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# US ARMY AEROMEDICAL RESEARCH LABORATORY ANNUAL PROGRESS REPORT, FY 1983

(1 October 1982 - 30 September 1983)

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USAARL

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20. ABSTRACT

The annual progress report gives the FY 83 personnel and funding strength of the US Army Aeromedical Research Laboratory. It outlines the ten scientific programs being pursued by the laboratory. Those programs are: visual and auditory impact physiology; auditory effects of blast overpressure; noise hazards of combat vehicles; impact biodynamics of crashworthiness and personnel armor; vibration hazards of combat vehicles; crew life support systems biotechnology; sensory limitations and man/machine systems; biomedical aspects of crew workload, selection, and staffing; anthropometry and ergonomics: criteria for Army aviators; and antidote and antidote/agent effects on the visual system.

# Mission Statement

Conducts research and development on health hazards of Army aviation, tactical combat vehicles, and selected weapon systems. Assesses the health hazards from noise, vibration, acceleration impact, and visual demands of such systems, and defines measures to offset hazards. Assesses stress and fatigue in personnel operating these systems and develops countermeasures. Assists in development of criteria upon which to base standards for entry and retention in Army aviation specialties. Assists other US Army Medical Research and Development Command (USAMRDC) laboratories and institutes in research on the bioeffects of laser systems, medical defense against chemical agents, impact of continuous operations on individual and crew performance, and development of improved means of patient evacuation. Assesses current life support equipment to identify causes of failure and devise improved design. Assists the combat developers and materiel developers of new Army aviation and tactical combat vehicle systems to recognize and eliminate health hazards as early as possible in the developmental cycle. Conducts collaborative research with other Department of Defense and other Federal agencies on medical research and development issues of common concern.

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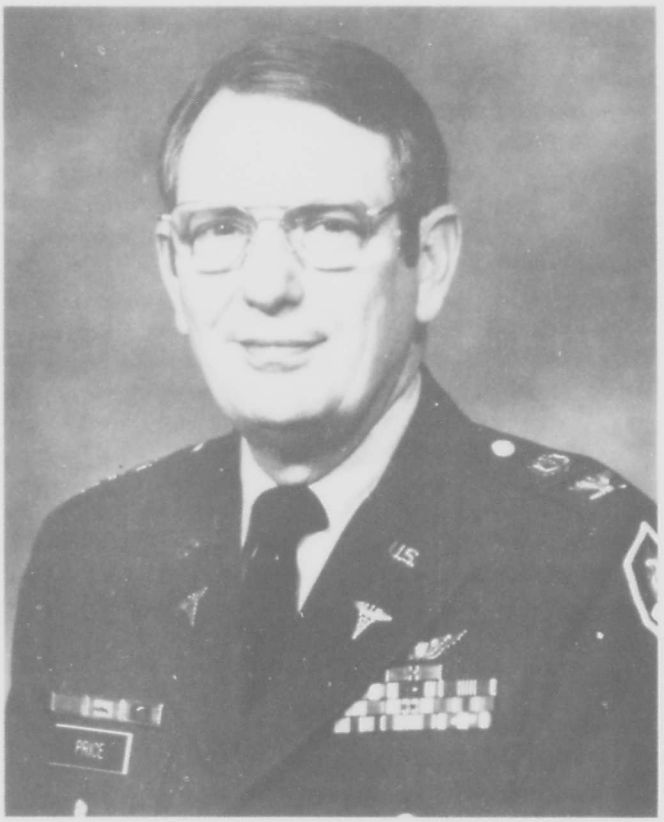



COL DUDLEY R. PRICE, COMMANDER

LTC J. D. LaMothe,
Deputy Commander


LTC Roger P. Hula, II
Executive Officer

# Introduction

Research goals are derived from a thorough review of threat information and on-going doctrine development as portrayed in AirLand Battle 2000 concepts; further impetus is driven by an understanding of the recognized Army deficiencies contained in the various Mission Area Analysis (MAA).

The United States Army Aeromedical Research Laboratory was established by Department of the Army General Order 39 on 1 Jul 62, and was implemented by Office of The Surgeon General General Order 42 on 4 Oct 62 to accomplish research in support of the Army aviation community and airborne activities and to provide a central aeromedical research and reference library for the Army aviation effort. Additional mission areas were added to the laboratory in 1974. The laboratory's further expanded mission now includes the assessment of the medical impact of advanced armor and artillery weapons systems and other nonmedical materiel.

USAARL is one of nine medical research laboratories of the US Army Medical Research and Development Command (USAMRDC), Office of The Surgeon General, and is a tenant organization located at the US Army Aviation Center (USAAVNC), Fort Rucker, Alabama. It is the only medical laboratory designated to deal with Army aviation's unique occupational problems.

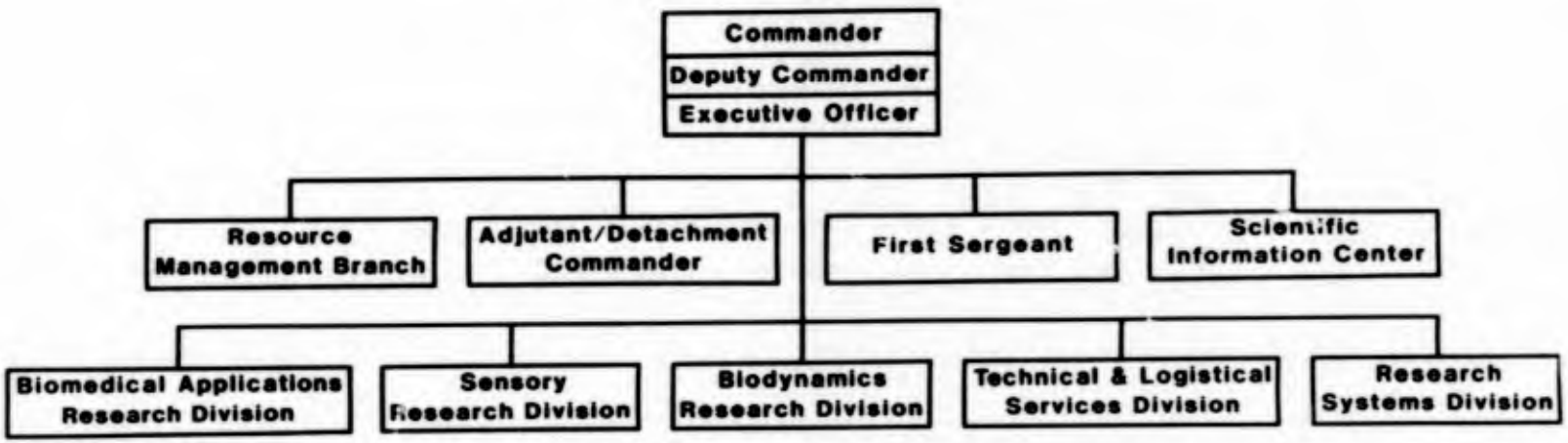
In 22 years the laboratory has grown from one building with seven personnel to a large, modern facility with 152 people. Our growth has been in research, people, and facilities, and we're proud of them all.

Under the direction and guidance of the USAMRDC, USAARL moves with the sure steps of maturity and responsibility of a firmly established research organization into the 1980s. The mission remains, through research, to preserve and enhance the health, safety, combat effectiveness, and survivability of the soldier.

This report gives an overview of USAARL during FY 83, identifies current areas of research, and gives a brief description of the research programs. The DD Forms 1498 under which this research work is accomplished are contained in the appendix.

This report is prepared to fulfill the requirements of OTSG Regulation 70-31.

## UNITED STATES ARMY AEROMEDICAL RESEARCH LABORATORY
## ORGANIZATIONAL CHART



# Management

Research liaison activities were enhanced significantly by establishing an aviation medicine research officer liaison position in the Office of the Commander. In January 1983, a memorandum of agreement was signed between the Commanding Generals of the US Army Aviation Systems Command (AVSCOM) and the US Army Medical Research and Development Command (USAMRDC) establishing the duty assignment of this liaison officer at AVSCOM in St. Louis, MO. In August 1983, MAJ Danny E. Lacy, an AMEDD aviator, became the first USAARL liaison officer to AVSCOM. He already has made important linkages of medical research to aviation systems development.

Significant improvements in automation management were made during FY 83. The laboratory formally designated an automation management officer who is responsible for developing a long-range automation plan in compliance with applicable regulations. Word processing needs and requirements were developed, and equipment was placed on order. The laboratory word processing plan includes integration of stand-alone word processors, electronic typewriters, and a newly-acquired VAX 11-780 research computer. In addition to those automation improvements, coordinating actions were taken with the US Army Aeromedical Center (USAAMC) to establish an aviation epidemiology data register that will provide an interactive automated data base for medical research and for daily operations of decision makers in the waiver and review process at the US Army Aeromedical Activity.

During FY83, the laboratory received over 2800 visitors. Included were distinguished visitors from Canada, Yugoslavia, Great Britain, Federal Republic of Germany, France, Belgium, Denmark, The Netherlands, Israel, and Australia. Visits also were conducted for the Under Secretary of the Army, the Commanding Generals of the Training and Doctrine Command, US Army Intelligence and Security Command, III Corps, US Army Aviation Center, US Army Test and Evaluation Command, and US Army Medical Research and Development Command.

# Technology Transfer

Provisions of the Stevenson-Wydler Technology Act of 1980 (PL96-480) continued to be implemented during FY 83. Representatives were sent to the Spring Federal Laboratory Consortium (FLC) Meeting in Colorado Springs, Colorado, and to meetings called by Department of the Army, held in Washington, DC, in November 1982. USAARL's Office of Research, Technology, and Assessment (ORTA) representative attended a meeting in Atlanta of the Southeastern Region of the Federal Laboratory Consortium and was elected Deputy Director of the Southeast Federal Laboratory Consortium.

More than 75 requests were received by the Scientific Information Center for either information or copies of bibliographies or technical reports.

Eight scientific seminars were given during FY 83 for the purpose of exchange of information. Average attendance was 35 per seminar, and included both USAARL and non-USAARL personnel. A brochure describing USAARL was developed by the Writer-Editor to be included as handouts. USAARL provided an exhibit at four conferences during FY 83.

# Support Divisions

## Headquarters

The headquarters group, in addition to the Commander, Deputy Commander, and Executive Officer, consists of the offices of the Adjutant/Detachment Commander, the Scientific Information Center, and the Resource Management Branch.

## Office of Adjutant/Detachment Commander

The office of the Adjutant/Detachment Commander provides command control over all military personnel to include personnel actions, disciplinary actions, billeting, and training. This office also coordinates and supervises the administrative functions and related office service operations of the USAARL headquarters.

Protocol affairs regarding visitors from lateral and higher headquarters are supervised and coordinated by the Adjutant/Detachment Commander's office. During FY 83, the laboratory received over 2,800 visitors. Included were distinguished visitors from Canada, Yugoslavia, Great Britain, Germany, France, Belgium, Denmark, The Netherlands, Israel, and Australia. Visits also were conducted for the Under Secretary of the Army, the Commanding Generals of the Training and Doctrine Command, US Army Intelligence and Security Command,

III Corps, US Army Aviation Center, US Army Test and Evaluation Command, and US Army Medical Research and Development Command.

Other services provided were safeguarding of classified documents and postal support for the organization, as well as support for the laboratory's research flight requirements.

## Resource Management Branch

The Resource Management Branch provides services in fiscal and manpower management, civilian personnel administration, and other management programs for the laboratory.

Significant accomplishments in manpower/personnel support during FY 83 included reduction of the hiring lag to less than one percent. The providing of 189 training experiences to laboratory personnel included skills development, professional development, and prevention of sexual harassment in the work place. An ongoing problem continues in the ability to recruit and place qualified applicants for engineering and scientific positions.

Intensified management efforts were used to improve fiscal management and providing quality financial support to the laboratory. Accomplishments in this area were funding for acquisition of an automated data processing system providing an ADP services network throughout the laboratory, funded resources to support research mission, acquisition of new and replacement equipment, and a significant improvement in the funds obligation rates.

## Scientific Information Center

The Scientific Information Center is the centralized scientific information reference repository for the Army aviation community concerning aeromedical and life sciences research. The Scientific Seminars, Cooperative Education, Equal Employment Opportunity, and Technology Transfer programs also are administered from the center.

The writer-editor's office continued to provide technical editing and writing for technical and laboratory reports, as well as for articles for publication in open literature. Public and command information was provided and the writer-editor's office also provided support for the USAARL exhibit, and assisted in research on the history of the laboratory. The writer-editor's office provided the news releases to increase awareness and attendance at USAARL's Scientific Seminars. The long, bulky "USAARL in Review" publication was discarded as promotion literature. The writer-editor's office wrote a one-sheet trifold brochure that now is employed as a handout both at the laboratory and for visitors to the USAARL exhibit.

During FY 83, USAARL became a participant in a number of on-line data bases including:

Defense Research, Development, Test, and Evaluation (RDT&E) Diverse Dial-Up On-Line System, the resource for information on this type of data.

Chemical Agent Retrieval System (CARS) provides on-line to more than 2,000 citations on Soman.

Chemical Defense Data Base (CDD) provides on-line access to more than 5,000 citations in chemical defense and biological warfare.

Optimis - An electronic mail system linking librarians from other commands through on-line usage.

In order to enhance the usefulness of these on-line systems, a dedicated telephone line to Birmingham, Alabama was installed along with a Dataphone modem enabling on-line communication to be more effective and eliminating line noise that interrupted past transmissions. More than 120 searches were completed using on-line systems during this fical year.

A new bibliography of USAARL Letter and Laboratory Reports was completed and eight scientific seminars were held. The Chief of the Scientific Information Center was appointed Career Program Manager for the Librarian Career Field at Fort Rucker.

# Research Systems Division

The Research Systems Division provides laboratorywide support in the areas of biomedical engineering, data systems and instrumentation, computer services, aviation, veterinary medicine, and mathematical and statistical services. During FY 83 the capability to provide this support increased significantly by the acquisition of a VAX-11/780 computer and its related hardware/software, and by the rebuilding of the Z-axis of the Multi-Axis Vibration System. Other systems were evaluated and modified to increase their reliability as measuring devices for research projects. Some of these modifications involved the Helicopter In-Flight Monitoring System and the Helicopter Operational Trainer.

## Aviation Branch

During FY 83 research flights were provided to support the On-Board Oxygen Generator System study which required flying at 15,000 feet in the JUH-1H and 25,000 feet in the JU-21G. Other studies supported by research flights included night vision device studies and chemical defense ensemble studies. Support continued for the cockpit anthropometric studies.

Three new aviators received ground school and flight training so that they could become part of the support team for aviation research.

The JUH-1M aircraft was transferred to the US Army Aviation Museum at Fort Rucker for static display purposes. The JUH-1M was the last flyable UH-1M in the active duty inventory.

The computer-assisted flying hour management program, instituted in FY 82, has been a tremendous asset to the laboratory.

It provides aralysis and projection of flying hours and associated costs. This ability to project peak flying months makes possible a closer management of research and training resources.

## Biomedical Engineering Branch

Major accomplishments in FY 83 included new sensors, a terminal, and a calibration feature being added to the Helicopter In-Flight Monitoring System--Second Generation (HIMS II) to increase its reliability as a measuring device of factors affecting aviator performance. An extensive flight program of the HIMS II was conducted to check its accuracy. Also, a technical report was published to describe the various aspects of the HIMS II, and for use as an operator's manual.

In conjunction with the US Army Human Engineering Laboratory, data gathering equipment was provided for the assessment of tank firing impulses generated by the US Army Tank-Automotive Command simulator. Field tests were performed to verify the simulator's performance in duplicating actual tank firing measurements.

Circuitry was designed for the project "Auditory Display of Helicopter Flight Instruments." In this study, the bank angle and climb rate of the helicopter will be transformed into audio cues to the pilot.

Anthropometric dummies for a low altitude parachute drop test were instrumented. This test will be conducted at the Yuma Proving Grounds in Arizona.

A computer-operated system to measure and display physiological parameters in the laboratory was set up, modified, and checked. Software design was begun to enable interactive control of data acquisition and display.

A four-axis control force loading system was checked for operation. Safety interlock components were installed and computer interface cabling for connection to the VAX-11/780 computer was designed.

Design work on an in-flight monitoring system for the U-21 aircraft was continued. Sensor installation was completed on the aircraft and a system enclosure was fabricated under the supervision of branch personnel.

Branch engineers provided advice on the instrumentation for a drop tower facility which includes setup of a new pendulum device.

Assistance was provided in the installation of peripherals for the new Digital Equipment Corporation PDP-11/24 computer in the Biodynamics Research Division.

## Data Systems and Instrumentation Branch

The FY 83 work effort was distributed laboratorywide with support provided to an ongoing anthropometry research study with emphasis placed upon improvments to the operational condition and data collecting capabilities of the research systems of the laboratory

The multi-axis vibration system (MAVS) was used to furnish vibration stimuli for the Anthropometric Strength Criteria Study. Branch personnel provided maintenance and modification support to a wide variety of ancillary machines and data collection systems used for this study.

The Z-axis of the MAVS was rebuilt by the contractor. This modification has improved the frequency response of the system to the best fidelity since its installation. It should improve greatly the overall data collecting capability of the system.

The operational condition, capabilities, and expectations of the laboratory's helicopter operational trainer were determined through the use of a technical contract and in-house technical abilities.

Modification and overall maintenance continued on the Raydis system. Results from data collection flights indicated the system was operating well.

Other support provided to the research divisions included--

1. Cable fabrication, sensor installation, and modification to the HIMS II which is used to collect data aboard the UH-1H helicopter.

2. Fabrication, assembly, and modification support to the Biomedical Engineering Branch for a new data collection system proposed for the near future.

3. Fabrication of instrumentation for the project "Auditory Display of Helicopter Flight Instruments."

4. Computer interface cabling and troubleshooting assistance for a four-axis control force loading system. A turn-on procedure was written for this system.

One member of the branch coauthored an article titled "Controller selects active CRT raster line," which was published in the magazine *Electronics*.

## Modeling and Simulation Branch

USAARL's central automation capability was upgraded significantly during the year with the acquisition of a Digital Equipment Corporation VAX-11/780 computer. The central processor, one printer, one tape drive, three disk drives, and one terminal were delivered in January 1983. Two statistical software packages, Statistical Package for the Social Sciences (SPSS-X) and BMDP, and a scientific data base management system, Scientific Information Retrieval/Data Base Management System (SIR/DBMS), were delivered in August 1983. Additional software, data acquisition hardware, terminals, printers, and a communications network will be added early in FY 84 to provide on-line interactive computer support to all USAARL organizational elements and the Army Aeromedical Activity.

1. Increases the main memory capacity to 2 M bytes from 192 K bytes.

2. Increases the on-line disk storage capacity to 1,024 M bytes from 48 M bytes.

3. Increases the number of terminal lines to 96 from 27.

4. Increases the practical number of concurrent users to 32 from 6.

5. Increases the number of terminals to 48 from 17.

6. Increases the number of terminal printers to 23 from 5.

Software already purchased or on order for this advanced system will provide the following capabilities which were not available on the SYSTEMS 85 system:

1. Full security and file protection through a system of passwords, privileges, and access controls.

2. A convenient control language for file maintenance, utility operations, communication with other users, and simple applications.

3. Up-to-date analyses using either the SPSS or BMDP statistical packages.

4. Rapid development of SIR/DBMS.

5. Rapid development of administrative data management applications using VAX-11 DATATRIEVE.

6. Rapid development of computational and processing applications with either the FORTRAN or BASIC language and a powerful symbolic debugger.

7. Rapid development of data-entry applications using the Forms Management System (FMS).

A 3-hour orientation on the new VAX system was presented to all laboratory personnel by the contractor on 18 February 1983. Two full days of intensive training will be given to all VAX users by the contractor in January 1984, after the expected completion date of the laboratorywide terminal network.

The conversion of existing SYSTEMS 85 programs to the VAX system began in February following acceptance of most of the new system. This conversion is proceeding concurrently with the development of new applications and now is approximately 80% complete. The conversion of SYSTEMS 85 data acquisition programs which support the Eye-Nac system, the UH-1 simulator, and the UH-1 airborne data system (HIMS II) cannot be completed until the data acquisition hardware is installed on the VAX computer (early FY 84).

In addition to the conversion of all active SYSTEMS 85 programs, 68 new programs were developed on the VAX computer for application in the following areas:

1. Five programs were developed for two administrative applications. One application provides management information on long-distance telephone use and the other prepares personnel roster and TDA information for entry into a data base system (SIR/DBMS).

2. Four programs were developed in support of a project to study cardiopulmonary functions in Army aviators. Two of these programs acquired and reduced experimental measurements from an automated cardiopulmonary function testing machine. Another program interactively acquired information from a subject questionnaire, and the final program prepared all the data for entry into a data base system (SIR/DBMS) for later retrieval and analysis.

3. Seventeen programs were developed in support of a project to study the forces required by aviators in landing a UH-1 helicopter with and without hydraulics assistance. The functions performed include acquiring the data from the HIMS II processor, producing summary tables, and formatting the data for four separate statistical analyses.

4. Three programs were developed in support of the life support equipment retrieval project (LSERP). From a laboratory minicomputer, two programs were used to acquire and validate data on helmets recovered from aircraft accidents. The third program prepared this data for entry into a data base system (SIR/DBMS) for later retrieval and analysis.

5. Thirteen programs were developed in support of an anthropometric project, a study of the abilities of individuals in eight anthropometric groups. These programs were used to validate and reduce data from five laboratory measurement devices. Data from two of the devices also were prepared for entry into a data base system (SIR/DBMS).

6. Twenty other minor programs were developed for testing laboratory devices, general-purpose utility functions, or to aid in the software conversion process.

7. Six data base applications were developed using SIR/DBMS, the Scientific Information Retrieval Data Base Management System. These applications are--

(a) Cardiopulmonary measurements and questionnaires.

(b) Long-distance telephone use information.

(c) USAARL personnel roster and TDA information.

(d) Anthropometric vibration table exertion data base.

(e) Life support equipment (helmet) data base.

## Statistical/Mathematical Support

Statistical/mathematical support provided for ongoing research studies resulted in the reports: "Statistical Results for Induced Back Pain Study" (unpublished preliminary report); "The Hat Matrix: A Diagnostic Tool for Multiple Linear Regression" (Letter Report LR-83-3-5-2); "Statistical Interim Report: Some Experiment Design Considerations for an Investigation on Neck Muscle Stress/Endurance in Helicopter Pilots" (Letter Report LR-83-11-5-3); and "Statistical Interim Report: Statistical Comparison of Vibration Regimen Between a Standard and a German Helicopter Seat for Humans" (Letter Report LR-83-1-5-1). This last report formed a basis for results reported in a technical report "Impact and Vibration Testing of a Modified UH-1 Crew Seat" (USAARL Report No. 83-10). Statistical support continued to be provided for a sample survey of hearing loss in US Army aviators at Fort Rucker which culminated in a technical report summarizing the data collected (USAARL Report No. 83-12, "Extent of Hearing Loss Among Army Aviators at Fort Rucker, Alabama").

Considerable effort was expended on the development of a mathematical model of neck muscle stress (endurance time versus strength exerted) in US Army aviators. This work was done in collaboration with Dr. George E. P. Box of the Mathematical Research Center at Madison, WI. He also contributed significantly to the work done for the statistical interim report on considerations for an investigation of neck muscle stress. The work on the mathematical modeling of neck muscle stress resulted in the report "Statistical Interim Report: Some Considerations of a Mathematical Model of Neck Muscle Stress in U. S. Army Aviators" (in press).

Approximately 200 hours of statistical/mathematical advice or consultation was provided answering questions about statistics/mathematics and reviewing manuscripts and preliminary drafts of protocols or study plans. Statistical consultation was given to US Army Safety Center personnel on matters concerning the sampling of accident data from the total reports of US

Army accidents and the projection of numbers and kinds of US Army accidents (time series forecasting).

Two areas of mathematical statistics research undertaken during the year were (1) the use of the measure of kurtosis as a means of exploring data to ascertain whether or not samples are coming from a contaminated frequency distribution, and (2) a review of the literature on the underlying assumptions for repeated measures designs. Whenever one or two of the major assumptions are violated, which is frequently the case, erroneous conclusions can or may be drawn from the analyses. This situation can have an adverse impact on the scientific conclusions made by USAARL scientists.

## Veterinary Medicine Branch

During FY 83, the animal facilities continued a process of internal growth and stabilization with the purchase and initial installation of various systems designed to automate caretaker procedures and improve the environment for the animals.

The production colony of *Galago crassicaudatus* (bush babies) experienced an increase in live births. The number of live births within the chinchilla production colony also increased throughout the year and was accompanied by a significant increase in the number of animals weaned. This improved livability can be attributed directly to the stabilized environment of the new facility and the concurrent reduction of diseases. The cat colony experienced no disease outbreaks during the year. This absence of disease has resulted in a healthy, stable animal population for research.

Plans were submitted to modify the existing vivarium to consolidate all animal care facilities, i.e., surgery, treatment, necropsy, etc., under one roof. Completion of the modification and final installation of various automated animal care systems will result in state-of-the-art animal facilities.

**Publications:**

Jones, H. D., Lewis, J. A., and Higdon, A. A. 1983. *Helicopter in-flight monitoring system, second generation (HIMS II).* USAARL Report No. 83-13.

Holt, W. R. 1983. *The hat matrix: a diagnostic tool for multiple linear regression.* LR-83-3-5-2.

Holt, W. R. 1983. *Statistical interim report: some experiment design considerations for an investigation on neck muscle stress/endurance in helicopter pilots.* LR-83-11-5-3.

Holt, W. R. 1983. *Statistical interim report: statistical comparison of vibration regimen between a standard and a German helicopter seat for humans.* LR-83-1-5-1.

Rash, C. E. and Hapgood, J. H. November 1982. Controller selects active CRT raster line. *Electronics.* Pg 113.

# Technical and Logistical Services Division

The Technical and Logistical Services Division (TL&S) continued to provide total support to the laboratory through scientific arts, laboratory crafts, facilities engineering and maintenance, equipment maintenance, supply and acquisition, and property management. The division provides support to the laboratory and its research mission by planning, coordinating and implementing the technical, logistical, and maintenance programs required.

## Scientific Arts

Scientific Arts provides scientific and technical photography, medical and scientific illustration, engineering drafting, motion picture data collecting and documentation, and related audiovisual services for all USAARL research functions. The supervisory photographer has been designated as Audiovisual Management Officer for USAARL and has designed a state-of-the-art projector and sound system for scientific presentations conducted in the laboratory's lecture room. An unusual feature of this section is that each person assigned to a project becomes totally involved with the project by becoming a team member and working directly with the project officer.

With the use of automatic processing equipment, all research photographic support has been provided by only two full-time employees. Many illustration and drafting hours were saved by the use of researcher-submitted computer data. Work is continuing on preparing a data base for rapid retrieval of scientific arts data for reprint, duplication and/or modification.

This branch produced 13,503 units of still photo work, 12,800 feet of motion picture footage, and 1,190 units of graphic arts work. These figures encompass the 764 work orders completed during the fiscal year.

## Property Management

This section acquires and maintains control of all expendable and nonexpendable supplies for USAARL through checks, labeling and hand receipts of all incoming equipment required in support of the laboratory's mission. It is responsible for all equipment authorizations including tables of distribution and allowances (TDA), common tables of allowances (CTA), letters of authorization, etc. Property management monitors the excess equipment program, turn-in of equipment, and other equipment losses or gains, and insures that durable supplies are handled in an efficient and cost effective manner. References and property management services are provided to all laboratory personnel.

Ending FY 83, the value of the property book was $12,284,603. This included 3,055 lines with 5,367 items. Command emphasis on property accountability was evidenced by the increased awareness of hand receipt holders of their responsibilities in safeguarding government property. This was stressed greatly during the year.

A significant element of the FY 83 Command Supply Inspection and a Department of the Army (DA) area of special interest was verification of the property account inventory accuracy, which again was determined to be 100 percent. This is the second consecutive year that the laboratory has achieved a 100 percent inventory accuracy rate. Another significant element of the inspection revealed that all known loans have been properly approved and documented. Management of loans has been centralized in the property management office so that prompt action may be taken to renew the loan or recover the property as the loan expires.

## Maintenance

Maintenance personnel provide maintenance, repair, and calibration of all nonfacility equipment in the laboratory. Performance of maintenance is provided in one or more of the following: In-house support, post intraservice contracts, one-time support contracts or continuing service contracts. This branch maintains historical data on all equipment, monitors items under the Army Warranty Program, and provides technical information needed for new procurement. Branch personnel have the technical knowledge of laboratory equipment, as well as being knowledgeable of how the equipment relates to the research efforts.

Despite reduced personnel strength, the branch has managed to maintain the same high level of support as in previous years. A quality assurance program, as well as a new SOP, was introduced by the branch. A most significant achievement by maintenance personnel was the consolidation of service contracts to better monitor agreements to assure proper performance of service. Redirection of this branch to better support USAARL's completion and publishing of an internal SOP will avoid past problems and provide a better working document describing the overall activities of the branch.

## Facilities Management

The Building Engineer monitors all of the facility's maintenance planning and new construction. He assists in the approval, planning, designing, and modification of facilities changes. The supervision and inspection of the building maintenance and custodial contract also is accomplished from this office. FY 83 was the first full year of facilities contract maintenance where contractors provided outstanding work under the guidance of the Building Engineer. This was a first-ever type of service agreement at Fort Rucker. Representatives of this office have supervised the correction of many construction deficiencies and malfunctions during FY 83, as well as installation of a 265 KVA emergency generator, an air compressor, and modification of a

chemical defense laboratory to comply with security requirements for the Chemical Defense Project. Presently, work is being planned to contract for construction of a testing facility, and plans are being made to house the remaining part of the acoustics facility, which is now located in the old hospital area.

## Laboratory Crafts

Laboratory Crafts Branch plans, designs, and fabricates intricate, and commercially unavailable and special scientific equipment, tools, and fixtures to meet specific research project demands. Its personnel are technically proficient in identifying and understanding the researchers' needs.

During FY 83, the Laboratory Crafts Branch completed moving material and supplies from the shop storage building at the old laboratory site to the new facility enabling the contractor to move the storage building to its new site.

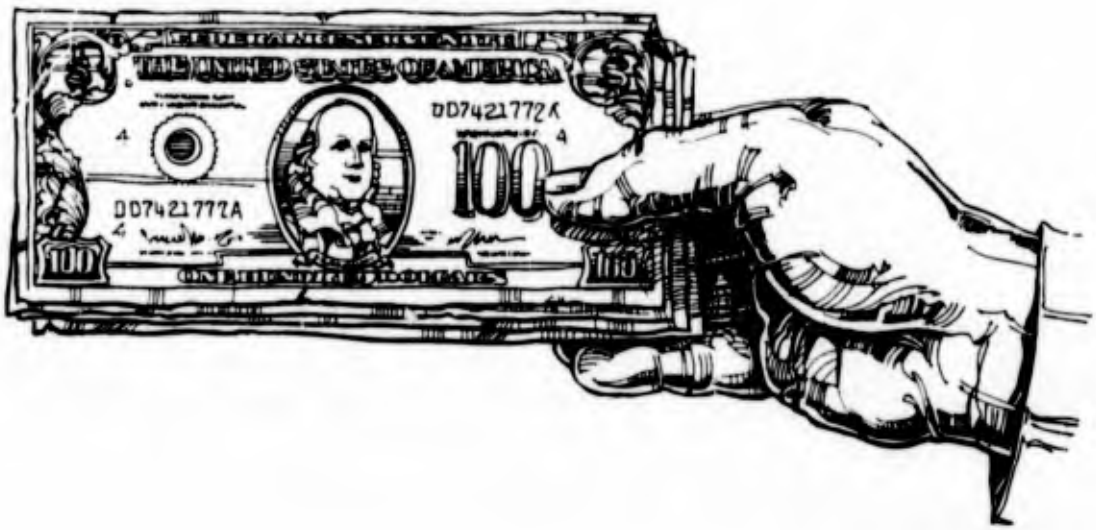
Shop personnel continued their support by fabricating items necessary to meet the research needs. Among the items requiring special work were components for the HIMS, components for oxygen studies, modifications to equipment in support of the stress studies, target support units, as well as many small modifications and fabrication work requests. A major effort was the completion of a one-of-a-kind shock tube to be used for acoustical experiments. Involving much planning and design, this project required over 500 man-hours to complete.

A 21 percent increase in completed work orders was achieved over FY 82 involving 341 completed work orders. Time expended per work order ranged from .5 to 75.5 man-hours.

# Supply

The Supply Branch prepares and submits purchase orders for nonstandard supplies and equipment with proper authorization and justification as well as requesting, sorting, and issuing all standard and nonstandard supplies. This branch acts as the technical liaison between researchers and the Fort Rucker procurement office for establishing high dollar contracts to support the USAARL research mission. The researcher is assisted by supply personnel in composing justification for purchasing equipment and supplies. The Mission Support Supply Account, the formal account that allows for bypass of standard procedures, also is managed by the Supply Branch. Supply operates a self-service account and maintains and conducts searches utilizing modern literature, catalogs and supply regulations. From the warehouse area, expendable supplies may be acquired, as well as other small items requested. Large and heavy items are delivered to the division by transportation and personnel provided by the Supply Branch. During FY 83, 963 purchase requests were submitted, of which a large percentage required special handling. A major accomplishment for the Supply Branch was the development and implementation of a new tracking system for providing immediate and up-to-date status on all supply items over $3,000 in value.

The realignment and new SOP for incoming products aligns the Supply Branch's formal account with the traditional operation of a formal account and separates all actions that have caused confusion with past performance. There now exists a clear definition of supply, property, receiving, storing, and transportation duties and responsibilities.



# PROGRAM FUNDING FY-81-82-83

(Thousands of Dollars)

| FY Year | 6.1 Research | 6.2 Development | 6.5 Management Support | Reimbursable | Total |
|---|---|---|---|---|---|
| 81 | 713.0 | 2607.0 | 49.0 | 615.0 | 3984.0 |
| 82 | 850.0 | 3985.0 | 181.0 | 263.9 | 5279.9 |
| 83 | 833.0 | 4736.0 | 303.0 | 73.5 | 5945.5 |

# Funding

## Customer-Funded Projects

Customer-funded research projects are complementary to our established scientific research programs. Each research laboratory has specific research expertise that can be utilized by designers and developers that do not possess the manpower or expertise to accomplish the research. USAARL performs the research, accumulates the data, and prepares the written report. This allows us to increase our scientific data base and to supply the information needed by the designers and developers.

There were nine customer-funded projects in FY 83; one carried forward from FY 81, four carried forward from FY 82, and four are new ones. The projects, funding agency, and a brief progress report are given.

**Title:** Night Vision Goggles Attitude Display Concept Evaluation Program, Phase II

FUNDED BY: Directorate of Combat Developments

INVESTIGATORS: Bruce E. Hamilton and Ronald R. Simmons

**Objectives:** A Letter of Agreement (LOA) commited the Naval Air Systems Command and USAARL to conduct joint research, funded by the Directorate of Combat Developments (DCD), on a heads-up-display with dynamic attitude indicator, integrated with night vision goggles. The research will evaluate the effectiveness of new display technology and focus upon determining whether or not the heads-up-display could be used effectively by pilots. Crucial to this evaluation is the quantitative documentation of changes in pilot workload as a function of the heads-up-display when used in various flight environments.

**Progress:** Flight testing has been finished and final report has been prepared to forward to Directorate of Combat Developments.

**Title:** Measurement of Head and Chest Accelerations of Tank Gunner During Gun Firing

FUNDED BY: Naval Surface Weapons Center, Dahlgren, VA; Human Engineering Laboratory (HEL), Aberdeen Proving Ground, MD

INVESTIGATORS: Ted Hundley, James A. Lewis, and Donald C. Schneider

**Objective:** To measure the head and chest accelerations imposed on the gunner during the firing of the tank gun. This information is needed to support the design requirements for the Mobile Protected Weapons System/Mobile Protected Gun program. There is some concern about the ability of the tank gunner to perform effectively when subjected to the recoil of the large caliber guns mounted on lightweight air-mobile tanks. A program has been initiated by HEL in concert with the Marine Corps and Navy to investigate the problem.

**Progress:** The head/chest acceleration data, as measured in dummies and live subjects, has been analyzed and a draft report completed. The report shows that peak acceleration values (up to 12g) were tolerated by a volunteer with no adverse effects. Based on the limited research data available, as gleaned from a literature search, this acceleration does not exceed human tolerance for one single impact, but no conclusion can be reached as to the effects of repeated exposure, either to the sequencing, total number, or frequency of exposure. Boxing studies imply that subinjurious impacts have a cumulative injurious effect. Follow-on test instrumentation work has been suspended while awaiting further guidance from HEL regarding future test dates at the Tank Command. The experimental test pulse to have been employed during the research will have to be reconstituted and verified at that facility. Additionally, their ride simulator will have to undergo a "man-rating" evaluation to permit it to be used with human subjects in conducting the research.

**Title:** Development of a Test Method for Evaluating the Effectiveness of Helmet Retention Systems

FUNDED BY: Naval Air Development Center, Warminster, PA

INVESTIGATORS: Ted Hundley and Joe Haley

**Objective:** Helmet loss during ejection and parachute opening continues to be a problem for the U.S. Navy. Current helmet retention system tests are not adequate for evaluation of their flight helmets. They have requested that we provide dynamic test criteria suitable for the qualification of helmet retention systems to be used in an ejection seat or crash environment.

**Progress:** All test equipment has been obtained and modified. In addition, four preliminary tests have been conducted, but film analysis is not yet completed. The modified Department of Transportation test device shows promise as an adequate, repeatable test method.

**Title:** Concept Evaluation Program Test of the Program of Instruction for the Pilot Night Vision System (PNVS) in a Surrogate Aircraft

FUNDED BY: U.S. Army Aviation Board, Fort Rucker, AL

INVESTIGATOR: William E. McLean

**Objective:** To monitor the Integrated Helmet and Display Sighting System (IHADSS) to determine problems with proper fit and alignment and individual adaptability to PNVS. The questions concerning eye dominance and visual suppression of successful operators of this unique monocular system will be investigated.

**Progress:** Flight tests have been completed for four classes of four students each, and the project has been terminated. The visual data on each student was given to the U.S. Army Aviation Board for regression analysis. Preliminary results show eye dominance, astigmatism, and spectacle wear as major contributing factors for predicting the time to complete PNVS training.

**Title:** Acoustic Evaluation of Samples of Helmet Compatible Communication/Aural Protective System (HCCAPS)

FUNDED BY: U.S. Army Natick Research and Development Command, Natick, MA

INVESTIGATOR: Ben T. Mozo

**Objective:** Determine the electro-acoustic characteristics of the "talk-through" circuit and the hearing protective characteristics of the muff system, to include distortion frequency response and acoustic output using device in combination with insert protection.

**Progress:** The remainder of the HCCAPS versions were received in August 1983 for evaluation. Results of real-ear attenuation testing indicate significant problems exist with the prototype systems. An investigation of the systems indicates the ear seal/earphone retainer design is the main contributor to inadequate attenuation at the low frequencies. The contractor currently is working on a new design which should be available for evaluation during first quarter FY 84. The Type I production system delivery is expected in early first quarter FY 84. An evaluation of this version should validate the design of this production model. Further work on Types II, III, IV, and V should be postponed until the ear seal/earphone retainer system is finalized.

**Title:** Calibration of Headsets for Weaponeer Training Device

FUNDED BY: Naval Training Center, Orlando, FL

INVESTIGATOR: Ben T. Mozo

**Objective:** Determine the frequency response and sensitivity of the headsets.

**Progress:** Thirty headsets were received in September 1983. The instrumentation required for these tests has been assembled and calibrated. The headsets are in the process of being calibrated. Preliminary data indicate these headsets are similar to previous devices which were calibrated by this laboratory. The remaining 70 devices should be delivered during December 1983.

**Title:** Instrumented Anthropomorphic Dummies for Airdrop Testing

FUNDED BY: Yuma Proving Ground, Yuma, AZ

INVESTIGATOR: Roy Maday

**Objective:** To monitor the Test and Evaluation Command parachute test to determine the potential for injury for jumps in excess of 200 knots airspeed.

**Progress:** The three articulated dummies were instrumented and shipped to Yuma Proving Ground for the tests. The drop tests have been delayed due to nonavailability of other parachute equipment. Tests are currently planned for third quarter FY 84.

**Title:** Optical Evaluation of Three XM-40 and One S-10 Protective Masks

FUNDED BY: U.S. Army Chemical Research and Development Center, Aberdeen Proving Ground, MD

INVESTIGATORS: Clarence E. Rash and William E. McLean

**Objective:** To optically evaluate four candidate protective masks in the testing areas of prismatic power, spherical and cylindrical refractive power, haze, spectral transmission, photopic transmission, distortion, and visual field.

**Progress:** Project was completed and results have been published in USAARL Letter Reports, LR-83-9-2-6 and LR-83-10-2-7.

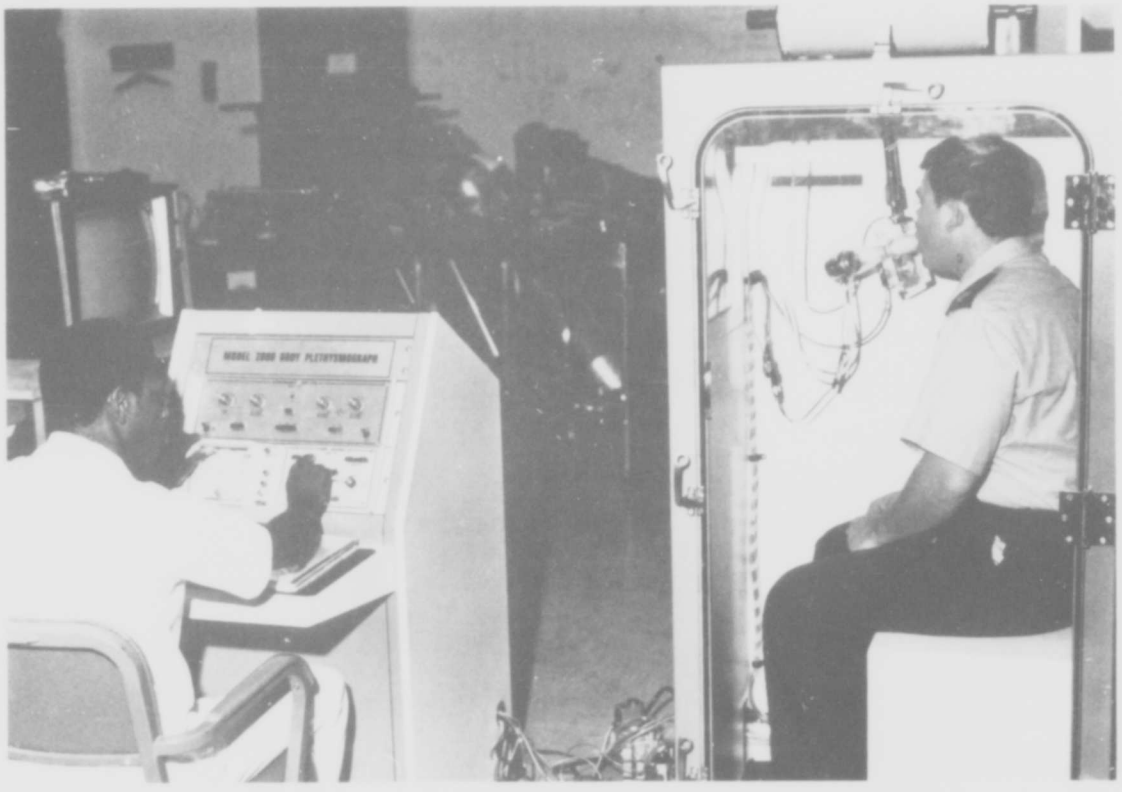
**Title:** Evaluation of Protective Characteristics of SPH-4 Helmet Against Criteria

FUNDED BY: U.S. Army Natick Research and Development Laboratories, Natick, MA

INVESTIGATORS: Joe Haley and Roy Maday

**Objective:** To conduct an assessment of the protective characteristics of the modified SPH-4 helmet against criteria set forth in MIL-H-43925.

**Progress:** Helmets have been received and have been tested for impact protection and retention. One extra large size helmet remains to be evaluated. Report will be written as soon as this helmet is tested.



# Contracts

The comprehensive extramural contract program contributes to USAARL's established scientific programs. Thirty-six research proposals were submitted for review by this laboratory in FY 83. Of these, 21 were favorably recommended for funding. Three have received funding, and five more have been approved for funding during the first quarter of FY 84.

**Title:** Hearing Protection Against Low Frequency Weapon Noise

CONTRACT NO. DAMD 17-82-C-2105

CONTRACTOR: Auburn University, Auburn, AL

INVESTIGATOR: R. M. Broughton, Jr.

**Objective:** The objective of this research is to discover what material properties are responsible for noise attenuation in foam earplugs. Recommendations should then be possible for materials and construction of an improved earplug.

**Progress:** Data collection and analysis of parameters which effect attenuation of foam earplugs have been completed. The report is in progress, with expected completion in December 1983.

**Title:** Development of Auditory Localization Test Procedure

CONTRACT NO. DAMD-17-80-0131

CONTRACTOR: Florida State University, Tallahassee, FL

INVESTIGATOR: L. F. Elfner

**Objective:** Current military weapons, such as the M198, VIPER, and M109, produce blast overpressures which require combinations of hearing protectors. The contractor will develop methods to determine the effects of these protectors on the ability of soldiers to localize sounds. The localization of sound is considered essential to safety and operational effectiveness. Results of this study will have direct implications for improved protector design and provide a methodology to be used throughout the development of future hearing protective devices for use around Army weapons.

**Progress:** Preliminary analyses of impulse measures made after corrections indicate that the effective reduction of reflected energy by the chamber walls is marginal at best. The completed rotating boom has been installed in the anechoic chamber. The boom control system is operational and has been interfaced to the laboratory computer system. It has been found that with broadband signals, insufficient energy is radiated from the boom speaker to overcome attenuation by passive hearing protectors. Narrow band signals can be generated with sufficient energy.

**Title:** Evaluation of Inner Ears for Loss of Sensory Cells

CONTRACT NO. DAMD 17-80-C-0109

CONTRACTOR: University of Texas at Dallas, Richardson, TX

INVESTIGATOR: R. P. Hamernik

**Objective:** To determine extent of damage to the cochlea from noise exposure.

**Progress:** Processing of cochleas received from USAARL during FY 83 has been completed. Reduced level of effort at USAARL has resulted in reduced activity by the contractor. An extension of the time without funding has been negotiated to allow completion of the work.

**Title:** Statistical Analysis of Helicopter Pilot Performance During Instrument Flight Across Repeated Flights

CONTRACT NO. DAMD 17-81-C-1174

CONTRACTOR: Jacksonville State University, Jacksonville, AL

INVESTIGATOR: Gary Yunker

**Objective:** Flight commanders must have as much information as possible concerning the length of time that helicopter pilots can safely and successfully fly during extended operations. Examination of pilot performance data during simulated extended operations along with concurrent visual performance data will facilitate a description of the total primary workload of aviators during IFR conditions and will allow an assessment of any degradation of performance which may occur.

**Progress:** Factor analyses of dependent measures of aircraft stability have been performed. The research has been completed and findings are being prepared for submission.

**Title:** Blast Trauma: The Effects on Hearing

CONTRACT NO. DAMD 17-80-C-0133

CONTRACTOR: University of Texas at Dallas, Dallas, TX

INVESTIGATOR: R. P. Hamernik

**Objective:** The objective of this study is to extend our basic knowledge of the nature of injury to the hearing receptors resulting from exposure to impulsive sounds (blast overpressure). Army weapons systems produce impulse noise which may be hazardous to hearing. The results of this study will contribute to the current data base by providing information about the nature of the injury.

**Progress:** Contract is completed and final report submitted. Audiometric, physiological, and anatomical measurements were obtained from chinchillas that were exposed to impulses of 155-160 dB peak sound pressure level. The traumatic effects of the exposure were quite variable; some animals essentially were unaffected while others showed large thresholds shifts and significant hair cell losses. At frequencies where the exposure caused a hearing loss, there was also a loss of frequency selectivity as determined by either evoked response or psychophysical tuning curves (PTC). Damage to the cochlea as a result of exposure to blast has been thought to result from direct mechanical damage to the tissue as well as to the subtle damage resulting from metabolic depletion. Direct mechanical damage to the cochlea (e.g., tearing and ripping of the organ of Corti from the basilar membrane) was shown to occur immediately after impulse noise exposure.

**Title:** Cochlear Microphonic Response to Low Frequency Noise

CONTRACT NO. DAMD 17-78-C-8067

CONTRACTOR: University of Florida, Gainesville, FL

INVESTIGATOR: D. C. Teas

**Objective:** To determine the mechanisms of high frequency hearing loss from low frequency noise.

**Progress:** Recent data have shown that the high-intensity, low-frequency noise stimulation induces discharges in auditory nerve fibers due to multiple stimulating events. That is, both the displacement and the velocity of the displacement produce discharges. Velocity and displacement components of the stimulus were associated directly with the different discharges seen in the recordings from the auditory nerve fibers. The research studies have been completed and the final report is in process.

**Title:** Neck Muscle Endurance and Fatigue as a Function of Helmet Loading: The Definitive Mathematical Model

CONTRACT NO. DAMD 17-80-C-0089

CONTRACTOR: Wright State University, Dayton, OH

INVESTIGATOR: C. A. Phillips

**Objective:** To provide objective data to complete the predictive model which USAARL can use in writing specifications for helmet weight and center of gravity placement. Such data will help minimize helmet development cost and maximize efficiency in the wearer of protective headgear by reducing helmet induced fatigue.

**Progress:** There is no clear correlation between maximal voluntary neck muscle endurance time and helmet weight for center-high and center-low center of gravity configurations. With a standard helmet weight (3.2 lbs), the forward-low or lateral-right-low center of gravity configurations show large endurance times for the lateral contraction mode, while with higher weights (5 lbs and 9 lbs) the endurance time is significantly reduced. Amplitude of electromyographic (EMG) signals recorded from surface electrodes continuously increases for all fatiguing contractions tested, while the center frequency for the EMG power spectrum continuously decreases. There is a pronounced increase in blood pressure and heart rate during isometric contractions of neck muscles. The RMS amplitude of the EMG as an index of isometric strength recovery appears to

be h.ghly variable for both the forward and lateral contraction modes, helmet center of gravity, and helmet weight. An additional subject pool has been recruited and final testing is well underway. Preliminary development of a multiple linear regression mathematical model has begun.

Title: The Effect of Helicopter Vibration on the Spinal System

CONTRACT NO. DAMD 17-82-C-2153

CONTRACTOR: University of Vermont, Burlington, VT

INVESTIGATOR: M. D. Pope

**Objectives:** To measure volunteer response to three-axes of UH-1 helicopter vibration in age-matched females and males. To establish the relationships between vibration posture and possible causes of low back pain in the Army rotary-wing aviator.

**Progress:** Using a UH-1 helicopter cockpit simulator, the electromyographic (EMG) response of the erector spinae musculature was monitored while volunteers maintained a standard aviator posture in a static (nonvibrating) mode. As the back muscles became fatigued, the RMS amplitude of the EMG activity increased while the center frequency of the EMG power spectrum decreased. Onset, intensity, and duration of any low back pain was recorded also. Static tests are near completion and vibration studies are scheduled to begin in first quarter FY 84.

Title: Characterization of the Photoreceptor Population in the Retina of the Bushbaby

CONTRACT NO. DAMD 17-83-C-3066

CONTRACTOR: University of Florida, Gainesville, FL

INVESTIGATOR: G. M. Hope

Objectives: To qualitatively and quantitatively analyze the photoreceptor population of the bushbaby, Galago crassicaudatus. To determine the kind of photoreceptors present, affinity differences between photoreceptors to different histochemistry techniques, and ultrastructural differences between receptor cells. To conduct a morphometric assessment of photoreceptor densities and distributions across retina. To perform a detailed ultrastructural analysis of photoreceptors.

Progress: Work continued on the general electron microscopic (EM) and light microscopic (LM) evaluations, quantification of the photoreceptor population at these levels and the initiation of two of the selective labeling experiments. The quantitative work is proceeding at a satisfactory pace. The qualitative EM and LM observations have been consistent with initial impressions. Have been unable to find photoreceptors having outer segment configurations which are convincingly cone-like. This may be an indication of infrequency of occurrence of cones or may reflect a unique feature of the photoreceptors presumed to be cones based on synaptic terminal/nuclear configuration and/or results of procion yellow staining. Two additional Galago eyes for general quantitative and qualitative EM currently are being processed. Initial selective marking experiments have provided mixed results.

Title: The Effects of Blast Trauma (Impulse Noise) on Hearing: A Parametric Study

CONTRACT NO. DAMD 17-83-G-9555

CONTRACTOR: University of Texas at Dallas, Dallas, TX

INVESTIGATOR: R. P. Hamernik

Objective: The objective of this study is to extend the biological data base relating parameters of impulse noise to auditory injury.

Progress: New contract; no progress report to date.

Title: The Personal Monitor and Communicator: An Electronic Dogtag

CONTRACT NO. DAMD 17-83-G-9559

CONTRACTOR: Purdue University, West Lafayette, IN

INVESTIGATOR: W. A. Tacker

Objective: To develop a personal medical monitor for the soldier which would be worn much like a wristwatch or dogtag and could (1) acquire vital signs, (2) acquire environmental data, (3) carry medical history, and (4) transmit information to command headquarters. The device would be used in the field for (1) triage by medics (both under conventional and integrated battlefield conditions, (2) monitoring during evacuation, (3) battalion aid station and field hospital monitoring,

(4) monitoring chemical and radiation exposure, (5) transmitting the data given in items 1 through 4, and (6) locating the wearer(s).

Progress: New grant; no progress report to date.

# PERSONNEL STRENGTH

| FY 81 | OFFICER | WO | EM | CIVILIAN PERM/TEMP | | CO-OP STUDENT | STUDENT AIDES | TOTAL |
|---|---|---|---|---|---|---|---|---|
| AUTHORIZED | 30 | | 47 | 61 | 12 | | | 150 |
| ACTUAL | 28* | | 48** | 56 | 6 | 6 | 4 | 148 |
| FY 82 | | | | | | | | |
| AUTHORIZED | 31 | | 47 | 62 | 12 | | | 152 |
| ACTUAL | 29 | | 54 | 60 | 10 | 6 | | 159 |
| FY 83 | | | | | | | | |
| AUTHORIZED | 31 | 1 | 47 | 66 | 12 | | | 157 |
| ACTUAL | 30 | 1 | 46 | 61 | 7 | 4 | 1 | 150 |

*Includes one Navy Officer
**Includes one Air Force Sergeant

# Personnel

The educational and skill levels of the laboratory's assigned personnel continually are increasing. These increases come through assignment of highly-qualified new personnel, completion of some long-term educational goals by others, and through the initiative and personal determination of those who pursue studies after duty hours.

Training is a vital element in maintaining and improving the proficiency of assigned personnel. Forty-three military and 146 civilian USAARL employees received training and professional development courses during FY 83. In addition, such training experiences as professional conferences, seminars, and short courses benefited 35 people.

Earned among the laboratory's professional personnel are 26 doctorate, 19 master, and 26 bachelor degrees.

Mandatory training requirements were met by all military personnel. In the skills qualification testing for FY 83, USAARL military personnel had a 98 percent pass rate.

Six persons reenlisted or extended their enlistments for a total of 27 years.

PERSONNEL BY CATEGORY

| Category | Authorized |
|---|---|
| Professional | 58 |
| Scientists (46) | |
| Engineers ( 6) | |
| Other ( 6) | |
| Skilled Technicians | 61 |
| Administrative | 10 |
| Clerical | 32 |
| TOTAL | 161 |

# Personnel Achievements

## Civilian Awards

| | |
|---|---|
| Certificate of Achievement | 3 |
| Sustained Superior Performance Award | 3 |
| Exceptional Performance | 30 |
| Quality Step Increase | 1 |

## Military Awards

| | |
|---|---|
| Legion of Merit | 2 |
| Meritorious Service Medal | 3 |
| Army Commendation Medal | 10 |
| Army Achievement Medal | 4 |

## Promotions

| | |
|---|---|
| Military | |
| Officers | 5 |
| Enlisted Personnel | 16 |
| Civilians | |
| Permanent | 9 |
| Temporary | 5 |
| Co-Op Students | 3 |

## Special Recognition

| | |
|---|---|
| USAARL Soldier of the Year | SP4 John R. Hughel II |
| Award of the "A" Professional Designator | LTC Roger W. Wiley (Ret.) |

# Civilian TDY Training

| COURSE TITLE | RACE | | | SEX | | Site |
|---|---|---|---|---|---|---|
| | Black | White | Hispanic | Male | Female | |
| Accelerated Reading | | 1 | | | 1 | Atlanta, Georgia |
| Office Management | | 1 | | | 1 | Atlanta, Georgia |
| Management of the Scientific and Engineering Organization | | 1 | | | 1 | Augusta, Georgia |
| Federal Women's Program Workshop | 1 | | | | 1 | Atlanta, Georgia |
| Effective Briefing Techniques | 1 | | | | 1 | Atlanta, Georgia |
| Government Property Administration | | 1 | | 1 | | Arlington, Virginia |
| Basic Statistics | 1 | 1 | | | 2 | Atlanta, Georgia |
| Joint Travel Regulations - Volume II | | 2 | | | 2 | Atlanta, Georgia |
| FEW 14th National Training Program | 1 | | | | 1 | Hawaii |
| Human Factors Engineering Advanced Concepts Course | | 1 | | | 1 | Ann Arbor, Michigan |
| Computer Graphics | | 1 | | 1 | | Washington, D.C. |
| Limited Budget Graphics | | 1 | | 1 | | Washington, D.C. |
| Planning, Programming and Budgeting | 1 | | | | 1 | Fort Benjamin Harrison, Indiana |
| Long Term Training for Professional Staff | | 1 | | 1 | | Long Term |

| COURSE TITLE | RACE | | | SEX | | Site |
|---|---|---|---|---|---|---|
| | Black | White | Hispanic | Male | Female | |
| Measurement Uncertainty at the Instrument Society of American Training Center | | 1 | | 1 | | Raleigh, N.C. |
| Scientific Info Retrieval Data Base Management Systems Introduction | | 2 | | 2 | | Evanston, Illinois |
| Current Status of Digitizing General Aviation Trainers | | 1 | | 1 | | Binghamton, New York |
| Senior Executive | | 1 | | 1 | | Charlotte, N.C. |
| Impact Dynamics | | 1 | | 1 | | Los Angeles, California |
| Smart Systems and Human Factors in Battlefield Robotics | | 1 | | 1 | | Los Angeles, California |
| High Speed Motion Analysis Systems and Techniques | | | 1 | 1 | | Madison, Wisconsin |

A total of $11,463.49 was spent on tuition or registration for civilian employees. A total of $24,980.31 was spent on travel and per diem.

More than 37 women were trained in courses to upgrade their skills and provide them with knowledges and skills to enhance their chances for competing for higher grade positions.

# Civilian Local Training

| COURSE TITLE | RACE | | | SEX | | Days |
|---|---|---|---|---|---|---|
| | Black | White | Hispanic | Male | Female | |
| Basic EEO Counseling | 1 | 3 | | 1 | 3 | 5 |
| Achieving Your Potential | 1 | 4 | | 1 | 4 | 4 |
| Contracting Officer's Rep | | 1 | | 1 | | 5 |
| Basic Supervisory Development | | 1 | | 1 | | 5 |
| Nichols Listening | 1 | 2 | | 1 | 2 | 1 |
| Proofreading | | 2 | | | 2 | 3 |
| Personnel Management for POC | | 2 | | 1 | 1 | 1½ |
| Management Orientation for Admin Clerks and Tech Employees | | 5 | | | 5 | 3 |
| Contracting for Tech Reps | | 1 | | 1 | | 3 |
| Shorthand Refresher | 1 | | | | 1 | 5 |
| ADP for Admin, Clerical and Secretarial Personnel | | 2 | | | 2 | 3 |
| Assertiveness Skills for Non-Supervisory Personnel | 1 | 5 | | 1 | 5 | 3 |
| Decision Making and Problem Solving Workshop | | 1 | | | 1 | 6 |
| Writing, Editing and Design Seminar | | 2 | | 2 | | 5 |
| Role of Supervisors and Managers in EEO | | 13 | | 11 | 2 | 3 |

| COURSE TITLE | RACE | | | SEX | | Days |
|---|---|---|---|---|---|---|
| | Black | White | Hispanic | Male | Female | |
| Middle Management Institute | | 3 | | 2 | 1 | 5 |
| Managing Stress | | 3 | | 2 | 1 | 2 |
| Basic Typing Skills | | 1 | | | 1 | 5 Wks |
| Improving Communications With The Public | | 1 | | | 1 | 3 |
| Word Processing - A Clerical Orientation | | 3 | | | 3 | 3 |
| Federal Women's Program Workshop | | 2 | | 1 | 1 | 3 |
| Expressive Speaking | | 2 | | 1 | 1 | 4 |
| Advanced EEO Counseling | 1 | 3 | | 1 | 3 | 4 |
| Prevention of Sexual Harassment | 4 | 56 | 1 | 31 | 29 | 1 |
| Practical Statistics Correspondence | | 1 | | 1 | | NA |
| Automatic Data Processing Correspondence | | 1 | | | 1 | NA |
| Time Management Correspondence | | 1 | | 1 | | NA |
| EEO - Its Place in Government Correspondence | | 1 | | 1 | | NA |
| Tuition Assistance - ESJC Introduction to Mini/Micro Computer | 1 | | | 1 | | NA |

# Co-op Program

Due to a diminished commandwide hire lag, the Cooperative Education Program reduced its number of spaces to six. The demand for students continues to exceed the authorizations. Ms. Sybil Bullock continued as Coordinator for the program, and Ms. Gail Jay continued to provide administrative support for it.

A total of 18 students were in co-op roles in FY 83. Nine of these were new students and three were graduate students. Requirements existed for the following job series: electrical engineering, mechanical engineering, biomedical engineering, research psychologist, microbiologist, and physiologist. A new requirement for a graduate level physiologist was established.

During FY 83, two new universities were added to our program: Clemson University, South Carolina, and the University of Alabama, University, AL.

The Cooperative Education Handbook was revised and continues to be used as an effective educational/recruitment tool.

Recruitment trips were made to Howard University, Washington, DC, and the University of South Alabama at Mobile.

# Equal Employment Opportunity (EEO) Program

Affirmative action continued to be emphasized at USAARL. FY 83 accomplishments include the following:

Black Employees:

The total number of Black employees at USAARL remained the same; however, the average grade rose to 9.0 from 8.50. This was due to the promotion of a GS-7 Black female to GS-9. There continues to be underrepresentation in total numbers of employees with four Black employees or seven percent.

Hispanic Employees:

USAARL increased its number of Hispanic employees with the hire of one GS-7 photographer. Average grade for Hispanic employees was GS-7. The basic problem with hiring Hispanic employees is their small number in the civilian labor force. Number of Hispanic employees is one or two percent.

Women Employees:

Total number of women at USAARL remains 29 or 48 percent. This is above civilian labor force statistics. However, average grade dropped from 6.0 to 5.86. This was due to the loss of a GS-11 writer-editor. Although the average grade dropped, there were a number of internal promotions for USAARL women including two promotions to GS-9 from GS-7. There is no overall under-representation of women, but there is underrepresentation at the professional level and above the GS-11 level for women in USAARL.

Handicapped Employees:

Special emphasis was placed on recruiting handicapped employees and as a result one GS-11 writer-editor was hired.

Other Minorities:

Other minorities are not significantly represented in the civilian labor force.

Other Accomplishments:

Two women were scheduled as speakers at Scientific Seminars during FY 83. Dr. Vivian Casagrande spoke on 17 May 1983, and Dr. Diane Damos lectured on 25 August 1983.

Sixty-day temporary promotions as editorial assistants at the GS-6 level were given to all secretary-steno GS-5s to work on a special project. The commander's secretary was detailed 60 days to GS-9 writer-editor's position to lead the project. These were all women in dead-end positions.

Thirteen key employees and supervisors received "Role for Supervisors and Managers in EEO" training. Four employees received "Basic EEO Counseling," and four employees received "Advanced EEO Counseling" training. All USAARL employees received training in "Prevention of Sexual Harassment." Federal Women's Program Manager (FWPM) was sent to the Federally Employed Women's (FEW) 14th National Training Program. A total of $4,379.89 was spent on EEO training during FY 83.

# Federal Women's Program

USAARL has an active Federal Women's Program headed by a Federal Women's Program Manager (FWPM) and an alternate FWPM. This program provided information on employment, training, and recruitment opportunities to women employed at USAARL. The USAARL FWPM was appointed by the Commander, USAARL, and served as his staff advisor on matters affecting women. The FWPM duty was, and remains a collateral duty assignment.

USAARL's FWPM also was a member of the Federal Women's Program Committee (FWPC) for the Commanding General, Fort Rucker, AL. This committee provided the Commanding General with advice and information regarding issues affecting the Federal Women's Program (FWP) and the female employees in the Fort Rucker work force, developed proposals for improvements in the FWP at Fort Rucker, and provided assistance in developing the Installation's Affirmative Action Program. During the past year, the FWPC co-sponsored the Employees/Supervisors' Luncheon during National Secretary's Week, a program for Women's History Week, and the Federal Women's Week.

# Junior Fellowship Program

One Junior Fellowship student continued her schoolwork assignment in FY 83. While attending a local junior college, she continued work assignments at the Scientific Information Center, USAARL, during holidays and summer vacation. She was promoted to GS-3 from GS-2 during this report period.

# Mobilization Designee (MOBDES) Program

The MOBDES program preassigns selected US Army Reserve (USAR) officers. These officers have contributed to the expansion of the USAMRDC in both scientific and administrative positions. In its 15 designee positions, the USAARL MOBDES program includes allied science officers, medical officers, aviators, and combat arms officers. Filling only half these positions, many designees completed third terms, while all have made significant contributions to the aeromedical research program. Significant accomplishments for this year included filling of the research aviator's position and the incumbent's transition qualification in the JOH-58 helicopter, the design of a new acoustics research facility, preliminary health hazard assessment of the tank test bed concept review program, and safety assessment of the new Fort Rucker health facility.

# Scientific Seminars

USAARL sponsored eight scientific seminars at the laboratory facilities. These seminars were given by experts performing research in the areas that coincide with USAARL research efforts. A total of $7,013.73 was spent for these seminars. The following is a list of speakers, their topics, and the dates of their seminars. Benefits included transfer of information, cross-training for the research staff, and interaction with the research staff on primary research efforts.

| Speaker | Affiliation | Topic | Date, Sponsor |
|---|---|---|---|
| Dr. Howard Baker | Florida State University | Are difference thresholds like absolute thresholds in vision? | 22 Feb 83 Dr. Behar |
| Dr. Thomas A. Gennarelli<br>Dr. Lawrence E. Thibault | University of Pennsylvania | Brain injury and acceleration. | 17 Mar 83 MAJ Shanahan |
| Dr. Y. King Liu | University of Iowa | A finite element model analysis of the protection provided by Army aviator helmets. | 21 Mar 83 Mr. Haley |
| Mr. Donald Vreuls | Vreuls Research Corporation | Assessment of pilot performance. | 21 Apr 83 Dr. Kimball |
| Dr. Guy A. Orban | Katholieke University, Leuven, Belgium | Motion sensitivity. | 29 Apr 83 CPT Fulbrook |
| Dr. Vivian A. Casagrande | Vanderbilt University | Visual system of the bush baby. | 17 May 83 Dr. Harding |
| Dr. Andrew Mariani<br>Dr. Ralph Nelson | National Institute of Health, Bethesda, MD | Neural cells in vertebrate retinas. | 15 Sep 83 CPT Fulbrook |
| Dr. Diane Damos | Arizona State University | Individual differences in multiple task performances. | 25 Aug 83 CPT Hamilton |

# Worker-Trainee Program

The worker-trainee program is designed to give unskilled persons an opportunity to develop their potential skills while on the job over a three-year period. They enter the work force at the GS-1 level and through satisfactory on-the-job and classroom training improve their skills to meet the requirements for the next level.

This program receives great emphasis at Fort Rucker and is used as a productive effort to further achieve affirmative action goals.

USAARL employs two worker-trainees who are assigned in permanent clerical positions at the US Army Aviation Center. Supervisors are involved actively on a daily basis in on-the-job training, developing, and implementing the formal training plan. When the requirements of the training plan have been met, the incumbents will be placed in permanent positions at Fort Rucker.

# Scientific Programs

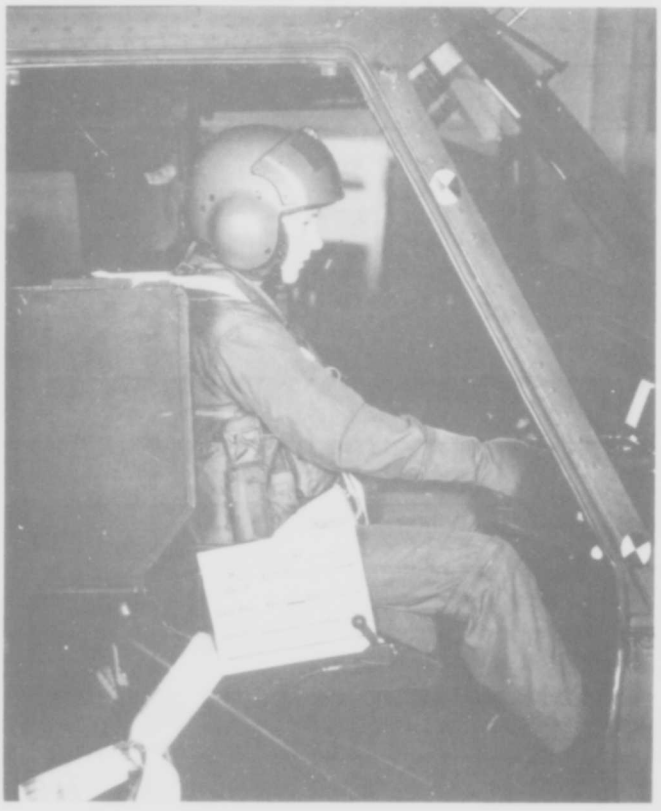
USAARL scientific research encompasses four of USAMRDC's major research areas. They are: Systems health hazard; hazards of mechanical forces; combat crew effectiveness; and soldier chemical warfare agent antidote. Under each of these research areas, USAARL has an established scientific program or programs. Such scientific programs involve one or more individual projects documented by a DD Form 1498. This is a convenient system for grouping the work USAARL does, and it makes easier the tracing of compliance with USAMRDC guidelines.

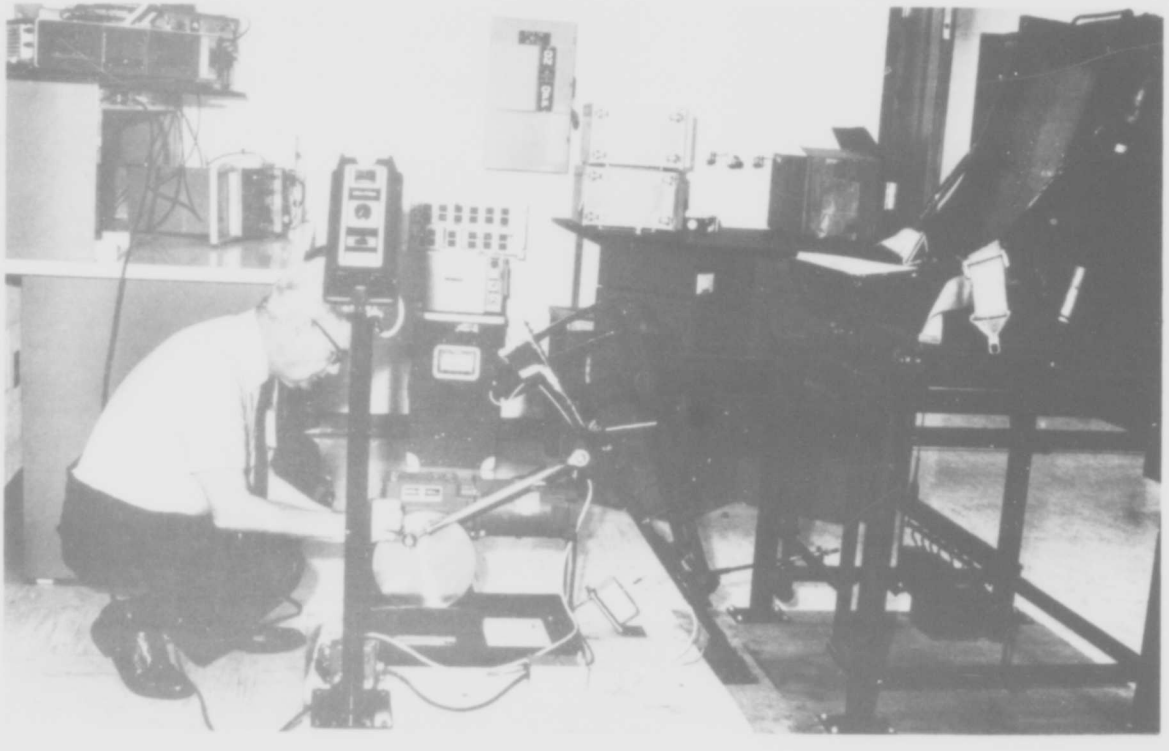
The research areas and the DD Forms 1498 that pertain to them are as follows:

| TITLE | DA ACCESSION NUMBER | PROGRAM ELEMENT, TASK AREA, WORK UNIT |
|---|---|---|
| **SYSTEMS HEALTH HAZARD RESEARCH AREA** | | |
| Physiology and Psychophysics of Information Transfer in the Visual System | DAOG 5999 | 6.11.02.A CB 283 |
| Military Acoustic Hazards: Mechanisms of Hearing Loss | DAOB 6889 | 6.11.02.A CB 282 |
| Ultrastructural Survey of Retina and Optic Nerve in Vertebrates | DAOH 0151 | 6.11.01.A 00 292 |
| **HAZARDS OF MECHANICAL FORCES RESEARCH AREA** | | |
| Auditory Effects of Blast Overpressure | DAOG 5998 | 6.27.77.A AA 136 |
| Hearing Protective Devices: Prevention of Adverse Physiological Effects of Noise | DAOB 6886 | 6.27.77.A AC 135 |
| Biodynamics of Life Support Equipment and Personnel Armor | DAOG 0167 | 6.27.77.A AG 131 |

| TITLE | DA ACCESSION NUMBER | PROGRAM ELEMENT, TASK AREA, WORK UNIT |
|---|---|---|
| Biodynamics of Impact Physiology | DAOD 6735 | 6.27.77.A AG 137 |
| Vibration Hazards of Combat Aircraft and Vehicles | DAOG 6100 | 6.27.77.A AD 132 |
| Biomedical Application and Health Hazard Assessment of Oxygen Enrichment Breathing Systems | DAOG 0169 | 6.27.77.A AF 134 |
| Development of Military/ ASTM Standard Method for Rapid Assessment of Burn Hazard | DAOH 0152 | 6.11.01.A 00 291 |
| Cardiopulmonary Physiology in Army Aviators | DAOG 1505 | 6.11.02.A 00 279 |
| COMBAT CREW EFFECTIVENESS RESEARCH AREA | | |
| Military Visual Problems: Assessment, Mechanisms, and Protection | DAOB 6893 | 6.27.77.A BG 164 |
| Research Directed at Biomedical Parameters Affecting Aircrew Workload During Sustained Operations | DAOG 0153 | 6.27.77.A BH 161 |
| Visual Performance Research Related to Operational Problems in Army Aviation | DAOG 0156 | 6.27.77.A BH 162 |
| Parametric, Multimodal Workload Assessment in Aircraft Guidance Systems | DAOG 6101 | 6.27.77.A BH 163 |
| Aeromedical Research of Operationally Significant Problems in the Army Aviation Environment | DAOG 0151 | 6.27.77.A BH 165 |

| TITLE | DA ACCESSION NUMBER | PROGRAM ELEMENT, TASK AREA, WORK UNIT |
|---|---|---|
| Anthropometric Criteria for Army Aviators | DAOG 6102 | 6.27.77.A BH 166 |
| Development of Techniques to Monitor Brain Function of Aviators During Flight in Army Fixed- and Rotary-Wing Aircraft | DA300426 | 6.11.01.A 00 293 |
| SOLDIER CHEMICAL WARFARE AGENT ANTIDOTE RESEARCH AREA | | |
| Antidote and Antidote/Agent Effects on the Visual System | DAOG 8399 | 6.27.34.A AO 381 |
| Effects of Nerve-Agent Antidotes on the Visual System | DAOG 1506 | 6.11.01.A 00 277 |





# Systems Health Hazards Program Area

This basic research project area principally involves the development of the minimum biological and biomedical data bases necessary and sufficient to protect personnel from hazards generated by Army systems, combat operations, and work environments. Research efforts are directed toward those physiological and biomedical technology bases which provide the foundation for the more applied USAARL research programs addressing military systems and operations presenting potential health hazards. Investigations in this program include studies to provide quantitative information on the physiological processes and mechanisms subserving visual perception, and studies to determine the physiological mechanisms of auditory injury from noise.

# Sensory Physiology Program

**Background:** The development, fielding, and use of modernized Army weapons, along with new doctrine for combat operations threaten to subject the modern soldier to forces and demands which exceed his biological limitations. For example, increased noise levels and exposure profiles for a broad range of weapons will place additional demands on the capability of the human ear to withstand high noise environments and still function adequately. New combat doctrine which places increased priority on night operations and target detection raises questions about the soldier's visual capabilities and effective procedures for maintaining and enhancing them.

The operational questions and problems which arise from new weaponry and doctrine require biomedical technologies and criteria for effective solutions. These technologies and criteria, in turn, demand sufficient biomedical data bases to support applied efforts. In most cases, however, the required data bases are either nonexistent or woefully inadequate. Consequently, the need for new biomedical data to support solutions to contemporary and future-oriented problems is substantial. USAARL's basic research program is designed to meet this need.

Obviously, future-oriented Army problems are critical in guiding the basic research program. However, not all of tomorrow's problems and questions are foreseen today. In order to maintain a scientific base capable of addressing unforeseen problems, a proportion of the basic research is nonproblem oriented in nature. This serves at least two primary purposes. First, it adds to our knowledge of basic biological principles; and second, it keeps our scientists abreast of current findings and thinking in biological sciences such that this knowledge may someday be applied to help and protect the individual soldier.

The generic goal of the basic research program is to provide biomedical data bases, along with technical concepts, to support applied research and development efforts of the laboratory. The applications for these data bases include damage-risk criteria, medically valid design criteria, medical input to doctrine and tactics, and medically-based technologies. Secondary goals of the program are to maintain professional proficiency of the scientific staff and to identify new concepts and technologies developed elsewhere with potential value for Army applications.

**Objectives:** The primary objectives of this research program include developing animal models for the study of visual and auditory functions; providing a data base on exposure-injury relationships for impulse and steady noise; providing quantitative information on the physiological processes and mechanisms which underlie visual perception; and developing and validating concepts for new methods, techniques and instruments to assess sensory capabilities and degradations.

**Progress:** In the visual neuroscience program, an electronic system and CRT display with the appropriate computer interface were developed to study precisely the receptive field properties of retinal ganglion cells. The system incorporates a novel development which increases the upper range of temporal frequencies which may be used experimentally by a factor of four over conventional technology.

A study was performed and completed which provided the first pharmacological method of selectively reducing the responsivity of a spatial frequency channel within the visual system. The finding provides a basis for determining the class or classes of visual neurons which function in a particular visual task.

A new technique for rapidly measuring spatial-temporal contrast sensitivity was developed and tested in this laboratory. The new technique, termed the "spatial bandwidth equalization method," provides for both threshold and suprathreshold contrast sensitivity measures which are correlated positively with measures derived from conventional methods.

An optical system was developed and completed along with electro-physiological recording instruments to test for the presence of additional functional photoreceptors in bushbabies and to provide for a noninvasive physiological method to assess luminosity function in humans.

A study in collaboration with members of the National Eye Institute, National Institutes of Health, provided clear anatomical evidence for a second photoreceptor type in bushbaby retina.

Pilot studies were completed which demonstrated the usefulness of using the Aplysia extraretinal photoreceptor preparation as a means of assessing the biophysical effects of anticholinesterase agents on membrane function and ion transport.

A report describing a positive reinforcement procedure for audiometry of the swine was completed as part of the development of a large animal model (USAARL Report No. 83-9). The results

indicated that inadequate control of motivational levels was a major contributor to a failure to obtain an acceptable audiogram. The basic procedure appears promising if this problem can be resolved. Efforts to improve the motivational variables used in this study have been initiated. Report preparation on a study of the role of pigmentation in susceptibility to hearing loss has continued.

DD 1498: This work was conducted under Research and Technology Work Unit Summaries.

Physiology and Psychophysics of Information Transfer in the Visual System, DAOG 5999, 283.

Military Acoustic Hazards: Mechanisms of Hearing Loss, DAOB 6889, 282.

Ultrastructural Survey of Retina and Optic Nerve Vertebrates, DAOH 0151, 292.

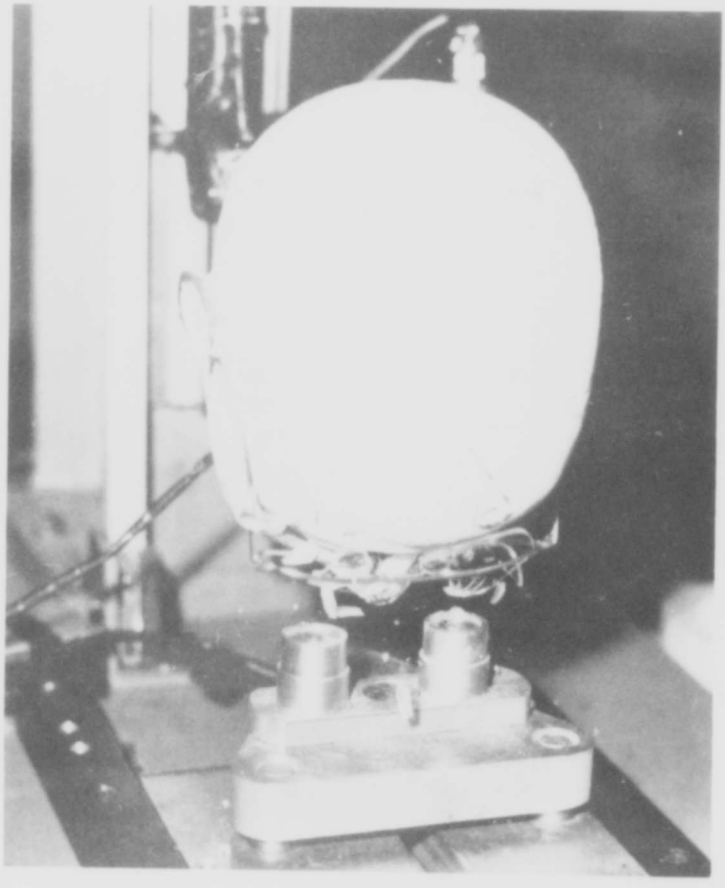
Two contract projects contributed to the research objectives of this program.

Evaluation of Inner Ears (Chinchillas) for Loss of Sensory Cells Using a Surface Preparation Histology Technique.

Research and Development of Cochlear Microphonic Response to Low Frequency Noise.

# Hazards of Mechanical Forces Program Area

Human health threats dealt with in this program area include, but are not limited to, those which are (a) built into weapon systems, (b) caused by or accompanying military operations, (c) generated during combat training, and (d) inherent to certain microenvironments. Examples include bone-degrading vibrations present in armored vehicles, heat stroke induced by wearing chemical protective suits in hot environments, and hearing loss attributable to artillery weapon noise. Efforts within this project area focus on identification and quantification of the vibration and noise assaults experienced by military personnel, development of dose-response relationships for each assault, and development of injury prevention and health protection criteria and technologies.



# Auditory Effects of Blast Overpressure Program

**Background:** Current Army weapons development efforts aimed at countering Warsaw Pact threat capabilities include improved artillery cannons, antitank rockets, and mortars. New artillery cannons and propellant charges are being developed to meet doctrinal requirements for enhanced delivery range, rapid rates of fire, and reduced weight for air mobility. Improved antitank rockets with high-energy propellants may be fired from reflective enclosures such as bunkers or covered foxholes. And, mortar technology is being advanced to achieve greater delivery ranges and rapid rates of fire. In each of these families of weapons, dangerously high levels of blast overpressure are a byproduct of advancing weapons technology.

The high levels of blast overpressure which will be commonplace on the modern battlefield pose potentially serious health hazards to soldier operators. Air-containing organs such as the ear are particularly susceptible to injury, with serious medical consequences possible. Hearing loss, even temporary, among troops using blast-producing weapons can degrade critical soldier-machine performance, endanger effective command, control and communications, and disrupt critical combat tasks such as detection of the enemy during patrol missions. Hearing loss thus can endanger the soldier's capability to accomplish the combat mission. Further, permanent hearing loss is a cause of substantial disability compensation payments, even under peacetime conditions.

The existing exposure limit for impulse noise (i.e., blast overpressure) is based on a grossly inadequate biomedical data base and on a number of assumptions which have yet to be validated. The physical characteristics of the blast wave which

are responsible for injury to the ear have not been completely identified, and the mechanisms of injury within the ear are understood only poorly. Consequently, improvements in protection technologies have been difficult to achieve.

The primary long-range goal of this research program is the establishment of a comprehensive biomedical data base to support the development of a valid damage risk criterion. A secondary long-range goal is the development of technology, approaches and devices with potential for improved protection against blast-induced hearing loss. A significant short-range goal is the direct validation of the adequacy of state-of-the-art hearing protective devices for critical developmental systems.

**Objectives:** The major technical objectives include quantitative analysis of the physical characteristics of blast waves, development and validation of a large animal model for studying auditory injury, development of laboratory impulse noise exposure capabilities where pressure wave characteristics can be systematically varied, systematic animal studies to determine the relationship between physical parameters of blast waves and auditory injury, development, and validation of mathematical models to assess the effects of protective devices on effective impulse noise exposure criteria. Further, technical objectives include identification of the mechanisms underlying blast-induced hearing loss, identification of susceptibility factors predisposing individuals to blast-induced hearing loss, and development and validation of mathematical models for predicting blast-induced hearing loss.

**Progress:** Report preparation has continued on the results of the direct validation of hearing protection for the M198/M203. The findings were used to develop recommendations for new limits on the number of lower zone propelling charges to be used per training day. Computer programs for data analysis and impulse noise generation were completed.

Data collection was completed in the third experiment on the role of peak pressure in auditory injury from impulse noise. Data analysis is in progress.

A major upgrade of the small animal (chinchilla) audiometric test facility was completed and validation tests were initiated.

Noise hazard analyses were completed for the I81mm mortar, two modified VIPER rounds, and five candidates to replace the Light Antitank Weapon (LAW). All of these resulted in recommended safe firing limits.

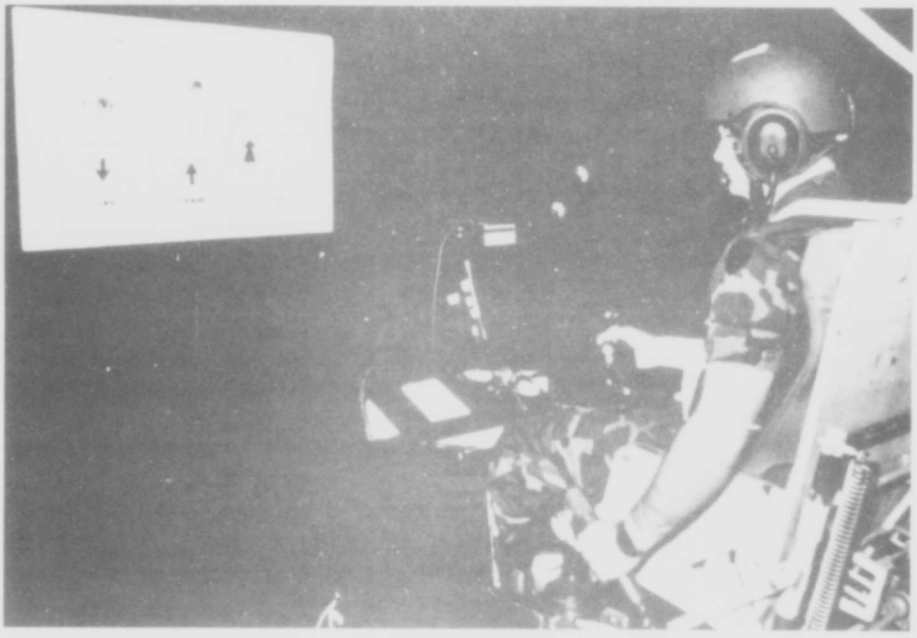
**DD 1498:** The above work was conducted under Research and Technology Work Unit Summary:

Auditory Effects of Blast Overpressure, DAOG 5998, 136.

**Contributing Work:** Work done under the following contracts contributed to the research objectives of this program:

Blast Trauma: The Effects on Hearing.

Effects of Hearing Protectors on Human Auditory Localization.



# Noise Hazards of Combat Vehicles Program

**Background:** As part of a large-scale modernization program, the Army is developing or fielding advanced design combat vehicles for a wide variety of battlefield applications. Combat doctrine being developed for the battlefield of the future calls for high-speed, lightweight, all-terrain (i.e., tracked) vehicles for fighting and transporting troops, and also for heavily armored, yet high speed tanks with enhanced firepower. Also integral to the high-intensity battlefield of the future will be high-performance helicopters with advanced design features. Such hardware combinations will generate hazardous levels of both steady noise from engines, sprockets, rotor blades, and the like, and impulse noise from machine guns, cannons, missiles, etc.

Coupled with such advanced hardware will be the requirement for continuous combat operations. This will have the effect of exposing crewmembers to greatly extended periods of steady and impulse noise in a 24-hour period. It also will likely induce fatigue and dehydration in large numbers of troops.

Extended exposure to hazardous levels of steady and impulse noise, especially when combined with other stressors, will present a serious risk of temporary and permanent hearing loss. Both types of hearing loss can degrade combat effectiveness by impairing effective command, control and communications, disrupting critical operator tasks, and degrading critical hearing-intensive combat activities. In addition, permanent hearing loss constitutes grounds for disability compensation.

The effective protection of troops from loss of hearing requires adequate hearing protective devices, both insert types and over-the-ear types. However, not all available hearing

protective devices provide adequate protection. Rigorous evaluation of developmental equipment, including helmets with earcups, communication headsets, and commercially available protective devices, is required to insure adequate protection. Further, an effective hearing conservation program requires up-to-date epidemiologic data on the extent of hearing loss and the resulting impact among specific groups of Army personnel.

The primary goal of this research program is to assess the effectiveness of hearing protective devices in order to minimize the incidence and severity of noise-induced hearing loss among Army personnel. Long-term goals include (1) the development of improved technologies and approaches for hearing protection and (2) the development of improved methodology for evaluation of hearing protective devices.

**Objectives:** The major technical objectives of this research program include measurement of the sound-attenuating characteristics of passive and active hearing protective devices and communication headsets, determination of the suitability of selected devices for specific Army applications, assessment of the influence of user variables on protective effectiveness, development and evaluation of new concepts for improved hearing protection, development and validation of improved laboratory and field techniques (e.g., physical ear method) for evaluation of hearing protective devices, development and validation of mathematical models for predicting suitability of hearing protective devices, assessment of attenuation characteristics on audiologic performance, and epidemiologic assessment of the extent of hearing loss and the asscciated impact among selected groups of Army personnel.

**Progress:** The attenuation characteristics of the first production Integrated Helmet and Display Sighting System (IHADSS) were measured in accordance with ANSI Standard Z24.22 (1957) for measurement of the real-ear attenuation of ear protectors at threshold. The attenuation of the helmet exceeded contractual requirements at all frequencies.

During FY 83, the ANSI S3.19 and ANSI Z24.22 attenuation measurement standards were implemented in the new facility. This will provide the Acoustical Sciences Research Group (ASRG) with the tools necessary to thoroughly evaluate hearing protective devices.

The Product Improvement Program (PIP) for the SPH-4 aviator helmet has produced several proposals which are currently under evaluation. A proposed change in the impact attenuation mechanisms of the helmet has caused an increase in shell size to

accommodate the additional foam. The increase in the shell dimensions and changes in the earcup retainer harness have created a significant problem in attaining the sound attenuation required for hearing protection in the aviation environment. The ASRG is working with Natick Research and Development Laboratories to resolve these problems.

The Helmet Compatible Communication/Aural Protective System (HCCAPS) prototypes were evaluated to determine acceptability for the contractual requirements and Army use. The systems, as delivered, had leaks through the ear flange/earcup interface and problems with the earseal. Production models of the HCCAPS are expected for evaluation during 2nd Quarter FY 84.

An evaluation of the effects of the XM-40 chemical protective mask on the sound attenuation and speech intelligibility characteristics of the SPH-4 aviator's helmet was completed. The evaluation indicated a degradation in characteristics relative to the SPH-4 helmet when worn alone. Recommendations are being made which should decrease these effects.

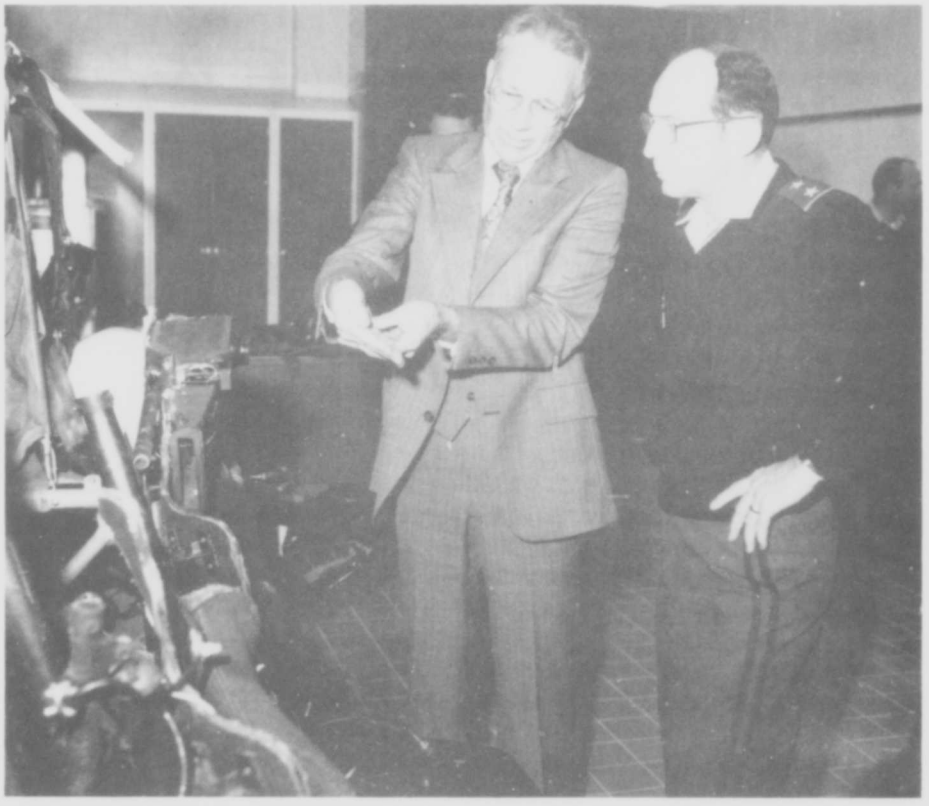
The ASRG assisted in the development of a Statement of Need (SON) for the military motorcycle helmet. This helmet is proposed for use with the military motorcycle and the Fast Attack Vehicle. In addition, a noise hazard assessment of the Bradley Fighting Vehicle was performed using tester-furnished noise data.

**DD 1498:** The above work has been conducted under Research and Technology Work Unit Summary:

> Hearing Protective Devices: Prevention of Adverse Physiological Effects of Noise, DAOB 6886, 135.

**Contributing Work:** Work done under the following contracts and customer-funded projects contributed to this research program:

> Effects of hearing protectors on human auditory localization.
>
> Hearing protection against low frequency noise.
>
> Characteristics of the HCCAPS.
>
> Crushable earcup development.



# Impact Biodynamics of Crashworthiness and Personnel Armor Program

**Background:** The inevitable result of man's use of vehicles throughout history has been impact injuries caused by crashes of vehicles. Since crashes cannot be totally eliminated, vehicles have been designed increasingly to be more "crashworthy." Airworthy sciences have been developing since the Wright brothers first flew, but crashworthy sciences have developed only since World War II. Crashworthy improvements still are needed in aircraft as revealed by statistics showing fatality rates little improved in the past 20 years. The performance of existing life support equipment in aircraft must be known prior to stating new crashworthy design criteria. Once the hazards are identified, methods to eliminate them can be developed.

In the past, USAARL primarily has been involved in the analysis of injuries seen in aircraft accidents under the auspices of the Aviation Life Support Equipment Retrieval Program (ALSERP), in which all equipment involved in the cause or mitigation of injury is sent to USAARL. In the past two years, however, the scope of this work has been expanded to include parachute "impact" in high airspeed jumps, chest armor "impact" from .50 caliber bullet defeat, tank gunner brow pad "impacts," and motorcycle helmet "impacts."

Objective: To identify impact injury mechanisms of US Army fliers via standard epidemiological techniques, and to correlate the injury to the input energy, so that design and

test criteria may be provided for helmets, restraint systems, parachutes, and personnel-armor loading.

**Progress:** Through on-site investigation, laboratory analysis, and the ALSERP, progress was made toward the goal of providing equipment performance information and future equipment design criteria. All major accidents involving UH-60 helicopter life support equipment (LSE) were investigated in order to assess the effectiveness of the seats, padding, helmets, and other LSE in these new "crashworthy" aircraft. The FY 1982 UH-60 Blackhawk Crashworthiness Conference resulted in a recommendation to conduct comparative crash tests of two different UH-60 pilot seats. USAARL jointly participated in the planning and execution of these tests at the Federal Aviation Agency's Civil Aeromedical Institute Impact Test Facility. In the course of these tests, several material failures occurred in one of the vendor seats. After the seat vendor changes the materials to prevent future failures, further tests are to be conducted in FY 1984.

A draft report describing the development of a "crushable aluminum earcup" to be used in future crash protective helmets was completed.

The data from 15 sideward impacts to the helmeted head of human surrogates were analyzed and reported in the open literature. The data revealed a significantly lower transmitted force to the human skull when energy-absorbing "crushable" earcups were used.

The effect of stress concentration in personnel restraint harness webbing was evaluated in a quasistatic condition. This preliminary investigation indicated a significant strength reduction at contact points of the webbing, i.e. adjustors, end fittings, and seat slots. The load capability was reduced by more than 50 percent when side loads were applied to the webbing. Further work is planned in this area in FY 1984.

Anthropometric dummies were instrumented and detailed plans made to measure loads on parachutists when jumping at 200+ knots airspeeds. The US Army Test and Evaluation Command (TECOM) will be conducting both dummy and volunteer jumps at Yuma Proving Ground in FY 1984. USAARL will evaluate the probability of injury to jumpers prior to the volunteer jumps.

US Navy-sponsored helmet retention tests were begun in the 4th quarter. The tests are planned for completion 1st quarter, FY 1984.

Continued assistance was provided to the Human Engineering Laboratory (HEL) to determine the tolerance of tank gunners

to brow pad impact from large caliber weapons on lightweight armored vehicles. A report on this work is planned to be published in FY 84.

DD 1498: The above work was conducted under the following Research and Technology Work Unit Summaries.

Biodynamics of Life Support Equipment and Personnel Armor, DAOG 0167, 131.

Biodynamics of impact physiology, DAOD 6735, 137.

# Vibration Hazards of Combat Vehicles Program

**Background:** This program was initiated to study the effects of vibration on musculoskeletal disorders in Army aviators. Since unique vibration exposures are present in each emerging vehicular weapon system, the program has been expanded to cover all types of vehicles as well as aircraft. The long-term goal of the vibration program is the development of vibration tolerance limits as a function of amplitude, frequency, and exposure time for use as criteria for vehicle development.

**Objective:** To conduct multidisciplinary basic and applied biomedical engineering to (a) record and characterize the field environment of vibration, (b) duplicate the field environment in the laboratory to study effects on human health and performance, (c) develop a scientific data base of pertinent medical and performance-related information, (d) determine short-term and cumulative biomedical effects of vibration on the musculoskeletal system and develop technological methods by which to reduce these effects, and (e) evaluate and develop medical and performance-based criteria on human vibration tolerance.

**Progress:** Data collected from a subjective study designed to assess low back pain among U.S. Army aviators was analyzed. A preliminary report has been written and submitted for review. Trends indicated that low back pain may be affected by helicopter seating posture.

Continuing work under a Wright State University contract confirmed that isometric strength of neck muscles is significantly less in the lateral mode compared to flexion or extension. Amplitude of surface electromyographic (EMG) signals showed continuous increases for fatiguing contractions, while the center frequency for the EMG power spectrum continuously decreased. A pronounced increase in both blood pressure and heart rate was observed during isometric contractions of the neck muscles. Preliminary development of a multiple linear regression mathematical model has begun in order to predict EMG shift as function of helmet mass distribution.

Under a University of Vermont contract, work began which will attempt to establish the relationships between vibration, posture, and possible causes of low back pain in Army rotary wing aviators. EMG response of the lower back musculature

was monitored while volunteers maintained a standard aviator posture in a nonvibrating environment. Root-mean-square (RMS) amplitude of the EMG activity increased, while the center frequency of the EMG power spectrum decreased as the back muscles became fatigued. Static tests are near completion and vibration studies are scheduled to begin in 1st quarter, FY 1984.

**DD 1498:** The above work was conducted under the following Research and Technology Work Unit Summary.

Vibration Hazards of Combat Aircraft and Vehicles, DAOG 6100, 132.

**Contributing Work:** Work conducted under the following contracts contributed to the research objectives of this program.

Neck Muscle Endurance as a Function of Helmet Loading: The Definitive Mathematical Model.

The Effects of Helicopter Vibration on the Spinal System.

# Crew Life Support Systems Biotechnology Program

**Background:** Modern warfare is predicated on the use of an ever increasing variety of technologically advanced weapons, transport and communication systems. Couple this trend with doctrine which emphasizes round-the-clock sustained operations and there exists the potential for a devastating conflict. On the one hand, the advanced technology and new tactics give our troops an edge in any potential battle. On the other hand, man's inherent physiological, and perhaps psychological, limitations can neutralize totally any such advantage. The Crew Life Support Systems Biotechnology Program is designed to identify, evaluate, and eliminate or prevent the health hazards resulting from the mismatch between the soldiers' physiologic needs and the environment resulting from use of new equipment, weapons, and tactics.

Specifically, current focus is on maintaining aviators in the proper state of oxygenation under all flight conditions and on minimizing the deleterious effects of wearing chemical protective ensembles while conducting aviation operations and training. Short-range goals are (1) to evaluate the concept of using pressure swing molecular-sieve technology to produce clean breathable oxygen-enriched air to alleviate all levels of hypoxia, and (2) to evaluate current and proposed chemical defense ensembles in the flight environment to ascertain how long aviators can fly effectively without succumbing to heat stress or other stressors imposed by these basically cumbersome protective systems. Long-range goals call for collection of extensive data bases relating physiologic response to environmental stressors from which computer models can be developed which will assist in optimizing life support systems design.

**Objective:** The Crew Life Support Systems Biotechnology Program is designed to identify, assess, and prevent unnecessary health hazards imposed by exposure to the operational environment, toxic gases, varying oxygen levels, chemical and biological agents, and antidotes or other drugs; to provide the Army technical information, recommendations and standards to be used in the development and modification of systems that provide protection from those hazards; and to develop a data base identifying and quantifying the physiological and medical impact of life support equipment on mission accomplishment. This program also is designed to identify and elucidate problems associated with life support equipment and to develop computer models based on analytic and empirical data to facilitate the conceptualization and development of design criteria for improved life support equipment.

**Progress:** The study entitled "Physiological Assessment of the Aircrew Chemical Defense Ensemble" continued to generate reports and formed the basis of a new draft protocol to study the "Aviator Performance Effects of Chemical Warfare Antidotes." This study will proceed in FY 84, but was a major planning effort in FY 83.

Team members continue to participate in the process to develop and test new aviation life support equipment for use on the integrated battlefield.

The cardiopulmonary research program moved ahead with the completion of computerized pulmonary function tests on over 200 active duty Army aviators. Early screening results indicate that more than 30% of these volunteer subjects had altered pulmonary functions suggestive of mild to moderate obstructive impairment. Full analysis of these results including demographic and medical history data is underway with a summary report due in early FY 84. The cardiopulmonary stress lab was installed and made ready for a planned extensive effort to build a data base on Army aviation physiology. This cardiopulmonary data base is being established to assist in longitudinal studies of effects of stress and to help in design of life support equipment.

Computer modeling progressed with the BRNSIM burn prediction model implemented on two additional computers, PDP 11/24 and DEC VAX 780. A model relating contact time, temperature, and thermal characteristics to burn injury was implemented on an Apple II computer and submitted to the Burn Prevention Committee of the American Burn Association.

A new start was made to develop techniques to measure evoked responses in aviators while they pilot simulators and aircraft. Equipment was ordered and received.

# Combat Crew Effectiveness Program Area

This project area encompasses research programs which are directed toward the delineation and study of behavioral, psychological, physiological, and performance requirements imposed by military operations, environments, and special equipment. The purpose of this work is to prevent casualties by assessing factors which serve to increase the soldier's vulnerability to the stressors of a combat environment. Inadequate training, indoctrination, physical conditioning, as well as high stress loads imposed by the rigors of the combat environment, all potentially impact on the soldier during operational missions. Further factors, such as excessive heat and cold, complex and sustained work requirements, may overload the soldier and exceed human tolerance in life-threatening situations.

Physiological and psychological investigations are conducted to identify environmental and operational stressors, and to provide data on the cost/payoff relationship between such stressors and soldier tolerance, sustainability, and survivability.

Efforts include, but are not limited to, visual capabilities and limitations; medical indexes of crew workload and fatigue; soldier selection and physical fitness; and biomedical aspects of environmental factors on human functioning as well as those soldier factors affecting performance and survivability under conditions of sustained and chemical operations.

# Sensory Limitations of Man/Machine Systems Program

**Background:** The extreme lethality of the modern mid-to-high-intensity battlefield is forcing changes in tactics, weapons, and personal protective equipment. Advancing weapons technology, along with doctrinal requirements for continuous operations (including nighttime operations), combine to produce stresses which threaten to exceed the capabilities and limitations of the human operator and thereby degrade crew performance. For example, the visual demands of night vision goggles may necessitate new visual selection and retention criteria, and the requirement for continuous operations may exceed the soldier's visual performance capabilities after extended periods of operation. The use of protective devices such as antilaser goggles, the sun, wind and dust goggles, and helmet visors threatens to disrupt the crewmember's visual performance.

The doctrinal requirement for around-the-clock combat operations results in special concerns about the human operator's capabilities to function effectively in darkness. Red lighting has been used in Army aircraft cockpits since pre-World War II days because of its ability to preserve nighttime visual sensitivity. However, in future aircraft blue-green lighting will be required in order to achieve compatibility with aviator night vision goggles. This may compromise flight capabilities with unaided vision. The existing biomedical data base regarding the visual performance effects of vibration, darkness, night vision goggles, protective goggles, and similar stressors is inadequate for countering the potential threats to combat effectiveness. The nature, extent, and mechanisms of visual performance degradation are largely undefined, and the resulting impact on combat effectiveness has not been determined.

The overall goal of this research program is the development of realistic measures to prevent compromised combat effectiveness due to impaired visual performance. These preventive measures will include exposure criteria, material design criteria, crew selection and retention criteria, and modified operational doctrine. A major intermediate goal is the establishment of a visual effects biomedical data base sufficient to support development of such measures.

**Objective:** The major technical objectives of this research program include identification of the parameters of visual functioning which are degraded by vibration, darkness, body position, protective devices, night vision goggles, fatigue, and spectral characteristics of lighting. Characterization and quantification of visual degradations produced by specific stress factors, identification and characterization of mechanisms underlying visual degradations, determination of the relationships between identified visual degradations and task performance, and development and validation of models for predicting the impact of specific visual degradations on combat effectiveness are major technical objectives. Also, included as objectives are development and validation of exposure criteria and/or material design criteria for selected stress factors, development and validation of selection/retention criteria and operational preventive measures for selected stress factors, and development of instrumentation for rapid, reliable measurement of selected visual performance parameters.

**Progress:** The role of aviation in US Army operations at night has been enhanced greatly by the wide use of the AN/PVS-5 and the soon-to-be introduced AN/AVS-6 night vision goggles. Each of these goggles utilizes tubes containing optics and electronics positioned directly in line with each eye. A project was conducted to determine the relative protection afforded the eyes from tube impact when wearing chemically-treated glass, CR-39 plastic, or polycarbonate spectacle lenses. Results show a dramatic superiority in protection provided by the polycarbonate lenses. A protocol is being written for the conduct of a study which will determine the feasibility of using polycarbonate opthalmic lenses in a field environment.

A comprehensive research plan has been developed to assess the visual tasks, demands, and constraints in Army aviation and utilize this information to develop, correlate, and validate meaningful clinical measures and criteria. The goals of this research would be to establish defensible vision standards for Army aviator selection and retention; to provide meaningful medical recommendations should alternative standards be administratively implemented; and, to enhance current vision examination techniques/instrumentation and test batteries.

An operational study of the effects of red versus blue cockpit lighting upon unaided dark adaptation was undertaken. A special portable computer-controlled adaptometer was constructed for this study. The aircraft was equipped with both red and blue cockpit lighting systems. Threshold data, collected under

actual flying conditions, yielded only slightly lower thresholds for red than for blue lighting, indicating that there does not appear to be a valid physiological requirement for dual cockpit lighting systems.

The range of acceptable levels of haze in military specifications for optical transparencies is at least 12-to-1 for different materials and appears not to be dictated by the vision requirements of the transparency user. To determine the visual performance effects of transparency haze, the visual contrast sensitivity function was measured with transparencies of 0.5 to 20% haze, both with and without glare. The data presently are being evaluated.

Three prototype protective masks (XM-40) and a British S-10 respirator were optically evaluated. All three XM-40 prototypes restricted the visual fields, particularly in the lower nasal area. Also, the combat spectacle was incompatible with the masks in some cases.

A computer program was developed to provide light level calendars of lunar illumination for planning of night vision goggle research and training flights.

An electronic circuit was designed and evaluated which allows selection of specific CRT raster lines, better facilitating the line spread function of CRT displays.

Consultation and optical evaluation were provided for the protective mask designed for the AH-64. Problem areas are distortion, undesired optical power, optical alignment, optical correction, field of view with Helmet Display Unit (HDU), eyelash clearance, and fogging. A number of alternative options for ametropia correction to allow full field of view with the HDU are being evaluated.

**Publications:**

Modified Faceplate for AN/PVS-5, Night Vision Goggles, USAARL RPT 83-1.

Analysis of Image Smear in CRT Displays Due to Scan Rate and Phosphor Persistence, USAARL RPT 83-5.

Controller Selects Active CRT Raster Line, Electronics, Vol 55, No. 24:113, 1982.

Physical and Optical Evaluation of the Gargoyles Spectacles. USAARL LR-83-2-2-1.

Preliminary Model of Dynamic Information Transfer in CRT Displays. Proceedings of IEEE, Washington, DC, 1983.

Computer Program for Generating Light Level Calendars of Lunar Illumination at Fort Rucker, AL. USAARL LR-83-4-2-2.

Light Level Calendars of Lunar Illumination at Fort Rucker, AL for July-December 1983. USAARL LR-83-8-2-5.

Visual and Optical Evaluations of the XM-40 Protective Mask. USAARL LR-83-9-2-6.

Optical Evaluations of the British S-10 Respirator. USAARL LR-83-10-2-7.

**Presentations:**

Preliminary Model of Dynamic Information Transfer in CRT Displays. IEEE, Inc., SOUTHEASTCON '83, Orlando, FL., April 1983.

# Biomedical Aspects of Crew Workload, Staffing, and Selection Program

**Background:** Identifying, defining, and quantifying man's physical requirements, task demands, and biomedical limitations associated with various systems and technology become critical for the optimal design of equipment, prediction of performance criteria, and development of biomedical models. Military developers, planners, and specialists at every level must be aware of the unique hazards generated by Army systems and technology, and that these hazards are further elevated by the adverse environment of the Army tactical operations in which the soldier is required to function.

Army aviation, with its highly sophisticated airborne systems, represents a prime example of a military operational area that lacks complete parametric research to develop empirical criteria for ideal man-machine interface and analytical tolerance/survivability/capability envelopes within which the selected aircrew will be forced to work and endure. A more complete biometric data base is not available to describe and quantify pilots' physiological and psychological tolerance to operational stressors, military hardware, advanced tactics, and progressive military operations.

USAARL's research program is designed to establish/update aircrew selection criteria, evaluate requirements for optimum man-machine interface, and provide physiological and psychological guidelines describing and quantifying tolerance, survivability, and capability envelopes of man within the military flight environment. The long-range goals of this research are to establish extensive biomedical data bases and predictive

models to reduce or eliminate aviators' impaired performance; sensory, cognitive, and physical overload; combat stresses; and, in general, hazards inherent in Army systems and in the Army environment.

**Objective:** The objective of this research program is to develop standards for aeromedical hazard definition and to postulate hazard definitions based upon field assessment of combat operations, including systems and environmental effects.

Extension of the data base regarding the visual performance/workload of fixed- and rotary-wing aviators during varying tactical missions with special emphasis on the quantification and interpretation of these data, on their relation to variables, such as pilot physiological and psychological states, and on task loading comprises a second objective of this program. Further efforts include determining decision requirements/processing limitations of man and developing predictive models identifying cognitive capabilities and overload criteria incurred by highly sophisticated aircraft technology within a combat environment, defining and quantifying aviator psychomotor processes with the biomedical parameters affecting aviation personnel during sustained military operations.

**Progress:** Considerable research effort has been accomplished within the past year regarding cognitive workload and psychological measurements. Two technical reports have been published dealing with psychological effects of Army aviators imposed by heat stress while wearing chemical defense ensembles. An invitation was received from the Commanding General, 7th Medical Command, US Army, Europe, to study cognitive and affective changes in aeromedical evacuation pilots participating in REFORGER 83. A research team of five personnel spent over 30 days in Germany conducting this study. The instrument utilized was the Psychological Assessment Battery (PAB) which was programmed to be used in conjunction with six Apple computers. The computers were preshipped to Europe, set up in field conditions, operated successfully, and then returned to Fort Rucker, Alabama. This demonstrates the high utility and potential of this system for further use in field environment studies.

A concept evaluation was completed regarding a mini-heads-up display to be used with night vision goggles. This instrument consists of a pair of adjustable spectacles, numeric symbol generator, dynamic attitude generator, and a custom microcomputer. Aircraft information, such as heading, airspeed, altitude, pitch and roll, etc., is displayed to the pilot on the glass pieces via a fiber optic bundle into light emitting diodes. Data analysis of another study involving night vision goggles has been

completed. This study examined the effects of extended use of night vision goggles on helicopter pilots.

Considerable effort and resources have been expended during the past year toward developing a research protocol to study the effects of chemical warfare antidotes on aviator performance. An extensive literature review was completed, which included both physiological and behavioral effects of the antidotes involved. Flight profiles to be utilized during the simulator phase and the actual flight phase have been developed. Support and research equipment, as well as additional manpower requirements, have been identified and requested.

**Publications:**

*Psychological Effects of Chemical Defense Ensemble Imposed Heat Stress on Army Aviators,* USAARL RPT 83-6.

*Psychological Measurements During the Wear of the U.S. Aircrew Chemical Defense Ensemble,* USAARL RPT 83-7.

**Presentations:**

*Army Aviator Fatigue During a 21-Day Field Training Exercise,* presented to Army Aeromedical Concepts Review Committee, Feb 83.

*Selected Factors Affecting Aircrew Performance During Sustained Operations,* presented to the US Army Operational Aeromedical Problems Course, Apr 83.

*Selected Factors Affecting Aircrew Performance During Sustained Operations,* presented to the Aerospace Medical Panel Symposium, Advisory Group for Aerospace Research and Development, Apr 83.

*Performance on a Memory and Search Task (MAST) by Army Aviators During a 21-Day Field Training Exercise,* presented to Second Symposium on Aviation Psychology, Apr 83.

*Progress in Army Helicopter Flight Simulation,* presented to Second Symposium on Aviation Psychology, Apr 83.

*Overview of the Biomedical Applications Research Division, USAARL,* presented to AMEDD Behavioral Sciences Research and Development, Apr 83.

**DD 1498:** The above work was conducted under Research and Technology Work Unit Summaries:

Research Directed at Biomedical Parameters Affecting Aircrew Workload During Sustained Operations, DAOG 0153, 161.

Parametric, Multimodal Workload Assessment in Aircraft Guidance Systems, DAOG 6101, 163.

Aeromedical Research of Operationally Significant Problems in the Army Aviation Environment, DAOG 0151, 165.

Visual Performance Research Related to Operational Problems in Army Aviation, DAOG 0156, 162.

**Contributing Work:** Work conducted under one customer-funded and one contract project contributed to the research objectives of this program.

Night Vision Goggles Attitude Display Concept Evaluation Program

Statistical Analysis of Visual Performance of Helicopter Pilots During Instrument Flight

# Anthropometry and Ergonomics Program: Criteria for Army Aviators

**Background:** With the emphasis upon incorporating females into the U.S. Army, there came the increasing realization that empirically-based criteria to guide the selection of personnel did not exist. For those seeking entrance into the Army aviation program, the criteria have traditionally been based on the 5th-95th percentile male. To rectify this circumstance, the laboratory embarked upon a major research effort to develop empirically-based selection standards to assure that an effective aviator-cockpit interface exists for each of the aircraft in the present Army inventory.

The program consists of five separate subprojects: (a) A physical determination of aircraft cockpit reach-related requirements; (b) a determination of actual, cockpit-referenced eye positions of rated Army aviators for the Army's principal rotary wing aircraft; (c) a determination of the in-flight control-force requirements which exist during "hydraulics off" emergency landing maneuvers; (d) a determination of helicopter-control-related physical forces exertion capabilities; and (e) an evaluation of the effects of variation in the level of control force resistance upon performance as a function of subject strength.

**Objective:** The objective is to establish anthropometric size, strength, and weight criteria for Army aviators.

**Progress:** Cockpit Compatibility Evaluations. Individuals comprising small groups of tall and short subjects were placed separately in the cockpit of each type of US Army aircraft

to evaluate upper- and lower-body reach compatibility. These evaluations were performed in two clothing configurations: (a) Warm weather training (Nomex® flight suit, SPH-4 aviator's helmet, boots, and survival vest) and (b) cold weather, full tactical (extreme cold weather clothing, chemical defense ensemble--less mask, SPH-4 helmet, and armor-plated survival vest--as appropriate to the aircraft). The "large" group was comprised of 11 males ranging in stature from 182.3 centimeters (88th percentile) through 194.5 centimeters (99th percentile). The "small" group consisted of both males and females whose stature was equal to or less than that corresponding to a 5th percentile male. The stature of these eight ranged from 146.9 centimeters through 162.5 centimeters. The data which resulted are in the final stages of analysis. Reports will be completed by March 1984.

Seated Eye Position Evaluations. To provide data relevant to forward field-of-view considerations, data were generated regarding the cockpit-referenced seated eye position of the US Army aviators. Rated aviators were laterally photographed in several of the US Army's principal rotary-wing aircraft: TH-55A trainer, OH-58C observation helicopter, UH-1H utility helicopter, UH-60A utility helicopter, CH-47C cargo helicopter, and the AH-1S attack helicopter. The photographs were taken using hangared aircraft. Each aviator adjusted the seat and controls to his preference. In addition to the photograph, control adjustments were recorded and anthropometric data were obtained from each aviator. Data describing the matrix of eye positions recorded and comparing them to the design-eye-position for each aircraft will be published in a report to be completed by March 1984.

Strength Assessment. Data have been collected regarding helicopter cyclic-, collective, and pedal-related force exertion capabilities from 125 subjects. Male participants ranged in stature from the 2d through the 99th percentile; female participants ranged from the 5th through the 99th percentile. Data reduction currently is in progress with formal reports anticipated to be completed by August 1984.

Control Force Requirements. To determine the force inputs required and to evaluate the possible influence of pilot experience upon these inputs, data were collected from the strain-gauge instrumented controls of an Army UH-1H utility helicopter during the final 60 seconds of 60 "hydraulics-off" approaches and landings. Six highly-experienced aviators ($\geq$ 1200 hours, $\bar{X}$ = 2292) and six less experienced aviators ($\leq$ 200 hours, $\bar{X}$ = 185) each flew five of these training maneuvers. These data presently are undergoing reduction and analysis. The report is anticipated to be completed by the third quarter, FY 84.

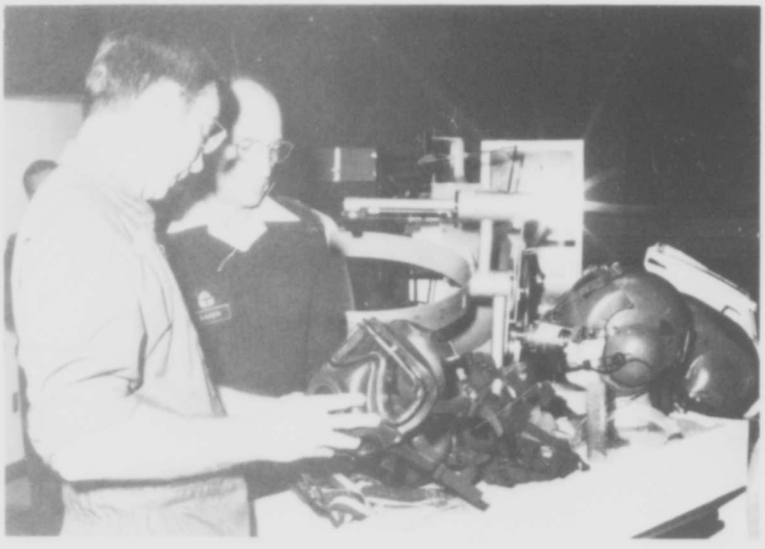
Exertion-Related Performance Analysis. This project addresses the issue of adequacy of overall performance of small, medium, and large subjects of both sexes during the performance of flight-related tasks upon helicopter controls as a function of variation in inherent task complexity and variation in the level of control force resistance. Major hardware components have been acquired. The writing of software to manipulate control force requirements and level of tracking task difficulty has been initiated. Preliminary studies have been undertaken to evaluate size, strength, and gender as factors affecting the performance of a secondary tone memory task performed in conjunction with either a hand- or foot-controlled primary tracking task. The data reduction and analysis of these data presently are in progress; reports will be rendered during the coming year.

**DD 1498:** The above work was conducted under the following Research and Technology Work Unit Summary.

Anthropometric Criteria for Army Aviators, DAOG 6102, 166.

# Soldier Chemical Warfare Agent Antidote Program Area

The overall objective of this program area is establishment of the visual effects data base required to develop safe and efficacious prophylaxes, pretreatment compounds, antidotes, and therapeutics necessary to assure individual protection, rapid return to duty, and militarily effective soldier performance on a CW battlefield. This will require development of (a) medical concepts and technologies, (b) pharmacologic material, and (c) resources and systems for prevention, treatment, and management of CW agent casualties. Emphasis is placed on development of antidotes that will assure soldier protection against nerve agents while preserving visual capabilities necessary to maintain combat effectiveness.



# Antidote and Antidote/Agent Effects on the Visual System Program

**Background:** The chemical warfare (CW) capabilities of the Warsaw Pact pose a real threat for potential mass casualties that could at the very least compromise unit effectiveness. Serious deficiencies in the existing protective capabilities include the lack of CW agent prophylaxes, an incomplete spectrum of antidotes, and antidotes with operationally compromising side-effects. The urgent DOD requirement to develop prophylaxes, pretreatment compounds and antidotes, and the necessary concepts for their use in the medical management of CW casualties cannot be accomplished through the utilization of currently available information and technology. We do not know the mechanisms of action for the current CW agents or their suspected antidotes or possible prophylactic compounds. And there is even less information regarding the combination of the three.

CW agents, especially the nerve agents (organophosphates), have diverse toxic effects on both the central and peripheral nervous systems. Many of the central and peripheral toxicities consist of disruptions of neural functions related to the action of organophosphates on neural transmission in the cholinergic system, where acetylcholine is the known neurotransmitter. We know that acetylcholine is important in control of pupil size as well as the processing of visual information by the retina. It may also be important at more central visual locations. However, neurotransmitters other than acetylcholine may also be involved and contribute to organophosphate-induced neurotoxicity.

In any battlefield situation, the soldier's capability to perform visual tasks is critical for completion of the mission. With widespread use of CW agents, the survival of the unit, as well as the individual, may depend on visual capabilities.

Consequently, the Army's effort to develop antidotes, pretreatments, and prophylactics require valid information on the effects of these compounds on visual functions. The primary objective of this research program is to develop a comprehensive biomedical data base on the effects of selected nerve agents, candidate antidotes, possible prophylactic compounds, or combinations of the three on the retina and higher visual centers. Animal models will be selected or developed to enable inferences regarding effects on the human visual system of various agent/antidote/prophylactic compound combinations. Ultimately, methods will be developed to predict how well a soldier will be able to visually complete his mission following a specified exposure.

**Objective:** The following technical objectives are required to achieve the program's goals:

(1) Characterization of the effects of nerve agents and/or their antidotes or pretreatments on retinal functions by means of acute and chronic animal experiments utilizing neurophysiological techniques. The retinal functions to be evaluated include: light/dark adaptation, relative sensitivities across classes of retinal neurons, spatial-temporal contrast sensitivities, stimulus-response relationships, receptive field properties, and spontaneous activity.

(2) Quantification of transmission loss along the visual pathway with gross potential neurophysiological recording techniques, and assessment of performance loss due to drug exposure.

(3) Assessment of cholinergic system interactions with other transmitters in the visual system following drug administration.

(4) Identification of sites of action and uptake of antidotes and agents within the visual system by means of autoradiography to provide additional information as to the mechanisms of action and the possible occurrence of local pooling of nerve agent.

(5) Comparison of single cell data with gross potential and anatomical findings to provide an overall picture of visual systems function following antidote/agent insult.

(6) Development of models and techniques to predict impact on human visual performance and combat effectiveness.

**Progress:** Protocols have been completed and approved and experiments begun on antidote and antidote/agent effects on the visual system. Initial experiments assessing the effect of physostigmine (a carbamate) and DFP (an organophosphate) on the cortical visual evoked potential (VEP) in cats were complicated by the instability of aqueous solutions of physostigmine and DFP. Cholinesterase assays now are being done and enzyme levels correlated with changes in the VEP. Preliminary experiments have suggested reduction of the VEP with physostigmine and some recovery following atropine.

Experiments assessing the effect of the carbamates physostigmine and pyridostigmine and the organophosphate DFP on the cortical visual evoked response (VER) in cats have been conducted. Physostigmine produced a marked decrement in the VER. Physostigmine sulfate preferentially reduced the response to low spatial frequencies while minimally affecting the response to high spatial frequencies. Physostigmine salicylate reduced the response to all spatial frequencies approximately equally. Currently, we cannot explain the differential effect due to the two physostigmines. EEG amplitude and blood acetylcholinesterase (AChE) levels were depressed by both drugs. The visual loss in both cases could be reversed by atropine.

Pyridostigmine, a quaternary carbamate which does not readily cross the blood-retinal or blood-brain barrier, moderately depressed the VER at higher dose levels in one of two cats studied. Atropine reversed the depression in the VER.

DFP, an irreversible organophosphate inhibitor of AChE, reduced VER amplitudes and cholinesterase levels in a somewhat dose-dependent manner. Although not as striking as with physostigmine sulfate, there was a tendency for greater VER reduction at the lower spatial frequencies. Administration of atropine sulfate provided at least partial recovery of the VER. Slow spontaneous visual recovery to baseline levels occurred within 20 hours after DFP, even though there was no recovery in enzyme activity.

Since atropine provided partial recovery of the VER, an accumulation of acetylcholine (ACh) likely is involved in the initial visual loss. Spontaneous recovery of the VER without recovery of cholinesterase levels suggests the involvement of mechanisms in addition to ACh accumulation. Studies of both true and pseudocholinesterase activity after DFP suggest that only activity related to AChE (true cholinesterase) is involved in this effect. Single unit studies to identify specific involved retinal neurons now are underway.

**DD 1498:** This work was conducted under Research and Technology Work Unit Summary.

Antidote and Antidote/Agent Effects on the Visual System, DAOG 8399, 381.

# Technical Participation

## Air Standardization Coordinating Committee (ASCC) Working Party 61, Aerospace

The Air Standardization Coordinating Committee (ASCC) Working Party 61 is a chartered international military organization of English-speaking nations which addresses aerospace medicine and life support. Emphasis is placed on standardization, interoperability, and technology exchange. Member nations include the United States, Canada, United Kingdom, Australia, and New Zealand. USAARL provides technical consultants and a principal committee representative to actively participate in the committee's activities and to coordinate Army Medical Department (AMEDD) participation. MAJ(P) Bruce Leibrecht represents the laboratory and Army Aviation Medicine to this group.

## International Test Participation Agreements

The ASCC is chartered to negotiate test participation agreements between member nations and military services. These agreements provide for the evaluation, use, test, or review of a specific piece of equipment by another country or service not normally having access to that equipment. The evaluation data may be jointly gathered but, in any event, is shared between countries and published as a formal report in accordance with the terms of the agreement.

## NAS-NRC, Committees on Vision and Hearing, Bioacoustics, and Biomechanics

USAARL has been an active participant in the science and technology exchange programs of the National Research Council (NRC) since the mid-60s. USAARL scientists participate as working members of the various ad hoc and working groups of the acoustics and vision committees. The Army representative to the Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) and the Committee on Vision (COVIS) is USAARL scientist, MAJ(P) Bruce Leibrecht. Dr. James Patterson, Dr. Isaac Behar, LTC John Crosley (Ret), Mr. Robert T. Camp, Mr. Ben Mozo, and Dr. William Howse also participate actively.

## American National Standards Institute (ANSI) Committees S1, S3, and S12

These committees operate under the Acoustical Society of America by agreement with ANSI. They manage the development of a variety of National Acoustical Standards and coordinate international standardization in these areas. In 1983, USAARL became a member of these three committees. USAARL representatives are Dr. James Patterson and Mr. Ben Mozo.

## United Kingdom NBC Protective Clothing Ensemble

In 1977, USAARL entered into a test participation agreement with the Institute of Aviation Medicine at Farnborough, England, to conduct a physiologic assessment of the United Kingdom Aircrew NBC Protective Clothing Ensemble. This study includes field trials and laboratory tests of the visual and acoustic properties of the AR5 respirator as well as in-flight biomedical assessment of the entire ensemble's effect on pilot performance and pilot thermal physiology. Aspects of this in-depth study are being conducted in conjunction with the Ergonomics Laboratory at the U.S. Army Research Institute of Environmental Medicine (USARIEM), Natick, MA, and the Crew Biotechnology Branch of the USAF School of Aerospace Medicine, Brooks AFB, Texas. Three reports were published and six presentations made on this study in FY 83.

# Advisory Group for Aerospace Research and Development--Aerospace Medical Panel

This panel was established in May 1952 and was an early pioneer in AGARD to discharge the mission of bringing together leading personalities of the NATO nations in the fields of science and technology relating to aerospace. The Aerospace Medical Panel (AMP) is concerned with the exchange of information on aerospace medical research and development, the recognition of operationally-oriented requirements of clinical aerospace medicine, the solution of human engineering problems, and the stimulation of new research activities to assist and enhance pilot performance in the demanding aviation environment. The panel has formally chartered subcommittees concerned with the specific problems of behavioral sciences, biodynamics, special clinical and physiological problems in military aviation, and special senses.

USAARL has been an active participant with this panel since 1963. Members of the laboratory serve on AMP subcommittees as technical consultants. COL Dudley R. Price is under appointment by the National Board of Delegates to AGARD/NATO as the US Army representative on this panel.

# NATO Defense Research Group Panel, Research Group 6, Effects of Impulse Noise

Formed in 1978, Canada, France, Germany, the Netherlands, Norway, the United Kingdom, and the United States collect and evaluate data on permanent threshold shifts induced by shooting noise in military practice from both light and heavy weapons in relation to the noise exposure. The group evaluates methods of measurement of impulse noise and compares the different impulse noise damage risk criteria used by the participating nations. It evaluates the effects of noise-induced hearing loss on performance, collects and evaluates data on nonauditory effects, and exchanges information on the applicability of hearing protectors on the effects of hearing protection in military practice.

Dr. James Patterson was appointed to membership in this working group in 1980.

# Tri-Service Life Support Equipment Retrieval Program

USAARL conducts a tri-service life support equipment retrieval program (LSERP) which brings crash-damaged helmets, seats, and flight clothing to our facility for analysis and study. Helmets are the items most often received from the Air Force and Navy.

Army aviation life support equipment involved in either injury causation or prevention, in the field, is sent to USAARL for biomedical and injury correlation evaluation. The evaluation assesses the effectiveness or deficiencies of the life support equipment through an analysis of the physical condition of the protective devices, the human injury incurred, and the related human dynamics involved in the accident.

Data collected through the LSERP helps identify hazard protection problems associated with the equipment. Also, these data enable USAARL to provide injury-reducing design recommendations and health criteria for the improvement of life support equipment. The Navy Medical Department maintains a permanent position for a Navy aerospace physiologist at USAARL to support this program.

# Army Life Support Equipment Steering Council

This advisory council was chartered in the mid-1970s by the Commanding Generals of the US Army Materiel Research and Development Command (DARCOM) and US Army Training and Doctrine Command (TRADOC), the Office of The Army Surgeon General, and Forces Command This is a review and advisory council that insures timely and pertinent technical exchange of information regarding the development, logistics, use, and field problems associated with Army aviation life support equipment. The committee meetings held yearly have proven to be an effective vehicle for maintaining a coordinated flow of technical information regarding life support equipment and supplying the solutions for many technical and administrative life support equipment problems of the Army. USAARL participates as the principal technical consultant to the council and is instrumental in formulating AMEDD positions and policies.

# Tri-Service Aeromedical Research Panel

The Tri-Service Aeromedical Research Panel (TARP) was established in 1976 for the purpose of fostering technical exchange, reviewing ongoing joint research programs, making recommendations for future joint research programs, conducting cooperative reviews of individual programs to avoid duplication, and submitting a recommended course of action to The Surgeons General. The panel has proven to be an effective administrative entity in the DOD research community.

The TARP consists of 12 members which include two laboratory representatives from each service; a Surgeon General's representative from each service; one representative of the US Army Medical Research and Development Command; one representative of the Naval Medical Research and Development Command; and one representative of the Headquarters, Air Force Aerospace Medical Division, or Headquarters, Air Force Systems Command. The TARP meets in business session twice a year and hosts one extensive technical meeting. The 1982 fall technical meeting on "Aeromedical Evacuation, Equipment, and Procedures" was hosted by USAARL on 18-19 October. There were 83 attendees at this meeting, and 13 presentations were made by members of the Army, Navy, and Air Force.

COL Dudley R. Price serves as the Army senior service representative and Deputy Cochairman of TARP, and LTC J. D. LaMothe represents the laboratory's interests.

The TARP has the authority to charter technical working groups (TWG) for the purpose of interacting at the scientific bench level and working on viable interservice cooperative research programs. At present, only one TWG exists--the one for Biodynamics: The Human Effects of Vibration, Impact, and Acceleration. Under the auspices of this TWG, a joint service, Department of Transportation study to develop a standardized set of algorithms that describe the 50th percentile male aircrewman has been accomplished and a draft report was written. The TWG meets formally twice a year and other times as necessary. USAARL hosted a TWG meeting 20-22 September 1983. The agenda included a review of the draft of the Standard Man Project and DD Forms 1498 from all three services on research and development efforts initiated during the past two years.

Mr. Joseph Haley and CPT Roy Maday are the laboratory representatives for the TWG.

# Tri-Service and NASA Human Factors Engineering Technical Advisory Group

Because of the diversity of the subject matter covered by the human factors engineering discipline, the scope of technical areas addressed by the Technical Advisory Group (TAG) is necessarily broad. In general, human factors engineering (HFE), as defined for the purposes of TAG operation, deals with concepts, data, methodologies, and procedures which are relevant to the development, operation, and maintenance of hardware and software systems. Subject matter subsumes all technologies aimed at understanding and defining the capabilities of human operators and maintainers and insuring the integration of the human component into the total systems to enhance systems effectiveness. Technologies directed toward improved manpower utilization through selection, classification, and training are included as appropriate.

TAG provides a mechanism for exchange of technical information in the development and application of HFE technology. This group enhances the coordination among government agencies and encourages in-depth technical interaction among subgroups in selected optical areas. TAG assists as required in the preparation and coordination of tri-service documents such as technology coordinating papers and topical reviews.

# Army Aeromedical Concepts Review Committee (AACRC)

The Army Aeromedical Concepts Review Committee (AACRC) is a standing committee of the AMEDD for the purpose of collecting and disseminating information relative to aeromedical evacuation concepts, equipment, and techniques, and preparing coordinated AMEDD positions on Army aeromedical evacuation issues. The committee meets formally once a year with representation from the worldwide AMEDD aviation community, Army Reserve, National Guard Bureaus, and DA Deputy Chief of Staff for Operations (DCSOPS), and other agencies as appropriate. USAARL, with a mission that includes aeromedical evacuation equipment development as well as general aviation medicine support that encompasses AMEDD aviation, has a long-standing history of intimate participation in the committee's activities.

# Committees

| Committee | Affiliation | Individual |
|---|---|---|
| AEROSPACE MEDICAL ASSOCIATION | | |
| Scientific Program Committee | Member | COL D. R. Price |
| | Member | Dr. K. A. Kimball |
| AMERICAN BURN ASSOCIATION | | |
| Prevention Committee | Member | Dr. F. S. Knox III |
| FEDERAL LABORATORY CONSORTIUM | Member | Ms. S. H. Bullock |
| AIR STANDARDIZATION COORDINATING COMMITTEE (INTERNATIONAL) | | |
| Working Party 61 (Aerospace Medicine and life support systems) | Army Representatives | MAJ B. C. Leibrecht<br>LTC A. W. Schopper |
| AMERICAN NATIONAL STANDARDS INSTITUTE | | |
| S1 Acoustics | USAARL Representative | Dr. J. H. Patterson |
| | Alternate | Mr. B. T. Mozo |
| S2 Mechanical Shock and Vibration | Alternate | Dr. J. H. Patterson |
| S3 Bioacoustics | USAARL Representative | Dr. J. H. Patterson |
| | Alternate | Mr. B. T. Mozo |
| S12 Noise | USAARL Representative | Mr. B. T. Mozo |
| | Alternate | Dr. J. H. Patterson |
| Z90.1 Helmet Committee | Member | Mr. J. L. Haley, Jr. |

| Committee | Affiliation | Individual |
|---|---|---|
| 53-62 Working Group on the Effects of Impulse Noise on Man | Member | Dr. J. H. Patterson |
| Working Group on Real-Ear Attenuation Standards | Member | Dr. J. H. Patterson |
| DEPARTMENT OF DEFENSE | | |
| Aircrew Station Standardization Panel (Tri-Service) | Member | LTC A. W. Schopper |
| Joint Service Display Panel Subpanel on Display Devices | Member | Mr. C. E. Rash |
| Military Librarian's Workshop Program Committee | Member | Ms. S. H. Bullock |
| Group on Specification Problems and Standardization Actions on Audio Devices | Member | Mr. R. T. Camp, Jr. |
| Helicopter Research Coordinating Panel (Tri-Service) | Member | Dr. K. A. Kimball |
| Human Factors Engineering Technical Advisory Group (Tri-Service) | Member<br>Member | Dr. K. A. Kimball<br>LTC A. W. Schopper |
| Tri-Service Aeromedical Research Panel (TARP) | Member<br>Member | COL D. R. Price<br>LTC J. D. LaMothe |
| Tri-Service Aerospace Medical Coordination Technical Working Group | Member | Mr. J. L. Haley, Jr. |
| DEPARTMENT OF THE ARMY | | |
| Advanced Attack Helicopter Alternate System Safety Group | Member | MAJ R. H. Schrimsher |
| Advanced Attack Helicopter Source Selection Evaluation Board | Member<br>Member | Mr. C. E. Rash<br>Mr. B. T. Mozo |
| Aircraft Noise, Working Group (MIL-STD-8806) | Member | Mr. R. T. Camp, Jr. |

| Committee | Affiliation | Individual |
|---|---|---|
| Army Aviation Personnel Requirements for Sustained Operations, Study Advisory Group | Member | Dr. K. A. Kimball |
| Helicopter Medical Human Factors Engineering Training/Selection Research Coordination Panel | Member | Dr. K. A. Kimball |
| USAMRDC Vision and Laser Bioeffects Subcommittee | Member | LTC J. D. LaMothe |
| | Member | Dr. I. Behar |
| | Member | Mr. C. E. Rash |
| Source Selection Board on Ocular Protection Against Laser Hazards | Member | Mr. C. E. Rash |
| USAMRDC Neuroscience Working Group for Chemical Defense | Member | Dr. A. W. Kirby |
| | Member | CPT T. H. Harding |
| TSG Ad Hoc Committee on Hearing Protective Devices | Member | MAJ W. R. Nelson |
| | Member | Mr. R. T. Camp, Jr. |
| | Member | Dr. J. H. Patterson |
| | Member | Mr. B. T. Mozo |
| US AIR FORCE | | |
| Test Plan Working Group: Second Generation Chemical Warfare Defense Personnel Protective Garment Program | Member | MAJ G. A. Nagel |
| FEDERAL AVIATION ADMINISTRATION | | |
| Seat Committee | Member | Mr. J. L. Haley, Jr. |
| NATIONAL ACADEMY OF SCIENCES--NATIONAL RESEARCH COUNCIL | | |
| Committee on Vision | Army Representative | MAJ B. C. Leibrecht |
| | Member | Dr. J. K. Crosley |
| | Member | Dr. I. Behar |
| Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) | Army Representative | MAJ B. C. Leibrecht |
| | Member | Dr. J. H. Patterson |
| | Member | Mr. R. T. Camp, Jr. |
| | Member | Dr. W. R. Howse |

| Committee | Affiliation | Individual |
|---|---|---|
| NORTH ATLANTIC TREATY ORGANIZATION--ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT | | |
| Aerospace Medical Panel | Army Representative | COL D. R. Price |
| Behavioral Sciences Committee, AMP | Member | Dr. K. A. Kimball |
| Evaluation of Methods to Assess Workload, AMP Working Group 08 | Member | Dr. K. A. Kimball |
| Research Study Group 6, Effects of Impulse Noise | Member | Dr. J. H. Patterson |
| US ARMY AVIATION CENTER | | |
| NBC Steering Committee | Member | Dr. F. S. Knox III |
| Army Aviation Threat Committee | Member | Dr. K. A. Kimball |
| Army Aviation Mission Area Analysis | Member | Dr. K. A. Kimball |
| Fort Rucker Flight Standardization Committee | Member | MAJ R. A. Huether |

# Bibliography

## Publications


Harding, T. H., Wiley, R. W., Kirby, A. W. 1983. A cholinergic sensitive channel in cat visual system tuned to low spatial frequencies. *Science*. 221:1076-1078.

Huether, R. A. 1982. Safe mission completion using AN/PVS-5 night vision goggles. *Aviation Digest*. 19.

Rash, C. E., and Hapgood, J. 1982. Controller selects active CRT raster line. *Electronics*. 113.

Shanahan, D. F. 1983. Basilar Skull Fracture in U. S. Army Aircraft Accidents. *Aviation, Space and Environmental Medicine*. 628-631.

Wiley, R. W., Glick, D. A., and Holly, F. F. 1983. AN/PVS-5 night vision goggles. *Aviation Digest*. 7-11.


## Technical Reports


Burdick, C.K., Patterson, J.H., Mozo, B.T., Hargett, C.E. Jr., Hamernik, R.P., and Henderson, D., *"Threshold Shifts and Cochlear Injury in Chinchillas Exposed to Octave Bands of Noise Centered at 63 and 1000 Hertz for Nine Days,"* USAARL Report No. 83-2, October 1982.

Burdick, C.K., *Hearing Loss from Low-Frequency Noise (Reprint),"* USAARL Report No. 83-3, October 1982.

Ettinger, M., Curd, D.I., and Patterson, J.H., *"Development of the Swine as a Large Animal Model for Noise Research,"* USAARL Report No. 83-9, May 1983.

Goldstein, J.L., *"Attenuation Variation Obtained with Subject Fit of the Sigma Engineering Triple-Flange Insert Hearing Protective Device,"* USAARL Report No. 83-11, June 1983.

Hamilton, B., Simmons, R.R., and Kimball, K.A., *"Psychological Effects of Chemical Defense Ensemble Imposed Heat Stress on Army Aviators,"* USAARL Report No. 83-6, November 1982.

Hamilton, B.E., and Zapata, L., *"Psychological Measurements During the Wear of the U.S. Aircrew Chemical Defense Ensemble,"* USAARL Report No. 83-7, February 1983.

Jones, H.D., Lewis, J.A., and Higdon, A.A. Jr., *"Helicopter In-Flight Monitoring System, Second Generation (HIMS II),"* USAARL Report No. 83-13, August 1983.

Knox, F.S. III, Nagel, G.A., Hamilton, B.E., Olazabal, R.P., and Kimball, K.A., *"Physiological Impact of Wearing Aircrew Chemical Defense Ensembles While Flying the UH-1H in Hot Weather,"* USAARL Report No. 83-4, October 1982.

McLean, W.E., *"Modified Faceplate for AN/PVS-5 Night Vision Goggles,"* USAARL Report No. 83-1, October 1982.

Mills, J.H., Osguthorpe, J.D., Burdick, C.K., Patterson, J.H., and Mozo, B.T., *"Temporary Threshold Shifts Produced by Exposure to Low-Frequency Noises (Reprint),"* USAARL Report No. 83-8, undated.

Peters, L.J., and Ford, H., *"Extent of Hearing Loss Among Army Aviators at Fort Rucker, Alabama,"* USAARL Report No. 83-12, August 1983.

Rash, C.E., and Becher, J., *"Analysis of Image Smear in CRT Displays Due to Scan Rate and Phosphor Persistence,"* USAARL Report No. 83-5, October 1982.

Shanahan, D.F., Haley, J.L., Johnson, J.C., Wells, J.H., and Knoche, H., *"Impact and Vibration Testing of a Modified UH-1 Crew Seat,"* USAARL Report No. 83-10, June 1983.

Shanahan, D.F., and King, A.I., *"Impact Response of an Energy Absorbing Earcup,"* USAARL Report No. 83-14, September 1983.

# Presentations

Campbell, D. L. 1983. *Cardiopulmonary Physiology in Active Duty Aviators: An Interim Report.* Presented to the National Society for Cardiopulmonary Technology Annual Conference, 1983 May 24-27; Washington, DC.

Hamilton, B. E. 1983. *Army Aviator Fatigue During a 21-Day Field Training Exercise.* Presented to Army Aeromedical Concepts Review Committee, 1983 Feb 11; San Antonio, TX.

Hamilton, B. E. 1983. *Overview of the Biomedical Applications Research Division, USAARL.* Presented to AMEDD Behavioral Sciences Research and Development, 1983 April 11-14; Fort Rucker, AL.

Hamilton, B. E. 1983. *Performance on a Memory and Search Task (MAST) by Army Aviators During a 21-Day Field Training Exercise.* Presented to Second Symposium on Aviation Psychology, 1983 25-27 April; Columbus, Ohio.

Kimball, K. A. 1983. *Selected Factors Affecting Aircrew Performance During Sustained Operations.* Presented to the USAF Operational Aeromedical Problems Course, 1983 Jan 24-28; San Antonio, TX.

Kimball, K. A. 1983. *Selected Factors Affecting Aircrew Performance During Sustained Operations.* Presented to the U. S. Army Operational Aeromedical Problems Course, 1983 April 12; Fort Rucker, AL.

Kimball, K. A. 1983. *Selected Factors Affecting Aircrew Performance During Sustained Operations.* Presented to the Aerospace Medical Panel Symposium. Advisory Group for Aerospace Research and Development, 1983 April 18-72; Paris, France.

Knox, F. S. 1983. *Army Requirements for OBOGS.* Presented to Joint Logistics Commanders Ad Hoc Committee on Aircraft OBOGS, 1983 June 20-23; San Antonio, TX.

Knox, F. S. 1983. *Computers, Problems and Statistics: Are They Helpful?* Presented to American Burn Association, 1983 Mar 16-20; New Orleans, LA.

Knox, F. S. 1983. *Development and Implementation of Fire/Burn Presentation Programs.* Presented to American Burn Association, 1983 Mar 16-20; New Orleans, LA.

Knox, F. S. 1983. *Integration of Aircrew Clothing and Equipment.* Presented to the 54th Annual Meeting of the Aerospace Medical Association, 1983 May 23-26; Houston, TX.

Knox, F. S. 1983. *Physiological Impact of Wearing Aircrew Chemical Defense Protective Ensembles While Flying the UH-1H in Hot Weather.* Presented to the International Conference on Medical and Biophysical Aspects of Protective Clothing, 1983 July 4-9; Lyon, France.

Knox, F. S. 1983. *Physiological/Psychologic Measures of Pilot Performance.* Presented to University of Missouri, Louisiana Technical University, and Louisiana State University School of Medicine, 1983 Jan 19-22; Columbia, MO; Ruston, LA, Shreveport, LA.

Rash, C. E. and Becher, J. 1983. *Preliminary Model of Dynamic Information Tranefer in CRT Displays.* Presented to IEEE, Inc., SOUTHEASTCON'83, 1983 April 11-14; Orlando, FL.

Siering G. D. 1983. *Progress in Army Helicopter Flight Simulation.* Presented to Second Symposium on Aviation Psychology, 1983 April 25-28; Columbus, Ohio.

Weber, R. M. 1983. *Army OBOGS Research.* Presented to the Oxygen Standardization Committee, 1983 April 20; Battle Creek, MI.

# Letter Reports

Conner, J.M., and Wells, J.H., *"In-Flight Helmet Dynamometer Operator's Manual,"* USAARL LR-83-5-4-1, June 1983.

Fulbrook, J.E., Verchot, M.A., and Lentz, D.L., *"Standard Operation and Alignment of Zeiss EM10C Electron Microscope,"* USAARL LR-83-6-2-3, August 1983.

Holt, W.R., and Wells, J.H., *"Statistical Interim Report: Statistical Comparison of Vibration Regimen Between a Standard and a German Helicopter Seat for Humans,"* USAARL LR-83-1-5-1, September 1982.

Holt, W.R., *"The Hat Matrix: A Diagnostic Tool for Multiple Linear Regression,"* USAARL LR-83-3-5-2, February 1983.

Holt, W.R., *"Statistical Interim Report: Some Experiment Design Considerations and an Investigation on Neck Muscle Stress/Endurance in Helicopter Pilots,"* USAARL LR-83-11-5-3, September 1983.

McLean, W.E., and Rash, C.E., *"Visual and Optical Evaluations of the British S-10 Respirator,"* (FOUO), USAARL LR-83-10-2-7, August 1983.

Rash, C.E., Martin, J.S., and McLean, W.E., *"Physical and Optical Evaluation of the Gargoyles Spectacles,"* USAARL LR-83-2-2-1, January 1983.

Rash, C.E., Vereen, E.A., and McLean, W.E., *"Computer Program for Generating Light Level Calendars of Lunar Illumination at Fort Rucker, Alabama,"* USAARL LR-83-4-2-2, May 1983.

Rash, C.E., *"Light Level Calendars of Lunar Illumination at Fort Rucker, Alabama for July-December 1983,"* USAARL LR-83-8-2-5, July 1983.

Rash, C.E., and McLean, W.E., *"Visual and Optical Evaluations of the XM-40 Protective Mask,"* USAARL LR-83-9-2-6, August 1983.


U.S. ARMY AEROMEDICAL
RESEARCH LABORATORY

# Appendix

## Research and Technology Work Unit Summaries (DD 1498) for FY 83

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DAQH0152 | 831001 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISPN INSTR'N | 9. LEVEL OF SUM A. WORK UNIT |
|---|---|---|---|---|---|---|
| 821001 | D. CHANGE | U | U | | CX | |

| 10. NO/CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 61101A | 3A161101A91C | 00 | 291 |
| b. CONTRIBUTING | | | | |
| c. CONTRIBUTING | | | | |

11. TITLE (Procedure and Security Classification Code)

(U) Development of Military/ASTM Standard Method for Rapid Assessment of Burn Hazard

| 12. SUBJECT AREAS | | |
|---|---|---|
| 0602 | 0616 | 0617 |

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 8206 | 8409 | DA | C |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM TOTAL |

18. RESPONSIBLE DOD ORGANIZATION

a. NAME: U.S. Army Aeromedical Research Laboratory

b. ADDRESS (Include ZIP Code): Fort Rucker, AL 36362

c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R

d. TELEPHONE NUMBER (Include Area Code): 205-255-6917

19. GENERAL USE

MILITARY/CIVILIAN APPLICATION: H

| 8. RESOURCE ESTIMATE | | |
|---|---|---|
| FISCAL YEAR | a. PROFESSIONAL MAN-YEARS | b. FUNDS (In Thousands) |
| 83 | 0.1 | 15 |
| 84 | 0.0 | 00 |

20. PERFORMING ORGANIZATION

a. NAME: U.S. Army Aeromedical Research Laboratory

b. ADDRESS: Biomedical Applications Research Division, Fort Rucker, AL 36362

c. NAME OF PRINCIPAL INVESTIGATOR: Knox, F S

d. TELEPHONE NUMBER (Include Area Code): 205-255-6860

e. NAME OF ASSOCIATE INVESTIGATOR (If Applicable)

f. NAME OF ASSOCIATE INVESTIGATOR (If Applicable)

22. KEYWORDS (Provide EACH with Security Classification Code): (U) Burns; (U) Mathematical Models; (U) Digital Stimulation; (U) Heat Transfer; (U) Protective Clothing; (U) RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Provide brief but specific information on work done with Security Classification Codes)

Objective: (U) Development of clinically valid, military/ASTM standard method for rapidly assessing the burn hazard associated with the use of flammable and so-called nonflammable fabrics in a variety of applications, e.g., aircrew, tankcrew, and firefighter clothing, and with exposure to other thermal sources, e.g., weapons exhaust and lasers.

Approach: (U) Modification of USAARL's existing model, BRNSIM, to optimize its performance in predicting burn depth when compared with burn data from four sources (USAARL porcine burn data base, University of Rochester porcire data, Stroll's human burn data and Moritz and Henriques' porcine data) while taking into account the dynamics of convective cooling of skin by blood, the characteristics of various heat flux sources, and the need for speed as well as accuracy. Method will employ calibrated heat flux sensors, fire simulator and microprocessor-based system which will sample the output of the sensor monitoring the fire simulator, the output of the sensor monitoring the energy transferred through or emanating from a fabric and calculate the depth of the burn which would have occurred if porcine (and by inference, human) skin had been exposed to the thermal source for the period in question.

Progress: (U) (8210-8309) Current efforts have been to modify BRNSIM to account for the effect of cooling by blood on burn severity. Burn model optimization could not be accomplished until updates in hardware were received from the PDP 11/03. These additions were received in August 1983 and are just now coming on-line. Two presentations entitled "Development and Implementation of Fire/Burn Preventing Programs" and "Computers, Programs, and Statistics: Are They Helpful?" were made at the 15th Annual American Burn Association Meeting in New Orleans, LA, 16-20 May 1983.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DAOG0156 | 831001 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISP'N INSTR'N | 9. LEVEL OF SUM / A. WORK UNIT |
|---|---|---|---|---|---|---|
| 831001 | D. CHANGE | U | U | | CX | |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62777A | 3E162777A879 | BH | 162 |
| b. CONTRIBUTING | | | | |
| c. [illegible] | STOG 82/83-6 2/2 | | | |

11. TITLE (Procede with Security Classification Code)

(U) Visual Performance Research Related to Operational Problems in Army Aviation

12. SUBJECT AREAS

0616 0508 0510

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 7810 | CONT. | DA | C |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM/TOTAL |

18. RESOURCES ESTIMATE

| FISCAL YEARS | a. PROFESSIONAL WORKYEARS | b. FUNDS (In thousands) |
|---|---|---|
| 83 | 2.3 | 346 |
| 84 | 5.2 | 533 |

19. RESPONSIBLE DOD ORGANIZATION

a. NAME: U.S. Army Aeromedical Research Laboratory

b. ADDRESS (Include ZIP Code): Fort Rucker, AL 36362

c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R

d. TELEPHONE NUMBER (Include Area Code): 205-255-6917

20. PERFORMING ORGANIZATION

a. NAME: U.S. Army Aeromedical Research Laboratory

b. ADDRESS: Biomedical Applications Research Division
Fort Rucker, AL 36362

c. NAME OF PRINCIPAL INVESTIGATOR: Simmons, R R

d. TELEPHONE NUMBER (Include Area Code): 205-255-6858

e. NAME OF ASSOCIATE INVESTIGATOR (If Known): Kimball, K A

f. NAME OF ASSOCIATE INVESTIGATOR (If Known): Stone, L W

21. GENERAL USE

MILITARY/CIVILIAN APPLICATION: L

22. KEYWORDS (Procede EACH with Security Classification Code): (U) Visual Performance; (U) Eye Movement; (U) Military Aircraft; (U) Man-machine Relations; (U) Psychology; (U) Recording; (U) Volunteers; (U) RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Procede each with Security Classification Code)

Objective: (U) Visual perception to Army aircrews is critical for pilotage navigation, and weapon utilization to fulfill various tactical requirements. The objective of this project is to provide U.S. Army aviation information regarding the visual performance of fixed and rotary wing aviators during varying tactical missions. Special emphasis will be placed on the objective quantification and interpretation of these data and their relation to variables such as pilot physiological and psychological states and task loading.

Approach: (U) The approach will involve the utilization of an oculomotor monitoring and recording device for visual data collection during flight. Areas of research to be addressed will include: Aviator visual performance during conditions of VFR, IFR, night, and nap-of-the-earth (NOE) flights; day and night navigation; scout helicopter operations, and varying aircraft comparisons. Measurements of dwell times, scan rates, fixations, and zones of workload will be analyzed to provide visual performance criteria and models. Future data collection will include the use of workload ratings to clarify the relationship of oculomotor data to pilot workload, fatigue, and stress.

Progress: (U) (8210-8309) Equipment to enhance eye movement measurement and analyses methodology has been received and tested. These techniques will be demonstrated at a workshop on "Measurement and Interpretation of Eye Motions" to be presented at the annual meeting of the Human Factors Society in Oct 83. A report of this methodology will be prepared for publication in the second quarter, FY 84. Data reduction and analysis of eye movement data during flight in OH-58 and UH-1 helicopters have been completed. The results of this work will be submitted for publication during the second quarter, FY 84. More rapid progress on this work unit can be expected with the return of the primary investigator from long-term civilian training in January 1984.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DA0G0169 | 831001 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISPN INSTR'N | 9. LEVEL OF SUM |
|---|---|---|---|---|---|---|
| 821001 | D. CHANGE | U | U | | CX | A. WORK UNIT |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62777A | 3E162777A878 | AF | 134 |
| b. CONTRIBUTING | | | | |
| c. CONTRIBUTING | STOG 82/83-6.2/2 | | | |

11. TITLE (Procede with Security Classification Code): (U) Biomedical Application and Health Hazard Assessment of Oxygen Enrichment Breathing Systems

12. SUBJECT AREAS: 0619 0611 0103

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 7905 | CONT. | DA | C |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM/TOTAL |

18. RESPONSIBLE DOD ORGANIZATION

a. NAME: U.S. Army Aeromedical Research Laboratory

b. ADDRESS (Number and Street): Fort Rucker, AL 36362

c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R

d. TELEPHONE NUMBER (Include Area Code): 205-255-6917

19. GENERAL USE

MILITARY/CIVILIAN APPLICATION: H

| 8. RESOURCES ESTIMATE | | |
|---|---|---|
| FISCAL YEARS | a. PROFESSIONAL MAN-YEARS | b. FUNDS (In thousands) |
| 83 | 2.9 | 396 |
| 84 | 3.3 | 446 |

20. PERFORMING ORGANIZATION

a. NAME: U.S. Army Aeromedical Research Laboratory

b. ADDRESS: Biomedical Applications Research Division, Fort Rucker, AL 36362

c. NAME OF PRINCIPAL INVESTIGATOR: Knox, F S

d. TELEPHONE NUMBER (Include Area Code): 205-255-6860

e. NAME OF ASSOCIATE INVESTIGATOR (If applicable): Wehrly, D J

f. NAME OF ASSOCIATE INVESTIGATOR (If applicable): Weber, R M

23. KEYWORDS (Precede EACH with Security Classification Code): (U) Oxygen Supply Equipment; (U) Life Support; (U) Stress Physiology; (U) Aircraft; (U) Toxicology; (U) Volunteers; (U) RAM III

22. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Precede each of these with Security Classification Code):

Objective: (U) To identify, assess, and prevent unnecessary health hazards associated with the flight environment and to obtain a biomedical data base on the human function associated with the use of aircraft oxygen enrichment breathing systems in the flight environment. To provide the Army data, information, recommendations, and criteria to aid in the development and deployment of life support systems to alleviate identified health hazards.

Approach: (U) Biomedical evaluation of state-of-the-art oxygen enrichment breathing systems during aircraft ground and flight conditions; including sampling of environmental air input to the systems as well as the systems' enriched air output. Analysis to determine the systems' ability to effectively filter contaminants known to exist in the operational environment. Collect physiological data, heart rate, oxygen tension, and respiratory functions, as well as systems' parameters, oxygen concentration, flow rates, temperatures, and pressures, during ground operations and aircraft flight at altitude to assess the systems' ability to provide aviators the required oxygen concentration and purity during various flight profiles. Evaluate collected data with respect to biomedical, safety, and man/machine limitations

Progress: (U) (8303-8309) Reports on three OBOGS units (Bendix/Clifton Precision, Garrett, and Essex) are in final review, as is the PQ Mask report. During FY 83, the Essex unit was evaluated in the U-21 and UH-1 and found to produce more oxygen than the Clifton or Garrett units, but with greater pressure drop. Oxygen standards have been reviewed and proposed changes to the prebreathing specifications of AR 95-1 are in the process. A cardiopulmonary stress lab has been set up and staffed. Oxygen utilization vs. flight profile studies are scheduled for early Oct 83. Effects of battlefield contaminants on OBOGS (MSOC) will start in earnest as the mass spectrometer comes on-line.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE.

**RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY**

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DA0G0165 | 821001 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISPN INSTR'N | 9. LEVEL OF SUM | 10. WORK UNIT |
|---|---|---|---|---|---|---|---|
| 831001 | D. CHANGE | U | U | | CX | | |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62777A | 3E162777A878 | AE | 133 |
| b. CONTRIBUTING | | | | |
| c. CONTRIBUTING | STOG 82/83-6 3/2 | | | |

11. TITLE (Procede with Security Classification Code)
(U) Research Countermeasures for Significant Medical Hazards in Military Systems

12. SUBJECT AREAS
0602 0607 0619

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 7810 | CONT. | DA | C |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. SUM/TOTAL |

18. RESPONSIBLE DOD ORGANIZATION

| a. NAME | b. ADDRESS (Include ZIP Code) |
|---|---|
| U.S. Army Aeromedical Research Laboratory | Fort Rücker, AL 36362 |

| c. NAME OF RESPONSIBLE INDIVIDUAL | c. TELEPHONE NUMBER (Include Area Code) |
|---|---|
| Price, D R | 205-255-6917 |

19. GENERAL USE
MILITARY/CIVILIAN APPLICATION: M

20. PERFORMING ORGANIZATION

| a. NAME | b. ADDRESS |
|---|---|
| U.S. Army Aeromedical Research Laboratory | Biomedical Applications Research Division<br>Fort Rucker, AL 36362 |

| c. NAME OF PRINCIPAL INVESTIGATOR | c. TELEPHONE NUMBER (Include Area Code) |
|---|---|
| Knox, F S | 205-255-6860 |

| f. NAME OF ASSOCIATE INVESTIGATOR (If Common) | g. NAME OF ASSOCIATE INVESTIGATOR (If Common) |
|---|---|
| Taylor, P L | |

21. RESOURCES ESTIMATE

| FISCAL YEARS | c. PROFESSIONAL MANYEARS | d. FUNDS (In Thousands) |
|---|---|---|
| 83 | 5.4 | 500 |
| 84 | 5.2 | 709 |

22. KEYWORDS (Provide EACH with Security Classification Code): (U) Hazards; (U) Protective Equipment; (U) Stress Physiology; (U) Life Support; (U) Bioengineering; (U) Biochemistry; (U) Volunteers; (U) RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Provide Key Words with Security Classification Code)

Objective: (U) Conduct applied medical research to identify, assess, and prevent unnecessary health hazards and personnel injuries imposed by exposure to the operational environment, toxic gases, oxygen levels, chemical and biological agents, and to provide the Army technical information, recommendations, and standards to be used in the development and modification of systems that provide protection from those hazards.

Approach: (U) Application of physiological and biomedical applied research methods utilizing physical examinations, X-rays, and biochemical analysis techniques to isolate the hazards involved and determine required protective measures. Establishment of biomedical requirements of environmental control systems and oxygen generating systems, life support survival equipment, and aeromedical evacuation and rescue equipment.

Progress: (U) (8303-8309) Results of study of chemical defense ensembles worn in hot weather were reported in USAARL Reports 83-4, 83-6, and 82-6. Biochemistry and physiology labs were expanded to prepare for a study of effects of antidotes and pretreatment drugs on pilot performance. Proposed hot weather study (summer 84) looking at new ensembles has been discussed with AVRADCOM. Data collected on a prototype microclimate cooling system were reviewed and analyzed for possible publication. A presentation of USAARL Reports 83-4 and 83-6 was made at a conference on protective clothing in Lyon, France. Future emphasis will be on new ensembles and drug effects.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE

| RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY | | | | 1. AGENCY ACCESSION: DA300426 | 2. DATE OF SUMMARY: 831001 | REPORT CONTROL SYMBOL |
|---|---|---|---|---|---|---|
| 3. DATE PREV SUMRY: 821001 | 4. KIND OF SUMMARY: D. CHANGE | 5. SUMMARY SCTY: U | 6. WORK SECURITY: U | 7. REGRADING | 8. DISSEMINATION: CX | 9. LEVEL OF SUM: A. WORK UNIT |
| 10. NO/CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER | | |
| a. PRIMARY | 61101A | 3A161101A91C | 00 | 293 | | |
| b. CONTRIBUTING | | | | | | |
| c. CONTRIBUTING | | | | | | |

11. TITLE (Procedure with Security Classification Code): (U) Development of Techniques to Monitor Brain Function of Aviators During Flight in Army Fixed and Rotary Wing Aircraft

12. SUBJECT AREAS: 0602 0619 0505

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 8301 | 8510 | DA | C |

17. CONTRACT/GRANT
a. DATE EFFECTIVE: EXPIRATION:
b. CONTRACT/GRANT NUMBER:
c. TYPE: d. AMOUNT:
e. KIND OF AWARD: f. SUM/TOTAL:

18. RESOURCES ESTIMATE

| FISCAL YEARS | a. PROFESSIONAL WORKYEARS | b. FUNDS (In thousands) |
|---|---|---|
| 83 | 0.3 | 25 |
| 84 | 0.5 | 35 |

19. RESPONSIBLE DOD ORGANIZATION
a. NAME: U.S. Army Aeromedical Research Laboratory
b. ADDRESS (Include ZIP code): Fort Rucker, AL 36362
c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R
d. TELEPHONE NUMBER (Include Area Code): 205-255-6917

20. PERFORMING ORGANIZATION
a. NAME: U.S. Army Aeromedical Research Laboratory
b. ADDRESS: Biomedical Applications Research Division, Fort Rucker, AL 36362
c. NAME OF PRINCIPAL INVESTIGATOR: Knox, F S
d. TELEPHONE NUMBER (Include Area Code): 205-255-6860
e. NAME OF ASSOCIATE INVESTIGATOR (If Applicable):
f. NAME OF ASSOCIATE INVESTIGATOR (If Applicable):

21. GENERAL USE
MILITARY/CIVILIAN APPLICATION: L

22. KEYWORDS (Provide Each with Security Classification Code): (U) Evoked Responses; (U) Neurophysiology; (U) RAM III (U) Environmental Stressors; (U) Inflight Monitors; (U) Volunteers

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Provide Each with Security Classification Code):

Objective: (U) Development of a technique for measuring evoked responses from aviators as they pilot Army aircraft in order to study the effect of environmental stressors on central nervous system function. The knowledge to be gained will enhance materially our understanding of how aviators accomplish their mission under stress and how life support equipment or training can ameliorate the effects of multiple stressors.

Approach: (U) Development of the technique of recording evoked responses from aviators as they pilot Army aircraft. Development of a militarized microprocessor-based stimulus presentation and data acquisition system to collect neurophysiologic data in-flight. The brainstem auditory-evoked response will be recorded to show that auditory information was received by the central nervous system. The visual-evoked response will be recorded from scalp electrodes over the visual cortex to assess visual system function. Recording and analysis techniques will be worked out in the simulator prior to being attempted in the aircraft.

Progress: (U) (8210-8309) Much of FY 83 was devoted to accruing background information and a microprocessor-based system. In mid-September, a Cadwell 5200 system was received and was tested in this laboratory. Contacted Dr. Nelson of NADC who records evoked responses in centrifuges and extracts single responses using highly matched filters. A short protocol was written and approved by the Human Use Committee to explore the problems associated with recording brainstem-evoked potential in aircraft.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE.

| RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY | | | | 1. AGENCY ACCESSION: DA0G0151 | 2. DATE OF SUMMARY: 831001 | REPORT CONTROL SYMBOL |
|---|---|---|---|---|---|---|
| 3. DATE PREV SUMRY: 830301 | 4. KIND OF SUMMARY: D. CHANGE | 5. SUMMARY SCTY: U | 6. WORK SECURITY: U | 7. REGRADING | 8. DISP'N INSTR'N: CX | 9. LEVEL OF SUM: A. WORK UNIT |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62777A | 3E162777A879 | BH | 165 |
| b. CONTRIBUTING | | | | |
| c. CONTRIBUTING | STOG 82/83-6.2/2 | | | |

11. TITLE (Procedure and Security Classification Code): (U) Aeromedical Research of Operationally Significant Problems in the Army Aviation Environment

12. SUBJECT AREAS: 0605 0616 0103

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 7810 | CONT. | DA | C |

| 17. CONTRACT/GRANT | | 18. RESOURCES ESTIMATE | | |
|---|---|---|---|---|
| a. DATE EFFECTIVE | EXPIRATION | FISCAL YEARS | a. PROFESSIONAL MANYEARS | b. FUNDS (In thousands) |
| b. CONTRACT/GRANT NUMBER | | 83 | 4.0 | 273 |
| c. TYPE | d. AMOUNT | 84 | 6.9 | 499 |
| e. KIND OF AWARD | f. CUM TOTAL | | | |

| 19. RESPONSIBLE DOD ORGANIZATION | 20. PERFORMING ORGANIZATION |
|---|---|
| a. NAME: U.S. Army Aeromedical Research Laboratory | a. NAME: U.S. Army Aeromedical Research Laboratory |
| b. ADDRESS (Number and Street): Fort Rucker, AL 36362 | b. ADDRESS: Biomedical Applications Research Division<br>Fort Rucker, AL 36362 |
| c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R | c. NAME OF PRINCIPAL INVESTIGATOR: Kimball, K A |
| d. TELEPHONE NUMBER (Include Area Code): 205-255-6917 | d. TELEPHONE NUMBER (Include Area Code): 205-255-6861 |
| 21. GENERAL USE<br>MILITARY/CIVILIAN APPLICATION: L | e. NAME OF ASSOCIATE INVESTIGATOR (If Available): Siering, G D<br>f. NAME OF ASSOCIATE INVESTIGATOR (If Available): Simmons, R R |

22. KEYWORDS (Procedure, Each with Security Classification Code): (U) Stress; (U) Biomedical Evaluation; (U) Aircraft; (U) Psychology; (U) Recording Devices; (U) Volunteers; (U) Aviation Medicine; (U) RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Procedure, use of abbreviations and Security Classification Codes):

Objective: (U) The objective of this project is to provide a definitive assessment of medical problems peculiar to the aviation environment and prepare guidelines for field commanders on the impact of these problems on the aviation mission. The results of such research will aid in development of improved standards and biomedical techniques for the field flight surgeon to use in monitoring and treating aviator stress and fatigue as well as the medical standards for selection of aviators and air traffic controllers for specific assignments.

Approach: (U) Operational aviation units will be observed to identify significant aeromedical problems. As problems are identified, scientific methodologies will be evaluated to ensure applicability and scientific evidence. Appropriate methodologies will quantify the extent of the problem and assist a multidisciplinary team in isolating controlling variables and the effect of proposed ameliorating changes.

Progress: (U) (8303-8309) The psychological effects of heat stress imposed by chemical defense ensembles have been studied and reported in USAARL Report No. 83-6. A baseline study of the psychological effects of wearing the chemical defense ensemble in the absence of heat stress was reported in USAARL Report No. 83-7. Analysis of the effects of a field deployment of aviators to the National Training Center was completed and the results published at the Second Symposium on Aviation Psychology. A 5-member team was deployed to two field sites in Germany to document fatigue and cognitive changes in aviators participating in REFORGER 83 with data collection concluding on 30 Sep 83. Approvals have been granted to modify the Division's physical plant in order to provide psychological and neurophysiological test capabilities for subjects participating in extended in-house research.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DAOD6735 | 83 10 01 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISPOSITION | 9. LEVEL OF SUM |
|---|---|---|---|---|---|---|
| 82 10 01 | H. TERM | U | U | | NL | A. WORK UNIT |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62777A | 3E162777A878 | AG | 137 |
| b. CONTRIBUTING | | | | |
| c. [illegible] | STOG 82/83-6.2/2 | | | |

11. TITLE (Procedure and Security Classification Code)
(U) Biodynamics of Impact Physiology

12. SUBJECT AREAS
01 03 06 02 06 17

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 66 12 | CONT | DA | C. In-House |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM/TOTAL |

18. RESOURCES ESTIMATE

| FISCAL YEARS | a. PROFESSIONAL MANYEARS | b. FUNDS (In thousands) |
|---|---|---|
| 83 | 2.9 | 267 |
| 84 | 0.0 | 000 |

19. RESPONSIBLE DOD ORGANIZATION

a. NAME: US Army Aeromedical Research Laboratory

b. ADDRESS (Include ZIP Code): Fort Rucker, AL 36362

c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R

d. TELEPHONE NUMBER (Include Area Code): 205-255-6917

20. PERFORMING ORGANIZATION

a. NAME: Biodynamics Research Division
US Army Aeromedical Research Laboratory

b. ADDRESS: Fort Rucker, AL 36362

c. NAME OF PRINCIPAL INVESTIGATOR: Haley, J L

d. TELEPHONE NUMBER (Include Area Code): 205-255-6890

e. NAME OF ASSOCIATE INVESTIGATOR (If Applicable): Shanahan, D F

f. NAME OF ASSOCIATE INVESTIGATOR (If Applicable): Hundley, T A

21. GENERAL USE

MILITARY/CIVILIAN APPLICATION:

22. KEYWORDS (Precede Each with Security Classification Code): (U) Helmet Testing; (U) Protective Equipment; (U) Head Protection; (U) Body Armor Tests; (U) Volunteers; (U) RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Precede Each with Security Classification Code)

Object: (U) To provide biomedical impact criteria for the development of improved whole body protection, and to assess the protective performance of helmets and whole body protective apparatus. Improved head protection from impact is very important because one of three aviation crash fatalities is a result of head and/or neck trauma.

Approach: (U) The approach is based on accepted experimental bioengineering methods (mathematical modeling, pathophysiologic techniques, biomechanics, structuring, engineering, and physics). This work unit supports the Army's responsibility for applied head-impact research for all three services.

Progress: (U) 8210-8309. Continued effort has been expended on the evaluation of various foams and helmet shell combinations. A final report is being written. Additional impact test data were provided to the Integrated Helmet Program Manager. A total of 15 impact tests with human surrogates on new "crushable" earcups for use in the SPH-4 or other flight helmets were completed. Comparative impact tests of UH-60 crew seats were begun at the FAA test facility at Oklahoma City, Oklahoma, but the tests are not complete. Evaluations of crash-damaged seats, restraints, and helmets continued: Five severe crashes of the UH-60 have revealed good lifesaving performance of the crew seat but showed problems with the troop seat. Plans for the construction of a .50-cal firing facility have been completed; the facility is to be used for .50-cal vest evaluations. The Staged Personnel Parachute System test plan was reviewed and test recommendations made to TECOM. Test components were received and assembled to conduct helmet retention tests for the US Navy in first half of FY 84. Instrumentation and personnel were provided to the Human Engineering Laboratory to determine the tolerance of tank gunners to muzzle brake impact from large-bore weapons on tanks; a report on this work was completed. Since no physiological research is currently being done under this unit, this program is terminated and unfinished tasks will be continued under Agency Accession Number DAOG0167.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE.

**RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY**

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DA302870 | 83 10 01 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISTR INSTR'N | 9. LEVEL OF SUM |
|---|---|---|---|---|---|---|
| | A. NEW | U | U | | NL | A. WORK UNIT |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62777A | 3E162777A878 | AG | 138 |
| b. CONTRIBUTING | | | | |
| c. [illegible] | STOG 82/83-6.2/2 | | | |

11. TITLE (Procedure and Security Classification Code)
(U) Life Support Equipment Crashworthiness Evaluations

12. SUBJECT AREAS
01 03 06 02 06 17

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 83 10 | CONT | DA | C. In-House |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM TOTAL |

18. RESOURCES ESTIMATE

| FISCAL YEARS | a. PROFESSIONAL MAN-YEARS | b. FUNDS (In thousands) |
|---|---|---|
| 83 | 0.0 | 00 |
| 84 | 5.8 | 569 |

| 19. RESPONSIBLE DOD ORGANIZATION | 20. PERFORMING ORGANIZATION |
|---|---|
| a. NAME: US Army Aeromedical Research Laboratory | a. NAME: Biodynamcs Research Division<br>US Army Aeromedical Research Laboratory |
| b. ADDRESS (Street, City, State and ZIP Code): Fort Rucker, AL 36362 | b. ADDRESS: Fort Rucker, AL 36362 |
| c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R | c. NAME OF PRINCIPAL INVESTIGATOR: Haley, J L |
| d. TELEPHONE NUMBER (Include Area Code): 205-255-6917 | d. TELEPHONE NUMBER (Include Area Code): 205-255-6890 |
| 21. GENERAL USE<br>MILITARY/CIVILIAN APPLICATION: | e. NAME OF ASSOCIATE INVESTIGATOR (If Applicable): Sippo, A C<br>f. NAME OF ASSOCIATE INVESTIGATOR (If Applicable): Licina, J R |

22. KEYWORDS (Precede EACH with Security Classification Code): (U) Helmet Testing; (U) Protective Equipment Evaluation; (U) Head Protection; (U) Energy-Absorbing Seat Testing; (U) RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Precede each with Security Classification Code):

Objective: (U) To provide biomedical impact and test criteria for new and existing life support equipment for US Army personnel.

Approach: (U) The approach is based on accepted bioengineering methods including: (1) Selected accident investigations to determine vehicle kinetics and kinematics, (2) impact testing of occupant restraint systems and helmets, (3) head impact simulations to relate helmet protection to human tolerance, (4) anthropomorphic (dummy) impacts to determine the performance of energy-absorbing devices to minimize the effect of forces on the body, (5) analysis of parachute riser loads to relate to human tolerance and, (6) development of test methods for helmets and other life support equipment.

Progress: (U) None.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE.

**RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY**

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DAOG6102 | 83 10 01 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISP'N INSTR'N | 9. LEVEL OF SUM A. WORK UNIT |
|---|---|---|---|---|---|---|
| 82 10 01 | D. CHANGE | U | U | | NL | |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62777A | 3E162777A879 | BH | 166 |
| b. CONTRIBUTING | | | | |
| c. COMPATIBLE | STOG 82/83-6.2/2 | | | |

11. TITLE (Procede with Security Classification Code)
(U) Anthropometric Criteria for Army Aviators

12. SUBJECT AREAS
05 08 06 16 01 03

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 80 11 | 84 02 | DA | C. In-House |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM/TOTAL |

18. RESPONSIBLE DOD ORGANIZATION
a. NAME: US Army Aeromedical Research Laboratory
b. ADDRESS (Include Zip Code): Fort Rucker, AL 36362
c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R
d. TELEPHONE NUMBER (Include Area Code): 205-255-6917

19. RESOURCES ESTIMATE

| FISCAL YEARS | a. PROFESSIONAL MAN-YEARS | b. FUNDS (In Thousands) |
|---|---|---|
| 83 | 5.1 | 374 |
| 84 | 2.0 | 182 |

20. PERFORMING ORGANIZATION
a. NAME: Biodynamics Research Division
US Army Aeromedical Research Laboratory
b. ADDRESS: Fort Rucker, AL 36362
c. NAME OF PRINCIPAL INVESTIGATOR: Schopper, A W
d. TELEPHONE NUMBER (Include Area Code): 205-255-6896
e. NAME OF ASSOCIATE INVESTIGATOR (If Applicable): Mastroianni, G
f. NAME OF ASSOCIATE INVESTIGATOR (If Applicable):

21. GENERAL USE
(MILITARY/CIVILIAN APPLICATION)

22. KEYWORDS (Precede EACH with Security Classification Code): (U) Anthropometrics; (U) Aircraft; (U) Strength; (U) Aviation Medicine; (U) Performance; (U) Volunteers; (U) RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Precede each with Security Classification Code)

Objective: (U) The increased concern about the use of women in the Army has resulted in the need to reevaluate the anthropometric criteria cited in AR 40-501 concerning Class 1, 1A, and 2 flying duty. Cockpit design criteria in MIL STD 1472B indicate that aircraft designers are to utilize the 5th-95th percentile male. Standards cited in AR 40-501 are not consistent with these guidelines, and previously conducted research has indicated that personnel smaller than the 5th percentile male are capable of flying some Army aircraft. Hence, a need exists to re-evaluate and modify, as appropriate, extant anthropometric criteria.

Approach: (U) Anthropometric data, including strength and weight measurements, will be obtained from males and females whose statures are less than 64 inches or greater than 73 inches. These data will be compared with the cockpit-related dimensions and individuals will be placed in aircraft to determine the anthropometric criteria. Weight criteria will be based on: Crash-survivability considerations, aircraft weight and balance considerations, and medical obesity guidance. Strength criteria will be based on a consideration of both the maximum force required to fly selected Army aircraft and the evaluation of sustained physical exertion upon cognitive and psychosensory capabilities while performing multielement tracking tasks using aircraft controls which require varied levels of physical force input for their operation.

Progress: (U) 8210-8309. Data collection has been completed for the cockpit compatibility, seated eye height, strength assessment, and in-flight control-force determination portions of the study. Data reduction and analysis are presently in progress in each of these areas.

DD FORM 1498 EDITION OF 1 JAN 73 IS OBSOLETE

**RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY**

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DAOG0167 | 83 10 01 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISP'N INSTR'N | 9. LEVEL OF SUM / A. WORK UNIT |
|---|---|---|---|---|---|---|
| 82 10 01 | D. CHANGE | U | U | | NL | |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62777A | 3E16277A878 | AG | 131 |
| b. CONTRIBUTING | | | | |
| c. CONTRIBUTING | STOG 82783-6.2/2 | | | |

11. TITLE (Procede with Security Classification Code)
(U) Biodynamics of Life Support Equipment and Personnel Armor

12. SUBJECT AREAS
06 11 06 19 06 02

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 78 10 | CONT | DA | C. In-House |

| 17. CONTRACT/GRANT | | 18. RESOURCES ESTIMATE | | |
|---|---|---|---|---|
| a. DATE EFFECTIVE | EXPIRATION | FISCAL YEARS | a. PROFESSIONAL MAN-YEARS | b. FUNDS (In thousands) |
| b. CONTRACT/GRANT NUMBER | | 83 | 3.9 | 214 |
| c. TYPE | d. AMOUNT | 84 | 5.7 | 292 |
| e. KIND OF AWARD | f. CUM TOTAL | | | |

| 19. RESPONSIBLE DOD ORGANIZATION | 20. PERFORMING ORGANIZATION |
|---|---|
| a. NAME: US Army Aeromedical Research Laboratory | a. NAME: Biodynamics Research Division<br>US Army Aeromedical Research Laboratory |
| b. ADDRESS (Number and Street): Fort Rucker, AL 36362 | b. ADDRESS: Fort Rucker, AL 36362 |
| c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R | d. NAME OF PRINCIPAL INVESTIGATOR: Sippo, A C |
| e. TELEPHONE NUMBER (Include Area Code): 205-255-6917 | e. TELEPHONE NUMBER (Include Area Code): 205-255-6943 |
| 21. GENERAL USE<br>MILITARY/CIVILIAN APPLICATION: | f. NAME OF ASSOCIATE INVESTIGATOR (If Known): Licina, J R<br>g. NAME OF ASSOCIATE INVESTIGATOR (If Known): |

22. KEYWORDS (Precede EACH with Security Classification Code): (U)RAM III; (U)Protective Equipment; (U)Stress physiology; (U)Man-Machine Relationships; (U)Biomedical; (U)Musculoskeletal Systems; (U)Body Armor Tests

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Precede each with Security Classification Code):

Objective: (U) Provide technicological data base for biomedical evaluation of life support equipment (LSE) correlated with injury data; identify hazards associated with LSE and provide design recommendations to improve LSE and personnel armor for use under combat conditions; provide evaluation of crash-related LSE through triservice LSE Retrieval Program (LSERP). Data collected will be used to help increase mission effectiveness by protecting aircrew from environmental and enemy weapon's hazards. Injury prevention will conserve the fighting strength of our highly trained aircrews in combat.

Approach: (U) Army aviation LSE involved in accidents is sent to USAARL for biomedical and injury correlation to assess the effectiveness/deficiencies of the LSE through the physical condition of the protective devices, the injury incurred, and the human dynamics in the accident. This is done by epidemiologic methods, medical engineering failure model analysis, accident investigative procedures, forensic pathology, mathematical modeling, and bioengineering research techniques. A helmet retention study for the US Navy also is scheduled for this year as a legacy from agency accession number DAOD6735.

Progress: (U) 8209-8305. Technical reports on German helicopter seat evaluations and the impact response of crushable earcups have been published. Articles have been accepted for publication in Aviation, Space and Environmental Medicine on basilar skull fractures in Army air accidents, spinal injury in light observation helicopters, and a preliminary study on helicopter pilot back pain. A helicopter back pain questionnaire survey involving 1100 subjects is being analyzed and will be submitted for publication within the year. The LSERP is being revamped and upgraded by a full-time life support specialist chief warrant officer. During this time frame, this individual was sent by this laboratory to attend the Crash Survival Investigator School and the Army Aviation Life Support Specialist School.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY | DAOG0101 | 83 01 01

| DATE PREV SUMM | TYPE SUMMARY | SECURITY CLASS | CLASS | | | LEVEL A WORK UNIT |
|---|---|---|---|---|---|---|
| 82 10 01 | M. TERMINA | U | U | | NL | |

| 10 NSN CODES | PROGRAM ELEMENT | PROJECT NUMBER | SUBPROJECT NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a PRIMARY | 62777A | 3E162777A879 | BH | 164 |
| b CONTRIBUTING | | | | |
| c [illegible] | STOG82/83-6.2/2 | | | |

11 TITLE (Precede with Security Classification Code)
(U) Parametric, Multimodal Workl ad Assessment in Aircraft Guidance Systems

12 SUBJECT AREAS
01 29 00 94 01 34 00 13

| 13 START DATE | 14 ESTIMATED COMPLETION DATE | 15 FUNDING ORGANIZATION | 16 PERFORMANCE METHOD |
|---|---|---|---|
| 80 10 | 84 12 | DA | C. In-house |

17 CONTRACT/GRANT
a DATE EFFECTIVE | EXPIRATION
b CONTRACT GRANT NUMBER
c TYPE | d AMOUNT
e KIND OF AWARD | f CUM TOTAL

18 RESOURCES ESTIMATE

| FISCAL YEARS | a PROFESSIONAL WORKYEARS | b FUNDS (In thousands) |
|---|---|---|
| 82 | 0.8 | 60 |
| 83 | 0.8 | 102 |

19 RESPONSIBLE DOD ORGANIZATION
a NAME
US Army Aeromedical Research Laboratory
b ADDRESS (include zip code)
Fort Rucker, AL 36362
c NAME OF RESPONSIBLE INDIVIDUAL
Price, D R
d TELEPHONE NUMBER (include area code)
205-255-6917

20 PERFORMING ORGANIZATION
a NAME Biomedical Applications Research Division
US Army Aeromedical Research Laboratory
b ADDRESS
Fort Rucker, AL 36362
c NAME OF PRINCIPAL INVESTIGATOR
Hamilton, B E
d TELEPHONE NUMBER (include area code)
205-255-6977
f NAME OF ASSOCIATE INVESTIGATOR (if available)
g NAME OF ASSOCIATE INVESTIGATOR (if available)

21 GENERAL USE
MILITARY/CIVILIAN APPLICATION

22 KEYWORDS (Precede each with Security Classification Code) (U) Visual-Motor Performance; (U) Military Aircraft; (U) Workload; (U) Physiology; (U) Psychology; (U) Human Volunteers

23 TECHNICAL OBJECTIVE 24 APPROACH 25 PROGRESS (Precede text of each with Security Classification Code)

Objective: (U) Sophisticated avionics, weapon systems, and taxing flight profiles place great demands upon aviator information processing abilities. The objective of this work unit is to provide measures of workload and cognition in order to critically assess the capabilities and limitations of aviators.

Approach: (U) Tactical scenarios are analyzed to determine stressful and fatiguing components which adversely affect the aviator's mission accomplishments. Psychological and visual/psychomotor tests are identified or developed with the goal of being specifically tailored to the aviation scenario.

Progress: (U) This work unit is being terminated. Research under this project is being consolidated with Work Unit 165, Agency Accession DAOG0151.

DD FORM 1498 EDITION OF MAR 68 IS OBSOLETE

**RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY**

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DAOG6100 | 83 10 01 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISPN INSTR'N | 9. LEVEL OF SUM / WORK UNIT |
|---|---|---|---|---|---|---|
| 82 10 01 | D. CHANGE | U | U | | NL | |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62777A | 3E162777A878 | AD | 132 |
| b. CONTRIBUTING | | | | |
| c. [illegible] | STOG 82/83-6.2/2 | | | |

11. TITLE (Procedure and Security Classification Code):
(U) Vibaration Hazards of Combat Aircraft and Vehicles

12. SUBJECT AREAS
05 05 05 08 06 16 06 11

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 80 10 | CONT | DA | C. In-House |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM/TOTAL |

18. RESPONSIBLE DOD ORGANIZATION

a. NAME
US Army Aeromedical Research Laboratory

b. ADDRESS (Include ZIP Code)
Fort Rucker, AL 36362

c. NAME OF RESPONSIBLE INDIVIDUAL
Price, D R

d. TELEPHONE NUMBER (Include Area Code)
205-255-6917

19. GENERAL USE

MILITARY/CIVILIAN APPLICATION:

20. PERFORMING ORGANIZATION

a. NAME Biodynamics Research Division
US Army Aeromedical Research Laboratory

b. ADDRESS
Fort Rucker, AL 36362

c. NAME OF PRINCIPAL INVESTIGATOR
Maday, R E

d. TELEPHONE NUMBER (Include Area Code)
205-255-6883

e. NAME OF ASSOCIATE INVESTIGATOR (If Known)

f. NAME OF ASSOCIATE INVESTIGATOR (If Known)

| 21. RESOURCES ESTIMATE | | |
|---|---|---|
| FISCAL YEARS | a. PROFESSIONAL MANYEARS | b. FUNDS (In Thousands) |
| 83 | 1.5 | 120 |
| 84 | 3.5 | 342 |

22. KEYWORDS (Provide at least 5 with Security Classification Codes): (U)Vibration; (U)Stress; (U)Acuity; (U)Biodynamics; (U) Simulation; (U)Electromyography; (U)Volunteers; (U)Performance; (U)Fatigue; (U)RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Provide Brief Statement of Work with Security Classification Codes):

Objective: (U) To conduct multidisciplinary basic and applied biomedical engineering research to determine short-term and cumulative biomedical effects of vibration on the operators of military vehicles and equipment and develop methods to reduce these effects. To duplicate the military field environment of vibration to study effects on soldier health and performance. To provide a scientific data base of militarily-relevant, medically-pertinent information on vibration effects. To evaluate and develop medical criteria on human vibration tolerance and to provide collateral support to human tolerance studies and materiel development. To aid in minimizing fatigue and maximizing physiological efficiency and endurance in the combat environment.

Approach: (U) Determine dynamic characteristics of the advanced combat vehicle technology program seat by Courier transform techniques using instrumented human subjects on the USAARL multiaxis vibration table. Assess stress and fatigue reactions, including back muscle stress and fatigue, associated with operation of vehicle controls, video displays, target acquisition systems, and seat-coupled vibration by psychophysiologic and electromyographic techniques.

Progress: (U) 8210-8309. A draft report on low back pain assessment of US Army aviators was compiled based on data collected by a subjective questionnaire. A report was completed which describes the vibration and impact absorbing characteristics of a modified UH-1H crew seat. Work was initiated to effect an inflight evaluation of a helmet dynamometer approach to measuring head-neck muscle stress. A report was drafted on the evaluation of human subject exposure to [illegible]ise while under experimental vibration conditions. A protocol was developed for measuring ne[illegible] muscle stress as a function of helmet weight and helmet center of gravity in an operational environment.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DAOH0151 | 83 10 01 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISP'N INSTR'N | 9. LEVEL OF SUM / A. WORK UNIT |
|---|---|---|---|---|---|---|
| 82 10 01 | K. COMPL | U | U | | NL | |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 61101A | 3A161101A91C | 00 | 292 |
| b. CONTRIBUTING | | | | |
| c. CONTRIBUTING | None | | | |

11. TITLE (Procedure and Security Classification Code)
(U) Ultrastructural Survey of Retina and Optic Nerve in Vertebrates

12. SUBJECT AREAS
06 03 06 16 06 15

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 82 01 | 83 09 | DA | C. In-House |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM TOTAL |

18. RESOURCES ESTIMATE

| FISCAL YEARS | a. PROFESSIONAL MANYEARS | b. FUNDS (In thousands) |
|---|---|---|
| 83 | 0.5 | 142 |
| 84 | 0.0 | 00 |

19. RESPONSIBLE DOD ORGANIZATION

a. NAME
US Army Aeromedical Research Laboratory

b. ADDRESS (Number and Street)
Fort Rucker, AL 36362

c. NAME OF RESPONSIBLE INDIVIDUAL
Price, D R

d. TELEPHONE NUMBER (Include Area Code)
205-255-6917

20. PERFORMING ORGANIZATION

a. NAME
Sensory Research Division
US Army Aeromedical Research Laboratory

b. ADDRESS
Fort Rucker, AL 36362

c. NAME OF PRINCIPAL INVESTIGATOR
Fulbrook, J E

d. TELEPHONE NUMBER (Include Area Code)
205-255-6811

21. GENERAL USE

MILITARY/CIVILIAN APPLICATION

e. NAME OF ASSOCIATE INVESTIGATOR (If Applicable)

f. NAME OF ASSOCIATE INVESTIGATOR (If Applicable)

22. KEYWORDS (Precede Each with Security Classification Code) (U) Electron Microscopy; (U) Ultrastructural Survey; (U) Neuroanatomy; (U) Vision; (U) Lab Animals; (U) Turtles; (U) Bushbabies

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Precede each with Security Classification Code)

Objective: (U) To integrate ultrastructural neuroanatomy with ongoing research in neurophysiology and neuropharmacology of the vertebrate visual system. To make an ultrastructural survey at different neural levels and in specific cell types of the vertebrate visual system by using morphometric techniques to analyze the synaptology, connectivity, and overall morphology of the cell class(es) studied. To develop and employ techniques for specific localization of selected electron-dense, labeled compounds. By employing such techniques a more molecular level of appreciation will be gained in better understanding the structural, functional, and neurochemical organizations that yield the complex interactions that result in visual perceptions.

Approach: (U) To study the ultrastructural organization of retinal plexiform layer cell using plastic-embedded ultrathin and thick sectioned tissue in an electron microscope. The structural organization of at least one retinal cell type will be studied using established morphometric techniques. The localization of putative neurotransmitters will be studied by employing selected electron-dense, labeled compounds in established histological protocols.

Progress: (U) 8204-8303. Development of laboratory instrumentation, software programs, and operating procedures has continued. Experiments assessing the photoreceptor populations and optic nerves in turtle and bushbaby were begun. Planning and preparation of protocols for future ultrastructural research has continued. This work is being integrated into DAOG5999.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DA0B6889 | 83 10 01 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISPN INSTR'N | 9. LEVEL OF SUM A. WORK UNIT |
|---|---|---|---|---|---|---|
| 82 10 01 | D. CHANGE | U | U | | NL | |

| 10. NO/CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 61102A | 3M161102BS10 | CB | 282 |
| b. CONTRIBUTING | | | | |
| c. CONTRIBUTING | STOG 82/83-6.2/2 | | | |

11. TITLE (Procedure and Security Classification Code)
(U) Military Acoustic Hazards: Mechanisms of Hearing Loss

12. SUBJECT AREAS
20 01 06 14 06 10

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 76 10 | CONT | DA | C. In-House |

| 17. CONTRACT/GRANT | | 18. RESOURCES ESTIMATE | | |
|---|---|---|---|---|
| a. DATE EFFECTIVE | EXPIRATION | FISCAL YEARS | a. PROFESSIONAL MANYEARS | b. FUNDS (In thousands) |
| b. CONTRACT/GRANT NUMBER | | 83 | 2.1 | 239 |
| c. TYPE | d. AMOUNT | 84 | 2.8 | 374 |
| e. KIND OF AWARD | f. CUM TOTAL | | | |

| 19. RESPONSIBLE DOD ORGANIZATION | 20. PERFORMING ORGANIZATION |
|---|---|
| a. NAME<br>US Army Aeromedical Research Laboratory | a. NAME Sensory Research Division<br>US Army Aeromedical Research Laboratory |
| b. ADDRESS (Include ZIP Code)<br>Fort Rucker, AL 36362 | b. ADDRESS<br>Fort Rucker, AL 36362 |
| c. NAME OF RESPONSIBLE INDIVIDUAL<br>Price, D R | c. NAME OF PRINCIPAL INVESTIGATOR<br>Patterson, J H |
| d. TELEPHONE NUMBER (Include Area Code)<br>205-255-6917 | d. TELEPHONE NUMBER (Include Area Code)<br>205-255-6821 |
| 21. GENERAL USE<br>MILITARY/CIVILIAN APPLICATION | e. NAME OF ASSOCIATE INVESTIGATOR (If Applicable)<br>Mozo, B T<br>f. NAME OF ASSOCIATE INVESTIGATOR (If Applicable)<br>Howse, W R |

22. KEYWORDS (Precede EACH with Security Classification Code) (U) Acoustics; (U) Occupational Medicine; (U)Volunteers; (U) Chinchillas; (U) Swine; (U) Lab Animals; (U) RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Precede each with Security Classification Code)

Objective: (U) To establish the necessary and sufficient biomedical data base to support valid noise exposure limits to insure adequate hearing protection of Army personnel exposed to continuous and impulse noise. Comprehensive exposure-injury data bases documenting the relationships between physical noise parameters and patterns of auditory injury will support the development of valid noise exposure limits and noise hazard assessments of Army weapons. The ultimate benefit will be reduced hearing loss among combat crewmembers.

Approach (U) Behavioral, histological, and electrophysiological procedures are used with animal models, and audiometric and psychophysical procedures are used with human subjects. Physical characteristics of continuous and impulse noise environments will be correlated with patterns of hearing loss.

Progress: (U) 8210-8309. A report describing a positive reinforcement procedure for audiometry of the swine was completed as part of the development of a large animal model (USAARL Report No. 83-9). The results indicated that inadequate control of motivational levels was a major contributor to a failure to obtain an acceptabl audiogram. The basic procedure appears promising if this problem can be resolved. Efforts to improve the motivational variables used in this study have been initiated. Report preparation on a study of the role of pigmentation in susceptibility to hearing loss has continued.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE.

| RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY | | | | 1. AGENCY ACCESSION: DAOB6893 | 2. DATE OF SUMMARY: 83 10 01 | REPORT CONTROL SYMBOL |
|---|---|---|---|---|---|---|
| 3. DATE PREV SUMRY: 82 10 01 | 4. KIND OF SUMMARY: D. CHANGE | 5. SUMMARY SCTY: U | 6. WORK SECURITY: U | 7. REGRADING | 8. DISP'N INSTR'N: NL | 9. LEVEL OF SUM: A. WORK UNIT |
| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | | TASK AREA NUMBER | WORK UNIT NUMBER | |
| a. PRIMARY | 62777A | 3E162777A879 | | BG | 164 | |
| b. CONTRIBUTING | | | | | | |
| c. CONTRIBUTING | STOG 82/83-6,2/2 | | | | | |

11. TITLE (Procedure and Security Classification Code)
(U) Military Visual Problems: Assessment, Mechanisms, and Protection

12. SUBJECT AREAS
20 06 06 14 05 08

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 76 10 | CONT | DA | C. In-House |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM TOTAL |

18. RESOURCES ESTIMATE

| FISCAL YEARS | a. PROFESSIONAL MAN-YEARS | b. FUNDS (In Thousands) |
|---|---|---|
| 83 | 5.7 | 591 |
| 84 | 7.8 | 994 |

19. RESPONSIBLE DOD ORGANIZATION

a. NAME: US Army Aeromedical Research Laboratory

b. ADDRESS (Street and ZIP Code):
Fort Rucker, AL 36362

c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R

d. TELEPHONE NUMBER (Include Area Code): 205-255-6917

20. PERFORMING ORGANIZATION

a. NAME: Sensory Research Division
US Army Aeromedical Research Laboratory

b. ADDRESS:
Fort Rucker, AL 36362

c. NAME OF PRINCIPAL INVESTIGATOR: Behar, I

d. TELEPHONE NUMBER (Include Area Code): 205-255-6813

e. NAME OF ASSOCIATE INVESTIGATOR (If Available): McLean, W E

f. NAME OF ASSOCIATE INVESTIGATOR (If Available): Nash, C E

21. GENERAL USE

MILITARY/CIVILIAN APPLICATION:

22. KEYWORDS (Procedure, Each with Security Classification Code): (U) KAM III;(U) Aircrew Selection;(U) Optical Ophthalmic Material;(U) Photometry/Radiometry;(U) Man-Machine Compatibility;(U) Visual Performance;(U) Volunteers

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Procedure, Each of Item with Security Classification Code)

Objective: (U) The technical objectives are to develop methods for assessing potential visual problems created by military operational environments, to establish the underlying mechanisms of these visual problems, and to develop and evaluate methods for protecting and enhancing visual performance. The data provided will impact: (a) Crew selection and retention standards; (b) optimal visual performance criteria; (c) observer-display compatibility; and (d) assessment of medical and nonmedical material. These impacts will combine to prevent visual degradations of the battlefield and enhance combat effectiveness.

Approach: (U) The approach will include physical optics techniques of photometry, radiometry, and colorimetry; optics lab testing of distortion, prismatic deviation, power, transmittance, haze, neutrality, and resolution; psychophysical procedures using human observers; and visual evoked response techniques.

Progress: (U) 8210-8309. An in-flight test compared red vs. blue-green cockpit lighting to determine whether a secondary red lighting system is needed to preserve dark adaptation for unaided nighttime flying. Blue-green cockpit lighting degraded visual sensitivity slightly compared to red, but the difference was sufficiently small that there does not appear to be a valid physiological requirement for dual cockpit lighting systems in Army aircraft. Impact tests of spectacles for use with the modified faceplate NVGs demonstrated that polycarbonate lenses afforded significantly greater shatter resistance than did CR39 or glass. Observers with low levels of astigmatism or high phoria did more poorly than normal observers on tests of static and dynamic acuity under whole-body vibration. A refractive status survey of Fort Rucker aviators was completed; visual and optical analyses of the XM-40 protective mask, the British S-10 respirator, and a polycarbonate eye-armor candidate were performed; a computer program was written producing lunar illumination charts for NVG training; an analysis was performed of image smear in CRT displays due to scan rate and phosphor persistance.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE.

| RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY | | | | 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|---|---|---|---|
| | | | | DA0B6886 | 83 10 01 | |
| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISPN INSTR'N | 9. LEVEL OF SUM / A. WORK UNIT |
| 82 10 01 | D. CHANGE | U | U | | NL | |
| 10. NO/CODES: | PROGRAM ELEMENT | PROJECT NUMBER | | TASK AREA NUMBER | WORK UNIT NUMBER | |
| a. PRIMARY | 62777A | 3E162777A878 | | AC | 135 | |
| b. CONTRIBUTING | | | | | | |
| c. [illegible] | STOG 82/83-6.2/2 | | | | | |

11. TITLE (Hearing Protective Devices: Prevention of Adverse Physiological Effects of Noise.

12. SUBJECT AREAS
20 01 06 17 06 10

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 76 10 | CONT | DA | C. In-House |

| 17. CONTRACT/GRANT | | 18. RESOURCES ESTIMATE | | |
|---|---|---|---|---|
| a. DATE EFFECTIVE | EXPIRATION | FISCAL YEARS | a. PROFESSIONAL WORKYEARS | b. FUNDS (In thousands) |
| b. CONTRACT/GRANT NUMBER | | 83 | 3.5 | 420 |
| c. TYPE | d. AMOUNT | 84 | 1.6 | 302 |
| e. KIND OF AWARD | f. CUM TOTAL | | | |

| 19. RESPONSIBLE DOD ORGANIZATION | 20. PERFORMING ORGANIZATION |
|---|---|
| a. NAME: US Army Aeromedical Research Laboratory | a. NAME: Sensory Research Division, US Army Aeromedical Research Laboratory |
| b. ADDRESS (Include ZIP Code): Fort Rucker, AL 36362 | b. ADDRESS: Fort Rucker, AL 36362 |
| c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R | c. NAME OF PRINCIPAL INVESTIGATOR: Mozo, B T |
| d. TELEPHONE NUMBER (Include Area Code): 205-255-6917 | d. TELEPHONE NUMBER (Include Area Code): 205-255-6828 |
| 21. GENERAL USE | e. NAME OF ASSOCIATE INVESTIGATOR (If Applicable): Nelson, W R |
| MILITARY/CIVILIAN APPLICATION: | f. NAME OF ASSOCIATE INVESTIGATOR (If Applicable): |

22. KEYWORDS (Precede Each with Security Classification Code): (U)Acoustics; (U)Protective Equipment; (U)Volunteers; (U)Occupational Medicine; (U)Aircraft; (U)Radio Communication; (U)Weapons Effect; (U)RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Precede each with Security Classification Code):

Objective: (U) This research determines the medical suitability of passive and active hearing protective devices to meet the needs of the Army, develops new hearing protective devices, develops laboratory and field techniques for evaluation, and investigates associated medical effects on audiologic performance. Enhanced hearing protection will reduce the risk of hearing loss among soldiers operating noise hazardous systems in training and combat.

Approach: (U) Methods utilized for the determination of the sound attenuation characteristics of hearing protective devices will be ANSI Z22.24 and ANSI S3.19. Objective laboratory and field electroacoustic methods and standard audiometric techniques also will be used.

Progress: (U) 8210-8309. Completed implementation of ANSI measurement standard S3.19. Evaluated multiple devices, including: experimental foam earplugs; E-A-R Model 600 earplugs; several proposed product improvements for the SPH-4 aviator's helmet; initial production samples of the IHADSS helmet; the proposed crushable earcup for the SPH-4 helmet. Evaluated the effects of the the XM-40 chemical defense mask on speech intelligibility and real-ear attenuation characteristics of the SPH-4 helmet. Evaluated the real-ear attenuation characteristics of prototype Helmet Compatible Communication/Aural Protective Systems (HCCAPS). Provided input to the military motorcycle helmet developer for the Statement of Need. Prepared noise hazard assessment of the Bradley Fighting Vehicle, using tester-furnished noise data.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE

| RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY | | | | 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|---|---|---|---|
| | | | | DAOG5998 | 83 10 01 | |
| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISP'N INSTR'N | 9. LEVEL OF SUM / A. WORK UNIT |
| 82 10 01 | D. CHANGE | U | U | | NL | |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62777A | 3E162777A878 | AA | 136 |
| b. CONTRIBUTING | | | | |
| c. [illegible] | STOG 82/83-6.2.2 | | | |

11. TITLE (Procede with Security Classification Code)

(U) Auditory Effects of Blast Overpressure

12. SUBJECT AREAS

20 01 06 17 06 10

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 80 10 | CONT | DA | C. In-House |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM TOTAL |

18. RESOURCES ESTIMATE

| FISCAL YEARS | a. PROFESSIONAL MAN-YEARS | b. FUNDS (In Thousands) |
|---|---|---|
| 83 | 2.7 | 418 |
| 84 | 2.7 | 530 |

19. RESPONSIBLE DOD ORGANIZATION

a. NAME: US Army Aeromedical Research Laboratory

b. ADDRESS (Include ZIP Code): Fort Rucker, AL 36362

c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R

d. TELEPHONE NUMBER (Include Area Code): 205-255-6917

20. PERFORMING ORGANIZATION

a. NAME: Sensory Research Division
US Army Aeromedical Research Laboratory

b. ADDRESS: Fort Rucker, AL 36362

c. NAME OF PRINCIPAL INVESTIGATOR: Patterson, J H

d. TELEPHONE NUMBER (Include Area Code): 205-255-6821

21. GENERAL USE

MILITARY/CIVILIAN APPLICATION:

e. NAME OF ASSOCIATE INVESTIGATOR (If Known): Mozo, B T

f. NAME OF ASSOCIATE INVESTIGATOR (If Known): Nelson, W R

22. KEYWORDS (Procede Each with Security Classification Code): (U) Acoustics; (U) Protective Equipment; (U)Occupational Medicine; (U) Weapons; (U) Impulse Noise; (U) Volunteers; (U) Lab Animals; (U) RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Procede each with Security Classification Code)

Objective: (U) To define the auditory effects of blast overpressure generated by Army weapon systems. To provide noise hazard assessments for developmental materiel. To develop and validate more accurate tolerance limites for impulse noise. Research products will reduce the risk of hearing loss among crewmembers firing cannons, mortars, rockets, etc.

Approach: (U) A three pronged approach is followed: (a) characterization of weapons noise and standards-based analys of auditory hazard implications; (b) direct validation of hearing protective devices and development of indirect methods to determine their adequacy; and (c) integration of exposure-injury data bases into revised tolerance limits.

Progress: (U) 8210-8309. Report preparation has continued on the results of the direct validation of hearing protection for the M198/M203. The findings were used to develop recommendations for new limits on the number of lower zone propelling charges to be used per training day. Computer programs for data analysis and impulse noise generation were completed. Data collection was completed in the third experiment on the role of peak pressure in auditory injury from impulse noise. Data analysis is in progress. A major upgrade of the small animal (chinchilla) audiometric test facility was completed and validation tests were initiated. Noise hazard analyses were completed for the I81mm mortar, two modified VIPER rounds, and five candidates to replace the Light Antitank Weapon (LAW). All of these resulted in recommended safe firing limits.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DAOG8399 | 83 10 01 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISP'N INSTR'N | 9. LEVEL OF SUM A. WORK UNIT |
|---|---|---|---|---|---|---|
| 82 10 01 | D. CHANGE | U | U | | NL | |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 62734A | 3M162734A875 | AO | 381 |
| b. CONTRIBUTING | | | | |
| c. [illegible] | STOG 82783-6.2/1 | | | |

11. TITLE (Procedure and Security Classification Code)
(U) Antidote and Antidote/Agent Effects on the Visual System

12. SUBJECT AREAS
06 16 06 15 06 20

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 80 05 | CONT | DA | C. In-House |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM/TOTAL |

18. RESPONSIBLE DOD ORGANIZATION

a. NAME: US Army Aeromedical Research Laboratory

b. ADDRESS (Include ZIP Code):
Fort Rucker, AL 36362

c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R

d. TELEPHONE NUMBER (Include Area Code): 205-255-6917

21. GENERAL USE

MILITARY/CIVILIAN APPLICATION:

19. RESOURCES ESTIMATE

| FISCAL YEARS | a. PROFESSIONAL WORKYEARS | b. FUNDS (In Thousands) |
|---|---|---|
| 83 | 2.7 | 530 |
| 84 | 3.7 | 478 |

20. PERFORMING ORGANIZATION

a. NAME: Sensory Research Division
US Army Aeromedical Research Laboratory

b. ADDRESS:
Fort Rucker, AL 36362

c. NAME OF PRINCIPAL INVESTIGATOR: Kirby, A W

d. TELEPHONE NUMBER (Include Area Code): 205-255-6815

e. NAME OF ASSOCIATE INVESTIGATOR (If Common): Harding, T H

f. NAME OF ASSOCIATE INVESTIGATOR (If Common):

23. KEYWORDS (Provide EACH with Security Classification Code): (U)Visual Physiology; (U)Visual Neuropharmacology; (U)Visual Anatomy; (U)Retina; (U)Nerve Agents; (U)Antidotes; (U)Autoradiography; (U)Lab Animals; (U) Cats; (U) RAM III

22. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Provide Brief of Each with Security Classification Code)

Objective: (U) The primary objective of this research program is to determine the effects of nerve agents and/or their antidotes on retina or higher visual mechanisms and/or processes. Transmission loss along the visual pathway, performance loss, and sites of action and uptake will be assessed. Results will be used to select and evaluate antidotes and phrophylactics to protect the soldier against nerve agents.

Approach: (U) The approach will include single and multiple neuron (gross potential) recording techniques in anesthetized animals. Histological and autoradiographic techniques will be used to localize sites of action and uptake. Gross potential data will be compared to anatomical and single unit findings. Results from these studies will be used to infer actions on the impairment of the human visual system and the ability of the soldier to visually complete his mission.

Progress: (U) 8201-8309. Administration of physostigmine sulfate or relatively low doses of DFP to cats preferentially reduced the visual evoked response (VER) to low spatial frequencies while minimally affecting the response to high spatial frequencies. Physostigmine salicylate or higher doses of DFP resulted in a uniform VER depression across all spatial frequencies. The depression after DFP correlates well with changes in acetylcholinesterase but not butyrylcholinesterase, even though their histochemical localization is similar in the central visual pathway. In all cases the reduction could be reversed at least partially with atropine. Preliminary studies have shown that higher dose levels of pyridostigmine moderately depress the VER.

DD FORM 1498 EDITION OF MAR 65 IS OBSOLETE

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

| 1. AGENCY ACCESSION | 2. DATE OF SUMMARY | REPORT CONTROL SYMBOL |
|---|---|---|
| DAOG5999 | 83 10 01 | |

| 3. DATE PREV SUMRY | 4. KIND OF SUMMARY | 5. SUMMARY SCTY | 6. WORK SECURITY | 7. REGRADING | 8. DISTN INSTR'N | 9. LEVEL OF SUM / A. WORK UNIT |
|---|---|---|---|---|---|---|
| 82 10 01 | D. CHANGE | U | U | | NL | |

| 10. NO./CODES: | PROGRAM ELEMENT | PROJECT NUMBER | TASK AREA NUMBER | WORK UNIT NUMBER |
|---|---|---|---|---|
| a. PRIMARY | 61102A | 3M161102BS10 | CB | 283 |
| b. CONTRIBUTING | | | | |
| c. [illegible] | STOG 82/83-6.2/2 | | | |

11. TITLE (Procede with Security Classification Code)
(U) Physiology and Psychophysics of Information Transfer in the Visual System

12. SUBJECT AREAS
06 16 20 06 06 02

| 13. START DATE | 14. ESTIMATED COMPLETION DATE | 15. FUNDING ORGANIZATION | 16. PERFORMANCE METHOD |
|---|---|---|---|
| 80 10 | CONT | DA | C. In-House |

17. CONTRACT/GRANT

| a. DATE EFFECTIVE | EXPIRATION |
|---|---|
| b. CONTRACT/GRANT NUMBER | |
| c. TYPE | d. AMOUNT |
| e. KIND OF AWARD | f. CUM TOTAL |

18. RESOURCES ESTIMATE

| FISCAL YEARS | a. PROFESSIONAL MAN-YEARS | b. FUNDS (In Thousands) |
|---|---|---|
| 83 | 4.5 | 605 |
| 84 | 3.9 | 347 |

19. RESPONSIBLE DOD ORGANIZATION

a. NAME: US Army Aeromedical Research Laboratory

b. ADDRESS (Include Zip Code):
Fort Rucker, AL 36362

c. NAME OF RESPONSIBLE INDIVIDUAL: Price, D R

d. TELEPHONE NUMBER (Include Area Code): 205-255-6917

20. PERFORMING ORGANIZATION

a. NAME: Sensory Research Division
US Army Aeromedical Research Laboratory

b. ADDRESS:
Fort Rucker, AL 36362

c. NAME OF PRINCIPAL INVESTIGATOR: Harding, T H

d. TELEPHONE NUMBER (Include Area Code): 205-255-6819

e. NAME OF ASSOCIATE INVESTIGATOR (If Applicable): Kirby, A W

f. NAME OF ASSOCIATE INVESTIGATOR (If Applicable): Fulbrook, J E

21. GENERAL USE

MILITARY/CIVILIAN APPLICATION:

22. KEYWORDS (Precede EACH with Security Classification Code): (U)Retinal Physiology; (U)Visual Psychophysics; (U)Volunteers; (U)Visual Performance, (U)Visual Neuropharmacology; (U)Lab Animals; (U)Cats; (U)Bushbabies; (U)Aplysia; (U)RAM III

23. TECHNICAL OBJECTIVE 24. APPROACH 25. PROGRESS (Precede each with Security Classification Code):

Objective: (U) The objective is to provide quantitative information on the physiological processes and mechanisms which underlie visual perception to provide a data base which supports applied vision research. By exploring retinal and cortical processes which are involved in the transfer of visual information, a quantitative link may be established between neural mechanisms and visual performance. This will support development of countermeasures to offset the adverse effects of combat stressors.

Approach: (U) The approach primarily includes single and multiple neuron recording techniques in animals and evoked potential and psychophysical procedures in human subjects. Results from animals will be used to construct models of the human visual system. A multidisciplinary approach will include (1) neurophysiology, neuropharmacology and neuroanatomy, (2) optical physics, optometry and physiological optics, and (3) sensory psychology.

Progress: (U) 8210-8309. A methodological study compared human visual contrast sensitivity obtained with the conventional method and with a rapid assessment method developed in-house. The two methods yielded comparable results. A study was completed which provided clear physiological evidence for spatial frequency selective channels in the cat visual system (T.H. Harding, R.W. Wiley, & A.W. Kirby, Science, 221, 1076-1078, 1983). An optional system was developed with associated instrumentation for assessing luminosity functions in experimental animals by using an electrophysiological response measure. Additional pilot studies support the hypothesis that the Aplysia extraocular photoreceptor and synaptic pathway provide a good experimental model for assessing the mechanism of action of pharmacological agents. Instrumentation and special-purpose stereotaxic devices have been obtained for single-unit recordings in the cat retina.

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