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**OCCUPATIONAL HEALTH  
AND THE SERVICE MEMBER**

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The Coat of Arms  
1818  
Medical Department of the Army

A 1976 etching by Vassil Ekimov of an original color print that appeared in *The Military Surgeon*, Vol XLI, No 2, 1917

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Waiting out the dust storm: Sgt. 1st Class Lance Amsden, platoon sergeant for the 1st Platoon, Company C, 1st Battalion, 501st Infantry Regiment, 4th Brigade Combat Team (Airborne), 25th Infantry Division, watches as CH-47 Chinook helicopters circle above during a dust storm at Forward Operating Base Kushamond, Afghanistan, July 17, 2009, during preparation for an air assault mission.

Taken July 2009 by Army Photographer Pfc Andrya Hill.

# OCCUPATIONAL HEALTH AND THE SERVICE MEMBER

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*Senior Editor*

TIMOTHY M. MALLON, MD, MPH  
*Colonel (Retired), Medical Corps, US Army*  
*Adjunct Assistant Professor*  
*Department of Preventive Medicine & Biostatistics*  
*Uniformed Services University of the Health Sciences*

---

*Office of The Surgeon General*  
*Borden Institute*  
*US Army Medical Department Center and School*  
*Health Readiness Center of Excellence*  
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**Editorial Staff:** Joan Redding  
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Aiesha Harvey  
*Volume Editor*

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*Illustrator*

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---

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# Contributors

## **DAVID ALBERTH, MS**

Formerly, Health Physicist, Master Consultant, Health Physics Program, Army Institute of Public Health, US Army Public Health Command, 5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010; Deceased

## **MAHMUT ATABAY, MS**

Second Lieutenant, US Army; Medical Services Corps, Health Physics Operations Officer, US Army Public Health Center, Aberdeen Proving Ground, Maryland 21010-5403

## **COLEEN P. BAIRD, MD, MPH**

Division Chief, Department of Environmental Medicine, US Army Public Health Center, Aberdeen Proving Ground, Maryland 21010-5403

## **JENNYLYNN BALMER, RN, MPA**

Occupational Health Nurse Consultant, Occupational and Environmental Health Portfolio, Army Public Health Center (Provisional), Aberdeen Proving Ground, Maryland 21010

## **JOHN P. BARRETT, MD, MPH**

Colonel, Medical Corps, US Army; Deputy Chief, Epidemiology Division, Department of Preventive Medicine and Biostatistics, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, Maryland 20814

## **DOUGLAS BARRICKMAN, BS**

Major (Retired), Medical Service Corps, US Army; Radiation Safety Officer, Augusta VA Medical Center, Department of Veterans Affairs, Augusta, Georgia 30904

## **RAYMOND R. BATZ, DO, MPH**

Captain, Medical Corps, US Navy; Force Surgeon, III Marine Expeditionary Force, PSC 559 Box 6853, FPO AP 96377, Okinawa, Japan

## **SHARON L. BEAMER, AuD, CCC-A**

Program Analyst, Navy Bureau of Medicine and Surgery, 7700 Arlington Boulevard, Falls Church, Virginia 22042

## **SHERYL A. BEDNO, MD, MPH**

Lieutenant Colonel, Medical Corps, US Army; Chief, Preventive Medicine Service, Womack Medical Center, Fort Bragg, North Carolina 28310

## **TIMOTHY J. BERGAN, DO, MPH**

Lieutenant Commander, Medical Corps, US Navy; Force Medical Officer, Military Sealift Command, Medical Department (Code: N13X), Bldg SP-64, 471 C Street, Norfolk, Virginia 23511-2419

## **DONALD T. BODEAU, MD, MPH**

Department of Occupational Medicine, Midelfort Clinic, 733 West Clairemont Avenue, Eau Claire, Wisconsin 54701

## **DEBORAH BOHLMAN, RN**

Regional Nurse Consultant, Naval Health Clinic, 695 Kinkaid Road, Annapolis, Maryland 21402-5050

## **MARK W. BOWER, PhD**

Colonel (Retired), Medical Service Corps, US Army; Command Radiation Safety Officer, Regional Health Command-Pacific, Madigan Army Medical Center, 9040 Jackson Avenue, Tacoma, Washington 98431

## **ERNEST C. BRUMAGE, MS**

Physicist, Occupational Health Sciences Directorate, Nonionizing Radiation Division, US Army Public Health Center, Aberdeen Proving Ground, Maryland 21010-5403

## **HAN Q. BUI, MD, MPH**

Commander, Medical Corps, US Navy; Chief, Occupational and Environmental Medicine, Naval Health Clinic Quantico, 3259 Catlin Avenue, Quantico, Virginia 22134

## **DANIEL J. CALDWELL, PhD, MHS**

Lieutenant Colonel, US Army; Chief, Exposure Assessment Section, Occupational Health Research Detachment, Wright Patterson Air Force Base, Ohio 45433-7400; formerly, Chief Medical Systems Safety and Health Branch, Industrial Hygiene Division, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland 21010-5422

## **JAMES CAVINESS, MD, MS**

Occupational Medicine Physician, Branch Health Clinic China Lake, Department of Occupational Health, 1 Administration Circle, Building 1403, China Lake, California 93555

## **NICOLE S. CHAVIS, MPH**

Research Associate, Department of Preventive Medicine & Biostatistics, Uniformed Services University of the Health Sciences, Bethesda, Maryland 20814

## **ANDY CHERN, MD, MPH**

Captain, Medical Corps, US Army; Associate Program Director and Assistant Professor, Occupational & Environmental Medicine Residency Program, Department of Preventive Medicine and Biostatistics, Uniformed Services University of the Health Sciences, Bethesda, Maryland 20814

## **JAY CLASING, PhD**

Lieutenant Colonel, Medical Specialist Corps; Manager, Industrial Hygiene Field Services Division, US Army Public Health Center, 5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010-5403

## **JERALD COOK, MD, MS**

Lieutenant Commander, Medical Corps, US Navy; Occupational Health Department Head, Robert E. Bush Naval Hospital, 1145 Sturgis Road, Twenty-nine Palms, California 92278

## **LYNN E. COOK, AuD**

Occupational Audiologist, Naval Health Clinic, 695 Kinkaid Road, Annapolis, Maryland 21402-5050

## **CARLOS E. CORREDOR, MSNE**

Major (Retired), Medical Service Corps, US Army; Health Physicist, Health Physics Program, Army Institute of Public Health, US Army Public Health Command, 5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010

**JOHN P. CUELLAR, MS**

Colonel, US Army, US Army Public Health Center, Aberdeen Proving Ground, Maryland 21010-5403

**DAVID P. DEETER, MD, MPH**

Lieutenant Colonel (P), US Army; Director, Occupational and Environmental Health, and Director, Occupational Medicine Residency Program, US Army Environmental Health Agency, Edgewood Area, Aberdeen Proving Ground, Maryland 21010-5422; formerly, Occupational Health Consultant to the Surgeon General

**JOHN J. DeFRANK**

Chief, Nonionizing Radiation Division, Occupational Health Sciences Directorate US Army Public Health Center, Aberdeen Proving Ground, Maryland 21010-5403

**DAVID W. DEGROOT, PhD**

Major, Medical Service Corps, US Army; Deputy Chief, Department of Clinical Investigation, Tripler Army Medical Center, Honolulu, Hawaii 96859

**JOHN W. DOWNS, MD**

Major, Medical Corps, US Army; Chief, Department of Preventive Medicine, Blanchfield Army Community Hospital, Fort Campbell, Kentucky 42223

**SAMUEL G. DUNSTON, MS**

Major (Retired), US Army; Nuclear Medical Science Officer, Laser/Microwave Division; formerly, Chief, Medical Health Physics Branch, US Army, Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland 21010-5422

**HARRIS EDGE**

Chief, Industrial Health Physics Branch, Health Physics Division, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland 21010-5422

**ALFRED C. EMMEL, MD, MPH**

Colonel (Retired), US Air Force; Attending Physician, Emergency Medicine and Occupational Medicine, Presbyterian Hospital, 1100 Central Avenue, SE, Albuquerque, New Mexico 87106

**PENELOPE K. GALOFF**

Physical Scientist, Laser Branch, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland 21010-5422

**BRANDON GARDNER, DO, MPH**

Major, Medical Corps, US Army; Chief, Occupational Medicine Branch, US Army Medical Department Center and School, 3599 Winfield Scott Road, Fort Sam Houston, Texas 78234

**JOEL C. GAYDOS, MD, MPH**

Colonel (Retired), US Army, Occupational Medicine Physician, US Army Public Health Center, Aberdeen Proving Ground, Maryland 21010-5403

**SCOTT GOODISON, BS**

Radiation Safety Officer, Army Institute of Public Health, US Army Public Health Command, 5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010

**MARJORIE GRANTHAM, PhD**

Colonel (Retired), US Army; Technical Science Writer, Ho-Chunk Technical Solutions, Austin, Texas 78723

**DEANNA K. HARKINS, MD, MPH**

Medical Officer, Department of Environmental Medicine, US Army Public Health Center, Aberdeen Proving Ground, Maryland 21010-5403

**DALE HARMAN, MD, MPH**

Captain (Retired), Medical Corps, US Navy; Occupational and Environmental Medicine Physician, Independent Contractor, Portsmouth, New Hampshire 03870

**JACK M. HELLER, PhD**

Environmental Scientist, Department of Environmental Medicine, US Army Public Health Center, Aberdeen Proving Ground, Maryland 21010-5403

**GARY E. HERR, MS, MPH**

Major, US Army; Chief, Environmental Health and Industrial Hygiene, Preventive Medicine Services, William Beaumont Army Medical Center, El Paso, Texas 79920

**ELISABETH M. HESSE, MD, MTM&H**

Major, Medical Corps, US Army; Division Chief, Disease Epidemiology Division, US Army Public Health Center (Provisional), Aberdeen Proving Ground, Maryland 21010-5403

**CHARLES W. HICKS JR**

Chief, Microwave Branch, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland 21010-5422

**JON R. JACOBSON, DO, MPH**

Colonel, US Air Force; Air Force Chief of Occupational Medicine; Occupational Medicine Consultant to the Air Force Surgeon General, Defense Health Headquarters, 7700 Arlington Blvd, Falls Church, Virginia 22042

**CRAIG JONES, BS**

Health Physicist, Health Physics Program, Army Institute of Public Health, US Army Public Health Command, 5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010

**DEAN P. JONES, PhD**

Professor, Clinical Biomarkers Laboratory, Division of Pulmonary, Allergy, and Critical Care Medicine, Emory University, Atlanta, Georgia 30322

**BRYAN D. KOBE**

Electronics Engineer, Occupational Health Sciences Directorate, Nonionizing Radiation Division, US Army Public Health Center, Aberdeen Proving Ground, Maryland 21010-5403

**PAMELA L. KRAHL, MD, MPH**

Captain, Medical Corps, US Navy; Occupational and Environmental Medicine Residency Program Director, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, Maryland 20814-4799

**LOUIS KROOT, MD**

Commander (Retired), Medical Corps, US Navy; Surface Medical Department Officer; currently, Department of Emergency Medicine, University of Kentucky Chandler Medical School, Lexington, Kentucky 40536-0298

**RICHARD L. LACHIVER, MD, MPH**

Formerly; Medical Director, Occupational Health Service of York Hospital, York, Pennsylvania; Major, US Army; Program Manager for Occupational Medicine and Residency Training Director, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland

**GRACE LANDERS, MD**

Lieutenant, Medical Corps, US Navy; Naval Medical Center Portsmouth; Resident, Emergency Medicine, 620 John Paul Jones Circle, Portsmouth, Virginia 23708

**KIERAN T. LERCH, MS**

Physicist, Occupational Health Sciences Directorate, Nonionizing Radiation Division, US Army Public Health Center, Aberdeen Proving Ground, Maryland 21010-5403

**THOMAS D. LOUWERS, MD, MPH**

Lieutenant Commander, US Navy; Physician, Department of Occupational Medicine, Naval Hospital Bremerton, Bremerton, Washington 98337

**TIMOTHY M. MALLON, MD, MPH**

Colonel (Retired), Medical Corps, US Army; Adjunct Assistant Professor, Department of Preventive Medicine and Biostatistics, Uniformed Services University of the Health Sciences, Bethesda, Maryland 20814

**GREGORY J. MARTIN, MD, MPH**

Colonel, Medical Corps, US Army; Chief, Occupational Medicine, Madigan Army Medical Center, 9925 5th Street, Building 9025, Tacoma, Washington 98431

**PETER G. MATOS, MD, MPH**

Formerly, Major, US Army; Command Surgeon, US Army Joint Munitions Command, Rock Island Arsenal, Illinois 61259-5000

**MELISSA A. McDIARMID, MD, MPH**

Professor of Medicine, Epidemiology and Public Health; Director, Division of Occupational & Environmental Medicine, University of Maryland School of Medicine, 11 South Paca Street, Suite 200, Baltimore, Maryland 21201

**ANNE McDONOUGH, MD, MPH**

Lieutenant Commander, Medical Corps, US Navy (Undersea Medical Officer/Diving Medical Officer); Department Head, Occupational Medicine Department, US Naval Hospital, PSC 827 Box 281, FPO AE 09617, Naples, Italy

**KEVIN P. MICHAELS, MD, MPH**

Colonel (Retired), US Army; Medical Director, Providence Hospital, Department of Occupational Health, 5100 Rangeline Service N, Mobile, Alabama 36619

**WENDY E. MIKLOS, MD, MPH**

Lieutenant Colonel, Medical Corps, US Army; Chief, Department of Preventive Medicine, US Army Medical Activity/Fort Carson, Department of Preventive Medicine, MCXE-PMD, 1650 Cochrane Circle, Fort Carson, Colorado 80913

**RAÚL ALEXANDER MIRZA, DO, MPH**

Major, Medical Corps, US Army; Division Chief, Occupational Medicine Division, US Army Public Health Center (Provisional), Aberdeen Proving Ground, Maryland 21010-5403

**W. SCOTT MONKS, PA-C, MPAS**

Army Public Health Center, Directorate of Clinical Public Health & Epidemiology, Division of Occupational Medicine, Aberdeen Proving Ground, Maryland 21010

**MICHAEL W. MUELLER, MPH**

Lieutenant Colonel, US Army; Health Services Command Radiation Protection Staff Officer, Fort Sam Houston, Texas 78234

**CAMERON J. L. NELSON, MD, MPH**

Commander, Medical Corps, US Navy; Chief of Occupational Medicine, Naval Hospital Bremerton, 1 Boone Road, Bremerton, Washington 98312

**DOUG W. OHLIN, PhD**

Formerly, Chief, Hearing Conservation Program, US Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, Maryland 21010; Deceased

**M. DEBRA PARKER, JD, MSN**

Colonel (Retired), US Air Force; formerly, Senior Occupational Health Nurse Consultant, Occupational and Environmental Health Portfolio, Army Public Health Center (Provisional), Aberdeen Proving Ground, Maryland 21010

**SANDRA PARKER-MONK, CIH**

Program Manager, Occupational Health Sciences, Army Public Health Center, 5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010

**JOHN PENTIKIS, PhD**

Ergonomist, US Army Public Health Center, 8977 Sibert Road, Aberdeen Proving Ground, Maryland 21010-5403

**RICHARD P. PHIPPS, PhD**

Professor, Departments of Medicine and Environmental Medicine, University of Rochester Medical Center, Rochester, New York 14618

**PAPIYA RAY, MD, MPH**

Occupational Medicine Consultant Physician, Federal Occupational Health, 7700 Wisconsin Avenue, Suite 7201, Bethesda, Maryland 20857

**CHARLES DAVID RIDGELEY, JR, MD**

Lieutenant Colonel, US Army; Occupational Medicine Physician, Occupational and Environmental Medicine Division, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland 21010-5422

**BRIAN RILEY, DO, MPH**

Commander, Medical Corps, US Navy; Occupational Medicine Department Head, Naval Branch Health Clinic, 881 USS James Madison Road, Kings Bay, Georgia 31547

**TERRANCE RILEY, MD**

Formerly, Captain (Retired), Medical Corps, US Navy; Professor of Neurology, Department of Neurology, Baylor College of Medicine, One Baylor Plaza, Houston, Texas 77030; Deceased

**JANET M. RUFF, RN, MPH**

Senior Occupational Health Nurse Consultant (Retired), Occupational and Environmental Medicine Division, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland 21010-5422

**MARLENE SANCHEZ, MD, MPH**

Commander, US Navy; Director of Public Health, Department of Occupational Medicine, Naval Health Clinic Hawaii, 480 Central Avenue, Building 1750, Joint Base Pearl Harbor-Hickam, Hawaii 96860-4908

**DAVID H. SLINEY, PhD**

Chief, Laser Branch, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland 21010-5422

**STEVEN R. SMITH, MD, MPH**

Colonel (Retired), Medical Corps, US Army; formerly, Chief, Occupational Medicine, Department of Preventive Medicine, Madigan Army Medical Center, Joint Base Lewis-McChord, Washington 98433

**RYAN W. SNOW, MD**

Lieutenant, Medical Corps, US Navy; Diving Medical Officer, Explosive Ordnance Disposal Mobile Unit Five, Santa Rita, Guam

**J.C. PHILLIP SPOTTSWOOD, JD, MPH**

Medical Policy and Program Specialist, Hiring Policy, US Office of Personnel Management, 1900 E Street, NW, Room 6500, Washington, DC 20415

**MICHAEL J. TESTA, MS**

Major, US Army; Chief, Healthcare Hazards Division, US Army Public Health Center, 5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010-5403

**JUILEE THAKAR, PhD**

Professor, Departments of Microbiology & Immunology and Biostatistics & Computational Biology, University of Rochester Medical Center, Rochester, New York 14618

**THOMAS THATCHER, PhD**

Research Associate Professor, Department of Medicine/Pulmonary and Critical Care, University of Rochester Medical Center, Rochester, New York 14618

**RICHARD J. THOMAS, MD, MPH**

Captain (Retired), Medical Corps, US Navy; Associate Professor, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, Maryland 20814-4799

**CAROL I. TOBIAS, MBA, BSN**

Nurse Consultant, US Army Center for Public Health (Provisional), 1570 Wise Road, Building 1570, Aberdeen Proving Ground, Maryland 21010

**P. K. UNDERWOOD, MD, MPH, MHA**

Colonel (Retired), US Army; Army Materiel Command, Command Surgeon, Redstone Arsenal, Alabama 35898

**ROBERT N. UNISKIEWICZ, MD, MPH**

Lieutenant Commander, Medical Corps, US Navy; Occupational Medicine Department Head, Naval Medical Center Portsmouth, 620 John Paul Jones Circle, Portsmouth, Virginia 23708

**KARAN UPPAL, PhD**

Assistant Professor, Clinical Biomarkers Laboratory, Division of Pulmonary, Allergy, and Critical Care Medicine, Emory University, Atlanta, Georgia 30322

**MARK UTELL, MD**

Professor, Departments of Medicine and Environmental Medicine, University of Rochester Medical Center, Rochester, New York 14618

**RICHARD D. VANN, PhD**

Captain, US Navy Reserve (Retired); Divers Alert Network, Center for Hyperbaric Medicine and Environmental Physiology, Box 3823, Duke University Medical Center, Durham, North Carolina 27710

**JOHN J. VENEZIA, DO, MPH**

Major, Medical Corps, US Army; Associate Program Director, Department of Occupational Medicine, US Army School of Aviation Medicine, 340 Hulse Road, Naval Air Station, Pensacola, Florida 32508

**JAMES VOROSMARTI, JR, MD**

Captain, Medical Corps, US Navy (Retired); Consultant in Occupational, Environmental, and Undersea Medicine, 16 Orchard Way South, Rockville, Maryland 20854

**DOUGLAS I. WALKER, PhD**

Assistant Professor, Clinical Biomarkers Laboratory, Division of Pulmonary, Allergy, and Critical Care Medicine, Emory University, Atlanta, Georgia 30322

**TIMOTHY B. WEYANDT, MD, MPH**

Director, Occupational Health Program, Pennsylvania State University, University Park, Pennsylvania 16802; Lieutenant Colonel, US Army (Retired); formerly, Medical Advisor for Clinical, Occupational, and Environmental Health; US Army Biomedical Research and Development Laboratory, Fort Detrick, Maryland

**PATRICK F. WHITNEY, MD, MSPH**

Lieutenant Colonel (Retired), Medical Corps; US Air Force; formerly, Commander, 7th Aerospace Medicine Squadron; Occupational Medicine Consultant to the Air Force Surgeon General

**COLLYN WOELLER, PhD**

Professor, Department of Environmental Medicine, University of Rochester Medical Center, Rochester, New York 14618

**JOHN W. YASALONIS, CIH**

Formerly, Lieutenant Colonel, US Army; Industrial Hygiene Consultant to The US Army Surgeon General, Headquarters, Department of the Army, 5109 Leesburg Pike, Falls Church, Virginia

**MICHAEL G. ZAKAROFF, MD**

Lieutenant, Medical Corps, US Navy; Diving Medical Officer, Mobile Diving and Salvage Unit One, Pearl Harbor, Hawaii 96818

# Foreword

The first Textbook of Military Medicine on occupational health for the Soldier and workers in the military industrial base was published in 1993. It described the development of occupational and environmental health and occupational medicine in the Army from 1775 until 1990. This follow-on volume covers 1990 to 2015, a period during which the United States was involved in prolonged warfare. In these operations, deployed Soldiers encountered multiple potentially harmful environmental exposures and reported postdeployment adverse health effects they often related to these exposures. The exposures included impressively large sandstorms; emissions from burning oil wells in Kuwait; chemical agents released during the destruction of chemical weapons caches; hexavalent chromium from a damaged industrial site; sulfur gases from a large, prolonged sulfur mine fire; and emissions from the destruction of all types of waste in large burn pits over many years. The absence of timely, reliable exposure data that could be directly linked to the Soldiers exposed, and the absence of defined symptom complexes that could be used to diagnose postdeployment illnesses, led to anxiety and frustration for the service members affected and those caring for them.

In response, Veterans' groups and Congress called for the Department of Defense (DoD) to document potentially harmful exposures related to deployment, and to identify the adverse health outcomes that might result. Registries were initiated to record and archive exposures of concern and Veterans' maladies, and the Army was required to identify and evaluate Soldiers previously exposed to chemical warfare agents during deployment. Epidemiologic resources to study deployment-related illnesses included considerable amounts of area sampling data from deployed areas, archived predeployment and postdeployment health questionnaires, administrative health encounter data in the Defense Medical Surveillance System (DMSS), and sera stored in the DoD Serum Repository (DoDSR). Efforts were made to secure deployment-related data in large databases, such as the Defense Occupational and Environmental Health Readiness System, for future reference and study, to use the DMSS for deployment-related epidemiologic studies, and to investigate the possible use of the DoDSR predeployment and postdeployment specimens to identify and study deployment-related exposures.

The National Research Council of the National Academy of Sciences recommended that the DoD significantly improve its capability to identify exposures and perform exposure assessments. In response, the DoD undertook an effort to explore alternatives to environmental and breathing zone sampling with the use of wearable sensors, and to assess the use of biomarkers to identify exposures in the deployed environment using DoDSR sera. The rapidly evolving field of biomarker technology showed promise in determining the internal doses after environmental exposures and identifying biomarkers of effect.

This volume documents the services' support for workers in the military industrial base, which remains a critical mission that cannot be neglected. It also archives information on exposures of concern among deployed service members, documenting the development of data repositories and registries as well as studies done with this data. Additionally, it identifies innovations in exposure identification and assessment for future efforts. This volume should be useful to practitioners of Military Medicine and those involved in military occupational and environmental health research, so that avoidable exposures among service members and civilian staff can be avoided, and adverse health effects stemming from military service can be treated with the best available knowledge and procedures.

Lieutenant General Nadja Y. West, MD  
The Surgeon General  
US Army

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# Preface

Decades have passed since doctors Llewellyn J. Legters and Craig H. Llewellyn of the Uniformed Services University of the Health Sciences, in Bethesda, Maryland, taught that military medicine was occupational medicine because its practice encompasses the treatment and prevention of injuries and diseases related to work in military occupations and military operational environments. Over the last quarter century, health-related events associated with war and other deployments have served to support the Legters-Llewellyn concept. A variety of exposures with the potential to cause harm to our Service Members are described in this volume, as are the problems encountered in identifying and defining these exposures, and performing exposure assessments in military operational environments. Unfortunately, timely, informed medical evaluations of those exposed has not commonly occurred. The authors hope that familiarity with the contents of this volume will instill in military medical providers the importance of taking an occupational history and seeking consultation when an unusual event is suspected or a possible exposure-related clinical case is encountered.

Support for uniformed members is only one side of military occupational medicine. The other side is support for the military industrial base, which provides the warfighters with the equipment and supplies needed to complete their missions. Some of our depots and arsenals are similar to civilian industrial sites, but many are unique in the operations they conduct. The importance of their sustained operations in supporting our military forces cannot be overstated. Any breakdown in productivity in the military industrial base means a breakdown in the supply chain to those facing our enemies. Equally important is the need for flexibility in the base so that production may be increased to meet the needs of the warfighters. All of this underscores the requirement for a healthy, fit workforce. This volume contains essential information for the healthcare teams supporting the industrial base workforce.

This volume of the Textbooks of Military Medicine, published in hardcopy and electronic formats, will be a valuable reference for providers who need to address unique hazards on military installations and during deployments, as well as the occupational hazards in our military industrial base. I hope readers find it a useful update to the first textbook dedicated to the practice of occupational medicine in the Army, which was published in 1993. The US Navy and Air Force occupational health programs have been included in this update. Additionally, the content has been significantly expanded to cover a wide range of topics, including beryllium, aerospace medicine, undersea medicine, diving and the physiology of diving, ergonomics, ionizing and non-ionizing radiation, respiratory protection, workers' compensation programs, deployment surveillance, and biomonitoring.

This book became a reality due to the commitment and hard work of many people, the encouragement of my wife, Ilona Mallon; the administrative and editorial assistance of Ms. Nicole S. Chavis, and Johanna L. Gribble and mentorship of Colonel (Retired) Joel C. Gaydos

Timothy M. Mallon, MD, MPH  
Adjunct Assistant Professor  
Department of Preventive Medicine  
and Biostatistics  
Uniformed Services University

Bethesda, Maryland  
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