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DIRECTOR'S NOTE

Mission First: Combating Chemical Weapons

I would like to extend my deepest gratitude to all of you for your resilience over the past couple months. They have not been easy, but we have made it through furloughs and budget uncertainty with strength and commitment. Despite the FY14 budget gridlock, we will continue to forge ahead with pride and a purpose with our most important counter weapons of mass destruction (CWMD) mission. Indeed, the Warfighter and the Nation are counting on us.

No example of this importance was stronger than on August 21, when over 1,400 civilians were killed by sarin in the suburbs of Damascus. ECBC expertise was front and center in identifying and providing solutions such as the Field Deployable Hydrolysis System (FDHS). The FDHS, which has been featured in The Washington Post and The New York Times among other publications, was a center-wide team effort. Our own Chemical Sciences Division determined the hydrolysis chemistry for FDHS. Then the Advanced Design and Manufacturing Division designed the system, and the Chemical Biological Application and Risk Reduction Business Unit (CBARR) fabricated the system.

The importance of the work we do was shown again when the Organization for the Prohibition of Chemical Weapons was awarded the Nobel Peace Prize. Our Forensic Analytical Center serves as one of only two OPCW-designated laboratories in the U.S. The recognition of the work of OPCW by the Nobel Committee shows that our mission of keeping the world safe from chemical warfare is recognized and respected internationally.

As we enter the new fiscal year, remember what makes us strong and let us continue to forge ahead as a team to make a difference regarding the scourge of WMD.

Dr. Joseph L. Corriveau
Director, Research & Technology Directorate

Statement by the OPCW Director-General on the 2013 Nobel Prize for Peace

Friday, 11 October 2013

The decision by the Nobel Committee to bestow this year's Peace Prize on the OPCW is a great honour for our Organisation.

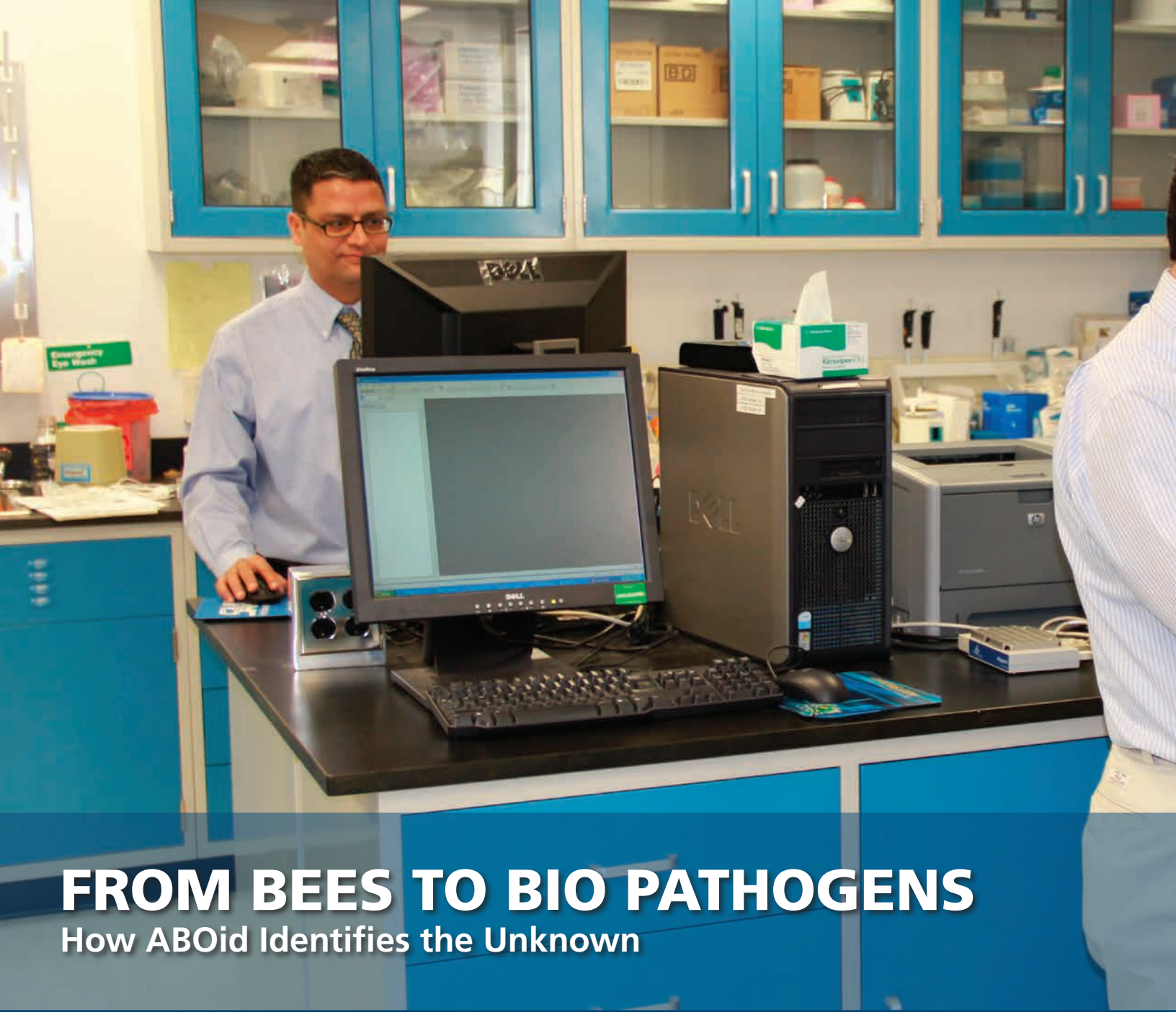
We are a small organisation which for over 16 years, and away from the glare of international publicity, has shouldered an onerous but noble task – to act as the guardian of the global ban on chemical weapons that took effect in 1997.

That year, a hundred-year effort was crowned with success as the

OPCW Director-General Ahmet Üzümcü addresses the media on 11 October.

CURRENT EVENT:

Organization for the Prohibition of Chemical Weapons earns 2013 Nobel Peace Prize.



FROM BEES TO BIO PATHOGENS

How ABOid Identifies the Unknown

Some may remember the 2007 bee epidemic, when scientists began noticing a drastic decline of bee colonies with no known cause. What few likely know is that a team of scientists at the U.S. Army Edgewood Chemical Biological Center (ECBC) utilized its own software to detect that a combination of both a virus and a fungi was a possible culprit.

Scientists with ECBC's Research & Technology Directorate's (R&T) Point Detection Branch continue to enhance and expand this novel software suite of bioinformatics algorithms, which is capable of identifying biological microbes in various backgrounds without any prior knowledge of the sample. Utilizing data from a mass spectrometry-based proteomics system, the team can run any tandem mass spectral data through the software to provide statistical validation of its identity.

The innovative detection algorithm, known as Agents of Biological Origin Identifier (ABOid), with two patents to date, is capable of providing automated identification of the sample contents from both pure cultures and mixture of microbes present in culture, environmental or biological matrices in far less time than traditional techniques—minutes versus days. When one puts this into the context of the letters laced with ricin that were sent to the president and other government officials, quick and accurate identification is imperative.

Mass spectrometry-based proteomics is a technique capable of providing the structured sequence information of a given protein. All proteins consist of amino acids arranged in a specific sequence; changing the arrangement generates a new protein. Mass

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"This significantly cuts down on the cost and red tape when shipping internationally or even across state lines, serving to further increase efficiency."

– Mary Wade, Ph.D., Point Detection Branch Chief

ECBC's Point Detection Branch developed the Agents of Biological Origin Identifier (ABOid), software capable of providing automated identification of samples.

spectrometry-based proteomics looks at all the digested protein fragments and peptides and determines the exact sequence arrangement of the peptides. It then correlates them to its original proteins that are present in a given sample, whether it's bacterial, viral or toxin.

"We often refer to this as a fishnet approach; with this technique, we collect everything and then sort through it to find what has biological meaning," said Rabih Jabbour, Ph.D., Research Chemist with the Point Detection Branch. "Unlike other techniques, we need no primers for a specific organism, just like with a fishnet you need no bait for a specific fish. We look at it all and then provide identification of microbes in a given sample."

The mass spectra signatures are then run through ABOid, which sorts out the information on a genomic level and translates it into proteomic output. Results are color-coded to highlight anything that could be considered a pathogen and whether it is toxic. For sequenced organisms, ABOid is capable of providing strain level identification, which is significant in that one can then reveal important diagnostic information for medical countermeasures.

ABOid utilizes a taxonomic classification approach to classify emerging or unknown—or unsequenced—microbes. If a specific bacteria or microbe is not sequenced, the team can use this approach to determine the closest near-neighbor to a given microbe. This complements polymerase chain reaction (PCR) technology and genomic sequencing, providing a critical first step to a genomics team to design an effective primer to sequence the bacteria to a specific target.

Algorithms are hardware independent, so they need only the data file from a mass spectrometer, not the sample itself, which eliminates the cost and logistics of shipping potentially toxic biological material. As cloud technology becomes more advanced, shipping costs will be reduced even further and the applications for ABOid will continue to expand.

"This significantly cuts down on the cost and red tape when shipping internationally or even across state lines, serving to further increase efficiency," said Mary Wade, Ph.D., Point Detection Branch Chief. "From a logistical standpoint, it's especially important when you consider soldiers or other personnel out in the field who can quickly send the data to a lab equipped with ABOid for quick analysis and accurate identification."

Another unique aspect of ABOid is that it can be tailored to meet specific needs. The Point Detection Branch narrowed the database to 104 viruses specific to the needs of the 20th Support Command, which is currently being trained on ABOid. The full database currently scans for more than 2,800 bacteria, 3,600 viruses and all known toxins, and more than 80 fungi and parasites—a significant growth since the development of ABOid.

Samir Deshpande, Ph.D., Research Bioinformatician with the Point Detection Branch, first began writing

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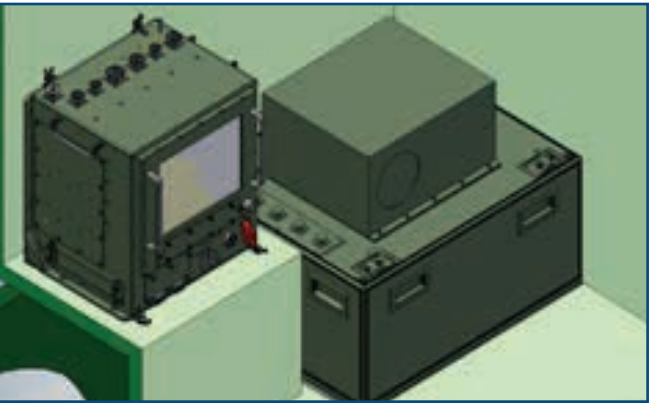

ECBC scientists and representatives from the Agency for Defense Development (ADD) in Korea partnered to create an updated, more modular Joint Contaminated Surface Detector.

ECBC AND SOUTH KOREA DEVELOP NEW CHEMICAL DETECTOR TECHNOLOGY

Scientists at the U.S. Army Edgewood Chemical Biological Center's (ECBC) Research & Technology Directorate (R&T) were recently awarded funding to redesign an outdated ultraviolet (UV)-based Raman detector, with the goal of developing a more robust, compact product that is compatible with the latest advances in technology. Partnering with ECBC is the Agency for Defense Development (ADD), a national agency for research and development located in South Korea.

The Joint Contaminated Surface Detector (JCSD) was very effective in detecting chemicals on surfaces, and was developed as a possible replacement for the earlier wheel-based system in which a wheel-style detector was placed on the ground outside a moving vehicle to collect samples. Scientists placed the Raman-based JCSD on a reconnaissance vehicle which allowed scientists and soldiers to detect and map out contamination zones. Despite the success of the technology both in the field and in the lab, significant resources would be needed to identify potential solutions to issues with the system. The findings from this testing, completed five years ago, will serve as the foundation for the system's renovation into a new product.

Darren Emge, an electrical engineer with R&T's Laser Spectroscopy Branch under the CB Detection Division, served as the subject matter expert on Raman technology who supported this testing, and said that the team has been waiting for the right opportunity to seek funding to update the system. Thanks to a meeting with the ADD in the fall, the time appears to be now.

"When we met with the Korean scientists, they told us they had read about the detector in published journals and were curious to learn more about it," said Emge. "The JCSD has been sitting here for years as we wondered how to best utilize it. The component technology is 10 years old, but the system could still provide a great foundation for a new, more efficient and more effective product. So we began a conversation about a collaborative effort to build a new detector based on the old system, moving to a more modular approach."

That new system, Raman Agent Monitoring System (RAMS), will be a smaller, modular and more rugged detector that they hope will eventually be fielded to the Warfighter. Two JCSD systems will be refurbished so they are fully functional, and one will remain at ECBC for testing and evaluation and one will be sent to the ADD. After a few months, the two teams will discuss how the system can be updated and what they would each like to add to it, and then divide the work.

"We have a lot of experience building libraries and developing detection algorithms, so we will handle most of that work. The Korean team has already planned out operational field testing. Over the next two years, we will each work on developing these two areas, modularizing the system and filling in the technology gaps," said Emge.

At the end of the two years, the team plans to conduct an operational

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> "It's pretty incredible to see a moving vehicle come to a complete stop when it detected a chemical on the ground that can't be seen by the naked eye. This technology works; with the changes we plan to undertake, RAMS will provide a new level of chemical detection."
>
> – Darren Emge, an electrical engineer with R&T's Laser Spectroscopy Branch

demonstration on the Korean Peninsula. Two prototypes will be developed during the RAMS project – one for the U.S. and one for the ADD, allowing both the Americans and the Koreans to have a new, working system. The end goal for the ECBC team is to partner with the Joint Program Manager for Nuclear Biological Chemical Contamination Avoidance to conduct military testing to get RAMS fielded to the soldier.

"Raman technology and UV-based systems have proven to be exceptionally capable of doing on-the-move detection," said Emge. "It's pretty incredible to see a moving vehicle come to a complete stop when it detected a chemical on the ground that can't be seen by the naked eye. This technology works; with the changes we plan to undertake, RAMS will provide a new level of chemical detection."

The effort will be funded by the Coalition Warfare Project for the first two years, with additional funding from the Joint Program Executive Office for Chemical and Biological Defense during that period. ECBC R&T scientists will work directly with their Korean partners during this period. An initial meeting was held at ECBC on May 23, 2013, during a visit with members of the ADD.

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From Bees to Bio Pathogens: How ABOid Identifies the Unknown

the code for ABOid in 2005. Through funding from the Defense Threat Reduction Agency (DTRA), the Point Detection Branch was able to develop this software to become highly effective in identifying an unknown sample, and they were awarded the first-ever DTRA basic research award in 2008.

Since that time, the team continues to update the algorithms to ensure the software is compatible with updated mass spectrometry hardware as well as incorporating and curating newly sequenced organism continually.

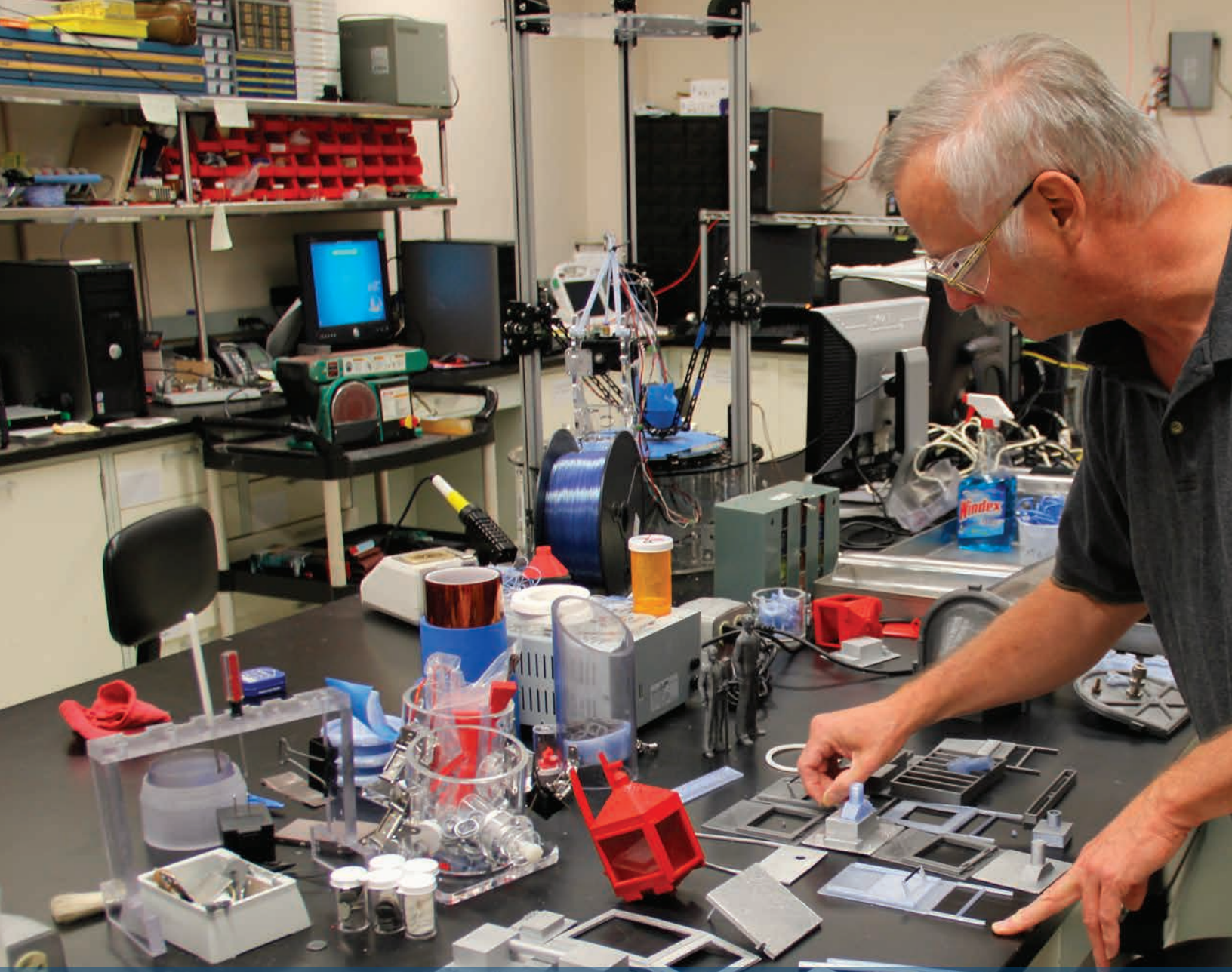
"Since ABOid was created, there have been multiple advancements in mass spectrometry technology resulting in increased sensitivity and throughput," said Deshpande. "We are only bound by the sensitivity of the mass spec: the more sensitive the hardware, the more it can 'see,' which helps provide even better information for ABOid."

To date, ABOid has been has been utilized for multiple applications including detection of viruses, toxins and bacteria in various matrices, from buffers to more complex matrices such as blood. Through basic research funding from the U.S. Army In-House Laboratory Independent Research (ILIR) program, ABOid has been utilized to discriminate between pathogenic and non-pathogenic strains of E. coli, as well as evaluating the use of excreted proteins for identification of bacteria.

ABOid also has applications in food safety, and the Point Detection Branch has collaborated with the U.S. Army Public Health Command (PHC) for initial testing for salmonella in mashed potatoes and lettuce. PHC is focused on food safety for the Warfighter, looking to ensure rapid, accurate testing of any food source should a soldier become ill. The U.S. Army Public Health Command Region South, Food Analysis and Diagnostic Laboratory created the blinded food samples, some containing salmonella and some not, which were then shipped to ECBC for analysis. Because ABOid is a nonrestrictive detection technique, the system was able to accurately identify salmonella in each tainted sample, and also identified other background organisms present. That is a key factor when identifying any bacteria or toxins that may exist in a soldier's food.

With positive test results from the salmonella samples, ECBC and PHC are now looking to conduct testing for other potential toxins that could affect foodstuffs, such as ricin and botulinum toxin. There has been other interest in additional ABOid applications as well, such as the use of ABOid in outbreak scenarios, biosurveillance and bioforensic profiling.

ABOid will be among several systems tested as part of the new advanced technology demonstration (ATD) - the Joint USFK (United States Forces Korea) Portal and Integrated Threat Recognition (JUPITR). The team will take its mass spectrometry equipment and the software to the Korean Peninsula next summer for field tests in conjunction with Contamination Avoidance, where it will be evaluated onsite for its ability to identify true and false positives. The team hopes that the opportunity will serve as a launching pad to eventually miniaturize, ruggedize and field the system, allowing the technology to be in the hands of one of the U.S. Army's most needed resources: the Warfighter.



ECBC UTILIZES SMALL-SCALE 3D PRINTERS TO SUPPORT INNOVATIVE TESTING NEEDS

Scientists within the Edgewood Chemical Biological Center's Operational Toxicology Branch have taught themselves an entrepreneurial way to build the tools they need on a dime. Dennis Miller and Ed Emm have utilized commercial Three-Dimensional printers (3D printers) to manufacture small objects such as test tube holders and bolts quickly.

Miller, an engineering technician, said he can recall spending hours in a machine shop creating metal plates that could be used during testing, only to find out that the size of the plate was not suitable. He would spend days going back and forth making modifications running out of time and spending money on materials. Eventually, Miller set out to find a cheaper option that could get him a quick prototype, without taking too much time to make modifications. The solution he ended up with was purchasing two 3D printers, a MakerGear M2 and a Rostock Max.

3D printers take Computer Animated Design (CAD) digital images or drawings and creates a desired 3D object based on the images using different types of

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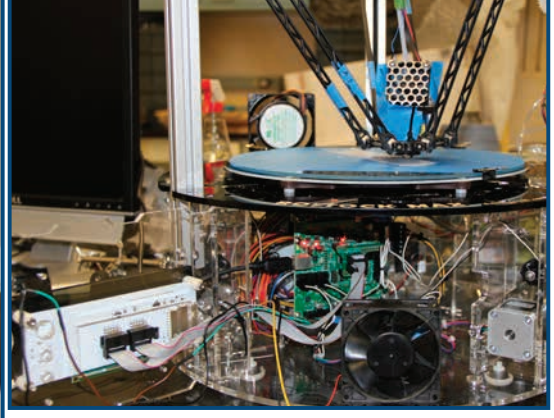

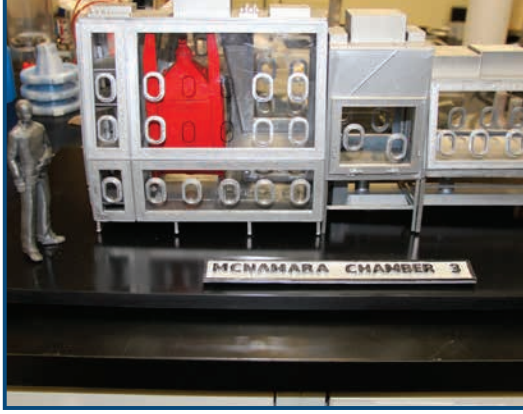

FROM LEFT TO RIGHT: a) Dennis Miller, from the Operational Toxicology Branch purchased 3D printers to create testing equipment. b) Miller and Ed Emm assembled the 3D printer on their own helping them gain knowledge of the equipment. c) Miller and Emm created a small model of the new McNamara Test Chamber II for visitors and customers to view the final product.

materials. The printers used by Miller and Emm use PLA and ABS plastic which are both recyclable and inexpensive.

"We were able to purchase the printer for a small amount and the difference it has made for us has been tremendous," Miller said. Unlike the large scale additive manufacturing labs within the Center, these printers are small and typically used by hobbyists. These machines have made notable changes on the efficiency and ease of work.

Miller was able to create disposable holders that are perfect for testing as they are cheap, take a couple minutes to produce and are easy to modify. While the printers the team has are not suitable for any type of large-scale prototyping, they work well creating small objects. Miller and Emm were also able to create screw knobs by using nuts and bolts inserted in plastic holders as well. The time saved on creating materials has given the team the opportunity to focus on ways to add creativity to their overall methods.

"Most teams don't require as much innovative fabrication as we do," Miller said. "ECBC is at the cutting edge of testing, so having these printers allows us to innovate between different materials and sizes much faster."

This innovative fabrication has aided Miller and Emm with configuring the 3D printers from the very beginning. When the two printers first arrived, they came in a kit—unassembled and in small pieces. Miller and Emm first needed to build the machines by hand in order to use them. "Having to literally build the machine that you need to work on, gives you an intimate knowledge of the equipment," Emm said. "You feel like you're starting to understand how the machine works before you even start a production on it."

After setting up the actual systems, Miller and Emm then needed to teach themselves how to use the FreeCAD, a free open source software. The team pushed themselves to master the material through utilizing online forums, and trying out different models on the printer. Miller and Emm were also able to leverage the experience from the Engineering Directorate's Rapid Technologies and Inspection Branch to understand a few basics of the 3D printer. The learning curve, however, did not slow the team down. Within a few weeks they were able to start creating small objects; now they are on to bigger ones, including a small-scale model of the upcoming Big Mac II glove box. The glove box model was used to help the Toxicology and Obscurants Branch visualize their finished project and is also being used to show visitors.

"Working on the 3D printer has been a really neat undertaking," Emm said. "We started off making small objects like nuts, bolts and knobs just to get things up and working. Now we were making our way to full models and holders that people can use. Setting up this 3D printing has been a rewarding process that definitely grants some instant gratification."

The plastic materials used in the 3D printer are all recyclable, making this a sustainable process. Open source websites like thingiverse.com and other 3D printing blogs have also helped the group think of outside of the box designs to try for their testing materials.

"Sometimes you don't need a Rolls Royce and could just use a bike," Miller said. "Our 3D printers are certainly not meant for large-scale production, but they give us much-needed materials in a short span of time. It has made a huge impact to our efficiency and creativity."

ECBC'S FORENSIC ANALYTICAL LABORATORY EARNS TOP GRADE IN OPCW PROFICIENCY TEST

ECBC remains longest standing OPCW designated laboratory in the United States

The U.S. Army Edgewood Chemical Biological Center (ECBC)'s Forensic Analytical Center continues to be a pioneer in the area of forensic analysis for monitoring the proliferation of weapons of mass destruction (WMD), as well as analysis of samples associated with possible terrorist attacks or breaches of security. In scenarios such as the chemical weapons used in Syria, ECBC's scientists are able to analyze biomedical samples such as urine and plasma for chemical agents. To secure such a reputation, the Forensic Analytical Center masters strict evaluations.

The Treaty Laboratory at ECBC received an "A" grade in the latest international proficiency test (33rd OPCW IPT). Of the 12 labs worldwide that participated in the test, only two received an "A," and two laboratories received a "B," the minimum grade required for a laboratory to maintain their status as a designated laboratory.

The Organization for the Prohibition of Chemical Weapons (OPCW), which won the 2013 Nobel Peace Prize, is an independent organization based in The Hague, The Netherlands, administers the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (CWC). The CWC is an arms control agreement that outlaws the production, stockpiling and use of chemical weapons. There are 189 member nations that have ratified the CWC. From these member nations, there are 21 OPCW designated laboratories worldwide. To maintain their status as an OPCW-designated laboratory, these laboratories must adhere to strict administrative guidelines, maintain accreditation by an internationally recognized organization, and successfully complete an international proficiency test annually.

Currently, the ECBC Forensic Analytical Center is one of two OPCW designated laboratories in the United States; the other is at Lawrence Livermore National Laboratory in California. Treaty labs specialize in analysis of samples for chemical warfare agents, byproducts, precursors, and other compounds of interest. A designated laboratory volunteers to prepare challenging, realistic samples for other designated laboratories and candidate laboratories to analyze. A different designated laboratory evaluates the test reports prepared by the participating designated laboratories to validate their conclusions and recommend scoring to the Director General who issues the official scores. The participating laboratories have 15 calendar days from the time they receive the samples to complete the analysis and reporting required by the proficiency test. During the 33rd OPCW IPT, a designated lab from China prepared some extremely challenging samples, including a scheduled

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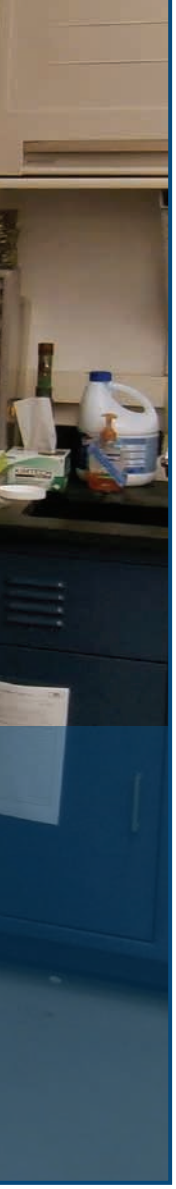

FROM LEFT TO RIGHT: a) ECBC's Forensic Analytical Center earned an A grade from the Organization for the Prohibition of Chemical Weapons (OPCW) allowing the team to test biomedical samples for chemical agents. b) The Forensic Analytical Center team worked together turned their conference room into a war room for 15 days while completing the OPCW confidence test.

compound that did not exist in any databases. The evaluation laboratory was the designated lab from Singapore. Despite the challenges, ECBC scientists proved again that they are worthy of top marks and can handle any real world situation.

"Since one of the compounds was not in our database, we had to combine data from multiple instruments to come up with a structure and then synthesize the chemical to confirm its identity," said Alex Jestel, the chemist who led the proficiency test effort within ECBC's Forensic Analytical Center.

"The goal of preparing the test is to replicate real world samples, however the labs preparing the samples know what compounds might hide or mimic reportable compounds, so the test samples are likely more difficult than real world samples. They want to make these tests as difficult as they can to ensure that we really can handle threats," said Dr. Stan Ostazeski, Forensic Analytical Center Chief.

ECBC's Forensic Analytical Center was the first U.S. laboratory to become a designated OPCW laboratory. They were given that status by the Director General of the OPCW in 1996. Although testing takes place on an annual basis, the total process takes place in a three-year timeframe. In order to maintain OPCW accreditation, laboratories must maintain a three-year rolling average of at least two "As" and one "B."

"We start planning for the test about six months in advance. To plan we read up on past tests, ensure that all of the lab instruments are operational and in their best condition, order necessary supplies and do a practice test," Jestel said.

A couple of weeks before the official samples are released, the OPCW publishes a scenario with a couple of clues as to what the real test will be. Within the scenario, teams are informed on whether to expect soil, water, organic solvent, or surface material samples, and other minor clues that could be helpful with preparation. With that information, the team is able to get their processes in place and set up a "toolbox" that may best help them with the actual sample. Then, the real sample is released and the hard work really begins.

"During the 15 days of testing, we turn our conference room into a war room. We eat pizza and sweets, lock the gates and go to work. Essentially we live in the labs," Dr. Ostazeski said. "All other work stops, unless something of national importance happens. Even if it does, that work must be done in parallel with the testing."

When the testing begins, one of the most important aspects is ensuring that scientists are reporting only information relevant to the OPCW and the scenario for the test. Reporting a compound that is not present in the sample or that is not relevant is considered a false positive and results in an automatic failure. Unlike some analyses, the scientists are locating and identifying unknown compounds as opposed to attempting to confirm the presence or absence of a known substance.

Dr. Ostazeski explained that the team receives six samples in vials with two different matrices. "For example, a team can receive three vials of soil and three of water. You analyze all six knowing that one of the three of each matrix will not contain any reportable compounds," Dr. Ostazeski said.

Two of the other samples are considered to be the actual unknown samples so they may or may not contain reportable compounds.

During the analysis process, attention to detail is critical. The team confirms all tentative identifications by a second technology. Liquid and Gas Chromatographs (LC and GC) with a variety of detectors are the most used tools. Some of these detectors are mass spectrometers and element specific detectors (i.e. FPD, NPD, AED). The laboratory also has Nuclear Magnetic Resonance (NMR) spectroscopy, inductively coupled plasma mass spectrometry (ICPMS), capillary electrophoresis (CE), and other analytical tools that are essential contributors to the process. The team uses spectral libraries and retention indices to keep data from all of the instruments in sync. "Routinely the samples contain numerous interferents and red herrings so sample preparation and experienced chemists are essential to finding and identifying the reportable chemicals," said Jestel.

Another critical aspect is to have the correct format for testing a sample. For example, sometimes the team will receive a small floor tile with a sample on it. They must be able to get that sample in a testable format and conserve the sample for all of the analyses required. The laboratory cannot ask the OPCW for additional sample material.

Each day before testing, the team performs a blank run on their instruments to make sure that everything is clean. The results of each blank run are reported to the reviewers as part of the test report to demonstrate the instrument is operating properly and that subsequent analyses are valid. Formatting the final ~100 page report is also vital to the process.

continued on page 13

ECBC DEVELOPS U.S. ARMY'S FIRST

Enhanced fill provides new levels of protection to counter

Imagine you are a soldier in a remote location facing an immediate threat of enemy attack. You have one route of escape, but shifting locations would mean being visible and vulnerable to the enemy. You have a smoke grenade, but it won't protect you if the enemy has advanced technology that allows him to see through the smoke. You have no choice but to take your chances and move out.

A team of researchers with the U.S. Army Edgewood Chemical Biological Center's Research & Technology (R&T) Directorate are looking to provide enhanced protection for soldiers in the field with the development of a bispectral grenade that blocks visibility from the visual through far infrared range of the electromagnetic spectrum—the first in the U.S. Army. This advanced grenade would be capable of defeating thermal imagers, rifle scopes and devices equipped for night vision or infrared and other optical sensors, significantly increasing a soldier's survivability when faced with existing and emerging threats.

"Bispectral obscuration has immediate applications in countering thermal imagers, image intensifiers and thermal guided threats," said Robert Carestia, Project Engineer with the Smoke and Target Defeat Branch. "This is a new capability for the Warfighter that will provide an important level of protection against an enemy equipped with thermal and IR devices, and increases a soldier's mobility in theater."

> "This is a new capability for the Warfighter that will provide an important level of protection against an enemy equipped with thermal and IR devices, and increases a soldier's mobility in theater."
>
> – Robert Carestia, Project Engineer, Smoke and Target Defeat Branch

Members of the R&T Directorate's Smoke and Target Defeat Branch are developing a new capability for the current M106 grenade, which blocks visual (naked eye) through near infrared portions of the electromagnetic spectrum. In addition to enhancing the fill of the grenade, the team is also focused on improved safety features and ways to reduce cost and weight.

"We have researched various materials for the improved grenade body that help eliminate a "frag hazard" – fragments that break off during the functioning of the grenade which could cause harm to the soldier or a bystander – utilizing glues, rubber materials, cardboard and plastics," said Carestia. "These have significantly reduced the cost and weight, and eliminated end-cap bolts of the current grenade, which improves the filling process and increases obscurant payload."

Initial testing for the most efficient and best performing bispectral fills has already been completed in the team's aerosol chamber, which captured data on duration, mass extinction coefficient, yield factor and transmittance. The team will next fill the new grenade configuration with various lead candidate bispectral materials and assess their effectiveness using the backdrop of a special instrumented grid on Aberdeen Proving Ground. Data will be collected on contrast reduction, spectral information over the entire spectral region, field extinction coefficient and meteorological data.

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BISPECTRAL GRENADE
emerging high-tech threats

After examination of the results, the plan is to then down-select candidates for further refinement and evaluation.

Testing took place in August 2013, with support from the Army Research Lab, U.S. Army Night Vision and Electronic Sensors Directorate, U.S. Army Aberdeen Test Center, New Mexico State University and the Georgia Tech Research Institute. The Engineering and Program Integration (DPI) Directorates were both involved with the development and testing of the bispectral grenade. The Engineering Directorate assisted with creating pyrotechnic mixes and DPI helped with the grenade design. Collaboration with the Directorates as well as the other government agencies was key in the success of the testing. During the testing, the group utilized Meteorological Stations to predict weather behaviors ahead of time, ensuring the team only tested on days when weather would not affect results. In addition, to enhance the quality of testing results, Carestia and the team arranged for Unmanned Aerial Vehicle support that could fly at 110 ft to capture more views of the smoke to ensure the strength of smoke.

"We were able to finish this testing one week ahead of schedule, despite the furlough and other obstacles, thanks to the teamwork and Mother Nature being on our side for testing," Carestia said.

The current Bispectral Obscurant Grenade program is part of the Technology Concept Demonstration for Soldier and Small Unit Protection. A demonstration of a prototype system is planned for late 2014.

The Bispectral Grenade is an advanced grenade capable of defeating thermal Imagers, rifle scopes and devices equipped for night, providing enhanced protection for Warfighters.

NEW ASSAY IDENTIFIES LESSER AFFECT CHEMICAL AGENT TOXICITY

ECBC scientist Jennifer Sekowski traveled to Rijsvik, Netherlands for a technology transfer with The Netherlands Organization (pictured above) for Applied Scientific Research

When a chemical agent enters the body, it's not just the chemical's toxicity you need to worry about—a number of variables come into play, which determine the toxic effects the agent can have. A key player is the reaction that comes from proteins in the body that may bind to the chemical and contribute to its toxicity. To study how such proteins may interact with emerging threat agents, scientists with the U.S. Army Edgewood Chemical Biological Center's (ECBC) Research & Technology (R&T) Directorate recently participated in a technology transfer with The Netherlands Organization (TNO) for Applied Scientific Research (Rijsvik, Netherlands) to utilize a new assay that identifies lesser known proteins that may bind to chemical molecules.

The activity based protein profiling assay (ABPP) has the unique ability to identify active binding partners to any chemical of interest, allowing scientists to gain a better understanding of potential reactions and possible countermeasures and therapeutics. Currently, one of the most studied proteins for nerve agent intoxication is acetylcholinesterase, the main protein responsible for its primary mechanism of toxicity. There are many other proteins, however, that have yet to be identified, but which could also impact the toxicity of a chemical agent; these are what the ABPP assay seeks to identify.

"It's important to begin to characterize those lesser known binding proteins" said Jennifer W. Sekowski, Ph.D., DABT, and principal investigator on this project. "Ultimately, we need to know: Do these contribute to secondary, tertiary, or synergistic toxic mechanisms? What are those mechanisms, and do they reveal useful targets for new countermeasure strategies? This assay provides a unique tool to begin to open doors to these answers." Technology transfer partner, Daan Noort, Ph.D., from TNO, is also one of the leading experts in developing ABPP assays, adds, "I have a feeling that nerve agent intoxication is not solely related to inhibition of acetylcholinesterase. The ABPP approach might lead to the discovery of novel early biomarkers of exposure and/or effect for organophosphate intoxications, which is relevant for timely application of proper medical countermeasures."

Sekowski and fellow member of R&T's BioChemistry Branch, Dan Carmany, a senior research associate with Battelle, spent a week at Noort's TNO laboratory in June to gain hands-on experience with the ABPP assay. Sekowski and Carmany returned to ECBC with the assay and all of the necessary knowledge to carry out the complex, multi-step assay in our own ECBC laboratories.

The Defense Threat Reduction Agency (DTRA) initiated the idea for the technology transfer. DTRA S&T Manager, Alison Director-Myska, Ph.D., approached ECBC and TNO with the concept of transitioning the technology. Director-Myska came up with the idea to put ECBC and TNO together after she read the ECBC proposal.

"I realized that a portion of their effort would require methods that I was already planning to bring into the DTRA/J9CB Threat Agent Toxicology portfolio via a contract to TNO. ECBC had proposed using an US-based sub-contractor who had not yet brought the methods up in their labs and would not be able to work with surety or surety-like agents, only simulants. TNO had already demonstrated their ability to develop these methods for surety compounds via a peer-reviewed journal publication (Tuin et al., Chem Res Toxicol. 2009 Feb 18). Given TNO's demonstrated capability and the fact that I was in the midst of negotiating a contract with them to develop the methods for the same compounds that DTRA/J9CB wanted ECBC to target for their proposed effort, it seemed like a natural match for a technology transition between the two organizations," said Dr. Director-Myska.

This work will support the ongoing DTRA-funded Systems Biology of Chemical Threat Agents Project, a multi-year, multi-institutional effort led by ECBC in collaboration with Medical Research Institute of Chemical Defense (MRICD), Johns Hopkins Medical Institutions (JHMI) and Johns Hopkins Applied Physics Laboratory (JHU-APL), which seeks both countermeasure development and the development of biomarkers, or molecules in the body that can indicate exposure to a toxicant or disease. The S&T Manager for the Systems Biology Project, Kristen Herring,

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KNOWN BINDING PARTNERS THAT IN THE BODY

Ph.D., added, "This collaboration prevents ECBC from having to reinvent the wheel on this technology. Since DTRA already had already funded a successful project at TNO using the ABPP method, it made sense for the Systems Bio Project team to work with the people who have been successful already to learn how to do it. This allows DTRA to leverage investments and to possibly reduce the schedule of the Systems Bio project".

Beyond the immediate scientific benefit to the Systems Biology Project team, Director-Myska said she feels that there are much broader positive implications. "The technology transition also benefits DTRA/J9CB and the broader US CBDP [US Chem Bio Defense Program] by strengthening our ties with our international partners in Chemical Defense; bringing a needed and state-of-the-art methodology into a premier US Chemical Defense research laboratory. Finally, with both labs working toward similar goals we will broaden our understanding of the mechanisms of action of chemical weapons and hopefully identify new targets for developing diagnostics and/or therapeutics," said Dr. Myska.

Fred Berg, Ph.D., ECBC R&T's Chemical Sciences Division Chief, and Fu-Lian Hsu, Ph.D., of R&T's Agent Chemistry Branch, are currently building the modified VX analogs, which will serve as the team's first agent to test with the ABPP assay. The modifications, required for the assay, maintain all of the characteristics of VX but add a biotin protein element on the end – literally a long "tail" on the end of the chemical molecule. This "tail" allows the team to use the hybrid agent-like chemical as one would use a fishhook – "fishing" for the proteins that will bind to the agent-like end of the chemical. Using the fishing analogy, the line is then "reeled in" using a microbead coated in avidin, a protein with a very strong binding reaction to biotin. The heavy beads are separated, or pulled down, using gravity (or centrifugation), and proteins which are not very tightly bound to the chemical are then washed away. The remaining proteins bound to the "fishing hook and line" are separated by size and then extracted for identification. In the first year, the team will work with Akhilesh Pandey, M.D., Ph.D., of the Johns Hopkins Medical Institute to run the extracted contents through a mass spectrometer to identify any proteins that stuck to the chemical.

"Once we have the identities of the proteins, we can use other biochemical assays and the literature to better understand how those specific proteins may impact the toxicity pathway(s) of the chemical," said Sekowski. "We hope to be able to explore these interacting proteins for developing new biomarkers or new therapeutic interventions. For example, through computer modeling we may be able to identify drug molecules that could reduce or block the interaction with the agent. Those drug compounds could potentially lead to entirely new countermeasure strategies.

The assay can be designed to capture both proteins that bind very strongly to the chemical, and others that bind with a weaker interaction. The team also plans to research different approaches to the washing solutions and affinities of the proteins.

This story was also featured in the September 2013 issue of DTRA in the News
http://www.dvidshub.net/publication/issues/13113

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continued from page 9

ECBC's Forensic Analytical Laboratory Earns Top Grade in OPCW Proficiency Test

OPCW enforces very strict formatting and report content rules such that the final report is legally defensible. "Laboratories often do very well at the science, but the strict reporting rules become a stumbling block," said Dr. Lynn Hoffland, a Senior Chemist.

"It's even as simple as if a data file name has a space on one page and no space on another," Jestel said. "Every detail counts." After the 15 days are over and the final report submitted, the laboratory waits one to two months to learn their score.

Sorting through the relevant and irrelevant materials requires teamwork. About 16 people are involved in the proficiency test. "When we come together for this testing, it is all hands on deck," Dr. Ostazeski said. "It's rare to find a team pulling together like this team does during the OPCW process."

The cohesive teamwork and expert lab work is something to be admired. Sometimes representatives from the Federal Bureau of Investigation or the U.S. Navy come to observe the testing to see what they can learn from the process.

ECBC has prepared samples once and evaluated the test reports from other laboratories during proficiency tests four different times over the years, helping the scientists test their skills while seeing how other labs are performing.

"Conducting tests like these are critical for ECBC and for the nation," said Dr. Ostazeski, "It brings sponsors with analytical needs to ECBC, and our A-grade offers confidence that we can successfully perform. Information like this is essential to our nation's security."

The Forensic Analytical Center was featured in the November 6, 2013 issue of The Baltimore Sun. Check it out here
http://www.baltimoresun.com/health/maryland-health/bs-hs-chemical-weapons-lab-20131101,0,5601575.story

BUILDING THE HUMAN BODY, ONE CELL AT A TIME

Reginald Gray, Ph.D discusses how he applies his medical background to the Human-on-a-Chip Project at ECBC

Reginald Gray, Ph.D, M.B.A., was always excited about medicine and science. After spending his undergraduate summers doing biomedical research, he graduated from Xavier University of Louisiana and enrolled in graduate school, earning his Ph.D in Pharmacology from Case Western Reserve University. He later attended medical school and began working for the United States Medical Research Institute of Chemical Defense (MRICD). Dr. Gray is now an Oak Ridge Institute for Science and Education (ORISE) postdoctoral fellow working with the in vitro stem cell group at the Edgewood Chemical Biological Center (ECBC).

Dr. Gray is utilizing his graduate studies in pathology, pharmacology and medical school training in cardiology to support Harry Salem, Ph.D, Chief Scientist for Life Sciences, to develop the Human-on-a-Chip project. The Human-on-a-Chip project is currently focused on using in vitro stem cell technologies in predictive human toxicology of four organ systems: heart, lung, liver, and nervous system. The project will help give better data as to how the human body might react to everything from chemical warfare agents to diseases. Recently, Human-on-a-Chip was awarded $24 million by Space and Naval Warfare Systems Center, Pacific, on behalf of Defense Threat Reduction Agency (DTRA) to continue research for Human-on-a-Chip along with Wake Forest Baptist Medical Center, Brigham and Women's Hospital, Boston, the University of Michigan, Morgan State University and The Johns Hopkins Bloomberg School of Public Health.

Dr. Salem said that the In vitro Stem Cell team is very pleased to have Dr. Gray as an integral part of the program. "His contributions to the Human-on-a-Chip Program using human induced pluripotent stem cells (iPSC) will further advance ECBC's predictive tools for human toxicology, pharmacology and disease study," Dr. Salem said. "His participation in all four tissues with emphasis on the heart, will assist in human estimates, risk reduction, and counter measures. In addition, using human iPSCs appears to be a more relevant system for refining, reducing and replacing the use of animals in research." Dr. Gray recently sat down with us to discuss his experience with ECBC and future science aspirations.

How did you get involved in the ORISE Research Program and ECBC?

After I moved to the Baltimore area, I was looking for a place to do postdoctoral research. Since my background was in pharmacology, I ended up finding a position at MRICD, where I worked for the last two years. I remained focused on doing a postdoc and continued to search the National Research Council (NRC) and ORISE websites and contact principal investigators in search of local postdoc positions. While speaking with a colleague of mine at MRICD about my situation, he told me that he knew a principal investigator at ECBC doing similar work in the field of in vitro cardiovascular science. He forwarded my CV, and I received an email from Dr. Harry Salem inviting me to an interview. Dr. Salem's cardiovascular postdoc was leaving in a couple of months and he felt that my background in pathology,

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pharmacology and medicine was a good fit to resume the cardiovascular stem cell project. So, I applied for the postdoc position through ORISE and began working at ECBC in late March 2013.

Describe the work you do here at ECBC.

The other postdocs and I are working together to develop the Human-on-a-Chip. We each specialize in different organs systems, i.e., heart, liver, lung, and the nervous system with the long-term objective of connecting the four systems through microfluidics or other mediums for human predictive toxicity testing. Little data exists on the cardiovascular effects of chemical warfare agents and other compounds that are potential threats to the Warfighter. Currently I am using induced pluripotent stem cells to derive cardiomyocytes (iPSC-CM) to examine cardiovascular toxicity of pesticides and chemical warfare agents. The significance of these studies is that by using human stem cells we eliminate the interspecies variability that limits the interpretation of current cadiotoxicity studies, which are largely developed with animal models.

What is the best part about your role at ECBC?

Before I started working for MRICD, I never thought much about chemical warfare agent research and medical countermeasure development. During my MRICD interview, Dr. Koplovitz and Cpt. Palmer enlightened me as they discussed the significance of and types of research done within the Army's chembio defense program and the lives it saves in today's threats of terrorism, both with respect to the Warfighter and the civilian population. It is a priceless feeling to serve my country as a scientist, applying my knowledge, ideas and skillsets, knowing that my work is contributing to the needs of the Warfighter and society as a whole.

How did you know you wanted to get involved with research and science?

Ever since I could remember, I have always been interested in medicine and science. During undergrad at Xavier University, I was a double major and double minor. The university encouraged science majors to participate in summer research programs, so between my sophomore and junior year, I did a summer program at Wake Forest University in the Department of Neurobiology/ Anatomy studying Amyloid Precursor Protein mRNA expression and its role in Alzheimer's disease. It was my first research experience, and I was hooked. When I returned to Xavier during my junior year, I applied and was accepted in the Science, Engineering, and Mathematics (SEM/ MIE) Fellowship program, and I participated in a research project at Xavier for the next two years in the Department of Chemistry. Between my junior and senior year I participated in a second summer research program at Marquette University in muscle physiology while researching Ph.D programs to apply to in the fall of my senior year.

Can you describe your background?

I earned my Ph.D in pharmacology from Case Western Reserve University, and my research specialization was in immunology and pathology. I then attended medical school for three years, but took a financial leave of absence, moved to Baltimore and started working at MRICD, pharmacology branch, under Irwin Koplovitz, Ph.D. The work I participated in at MRICD was similar to the work we do here, predicting toxicity of nerve agents. We also were starting a cardiotoxicity project using the Langendorff apparatus when I resigned and began at ECBC.

Describe your day to day experience at ECBC.

I like to begin my day early because I feel the most productive in the morning and usually the lab is less busy. When I am not in the lab doing experiments, I spend time analyzing data, reading scientific articles, planning future experiments, or taking care of administrative tasks.

What is the goal of your research?

The goal of my research is to validate our system through testing pesticides, toxicants, and CWAs using human and animal cardiomyocytes to determine mechanisms of action and make educated estimates of cardiotoxicity. The long-term objective of my research is the development of an in vitro platform for high throughput assessment of human cardiotoxicity of xenobiotics capable of testing compounds of interest to DoD. Additionally, my studies will assist researchers in developing cardiovascular focused medical countermeasure therapies for the Warfighter and civilian.

What is the most challenging part of this program for you?

A challenging aspect of the program for me is the transition from working in an academic environment to working in a government environment. Research requires long extensive hours including many weekends. The hours here are more restricted. As a postdoc your goal is productivity and to publish as much as possible. I had to really program myself to work within the restraints of working hours and manage my research studies within the prescribed workweek.

What are your plans for the future after your postdoc ends?

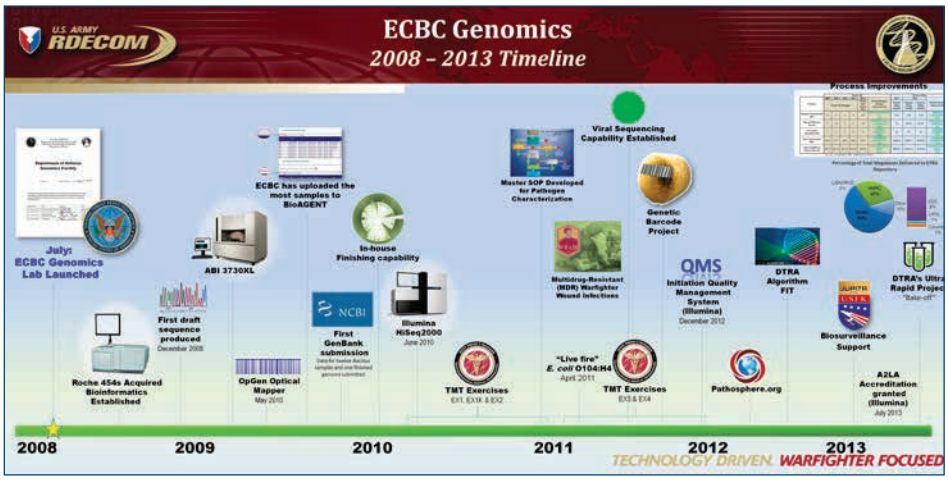
After my postdoc ends, I would like to continue in the field of stem cell technology. Stem cells are at the cutting edge of science and medicine. For example, stem cell technology is spearheading the field of personalized medicine and targeting debilitating diseases such as Parkinson's disease, Multiple Sclerosis, and cancer, to name a few. My long-term goal is to continue biomedical research in the government or academia and one day have my own lab.

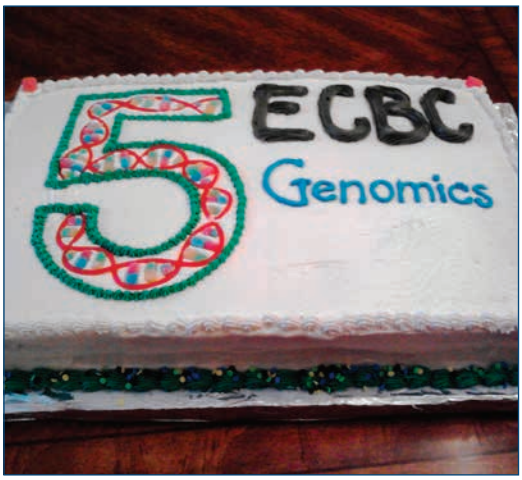
GENOMICS LABORATORY CELEBRATES FIVE YEARS OF

ISO 17025 ACCREDITATION

The Edgewood Chemical Biological Center's Genomics Lab, which provides whole genome sequencing of high-priority pathogens - such as those affecting Warfighters hit by improvised explosive devices (IEDs) - earned the American Association for Laboratory Accreditation (A2LA) for technical competence in the field of biological testing based on compliance to the requirements of both the ISO/IEC 17025:2005 Standard and A2LA just as the lab celebrates its fifth anniversary supporting DTRA in July 2013.

To learn more about the Genomics Lab's milestone, check out the October 2013 issue of DTRA in the News http://www.dvidshub.net/publication/issues/13636





The Genomics Lab team at ECBC celebrated five years of ISO 17025 accreditation. The timeline (pictured above) shows the progression of the lab over the years.

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R&T DIRECTORATE HOSTS ANNUAL TECHNICAL ADVISORY BOARD REVIEW

Academia and DoD experts assess ECBC Basic Science Programs

Technical Advisory Board (TAB) review took place in September 2013 and provided R&T personnel with an unbiased assessment of basic science programs."

The Edgewood Chemical Biological Center's Research and Technology (R&T) Directorate hosted its annual Technical Advisory Board (TAB) Review of Basic Science programs on September 10 and 11. The TAB Review gives R&T the opportunity to obtain an unbiased, external assessment of content, quality, innovation, accomplishments and relevance of certain R&T science programs from a panel of distinguished personnel.

In addition to the In-House Laboratory Independent Research (ILIR) and Surface Science Initiative (SSI) programs, the TAB was also invited to assess Section 219, Seedling Projects and select Army-funded (6.2/6.3) programs. The TAB Review was presented in a two-day conference style. Day one consisted of presentations from the ILIR and SSI programs, and an afternoon poster session showcasing the Section 219 and Seedling Projects. On Day two, the 6.2 and 6.3 programs presented their projects, and the TAB board members gave an out brief of their assessment of the science programs to ECBC's Technical Director and the R&T Director. The board members' assessments analyzed the strengths, weaknesses and recommendations of the ILIR, SSI and 6.2/6.3 projects.

The TAB Review panel was comprised of experts from across academia and the Department of Defense. This year, the TAB Reviewers were:

- Dr. Naomi Halas, Rice University
- Dr. Jeanne Pemberton, University of Arizona
- Dr. Sharon Weiss, Vanderbilt University
- Dr. Tim Bays, Pacific Northwest National Laboratories
- Dr. Jen Becker, Army Research Office
- Dr. Kate Ong, Joint Program Executive Office for Chemical and Biological Defense
- COL Ronald Hann, Defense Threat Reduction Agency
- COL Leon Robert, United States Military Academy

During the out-brief, TAB reviewers commented on the state of the science programs at ECBC. "I think ECBC got a lot of return out of this TAB Review for the amount of resources that were put in," said COL Leon Robert, USMA. "Even with current government limitations and funding, I'm happy to see that the organization was able to create a program that yielded such great reward for a low cost."

Dr. Kate Ong, JPEO-CBD, commented during the out brief that the poster sessions not only provided insight on the kinds of programs at ECBC, but also was a good forum for fellow scientists to learn from each other's research and techniques – a forum that had been vacant due to the current budgetary climate and conference limitations.

While not everything presented was basic research, each project was innovative in its own right. There were presentations on everything from Microbial wargaming to physical and chemical adsorption on Raman enhancement. These presentations demonstrate ECBC's variety across its portfolio.

The TAB Review was organized and hosted by Dr. Augustus Fountain, on behalf of the ILIR Program.

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Spotlight on Chemical Weapons:

THINKING CRITICALLY ON COMPLEX TOPICS

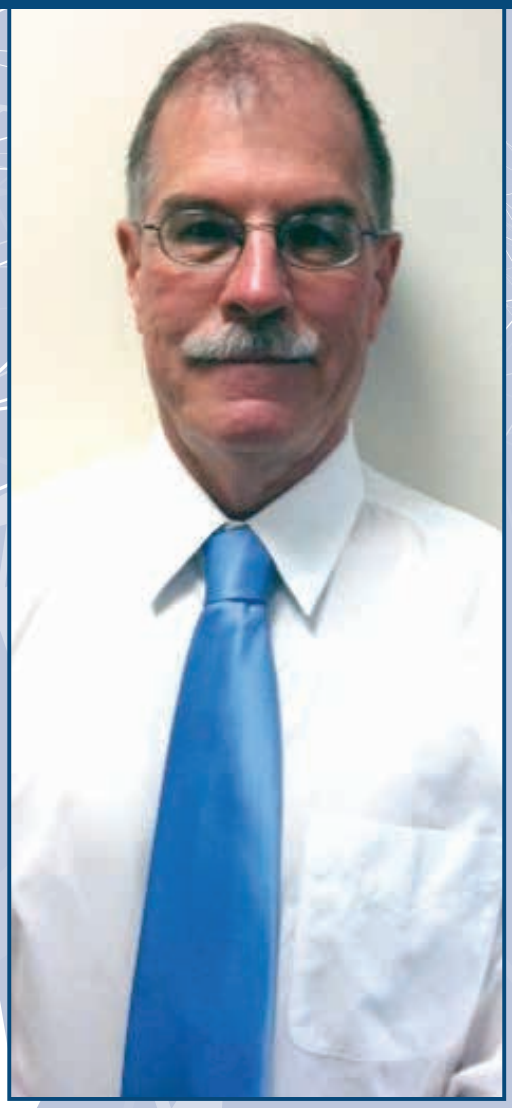
I have had a lifelong interest in military history. I don't read novels or other fictional works; instead I read technical books and magazines about military hardware. Furthermore, when I was much younger I spent a lot of time examining and exploring museums and military bases looking at all sorts of military hardware. Since my Dad was a career Air Force Officer, access to bases was not difficult for me.

In adulthood, I have participated in several programs that were outside my expertise, such as the Agents of Biological Origin program and the Corporate Lethality Program of Ballistic Missile Defense Organization; now known as Missile Defense Agency (MDA). As a trained neurophysiologist, a lot of what I learned in these groups was new and exciting to me. The other individuals in these programs taught me a lot about key engineering and chemical principles. I absorbed this information like a sponge. The field trials that I participated in at White Sands Missile Range, Dugway Proving Ground and other testing facilities for the MDA program, whetted my appetite to know more about missiles and rockets, as well as their payloads (for these tests I was the BTk biosimulant guru). In learning more about these weapons, I was challenged to not just memorize, but to understand and think.

There were quite a number of people who guided me to think critically regarding delivery systems of chemical and biological agents: Carl Alexander, Henry Bach, Jack McGeorge, Jeff Smart, William Patrick III, people from Tech Escort (now known as the 20th CBRNE Command), Scott Ward, Irv Barditch and a number of others (sadly a number of these individuals are now deceased). I remember some fun times trying to identify unknown odd ordnance found at APG with Jeff Smart and individuals from Tech Escort. My participation in these groups and meeting these people have not only satisfied my appetite to learn, but has also helped me become a better scientist, a scientist that thinks more critically.

One of the major lessons that I learned in my career and in my hobbies was that the development of a successful device to disseminate chemical or biological agent is not a simple task. Originally, I had a rather simplistic view that all one had to do was make the stuff, pack it in a warhead and send it on its way. I was wrong. The engineers and chemists I worked with have taught me to think critically and do my homework to understand the complexities of successful delivery of these agents. Doing so will help determine what is credible threat. This is true for understanding delivery systems as well as the agent. For example, some biologicals agglomerate after dissemination due to their physical properties. Other biologicals are susceptible to shear forces and desiccation following dissemination. Knowing this, one can more readily predict what is really a threat following dissemination. Also, just packing a biological in a chemical munition does not make a successful biological munitions, as was learned in the 1940s.

Naturally, the August 21 chemical attack in Syria prompted me to research about potential military hardware used. Once I started searching a few key words online, it didn't take me long to find more information on two suspected rockets (330mm, possibly an indigenous Syrian design labeled UMLACA-UK by the press, and 140mm diameter, aka M-14KChR, surface-to-surface rockets). In the past, finding information or photos for these items would take many hours in the library sifting through dusty card files and moldy documents to glean information. Now, learning more takes one click of a button. Once I did some of my personal research, I was able to think and find ways to apply my findings to how I approach my job.



As scientists and engineers who combat some of the world's most difficult chemical and biological challenges, we need to think critically about exactly what the threats are and how they are being used. Through taking the effort to fully understand the complexities around chemical and biological threats, we can develop innovative solutions to safeguard our Warfighters and Homeland against those threats. Using our instincts, and using resources that are at our fingertips, can inspire us to think and prepare for the possibilities. Information today is easy to find, it is our job to create applications to the information out there. This type of forethought can help us supplement the work we are doing and create even more effective solutions for the Warfighter, the Nation and the World.

Chris Whalley is the Operational Toxicology Branch Chief at the Edgewood Chemical Biological Center.

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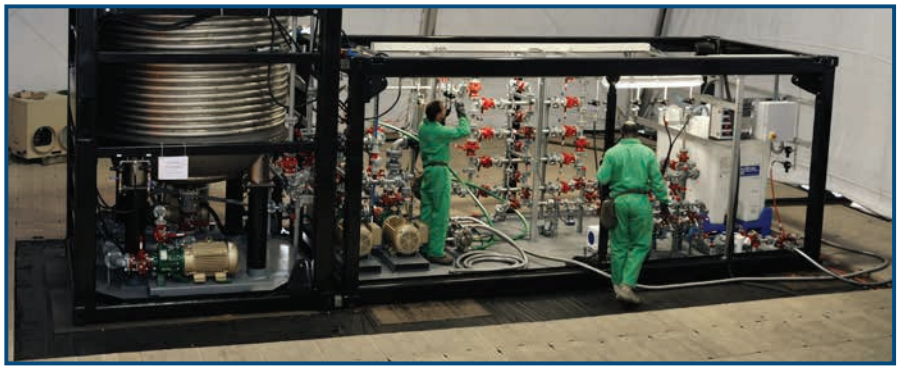
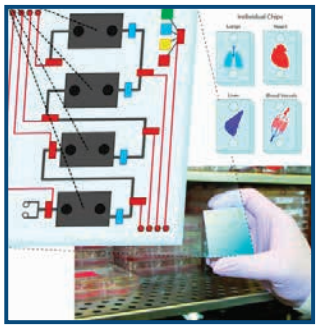
Celebrate some of ECBC R&T's Recent Achievements

In the news

- The Field Deployable Hydrolysis System was featured in The Washington Post and The New York Times. http://goo.gl/MJVqMN



- The Human-on-a-Chip Project lead by Dr. Harry Salem, Chief Scientist of Life Sciences was featured in several media outlets, including:
  - Radio segment with Kate O'Connell from WXXI Rochester. http://innovationtrail.org/post/human-chip
  - Television broadcast with WJLA (Washington, D.C. ABC affiliate). http://goo.gl/Fa3qTl



Awards

- Dr. Joseph L. Corriveau earned Meritorious Civilian Service Award
- Ms. Betty Spurlin, Aime Goad, Michael Kierzewshi, William Conlon, Jared Stafford earned the Commander's Award for Civilian Service
- Representatives from ECBC's Forensic Analytical Center earned SES notes at a recent Town Hall with Dr. Gerald Parker, former Deputy Assistant Secretary of Defense for Chemical and Biological Defense
- John Carpin and David McCaskey earned Excellence in Safety Award
- Dr. Peter Emanuel, Biosciences Division Chief earned Penn State University Outstanding Science Alumni Award
- Dr. Fred Berg and 15-person ECBC team earned the United States Department of Agriculture (USDA) Secretary's Honor Award for providing the USDA's Food and Safety Inspection agency (FSIS) with capabilities and facilities for food inspection

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Publications

A number of R&T staff members have showcased their great work through publications. Here is a sampling:

- Koskiniemi, S., Gibbons, Ouellette, G., Broomall, S., Karavis, M., McGregor, P., McNew, L., Rosenzweig, N., Skowronski, E., et. al. Pathoadaptive Mutations in Salmonella enteric Isolated after Serial Passage in Mice. PLoS ONE 8(7): e70147. Doi: 10.1371/journal.pone.0070147
- Peterson, G., The effect of water adsorption on the structure of the carboxylate containing metal-organic frameworks Cu-BTC, Mg-MOF-74, and UiO-66. The Journal of Materials Chemistry A (web publication date 18 August 2013 DOI:10.1039/C3TA12497
- Harvey, S., Henderson, T., Enzymatic Neutralization of the Chemical Warfare Agent VX: Evolution of Phosphotriesterase for Phosphorothiolate Hydrolysis. Journal of the American Chemical Society
- Sagripanti, J., Grote, G., et. al. Inactivation of Pseudomonas aeruginosa by Direct Sunlight. Journal of the American Association of Photochemistry and Photobiology. Publication date 7 February 2013, DOI: 10.1111/php.12059
- Ashish Tripathi , Erik D. Emmons , Steven D. Christesen , Augustus Way Fountain, and Jason A Guicheteau Kinetics and Reaction Mechanisms of Thiophenol Adsorption on Gold Studied by Surface-Enhanced Raman Spectroscopy. The Journal of Physical Chemistry. Publication date 2 October 2013
- Rastogi, Vipin K.; Smith, Lisa S.; Wallace, Lalena; Tomasino, Stephen F. Modified AOAC Three Step Method (Official Method 2008.05): Consolidation of Fractions B and C Journal of AOAC International, Volume 96, Number 5, September-October 2013
- Kuperman, R.G., Checkai, R.T., Simini, M., Phillips, C.T., Kolakowski, J.E., and Lanno, R. (2013). Soil properties affect the toxicities of TNT and RDX to the enchytraeid worm, Enchytraeus crypticus. Environmental Toxicology and Chemistry 32, 2648-2659.
- Paul D. Gardner , Jonathan P. Eshbaugh, Shannon D. Harpest , Aaron W. Richardson & Kent C. Hofacre (2013) Viable Viral Efficiency of N95 and P100 Respirator Filters at Constant and Cyclic Flow, Journal of Occupational and Environmental Hygiene, 10:10, 564-572, DOI: 10.1080/15459624.2013.818228

R&T Tech Reports

In FY13, 156 reports were published; the most ever published in a year at ECBC, and 42 percent higher than any year in record. This accomplishment serves as a testimony for the team effort to write and publish quality technical reports for our customers. Congratulations!

A number of R&T staff members have showcased their great work through technical reports. Here is a sampling:

TR-1049 - Riot Control Agent Comparison Study, authors Eugene Olajos, Lawrence Bickford, John Walther, Steven Hyde.

TR-1130 - Effects of Nitramine Explosive CL-20 on the Soil Microinvertebrate Community in a Sandy Loam Soil, authors Roman G. Kuperman, Ronald T. Checkai, Carlton T. Phillips, Michael Simini, Steven J. Anthony.

TR-1032 - Solid Oxidizer Decontaminant Technology Performance Evaluation Report Part I: Program Overview, author Michelle Hover.

TR-1096 - Pilot-Scale Manufacturing of ZZAT for Chemical Filtration Applications, authors Gregory Peterson, Joseph Rossin, William Feaver, Michael Knapke.

TR-1098 - Solid Oxidizer Decontaminant Technology Performance Evaluation Report Part 4: HD Vapor Emissions Evaluation, authors Joseph Meyers, Michelle Hover.

TR-1189 - Semi-Automated Technique for Detection of Explosive Materials within Fingerprints on Novel Surfaces, authors Phillip Wilcox, Jason Guicheteau, Steven Christesen, Augustus Way Fountain III.

TR-1123 - Assessment of Law Enforcement Chemical, Biological, Radiological, and Nuclear Personal Protective Equipment Audible Signature, authors Daniel J. Barker, Karen M. Coyne.

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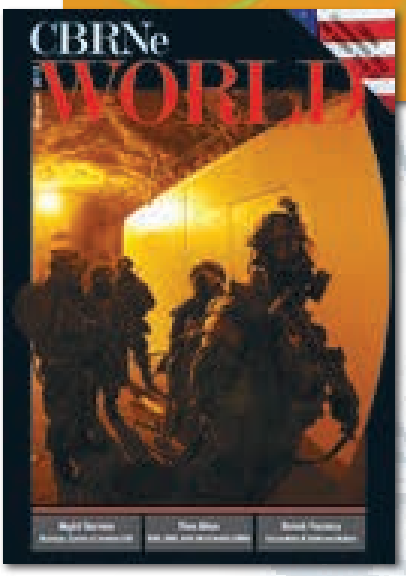

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