

UNITED STATES ARMY  
BIOMEDICAL  
RESEARCH & DEVELOPMENT  
LABORATORY

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Report MEDDH-288 (R1)

ANNUAL PROGRESS REPORT  
1 October 1986 - 30 September 1987  
VOLUME I



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U.S. ARMY BIOMEDICAL RESEARCH AND DEVELOPMENT LABORATORY,  
ANNUAL PROGRESS REPORT FY87, VOLUME I

U.S. ARMY BIOMEDICAL RESEARCH AND DEVELOPMENT LABORATORY  
FORT DETRICK  
FREDERICK, MD 21701-5010

7 December 1987

Annual Progress Report for Period 1 October 1986 - 30 September 1987

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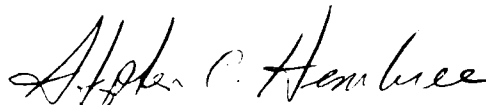
## INTRODUCTION

The U.S. Army Biomedical Research and Development Laboratory (USABRDL) is a small, highly efficient subordinate unit of the U.S. Army Medical Research and Development Command (USAMRDC), located at Fort Detrick, Maryland. The Laboratory performs research and development within all of the parent Command's research areas. The USABRDL is characterized by broad mission responsibilities met by a diverse, multidisciplinary team of scientists and engineers performing basic and applied research and development in all funding categories, 6.1 - 6.4. The mission includes development of medical materiel, protection of soldiers and civilian employees from occupational health threats and protection and enhancement of the environment.

This past year has been marked by two significant changes for the Laboratory. On 25 November 1986, the name of the Laboratory was changed from the U.S. Army Medical Bioengineering Research and Development Laboratory (USAMBRDL) to the U.S. Army Biomedical Research and Development Laboratory. This more accurately reflects the diverse array of professional capabilities dedicated to our mission accomplishment. On 8 September 1987, the unit colors were passed as the command of the Laboratory changed hands.

Trends and accomplishments are highlighted in Volume 1 of this report and all Research and Technology Work Unit Summaries (DD Form 1498s) are presented in Volume 2. Detailed in-house and contractor's research is synopsised in reports which are filed with the Defense Technical Information Center.

Questions or comments about this report are welcomed and may be addressed to the Commander, USABRDL.



STEPHEN C. HEMBREE, Ph.D.  
Colonel, MS  
Commanding

## SUMMARY OF SIGNIFICANT ACHIEVEMENTS

The USABRDL research programs produced significant new findings during FY87. Laboratory reorganization enhanced productivity and permitted the initiation of new research to protect the health of soldiers in the field and military industrial workers and to meet our environmental protection obligations. The following highlights significant achievements in FY87:

- The USABRDL program was refined to focus more directly on resolution of Army readiness issues.

- Response to medical materiel needs for Special Operations Forces was accelerated.

- The USABRDL continued development and fabrication of unique equipment for in-vitro healing studies in the Army space initiative. Collaboration between USABRDL, Walter Reed Army Institute of Research, and National Aeronautics and Space Administration should result in studies on the space shuttle flight scheduled for late FY88.

- Combat casualty care research focused on more rapid fielding of medical materiel developed for the field soldier and the program was expanded to include research into field medical applications of artificial intelligence.

- In-Process Reviews resulted in type classification, standardization, or transition to the appropriate activity of several items of medical hardware.

- The USABRDL established a Configuration Management Program for updating military specifications used in the procurement of vector control equipment.

- The USABRDL initiated development of specific control strategies for selected potential vectors of Biological Warfare Agents. The project will initially focus on vectors of Rift Valley Fever in Kenya.

- A cooperative effort with the Pan American Health Organization was initiated to analyze physical and chemical parameters of Anopheles larval habitat in Central America. Development of an Integrated Pest Management Research Project in Honduras progresses. Conventional malaria and dengue control methodologies are being replaced with more effective strategies.

- The Centers for Disease Control expert panel on chemical agents accepted this Laboratory's data base on health effects for industrial workers and general populations potentially at risk during chemical agent demilitarization operations.

- Members of this Laboratory were asked to provide health effects information and to participate in briefings of The Army Surgeon General on issues arising from the presence of potential carcinogenic substances in inventory smoke and obscurant munitions.

- The Preliminary Pollutant Limit Value concept, developed at this Laboratory, continued to experience wider use and acceptance. The notoriety of this concept was evidenced by the recent request for USABRD L to send a technical consultant to assist in the filming of a Public Broadcasting System documentary at Milan Army Ammunition Plant in Tennessee.

- This Laboratory received major funding under the Defense Environmental Restoration Account as a result of staff briefings for the Department of the Army and Chief of Engineers concerning USABRD L efforts in alternative species testing and in the development of on-site biological monitoring of Army effluents from industrial operations and hazardous waste sites.

- The USABRD L signed a Memorandum of Agreement with U.S. Army Toxic and Hazardous Materials Agency for the development of health related data bases necessary to the design of pollution abatement systems, to the definition of the hazards of military relevant materials, and to provide target concentrations for clean-up.

- Enhancement of organizational relationships with other Army and Department of Defense and Federal agencies included:

- A Memorandum of Agreement with the U.S. Army Troop Support Command to enhance USABRD L's capabilities to field equipment in the broad area of preventive medicine.

- Execution of first article testing for Defense Construction Supply Center and Defense Personnel Support Center resulted in accelerated fielding of new equipment.

## DESCRIPTION OF USABRDL

### LABORATORY MISSION

The USABRDL conducts basic research in the areas of field medical materiel, vector control systems, health hazard assessments, and environmental health effects. It also develops or modifies, tests, and evaluates field medical, dental, and water treatment equipment and technologies and develops vector control and field sanitation methods, materials, and equipment to meet military needs; establishes atmospheric and water related health hazard data bases for occupational and field exposures to chemicals and microorganisms; provides exposure guidance and recommends criteria and develops and recommends environmental criteria and pollution abatement procedures for chemical substances from Army industrial and field operations. In addition, USABRDL provides research, consultation, and technical services to the Army and other Federal agencies as requested.

### FACILITIES

The Laboratory occupies eight buildings. A number of construction and renovation projects were initiated in FY87 to upgrade facilities. Security windows were added to Building 1053, constructed recently for developmental appraisal and display of foreign medical materiel. A drop ceiling, well water filtration system, water sterilizer, emergency lights, hood exhaust, stair treads, floor tile and new doors were installed in Building 568, which was built as a laboratory in 1952 and currently houses the office of the Commander and elements of all divisions. Several laboratories in the building were renovated and refurnished for use in studying occupational health chemistry and military disease hazards. The Materials Test Laboratory was relocated from Building 568 to Building 1054. This move made prime laboratory space available to the research divisions and co-located all engineering evaluation functions into one area. Future plans for Building 568 include conversion of the test tank utility room into storage space and renovation of rooms for an experimental toxicology laboratory.

An entry vestibule was added to Building 524 to eliminate unhealthy drafty conditions and to conserve energy. This building, constructed in 1945, houses Health Effects Research Division (HERD) administrative personnel. Another HERD facility, Building 459, also constructed in 1945, was vacated for 9 months for removal of asbestos. Plans to upgrade this building are in the purchasing and contract phase. The changes will bring the building into compliance with Occupational Safety and Health Administration requirements for safety and fire protection. It will also meet Good Laboratory Practices standards.

Building 1054, built in 1954 as a Research, Development, Test, and Evaluation (RDTE) Shop, now houses the Industrial Services Branch, Logistics Branch, portions of the Technical Services Branch, the Library, a small number of personnel from the HERD and the Field Medical Materiel Development Division (FMMDD), and a computer system and staff from Headquarters, USAMRDC. Improvements completed this year were the renovation of a cage storage area for expansion of the USAMRDC's computer system and installation of a chain-link fence for security. Scheduled additions include a materials test facility, renovation of a washroom, construction of an outside stairway to provide access to the second floor, relocation of the fabric shop, and alterations to the Unit Process Laboratory.

Building 1058, built in 1975 as a storage facility, was upgraded with sheathing to prevent separation of siding from the building.

Renovation of Building 1215, Area B, to meet safety and security requirements for storage of munitions, has begun. The in-house portion of the work is completed, and the contract portion is in process.

An additional biomonitoring trailer was ordered for installation at the Fort Detrick Wastewater Treatment Plant to conduct field evaluation of a toxicity biomonitoring system developed at the USABRD L.

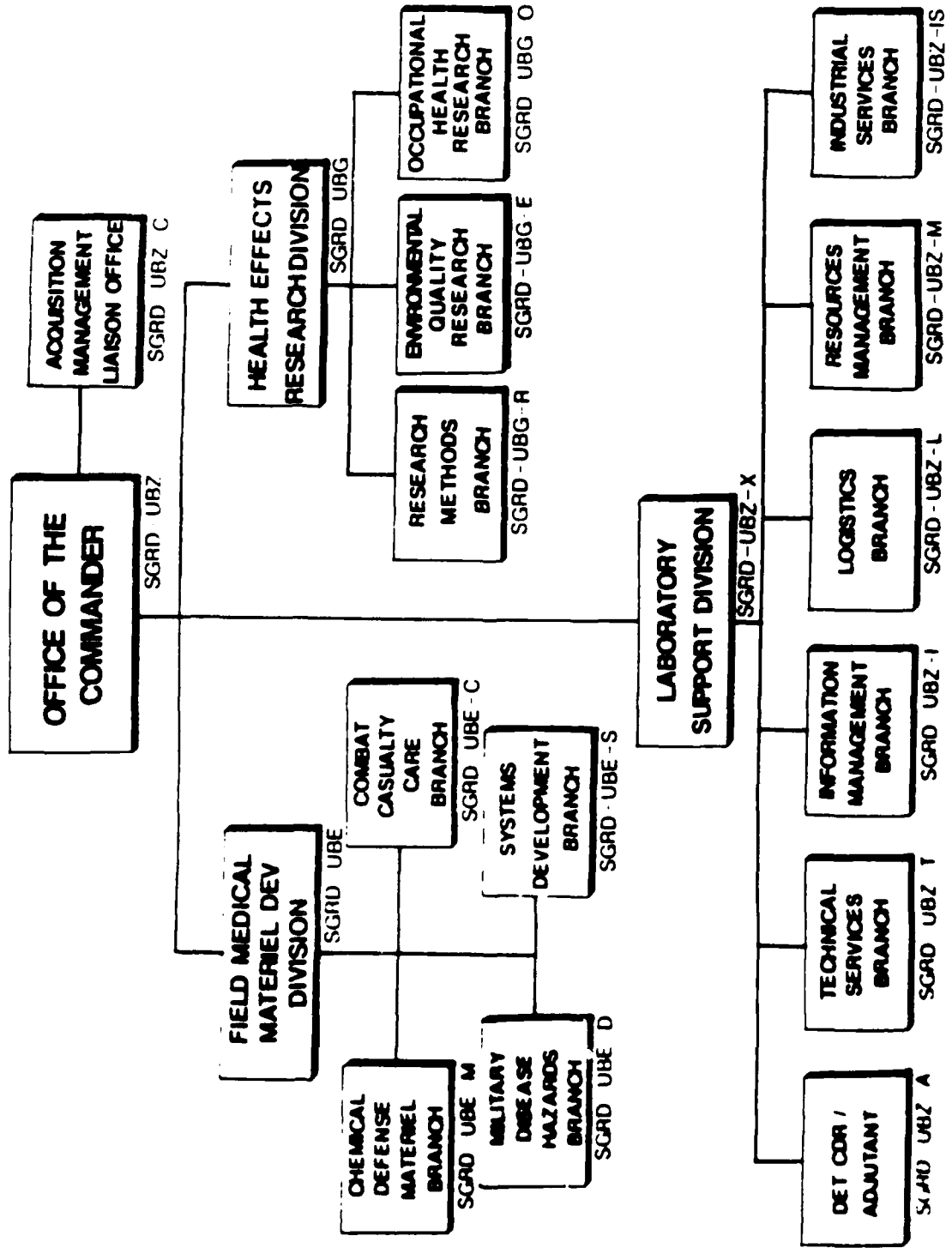
Laboratory capability to conduct research in aerosol science greatly increased in FY87. A state-of-the-art aerosol science laboratory containing a wind tunnel and cascade impactor was established. These improvements will allow development and evaluation of new bioassay methodologies using confined mosquitoes.

BUILDING SPACE  
SQUARE FOOTAGE

<u>BUILDING</u>	<u>ADMIN</u>	<u>LAB</u>	<u>OTHER</u>	<u>TOTAL</u>
459		8,775	250	9,025
524		4,261	389	4,650
568	5,442	35,475	8,361	49,278
1053	4,704			4,704
1054	26,505	6,250	1,382	34,137
1056	512	447	64	1,023
1058	1,575			1,575
1059		325		325
1215	100			100
TOTALS	38,838	55,533	10,446	104,817

# U S ARMY BIOMEDICAL RESEARCH & DEVELOPMENT LABORATORY

FORT DETRICK, FREDERICK, MARYLAND 21701-5010



## STAFFING

The USABRD L operated with an authorized staff of 120 professional, technical, and support personnel representing a wide range of scientific, administrative, and engineering disciplines, experienced in both in-house and extramural research management, and supported by state-of-the-art laboratory equipment. The USABRD L provides unique capabilities for support of Army research activities in the broad areas of combat casualty care, human health effects of environmental pollution, preventive medicine, and medical aspects of chemical defense.

Professional disciplines represented in the organization include:

Aquatic Biology	Entomology
Biology	Environmental Health Sciences
Biomedical Maintenance	Microbiology
Biostatistics	Medical Illustration
Chemistry	Nursing
Computer Sciences	Physiology
Dentistry	Toxicology/Pharmacology
Drafting	Trades and Crafts
Engineering	Veterinary Medicine

TABLE 1. USABRD L FY87 STAFFING

	<u>Required</u>	<u>Authorized</u>
Officer	18	15
Enlisted	15	14
Civilian	<u>123</u>	<u>91</u>
TOTAL	156	120



## FUNDING

Fiscal Year 87 was a transitional year for the method of funding the Laboratory's Basic Operating Information System/Real Property Maintenance Activities (BASOPS/RPMA) requirements. Headquarters, USAMRDC, will fund FY88 BASOPS/RPMA by direct transfer at the appropriation level to the host installation.

The USABRD L progressed further with zero based, project line funding and implemented AR 70-6 requirements. The USABRD L operated under a Commander's target for travel, involving a stringent justification process, and under the constraints of a hiring freeze for 6 months.

The FY87 in-house research and development budget for the USABRD L totaled 5.852 million dollars, and the extramural program managed by the Laboratory totaled 8,029 million dollars (table 2). Funds were derived from a diverse funding base reflective of significant program expansion and responsiveness to key Army readiness issues. Funding was received from a wide range of USAMRDC core programs supplemented by an equally wide range of reimbursable efforts.

TABLE 2. USABRD L FY87 OPERATING BUDGET

Funding Source and RDTE Project Category	Total FY87 Budget (\$000)	
	<u>Intramural</u>	<u>Extramural</u>
1. USAMRDC Core Program		
a. 6.1 Basic Research	787	290
b. 6.2 Exploratory Development	3,351	5,375
c. 6.3 Advanced Development	484	892
d. 6.4 Engineering Development	424	-0-
e. 6.5 Management and Support	596	57
2. Reimbursable	<u>210</u>	<u>1,415</u>
TOTAL	5,852	8,029

Reimbursable funding continued to result from involvement between the USABRDL and major elements of the U.S. Army munitions production and weapons developer communities. Growth in critical medical research support to Army readiness issues relating to the life cycle management of materiel and weapons systems is reflective of major policy clarification under AR 1000-1, Basic Management, and AR 40-10, Health Hazard Assessment Program in Support of the Army Materiel Acquisition Decision Process. The USABRDL, in pursuing its mission of support to the field soldier, military workers, and public health, has worked closely with the materiel development and readiness community to integrate health and performance considerations in the development of new weapons systems and materiel. Medical research support to the U.S. Army Toxic and Hazardous Materials Agency is in support of occupational health and environmental quality criteria development for military unique contaminant hazards associated with existing and new munition plant operations. Support to the Project Manager for Smoke and Obscurants focused on protecting military industrial workers during production and the field soldier during training and/or combat use of field munitions. Support to Missile Command focused on protection of the field soldiers against toxic hazards of the combustion products of Army munition propellants. Support to the Ballistics Research Laboratory focused on protecting military industrial workers and field soldiers against toxic hazard of developmental munition compounds.

## ACQUISITION MANAGEMENT LIAISON OFFICE

The Acquisition Management Liaison Office (AMLO) coordinates the USABRDL extramural contract program and serves as the Laboratory business office for that program. Primarily interested in financial matters, the AMLO also maintains an awareness of the technical aspects of contracts. The Chief, AMLO establishes the policies and procedures to be followed within the program. He communicates directly with USABRDL contractors and may make site visits when warranted. The AMLO finalizes all contract documents before they are forwarded from the Laboratory. The official Contracting Officer's Representative file for the Laboratory, including the file copy of all deliverable reports, is maintained within the office. Preproposals and proposals are received from the Acquisition Management Office, USAMRDC. The Chief, AMLO conducts an initial administrative review, and then obtains technical reviews from the Research Divisions. He coordinates with financial managers within USABRDL and determines incremental funding to be applied to individual contracts and intragovernmental transfers. He also coordinates with Research Area Directors regarding available funding for contracts and intragovernmental transfers. The AMLO monitors receipt of technical progress reports and other contract deliverables. As each technical progress report is received, the Chief, AMLO conducts an administrative review of the status of the contract and then coordinates with Division personnel regarding ways to address problems found during the review. The AMLO prepares the Advanced Acquisition Plan and coordinates the semiannual Review and Analysis of the USABRDL research program. The office is also responsible for scheduling necessary COR training. Additionally, the AMLO serves as the Quality Assurance Office for the Laboratory. This function is expected to take on greater importance during the coming year.

**Progress and Accomplishments:** During FY87 documentation was prepared to initiate 27 new contracts and Intragovernmental Transfers. The total FY87 extramural contract budget was \$8.0 million. As of the end of FY87 the USABRDL extramural contract program consisted of 54 active contracts and Intragovernmental Transfers having a total value of \$37.6 million, including 13 pending contracts and Intragovernmental Transfers which were under negotiation. Under the new procedures of the USAMRDC Broad Agency Announcement, the Chief, AMLO has begun making direct contact with prospective contractors to discuss and clarify the Scope of Work to be included in the full proposal. After much discussion, the exact functions of the AMLO have been established and a draft USABRDL Memorandum on the USABRDL Extramural Contract Program is under review. A contract was awarded to obtain the services of a Quality Assurance consultant to assist in establishing the USABRDL Quality Assurance Program.

## DIVISION ACTIVITIES

### LABORATORY SUPPORT DIVISION

The Laboratory Support Division (LSD) provides professional and administrative support for scientists and engineers engaged in research and development. Division missions include the processing of personnel actions, security management, resources management, information management, logistics and maintenance, contract administration, and quality assurance. Engineering evaluation tests are also done in this Division. The Division is composed of 5 distinct branches with a total of 8 military and 29 civilian employees.

### PERSONNEL

The USABRDL managed personnel assets carefully throughout the year in spite of two moratoria on hiring, 3 December 1986 and 15 April 1987. One method of prudent management was to actively recruit and employ the appropriate mixture of special category personnel from the following:

- International Science and Engineering Fair Program
- Summer Hire Students (contract)
- Faculty Science and Mathematics Program
- Faculty Research and Engineering Program
- Volunteer Program
- Stay-in-School Summer Aid Program
- Temporary and Part-Time Employment

### DETACHMENT COMMANDER/ADJUTANT

The Detachment Commander/Adjutant has responsibility for the processing of military personnel and financial actions, the maintenance of military publications and classified documents, the operation of the personnel and information security programs, and command correspondence quality control. Other administrative responsibilities include the records management program, mail and distribution services, and mobilization planning and programming. Command responsibilities are exercised for enlisted personnel, including reenlistment, training, and military unique programs such as weight control.

### RESOURCES MANAGEMENT BRANCH

The Resources Management Branch coordinates budget preparation and execution, directs activities of the Program Budget Advisory Committee, and manages financial accounting through the Standard Finance System and the Financial Manpower Accounting System. All civilian personnel actions are initiated by the Branch and coordinated with the Fort Detrick Civilian Personnel Office. Other Branch responsibilities include the review and analysis of the Table of Distribution and Allowances (TDA) and provisions for centralized travel services.

## LOGISTICS BRANCH

The property book value of USABRDL's assets is approximately \$6 million, a decrease of \$0.2 million from the previous year. The number of line items within the property book continues to increase. Currently, there are 4,254 line items, an increase of 300 as compared to FY86. Excess equipment turned in to the Property Disposal Office was valued at \$1,114,572. There are 36 hand receipt holders responsible for the control of supplies and equipment--14 in LSD, 11 in HERD, and 11 in FMMDD. During our most recent Command Logistics Inspection, the Property Book Section was commended for having an inventory verification accuracy of 100 percent, establishing an excellent rapport with investigators and researchers, and maintaining an excellent property management section.

Acquisition of expendable supplies and services during FY87 totaled \$852,108, including \$182,443 for contracts to maintain both medical and nonmedical equipment. An additional \$153,380 was expended through blanket purchase agreements in which small businesses received approximately two-thirds of the transactions. Approximately 2,000 purchase requests were submitted for expendable items, durable items, and services during FY87.

The Biomedical Equipment Maintenance Section performed on a decreased level during this fiscal year due to the closure of Building 459 for renovations. The Biomedical Equipment Maintenance Section met the goal of 92 percent calibration of test, measurement and diagnostic equipment for FY87, with 100 percent calibration projected for FY88. Preventive maintenance was performed on approximately 79 percent of the medical equipment during FY87. During the Command Logistics Inspection, the section was commended for being one of the best in the U.S. Army Medical Research and Development Command. Twenty-six contracts were active for maintenance (19 medical, 7 nonmedical), totaling \$82,443.

The Laboratory has 24 work orders pending, 17 of which are construction/renovation projects. During this fiscal year, 15 work orders were initiated, 13 completed and 10 cancelled or converted to service orders. The Fort Detrick Directorate of Engineering and Housing initiated 11 work orders related to our buildings.

Physical Security, Crime Prevention, Key Control, Fire Prevention, Safety and Energy Conservation Programs continue to be sound. An excellent rating was received by the Laboratory during our most recent Physical Security Inspection. In addition, no faults were noted in the Logistics Branch portion of the Internal Review Program.

## TECHNICAL SERVICES BRANCH

Testing is currently being conducted on five different types of equipment with varying degrees of completion. Included are multichamber autoinjectors, pesticide dusters, ventilators, and field refrigerators. Twenty Test Reports have been completed this fiscal year, with a total of 217 items.

Library operations proceeded smoothly. Routing circulations, cataloging, and charges are being conducted in an efficient manner. New acquisitions and subscription renewals were addressed, as required, with a total of 171 requisitions (DA Forms 3953).

The demand for graphic arts and illustrations has been significant. Illustrations, displays, poster sessions, and manuscripts totaled 421 items. Updating briefing slides required revising and redoing 51 viewgraphs. Special requirements from Headquarters, USAMRDC, were significant. The organizational name change required an immediate response to address this item.

The organizational safety program continues aggressively, with significant emphasis on training in safe chemical handling and Occupational Safety and Health Administration Right-to-Know (material safety data sheets). Inspections and analyses addressed questionable materials, eye hazard areas, and safety lighting in various buildings. New procedures for hazardous waste turn-in necessitated updating USABRDL Memo 385-1 and coordination with U.S. Army Garrison safety office. Forty items of personal protective equipment (shoes, safety glasses, etc.) were provided as requested by new personnel and others.

## INFORMATION MANAGEMENT BRANCH

The Information Management Branch expanded the Laboratory's highly integrated local area network of personal computers to all four main buildings. This network provides the capability to develop the corporate information resources required by the organization. The personal computer provides the highest possible degree of flexibility for the end user computing environment. The number of user workstations was increased to 100, including 6 dedicated to a newly established training center. Approximately 50 percent of the Laboratory's staff completed word processing training, and the transition from stand alone word processors to network supported software was completed.

Computer aided design (CAD) was introduced to the Laboratory this year. Several engineers and designers attended CAD training. Two CAD workstations were put on-line to support their needs. A significant real time data collection system was completed and fielded in support of this Laboratory's efforts to develop aquatic biomonitoring systems. Several other data collection and process control applications have been initiated. These efforts are being supported in part by capabilities developed during the original project.

Significant software development resources were devoted to operation, maintenance and development of the Laboratory Management Information System. An automated system for developing employee performance standards and appraisals was implemented. A similar system to print DD Form 1498, Research and Technology Work Unit Summary, was also implemented. Modifications to the Laboratory's automated financial management system were completed in accordance with new regulations.

Statistical support was provided to 19 extramural contracts and 24 in-house research protocols. These efforts spanned nine separate research areas and resulted in five co-authored articles submitted for publication, presentation, or posters.

The overall response time to individual user questions was significantly improved by the addition of two employees to the Branch. User access to computing resources was also improved with the introduction of a portable computer lending service.

Future efforts of the Branch will be directed towards improving overall user productivity. These efforts will include a broad-based user training program which will be initiated and maintained throughout the year. The underlying network resources will be improved by the addition of larger, faster file servers with true multi-user, file sharing support. Communications capabilities to remote data centers, user software, printing, and graphic capabilities will also be improved.

## INDUSTRIAL SERVICES BRANCH

The Industrial Services Branch designs and fabricates initial prototypes and test models of field medical materiel and produces limited quantities to support urgent military requirements. The Branch exercises good manufacturing practices, provides graphic layouts, evaluates raw materials and hardware and assists in prototype testing. It also provides industrial services to all elements of the Laboratory and other agencies as required. The Industrial Services Branch completed 182 internal service requests during FY87. At the end of the fiscal year work continued on 13 service requests, while 8 requests awaited scheduling. The Branch was involved in a number of major projects which included: a Special Forces sterilizer, a water recovery system, a collapsible mosquito light trap, a gasoline powered delousing outfit, and an HCl field monitoring and collection system.



## FIELD MEDICAL MATERIEL DEVELOPMENT DIVISION

The Field Medical Materiel Development Division (FMMDD) conducts research and development of military medical equipment for the Army and, on an as required basis, for the Navy and Air Force. The Division constructs initial pilot prototypes, test models, and produces limited quantities of medical materiel to support urgent military requirements. The Division also conducts The Surgeon General's Research, Development, Test and Evaluation (RDTE) program in integrated vector control systems to include materials, methods, equipment and concepts. This is a comprehensive program involving combat development, research, development, testing, training, procurement, production and deployment. The Division's research and development efforts are aimed at adapting state-of-the-art medical technology for field use and at establishing a solid technology data base to improve and expand health care delivery resources by concept exploration and exploratory development of better field medical and vector control materials and equipment. These efforts are targeted to resolve recognized deficiencies described in the medical mission area analysis. Current research and development is directed toward establishing applicability of new materials and technological advances, exposing unexpected problems, reducing to an acceptable level the risk of adopting new technology in the material acquisition process and demonstrating and testing advanced materials and equipment. To this end, medical materiel research and development in FMMDD is managed under four branches: Systems Development, Combat Casualty Care, Chemical Defense Materiel, and Military Disease Hazards.

### SYSTEMS DEVELOPMENT BRANCH

The Systems Development Branch tracks the technical, financial, and administrative management of specified development and acquisition programs within the spectrum of life cycle management from concept through type classification. It provides design and drafting services for development of field medical materiel.

### COMBAT CASUALTY CARE BRANCH

The Combat Casualty Care Branch conducts in-house and extramural research and development to develop and demonstrate concepts for medical equipment deployable under all battlefield conditions and to develop materiel which will assist the care provider in triage, diagnosis, treatment, and support of combat casualties at all battlefield echelons. It works closely with Research Area II, U.S. Army Medical Research and Development Command (USAMRDC), serving research and development needs for combat casualties.

## STEAM VACUUM PULSE AND ETHYLENE OXIDE STERILIZATION SYSTEMS

**Progress:** A current full-scale development contract on the Steam Vacuum Pulse (SVP) and Ethylene Oxide Sterilization (EOS) Systems will ensure state-of-the-art technology, thus improving the readiness posture of U.S. Army Medical Department field hospitals in terms of time, throughput, and operational capabilities. The maximum daily throughput for the steam vacuum pulse sterilizer is 244 cubic feet of instruments and linens and 720 liters of solutions versus 128 cubic feet of instruments and 468 liters of solutions for the current field sterilizer (NSN 6530-00-926-2151). With high-vacuum equipment, the total sterilization time can be greatly reduced; once a vacuum has been drawn, steam permeates the load almost instantaneously. Full-scale development prototypes are scheduled to be delivered the fourth quarter FY88.

**In-House Work Unit:** Steam Vacuum Pulse Sterilizer System; DAOG9318; Arnold, M.F. Ethylene Oxide Sterilizer System; DAOG9320; Arnold, M.F.

## SPECIAL OPERATIONS FORCES (SOF) STERILIZER

**Progress:** In response to an expressed need by SOF, a small, backpackable, multifueled sterilizer was designed and fabricated for their specific operational requirements. This sterilizer will enable SOF to have surgical sterilization capability under primitive field conditions. The American Society of Mechanical Engineers (ASME) safety review was completed. Preproduction model is being constructed to meet ASME requirements and incorporate user suggestions.

**In-House Work Unit:** Technical Feasibility Testing of Medical Materiel; DA309494; Arnold, M.F.

## TECHNICAL FEASIBILITY TESTING (TFT) OF MEDICAL MATERIEL

**Progress:** As part of the continuing effort to exploit new medical equipment technology, both foreign and domestic, a pocket size cardioscope has been obtained from a commercial source in West Germany and is being evaluated. Also, the use of drawover anesthesia vaporizers in the field as an alternative to the more cumbersome gas machines now in use is being investigated. Data are being gathered on foreign applications of military medical "expert advisor" systems to enhance medical personnel capabilities.

**In-House Work Unit:** Technical Feasibility Testing of Medical Materiel; DA309494; Conway, W.H.

## **IN-HOUSE RESEARCH, COMBAT CASUALTY CARE**

**Progress:** A new commercial product has been identified that has a number of potential applications in field medical equipment. The product is a sheet plastic formulation that exhibits piezoelectric properties when deformed. Preliminary evaluation indicates that it does indeed produce a readily detectable electrical signal in response to minute deformations. This property can form the basis for development of such items as simple and compact vital signs monitors, miniature electronic stethoscopes, apnea monitors, etc.

**In-House Work Unit:** In-House Research, Combat Casualty Care; (Number to be assigned); Conway, W.H.

## **WATER RECOVERY SYSTEM FOR FIELD STERILIZER**

**Progress:** In response to a need to extend the service life of the Sterilizer, Surgical Instrument and Dressing (NSN 6530-00-926-2151), a water recovery system was designed and fabricated. Prototype test results indicate that at least 90 percent of the water normally lost as vented steam can be recovered by this system. Incorporation of the water recovery system will increase the throughput of the sterilizer, drastically reduce the need for water, and make performance of the sterilizer comparable to that of newer equipment.

**In-House Work Unit:** Steam Vacuum Pulse Sterilizer System; DA0G9320; Arnold, M.F.

## **MEMBRANE VAPOR ENRICHER FOR WATER FOR INJECTION PRODUCTION**

**Progress:** A prototype system is under development to provide water for injection (WFI) from any source of field water. Other filtration systems are currently available that produce WFI, but these require potable water as a source. The new system first converts the source water to a vapor and then employs gas separation membrane enrichment to produce the WFI. This scheme allows the use of very dirty source water. Laboratory tests with the prototype indicate that a field sized system that can produce 75 liters per hour of WFI is entirely feasible.

**Contracts and Intragovernmental Transfers:** Membrane Vapor Enricher for WFI Production; DA311671; A G Technology, Inc., (Gollan, A.); Conway, W.H.

## FILMLESS RADIOGRAPHIC SYSTEM FOR FIELD USE

**Progress:** Several contract efforts have been conducted which sought to reduce the bulk and complexity of field x-ray equipment. As a follow-on to the flywheel powered x-ray system developed a year ago, a small, battery powered hand-held x-ray system for use by SOF has been constructed. This device employs capacitor discharge to produce the energy pulse that generates the x-rays and can use a variety of detectors, including the Electrophoretic Image Display (EPID) panels, also developed under contract to this Laboratory. Work was also begun on a system for digitizing x-ray images and storing them on LASER cards, which are small enough to accompany the patient as he moves back through the evacuation chain. Digitized images can also be manipulated, computer enhanced, and can be readily transmitted by electronic means.

**Contracts and Intragovernmental Orders:** Flywheel-Powered Mobile X-Ray Generator with Fluoroscopic Capability; DA0G9379; University of Wisconsin (Siedband, M.P.); Conway, W.H.

Filmless Radiographic System for Field Use; DA309002; University of Wisconsin (Siedband, M.P.); Conway, W.H.

To Develop and Demonstrate a Filmless Radiographic System for Field Use; DA308247; Phillips Laboratories (Murau, P.C.); Conway, W.H.

## NONINVASIVE CORE TEMPERATURE MEASUREMENT

**Progress:** An investigation has begun into the noninvasive determination of body core temperature for rapid determination of hypothermia/hyperthermia in the field. Preliminary findings indicate that infrared radiometric measurements of the tympanum may be able to satisfy the requirement.

**In-House Work Unit:** Noninvasive Core Temperature Measurement; DA 102; Tragesser, J.G.

## NECROTIC TISSUE DETECTION

**Progress:** A study was conducted to determine the characteristics of necrotic versus viable tissue with a goal of identifying a technology whereby a discriminating necrotic tissue detector might be developed. This effort began in response to a need expressed by surgeons to have a table-side device that would identify necrosis more reliably than the surgeon's visually backed judgment, and thereby minimize the damage done to vital tissue during wound debridement. The study has thus far concentrated on the electronic signature of necrotic tissue, expanding on impedance measuring work. Other possible technologies, such as ultrasound attenuation and chemical reactions, will be investigated in this ongoing effort. Toward this end, the Laboratory has been in contact with entomology experts at the University of Illinois to determine the means by which some dipteran larvae identify necrotic tissue.

**In-House Work Unit:** Necrotic Tissue Detection; DA311265; Dubill, P.A.

#### **AUTOMATED FIELD ANESTHESIA SYSTEM**

**Progress:** A concept evaluation model of an automated field anesthesia machine is being developed. The purpose is to relieve the workload on field anesthetists during mass casualty situations and to improve the safety of the process. The machine will employ state-of-the-art computer technology to monitor an anesthetized patient and respond to perturbations in the patient's situation by adjusting machine parameters accordingly. Automatic records keeping will also be incorporated.

**In-House Work Unit:** Automated Field Anesthesia System; (Number to be assigned); Dubill, P.A.

#### **ARMY SPACE INITIATIVE**

**Progress:** This Laboratory is supporting the Army Space Initiative efforts of Walter Reed Army Institute of Research by developing the hardware necessary for a study of wound healing in zero gravity to be conducted aboard an upcoming Shuttle flight.

**In-House Work Unit:** Army Space Initiative; DA311264; Arnold, M.F.

#### **EVALUATION OF DEMAND OXYGEN CONTROLLER**

**Progress:** Preclinical trials of a commercial Demand Oxygen Controller (DOC) were conducted on pig models with promising results. The DOC is an in-line device that can conserve 50 percent or more of the oxygen normally supplied to a cannulated patient by delivering metered pulses of oxygen only during the initial portion of the inhalation cycle. The pulses are just sufficient to fill the lungs, with the remaining air spaces being filled by inhaled ambient air. Oxygen is also withheld during patient exhalation. Use of the device produces no significant decrease in patient  $PO_2$ .

**In-House Work Unit:** Technical Feasibility Testing of Medical Materiel; DA309494; Strzelecki, L.R.

## CHEMICAL DEFENSE MATERIEL BRANCH

The Chemical Defense Materiel Branch conducts in-house and extramural research and development for materiel with emphasis on materiel and policy for ventilation devices, triage criteria, evacuation, and specialized medical equipment to treat, protect, and transport casualties in a chemical environment. This involves research and development of specialized equipment for patient decontamination and chemical hardening of medical materiel. The Branch works closely with Research Area V, USAMRDC, serving research and development needs for chemical defense.

### BATTLE CASUALTY SUPPLEMENTAL HEAT SOURCE

**Progress:** A Battle Casualty Supplemental Heat Source was designed to be an alternative to the Norwegian charcoal heater. Test results of lightweight thermochemical heat packs indicate that they are capable of providing heat for rewarming of specific body parts, (i.e., hands and feet) and can be used to prevent cold injury.

**In-House Work Unit:** Battle Casualty Supplemental Heat Source; DA311254; Rhodes, C.T.; Liner, Heated, Patient Holding and Evacuation System; DAOA6282; Rhodes, C.T.

### CHEMICAL HARDENING OF FIELD LITTERS

**Progress:** To address the extremely important and real threat of chemical warfare agent (CWA) contamination of field medical materiel, the standard field litter was chosen as a model (due largely to its ubiquity, simplicity, and proximity to the casualty). An intensive investigation into alternative materials culminated in FY87 with the identification and completion of CWA testing of polypropylene mesh materials. A recommendation that the standard litter hardware be covered with Chemical Agent Resistant Coating (CARC) and the litter strap be replaced with a CWA-resistant rubber strap, resulted in a modified field litter which is chemical warfare agent resistant and capable of being thoroughly and rapidly decontaminated.

**In-House Work Units:** Chemical Hardening of Field Litters; DA306622; Reams, W.H.

### CHEMICAL HARDENING OF MEDICAL FIELD CHESTS

**Progress:** There is a recognized need to provide containers for medical equipment and supplies which provide protection from both environmental and chemical contamination. Extensive chemical warfare agent testing of the standard field medical chest and a Nondevelopment Item, the Hardigg<sup>r</sup> chest, has demonstrated that both are agent resistant; and, if the standard field medical chest is covered with CARC, both are decontaminable. Recommendations and findings will be provided to the Defense Medical Standardization Board and U.S. Army Medical Materiel Agency, first quarter FY88.

**In-House Work Unit:** Chemical Hardening of Medical Field Chests; DA0G1513; Reams, W.H.

## CHEMICAL WARFARE PROTECTIVE PATIENT WRAP

**Progress:** We have moved very rapidly toward fielding a chemical warfare agent protective patient wrap. Current doctrine states that during chemical warfare operations, all casualties will be stripped of the chemical protective over garments for decontamination; therefore, a need was recognized for protection of chemical casualties during evacuation. Available equipment was found to be operationally unacceptable. The USABRD L responded immediately to this deficiency with design and development of the Chemical Warfare Agent Protective Patient Wrap. Materials were narrowed from six to one candidate, and design options were tested for optimization. Chemical warfare agent tests of both the design and material indicate that all features of the wrap perform significantly better than the available equipment (the United Kingdom wrap). Physiologic studies of test subjects to environmental extremes are complete and will form the basis of doctrinal guidelines on employment of the wrap during training and combat. Technical and Operational Testing is complete, and The Milestone III production and deployment In-Process Review is scheduled for the first quarter FY88.

**Contracts and Intragovernmental Transfers:** Chemical Warfare Agent Protective Patient Wrap; DAOG7067; U.S. Army Natick Research, Development, and Engineering Center (Snow, P.R.); Reams, W.H.

Chemical Agent Testing of the Chemical Warfare Agent Protective Patient Wrap; DA304534; U.S. Army Dugway Proving Ground (Hanzelka, J.); Reams, W.H.

## RESUSCITATION DEVICE, INDIVIDUAL, CHEMICAL

**Progress:** We have the requirement to field an individual chemical resuscitation device. The primary life threatening reaction associated with nerve agent poisoning is respiratory arrest. Laboratory data indicate that ventilatory support and antidote administration enhance casualty survivability. Therefore, the need for a compact, manually operated resuscitation device was established by the Combat Developer. The USABRD L has designed, fabricated, and tested a device that is capable of maintaining normal blood gases in nerve agent poisoned laboratory animals when used in conjunction with available cricothyroid cannulas. A test bed for pathophysiologic experimentation and efficacy studies has been established at the Uniform Services University of the Health Sciences and was used to confirm the efficacy of this ventilatory device.

**In-House Work Unit:** Resuscitation Device, Individual, Chemical; DAOG1512; Reams, W.H.

**Contracts and Intragovernmental Transfers:** Evaluation of Gas Exchange Capability and Work Requirements of a Hand-Powered Resuscitator for Organophosphate Casualties; New Start; Uniformed Services University of the Health Sciences (Abbrecht, P.H.); George D.T.

## **EVALUATION OF GAS EXCHANGE CAPABILITY AND WORK REQUIREMENTS OF A HAND-POWERED RESUSCITATOR FOR ORGANOPHOSPHATE CASUALTIES**

**Progress:** Although the concept of supporting casualties with ventilatory devices was well established and proven in controlled laboratory studies, ventilation of nerve agent poisoned, atropine treated subjects had never been tested using a hand-powered ventilator connected to a small-bore cricothyroid cannula (3.6 mm ID). Laboratory studies were completed demonstrating the feasibility of ventilation of soman-poisoned, atropine treated subjects through a 3.6 mm cricothyroid cannula for a minimum of 60 minutes, twice the doctrinal requirement of 30 minutes. Test data established feasibility, optimal frequencies and volumes, and demonstrated that subjects in mission-oriented protective posture (MOPP) 4 could maintain adequate blood gases for at least 60 minutes without undue fatigue.

**Contracts and Intragovernmental Transfers:** (Same as Resuscitation Device, Individual, Chemical.)

### **RESUSCITATION/VENTILATOR, POWERED, INDIVIDUAL**

**Progress:** The requirement for ventilation of chemical warfare casualties includes powered ventilators intended for support of casualties during evacuation within the theater of operations. To fulfill this requirement USABRDL has initiated a project to identify and develop a portable powered device for ventilation of casualties in forward areas of the battlefield and during evacuation. Six commercial ventilators are being tested and evaluated by USABRDL. User and Technical Testing are scheduled for completion during FY88 and will identify options for modification or adoption as a powered ventilator.

**In-House Work Unit:** Resuscitation/Ventilator, Powered, Individual; DA303504; George D.T.

### **DEVELOPMENT OF A NONINVASIVE NBC WARFARE PATIENT VITAL SIGNS MONITOR**

**Progress:** Our work on the noninvasive NBC warfare patient vital signs monitor is urgent, as effective treatment and triage of battlefield casualties are dependent upon the medic being able to accurately measure vital signs. During chemical warfare operations, the protective ensemble effectively prevents determinations of heart rate, blood pressure, and respiratory rates. To address this deficiency the USABRDL has developed a Noninvasive NBC Warfare Patient Vital Signs Monitor. Because the technology did not exist to measure the vital signs in protective clothing, high noise and high vibration environments, new patented technologies have been developed. This new statometric technology is the only known method which is capable of determining heart rate and blood pressure through the protective ensemble in a high noise and vibration environment. Technical Testing of the vital signs monitor is complete and Concept Evaluation Program Testing is scheduled for the first quarter FY88.



**Contracts and Intragovernmental Transfers:** Development of a Noninvasive NBC Warfare Patient Vital Signs Monitor; DA308748; GMS Engineering Corporation (Samaras, G.M.); George, D.T.

#### **DEVELOPMENT OF A MULTI-FREQUENCY JET VENTILATOR FOR USE UNDER BATTLEFIELD CONDITIONS**

**Progress:** A requirement exists for the development and fielding of ventilators in forward areas of the battlefield. High frequency jet and ultra high frequency (greater than 300 cycles per minute) jet ventilators appear to have advantages over standard positive pressure ventilatory techniques. To determine the differences among the three modes of ventilation, a Phase I Small Business Innovative Research contract comparing standard positive pressure with high frequency jet and ultra high frequency jet ventilation has been completed. The final report and a Phase II proposal have been received. The data indicate that ultra high frequency ventilation (greater than 300 cycles per minute) is superior to both conventional positive pressure and high frequency ventilation in subjects with bronchopleural fistulas.

**Contracts and Intragovernmental Transfers:** Development of a Multi-Frequency Jet Ventilator for Use Under Battlefield Conditions; Number to be assigned; Scientific Research Associates, Inc. (Weinberg, B.C.); Solberg, V.B.

#### **TECHNICAL FEASIBILITY TESTING (TFT) OF DELIVERY SYSTEMS FOR CHEMICAL WARFARE MEDICAMENTS**

**Progress:** We continued to provide technical feasibility testing for delivery systems for chemical warfare medicaments. Effective self and buddy aid for the treatment of chemical warfare agent (CWA) poisoning is dependent upon the simple, rapid administration of CWA medicaments. To assure that the antidote delivery systems are safe, effective, and state-of-the-art, engineering evaluations of candidate and prototype delivery systems have been conducted to provide the Materiel Developer with objective data for selection of the most reliable, acceptable, and cost-effective alternative for administering CWA antidotes for self and buddy aid. The current data base includes a complete engineering evaluation of the Mark I and Mark II autoinjectors, three multi-chamber autoinjectors, one of U.S. manufacture and two of foreign manufacture. Future studies will include evaluation of alternative technologies and injectors for administration of nerve agent antidotes.

**In-House Work Unit:** Technical Feasibility Testing (TFT) of Delivery Systems for Chemical Warfare Medicaments; DAOG2702; Reams, W.H.

## **MEDICAL STAFF CHEMICAL WARFARE AGENT DOSIMETER**

**Progress:** The potential exists for the buildup of toxic chemical warfare agents in a forward medical facility receiving CWA casualties. To prevent the incapacitation of medical personnel by low level CW agents, the USABRDL has evaluated the technology data base for development of a medical staff CWA dosimeter. Analysis of the data base indicates that a "real time" individual dosimeter, sensitive to sublethal doses of CWA, is probably beyond the current state of the art. Alternative approaches are being pursued to develop a compact, timed-interval device which will provide total exposure and interval data to medical staff. A request for proposals was published, and responses are under evaluation with contract award expected during the first quarter FY88.

**In-House Work Unit:** Medical Staff Chemical Warfare Agent Dosimeter;  
Solberg, V.B.

## **MILITARY DISEASE HAZARDS BRANCH**

The Military Disease Hazards Branch supports The Surgeon General's responsibilities in disease vector control methods, materials, equipment and systems RTE. Through extramural and in-house research, the Branch develops vector control equipment and systems for military requirements. The Branch also maintains Laboratory colonies of arthropods for in-house research for use as biological indicators for chemical and biological control studies. Intensified efforts concern the widespread involvement of U.S. soldiers in operations in tropical, arid, and other extreme environments with diverse vector-borne hazards. The Branch works closely with Research Area I, USAMRDC, serving research and development needs for military disease hazards.

## **PESTICIDE DISPERSAL UNIT, MULTICAPABILITY, HELICOPTER SLUNG**

**Progress:** Medical personnel engaged in field operations need the capability for aerial dispersal of both liquid and solid pesticide formulations. The Pesticide Dispersal Unit, Multicapability Helicopter Slung, was type classified on 21 July 1987 with a First Unit Equipped date of first quarter FY89. The technological advancements achieved during the Research, Test, Development and Evaluation phases of this unit were transferred to the civilian sector via military specification (MIL-P-49500), drawing package (1134FD), five scientific publications, six formal presentations, and direct communications with potential users and manufacturers. Currently this Laboratory is developing new and innovative vector control methodologies made possible by the addition of this highly versatile dispersal unit to the Army inventory. The fielding of this unit will significantly improve Army readiness by helping the Army Medical Department conserve the fighting strength.

**In-House Work Unit:** Pesticide Dispersal Unit, Multicapability, Helicopter Slung; DA305615; Anderson, L.M.

#### **TRAP, MOSQUITO, LIGHT, COLLAPSIBLE**

**Progress:** The Army Collapsible Insect Surveillance (ACIS) Trap was developed to reduce the weight and cube of insect traps carried by Preventive Medicine Units. Advanced technology and innovative design produced a trap 62 percent smaller and 33 percent lighter than the current trap in the Army Inventory. The reduction of weight and cube was made without degrading trap efficiency. Durability was enhanced by using polyvinyl chloride body and state-of-the-art electronics. The ACIS Trap, a lighter, more compact mosquito light trap will ensure the maintenance of disease vector surveillance capability in preventive medicine teams and will be utilized to identify vectors of malaria and dengue fever to troops in areas of known occurrence. This Laboratory reduced normal acquisition process by years by reengineering the 1932 model of the light trap and revising its military specification. The first procurement will occur in 1988.

**In-House Work Unit:** Trap, Mosquito, Light, Collapsible; DAOG0701; Sardelis, M.R.

#### **TECHNICAL FEASIBILITY TESTING (TFT) OF VECTOR CONTROL EQUIPMENT**

**Progress:** Technical feasibility testing of commercial pesticide equipment is performed continuously by personnel at USABRDL. This program is designed to provide user agencies with comparative information on the durability, reliability, and suitability of equipment tested. Measurable quantitative parameters include particle size determinations, maintenance of desired flow rate, and ability to kill the target pest. Qualitative investigations include general engineering design for reliability, durability, maintainability, and safety. Definition of high mortality repair parts, gas and oil consumption, and verification of manufacturer's performance specifications are also investigated. First Article Tests for the Curtis Dyna-Products one- and two-gallon compression sprayers have been completed, and results have been provided to the Defense Logistics Agency. A Curtis Dyna-Products aerosol generator Symplex Model 2952 will be provided to this Laboratory for First Article Testing. A Whispermist-10 with a modified rotary nozzle will be provided to this Laboratory for technical testing.

**In-House Work Unit:** Technical Feasibility Testing (TFT) of Vector Control Equipment; DAOA6296; Sardelis, M.R.

## VECTOR CONTROL METHODS, MATERIALS, EQUIPMENT

**Progress:** This task is aimed at providing the knowledge base for future investigations, formulating control concepts in early-on studies of systems, and evaluating experimental and commercial hardware. A prototype kit capable of converting a backpack sprayer to a delouser has been fabricated. Tests of its operational capabilities will be conducted. Aerial application of granular pesticide was done to control ticks at Fort A.P. Hill, Virginia. Preliminary results from tick surveys indicated that this method was capable of reducing nymph and adult tick populations in highly infested areas. Literature review for information concerning mathematical models for vector control and evaluation of U.S. Department of Agriculture computer models for vector control have been completed.

**In-House Work Unit:** Vector Control Methods, Material, Equipment;  
DAOG8679; Darby, W.M.

## VECTOR CONTROL SCIENCE BASE

**Progress:** This research area ensures a steady stream of new, innovative, and often novel approaches to effective vector control. In FY87 a systematic study to determine the reliability and validity of tests using caged sentinel mosquitoes as a bioassay tool was initiated. Results obtained when using a conventional wind tunnel and the Army Insecticide Measuring System (AIMS) had high variations. A manuscript describing electrical charge and screen filtration effects on aerosol penetration of sentinel mosquito cages has been submitted for publication. Experiments comparing the aerosol mechanics of water, mineral oil, and chlorpyrifos in four sentinel cage shapes are near completion. Additionally, studies analyzing the impact of the sublethal leading edge of aerosol clouds on target population behavior are in progress. A cooperative effort with the Pan American Health Organization has been initiated to analyze physical and chemical parameters of Anopheles larvae habitat. Protozoan composition of Anopheles larval habitat in Central America is being compared to compositions of similar habitats without larvae to identify natural control mechanisms.

**In-House Work Unit:** Vector Control Science Base; DAOG5997; Perich, M.J.

## INTEGRATED PEST MANAGEMENT - MOSQUITOES

**Progress:** During FY87, this Laboratory continued the program in integrated pest management for mosquitoes by a systematic study to develop methods for mosquito control that integrate physical, chemical, and biological control methods so as to maintain effective control economically without undue damage to the environment. In addition, efforts were initiated to provide baseline laboratory and field data on the efficacy of various insecticides for control of mosquito larvae from which field application rates and methods will be developed for use by Army Preventive Medicine Units. Further, means are being developed to improve adulticide application techniques specifically designed to optimize control in field situations typically encountered in a Combat Zone. Significant accomplishments during FY87 included collaborative projects between the USABRDL, Honduran Division of Vector Control, and the U.S. Agency for International Development. Specific research focused on the evaluation of barrier spraying FICAM W against adult Anopheles albimanus, the evaluation of four biorational larvicide formulations (Duplex, Arosurf<sup>®</sup>, Teknar<sup>®</sup>, and Arosurf<sup>®</sup> plus Teknar<sup>®</sup>), and the comparison of ground versus aerial ultra low volume insecticide application. Data for these projects will be compiled and analyzed, and manuscripts on the results prepared. The effects of planaria on aquatic nontarget organisms in the Laboratory were completed and a manuscript on the results is being prepared. Bioassays to determine efficacy of slow-release formulations of Bacillus thuringiensis israelensis (B.t.i.) and methoprene against Aedes aegypti and Culex quinquefasciatus are in progress.

**In-House Work Unit:** Integrated Pest Management - Mosquitoes; DA0G0649; Perich, M.J.

## HEALTH EFFECTS RESEARCH DIVISION

The Health Effects Research Division (HERD) conducts The Surgeon General's environmental research mission and a major part of his occupational health research mission. Research is conducted to assess environmental impact of military training and industrial activities and to assess risk to military and civilian populations resulting from exposure to contaminated soil and water. The Division also conducts research to assess the risk to military personnel and civilian employees from military equipment, materiel, and industrial activities. Information from research findings is combined with that from other sources, when available, to form data bases which permit the establishment of rational exposure limits and industrial effluent concentration levels safe to man and the environment. The USABRD supports the Army's Installation Restoration program by developing technology to measure military-unique contaminants and data to support program decisions. The Division also has a major effort in the development of technology to assure an adequate, safe supply of drinking water in combat environments potentially contaminated with biological or chemical warfare agents or effluents from disrupted industrial operations. The Division is composed of one basic research branch, Research Methods Branch, and two applied research branches, one addressing primarily environmental issues and the other primarily occupational health issues.

### RESEARCH METHODS BRANCH

The Research Methods Branch conducts in-house and extramural basic research programs in support of the Division applied programs in occupational health and environmental protection. This includes methods development in aquatic toxicology, requiring the maintenance and testing of a variety of aquatic organisms; in-vivo and in-vitro research on alternative animal models for determining long-term effects on mammalian and non-mammalian systems; and development of analytical chemistry methods and the performance of organic synthesis in support of the basic and applied programs. Efforts are divided into two distinct areas: Aquatic Toxicology Research and Toxicity Test Model Research.

### AQUATIC TOXICOLOGY RESEARCH

#### Effects of Water Quality on Acute Toxicity

**Progress:** Standard aquatic toxicity tests conducted under laboratory conditions with controlled water quality may fail to predict actual toxicity under varied water quality conditions found in nature. The purpose of this research is to improve interpretation of aquatic toxicity data of military relevant chemical compounds for varied water quality conditions such as pH, dissolved oxygen levels, and temperature. Research efforts have improved test methods used in establishing water quality criteria and discharge standards.

**In-House Work Unit:** Basic Research in Aquatic Toxicology; DA309062; Miller, T.A.

## **Effects of Fluctuating Toxicants on Aquatic Organisms**

**Progress:** Discharge standards for Army Ammunition Plants and other Army activities are frequently based on water quality criteria derived from toxicity studies conducted at constant toxicant concentrations. A pharmacokinetic model for predicting the effects of fluctuating toxicant concentrations on aquatic organisms was evaluated and will be used to improve the application of laboratory data to field situations.

**In-House Work Unit:** (Same as Effects of Water Quality on Acute Toxicity.)

## **Field Test of a Biological Toxicity Early Warning System**

**Progress:** An experimental fish ventilatory monitoring system for early detection of toxicity problems was field tested at the Fort Detrick wastewater treatment plant. Advanced computer monitoring of fish ventilatory rate and depth, gill purge rates, and body movement can provide operators with early warning of toxicity problems. In addition field testing of the unit included other biomonitoring systems for acute and chronic toxicity that will have wide application not only at wastewater treatment facilities but also at contaminated waste sites and groundwater contamination sites.

**In-House Work Unit:** (Same as Effects of Water Quality on Acute Toxicity.)

## **Development of a Microcosm Test**

**Progress:** Currently there is no standardized test to evaluate toxic effects at the ecosystem level. Single species toxicity tests are now used to predict ecosystem effects. Research involving the ability of protozoans to colonize an artificial substrate has been conducted for evaluating ecosystem level toxicity effects. The application of a microcosm test for on-site assessment in a mobile biomonitoring facility is being investigated.

**In-House Work Unit:** (Same as Effects of Water Quality on Acute Toxicity.)

## **Analytical Chemistry**

**Progress:** In-house analytical chemistry capability was developed and maintained for the analysis of diethylnitrosamine (DEN), methylazoxymethanol acetate (MAM), 2,4-dinitrotoluene (2,4-DNT), and 2,6-dinitrotoluene (2,6-DNT). Relocation of Laboratory facilities was required during asbestos abatement work. A program for routine monitoring of well water for trichloroethylene (TCE) was established during September.

**In-House Work Unit:** (Same as Effects of Water Quality on Acute Toxicity.)

## TOXICITY TEST MODEL RESEARCH

### Developmental Toxicity Models

**Progress:** New in-house research was planned and initiated to develop improved methods for conducting teratogenic testing of Army unique compounds and waste effluents from hazardous waste sites and contaminated groundwaters. A non-mammalian model was selected and preliminary testing conducted. The Xenopus frog was selected due to its current use in the Frog Embryo Teratogenesis Assay (FETAX) and its potential use in an on-site biomonitoring system.

**In-House Work Unit:** Basic Research in Experimental Toxicology; DA309065; Miller, T.A.

**Contracts and Intragovernmental Transfers:** Extrapolation of Inhaled Particle Cytotoxicity Data From Experimental Animals to Humans; EPA, Research Triangle Park, (Hatch, G.); Reddy G.

### In-vitro Test Models

**Progress:** In-house research facilities were designed for conducting in-vitro cell culture research for improving hepatotoxicity testing of military unique compounds. Development of a simple in-vitro test method for predicting toxicity to the liver, as a major xenobiotic target organ, will improve current methods for evaluating a wide range of military relevant compounds. Renovation of in-house Laboratory facilities will begin in the first quarter of FY88. Studies were conducted on the extrapolation of cytotoxicity data from animals to man involving the comparison of energy charges of nasal turbinate epithelial cells exposed to cadmium.

**In-House Work Unit:** (Same as Developmental Toxicity Models.)

**Contracts and Intragovernmental Transfers:** (Same as Developmental Toxicity Models.)

### Carcinogenicity Test Model

**Progress:** Current methods to evaluate the potential carcinogenicity of contaminated wastewaters, contaminated groundwaters, and contaminated runoff from hazardous waste disposal sites or new military chemical compounds involve the use of large numbers of mammals and require from 2 to 3 years to complete. The use of techniques for short term, economical, assessment of potential carcinogenicity will improve clean-up activities at waste sites and the screening of new chemical compounds. Preliminary assessment and comparison of the expression of oncogenes in fish was accomplished. Further work defining the effects of temperature on the development of cancer in new in-vivo models was conducted. Collaboration and review with EPA and NCI were accomplished.



**In-House Work Unit:** (Same as Developmental Toxicity Models.)

**Contracts and Intragovernmental Transfers:** (Same as Developmental Toxicity Models.)

### **Analytical Chemistry**

**Progress:** Direct support for toxicity test model research will be initiated when the construction and renovation of Laboratory facilities are completed. In-house analytical chemistry capability for the analysis of weapon system combustion products was established. Support was provided to other investigators including the analysis of air lead samples, analysis of insecticide samples, and the purification of hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX).

**In-House Work Unit:** (Same as Developmental Toxicity Models.)

**Contracts and Intragovernmental Transfers:** (Same as Developmental Toxicity Models.)

## **ENVIRONMENTAL QUALITY RESEARCH BRANCH**

The Environmental Quality Research Branch plans and conducts in-house and extramural applied research in environmental protection. This program includes: data base assessment, physical and chemical characterization, and environmental fate studies for Army-unique chemicals in the environment. The Branch also conducts environmental effects studies and aquatic and mammalian bioassays of chemicals of environmental concern to the Army. Findings are documented through the preparation of health advisories and discharge criteria documents. Branch efforts are divided into three distinct areas: environmental assessment, characterization, and fate research; environmental hazard assessment; and environmental criteria documentation.

### **ENVIRONMENTAL ASSESSMENT, CHARACTERIZATION AND FATE RESEARCH**

#### **Assessment**

**Progress:** Under this area critical literature based data assessment (DBA) was performed utilizing available Army and civilian scientific literature to establish the current level of knowledge concerning the fate, effects, and the aquatic and mammalian toxicological hazards associated with environmental exposure to military relevant materials. A new in-house study to develop the environmental hazard data base for depleted uranium containing weapons was initiated. Extramural DBA studies for conventional munitions demilitarization and inventory and developmental smokes neared completion.

**In-House Work Unit:** Identification and Health Effects of Military Pollutants; DA309063; Miller, T.A.

**Contracts and Intragovernmental Transfers:** Conventional Weapons Demilitarization: A Health and Environmental Effects Data Base Assessment; DOE/Lawrence Livermore National Laboratory (Layton, D.); Small, M.J.

**Smokes and Obscurants:** A Health and Environmental Effects Data Base Assessment; DOE/Lawrence Livermore National Laboratory (Shinn, J.); Small, M.J.

**Methods for Estimation Physicochemical Properties of Inorganic Chemicals of Environmental Concern;** Arthur D. Little, Inc., (Lyman, W.); Rosenblatt, D.H.

**Environmental Fate of Nitroguanidine, Diethyleneglycol Dinitrate, and Hexachloroethane Smoke;** SRI, International (Spangord, R.); Small, M.J.

### **Characterization**

**Progress:** Development of the logic and algorithms was initiated for a user friendly computer system combining hazardous materials data bases, physical and chemical property estimation methods, and approaches to predicting adverse effects or environmental damage caused by improper use or disposal practices of military relevant materials. A new in-house effort was begun to computerize the Preliminary Pollutant Limit Value (PPLV) methodology for estimating clean-up requirements at installation restoration sites. Methods for estimating physical and chemical properties of inorganics were developed.

**In-House Work Unit:** (Same as Assessment.)

**Contracts and Intragovernmental Transfers:** (Same as Assessment.)

### **Fate**

**Progress:** This study evaluates the mechanisms, routes, and rates of physical, chemical and biologically mediated degradation, transformation, and transport of military relevant chemicals in water and soil systems. In-house efforts concentrated on the development of a program to define the microbiological fate mechanisms and process important for the transformation of military relevant chemicals. Fate studies on hexachloroethane (HC), nitroguanidine, and diethylene glycol dinitrate (DEGDN) continued.

**In-House Work Unit:** (Same as Assessment.)

**Contracts and Intragovernmental Transfers:** (Same as Assessment.)

## **ENVIRONMENTAL HAZARD ASSESSMENT**

### **Ecological Effects**

**Progress:** The potential effects on plants, soil biota, and feral animals and birds resulting from exposure to military wastes and materials are determined using, where possible, standardized, EPA approved methodologies. Effects studies on hydrogen chloride (HCl), red phosphorus, fog oil, and multispectral screening smokes continued. Effects of the disposal of nitroguanidine (NQ) waste waters on terrestrial plants have been initiated. A study to determine the effects of phosphorus smokes on plants has been completed.

**In-House Work Unit:** Identification and Health Effects of Military Pollutants; DA309063, Miller, T.A.

**Contracts and Intragovernmental Transfers:** Evaluate and Characterize Mechanisms Controlling the Transport, Fate and Effects of Army Smokes in the Aerosol Wind Tunnel; DOE/Pacific Northwest National Laboratory (Van Voris, P.); Mitchell, W.R.

Effects of Nitroguanidine-Contaminated Wastewater on the Physiology of Plants; USDA/Agricultural Research Service (Hodgson, R.); Burrows, E.P.

Environmental Fate and Effects Studies on Multispectral Smoke; USACRDEC (Wentzel, R.); Mitchell, W.R.

Behavioral-Physiological Effects of Phosphorus Smoke Inhalation on Two Wildlife Species; USDA/Fish and Wildlife Service (Thompson, R.); Gardner, H.S.

Toxicity of DEGDN, Synthetic-HC Smoke Combustion Products, Solvent Yellow 33 and Solvent Green 3 to Freshwater Aquatic Organisms; DN/Applied Physics Laboratory (Burton, D.); Kelly, J.A.

Nitrocellulose/Nitroguanidine (NC/NQ) Mammalian Toxicity Testing; X09201; Letterman Army Institute of Research (Korte, D.); Reddy, G.

### **Aquatic Bioassays**

**Progress:** The toxicity of military relevant materials and wastes for aquatic animals and plants is determined using protocols dictated by the EPA and under Good Laboratory Practices (GLP)/Quality Assurance (QA) protocols. Aquatic bioassays of DEGDN, HC smoke combustion products, and colored signaling smoke dyes were completed. The objective of one of these studies is to develop, in-house, an understanding of the uptake, metabolism, and elimination of radiolabeled materials that have been demonstrated to be mammalian carcinogens through toxicokinetic studies, using the Japanese Medaka as an alternative to mammalian test species.

**In-House Work Unit:** (Same as Ecological Effects.)

**Contracts and Intragovernmental Transfers:** (Same as Ecological Effects.)

### **Mammalian Bioassays**

**Progress:** Determination of the mammalian toxicity and toxicokinetics of selected military relevant materials using protocols dictated by the EPA and under FDA or EPA GLP/QA protocols is the objective of this research area. In-house effort to determine the metabolism of RDX by rats was initiated. Sub-chronic mammalian toxicity studies on ball powder (BP), NQ and its by-products, DEGDN and other glycol nitrates, and the Installation Restoration compound, dithiane, are in progress.

**In-House Work Unit:** (Same as Ecological Effects.)

**Contracts and Intragovernmental Transfers:** (Same as Ecological Effects.)

## **ENVIRONMENTAL CRITERIA DOCUMENTATION**

### **Health Advisories**

**Progress:** Army sponsored background data for Health Advisory preparation for nitrocellulose (NC), trinitroglycerine (TNG), RDX and TNT have been delivered to the EPA, Office of Drinking Water. Draft Health Advisories have been prepared and delivered to USABRDL for review for nitrocellulose (NC) and trinitroglycerine (TNG).

**In-House Work Unit:** Identification and Health Effects of Military Pollutants; DA309063, Miller, T.A.

**Contracts and Intragovernmental Transfers:** Water Quality Criteria for Six Munition Chemicals; DOE/Oak Ridge National Laboratory (Ross, R.); Parmer, D.L.

**Water Quality Criteria for Colored Smokes;** DOE/Oak Ridge National Laboratory (Ross, R.); Rosencrance, A.B.

**Health Advisories on Munition Chemicals;** EPA/Office of Drinking Water (Khanna, K.); Bausum, H.T.

### **Environmental Criteria Documents**

**Progress:** Documents have been prepared for NC, TNG, and RDX; final draft documents for TNT and DNT white phosphorus (WP) are under review. A new in-house effort has been initiated to develop interim criteria for octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX). Development of interim criteria for inventory colored signaling smokes, hexachloroethane and zinc chloride continues.

**In-House Work Unit:** (Same as Health Advisories.)

**Contracts and Intragovernmental Transfers:** (Same as Health Advisories.)

### **Installation Restoration Assessment**

**Progress:** In support of the Army's Installation Restoration effort we perform risk/endangerment assessment studies and other activities required under either the base A835 Project or under the Memorandum of Understanding with USATHAMA. We reviewed endangerment assessment for the Property Disposal Office Area at Letterkenny Army Depot and the Rocky Mountain Arsenal Hydrazine Blending and Storage Facility Wastewater Treatment and Decommissioning Assessment.

**In-House Work Unit:** (Same as Health Advisories.)

**Contracts and Intragovernmental Transfers:** (Same as Health Advisories.)

### **OCCUPATIONAL HEALTH RESEARCH BRANCH**

The Occupational Health Research Branch plans and conducts in-house and extramural applied research in occupational health and health hazard assessment. This includes: data base assessment, physical and chemical characterization, and work place fate studies for Army-unique chemicals and exposure scenarios. The Branch also conducts mammalian bioassays of chemicals of occupational health concern to the Army and performs risk assessment and develops military-unique health criteria. Branch efforts are divided into four distinct areas: occupational exposure assessment research, military health effects research, field water supply and sanitation, and biomedical assessment of toxic effects of chemical agents.

## OCCUPATIONAL EXPOSURE ASSESSMENT RESEARCH

### Weapons Combustion Products

**Progress:** Extramural research efforts to characterize soldiers' exposure to weapons combustion products in selected armored vehicles at both TRADOC and FORSCOM installations were successfully completed. Developmental testing of the advanced antitank weapon system-medium (AAWS-M) was initiated in August 1987 by the U.S. Army Missile Command (MICOM). This Laboratory has supported testing by specifying the air sampling criteria for quantifying major airborne contaminants from the prototypes. A related but separate research program is in progress to thoroughly characterize the combustion products from the M36 propellant, a formulation used in the AAWS-M. The attachment of sampling devices on soldiers has always presented certain inconvenience and interference to their training activities. To minimize these problems, this Laboratory has modified the standard aviation survival vests and the load-carrying equipment to hold sampling devices, keeping all loose assemblies tugged tightly to the body of the test subject. Both items were used in recent field studies and found wide acceptance by the wearers. The USABRDL HCl Monitor has demonstrated an analytically acceptable response to HCl gas and HCl aerosols. A portable prototype HCl Monitor has been completed and will be tested in FY88. A literature study has been completed on the various methods and instrumentation available for measuring NO<sub>x</sub>. A technical report containing the findings of this study will be available in early FY88. A computer program to perform thermodynamic modeling of weapons combustion products has been modified so that data can be entered and results obtained to support USABRDL studies. Studies on lead emissions from artillery propellants have identified extremely high atmospheric levels under some meteorological conditions. These levels of lead exposure violate federal standards for protection of workers in industry, but the pattern of exposure is radically different for field Army situations (long-term, low level exposure versus short-term, high-level). Argonne National Laboratory is studying the biological significance of Army-unique exposure to weapons-derived lead.

**In-house Work Unit:** Occupational Exposure Criteria Development; DA309066; Miller, T.A.

**Contracts and Intragovernmental Transfers:** Lead Exposures and Biological Responses in Military Weapons Systems; DA310641; DOE Argonne National Laboratory (Bhattacharyya, M.H.); Parmer, D.L.

**Problem Definition Study for Evaluating the Chemical and Toxicological Properties of the Combustion Products of Rifle and Gun Systems;** DA307122; DOE Oak Ridge National Laboratory (Ross, R.H.); Parmer, D.L.

**Combustion Product Evaluation of Various Charge Sizes and Propellant Formulations;** Illinois Institute of Technology Research Institute (Snelson, A.); Hoke, S.H.

**Evaluation of Weapons Combustion Products in Armored Vehicles,** Arthur D. Little, Inc. (Menziez, K.T.); Young, J.Y.

Characterization of Rocket Propellant Combustion Products; DOE Oak Ridge National Laboratory (Jenkins, R.); Young, J.Y.

Field Sampling and Analysis of Shale Oil Derived Airborne Diesel Exhausts; DA306952; DOE Oak Ridge National Laboratory (Guerin, M.R.); Eaton, J.C.

Chemical Characterization and Toxicological Evaluation of Airborne Mixtures; DA0G5136; DOE Oak Ridge National Laboratory (Guerin, M.R.); Eaton, J.C.

### **Smokes and Obscurants**

**Progress:** A research effort on the health risks encountered by soldiers operating in or creating chemical smoke has been undertaken in response to tasking from the Office of The Surgeon General. A Smoke Exposure Master Plan, which will characterize and prioritize anticipated smoke exposures, is being developed. Sampling to measure exposures actually experienced in the field will be based on the plan. Such sampling has been initiated at the Chemical School and will be continued in FORSCOM units for combat scenarios. A prototype generator for use in toxicologic evaluation of the XM55 smoke generator has been built and is being tested. The M18 smoke grenades containing the new yellow and green and the developmental red and violet smoke dye mixes have been exploded, and the aerosol produced is being characterized and compared with the starting materials. A review is underway of the existing information on the effectiveness of current protective equipment and doctrine to provide respiratory protection against potential adverse health effects of smokes to troops, and to identify relevant medical research needs. The National Institute of Occupational Safety and Health (NIOSH) tests for respiratory protective devices and the U.S. Army Chemical Research, Development, and Engineering Center (USACRDEC) tests of the performance of masks and mask filter elements in smokes were reviewed. The USACRDEC tests were conducted using methodology analogous to and as stringent as the the NIOSH methods, and the results showed that the current M17 mask and the new M40 mask should provide adequate protection in most smoke exposure scenarios. Work still to be done includes the evaluation of the mask test conditions in light of the field concentrations measured by USABRDL contractors, during field studies that are currently underway, and consideration of less cumbersome protective devices that may provide protection from smokes in training activities.

**In-house Work Unit:** (Same as Occupational Exposure Assessment Research, Weapons Combustion Products.)

**Contracts and Intragovernmental Transfers:** (Same as Occupational Exposure Assessment Research, Weapons Combustion Products.)

## Alternate Fuels and Engine Exhausts

**Progress:** Samples of the workplace atmosphere were taken in three different motor pools where different levels of maintenance are performed on military diesel-powered armored and engineer vehicles at Fort Carson, Colorado. Samples were taken for 1-hour and 8-hour periods during the work day and also overnight. Solid and liquid particulate matter was trapped on filters, and vapor components were adsorbed on resin traps. The filters and traps are now undergoing analysis at Oak Ridge National Laboratory to identify and quantify potentially hazardous components. Preliminary analysis of the samples shows that the major organic compounds found in the particulate samples are different for the three motor pools, that the differences at a single location are mainly quantitative, and that there were high levels of polynuclear aromatic hydrocarbons produced by activities at the Division Support Command motor pool. Analysis of the final vapor phase samples and preparation of the final report are underway. Physical, chemical, and biological testing was conducted on samples of several diesel fuels from shale oil, tar sands, and petroleum. The Sensitive Carcinogen (SENCAR) mouse tumor promotion assay of five diesel fuels has been completed, and preliminary evaluation of the data from histopathologic examination indicates that the level of refining of the fuel had a greater effect upon its tumorigenicity than did the source. A final report with complete pathologic evaluation is in preparation.

**In-house Work Unit:** (Same as Occupational Exposure Assessment Research, Weapons Combustion Products.)

**Contracts and Intragovernmental Transfers:** (Same as Occupational Exposure Assessment Research, Weapons Combustion Products.)

## MILITARY HEALTH EFFECTS RESEARCH

### Smokes and Obscurants

**Progress:** Short term in-vitro screening studies have been performed on graphite and brass powders in the respirable size range under Army Project Order (APO) 84PP4850. Brass powder produced significant effects in the rabbit alveolar macrophage test at a dose of 50  $\mu\text{g}/\text{ml}$  and in the hamster tracheal ring organ culture assay at 250  $\mu\text{g}/\text{ml}$ , but no effects in the pulmonary bactericidal activity (PBA) test at doses to 100  $\mu\text{g}/\text{mouse}$ . Two samples of graphite produced significantly decreased bactericidal activities in the PBA test at doses of 250  $\mu\text{g}/\text{mouse}$ . Genotoxicity of Solvent Red 24, Solvent Red 1, terephthalic acid, Disperse Red 11, and Disperse Red 15 (and mixtures thereof) were examined under APO 85PP5801. None showed mutagenic activity in the Ames test without liver microsomal activation; with activation, the last two dyes showed low but significant activity. Solvent Red 1 and Disperse Red 11 induced significant increases in sister chromatid exchange frequency. Only Solvent Red 1 was cytotoxic in mammalian cells. The toxicity of fog oil smoke was studied under APO 81PP1810. Four-week subacute and 13-week subchronic (0.2, 0.5 and 1.5 mg/L, 3.5 hours/day, 4 days/week) inhalation exposures appeared to cause an inflammatory response in the lungs of adult male and female rats; however, pulmonary function and gas exchange were not compromised.



Effects at the lowest dose were minor and reversible. The LC<sub>50</sub> for a 3.5-hour exposure was 5.2 mg/L. The inhalation toxicology of red phosphorus/butyl rubber (RP/BR) combustion products has been evaluated under contract DAMD17-82-C-2121. Male rats were exposed for 2.25 hours/day, 4 days/week for 13 weeks at aerosol concentrations of 1.20, 0.75 and 0.30 mg/L in one study, and 0.30, 0.18 and 0.05 mg/L in another. The primary treatment related change in the lung was terminal bronchiolar fibrosis; there were no treatment-related changes in tissues outside the respiratory tract. The no-measurable effect level was 0.05 mg/L. Work is proceeding to construct a suite for the inhalation exposures of rats to the dye materials scheduled to replace the current red and violet dyes in the product-improved M18 smoke grenade. Preliminary work has been performed on chemical analysis of the dyes, and preliminary genetic toxicology is underway.

**In-house Work Unit:** (Same as Occupational Exposure Assessment Research, Weapons Combustion Products.)

**Contracts and Intragovernmental Transfers:** Toxicity Study of Liquid Gun Propellant; Letterman Army Institute of Research (Korte, D.); Finch, R.A.

Evaluation of the Dermal Toxicity of LP 1846; DOE Battelle Pacific Northwest Laboratories (Weller, R.); Finch, R.A.

Human Health Studies of Carbon Monoxide (CO) Under Conditions of Military Weapons System Crewman Exposures; DAOG7486; EPA Health Effects Research Laboratory (Benignus, V.); Parmer, D.L.

Neurobehavioral Effects of Carbon Monoxide (CO) Exposure in Humans; DAOG7494; EPA Health Effects Research Laboratory (Benignus, V.); Kelly, J.A.

Evaluation of DEGDN (Diethyleneglycol dinitrate) and Two DEGDN Containing Compounds; DA305429; DOE Laboratory for Energy-Related Health Research (Goldman, M.); Parmer, D.L.

Health Effects Research on Dimethylsulfoxide (DMSO) Munition Recrystallization Process Solvent. Phase II; DOE Laboratory for Energy-Related Health Research (Goldman, M.); Dacre, J.C.

Comparative Inhalation Toxicology of Selected Materials; DOE Lovelace Inhalation Toxicology Research Institute (Snipes, B.); Finch, R.A.

Toxicity of Red and Violet Dyes in M18 Grenade; EPA Health Effects Research Laboratory (Costa, D.); Eaton, J.C.

Inhalation Toxicity of Single Materials and Mixtures; Request for Proposals; Smart, D.A.

Comparative Acute Inhalation Screen of Iron Oxide and Graphite Dusts; U.S. Army Chemical Research, Development and Engineering Center (Thomson, S.); Burrows, W.D.

## **Ammunition and Explosives**

**Progress:** The USABRDL is examining the health effects of candidate liquid mono-propellants. One study will determine the relative sensitivity and reversibility of methemoglobinemia, hypotension, and Heinz body formation in rats. Another is to determine whether the ocular irritation produced by the propellant can be reversed. A separate, three-part contract is determining both the dermal and systemic toxicity, dermal sensitization, and genotoxic potential of the material. Data from all of these contract efforts will serve as input to a risk assessment model being developed in-house. Research is essentially complete on a preliminary study of DEGDN-based propellants. Most of the routine screening tests (e.g., LD<sub>50</sub>, ocular irritation) showed that existing procedures for protecting personnel from the effects of nitroglycerin would protect against harmful effects of DEGDN-based propellants. Mutagenicity/carcinogenicity assays for two propellants were, however, strongly positive, even though the parent DEGDN was not. The mutagenic/carcinogenic active component appears to be an ingredient used for ballistic stability. Further research is recommended. Efforts continue to identify the mutagenic active ingredient in munitions contaminated process solvent (Dimethylsulfoxide). Samples are being collected from a new pilot plant production run.

**In-house Work Unit:** (Same as Occupational Exposure Assessment Research, Weapons Combustion Products.)

**Contracts and Intragovernmental Transfers:** (Same as Military Health Effects Research, Smokes and Obscurants.)

## **Weapons Combustion Products**

**Progress:** The principal health effects research on weapon combustion products continues to focus on carbon monoxide. Neurobehavioral studies have demonstrated that response decrements at low carboxyhemoglobin levels occur when the task is complex (i.e., divided attention), but not when the task is simplistic. Completed experiments utilizing short-term, high-level carbon monoxide were unable to show a performance decrement at levels up to 20 percent carboxyhemoglobin, under simple task conditions. A new experiment to determine physiological responses to short-term, high-level exposures to carbon monoxide has been initiated.

**In-house Work Unit:** (Same as Occupational Exposure Assessment Research, Weapons Combustion Products.)

**Contracts and Intragovernmental Transfers:** (Same as Military Health Effects Research, Smokes and Obscurants.)

## FIELD WATER SUPPLY AND SANITATION

### Disinfection Studies

**Progress:** Research to assess the disinfection kinetics of hepatitis A virus (HAV) using calcium hypochlorite and iodine tablets revealed that the virus inactivation essentially paralleled polio and ECHO viruses for both disinfectants. While both disinfectants at normal field use concentrations were able to inactivate all three viruses, the results suggested that the removals were only marginally safe at high and low pH extremes in laboratory grade test water. No significant HAV strain differences were noted using either type disinfectant. Another contract research project revealed that virus disinfection kinetics using calcium hypochlorite were significantly influenced by the presence of chloride ion. The presence of chloride at 600 mg/L increased the kinetics of inactivation at least three-fold over that where no chloride was present. In the absence of chloride at high pH, disinfection at 5 mg/L free chlorine took almost 30 minutes to achieve a 99.9 percent removal. Efforts have been initiated to formally establish the deficiencies of current disinfectants in the field, and to define the characteristics needed to fully satisfy military requirements. These requirements will in turn be used to initiate experimental comparisons and to make recommendations on current developmental and commercially available disinfectants which can enhance field water disinfection capabilities. A project to evaluate the feasibility of using specific N-halamine compounds as disinfection agents for military field water supplies is essentially completed. All investigative work was complete in December 1986; the draft final report has been received and reviewed within USABRDL and by the U.S. Air Force co-sponsor; and samples of two compounds which were requested as deliverable items under the contract have been received. The current chemical disinfectant for field water supplies, calcium hypochlorite, has some disadvantages related to its reactivity and instability. Many of the compounds investigated under this contract overcame those disadvantages, but not without introducing other disadvantages of their own. These will be weighed along with other results in an evaluation of field water supply disinfection options currently underway at USABRDL.

**In-house Work Unit:** Biomedical Assessment of the Toxic Effects of Chemical Agents; DA30906; Miller, T.A.

**Contracts and Intragovernmental Transfers:** New Disinfection Agents for Water; DA300021; Auburn University (Worley, S.D.); Eaton, J.C.

Evaluation of Field Water Data Base Assessment Study Deliverables; DA304816; DOE Oak Ridge National Laboratory (Ross, R.H.); Schaub, S.A.

Effect of Chloride on the Virucidal Effectiveness of Chlorine Disinfectants for Military Needs; University of Cincinnati (Berg, G.); Schaub, S.A.

Data Base Assessment of Environmental and Toxicological Factors in Water to Upgrade and Modernize Content of TB MED 577; DA300881; DOE Lawrence Livermore National Laboratory (Anspaugh, L.R.); Schaub, S.A.

Rapid Bioassay Monitoring System for Water Quality - Phase 2, Tasks 2-12; DA303278; Wyatt Technology Corporation (Wyatt, P.J.); Schaub, S.A.

Inactivation of Hepatitis A Virus (HAV) by Chlorine and Iodine in Water; DA308753; University of North Carolina (Sobsey, M.D.); Schaub, S.A.

#### **Water Quality Standards and Risk Assessment**

**Progress:** Efforts to develop field water quality standards have continued with the establishment of recommended standards for the following: lindane, algal metabolites (taste and odor only), organophosphate nerve agents, T-2 mycotoxin, lewisite, and sulfur mustard. Also, a report was prepared on risk assessment for consumption of contaminants not meeting water quality standards and for theater specific risks relative to water supplies. These have been reviewed by the Oak Ridge National Laboratory review team, the Contract multi-service steering committee, and the USABRD health criteria review team. A number of technical considerations from these reviews have been worked out and the final recommendations are being prepared.

**In-house Work Unit:** (Same as Disinfection Studies.)

**Contracts and Intragovernmental Transfers:** (Same as Disinfection Studies.)

#### **Field Detection and Analytical Methods**

**Progress:** A screening method for the rapid detection of toxic chemicals in field waters underwent a statistically-oriented test to validate the basic capability of the technology. The technology consists of a laser spectrometer, with computerized mathematical algorithms which are used to assess changes in laser light scattering profiles and intensity by test microorganisms in water samples. The test organisms, Bacillus subtilis, in logarithmic growth phase are added to the water sample and allowed a 60-minute incubation period. Changes in their growth and morphology were detected and discriminated against control cultures by the differential laser light scattering. This data manipulation was used to assess the presence or absence of water soluble toxicants. Eleven toxicants were evaluated over a 2 order of magnitude range in concentration, and 9 of the 11 toxicants demonstrated dose response relationships in the test organisms. When the toxicants were tested as unknown samples, the technology correctly identified their presence or absence over 94 percent of the time in 53 discrete tests.

**In-house Work Unit:** (Same as Disinfection Studies.)

**Contracts and Intragovernmental Transfers:** (Same as Disinfection Studies.)

## **Filtration and Disinfection of Cryptosporidium Oocysts**

**Progress:** Studies were initiated to assess the capability of current Army field water treatment and disinfection equipment and procedures to remove the cysts of the protozoan, Cryptosporidium, from water. A meeting of experts on this protozoan and various DOD activities with responsibilities in field water supply was held to better assess the significance of this organism in combat water supplies. It was the consensus at the meeting that the protozoan was a potential pathogen of concern and that its treatment or disinfection could not be guaranteed with current Army equipment other than the Reverse Osmosis Water Purification Unit (ROWPU). Experiments are underway to evaluate ROWPU filtration components and disinfectants to verify the existence and extent of their shortcomings and to evaluate alternative filtration and disinfection equipment and procedures.

**In-house Work Unit:** (Same as Disinfection Studies.)

**Contracts and Intragovernmental Transfers:** (Same as Disinfection Studies.)

## **BIOMEDICAL ASSESSMENT OF TOXIC EFFECTS OF CHEMICAL AGENTS**

**Progress:** Chemical weapons research continues to focus on toxicological research, occupational health test development and health hazard issues involved in the handling, maintenance, and demilitarization of chemical agents. Toxicology studies on agents GA (Phase I, II), GB and GD (Phase II), HD (sulfur mustard), and L (lewisite) are in progress and on schedule. Teratology studies in rats and rabbits on HD and L have been completed and the final reports are being printed for distribution. Draft final reports have been received for agent VX, agents GB/GD (Phase I), and for the first criteria document ("Review of Methodologies for Establishing Occupational Health Criteria"). Preparation of a criteria document on agent VX is continuing. Draft final reports have been completed and are under review for the following: confirmatory chemical test for exposure to the incapacitating agent BZ; the effects on cholinesterase inhibition when agent VX is treated with limited amounts of hypochlorous acid; and the testing of several polymeric and monomeric diacetylene compounds as potential indicators to be used in dosimeters for the chemical agents GB, GD, and VX. A comprehensive review of the toxicity, carcinogenicity, mutagenicity, and teratogenicity of agent L has been completed. Following a final editing, the review will be submitted for publication. A similar review of HD is in the process of finalization.

**In-house Work Unit:** (Same as Disinfection Studies.)

**Contracts and Intragovernmental Transfers:** Development of a Confirmatory Chemical Test for Exposure to 3-Quinuclidinyl Benzilate (BZ); DA308749; National Bureau of Standards (White, E.V.); Bausum, H.T.

**Teratology Studies in Lewisite and Sulfur Mustard Agents;** DA302726; DOE Pacific Northwest Laboratory (Sasser, L.B.), Finch, R.A.

Toxicity Studies on Agent VX; DA300087; DOE Laboratory for Energy-Related Health Research (Goldman, M.); Dacre, J.C.

Toxicity Studies on Agents GB and GD; DA305392; DOE Laboratory for Energy-Related Health Research (Goldman, M.); Dacre, J.C.

Chemistry and Toxicology of Water Treated with Hypochlorite to Detoxify Chemical Agent VX; DA305445; DOE Pacific Northwest Laboratory (Kalkwarf, D.R.); Rosenblatt, D.H.

Toxicity Studies on Lewisite and Sulfur Mustard Agents; DA305394; DOE Pacific Northwest Laboratory (Sasser, L.B.); Dacre, J.C.

Occupational Criteria Documents for Chemical Agents; DAS311206; DOE Oak Ridge National Laboratory (Ross, R.H.); Dacre, J.C.

Toxicity Studies on Agent GA (Phase I); DA312532; DOE Laboratory for Energy-Related Health Research (Wilson, B.D.); Dacre, J.C.

Toxicity Studies on Agent GA (Phase II); DA312893; FDA National Center for Toxicological Research (Bucci, T.J.); Dacre, J.C.

Toxicity Studies on Agents GB and GD (Phase II); DA308759; FDA National Center for Toxicological Research (Bucci, T.J.); Dacre, J.C.

To Update and Complete Two Extensive Reviews of Chemical Agents Sulfur Mustard (HD) and Lewisite (L) for Publication in the Open Literature; DAAL 03-86-D-0001; U.S. Army Summer Faculty Research and Engineering Program (Goldman, M.); Merrell, L.

**PRODUCTIVITY  
SPECIFICATIONS WRITTEN**

**Initiated**

MIL-P-49500      Pesticide Dispersal Unit (PDU), Multicapability,  
Helicopter Slung

**Revised**

MIL-D2457      Duster, Insecticide, Mass Delousing

MIL-S-14102      Sprayers, Insecticide, Manually-Carried: Hand-Operated,  
Compression

MIL-T-52062      Trap, Mosquito, Light

RR-D-780      Duster, Manually-Operated; Tubular Pump, Manually-Carried  
and Rotary Fan, Strap-Carried

**MATERIEL FIELDIED, TYPE CLASSIFIED OR STANDARDIZED**

The PDU, Multicapability, Helicopter Slung was type classified on 21 July 1987. The PDU has the capability to disperse both solid and liquid formulations electrically independent of the aircraft and will be used for application of pesticide for disease vector control. The USABRDL will make first buy of 25 units in FY88 for fielding in FY89.

The Norwegian Charcoal Heater was recommended for standardization action in June 1987. A purchase specification was issued in June 1987 and a contract awarded 24 September 1987 for the purchase of 234 units of the "Heater Unit, Patient Holding and Evacuation."

A production contract was awarded to procure 1,964 Carrier, Litter, Wheeled (Field Gurneys) developed and type classified previously by USABRDL. Final delivery of the total production to the Army inventory is 22 August 1988.

## PATENTS

### Submitted

Method for Disinfecting Aqueous Medium with N-N'-dihalo-2-imidazolidinone, Worley, S.D. The U.S. Patent was approved but is not yet formally issued. This is an application patent for a new family of water disinfection compounds.

The Army Collapsible Insect Surveillance Trap, although developed to improve readiness, has many uses in the civilian community. A patent application was submitted on 23 April 1987.

A patent application was submitted on the Semi-Micro Magnetic Manipulator which was developed for injecting test substances into mosquito larvae intestines.

A patent has been sought for a new instrument developed at the USABRDL which is designed to measure airborne hydrogen chloride produced in the firing of certain military weapons systems.

### Granted

Sample Cell for Light Scattering Measurements, U.S. Patent No. 4616927. Issued 14 October 1986, to Phillips, S.D., J.M. Reece, and P.J. Wyatt, of Wyatt Technology Corporation.

N-N'-dihalo-2-imidazolidinone. U.S. Patent No. 4,681,948. Issued to Worley, S.D., 21 July 1987. This is a composition-of-matter patent for a new family of disinfection compounds for water.

Method for Treating Air Cooling System's Aqueous Medium. U.S. Patent No. 4,659,484. Issued to Worley, S.D. and L.J. Swango, 21 April 1987. This is an application patent for disinfecting cooling tower waters.

Noise-Immune Blood Pressure Measurement Technique and System. U.S. Patent No. 4,649,928. Issued to GMS Engineering Corporation. The patent was awarded on the statistical technique of determining blood pressure and heart rate. Application for foreign patents is in progress.



## TECHNOLOGY TRANSFER ACTIVITIES

The domestic technology transfer program at the USABRD L has been actively developing new strategies for the implementation of the new Federal Technology Transfer Act and subsequent Executive Order. The USABRD L Office of Research and Technology Applications has provided review and comment on DA and USAMRDC guidance on the implementation of this program. Several specific examples of the USABRD L activities in this area are illustrative of the USABRD L commitment to compliance with the letter and spirit of these directives.

The USABRD L scientists and engineers have been active during the last year in pursuing patents for technology developed at the USABRD L. A patent has been sought for a new instrument developed at the USABRD L which is designed to measure airborne hydrogen chloride produced in the firing of certain military weapons systems. This instrument has great potential for use in civilian applications. Patent application has also been made for the USABRD L developed Army Collapsible Insect Surveillance Trap. Both of these items are excellent candidates for transfer to the domestic civilian market under a licensing agreement from the Army.

The USABRD L scientists and engineers continued to provide assistance and consultation to state and local governments as well as other federal agencies in areas where the USABRD L has unique expertise. These efforts included the application of the USABRD L developed and refined Preliminary Pollutant Limit Value concept used for determining cleanup goals in environmental restoration activities. The USABRD L scientists also played a major role in a State Department project to assist the government of Honduras in environmental vector control.

The USABRD L representative to the Federal Laboratory Consortium was asked to serve on the program committee for the spring 1988 meeting of this group. The theme of this meeting is the transfer of federal research and development in health care. This meeting will be hosted by the NIH and will be held in the Washington, DC, area.

The USABRD L domestic technology transfer program continues to develop and provide leadership in the medical community in this developing field. The passage and implementation of new laws and regulations affecting this area will provide unprecedented opportunities for research and development agreements. The USABRD L is positioned very well to take full advantage of these opportunities to the benefit of both the military and the civilian communities.

## ASSISTANCE PROVIDED CIVILIAN AND OTHER GOVERNMENT AGENCIES

A Memorandum of Understanding was established between the USABRDL and the U.S. Army Toxic and Hazardous Materials Agency to define the inter-relationship of the two research programs with respect to Installation Restoration, Pollution Abatement, and Rocky Mountain Arsenal environmental concerns.

Consultation and technical guidance were provided to the U.S. Army Medical Materiel Agency (USAMMA) for procurement of the Carrier, Litter, Wheeled (Field Gurney) previously recommended for standardization by this Laboratory. The expeditious procurement of the field gurney will drastically reduce manpower problems associated with moving patients in field hospitals and the field environment. The device is also being considered by Natick Research Development and Engineering Center for the Combat Field Feeding System and potential use for movement of supplies in the field.

At the request of the Academy of Health Sciences (AHS), four commercial portable blood storage refrigerators were subjected to a rigorous test program as part of a "fly-off" selection process. A blood refrigerator for the field is an urgent requirement, since the noncommercial refrigerator now in the inventory is no longer supportable. Data on the four refrigerators tested were submitted to the Combat Developer, AHS, for consideration in nondevelopment item (NDI) procurement.

The USABRDL provided the necessary staff to revise the Pest Control Equipment Catalog. This catalog was revised to incorporate new pest control equipment and upgrade the overall photographic quality of the catalog.

Equipment, training, and technical assistance on the aerial dispersal of pesticides was provided to the DOD in the following ways:

- Instructors and equipment are furnished to the DOD Aerial Spray Course conducted annually at Rickenbacker Air National Guard Base, Ohio.
- Equipment and personnel were furnished to the Fort A.P. Hill, Virginia, for suppression of ticks. Personnel from the U.S. Army Environmental Hygiene Agency participated in the mission and received training on the equipment prior to spray missions.
- Information on the bionomics of major arthropod disease vectors and possible control strategies were provided to Task Force N69, Blazing Trails South, before they embarked to Equador.
- The Armed Forces Pest Management Board was furnished test results and recommendations on dusters for cockroach control.

A Memorandum of Agreement between the USAMRDC and the U.S. Army Troop Support Command (TROSCOM) was updated this fiscal year. The USABRDL has been given configuration management responsibility for processing all actions between the USAMRDC and the TROSCOM. This document clarifies and amplifies the coordination and support roles by each command in the fielding process for Insect and Rodent Control Equipment projects in the Federal Supply Class 3740. The Memorandum of Agreement is applicable to Army managed items/systems which are assigned to the USAMRDC for research, development, engineering, first production procurement, and follow-on engineering support of transitioned items. The TROSCOM will provide logistics, readiness support, and acquisition after transition of the project.

A USABRDL staff member, LTC David T. George, Chief, Chemical Defense Materiel Branch, served as the Task Area Manager to the Commander, U.S. Army Medical Research Institute of Chemical Defense, for Chemical Casualty Care Equipment.

The Laboratory provided final technical and engineering design options to Natick Research, Development and Engineering Center for initial production run of the Chemical Warfare Agent Protective Patient Wrap.

The Laboratory cooperated extensively with the U.S. Army Medical Materiel Development Activity in providing technical support for the development of Life Cycle Management documentation for 6.3B and 6.4 projects.

A USABRDL staff member, LTC David T. George, was an invited briefer at the U.S. Army Medical/Chemical Defense Review III, held at the U.S. Army Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, Maryland, on 3 September 1987.

The USABRDL provided the Defense Construction Supply Center support for performance of first article test of all items procured by the center under Federal Supply Class 3740.

Consultation and technical guidance were provided the USAMMA in the review of contractor proposals for fabricating a Field Optometry Chair.

A USABRDL staff member, Mr. William H. Conway, Chief, Combat Casualty Care Branch, participated in a technical and doctrinal review of a concept proposed by the Army Development and Employment Agency for an Advanced Trauma Treatment Team Vehicle.

A USABRDL staff member, LTC David T. George, served as a TAC Officer for the Combat Casualty Care Course at the AHS from 27 September 1986 through 4 October 1986.

Dr. James H. Nelson, Chief, FMMDD, was the principal briefer to the Joint Technology Coordinating Group for Combat Casualty Care Scientific Program Review during FY87.

Dr. James H. Nelson, Chief, FMMDD, presented the USABRDL's medical research and development program at the Combat Casualty Care Course Administration (C4A), AHS, during FY87.

The USABRDL staff members, Mr. Donald G. Englar and Mr. Robert D. Cramer, Design Office, Systems Development Branch, provided design assistance to the Fort Detrick Directorate of Engineering and Housing (DEH) to complete a high priority project on the Materials Test Laboratory and to the HERD to complete the design for an aerosol chamber which would have held up research activities for a significant amount of time had the design gone through routine DEH channels.

Recommendation on a adulticide for vectors of dengue was provided to the Center for Disease Control, Puerto Rico.

## OTHER TECHNICAL EXCHANGE

### Technical Meetings Sponsored:

The Laboratory sponsored a meeting on the health significance of Cryptosporidium in military water supplies, 4 February 1987. The meeting included presentations by a number of experts on the biology, prevalence, and clinical significance of the organism.

The Laboratory sponsored a tri-service meeting, 2 September 1987, for the purpose of establishing priorities for research in field water and sanitation. The meeting produced tri-service positions on important research topics which will be submitted for formal DOD endorsement.

Dr. W.D. Burrows served on the steering committee and arranged funding for Water Reuse IV, a symposium held on 2-6 August 1987, in Denver, CO, and also chaired the session on water reuse health effects.

### Seminars:

Deployable Medical Systems, Speaker: Colonel Wendell Stepp, Office of The Surgeon General.

Image Processing on Small Computer Systems, Speaker: Professor Frank Scarpace, Department of Civil and Environmental Engineering and the Institute for Environmental Science, University of Wisconsin, Madison, Wisconsin.

An Overview of the Trauma Treatment Vehicle Kit (Army Development and Employment Agency), Speaker: Mr. William H. Conway, Chief, Combat Casualty Care Branch.

Applications of Pulse Electromagnetic Fields to Enhancing Wound Healing, Speaker: Dr. Jesse Ross, President, Diapulse Corporation of America, Great Neck, New York.

Bone Marrow Transplant Technology and Its Relevance to Treatment of Battlefield Casualties, Speaker: LTC Arlene Zaloznik, Brooke Army Medical Center, Fort Sam Houston, Texas.

The Joint Military Medical Command - New Opportunities for Medical Research, Speaker: MAJ David Danley, Brooke Army Medical Center, Fort Sam Houston, Texas.

Development of a Multi-frequency Jet Ventilator for Use Under Battlefield Conditions, Speaker: Drs. Bernard Weinberg, Henry McDonald, and Eric Gluck, Scientific Research Associates, Inc., Hartford, Connecticut.

### Consultation and Foreign Exchanges:

LTC David T. George was selected to represent USAMRDC at the Republic of Korea/United States Technological Cooperation Committee meeting, held in Seoul, Korea, 4-7 November 1986. He presented a briefing on the chemical defense research and development program for protection and treatment of chemical warfare casualties.

## BRIEFINGS TO FOREIGN AND U.S. VISITORS

10 Oct 86: COL Andre LeBlanc, COL Meunier, COL Henri Coq, COL Henry Sentenac-Roumanou, and Mr. Claude Eon, Chemical Defense Team, Directorate for Research and Technology, Ministry of Defense, France.

16 Oct 86: Mr. Saul Leibinsohn, General Manager, Bio-medical Instruments Ltd, Tel Aviv, Israel.

29 Oct 86: U.S. Army Medical Materiel Agency Medical Materiel Management Course Students: CPT George E. Shultz, CPT Christopher J. Harrington, CPT David R. Heier, CPT Margaret A. Tribble, and CPT Michelle H. Vislosky.

7 Nov 86: MG William O. Rodgers, Director General of Army Health Services, Australia.

10 Nov 86: LTG Aswin Debakham, Army Surgeon General, Royal Thai Army; LTC Kittichatr Virochsiri, Chief of Plans Section, Operations and Intelligence Division, Army Medical Department, Royal Thai Army; and Air Vice Marshal Sahas Nagasiri, Director General, Armed Forces Research Institute of Medical Sciences, Royal Thai Air Force; Kingdom of Thailand.

18 Nov 86: MAJ(P) Jean Louis Belard, Assistant Attache for Health Affairs, Office of the Defense Attache, Embassy of France.

19 Nov 86: Dr. Radomski, Chief, Defence and Civil Institute of Environmental Medicine, Canada, and Mr. Curt Allen, Canadian Embassy.

15 Dec 86: Dr. Chen Ning-Qing, Vice President, People's Liberation Army, Military AHS, Associate Professor of Preventive Medicine; Dr. Zhao Fu-Huan, Deputy Director, Institute of Environmental Medicine, Assistant Professor of Environmental Medicine; Dr. Wang Shao-Shan, Deputy Director, Institute of Microbiology and Epidemiology, Assistant Professor of Epidemiology; Dr. Ruan Jin-Xiu, Deputy Director, Institute of Toxicology and Pharmacology, Assistant Professor of Pharmacology; and Dr. Xu-Zhao, Staff Officer, Foreign Affairs Bureau, People's Liberation Army General Logistics Department (Interpreter); People's Republic of China.

17 Dec 86: LTC Dean A. Collins, Chief, Test Division; CPT Michael H. Sullivan and CPT Paul T. Laushey, Test Branch; Army Medical Department Board.

4 Feb - 3 Mar 87: COL Branislav S. Tokovic, Professor, Military Medical Academy, Institute of Preventive Medicine, Department of Toxicological Chemistry, Yugoslavia.

20 Feb 87: CDR R. Nalewaik and members of Naval Reserve Unit, Biomedical Emergency Response Team Atlantic, Washington, DC; and CAPT R.J. Mullin and members of Naval Reserve Unit, Radiological and Chemical Response Team Atlantic, Chattanooga, TN; Office of Naval Research.

26 Feb 87: U.S. Army Medical Materiel Agency Medical Materiel Management Course students: CPT Steven L. Lord, CPT Patricia L. Goggins, CPT James L. Fletcher, CPT Terry K. Cox, and CPT Lee Thompson.

2 Mar 87: COL John C. Slaughter, Special Advisor for Clinical Affairs, Directorate of Health Care Operations, DA.

1 Apr 87: CPT Kerry R. Delaney, Director of Naval Medicine, Armed Forces of Australia.

7 Apr 87: CPT Beverly Schiwenk, Administrative Resident, Fort Carson, CO.

21 Apr 87: LTG Francois Scler, The Surgeon General, Director, Defense Health Services; LTG Charles Laverdant, Director, Army Medical Corps Specialization School; and COL(P) Pierre Danillou, Executive Officer to The Surgeon General, Republic of France; MAJ(P) Jean-Louis Belard, Assistant Attache for Health Affairs, Office of the Defense Attache, Embassy of France.

20 May 87: COL Martin Daly, British Army Medical Liaison Officer (Designated), and COL Ian Creamer, United Kingdom.

20 May 87: Residents of the U.S. Air Force School of Aviation Medicine, Brooks AFB, San Antonio, TX: COL Thomas I. Clements, LTC Dennis F. Shanahan, MAJ Gary N. Matteson, MAJ John M. McNamara, CPT Thomas J. Burke, CPT Clyde A. Turner and COL Jose Garcia, Fort Rucker, AL.

16 Jun 87: Dr. Robert B. Oswald, Chief, Research and Development, Corps of Engineers; Dr. Robert Benn, Assistant Director for Military Programs; Dr. Clemens Meyer and COL Raymond T. Beurket, Office of the Assistant Director for Military Programs.

25 Jun 87: CPT Mark W. Yow, Assistant Executive Aid to The Surgeon General, U.S. Army.

2 Jul 87: Walter Reed Army Institute of Research, Military Medical Science Fellows: COL Dietrich Geschke, MAJ Robert Przybelski, MAJ Thomas Wiswell, and MAJ Paulito Fontelo.

10 Jul 87: Mr. Richard D. Langston and Ms. Frances C. Webb, Charcoal Cloth Limited, Berkshire, United Kingdom.

16 Jul 87: U.S. Army Medical Materiel Agency Medical Materiel Management Course students: CPT David Orgler, CPT Debra Franco, CPT Shirley Mabry, and CPT Roger Lisk.

30 Jul 87: MG Hans Sautter, Chief, Medical Office of the Armed Forces, Ministry of Defense; RA Ernst Mueller, Director, Armed Forces Hospital, Coblenz; BG Alfons Grutzka, Director, Armed Forces Hospital, Hamburg; COL Dietmar Leist, Director, Armed Forces Hospital, Hamm; Federal Republic of Germany; and Mr. Rodney Hoots, Deputy Director for International Activities, Office of the Assistant Secretary of Defense for Health Affairs.

18 Sep 87: Mr. Joel Margolit, Entomologist and Director, Center of Biological Control, Department of Biology, Ben-Gurion University, Israel.

30 Sep 87: Dr. Richard Stewart, Johnson Co., Milwaukee, WI.

## PUBLICATIONS AND PRESENTATIONS

### Open Literature Publications:

1. Bell, B.A. and W.D. Burrows. 1987. Biological Treatment of Explosive Bearing Wastewaters. In: Proceedings of the 19th Mid-Atlantic Industrial Waste Conference, Lancaster, PA. (In press)
2. Boobar, L.R. and M.R. Sardelis. 1987. Pesticide dispersal Unit (PDU), Multicapability, Helicopter Slung. In: Proceedings of 32nd Annual Meeting of the Northeastern Mosquito Control Association, Sturbridge, MA, pp. 152-158.
3. Boobar, L.R., M.R. Sardelis, J.H. Nelson, and W.M. Brown, III. 1987. A New Type of Collapsible Insect-Surveillance Light Trap for Sampling Diptera. Med. Vet. Entom. 1:215-218.
4. Bunner, B.L., L.R. Boobar, L.J. Vorgetts, and F.H. Broski. 1987. Increased Toxicity of Malathion Diluted with Heavy Aromatic Naphtha on Adult Aedes taeniorhynchus. J. Am. Mosquito Control Assoc. 3:87-89.
5. Bunner, B.L., R.W. Wannemacher, Jr., L.R. Boobar, R.E. Dinterman and F.H. Broski. 1987. Chemical/Toxin Dermal Decontamination Equipment using Soap and Water Spray. In: Proceedings of Sixth Medical Chemical Defense Bioscience Review, Columbia, MD, pp. 511-514.
6. Burrows, E.P. and L.L. Szafraniec. 1987. Hypochlorite-Promoted Transformations of Trichothecenes. 3. Deoxynivalenol. J. Nat. Prod. (In press, Nov/Dec 1987)
7. Burrows, E.P. and L.L. Szafraniec. 1986. Hypochlorite-Promoted Transformations of Trichothecenes. 2. Fragmentation-Rearrangement of the Primary Product from Verrucarol. J. Org. Chem. 51:4706-4708.
8. Burrows, E.P. and L.L. Szafraniec. 1986. Hypochlorite-Promoted Transformations of Trichothecenes. Deoxynivalenol. In: Proceedings of the 1986 U.S. Army Chemical Research, Development, and Engineering Center Scientific Conference on Chemical Defense Research, Aberdeen Proving Ground, MD, pp. 993-998.
9. Burrows, W.D. and E.T. Paulson. 1987. Wastewater Treatment at an RDX/HMX Manufacturing Facility. In: Proceedings of the 15th Environmental Symposium, American Defense Preparedness Association, Arlington, VA. (In Press).
10. Darby, W.M., L.R. Boobar, and L.M. Anderson. 1987. An Improved Power Duster for Mass Delousing of Humans. J. Med. Entomol. (In press)
11. Darby, W.M., L.R. Boobar, B.L. Bunner, and J.H. Nelson. 1987. "A New Pediculicide Application System for Mass Human Delousing: Analysis of Operational Characteristics and Limitations," Pesticide Formulations and Application Systems, Seventh Symposium, ASTM STP 968, G.B. Beestman, and D.I.B. Vander Hooven, eds. American Society for Testing and Materials, Philadelphia, PA, pp. 189-196.



12. Dobson, S.E., L.R. Boobar, W.D. Royer, and B.L. Bunner. 1987. A Device for Restraining Rabbits While Bloodfeeding. Lab. Anim. Sci. 37:364-365.
13. Hoke, S.H., S.M. Carley, E.T. Johnson, and F.H. Broski. 1987. The Use of Solid Phase Extraction Systems to Improve the Sensitivity of Artemia Bioassays for Trichothecene Mycotoxins. J. Assoc. Off. Anal. Chem. 70:661-663.
14. Misch, D.W., L.M. Anderson, and L.R. Boobar. 1987. The Relative Toxicity of a Spore Preparation of Bacillus thuringiensis var. israelensis Against Fourth Instar Aedes aegypti and Toxorhynchites amboinensis Suspension Feeding Compared with Enemas and Forced Feeding. Entomol. Exp. Appl. 44:151-154.
15. Mitchell, W.R. 1987. Microbial Degradation of Guanidinium Ion. Chemosphere 16:1071-1086.
16. Perich, M.J. and L.R. Boobar. 1987. An Aerial Assault on Ticks. Pest Control Magazine 55:54-55.
17. Perich, M.J., J.T. Rogers, and L.R. Boobar. 1987. Efficacy of Arosurf MSF and Formulations of Bacillus thuringiensis var. israelensis against Anopheles albimanus: Laboratory Bioassay. J. Am. Mosquito Control Assoc. (In press)
18. Perich, M.J., R.E. Wright, and R.W. McNew. 1987. Estimating the Number of Tabanidae Feeding on Cattle. J. Agric. Entomol. 3:335-341.
19. Rosenblatt, D.H., W.R. Hartley, and E.Y. Williams, Jr. 1986. The Preliminary Pollutant Limit Value Concept. J. Mil. Med. 151:645-647.
20. Schaub, S.A. 1987. Round Robin Testing of Methods for Recovery of Enteric Viruses from Wastewater Sludges and Sewage Amended Soils - ASTM Consensus Standards Development. In: Proceedings of EPA Symposium on Chemical and Biological Characterization of Municipal Sludges, Dredge Spoils and Drilling Muds, Cincinnati, OH. (In press)
21. Schaub, S.A. 1987. Preventive Medicine Considerations for Army Individual Soldier Water Purification. In: Proceedings of International Disinfection Conference No. 4, SUNY, Binghamton, NY. (In press)
22. van der Schalie, W.H. 1987. Can Biological Monitoring Early Warning Systems be Useful in Protecting Aquatic Ecosystems from Toxic Effluents? In: Proceedings of Aquatic Toxicology and Environmental Fate: Ninth Symposium. American Society for Testing and Materials Committee E-47 (Biological Effects and Environmental Fate), Philadelphia, PA. (In press).
23. Vorgetts, L.J., R.L. Frommer, P.H. Gibbs, and L.M. Anderson. 1987. Standardizing Bioassays to Compare Bacillus thuringiensis var. israelensis Formulations. J. Entomol. Sci. (In press)

24. Vorgetts, L.J., J.H. Nelson, and L.M. Anderson. 1986. Effect of Homogenization on Preparations of Bacillus thuringiensis var. israelensis. Bull. Entomol. Soc. Am. 32:255-256.

#### Presentations

1. Abbrecht, P.H., H.J. Bryant, W.H. Reams, and R.R. Kyle. Evaluation of a Hand-Powered Resuscitator for Chemical Warfare Casualties. Sixth Medical Chemical Defense Bioscience Review, Johns Hopkins University, Applied Physics Laboratory, Columbia, MD, 4-7 August 1987.
2. Anderson, L.M., L.R. Boobar, and T.L. Murphy. Correlation Between Chlorpyrifos Recovered from Sentinel Cages and Mortality Rates of Aedes aegypti Adults. Annual Conference of the American Mosquito Control Association, Seattle, WA, 29 March - 2 April 1987.
3. Boobar, L.R. The USABRD L Pest Management Program. Armed Forces Pest Management Board Review of U.S. Department of Agriculture - ARS Research Results of Possible Interests to DOD, Gainesville, FL, 12-16 January 1987.
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1 Commander  
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