



Science Update

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Winter

NAMRU-D MISSION:

To maximize warfighter performance and survivability through premier aeromedical and environmental health research-delivering solutions to the field, the Fleet, and for the future.

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Air Force-Navy Open House at Wright-Patterson AFB

Dr. Richard Arnold
& LT Andre Ntamack

On 7 November 2012 the US Air Force 711th Human Performance Wing (711 HPW) & Naval Medical Research Unit - Dayton (NAMRU-D) held a research "Open House", which afforded scientists and engineers from both organizations an opportunity to tour over 25 separate laboratory facilities spread across the 711 HPW/NAMRU-D campus at Wright-Patterson AFB, Ohio.

During the event research staff from 711 HPW toured facilities in both NAMRU-D research directorates. During the Environmental Health Effects Directorate tour four laboratories were highlighted, including two inhalation toxicology laboratories, where CDR Daniel Hardt described the research capabilities of the facilities and provided summaries of two recent projects addressing women's health aboard submarines and the combined effects of jet fuel and noise exposure on hearing loss (see story on page 3).

Mr. Shawn McInturf provided an overview of the neurobehavioral research conducted at NAMRU-Dayton with a demonstration of water-maze tests



Dr. Karen Mummy explains her research to a tour during the Open House in the Environmental Health Effects Research Directorate.



CDR Hardt describes capabilities of the NAMRU-D inhalation lab.

routinely utilized to ascertain exposure effects on cognitive function. In the *in vitro* toxicology laboratory, Dr. Karen Mummy provided perspectives and insights into the effectiveness of using cells in culture rather than animals to conduct aspects of toxicity testing.

Visitors to NAMRU-Dayton's Aeromedical Directorate were provided briefings and tours highlighting a number of active research programs and capabilities. Dr. Rick Arnold, NAMRU-D Aeromedical Director led tours of NAMRU-D aeromedical research facilities. At the hypoxia countermeasures lab, Dr. Jeff Phillips provided an overview of ongoing research addressing the real-time detection of hypoxia in pilots, and the effects - and aftereffects - of hypoxia on cognitive function. Dr. Joe Chandler and LT Stephen Eggan described ongoing research on motion sickness countermeasures and spatial awareness utilizing NAMRU-D's Neurotoxicologic Test Center (see story on page 4).



An Open House tour is introduced to the Disorientation Research Device Lab.

(story continued on page 4)

Disorientation Research Device Update

Mr. Roy Dory

The design build of the Disorientation Research Device (DRD) at the Naval Medical Research Unit Dayton (NAMRU-D) is in its final stages, with completion slated for early spring 2013. The device, built by Environmental Tectonics Corporation (ETC), Philadelphia, PA, will be the newest in NAMRU-D's arsenal of motion based platforms and will offer an unparalleled ability to replicate motions generated in current and future generation aircraft. All major device hardware components are currently installed, and ETC has made significant progress configuring and testing more than twenty motors that drive the DRD's six axes of motion. ETC's final installation efforts are focused on completing individual axis testing and characterizing and refining device performance during combined axis motion.



Disorientation Research Device

Once complete, the state-of-the-art DRD will afford NAMRU-D researchers the ability to orient individuals in any direction relative to a precisely controlled, dynamically changing acceleration environment and synchronize those motions with high fidelity visuals in the cockpit. The DRD generates motion in six distinct degrees of

freedom but can also produce sustained accelerations of up to 3G. While most motion simulators utilize a single motion cueing strategy to replicate the forces generated during flight, the DRD's unique motion space will allow NAMRU-D researchers to employ multiple motion cueing strategies and tailor the device's motion response to specific flight scenarios, or even flight maneuvers, to



Mr. Roy Dory discusses the capabilities of the DRD with Gen (ret.) Gregory Martin, USAF Scientific Advisory Board (SAB) Chairman, during a recent NAMRU-D collaborated tour with Wright-Patterson AFB's 711 Human Performance Wing.

provide the most realistic flight environment possible. By realistically simulating aircraft motion, this one of a kind device will allow NAMRU-D scientists to identify, and better understand, physiologic stressors unique to the flight environment that contribute to spatial disorientation and the loss of situational awareness.

NAMRU-Dayton Expertise Applied in US Army Research Initiative

Dr. Brian Wong

The Automatic Fire Extinguishing Systems (AFES) protecting the occupied (crew) spaces in US armored vehicles have historically used an ozone depleting compound, Halon 1301. The US Army is phasing out Halon, replacing it with a fluorinated agent mixed with a sodium bicarbonate-based powder. However, the replacement agent has a high global warming potential, so the US Army is researching other, more environmentally-friendly fire extinguishing agents.

The US Army's Tank Automotive, Research, Development and Engineering Center (TARDEC) has sponsored fire-extinguishing agent research. That research includes studies of the



Automatic Fire Extinguishing System (AFES)

decomposition of a fire extinguishing agent at high temperatures, and studies of the effects on the decomposition byproducts by dry chemical. In support of this program, the US Army Public Health Command, Toxicology Evaluation Program, at Aberdeen Proving Grounds (APG) is studying the acute inhalation effects of the gaseous decomposition byproducts, while NAMRU-Dayton is being tapped for its expertise in aerosol studies to examine the effects of the inhalation of the fire-extinguishing dry chemical. The information from the Aberdeen and NAMRU-Dayton studies will help the US Army evaluate the relative performance and safety of various fire extinguishing agents.

NAMRU-D Continues Role in Ensuring Safety of Military Fuels

Dr. Karen L. Mumy

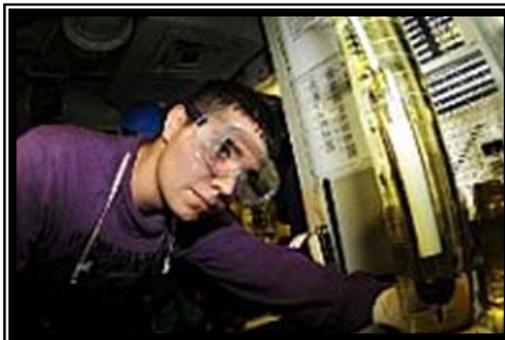
As the Department of Defense continues to march towards the incorporation of renewable fuels and decrease its reliance on conventional petroleum-based fuels, significant effort is being placed on ensuring the safety of the military personnel that work with and around the newly developed fuels. In support of this effort, the Army, Navy and Air Force have formed the Tri-Service Alternative Fuels Team with subcommittees aimed at evaluating the fuels from every angle, including the chemical, material, and propulsion sides.

Dr. Karen Mumy, Naval Medical Research Unit - Dayton team member and Deputy Director of the Environmental Health Effects Directorate, is the Navy representative on the Toxicology Subcommittee that was formed to assess potential health risks associated with exposure to the fuels. She works closely with other experts within the Air Force and Army to determine which toxicology tests should be performed for the individual services to certify the fuels for use. Members of the group, including Dr. Dave Mattie (toxicologist, US Air Force) and Tracy Davis (Senior Analyst, Avion Solutions, Inc. working with the US Army), convened in Dayton, Ohio on 27 November 2012 with other DOD and industry leaders in fuels to discuss recent progress and advancements in generating and testing the fuels for operational use.

NAMRU-D is currently involved in supporting the certification of various Alcohol-To-Jet (ATJ);

specifically cellulosic-based) fuels under consideration for military use. A study presently underway involves the occupational exposure by inhalation. Following 90 days of exposure (6 hours/day, 5 days/week), toxicological endpoints from neurobehavior to genotoxicity

and clinical effects are considered in the toxicity assessment. One ATJ biofuel is currently under evaluation, with another 90-day inhalation study for a separate ATJ fuel scheduled to begin in April of 2013.



120717-N-ZG290-107 PACIFIC OCEAN (July 17, 2012) Aviation Boatswain's Mate (Fuels) 3rd Class Joshua Palomares checks the specific gravity of biofuel with a thermo hydrometer in the quality surveillance fuel shop aboard the aircraft carrier USS Nimitz (CVN 68) during a replenishment at sea. Nimitz took on 200,000 gallons of a 50-50 blend of advanced biofuels and traditional petroleum based fuel during the U.S. Navy's Great Green Fleet demonstration portion of the Rim of the Pacific (RIMPAC) 2012 exercise. (U.S. Navy photo by Mass Communication Specialist 3rd Class Devin Wray/Released)

2012 International Achievement

NAMRU-Dayton Public Affairs

The International Society for Regulatory Toxicology and Pharmacology "annually presents an award to an outstanding individual in recognition of their contributions and achievements in the resolution of public environmental concerns," and are especially interested in "international scientific development in toxicology."

The society recently hosted their 2012 awards ceremony in Washington D.C. in a small gathering with council members and a few guests. Dr. Gary Burin, Senior Managing Toxicologist of Technology Sciences Group Inc. (TSG) presented the society's 2012 International Achievement Award to Dr. Michael Gargas, Director of Environmental Health Effects Research Directorate of Naval Medical Research Unit - Dayton (NAMRU-D). He was given the award for his career work in pharmacokinetics and its application in risk assessment for addressing environmental issues, both nationally and internationally.



Dr. Gargas is also an Adjunct Assistant Professor in the Department of Pharmacology/Toxicology and in the Department of Environmental Health at Wright State University, has served on the editorial board of Toxicology and Applied Pharmacology, and is an active member of both the Society of Toxicology and the Society for Risk Analysis.

Upon learning of his achievement, Dr. Gargas mentioned how privileged he felt for being in the company of such distinguished past recipients. This exceptional honor is a positive reflection of NAMRU-D and the Navy Medicine R&D enterprise.

Dr. Michael Gargas (left) accepts the 2012 International Achievement Award from Dr. Gary Burin, Senior Managing Toxicologist of Technology Sciences Group Inc. (TSG)

NAMRU-D's Neuro-Otologic Testing Center (NOTC)

Dr. Joseph Chandler & LT. Stephen Eggan

The NOTC is a key capability for NAMRU-D's motion sickness (MS) and spatial disorientation (SD) research programs.

This device is a state-of-the-art clinical vestibular rotating chair capable of three degrees of motion (rotation on axis, tilt, and horizontal translation) and housed in a light-tight enclosure. The NOTC has cutting-edge technologies that enable pre-programmed and custom tests of visual and vestibular function during rotation, including head-mounted eye-tracking and an opto-kinetic sphere (OKS) for projection of a visual field within the enclosure. Currently, two projects are utilizing the NOTC.

The first is a BUMED-funded, FDA Phase II clinical trial of intranasal delivery of the MS countermeasure scopolamine. Scopolamine is the most effective medication for the prevention of MS; however, current administration routes have drawbacks that can compromise its operational utility, such as slow absorption and high-dosing side effects (transdermal patch), and loss due to

emesis (oral pill). Intranasal delivery of scopolamine (INSCOP) in an aqueous spray may speed absorption while reducing the minimum effective dose. The NOTC is being used to induce MS

via off-vertical rotation and compare the amount of MS tolerated when participants receive INSCOP versus placebo.

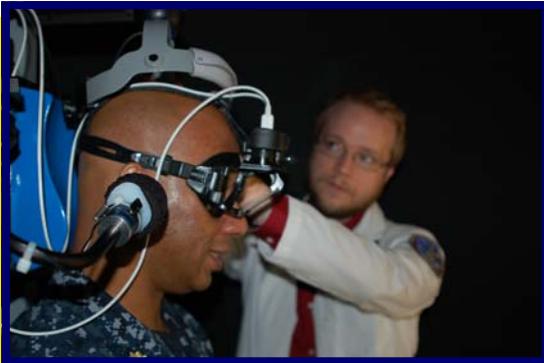
The second is a neuro-imaging study investigating the basic neural processes underlying normal human spatial orientation and represents the first



LT Eggan preps the dense-array electroencephalography (dEEG) for visual tracking task using.

step of a line of research that seeks to better understand pilot SD. Using advanced 256-channel dense-

array electroencephalography (dEEG) technology; spatial neurological functions are being measured during combinations of visual tracking tasks and vestibular stimulation created by the NOTC. High-resolution dEEG signals will be reconstructed in three-dimensional space and localized to specific anatomical brain structures, allowing visual and motion influences on spatial processing to be differentiated. Further refining the role of the vestibular system with regard to activation of specific brain cells will enhance understanding and modeling of human spatial processing and lead to improved flight simulation training and reduced SD in the Fleet.



Dr. Chandler applies the head-mounted eye-tracking, which is attached to the opto-kinetic sphere (OKS).

Open House (cont.)

At the fatigue and performance laboratory Dr. Lynn Caldwell described her current research on pharmaceutical countermeasures for fatigue. The tours were concluded with a visit to the NAMRU-Dayton Disorientation Research Device, soon to be the Navy's and DoD's premier research device to support dynamic human acceleration-based research on problems such as aviation spatial disorientation, motion sickness, flight simulation fidelity, and aviation human performance (see story on page 2).

The Air Force-Navy open house highlighted the unparalleled joint research capabilities of "Team Wright-Patt". NAMRU-Dayton and 711 HPW



During the Open House Burger Burn lunch CAPT Forcino thanks the crowd for touring NAMRU-D research facilities.

continue to strengthen their collaborative partnership, with events such as the open house facilitating this partnership by bringing scientists and engineers from across the campus together to learn about and discuss each other's scientific capabilities and programs.

Vision Science Laboratory at NAMRU-D Hosts NAMI and NMOTC

CDR Michael Reddix

CDR Michael Reddix checked aboard NAMRU-Dayton in mid-August and has been fully engaged in assisting the command in its efforts to stand up a vision science research program. The Vision Science Laboratory (VSL) is developing the capability to evaluate new and evolving clinical color-vision diagnostic devices, and apply spectral-photometry methods to quantify operating environments that involve color and color-discrimination tasks. This capability will support the overarching goal of the VSL to measure both the type and severity of color vision defects (CVDs) and use this information to predict CVD impact on operator performance. This knowledge will, a) augment color vision standards development, b) aid the interpretation of color vision tests with regard to special-duty billet assignment, and c) assist the process of acquiring the gamut of display technology with which surface, subsurface and aviation personnel interact (e.g., sonar, radar, weapon/combat-control systems, air traffic control, and medical imaging/diagnostic interpretation).



Ms. Cristina Kirkendall, CRD Michael Reddix, Dr. Richard Arnold, Dr. Henry Williams, CAPT Matthew Rings, Dr. Terrace Waggoner, CDR Michael Acromite, and LCDR Hong Gao during NAMI & NMOTC visit.

On 5 November 2012 CAPT Matthew Rings (Chief, Aerospace Ophthalmology) and Dr. Terrace Waggoner, both from the Eye Clinic, Naval Aerospace Medical Institute (NAMI), Naval Medical Operational Training Center (NMOTC), visited NAMRU-D and USAF School of Aerospace Medicine (USAF SAM). CAPT Rings spent the bulk of his time interacting with personnel in NAMRU-D's newly established VSL, and was instrumental in assessing the labs near- and long-term goals and providing insight regarding future research to support operational requirements. Additionally, USAFSAM's COL John Gooch (Chief, Aerospace Ophthalmology) and his clinical/research staff hosted CAPT Rings and Dr. Waggoner for a discussion of future color vision research information exchanges, tri-service military vision standards, and a possible joint effort with NAMRU-D in developing automated vision test technology for aircrew clinical vision screening.

NAMRU-D Products & Presentations

- Chandler, J. (2012, December). *Objective Assessment of Student Naval Flight Officer Fatigue during Primary Flight Training*. (Research Information Bulletin No. NAMRU-D-12-47).
- Williams, H., Sweeney, L., Hardt, D., Howard, W., Forcino, C.D. (2012, October). *NAMRU-D Science Update: Fall 2012*. (No. NAMRU-D-12-62)
- Vartanian O., Nakashima, A., Jobidon, M., Bouak, F., Peng, H., Smith, I., Lam, Q., Paul, M., Caldwell, L., Cheung, B. (2012, November). *Effects of Fatigue Induced by 24-Hour Total Sleep Deprivation on Cognitive Function: An fMRI Study*. Oral presentation given at Canadian Military and Veterans Health Research Forum in Kinston, Ontario.

Commanding Officer's Corner

CAPT C. Douglas Forcino

It has now been a little over six months since the NAMRU-Dayton change of command and each day, my appreciation and gratitude grow for having the opportunity to work with such a dedicated group of professionals. This is technically the science update for the first quarter of FY13, but as it is also the last quarter of the calendar year and the six month mark in my command tour, I'd like to talk more in this issue of the update about the past year than the past quarter.

Growth over the past six months has been significant. Our Aeromedical Research Directorate, which moved here from NAS Pensacola two years ago under BRAC mandate, is hitting its stride. Much of the time since 2010 was consumed by moving, writing proposals, arranging lab spaces, positioning equipment, hiring and training staff, and waiting for money to arrive. In just the past quarter, all of the work of the past two years is starting to come to fruition. It is a pleasure to see research subjects coming through the door into our beautiful new laboratory on an almost daily basis.

Although aboard Wright-Patterson AFB for more than thirty years, our Environmental Health Effects Research Directorate (Toxicology for short) is emerging as THE place in DoD to perform inhalation toxicology research. The toxicology group played a key role, with our sister lab, Naval Submarine Medical Research Lab, in doing work to ascertain that environmental standards aboard submarines which were established for male crew members are indeed safe for women who are now serving aboard submarines. And, although it was a minor role, we are proud that our work contributed to the historic awarding of submarine dolphins to the first three female submarine warfare qualified officers earlier in December. In addition, the toxicology group has made interesting discoveries on Air Force funded projects that demonstrate a synergistic effect of noise and jet fuel exposure on hearing loss – work which has obvious implications for naval aviation as well as Air Force flight and ground crews. As the culmination to a successful year in the toxicology group, its Director, Dr. Mike Gargas, was presented with the 2012 International Achievement Award from the Society of Regulatory Toxicology and Pharmacology.

I would be remiss if I did not mention the strong partnership that is developing here between NAMRU-D and the Air Force's 711th Human Performance Wing. Investigators from each organization are talking, developing ideas for research collaborations that will benefit both services, and planning to share the unique capabilities that we each possess, rather than duplicating them. We have become a regular tour stop as the 711th's VIP visitors are brought to NAMRU's door to see the capabilities that Navy Medicine brings to both the toxicology and aeromedical footprint here at Wright-Patterson.

As the year draws to a close, I would like to thank all of our partners across the Navy and DoD who may see this update. We at NAMRU-Dayton wish you happiness, prosperity and success in the new year.



Captain C. Douglas Forcino,
MSC, USN
Commanding Officer

Taking the Helm of Navy Medicine's Aeromedical & Environmental Health Research

NAMRU - Dayton

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