Director of INNOVATION

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GLOBAL TECHNOLOGY AWARENESS

Open Innovation, Open Collaboration, Connecting Scientists All Around the World

Vice Chief of Naval Research, BGen. Robert F. Hedelund *on* Innovation and Tech Awareness

Q. Where do you believe innovation can have the biggest impact for the current and/or future challenges we face in national security and peacekeeping around the world?

A. We need innovative ways to lighten the load of our dismounted Marines and to rapidly and reliably sustain them in widely dispersed employment. During the past 10 years we have made remarkable innovations in our ISR, our ability to deliver precision weapons, and networked communications that have made it possible to provide unprecedented shared situational awareness and collaboration of distributed forces over broad areas. However, we are limited in our ability to capitalize fully on these developments by our need to sustain that force either over road networks or in the air in our rotary and tilt-rotor assault aircraft.

We need to be able to respond much more rapidly to the needs of our widely dispersed forces on the ground over much longer distances than conceived of previously. This includes both from our ships at sea as well as from our larger forward operating bases ashore. Commanders must have the ability to evacuate their wounded and to be able to count on prompt resupply of critical items such as ammunition, batteries, spare parts, or fuel whenever needed in order to maximize their ability to maintain operational tempo and exploit opportunities as they appear.

Q. In your experience as a Marine, where have you operationally experienced an innovative solution to a technological problem or need?

A. In every unit I have been in, I've seen Marines innovating – either using fielded equipment in ways not taught in the manuals or commercial civilian products for military uses. Radio Shack hand-held radios were seen as an inexpensive way to improve coordination between maintenance crews, Garmin GPS with way points and reasonably reliable position location became common for pilots, vehicle drivers and convoy operations. Exploitation of commercial products is also proven to be a way for the Lab to explore emerging technologies or to employ a surrogate system that emulates selected characteristics of future systems or technologies. For example, the Lab has used commercial vehicles such as the Gator and Proteus as surrogate logistics robots and modified Iridium phones and iPhones as surrogates for future over-the-horizon, hand- held communications systems down to the squad level.

Q. In your current position you wear two hats, you are the Vice Chief of Naval Research and the Commanding General, Marine Corps Warfighting Laboratory (MCWL). What are some of the innovative things that MCWL has been looking at?

A. The focus of the Warfighting Lab is on concept-based experimentation. The Lab takes the current concepts that the Marine Corps is using to drive its combat development vision. It explores how new technologies can be used in concert with new tactics, techniques, and procedures to enable those concepts to result in measurably increased warfighting capabilities in the future.

We are just finishing several years looking at the Enhanced Company Operations concept influenced by the reality of current operations in Iraq and Afghanistan in which our forces are dispersed widely in assigned areas of responsibility down to company forward operating bases. We have conducted experimentation in changes to the infantry company operations center and company intelligence cell leading to changes in the organization, training, and equipping of the company headquarters. We have also been looking closely at how we can improve the infantry company's ability to maneuver – to lighten the load of dismounted infantrymen – and to reduce dependence upon truck convoys to provide sustainment to our forward units.

A couple of the more exciting areas we have been exploring in this regard have been in the use of unmanned systems. In the last year we conducted limited objective experiments with both autonomous ground vehicles as well as surrogate unmanned aerial systems (UAS) to support small tactical units in complex terrain – at our Mountain Training Center, in Bridgeport, California. We have also issued a challenge to industry to demonstrate "Cargo

UAS" candidates that might have a militarily viable capability that we might use in a user assessment in Afghanistan. As a result, we are in the process of assessing two commercial candidates' ability to support, for example, a representative profile of a round trip of 75 nautical miles from one forward operating base to another and off-load sustainment and then return.

Another difficult problem taken on by the Lab includes exploring the sensor payload alternatives for Group II Tactical UAS, using an Aerosonde surrogate platform, in order to assist in shaping the requirements for the next generation of tactical UAS replacing the Shadow and Scan Eagle.

Q. This issue of the Office of Naval Research (ONR) Innovation Newsletter is focused on Global Technology Awareness. In what ways are the Marine Corps engaging with the international communities' scientists and engineers?

A. The Lab has very limited direct contact with the international technical community. We depend upon ONR through ONR Global primarily and upon other US technical programs such as the Foreign Comparative Test Program for much of our input. We do participate in selected bilateral military-to-military venues that often involve discussion of emerging tactical systems that might have application to the U.S. Marine Corps.

We are often approached by foreign defense organizations and industries. Some are in response to our Request for Information (RFI) or Requests for Proposal (RFP) to support our experimentation efforts. Those that are not in response to a RFI or RFP are passed to our new Technology Initiatives Screening Officer – Dr. Paul Muessig who used to be at ONR – who is responsible for assessing proposals and ideas that are referred to the Lab for consideration from both the foreign and domestic industries.

Q. MCWL recently participated in a BILAT with Singapore; can you share with the readers the results of that agreement and how these exchanges benefit the Marines?

A. The most recent meeting under our BILAT agreement was held in Singapore in May 2009 and co-chaired by my predecessor, Brigadier General Thomas Murray and Mr. Quek Tong Boon, Chief Defense Scientist, Singapore Ministry of Defense.

During our turnover, we discussed our on-going relationship with Singapore in some depth with a focus on our long term goals for the arrangement. The agreement is centered on information sharing concerning experimentation, but with a special focus on how we are exploring technology incorporation into emerging tactics, techniques, and procedures. At the most recent meeting, we exchanged information on on-going developments in training for soldier skills and tactical decision-making to include discussion of the Marine Corps Infantry Immersive trainer (IIT) in Camp Pendleton and the Singapore Murai Urban Training Facility. Both sides had previously made visits to the other's facility so the discussion centered on how we can collaborate further in the future. We also provided some lessons learned in preparation for operations in a high threat IED environment. In addition, we discussed our on-going efforts to explore the feasibility of Cargo UAS to help reduce the vulnerability of our logistics delivery to interdiction by IED's and ONR 30's Integrated Day/Night Scope enabling capability development effort as a means of lightening the load of dismounted forces.

ONR's VCNR, BGen. Robert F. Hedelund and staff watching an Electromagnetic Railgun Innovative Naval Prototypedemonstration.

Q. How is MCWL leveraging its capabilities with ONR Strategic Communications to conduct a more robust command outreach program?

A. In early February, a number of Marine Corps Warfighting Laboratory's (MCWL) staff attended the Singapore Air Show. This global exhibition represented MCWL's

second official outreach initiative and first international exhibit debut was coordinated with well-seasoned ONR as its strategic partner. The primary focus of MCWL's strategic outreach focuses on commander's intent more fully define its missions in support of the warfighter. A secondary objective is to inform and educate MCWL's diverse communities of interest. The Singapore Air Show provided a distinct media and diplomacy opportunity that helped highlight Marine Corps and Navy technologies.

Additionally, spring boarding off a successful technical demonstration of an immediate Cargo Unmanned Aerial System technical demonstration conducted at Dugway Proving Ground, Utah, the command was able to speak with media about a current, high-visibility initiative that met Marine Corps aerial resupply capability requirements. The trip further enabled MCWL Commanding General and Vice Chair of Naval Research BGen Robert F. Hedelund to facilitate a number of face-to-face outreach initiatives as an honored guest of the Singapore Ministry of Defense. This MCWL and ONR collaborative approach to managing strategic outreach opportunities conveyed universal command messages and integrated technical capabilities by MCWL and ONR in support of the warfighter at a global venue.

Q. What are the most difficult operational issues for Marine aviation, amphibious assault, and expeditionary warfare?

A. Although the Lab focuses on concept-based experimentation, it is often asked to explore other issues of interest to the Operating Forces. For example, when IED's were recognized as a major enduring threat to our forces in Iraq and Afghanistan, the Lab was tasked with standing up an IED Working Group, coordinating C-IED liaison officers with deployed operating forces and in serving as the Marine Corps entry point into JIEDDO for the statement of Marine Corps requirements for IED counter-measures.

The threat posed by IED's to freedom of maneuver in Iraq and Afghanistan has led to the Lab being asked to identify responses to a number of related operational issues. For example, the Lab partnered with ONR in determining whether Marines would benefit from changes in their tactical training based on observation techniques employed by big game hunters, inner city detectives, and animal trackers. The resulting program called "Combat Hunter" led to identification of a number of observation techniques, anomaly recognition, and training syllabus changes aimed at better enabling Marines to act and think more like predators and less like prey.

Energy consumption in our forward operating bases has been identified specifically by the Commandant of the Marine Corps as a problem we need to solve immediately. The issue is related to IED's in that fuel and water make up by far the largest component of the sustainment we are moving in the air and across the roads in Afghanistan. Accordingly, the Lab in partnership with ONR has been tasked with taking the lead in exploring what can be done to reduce the energy consumption in our forward operating bases in Afghanistan. We are developing a base-line FOB in Quantico and have invited industry to demonstrate current technologies that can make our FOBs more energy efficient. Then, in late this summer we will be exploring the potential of technology approaches from Universities and Defense Labs to determine how we might make further advances in the future.

Q. ONR is the science and technology (S&T) leader for the Department of the Navy and Marine Corps and is expected to provide innovative solutions to naval needs. What do you see as the challenges for ONR in this task?

A. The greatest challenge is in projecting the technical needs of the sea services 10-20 years from now. The services have vision documents that do a great job of describing in broad terms the capabilities that the future services will need to have, but science and technology do not tend to arrive on a predictable road map. Disruptive innovation seems to occur on a yearly basis in both the worldwide commercial sector as well as in the defense laboratories and industries. ONR has to maintain the pulse on both technical innovations inside the US as well as around the world, project when and where innovation is going to occur, and plan to either exploit it or counter it as appropriate. We can see how successful we are when we already have programs that are designed to incorporate break-through technologies – or perhaps even more importantly – to counter them before they can be employed against us. ■

USMC Commercial Hunter

by Mac McKinney, S&T Programs Manager, Office of Science & Technology Integration
Bill Powers and Jay Walker, Research Fellows, Center for Emerging Threats and Opportunities

Technologies become disruptive to the United States Marine Corps if they threaten tactical operations. The most significant unexpected threats Marines have faced have been from existing technologies used or exploited in unexpected ways. The Naval Research Advisory Committee (NRAC) panel concluded that the Marine Corps did not need another list of technological threats, but a restructuring of education, intelligence, and acquisition processes.

In the summer of 2008, the Naval Research Advisory Committee (NRAC) considered the implications of disruptive commercial technologies likely to emerge within the next three to seven years to determine their potential impact on Marine Corps tactical operations. The panel recommended that the Marine Corps form a "Commercial Hunter" cell, "…to explore and anticipate the uses of readily available commercial technologies by irregular adversaries to attack key USMC capabilities or vulnerabilities." The purpose of these technology demonstrations would be to:

- Anticipate, identify and prioritize threats from irregular adversaries via exercises using teams of smart, web-savvy people from diverse backgrounds
- Establish a screening process to validate & prioritize
- 'Buy' readily available technology from the internet; integrate prototype to prove technical feasibility
- Determine appropriate USMC/Naval response

The Commercial Hunter program, under the leadership of the Commanding General at the Marine Corps Warfighting Laboratory conducted an experiment using teams from different universities or schools. The teams worked within a prescribed scenario developed by the Marine Corps which detailed the U.S. capabilities and gaps to develop commercial technology threats. Each team was given the same resources: unlimited internet access and funding for any Commercial Off The Shelf (COTS) technology. They also received the same constraints; they couldn't use technology that would not be mature within five years, and they could not buy from non-commercial sources, e.g., arms merchants or governments.

The teams, acting as a "technology sleeper cell" (bad guys), documented what they did, how they did it, which COTS solutions and countermeasures exist, and briefed the results to the MCWL team. Among those findings were assessments of how disruptive they could be with the capabilities they developed; prioritized vulnerabilities that resulted; and who or what type of people we should watch for similar activities.

The solutions generated by the teams were imaginative, seemingly effective, and relatively simple and inexpensive. The teams also had a high level of convergence of solutions, indicating a high probability of discovery by terrorist cells.

As a result, two Commercial Technology Assessments, (CTA) have been conducted using undergraduate and graduate students from The Pennsylvania State University, The University of North Carolina – Charlotte, The Georgia Institute of Technology, Southern Methodist University, and Jackson State University. These CTAs further confirmed the results of the NRAC panel and MCWL continues to refine the CTA process by consulting operating force commanders to determine their operational priorities, concerns, and 'what keeps them awake at night.'

Commercial Hunter promises to provide an innovative methodology for discovering potential threats to Marines. With the help of young, imaginative college students, Marines can go on the commercial technology offensive rather than wait for capabilities to show up on the battlefield. ■

Global Technology Awareness & Avoiding Technology Surprise

by Cathy Mulé, ONR S&T Liaison Officer

You open the door; flip on the light switch, and a room full of people you weren't expecting yell "Surprise!" It's that old classic – the surprise party. Military history is littered with examples of surprises, starting with the Trojan Horse and continuing to this day with the employment of improvised explosive devices (IEDs) in Iraq and Afghanistan. While not technologically sophisticated, IEDs were a departure from the weapons our forces had been trained to expect. Because we were surprised, it took time to employ effective tools to counter them; but we now armor our vehicles, jam enemy transmitters, predetonate the explosives, interrupt the supply chain, and employ better surveillance. None of these techniques are especially cutting-edge; we just weren't ready to utilize them. As such, IEDs constitute capability surprise, not technology surprise. True technology surprise, such as recent anti-ship ballistic missile developments and digital radio frequency memory devices, can be even more devastating because countermeasures are not "on the shelf" and may in fact take years to research, develop, and deploy.

Obviously, in the military, being surprised can lead to devastating personnel losses and mission failure. We need to know the intentions and capabilities of potential adversaries, so we can ensure we are ready to counter them. The national Intelligence Community exists to provide exactly this type of information, and does it quite well for known enemies and fielded weapon systems. But in the area of emerging science & technology, this knowledge isn't as easy to quantify and the 'swim lanes' aren't quite as clear cut. How does the US know the realm of the possible across the globe, so we can position ourselves and, in the current parlance, mitigate tech surprise?

The Naval S&T Strategic Plan tasks the Office of Naval Research (ONR) to "maintain broad technology investments both to hedge against uncertainty and to anticipate and counter potential technology surprise". That's a pretty tall order. ONR must take that top level direction and translate it into an actionable plan. ONR will never be able to fund all of the interesting research we encounter; we have to make judgments and set priorities.

No one person or organization can "do" tech surprise. Rather, Naval S&T, writ large, must be attuned to developments in science & technology, domestically and internationally, commercially and militarily. At ONR, we have labeled this ongoing process as Global Technology Awareness (GTA). Threat and opportunity can be viewed as two sides of the same coin. GTA enables us to capitalize on worldwide innovation (opportunity) and develop counters to thwart potential tech surprise (threat). To achieve true GTA, we need to answer the following questions on a recurring basis:

- Is there emerging S&T that we are missing?
- Is there an S&T acceleration or breakthrough not obvious in our own research?
- Has a previously disregarded path of exploration started to show new merit or generate interest in other countries and do we understand why?
- Are we on the path to develop the technology/capability first and how do we know that?
- Where is there work occurring that counters our new technology developments?

ONR utilizes multiple avenues and tools to foster GTA, enabling us to provide rational answers to the questions posed above. This entire process seeks to ensure that ONR leadership makes the best possible investment decisions. These tools include:

- Program Officers, who engage with world-class subject matter experts (SMEs)
- Discovery and Invention investments to develop and expand Naval relevant fundamental knowledge
- Global offices in London, Santiago, Tokyo, Singapore and soon Prague acting as mechanisms for worldwide engagement

- S&T Intelligence Liaison Officer (STILO) for access to threat information and expertise from the Intelligence Community
- Innovation Summits, to explore multidisciplinary topics and future concept generation
- GTA quarterly meetings, to focus attention on current and emerging critical topics, investments, and advances

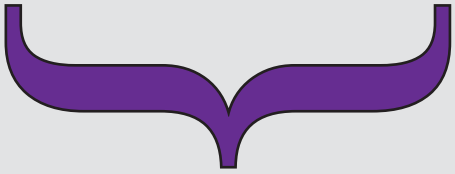
In particular, the quarterly meetings, hosted by the Chief of Naval Research, are meant to focus attention on current and emerging critical topics, investments, and scientific advances that impact Naval S&T. We bring together SMEs from the U.S. and abroad to examine emerging S&T, technology trends, and global innovation. These sessions are unique because they constitute an emerging technology "deep dive" allowing ONR to compare and contrast our research program with efforts outside DoD, commercial, military, and international. Recent topics covered include Metamaterials, Pulsed Power, and Non-Lethal Weapons. We are now drafting meeting summaries for each session and are working to make this information more widely available. Contact Melody Cook (melody.cook.ctr@navy.mil) or Cathy Mulé (Catherine.mule@navy.mil) for details.

The quest to avoid technological surprise is not a milestone to be achieved; it's not a box to be checked off. It's a mindset, a way of looking out for the little things which could add up to the next big thing. We must be more innovative, engaged, creative and agile than our adversaries, or we will continue to be surprised, forced into the role of adapting to outside forces instead of shaping the environment ourselves. ONR should be first in line to capitalize on the best and the brightest, and Global Technology Awareness is a means to achieving that goal. ■

"The quest to avoid technological surprise is not a milestone to be achieved; it's not a box to be checked off. It's a mindset, a way of looking out for the little things which could add up to the next big thing."

COMING UP ...

ONR GLOBAL S&T WORKSHOP IN RIO DE JANIERO



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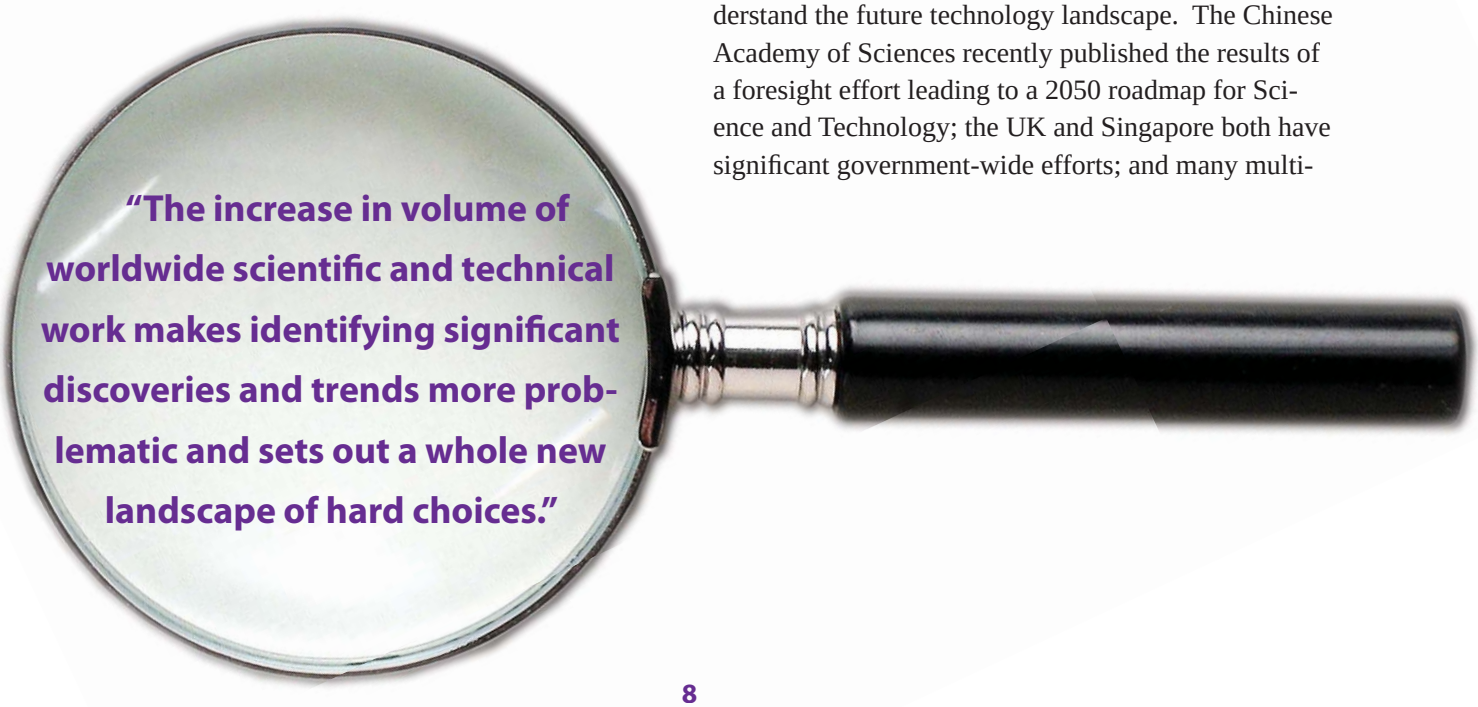
Sustaining Technological Excellence in a Changing Global Environment

by Dr. Melissa Flagg, OSD DDR&E, Deputy Director, Horizon Scanning

Over the past half century the United States and DoD have enjoyed, by most metrics, a world leadership role in S&T. While the U.S. DoD remains strong, there are emerging technology competitors and a shifting global environment to be considered. We move into a future with tough new challenges ranging from globalization of S&T and economic shifts to a diversification of threats to our national security. Among the most interesting challenges are those resulting from unprecedented information availability and understanding. The increase in volume of worldwide scientific and technical work makes identifying significant discoveries and trends more problematic and sets out a whole new landscape of hard choices. We must manage these hard choices in an increasingly complex environment, and doing so means that defining the tradespace – prioritizing capabilities, investments and partnerships – for future DoD investments in a way to shift from an abstract policy discussion to a critical capability. As other nations and globally networked groups (Google, IBM, etc.) focus increasing attention on harnessing large disparate data sets and significant resources on reducing future uncertainty, an inability to remain on an even playing field could result in declining decision superiority. Whether those decisions are strategic, programmatic, or operational, if they are being made more slowly or based on a less reliable foundation of knowledge than those of potential adversaries (or many commercial entities), the DoD may be placed at a significant disadvantage.

Maintaining military decision superiority and an ability to win wars of the future also requires a dynamic process of monitoring the broader environment, including social, political, and technological domains, to ensure not only that our priorities shift as the changing landscape dictates, but also that we see the opportunities for and impacts of our own shaping efforts. The DoD must be able to survey the S&T environment in an analytically rigorous and persistent way – this includes making technology forecasts with enough precision that they can be evaluated on a level playing field across forecasting methodologies (e.g. Delphi process; expert panels; etc.) and used effectively in planning programs. This provides real value added to development of strategic guidance, capability analysis and program evaluation.

Internationally, there are many efforts underway to understand the future technology landscape. The Chinese Academy of Sciences recently published the results of a foresight effort leading to a 2050 roadmap for Science and Technology; the UK and Singapore both have significant government-wide efforts; and many multi-



"It should not be assumed that novel technology will out perform conventional approaches, if we are going to expend resources we should strive to prove that we are supporting the most accurate methods available to identify the spark of innovation earlier and earlier in the cycle both to stimulate opportunity and avoid costly threats."

national companies commonly use a range of scenario planning, expert elicitations, internal prediction markets, and other tools to foresee technology breakthroughs and market shifts. Yet there are very few examples of objective analysis of analysis. Most evaluations of technology foresight programs, for instance, have focused on the process of organizing the foresight activity or using the information. Rarely are the forecasts evaluated for accuracy, and there are no instances to our knowledge of comparing the accuracy of separate technology forecasting methodologies over time.

For the past 50 years, technology forecasting has been articulated as an important way to mitigate technology surprise. Expert groups have been assembled in many fora, delphi studies produced, consensus reports from a wide range of experts funded, and a host of proprietary approaches based on an emerging ability to exploit large data sets have been used across the spectrum of National Security agencies for insight into threats and new opportunities. These approaches range from the purely qualitative to highly quantitative methods.

Today we find ourselves in a situation where each Defense organization and sub-organization employs a variety of committees, FFRDCs, and consultancy groups to provide technology assessments across multiple time horizons and maturity levels; each trying to help us clarify the future and improve strategic and programmatic decisions. However, what has become clear is that there are very few evaluations of this broad array of methodologies used to formulate technology forecasts and assessments along with their respective track records for relevance and accuracy over time. The end result is a large volume of 'expert' information but no way to objectively assess credibility and relative value of those disparate inputs.

There is great potential in gaining advantage by quantifying the accuracy of our current approaches and the domain in which the approach is most useful. How well different methods support forecasting will likely be a function of the output domain. We are looking at approaches that give us both general directions over time as well as specific answers to future technology directions. The stock market is an excellent example of an area where we use both broad forecasts and point forecasts – broad forecasts to develop an optimal mix in our portfolio over the long run and point forecasts to identify and capitalize on the outliers. In order to target the most relevant and accurate inputs, we must hold those providing advice to the DoD accountable for accuracy of assessments and forecasts in both domains. There also must be a common baseline of forecasting data and methodologies that are specific enough to be evaluated as the future unfolds.

In the future, superiority in technology forecasting may also require truly novel approaches to understanding causality in complex systems and the robust indicators of innovative thought. It will surely move beyond the segmented treatment of technological, political, and social dynamics and capitalize on those very interdependencies. But in order to understand whether there is value added in the new ideas emerging in the scientific community, we still require a construct within which to test and evaluate these approaches. It should not be assumed that novel technology will out-perform conventional approaches, if we are going to expend resources we should strive to prove that we are supporting the most accurate methods available to identify the spark of innovation earlier and earlier in the cycle – both to stimulate opportunity and avoid costly threats.

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While it seems an impossible task to bring clarity to a future derived from so many interlaced complex factors, there is a very real possibility to make that future less uncertain.

Those who accomplish this, whether they are companies, governments, non-state actors, allies or adversaries, will have an advantage – an advantage of global awareness that is not easily or rapidly replicated or stolen. ■

About the author...

Dr. Melissa Flagg is formerly the ONR Global Director of the International Liaison Office and the Director of Strategy and Plans. While at ONR she was instrumental in establishing the Global Technology Awareness quarterly meetings. She spent a few years in the ONR Global London office and prior to that she worked at the Department of State. Her international experience and background in science have equipped her to take on the challenges of strategic planning to prepare the Services for an uncertain technological future. Dr. Flagg currently works for OSD in the Office of the Director of Defense Research (DDR&E). Her role at DDR&E is to develop an effective approach to technology horizon scanning both to support more robust strategic planning and to reduce the overall rise of surprise to DoD programs.

ONR Global's Worldwide S&T Engagement

by Dr. Chong Ong, ONR Global Associate Director

The primary mission for ONR Global (ONRG) is to find the best S&T around the globe. The goal of GTA is to attempt to understand the rate of and direction of technology movements. Considering the US now accounts for less than a third of global R&D, GTA helps to inform US investment strategy and collaborations with our international partners.

A starting point for GTA is to deal with the tangibles, and this means looking at the funding and talents. The premise is that funding will attract talents, or funding will be provided to people with talents. Funding is the fuel and talent is the spark. If we think of air as inspiration, then clearly the right mixture and timing will ignite the innovation engine. The intersection of funding and the most talented scientists will be the most fruitful ground for further work.

We rely on publications and Thomson's Science Citation Index to follow the work of the foremost scientists. News information such as the establishment of new labs or research centers is indicative of research thrusts. Several years ago, the Singapore government announced three new research initiatives, namely biomedical, environmental and multimedia, and today ONRG has several opportunities to work with Singapore scientists on some significant and interesting biomedical research.

Good ideas are also born out of necessity and circumstances. If we look at the Scandinavian countries and Canada, we think of vast terrains with poor communications infrastructure. It is not a surprise that these countries were the early innovators in wireless communications. Companies like Nokia, Ericsson and Nortel were the leaders. Conversely, physical space is limited in Japan and the Japanese have taken space optimization to an art and science. As a result, miniaturization of electronics, packaging and functionality become Japanese traits for innovations.

Today, we are seeing a focus on energy and water. Countries like China and India are investing heavily in alterna-

tive energy. South East Asian nations are concerned with potential pandemics and severe water shortages. In anticipation, Singapore and Hong Kong are promoting pandemic research and novel water technologies.

We are also seeing more innovations at boundaries of different disciplines. Examples of these are in nanotechnologies and biomedical sciences. With these emerging fields, it is not uncommon for scientists and engineers from different disciplines to work together with synergies never seen before. Globalization also means that we have to look at international collaborations. Globalization is just as important in S&T as it is in other human endeavors such as commerce. Many leading investigators now hold joint appointments at universities in more than one country, and there is a great deal of exchange among investigators and their graduate students. Globalization applies to knowledge and with the advent of internet it is so much easier for researchers to have access to international research results and data.

By following the funding and talent; understanding how necessity and circumstances drive innovation; and watching the boundaries between different disciplines, we can gain the necessary insights to properly inform our S&T decisions. ■

The above graphic symbolizes ONR's general international perspective and does not imply a collaborative relationship with any of the countries depicted.

Program Officer Question & Answer Section

Interview with Dr. Ellen Livingston

In September of 2009, ONR cosponsored the 2nd International Conference on Shallow Water Acoustics in Shanghai, China. The conference focused on shallow-water acoustic propagation and reverberation models; effects of water column variability on acoustics; seafloor acoustic interaction; sea-surface acoustic interaction; ambient noise; field characteristics of the shallow water sound waveguide; and experimental techniques and instruments. Dr. Ellen Livingston sat on the Board of Advisors for the conference and assisted in the planning and participated in the conference.

What was the purpose of the conference?

Scientific exchange was the main purpose. We wanted first to provide a forum for the formal presentation of US and Chinese research in shallow-water acoustics. We also wanted to use the conference as an opportunity for scientific diplomacy, to visit research institutions, to meet the scientists, observe their infrastructure, learn about their technical culture and discuss published scientific research. We have been working to establish a good relationship with their scientists since the mid 1990s. For obvious reasons, that isn't always an easy task, but face to face discussion of science is far more productive than just reading published papers.

Holding the conference in China must have made it more difficult, why China?

It is difficult for Chinese researchers to travel to the US. That isn't to say we don't have our own challenges in traveling to China, but it isn't as hard. Perhaps more importantly, the Chinese coastal acoustic environment is a unique one; it's the perfect location for this type of research. Their coastal seas are bodies of shallow water hundreds of miles wide which have unique acoustic reverberation and noise characteristics. In addition, we wanted a better understanding of their infrastructure and what it is like to be a scientist in China. One of the things that stood out to me was that they are investing heavily in academics and research, and as a result they have a new generation of scientists that are making significant progress in shallow water acoustics.

This was the 2nd conference, when was the 1st?

The first conference was in 1997, held in Beijing. It generated scientific collaborations and eventually joint field programs in the Yellow, East China and South China seas. The experimental programs were especially helpful since those environments provide unique opportunities to further our shared understanding of acoustic reverberation and noise characterization. More recently, in 2009 we held a small workshop in Seattle. At these smaller meetings, we are able get to know China's best and brightest, and likewise they get to know us. We are establishing a trust that is necessary to truly leverage the basic research of both countries.

Why did we wait so long to have the second one?

Well, it is difficult to conduct these kinds of collaborations in a steady fashion. Often they are impacted by current events and logistics, policy on either side, and even individual personalities from time to time. I can't point to any single reason, but I can say that sometimes researchers have to work hard to overcome politics and cultural challenges to collaborate internationally. As a scientist, I believe it is worth the effort, especially when dealing with basic research.

Were you able to go beyond Shanghai and see the Chinese S&T infrastructure?

Yes, the trip allowed us to attend three conferences and conduct site visits throughout their research community.

We travelled to six different research institutions, where we grew to understand that the Chinese are placing research and education very high on their agenda. For instance, the Harbin Engineering University, is expanding their campus to sixteen colleges. It has the only college of Underwater Acoustic Engineering in China with over forty faculty members. Close by is a commercialization park, where they transition technologies from the university for applied purposes. Similarly, Northwestern Polytechnical University is a huge campus run like a city. People live there, go to school there, shop, everything. Very impressive.

ONR's Dr. Ellen Livingston sitting in between Chinese scientists and professors, Renhe Zhang (*left*) and Jing Tian (*right*) at the 2nd Annual International Conference on Shallow Water Accoustics, held in Shanghai, China.

What are you most excited about in terms of results?

I believe that China is poised to make significant progress in Shallow Water Acoustics. They have young, innovative scientists, a modern new infrastructure, a well funded research program, and a vibrant environment to work in. I found them to be very aware of the world wide research in this area; they keep up with the literature, and they are more aware of applications for their basic research, which will result in new technologies being fielded in the near term. Continued engagement with them will further our own understanding in this field.

"I wanted to put a face on 'ONR' in the Chinese acoustics community. ONR has the national responsibility for the discipline of ocean acoustics, so I want them to know us well. Science can be a force for engagement. I hoped to show them we can use science to engage on an important topic when other applied discussions might be too sensitive."

ONR'S Dr. Frank Herr on the topic of hosting the Shallow Water Acoustics conference in Shanghai, China.

Where will you go from here?

First we will publish the proceedings from the conference. Second, we are looking into exchange options so our scientists can spend time in the other country's laboratories. Third, we are investigating shorter, more frequent visits for seminars and similar events. And last but not least, the Acoustic Society of America, and the Acoustic Society of China are planning the first ever cosponsored event between those two associations. That will further enhance our relationships. ■

OFFICE OF INNOVATION
UPCOMING EVENTS

The Director of Innovation hosts various lecture series, summits and workshops to provide an environment for Naval scientists and engineers to engage with researchers from across DoD, academia and industry. This spring is jammed pack with events! From our Distinguished Lecture Series to the Total Ownership Costs summit to the Assistant Secretary of the Navy Top Scientists of the Year brown bag symposium, we hope to see you at one of these events! Visit our events website to register: **https://secure.onr.navy.mil/events/**

Distinguished Lecture Series

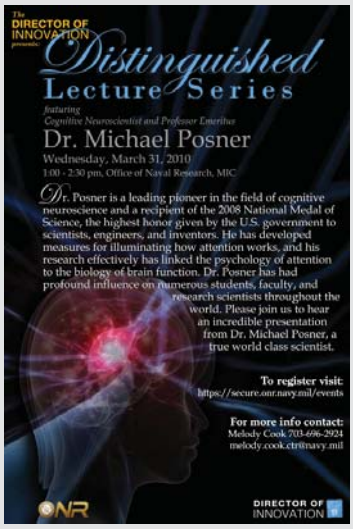
Dr. Michael Posner
Cognitive Neuroscientist & Professor Emeritus
31 March 2010 | 1300-1430 | ONR MIC

Gen. James N. Mattis
USMC Commander U.S. Joint Forces Command
29 April 2010 | 1000-1130 | ONR MIC

Dr. Werner J.A. Dahm
Chief Scientist of the U.S. Air Force
17 May 2010 | 1300-1430 | ONR MIC

Capt. Heidi Stefanyshn-Piper
Navy Captain and former NASA Astronaut
2 June 2010 | 1300-1430 | ONR MIC

Dr. Albert Laslo-Barabasi
Distinguished Professor and Complex Network Scientist
28 June 2010 | Time TBD | ONR MIC



ASN Top Scientist of the Year Brown Bag Lunches

23 March 2010 – 8 June 2010 | Tuesdays | ONR Training Room 533 A&B

ONR S&T Partnership Conference

23-25 August 2010 | Washington DC

DIRECTOR'S CORNER

by Dr. Larry Schuette

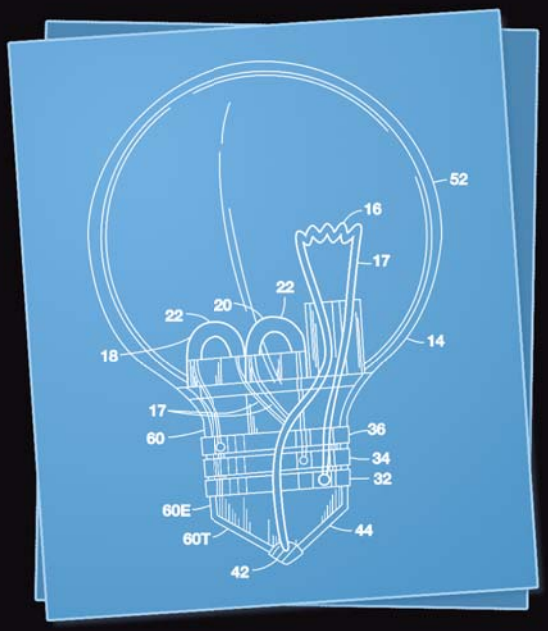
In this issue we looked at Global Technology Awareness (GTA). The topic is a critical one for the Navy, and especially true for the S&T program. As you might expect, GTA is also complex, and as a result the articles in this issue are more in depth looks at some of the current aspects and perspectives. I think we have many rich resources to meet the challenges of GTA, and some of those are authors of articles in this issue.

When we think about this notion of technology awareness we do so with the realization that the entire world is involved in championing and performing S&T. It is our role at ONR, as the organization sponsoring naval S&T, to make investments in superior S&T. To do so, it's critical that we look not only inward but outward. I'm pleased by the breadth and depth of our understanding and collaboration with scientists and governments across the globe. But I recognize that "we never know what we don't know" and that it is important that we keep searching for inventors and innovation around the world.

In my own job as the Director of Innovation at ONR, I travel internationally for a variety of reasons. I recently spent a week at an Autonomy conference hosted by ONR and the NATO Underwater Research Center in Lerici, Italy. The sophistication of thinking was humbling and I was very pleased to learn that ONR sponsors a number of world renowned scientists in the field of Autonomy. I was particularly impressed by Dr. Paul Newman of the Robotics Research Group at the University of Oxford whose enthusiasm was as infectious and compelling as his research results. In December of 2009, I traveled to Valparaiso, Chile for an ONR sponsored workshop on Operations Research. It is always interesting to watch how other Navy's solve problems and I found the Chileans to be very innovative. The extreme distances between Chile, North America and Europe require innovative Naval tactics and fleet sustainment approaches. I learned that the Chilean's excel at leveraging other countries advancements. My travel to Chile gave me confidence in their ability to respond to the recent 8.8 magnitude earthquake – a challenging reminder of the surprises of "Mother Nature."

In these times of budgetary pressures it's important that we provide substantive value to the Navy. GTA is a tool to help ensure that we get maximum leverage from the global scientific economy. I look forward to the continued challenges and engagements. I'll be traveling to the Naval Postgraduate School in February to help teach a class at the Naval Corporate Business Course to Navy Captains and GS-15s. Our topic is Open Inovation. We're interested in learning what Navy Commands have been doing and how to institutionalize the best of breed. I'll also be touring the new Free Electron Laser facility at NPS (part of the FEL Innovative Naval Prototype program portfolio).

I look forward to working on our next edition of the Innovation Newsletter which will focus on Open Innovation. ■



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