medical sciences will be offered by the Uniformed Services University of the Health Sciences beginning this fall. Deadline for submission of applications is Mar. 1, 1978.

Qualified military and civilian personnel may earn master's and doctoral degrees in anatomy, biochemistry, medical psychology, microbiology, pharmacology and preventive medicine. Students will serve as teaching and research assistants in support of the university's School of Medicine.

Military applicants must receive approval and sponsorship from their parent command and will incur obligation for additional service. A limited number of salaried pre-doctoral assistantships are available for civilian graduate students.

Located at the National Naval Medical Center, Bethesda, MD, the Uniformed Services University was established by Congress in 1972 and accepted its first students in 1976. About 100 students are enrolled.

People in Perspective...

Hobby Accents Authenticity . . .

Officer's Toy Soldiers Represent Many Nations

LTC Marvin R. Murray

The U.S. Marine Corps' "We Build Men" recruiting slogan might also apply, although on a miniature scale, to U.S. Army LTC Marvin R. Murray. His *men*, it should be stressed, are his hobby—not his subordinates!

LTC Murray makes, collects, and displays tiny lead soldiers which are representative of many nations. Complementing the collection are also horses, tanks, flags, numerous artillery pieces, and even a German marching band with spiked helmets.

His figures are not merely the silver-gray color of lead, but are detailed to reflect true colors of the original uniforms. His search for authenticity often leads to his library of historic books or old post cards.

LTC Murray's hobby began about three years ago while on an overseas assignment in Germany. After purchasing a wall unit, he spotted lead figures in an antique shop which he thought would make a nice display.

He later attempted to find molds with which to make his own soldiers. Some friends bought and painted some figures and gave them to him as a gift. He has been making his own soldiers in his backyard ever since.

He simply melts a pot of lead with a propane heater and pours the liquid into molds. "Whenever I'm out there," he says, "just about every kid in the neighborhood comes over for some samples. Of course," LTC Murray stresses, "I can't disappoint them."

Most of LTC Murray's molds are primarily from the World War II era and cost about $5. Very few new molds are made today, so many of the originals require some maintenance before they can be used.

LTC Murray is assigned to the Army Communications Systems Agency/Project Manager DCS (Army) Communications Systems, a major subordinate agency of the Army Communications Command, and a multisystem project management office of the U.S. Army Materiel Development and Readiness Command.

Personnel Actions . .

Dinger Appointed as MERADCOM Technical Director

Donald B. Dinger

Responsibilities for planning and directing the U.S. Mobility Equipment R&D Command's research, development and acquisition activities were assumed recently by Donald B. Dinger when he was appointed as MERADCOM technical director, a Public Law 313 position.

Assigned for the past seven years as MERADCOM's associate technical director for R&D, Dinger has been employed at the command since beginning his civil service career in 1958. He served initially as a project engineer in Electrical Power Research and Systems Analysis.

During 1964-71 he headed the Nuclear Electromagnetic Pulse Research Program and major Vulnerability and Hardening Programs as chief of MERADCOM's Electromagnetic Effects Division. This assignment followed service as project officer and leader of nuclear electromagnetic pulse effects investigations on Army field electrical power systems.

Graduated from the University of Rhode Island with a BS degree in electrical engineering (also recipient of a distinguished military graduate award), he earned an MS degree in engineering from George Washington University in 1964. He is working on an Applied Science degree in operations research under MERADCOM's professional development program.

(Continued on page 28)

(Continued from page 27)

A 1965 recipient of the MERADCOM Commander's Medal for Scientific Achievement, Dinger was recently elected to Omega Rho (the National Operations Research Honor Society). He is also a Fellow of the Washington Academy of Sciences, and is listed in *Who's Who in the Southeastern U.S. in 1976*.

Additionally, he is past president and member of the board of directors of the Belvoir Chapter of Sigma Xi Scientific Research Society of North America, and a member of the Institute of Electrical and Electronics Engineers and the American Defense Preparedness Association.

Moore Assumes Duties as DARCOM Chief of Staff

BG Robert L. Moore recently assumed new duties as chief of staff, HQ U.S. Army Materiel Development and Readiness Command, Alexandria, VA, following a 2½-year assignment as division engineer, North Central Division, Chicago, IL.

BG Robert L. Moore

BG Moore has a BS degree in building design from Virginia Polytechnic Institute and State University, a BS degree in civil engineering from the University of Missouri, and an MS degree in business administration from Georgetown University.

His military schooling includes the Army Command and General Staff College, Industrial College of the Armed Forces, Army Engineer School (Basic and Advanced Courses), and the Infantry School Basic Course.

During 1974-75 he served as commander, Division Support Command, 2d Infantry, Eighth U.S. Army, Korea, following a tour as executive to Development Team, Army Materiel Acquisition Review Committee, Office, Chief of Staff, Department of the Army, Washington, DC.

Other key assignments have included district engineer, U.S. Army Engineer District, Buffalo, NY; director, Plans and Analysis, U.S. Army Materiel Command (now DARCOM); and military assistant to the Assistant Vice Chief of Staff, HQ DA, Washington, DC.

BG Moore is a recipient of the Legion of Merit with three Oak Leaf Clusters (OLC), the Meritorious Service Medal, and the Army Commendation Medal with OLC.

Smith Chosen as MIRADCOM Deputy Commander

Deputy commander, U.S. Army Missile R&D Command, Redstone Arsenal, AL, is the new title of COL David C. Smith, following service as assistant PM for Logistics Operations, Patriot Project Office.

COL David C. Smith

Assigned to the Patriot Office since 1976, COL Smith served initially in the Redstone Arsenal area in 1958 with the Army Rocket and Guided Missile Agency, and later with the Pershing Project Office.

Other career tours have included acting and assistant commandant, U.S. Army Missile and Munitions Center and School; commander, 705th Maintenance Battalion, 8th Infantry Division (Mechanized/Airborne), Europe; and commander, 704th Maintenance Battalion, 4th Infantry Division, Vietnam. He wears the Legion of Merit with Oak Leaf Cluster (OLC), Bronze Star Medal with two OLC, and the Army Commendation Medal with two OLC.

Seidel Directs HumRRO's Eastern Division

Responsibilities for directing the Human Resources Research Organization's (HumRRO) Eastern Division have been assumed by Dr. Robert J. Seidel, following service as senior staff scientist and director of the division's Instructional Technology Group.

Employed by HumRRO since 1961, Dr. Seidel is a Phi Beta Kappa graduate of Rutgers and has MA and PhD degrees from the University of Pennsylvania. He has authored 55 professional articles and two books.

Dr. Seidel has more than 20 years of R&D experience and is credited with recent refinement of a "Transactional Evaluation" technique for analyzing perceptions of roles and relationships in program development.

Army R&D — 15 Years Ago

The Army R&D Newsmagazine reported on . . .

Army Program Aims at Improving Use of STINFO

An aggressive, intensively considered approach to a massively difficult problem is presented in a proposed Department of the Army Scientific and Technical Information (STINFO) Program required by a Defense Department instruction.

Assistant Secretary of the Army (R&D) Dr. Finn J. Larsen approved the program late in January. It was then submitted to Dr. Harold Brown, Director of Defense Research and Engineering, for integration, along with proposals from other agencies, into the Defense program.

The Army STINFO Program is based on findings and recommendations of 23 task study groups. The tasks were assigned by an Army Ad Hoc Group on Scientific and Technical Information, established by direction of Chief of Research and Development LTG Dwight Beach.

The program is divided into three main projects: program support, exploratory development, and research. Further task studies will be made, employing talents not only of Army experts but also consultants from business and academic worlds.

The Ad Hoc Group recommendation is that the CRD assign the office to the Director of Army Research, and that it be located at Headquarters, U.S. Army Research Office, Arlington, VA.

CDEC Plans Commanders, Tech Directors Conference

The First Commanders and Technical Directors Conference, an outgrowth of the reorganization of the Army, is scheduled May 1-3 at the U.S. Army Combat Developments Experimental Center, Fort Ord, CA.

Under the joint sponsorship of the Assistant Secretary of the Army (R&D) Dr. Finn J. Larsen and Chief of R&D LTG Dwight E. Beach, the conference will broaden the scope of Army Key Scientists meetings.

AKS meetings, which had been held semiannually for eight years, were suspended last fall as a result of the merging of the materiel functions of the Technical Services in the new U.S. Army Materiel Command. The new series of Commanders and Technical Directors Conferences is planned to bridge the communications gap resulting from that change.

National Referral Center for S&T Cites Aims

In the rapidly mushrooming complex of agencies being established to deal with the high priority and complicated problem of improving utilization of scientific and technical information, the new National Referral Center for Science and Technology expects to be a "catalytic agent."

Scheduled to go on a limited operational basis in March, as announced by Director John F. Stearns, the Center is established as a division of the Library of Congress supported by the National Science Foundation.

The envisioned scope of operations—that of collecting, indexing, listing and identifying availability of information requested in the nearest geographical location to achieve rapid response—is expected to require at least a year before the Center is fully operational.

As stated by Mr. Stearns, the Center will be concerned with libraries, information centers, publications, specialized bibliographic and data service, and the activities of Federal Government agencies, industry and even foreign nations in the technical information field.

Located in the Library of Congress Annex at Pennsylvania Avenue and Second Street, S.E., Washington, DC, the Center is currently sending out thousands of letters of inquiry to determine specifically what types of information, and in what form, may be obtained from the resources.

Army Sets Up Foreign Science-Technology Center

Dissemination of timely information on foreign military developments to the Army and other government agencies is the function of a newly established Army Foreign Science and Technology Center (FSTC).

Under the U.S. Army Materiel Command, the Center at Arlington Hall Station, Arlington, VA, is responsible for technical intelligence activities formerly conducted by the Chemical, Signal, Transportation, and Quartermaster Corps.

The Center is charged with collecting, evaluating and supplying information on foreign equipment, sciences and technologies of interest to the Army. It is particularly interested in uncovering superior foreign technologies in weapons and equipment for study by the Army.

Areas of interest include Army aircraft; atomic, biological and chemical agents; combat materiel; combat support systems; communications and electronics; general equipment; material exploitation; missiles and space; transportation equipment; weapon systems; environmental, physical and life sciences; and scientific resources.

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darcom goals

THE READINESS GOAL

Provide adequate levels of operable materiel, related support and the logistical support base necessary for rapid and successful transition to combat.

THE HUMAN GOAL

Encourage further development of the workforce through education and training. Insure equal opportunity for all members. Improve the quality of the working and living environment of both military and civilian personnel. Inspire, enhance and require dedication of the workforce to the highest personal and professional standards.

THE MATERIEL GOAL

Develop, procure, store, field and maintain the authorized materiel required to support a balanced warfighting and sustaining capability in combat.

THE STRATEGIC DEPLOYMENT GOAL

Insure the design and availability of materiel and equipment to enhance deployment in peacetime and mobilization.

THE FUTURE DEVELOPMENT GOAL

Develop or improve Army equipment and logistic concepts by exploiting new technology consistent with stated user needs.

THE MANAGEMENT GOAL

Improve the effective use of resources and strengthen the resource justification process.


ZERO
ARMY
BASE
BUDGETING