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Proceedings of the Technology and the Mine Problem Symposium, vol II of II

Monterey, California: Naval Postgraduate School

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Symposium on TECHNOLOGY AND THE MINE PROBLEM

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INTRODUCTION

The 1996 Symposium on Technology and the Mine Problem explores and celebrates the rapid maturation of mine-threat-relevant technologies on land and at sea. These emergent and maturing technologies hold the promise of mitigating the seriousness of the mine problem in both military and humanitarian contexts. In particular, technological advances in vehicles, navigation and control, sensors, power plants, and materials make it possible to bring increasing degrees of automation (robotics) to bear on the difficult, expensive and time-consuming arts of mine countermeasures.

This is the second in a planned series of Symposia addressing the mine problem, and is entirely at the UNCLASSIFIED level of clearance. Jointly sponsored by the Mine Warfare Association, the Naval Postgraduate School and the Office of Naval Research, these Symposia will take place at the Naval Postgraduate School at approximate 18-month intervals. The first Symposium, in April 1995, focused on Autonomous Vehicles in Mine Countermeasures. The next major technical Symposium in the series is scheduled for April 20-24, 1998. Additionally, consideration is being given to holding "special focus" meetings and workshops, also jointly sponsored by the Mine Warfare Association and the Naval Postgraduate School, and possibly other government and academic organizations and institutions.

This Symposium is dedicated to the memory of ADMIRAL JEREMY M. "MIKE" BOORDA, USN, former Chief of Naval Operations, who strongly supported and encouraged the efforts at the Naval Postgraduate School that led to this Symposium series and its focus on emergent technologies. The Honorary Chair is REAR ADMIRAL JOHN D. PEARSON, USN, who is stepping down as Commander of the Navy's Mine Warfare Command, a position he has held for the past five years.

VISION STATEMENT

The Vision for evolving mine countermeasures/countermine systems is that of a family or families of affordable, autonomous systems capable of carrying out the tasks associated with the management of risks from mines in military contexts and for clearance assurance in humanitarian de-mining contexts. In practice, autonomy will likely be a matter of degree - progressing from tethered to remotely-operated to programmed, and finally, to rule-based autonomy. This Vision includes the idea of autonomous mine countermeasures brigades and recognizes that components of the total system may range in size from bulldozers to automated lobsters. There will also be variation in the cost of individual elements, depending on size and complexity of the element.

THE CHALLENGE

To apply emerging technologies to create a system or systems costing in the neighborhood of \$5,000 in production lots of 100,000. Members of this family of systems must be capable of being operated and maintained by military field units and/or by indigenous personnel in third world countries.

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- Identify the technologies that can revolutionize approaches to dealing with the mine problem;
- Emphasize those technologies that contribute to the Navy-Marine Corps Mine Warfare Campaign Plan and its thrusts to support Operational Maneuver from the Sea and organic mine countermeasures;
- Match technologies and systems with the realities of requirements for Humanitarian De-Mining;
- Define the scope, magnitude, and future course of the national and international markets for mine clearance-related technologies and systems, including those based on commercial, off-the-shelf (COTS) technology and products.

ALBERT M. BOTTOMS

Ellis A. Johnson Chair of Mine Warfare

Naval Postgraduate School

SYMPOSIUM ORGANIZATION

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Mine Warfare Association

Symposium Host

RADM Marsha J. Evans, USN, Superintendent, Naval Postgraduate School

Honorary Symposium Chair

RADM John D. Pearson, USN (Ret), Former Commander,

U.S. Navy Mine Warfare Command

General Symposium Chair

Albert M. Bottoms

Ellis A. Johnson Chair of Mine Warfare

Naval Postgraduate School

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MS. Barbara Honcggel, M.S.,

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 Public Affairs Office, Naval Postgraduate School
 Suzanne Wyatt, President, Destination Monterey Carmel
 Melody Burgess, Destination Monterey Carmel
 CDR John Peterson, USN (Ret), Coordinator
 Dr. Robert Rowntree, Rapporteur
 Maitland Bottoms, MINWARA Webmaster;
 Naval Research Laboratory, Washington, D.C.

Symposium Executive Committee, Naval Postgraduate School

James N. Eagle, Ph.D., Undersea Warfare
 Don Brutzman, Ph.D., Undersea Warfare
 Anthony J. Healey, Ph.D., Mechanical Engineering
 Harrison Shull, Ph.D., Former Provost
 Mitchell Brown, Ph.D., National Security Affairs
 Albert M. Bottoms, Ellis A. Johnson Chair of Mine Warfare
 Xavier K. Maruyama, Ph.D., Dept of Physics and
 Institute for Joint Warfare Analysis

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8:50 Invocation - CAPT John M. Wright, ChC, USN ,

Command Chaplain, Naval Postgraduate School

8:55 Welcome - CAPT. James M. Burin, USN, Acting Superintendent, Naval Postgraduate School

9:00 Sponsor's Welcome - RADM Paul G. Gaffney II, USN , Chief of Navy Meteorological Command and Chief of Naval Research; and

Dr. Fred E. Saalfeld, Deputy Chief of Naval Research and Technical Director, Office of Naval Research

9:45 Break

(during the break, Faculty, Staff, and Students of the Naval Postgraduate School will join Symposium Participants for the Keynote Address).

Session II Keynote Address King Hall

10:10 Introduction of Keynote Speaker - CAPT James M. Burin, USN , Acting Superintendent, Naval Postgraduate School

10:15 Keynote Address - GEN John J. Sheehan, USMC , Supreme Allied Commander, Atlantic, and Commander, U.S. Atlantic Command

This keynote address by a very senior American military official challenges military planners, resource managers, operational executors, and industrial and academic researchers to fundamentally reexamine, rethink and forge new approaches to the Mine Problem. Its bold message is that there is no room for complacency or "business as usual" when assessing or addressing this problem. The Challenges put forward in this session are developed and amplified in Sessions III-XI.

11:00 Break (NPS Students return to normal class schedule)

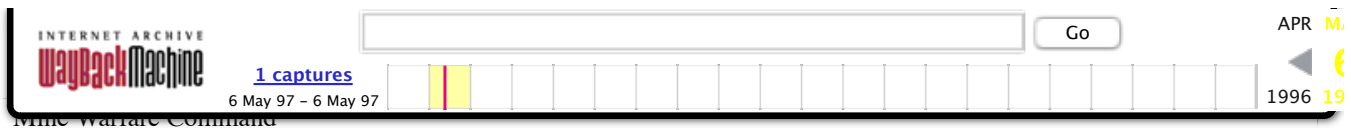
Session III Initiatives in Mine Warfare King Hall

11:20 MGEN Clair F. Gill, USA, CG The Engineer Center, Fort Leonard Wood, and Personal Representative of GEN. W. Hartzog, USA, Commanding General. U.S. Army Training and Doctrine Command - *U.S. Army Initiatives in Mine Warfare*

11:50 Dr. Don Brutzman, LT Bryan Brauns, USN, LT Paul Fleischman, USN, LT Tony Lesperance, UNN, LT Brian Roth, USN, and LT Forest Young, USN, Undersea Warfare Accademic Group, Naval Postgraduate School - *Evaluation of AUV Tactics for Rapid Minefield Traversal using Analytic and Virtual World Simulation*

Session IV Lunch: Strategic Considerations in Expeditionary and Littoral Warfare McNitt Ballroom

This Session and the next capture elements of evolving Mine Warfare policy and objectives as articulated by senior Army, Navy and Marine Corps officers. The period since the Gulf War has seen an intense review of Mine Warfare needs and objectives resulting from the renewed interest in assault and minefield breaching operations. Technology has both forced some of these reconsiderations and enabled new initiatives, such as the move in Naval Mine Warfare to increased reliance on mine countermeasure capabilities organic to the deployed naval task forces. This requirement also opens the door to an



12:40 Luncheon Address - MGEN Edward Hanlon, Jr., USMC , Incoming Director, Expeditionary Warfare, Office of the Chief of Naval Operations

Session V Operational Needs and Perspectives King Hall

Chair - RADM Charles Horne, USN (Ret)

Co-Chair - CDR John Peterson, USN (Ret)

This Session outlines the major challenges facing the Navy in countering mines in the ocean littoral (including beaches and inland waterways), the Army/Marine Corps in dealing with mines in land warfare/amphibious assault contexts, and the potential roles of technology in facing these challenges. The key ideas behind strategies so far developed are "seamlessness" and "in stride." Initiatives by the Office of the Secretary of Defense have concentrated on proving relationships among the many operational components of the total mine warfare system.

The U.S. Air Force plays a number of significant roles in Mine Warfare. In addition to tactical and strategic reconnaissance from air-breathing and space platforms, the capacities of its Heavy Bombardment assets give them major roles in the precision emplacement of very large explosive charges and the delivery of heavy naval mines.

2:15 Dr. Jack Bachkosky, Deputy Undersecretary of Defense for Advanced Technology - *OSD Requirements*

2:45 COL Leroy Barnidge, USAF, 28th Bombardment Wing Commander, Ellsworth Air Force Base - *U.S. Airforce Roles in Mine Warfare*

3:15 Break

3:30 MGEN John E. Rhodes, USMC, Deputy Commanding General, Marine Corps Combat Development Command- *U.S. Marine Corps and U.S. Navy Requirements*

4:00 COL Joseph M. Singleton, USMC, Office of Naval Research - *Army/Navy Requirements - The Joint Mine Countermeasures/Countermine Advanced Concepts Technology Demonstration Process*

Session VI The Littoral Environment Monterey Bay Aquarium

Chair - Dr. Don Brutzman, Naval Postgraduate School

The Monterey Bay Aquarium provides a unique opportunity to experience the littoral environment in detail its flora, fauna and geology, and the physical structure of the water column. Each of these physical variables has a strong impact on the performance of sensors and vehicles used in and planned for mine countermeasures operations.

The Mine Warfare Association wishes to thank the following sponsors whose financial assistance made this event possible:

Office of Naval Research, Coastal Systems Station, COMINWARCOM and

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6:50 RADM Paul E. Tobin, USN, Oceanographer of the Navy

7:10 CAPT Thomas R. Bernitt, USN, Commander, Explosive Ordnance Disposal Group One



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Session VII Mining and Mine Threats King Hall

Chair - Walter E. Dence, Jr., Senior Electronics Engineer,

Coastal Systems Station, Mine Concepts and Performance Branch

Co-Chair - Xavier Maruyama, Professor of Physics, Naval Postgraduate School

Even at the UNCLASSIFIED level, the wide array of mine types, mechanisms and potential applications is awesome. Over thirty countries are mine exporters, and sophisticated mine mechanisms have proliferated worldwide. The inventory of defined land mine types exceeds 700, and conventional naval mines number in the dozens. To this, one must add "home-made" mines and unexploded ordnance, as well as the potentially serious extension of these types of weapons to incorporate chemical, biological or even nuclear warheads. Because they are cheap and deadly, rogue nations and groups, in fact, see mines as a weapon of choice for both conventional warfare applications and as weapons of terror.

In addition, this Session introduces participants to the magnitude of the worldwide challenge facing humanitarian de-miners. Speakers will document current estimates of 100 million plus in place mines a number growing at many times the rate at which mines are being removed.

8:10 Tom Reder, National Ground Intelligence Center - *Land Mine Threat*



8:50 Terry Kasey, Coastal Systems Station - *The Proliferation of the Mine Threat*

9:10 John Arquilla, Assistant Professor, Naval Postgraduate School - *Alternatives to Mines*

9:30 Discussion

9:45 Break

Session VIII Regional Perspectives on the Mine Threat King Hall

Chair - RADM John D. Pearson, USN (Ret)

Co-Chair - CDR John Peterson, USN (Ret)

In this Session, scenarios arising out of the unique operational contexts in Bosnia, Southwest Asia, Northeast Asia and the Southern Hemisphere will be discussed by senior Commanders with operational responsibilities in those theaters.

The effects of environmental variables on equipment performance are a major consideration in mine countermeasures, and can result in important differences in the degree of military security in various operational theaters. Certain scenarios also require strategic and tactical surprise, thus putting a premium on being able to carry out covert or clandestine operations and reconnaissance operations particularly sensitive to environmental variables. Careful consideration of environmental variables in operational theaters also leads to an emphasis on such factors as the logistical problems associated with maintaining a fighting force at a distance from major supply bases.

10:00 LTGEN Jefferson Davis Howell, Jr., USMC , Commanding General, Marine Forces, Pacific (MARFORPAC) and Marine Component Commander, U.S. Pacific Command

10:30 RADM Dennis R. Conley, USN, Commander, U.S. Navy Mine Warfare Command (COMINEWARCOM)

11:00 COL Robert Greenwalt, USA, Director, Combat Developments, U.S. Army Engineer Center

11:30 Dr. Louis Marquet, Director, U.S. Army Night Vision Laboratory, CERDEC, U.S. Army Night Vision and Electronic Sensors Directorate, Fort Belvoir, Personal representative of MGEN Roy Beauchamp, USA , Army Materiel Command

12:00 Break for lunch

Session IX Luncheon Session: Humanitarian Demining McNitt Ballroom

This Session sets the stage for the afternoon's examination of policy issues surrounding the control of proliferation of mine technologies, and very current questions about U.S. initiatives to ban the use of "dumb" landmines. While easy solutions to these policy issues have not been forthcoming, it is important that both user and developer communities understand the nature of the policy debate, and the potential of technology to shape that debate and provide acceptable solutions from an operational and economic, as well as a moral, standpoint.

1230 Luncheon Address - The Hon. H. Allen Holmes , Assistant Secretary of Defense, Special Operations and Low Intensity Conflict (SOLIC)

Session X Humanitarian Demining and Mine Policy King Hall

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Dr. Mitch Brown, Assoc. Professor, National Security Affairs, Naval Postgraduate School

2:20 Mr. Steve Goose, Human Rights Watch

2:40 LTGEN Robert C. Gard, USA (Ret), President, Monterey Institute of International Studies

3:20 Mr. Robert Sherman, U.S. Arms Control and Disarmament Agency

3:40 Break

Session XI Technology & Humanitarian Demining King Hall

Chair - Harry N. (Hap) Hambric, Project Leader, Humanitarian Demining Program, U.S. Army Night Vision Electro-Optical Directorate, Fort Belvoir, VA

Co-Chair - Dr. Mitch Brown, Assoc. Professor, National Security Affairs, Naval Postgraduate School

This Session, which is a prelude to Parallel Session XXII, provides an overview of the approaches being used in humanitarian de-mining. The staggering magnitude of this worldwide task, coupled with the necessity to provide techniques and hardware within the means of third-world countries, makes this aspect of mine clearing qualitatively different from military mine clearance. It is far more difficult to provide an indigenous people with assurance that their land is safe to use than it is to tell a military commander that the risk from mines is commensurate with other threats to his force and mission.

4:00 MAJ Colin King, British Army (Ret), Editor, Janes Yearbook on Mines

4:30 Chick Mixter, President, EOD World Services, Inc., Sam Samuel, Demining Program Manager, Essex Corp.

5:00 Prof. J. D. Nicoud, Laboratoire de Microinformatique (LAMI), Lausanne, Switzerland

5:30 Richard Walden, President, Operation USA/Operation Land Mine

Session XII System Demonstrations and Videos McNitt Ballroom, Spanagel Hall, The Monterey Bay Aquarium

There are three sites for demonstrations, static displays and videos at the Symposium. The first is the Monterey Bay Aquarium the evening of the Reception, reserved primarily for industrial sponsors of that event. The second and third, accessible throughout the Symposium, are the Barbara McNitt Ballroom in Herrmann Hall, the location of the banquet and all luncheons, and the Registration Area (Spanagel Hall, Room 101-A).

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Session XIII

Autonomous Systems in Mine Warfare - A Progress Report

King Hall

(Continuation Session: Session XXIX, Wed., Nov. 20, 2:00 P M)

Chair - Prof. Anthony Healey, Naval Postgraduate School

Co-Chair - Dr. Claude Brancart, C.S. Draper Laboratories

The question whether the state of development of autonomous systems was sufficient for mine countermeasures applications was answered resoundingly in the affirmative at the April 1995 Symposium on Autonomous Vehicles in Mine Countermeasures. The consensus there was that the necessary technologies are within our grasp. In the eighteen months which have elapsed since that Symposium, the mine countermeasures application has sparked further innovations at NPS, Rockwell International, and a number of other academic and industrial institutions. The Naval Postgraduate School, in particular, has seen a surge of successful development and field testing.

As a follow-up to last year's Symposium, one objective of this Plenary Session is to provide program planners with a snapshot of recent progress in autonomous developments. Two key goals are to demonstrate that these technologies are maturing to the point that applications to military and humanitarian systems are becoming both feasible and prudent; and to show that with autonomous and semi-autonomous systems comes the possibility of "changing the world" - a key objective of this Symposia series.

Contributed Papers:

8:00 Chris DeBolt and Chris O'Donnel, NAVEODTECHDIV, R&D Dept. - *The Basic UXO Gathering System (BUGS) Program for Unexploded Ordnance Clearance & Minefield Countermeasures: An Overview and Update*

8:20 Bryan Koontz, Charles Tung, Ely Wilson, Massachusetts Institute of Technology; and David Kang, C. S. Draper Laboratory - *Small Autonomous Robotic Technician*

8:40 Helen Greiner, Colin Angle, Joseth Jones and Art Schectman, IS Robotics, and Rich Myers, ISX - *Enabling Technologies for Swarm Coverage Approaches*

9:00 Arnis Mangolds, Foster Miller, Inc. - *Lemming/BUGS System*

9:20 Prof. A.J. Healey, Y. Kim and LT T. Lewis, USN, Naval Postgraduate School - *Simulation and Modeling for UXO/Mine Clearance Problems*

9:40 Break

10:00 Craig Freed and Tuan Nguyen, Naval EOD Technology Center R&D, Department - *Unexploded Ordnance Clearance and Minefield Countermeasures by Multi-Agent, Small Robotics*

10:20 Gary M. Trimble, Lockheed-Martin Ocean, Radar and Sensor Systems - *Application of the Explosive Ordnance Disposal Robotic Work Package to the Clearance of Terrestrial Improved Conventional Munitions (AutoRECORM)*

10:40 Claude Brancart, C.S. Draper Laboratory - *DARPA's Autonomous Minehunting and Mapping Technologies (AMMT) Program*

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Dave McClain, Bob McEneaney and Russ Whalen, Naval Postgraduate School - NPS Phoenix AUV Software Integration & In-Water Testing

11:40 Panel Discussion

12:15 Break for Lunch

(Session Continues- Session XXIX, Wed., Nov. 20, 2:00 P.M)

Session XIV Luncheon: Acquisition of Mine Warfare Systems McNitt Ballroom

Under the division of responsibilities in the Department of Defense and the Armed Services, it is the role of the Secretary of the Navy to equip and provision the force. Thus a primary duty of the Office of the Secretary of the Navy is the acquisition of mine warfare systems. Research and Development lies at the front end of this acquisition cycle, and at every step in the process there is competition for resources. These competitions occur within a warfare area, across warfare areas in the Navy-Marine Corps, and across Service lines.

The fact that mines can be instant "showstoppers" puts the acquisition of mine warfare systems in a strong competitive position, and the importance of Mine Warfare is a message carried jointly by the Office of the Assistant Secretary of the Navy and the Office of the Director, Expeditionary Warfare, in the Office of the Chief of Naval Operations. Significantly, since its inception, that office has been headed by a General Officer in the United States Marine Corps.

12:30 Introduction of Luncheon Speaker - Mr. Gary Olin , Mercury Computers

12:40 Speaker - Mr. Ed Zdankiewicz, Office of the Asst. Secretary of the Navy (Mine and Undersea Warfare)

Parallel Sessions:

Wednesday afternoon, Thursday morning and Thursday afternoon

It is the intention of the Organizers to provide every contributor an opportunity to present his or her paper at the Symposium, and to publish those papers in the PROCEEDINGS. With such a large number of contributed papers and Invited Ad dresses, it becomes necessary to use Parallel (Simultaneous) Sessions. With the exception of Session XVII, which is a Roundtable, papers in each Parallel Sessions have been scheduled at 20 minute increments to facilitate attendees who wish to hear papers in different sessions. The NPS Co-Chair for each Session will ensure conformance with listed time schedules.

Parallel Session XV Systems and Technologies for Countering Land Mines (Countermine) Wednesday, Nov. 20, 1996, 2:00 PM Ingersoll Hall, Room 122

Contributed papers for this Session cover sensors and land-mobile systems. Discussants are asked to put their specific contributions in the larger operational and acquisition contexts.

2:00

Co-Chairs- Dr. David Heberlein, Program Manager, Countermine, Fort Belvoir;

COL Robert Greenwalt, USA, Director, Combat Developments, U.S. Army Engineer Center



Dr. David Heberlein, U.S. Army Night Vision Electro-Optical

Directorate;

Al Nease, Tyndall Air Force Base

Contributed Papers:

2:20 J. D. Nicoud, Laboratoire de Micro Informatique EPFL, Lausanne, Switzerland - *GPR and Metal Detector Portable Systems*

2:40 Gerhard Vallon, VALLON GmbH, Germany - *Mine Detection with Modern Day Metal Detectors*

3:00 Lawrence Carin and Stanislav Vitebskiy, Dept. of Electrical and Computer Engineering, Duke University; Marc Ressler and Francis Le, Army Research Laboratory - *Ultra-Wideband, Short Pulse Ground-Penetrating Radar: Theory and Measurement*

3:20 Bradley Blume, Nichols Research Corp - *Technology Assessment of a Passive Millimeter Wave Imaging Sensor for Stand-off Mine Detection*

3:40 Break

4:00 Craig Sayre, NCCOSC R T D & E Division; David J. Fields, Defense Advanced Research Projects Agency; Anu P. Bowman and Alan L. Giles, Space Applications Corporation; Edwin M. Winter, Fred Badik, Michael Schlangen, Technical Research Associates, Inc.; Paul Lucey, Tim Williams, Jeff Johnson, John Hinrichs, Keith Horton and Greg Allen, University of Hawaii; Alan Stocker, Ara Oshagan, Bill Schaff and Bill Kendall, Space Computer Corporation; Michael R. Carter, Charles L. Bennett and William Aimonetti, Lawrence Livermore National Laboratory - *DARPA's Hyperspectral Mine Detection (HMD) Program*

4:20 J.T. Nilles, Gus Tricoles and G.L. Vance, GDE Systems, Inc. - *On the Feasibility of Microwave Imaging of Buried Land Mines at Modest Stand-Off Distance*

4:40 S.G. Azevedo, J.E. Mast, S.D. Nelson and E.T. Rosenbury, Lawrence Livermore National Laboratory, Imaging and Detection Program - *Radar Imaging Experiments for Land-mine Detection*

5:00 Panel Discussion

**Parallel Session XVI Mining the Historical Record
Wednesday, Nov. 20, 1996, 2:00 PM
Spanagel Hall, Room 117**

America's wars yield a rich history of Mine Warfare. The main purpose of capturing primary historical data is to be able to draw correct inferences from the historical record. This is similar to the reason for obtaining first-hand reports of operational experience with hardware to determine what works and what doesn't. The institutional processes for collecting such experiential and experimental data are, however, still far from robust.

Chair - Frank Uhlig, Advanced Research Scholar, Naval War College

Co-Chair- Dr. Mitch Brown, Assoc. Professor, National Security Affairs, Naval Postgraduate School

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2:40 Dr. Susan Bales, Director, Naval Science Assistance Program (NSAP), Office of Naval Research - *NSAP and Operational Experience*

3:20 Dr. Tamara A. Smith, Historian - *Process Challenges and Examples*

3:40 Break

4:00 Harry N. (Hap) Hambric, Project Leader, Humanitarian Demining Program, U.S. Army Night Vision Electro-Optical Directorate, Fort Belvoir - *Lessons from Humanitarian Demining*

4:20 George Pollitt, Technical Director, COMINEWARCOM - *Mine Warfare Exercise Analysis*

4:40 LCDR Frank Daggett, USN, MIREM Program, Office of the Commander, Surface Warfare Development Group, Naval Amphibious Base Little Creek - *MIREM Goals and Exercises: Past, Present and Future*

5:00 Discussion

Parallel Session XVII
Roundtable: Identifying and Sizing the Mine Warfare Market
Wednesday, Nov. 20, 1996, 2:00 PM
Spanagel Hall, Room 421

This Session springs from the conviction that American industry and individual companies simply will not make the investments required to bring promising technologies to fielded hardware unless they can be convinced of the potential return on investment. This panel of industrialists will identify and explore how to overcome impediments to developing a worldwide market, and how to develop confidence by U.S. industry that its companies can compete on a level playing field.

Chair - Mr. Ric Trotta, President, Trotta Associates, Strategic Management Consultants

Co-Chair - Dr. Kevin Owen, Technology Transfer, Naval Postgraduate School

ROUNDTABLE PANELISTS (in alphabetical order)

Dr. Louis Marquet, Director, U.S. Army Night Vision Laboratory, CERDEC, U.S. Army Night Vision and Electronic Sensors Directorate

Ron Blue, Director of Undersea Systems, Electronics Sector, Lockheed-Martin

CAPT Bill Herman, USN (Ret)

Robert McGurrin, Manager of Strike System Programs, Raytheon Company

Kathleen Robertson, Director, Booz Allen & Hamilton

David Rossi, Department Head, Office of Naval Research Industrial Programs

Vincent Schaper, Director, Small Business Innovative Research,

Office of Naval Research

James Smith, Vice President, Aeroflex Laboratories

Parallel Session XXIX Autonomous Systems in Mine Warfare
Wednesday, Nov. 20, 2:00 PM
King Hall

This Session is the continuation of Session XIII.

2:00

Chair - Prof. Anthony Healey, Dept. of mechanical Engineering Naval Postgraduate School

Co-Chair -Mr. Claude Brancart, C.S. Draper Laboratories

Contributed Papers:

2:20 Ray Daigh and Tom Crocker, RAHCO International - *Fully Autonomous Land Vehicle for Mine Countermeasures*

2:40 James Edberg, Jet Propulsion Laboratory - *JPL Technology Relevant to Unmanned Underwater Operations*

3:00 Michael J. Ricard, C.S. Draper Laboratory - *Mission Planning for an Autonomous Undersea Vehicle: Design and Results*

3:20 Yutaka Kanayama, Isaac Kaminer, Xiaoping Yun , Xavier Maruyama and Nelson Ludlow - *An Integrated Ground and Aerial Robot System for UXO/ Mine Detection*

3:40 Ned H. Witherspoon, Coastal Systems Station, and James Wright, Research Engineer, Environmental Research Institute of Michigan (ERIM) - *Minefield Detection from the Pioneer Unmanned Aerial Vehicle Using the COBRA Multispectral Sensor*

4:00 Discussion

Parallel Session XXX The Underlying Science of Mine Warfare
Wednesday, Nov. 20, 1996, 2:00 PM
Mechanical Engineering Auditorium

This Session captures some of the fundamental physics underlying mine warfare systems.

2:00

Chair - Dr. Norris Keeler, Kaman Diversified Technologies Cororation; and former Director of Navy Technology, Naval Material Command

Co-Chair - Dr. David Netzer - Dean of Research and Professor of Aeronautics and Astronautics, Naval Postgraduate School

2:20 Dr. Maja Mataric, Professor of Computer Science, Brandeis University - *Group Behavior and Learning in Distributed Multi-Robot Systems*

2:40 Dr. George Bekey, Professor of Computer Science, University of Southern California - *Coordination of Aerial and*

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Maxwell's Equations in Magnetic Signature Analysis

3:40 Dr. Joel Burdick, Professor of Mechanical Engineering, California Institute of Technology - *The Mechanics and Control of Robotic Locomotion*

4:00 Dr. Ruzena Bajcsy, Professor of Electrical Engineering and Computer Science, University of Pennsylvania, in collaboration with Max Mintzand the Staff of the GRASP Laboratory - *Fusion for Mine Detection*

4:20 Dr. Norris Keeler, Kaman Diversified Technologies Cororation; former Director of Navy Technology, Naval Material Command - *The Use of Ocean Optical Data to Predict the Performance of Mine Detecting Lidar Systems*

4:40 Discussion

Session XVIII Banquet Session

6:30 No Host Reception - Quarterdeck Lobby, Herrmann Hall

7:00 Dinner

7:45 Presentation of Awards

Fullinwider Award by RADM John D. Pearson, USN, Honorary Chair of the Symposium

Charles Rowzee Award by Mr. Charles Rowzee

8:15 Introduction of Honorary Chair of the Mine Warfare Association - RADM Charles "Chuck" F. Horne III, USN (Ret)

8:20 Introduction of Banquet Speaker - ADM Thomas B. Hayward, USN (Ret) , Former Chief of Naval Operations and Honorary Chair, Mine Warfare Association

8:30 Banquet Speaker - ADM Stan Arthur, USN (Ret) , Vice President Naval Systems, Lockheed Martin Corp.

RECOGNITION OF TECHNICAL CONTRIBUTED PAPERS

The Mine Warfare Association is establishing two prize categories for contributed technical papers at the Symposium on Technology and the Mine Problem. The CAPTAIN SIMON PETER FULLINWIDER Awards are for the best papers submitted by serving members of the Armed Forces. The First Prize in this category will carry an honorarium of \$500 and a Life Membership in the Mine Warfare Association. The Second and Third Prizes, respectively, will carry honoraria of \$250 and \$100. Each will also be accompanied by Life Membership in the Mine Warfare Association.

Captain Simon Peter Fullinwider (1871-1957) is deemed the Father of Mine Warfare in the U.S. Navy. Additional information about the contributions and energy of this remarkable man can be found in Dr. Greg Hartmann's book, WEAPONS THAT WAIT. This year, the award will be presented by RADM John D. Pearson, USN (Ret), Honorary Chair of the 1996 Symposium.

The CHARLES ROWZEE Awards are for the best overall technical papers. The schedule of awards is the same as that for the Fullinwider Awards.

Charles Rowzee is the individual who applied years of experience in mine design to, in effect, enable the conversion of the large stocks of bombs into influence mines. This technical achievement led to the mining campaign against North Vietnam, which, in turn, led to the return of the North Vietnamese to the negotiating table and to the subsequent release of Americans

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Dr. Ellis A Johnson, Captain Simon Peter Fullinwider and Mr. Charles Rowzee are but three of the intellectual and operational giants to whom the United States owes its distinguished accomplishments in the fields of Mine Warfare. There are many others in and out of uniform. Perhaps a long-term project for the Mine Warfare community could be the creation of a Mine Warfare Hall of Fame.

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Thursday, November 21, 1996

[Parallel Session XIX Navy Mine Countermeasures](#)
[Parallel Session XX Explosive Clearance Techniques](#)
[Parallel Session XXI Miscellaneous Contributed Papers](#)
[Parallel Session XXII Humanitarian Demining](#)
[Parallel Session XXIII Alternative Approaches to Minesweeping and Mine Clearance](#)
[Session XXV Luncheon Session](#)
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[Parallel Session XXVII Navy Mine Countermeasures](#)
[Parallel Session XXVIII Miscellaneous Contributed Papers](#)
[Session XXIV Summary Plenary Session and Adjournment](#)

Parallel Session XIX Navy Mine Countermeasures Ingersoll Hall, Room 122

8:00

Chair - RADM Richard D. Williams, III, USN, PEO Mine Warfare

Co-Chairs- George Pollitt, Technical Director, COMINWARCOM

Assoc. Professor Don Walters, Physics Dept., Naval Postgraduate School

PANELISTS:

Minesweeping - Walter N. Rankin, Coastal Systems Station;

Minehunting - James D. Grembi , Office of PEO Mine Warfare, Passive MCM;

Steve Loui, President and CEO, Pacific Marine and Director, Honolulu Shipyard

Contributed Papers:

8:20 Dale A. Lawrence, Renjeng Su and Noureddine Kermiche, Center for Space Construction, University of Colorado - *Identification of Underwater Mines via Surface Acoustic Signature*

8:40 Frank Cianciotto, SatCon Technology, Electro-Optics Advance Development Center - *Detection and Classification of Surface and Subsurface Objects(Mines) by the use of a Airborne Imaging Lidar System*

9:00 Dr. Ted R. Clem, Naval Surface Warfare Center, Coastal Systems Station, G.I. Allen, M.C. Froelich, J.D. Lathrop, D.J.

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9:40 W.A. Kuperman, Gerald D'Spain, W.S. Hodgkiss, L.P. Berger, L.M. Dormanand, W.A. Gaines, Marine Physical Laboratory, Scripps Institution of Oceanography - *The Seismoacoustic Signature of Mark 52 Mine Drops Recorded on a Seafloor Hydrophone Array in Shallow (20 m) Water*

10:00 Break

10:20 Robert W. Floyd and John E. Sigurdson , Naval Command Control and Ocean Surveillance Center, RDT&E Division, San Diego - *Autonomous Detection and Classification of Bottom Objects with Multi Aspect Sonar*

1040 Raj Mitra, Electromagnetic Communication Laboratory, University of Illinois, Urbana - *A Neural Network Approach to the Detection of Buried Objects in Seafloors*

1100 Peter M. Smith, Navy Research Laboratory, Stennis Space Center - *Free Surface Slope Signature of Moored Mines in a Current: Experimental Results*

1120 Eric Smith and Thomas Muir, Applied Research Laboratories, University of Texas, Austin - *Echo-location of Buried Objects with Seismo-acoustic Rayleigh Waves*

1140 Gerhard Vallon and Okkar Dietz, VALLON GmbH, Germany - *Portable Turnkey UXO Detection System*

1200 Break for lunch

(Continuation Session XXVII begins at 2 p.m.)

Parallel Session XX Explosive Clearance Techniques
Thursday, Nov. 21, 8:00 AM
Spanagel Hall, Room 117

This special focus Session highlights non-conventional approaches to mine breaching and to dealing with obstacles.

8:00

Chair - Lee Hunt, Former Executive Director, Naval Studies Board, National Academy of Sciences

Co-Chair - Knox Millsaps, Assistant Professor of Mechanical Engineering, Naval Postgraduate School

Contributed Papers:

8:20 William Hinkley, Naval Surface Warfare Center, Indian Head - *Explosive Neutralization Effectiveness*

8:40 Joel Gaspin, Naval Surface Warfare Center, Indian Head - *Mine Vulnerability*

9:00 Daniel Crute, Coastal Systems Station, Naval Surface Warfare Center - *Serf Zone Technology*

9:20 Don Robeson, CSS, Naval Surface Warfare Center; and Arnis Mangolds, Foster-Miller, Inc. - *Thunder Road: Distributed Explosive Nets*

9:40 Kennard Watson and Tuan Nguyen, Coastal Systems Station, Naval Surface Warfare Center - *Deployment Modeling*

10:00 Break

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Warfare Center, Indian Head, Phong Nguyen, Naval Surface Warfare Center, Cadolock, Eric Seneid, Naval Surface Warfare Center, Crane - *In-Stride Mine and Obstacle Breaching for Amphibious Assaults*

11:20 LT COL Dennis Verzera, USMC, Coastal Systems Station, Dahlgren Division, Naval Surface Warfare Center - *Russian Shallow Water Breaching System*

11:40 Discussion

12:20 Break for lunch

Parallel Session XXI Miscellaneous Contributed Papers
Thursday, Nov. 21, 8:00 AM
Mechanical Engineering Auditorium

(Continuation Session XXVIII, 2:00 P.M.)

8:00

Chair - Dr. Ray Widmayer, Technical Director, Mine Countermeasures Branch, Expeditionary Warfare Directorate, Office of the Chief of Naval Operations

Co-Chairs- Mr. Dennis Hiscock, DRH Associates; Former Head of Mine Countermeasures for the Royal Navy, U.K. ;and

Xavier Maruyama, Professor of Physics, Naval Postgraduate School

Contributed Papers:

8:00 Dennis R. Hiscock, Former Head of Mine Countermeasures for the Royal Navy - *The Underwater Influence Fields of Target Ships, Some Mine Sensor System Considerations, and the Strengths and Weaknesses of Influence Mine Sweeping*

8:40 Barbara Fletcher and Stewart Harris, Imetrix, Inc. - *MCM Applications of a Virtual Environment-Based Training System for ROV Pilots*

9:00 E. Michael Golda, Naval Surface Warfare Center - *Development of a Conductively-Cooled Superconducting Magnet System for Mine Countermeasures*

9:20 Edward C. Gough, Jr., Applied Physics Laboratory, University of Washington, and Robert L. Barrett, Naval Oceanographic Office - *Information Warfare and the Countermine Problem*

9:40 Break

10:20 Vladimir R. Karasik, Babcock and Wilcox, Naval Nuclear Fuel Division - *The First Mine Countermeasures Devices with Superconducting Magnets*

10:40 J. W. Kesner, Alliant Techsystems, Inc. - *Acoustic Time Series Simulator (ATSS) Synthetic Environment Applied to Mine Warfare*

11:00 Mark E. Lehr and Keh-Shin Lii, Dept. of Statistics, University of California at Riverside - *Automated Mine Identification Using Wavelet Analyzing Functions*

11:20 Elena McCarthy, Naval Undersea Warfare Center - *Acoustic Interference from Seagrass with Mine-Hunting Sonars*

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12:20 Break for lunch

(Continuation Session XXVIII begins after lunch, at 2:00 p.m.)

Parallel Session XXII Humanitarian Demining
Thursday, Nov. 21, 1996, 8:00 AM
King Hall

8:00

Chair - Professor J. D. Nicoud, Laboratoire de Microinformatique (LAMI), Lausanne, Switzerland

Co-Chair - Dr. Mitch Brown, Assoc. Professor, National Security Affairs, Naval Postgraduate School

Contributed Papers:

8:20 Harry N. (Hap) Hambric, Project Leader, Humanitarian Demining Program and Beverly Briggs, U.S. Army CECOM Research Development & Engineering Center, Night Vision and Electronic Systems Directorate, Ft. Belvoir; and Thomas Henderson, Camber Corporation - *Research and Development in Support of Humanitarian Demining*

8:40 Sean P. Burke, Humanitarian Demining Program, Night Vision and Electronic Sensors Directorate, Ft. Belvoir - *Command Communications Video and Light System (CCVLS)*

9:00 Prof. J. D. Nicoud, Laboratoire de Micro Informatique - EPFL, Lausanne, Switzerland - *Cooperation in Europe for Humanitarian Demining*

9:20 David W. Parish, President, Omnitech Robotics - *Minefield Proofing and Route Clearing in Bosnia using Unmanned Ground Vehicles and the Standard ized Teleoperation System*

9:40 Jason J. Regnier, U.S. Army CECOM NVESD, Ft. Belvoir; and Douglas Brown, Joseph Bendahan, Giancarlo Borgonovi and Delmar Haddock, Science Applications International Corporation - *Multi Sensor Vehicular Mine Detection Testbed for Humanitarian Demining*

10:00 Break

10:20 Joseph Foley, OAO Corp, and Jason Regnier, Project Engineer, U.S. Army CECOM NVESD - *Teleoperated Ordnance Disposal System for Humanitarian Demining*

10:40 Steven Tunick, Hughes Aircraft Company, and Jason Regnier, Project Engineer, U.S. Army CECOM NVESD - *Mine Marking and Neutralization Foam for Humanitarian Demining*

11:00 Amos Samuel, Essex Corporation, and William C. Schneck, Humanitarian Demining Project, Night Vision Electronic Sensor Directorate, Ft. Belvoir - *The Development of a Multimedia Electronic Performance System for Humanitarian Demining*

11:20 Divyakant L. Patel and Beverly D. Briggs, U.S. Army Night Vision and Electronic Sensors Directorate, Countermine Division, Fort Belvoir - *Chemical Systems for In-Situ Neutralization of Landmines in Peacetime*

11:40 Dr. Daniel Wolf, Transborder Institute, San Diego - *Market-focused strategy in the Regulation and Eradication of Land Mines*

12:00 Discussion

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Parallel Session XXIII

Alternative Approaches to Minesweeping and Mine Clearance
Thursday, Nov. 21, 8:00 AM
Spanagel Hall, Room 421

8:00

Chair - Bill Baker - Clausen Power Blade, Inc.

Co-Chair - Dr. Robert Keolian, Assoc. Professor of Physics, Naval Postgraduate School

Contributed Papers:

8:20 Geoffrey Davis, President, Capstone, Inc., and Steve Ballinger, Executive Vice President and General Manager, Mertz, Inc. - *Application of Seismic Vibration Concepts for Rapid Mine Clearance and Detection*

8:40 C. John Anderson and A. W. Bill Bauer, Mining Resource Engineering, Ltd.; and Joseph L. Trocino, Golden West Products - *LEXFOAM for Humanitarian Demining*

9:00 Jaime Bunczek, Coastal Systems Station, Naval Surface Warfare Center - *LCAC Autonomous Algorithms*

9:20 Dr. Warren Loughmiller, Staff, Naval Surface Warfare Center - *Highway and Pipeline Construction Equipment*

9:40 Chris O'Donnell, OED Tech Center/Army Engineer Center - *Coordination of Technologies for the Neutralization and Disposal of Unexploded Ordnance*

10:00 Dr. Ron Woodfin Sandia National Laboratories - *Rigid Polyurethane Foam (RPF) Technology for Countermines (Sea) Program*

10:20 Dr. Owen Hofer, Project Manager-Mobile Ordnance Disruption System /ZEUS, Sparta, Inc. - *Mobile Ordnance Disruption System*

10:40 ARCHIMEDES SCREW - Mine Warfare Vehicles (Including Commercial and Indigenously Craft Capable of Being Modified for Mine Warfare/Humanitarian Demining Applications) - *Oceanering Technologies*

Session XXV Luncheon Session
Thursday, Nov. 21, 12:30 PM
McNitt Ballroom

12:45 Luncheon Address - Dr. Tamara A. Smith, Historian,

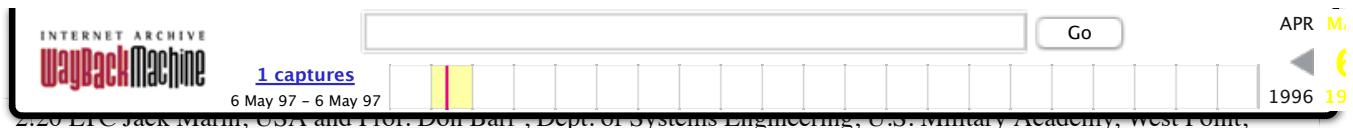
1:00 Luncheon Address - RADM John F. Sigler, USN, Deputy and Chief of Staff, Commander-in-Chief, U.S. Pacific Fleet

Parallel Session XXVI Mine Warfare C4I
Thursday, Nov. 21, 1996 2:00 PM
Spanagel Hall, Room 117

2:00

Chair - RADM John F. Sigler, USN, Deputy and Chief of Staff, Commander-in-Chief, U.S. Pacific Fleet

Co-Chair - CAPT Wayne Hughes, USN (Ret), Naval Postgraduate School



2:20 LTC Jack Mann, USA and PROF. DON DAN, Dept. of Systems Engineering, U.S. Military Academy, West Point, *Evaluation of Intelligent Minefields*

2:40 Dr. Frank L. Herr, CAPT Dennis Ryan, USN, and Dr. J. M. McDonald, Office of Naval Research - *Littoral Remote Sensing*

3:00 CDR Dennis McBride, MSC, USN, Chief Scientist for Modeling and Simulation, Naval Research Laboratory; and Guy J. Carrier and Keith P. Curtis, The MITRE Corporation, Advanced Information Technology Center - *Joint Countermine Operational Simulation (JCOS)*

3:20 John Benedict, Applied Physics Laboratory, Johns Hopkins University - *Pervasive Technical Issues Related to Organic Mine Countermeasures*

3:40 Discussion

**Parallel Session XXVII Navy Mine Countermeasures
Thursday, Nov. 21, 2:00 PM
Ingersoll Hall, Room 122**

(Continuation of Session XIX)

Chair - RADM Richard D. Williams, III, USN, PEO Mine Warfare

Co-Chairs - George Pollitt, Technical Director, COMINWARCOM

Assoc. Professor Don Walters, Physics Dept., Naval Postgraduate School

PANELISTS:

Minesweeping - Walter N. Rankin, Coastal Systems Station;

Minehunting - James D. Grembi, Office of PEO Mine Warfare, Passive MCM;

Steve Loui, President and CEO, Pacific Marine and Director, Honolulu Shipyard

Contributed Papers:

2:00 Lawrence Carin and Marc McClure, Department of Electrical Engineering, Duke University - *Analysis and Time Frequency Processing of Scattered Signals from Submerged Mines in Shallow Water*

2:20 Meng Xu and Norman Bleistein, Center for Wave Phenomena, Colorado School of Mines - *Imaging Small Scatterers in Shallow Water from Towed Array Data*

2:40 Steve Loui, President, Pacific Marine and Supply Company, Hawaii - *Slice A Stable Reconfigurable Platform: A New MCM Opportunity*

3:00 Carl Fisher, EDO Corporation, Marine and Air Systems - *Rapid Response Minesweeping*

3:20 CDR Gary Spalton, Royal Navy - *MCM: Integrated Concept of Operations*

3:40 CAPT Charles Young, USN, Program Manager, U.S. Navy Unmanned Undersea Vehicles Program Management Office



4:40 Celeste Z. Hansel, Coastal Systems Station, Dahlgren Divison -

History of Minehunting

5:00 ADJOURN TO SUMMARY PLENARY SESSION IN KING HALL

Parallel Session XXVIII Miscellaneous Contributed Papers
Thursday, Nov. 21, 2:00 PM
Mechanical Engineering Auditorium

(Continuation of Session XXI)

2:00

Chair - Dr. Ray Widmayer, Technical Director, Mine Countermeasures Branch, Expeditionary Warfare Directorate, OCN

Co-Chair - Mr. Dennis Hiscock, DRH Associates; Former Head of Mine Countermeasures for the Royal Navy, U.K.

Contributed Papers:

2:20 Joseph J. Molitoris, GRC International - *New Technologies for the Military: Mine Warfare as a Test Case*

2:40 LTCOL Dennis Verzera, USMC, Coastal Systems Station Dahlgren Div., Naval Surface Warfare Center - *A New Dimension in Amphibious Warfare*

3:00 John P. Wetzel, WL/FIVCF, Robotics Laboratory, Tyndall Air Force Base - *D8 Tractor/Israeli Mine Plow (IMP) Mine and Obstacle Clearance Testing*

3:20 Marek Narewski and Lech Matuszewski, Department of Underwater Technology, Faculty of Ocean Engineering, Technical University of Gdansk - *Mission Definition for AUV Dedicated to War Gas Ammunition Deposits Assesment*

3:40 Ira Ekhaus, Synap Corporation - *Reduced Wavenumber Synthetic Aperture for MCM Applications*

4:00 Discussion

Session XXIV
Summary Plenary Session and Adjournment until April 20, 1998
Thursday, Nov. 21, 5:00 PM
King Hall

5:00 Prof. Albert M. Bottoms, Ellis A. Johnson Chair of Mine Warfare Naval Postgraduate School

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