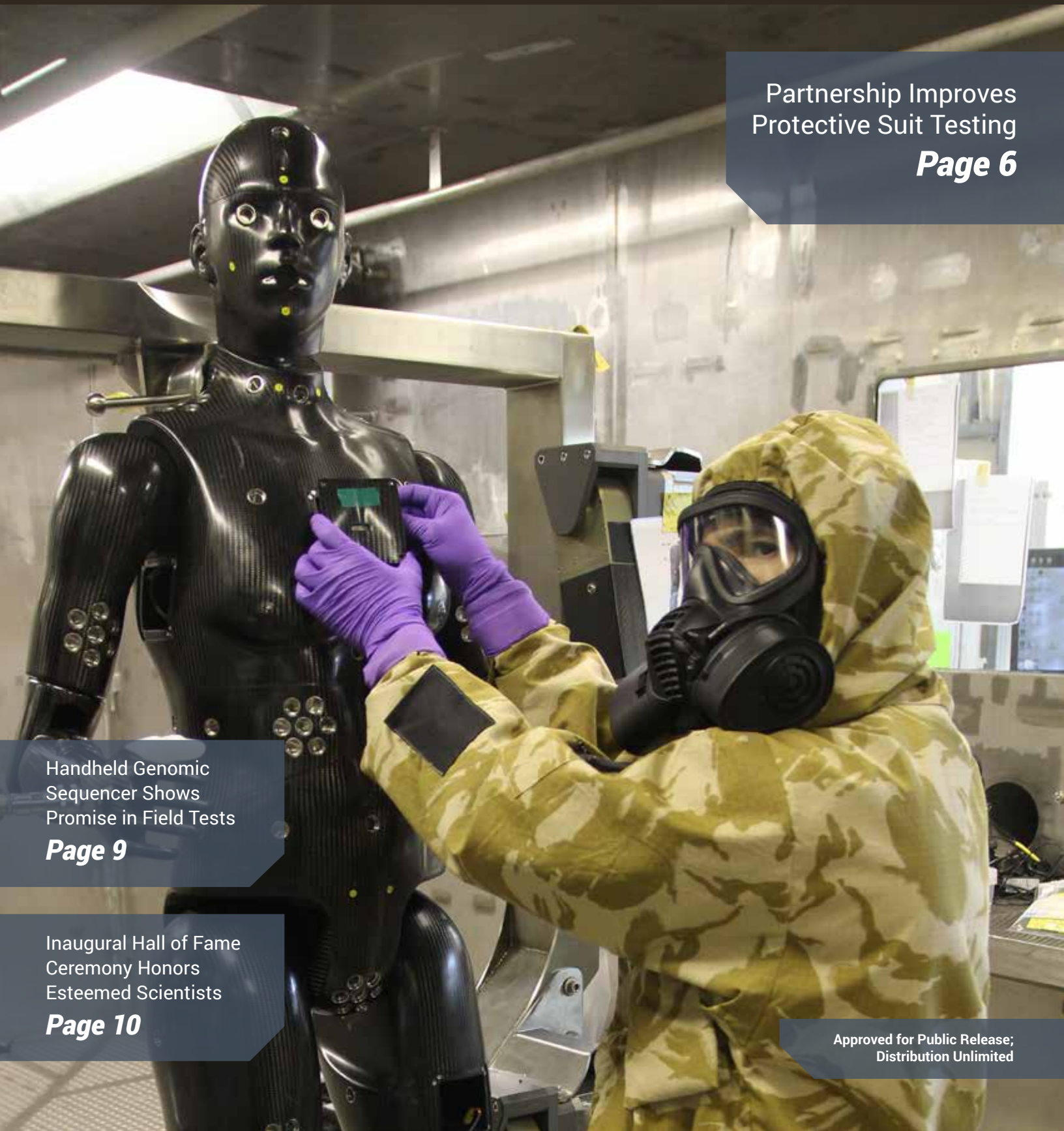
Solutions

U.S. Army Research, Development and Engineering Command
Edgewood Chemical Biological Center

NEWSLETTER
Fall 2018



Director's Message

The holiday season is a great time to reflect and show gratitude for the strength and courage that the members of our armed forces show every day. At the U.S. Army Research, Development and Engineering Command's Edgewood Chemical Biological Center, we demonstrate our gratitude by developing chemical and biological solutions that keep our warfighters prepared for battle and able to return home safely. The solutions we provide must address the challenges of the future operational environment and directly support the 2018 National Defense Strategy.

The defense landscape is changing, and our warfighters must be prepared to defend against new threats. ECBC is adapting an existing detection technology to enhance the warfighter's readiness to respond. Our scientists recently expanded the capability of the Joint Chemical Agent Detector, a piece of equipment currently used in the field for chemical agent detection, to also detect explosives and drugs. This technology upgrade gives warfighters additional detection capabilities without requiring new training or equipment. You can read more about how we modified the JCAD on Page 17 of this issue.

In addition to providing the equipment to warfighters, RDECOM ECBC supports warfighters through education. The RDECOM ECBC Advanced CBRNE Training Team gives Soldiers the knowledge to operate successfully in the field by educating them about emerging threats and the science behind them. The CBRNE Training Team's ultimate goal is to teach Soldiers to think critically and to use the knowledge and equipment at their disposal to assess and mitigate threats. You can read about how the CBRNE Training Team supported a CBRNE unit in Korea on Page 4.

Developing updated equipment and providing advanced training are just two examples of the work we do every day to ensure our warfighters are equipped to overcome the threats they face on the battlefield and come home safely. As we begin a new year, I want to express my sincere appreciation for our men and women in uniform. You are the reason that drives all the work we do, and we are proud to support you. Thank you for reading,

Eric L. Moore, Ph.D.
Director, U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center

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RDECOM ECBC News from the Field

RDECOM ECBC is made of many parts and each part has an important role to play in the protection against and destruction of chemical and biological threats. In the past several months, RDECOM ECBC personnel have traveled not only around the country, but around the world in support of our common mission. Here's a look at just a few of the many places our workforce has touched down.

1

U.S. Army Pueblo Chemical Depot, Colorado - Continuing its support for the greater mission of its partners, RDECOM ECBC personnel began a second round of chemical weapons munitions destruction using the Explosive Destruction System.

Fort Leonard Wood, Missouri - RDECOM ECBC personnel presented a futures briefing to U.S. Army Training and Doctrine Command's commanding general, Gen. Stephen Townsend during a recent visit, which included the Deep Purple unmanned aerial vehicle and ACORNS sensor package, a virtual reality overview of the Chemical Defense Training Facility upgrades using virtual reality technology and an overview of the Nuclear, Biological, Chemical Reconnaissance Vehicle Sensor Suite upgrade. Additionally, Gen. Townsend virtually toured a training facility that featured a SubT environment as a component of a clandestine chemical biological lab.

2

Camp Red Cloud, South Korea - RDECOM ECBC personnel from the Advanced Chemical, Biological, Radiological, Nuclear and Explosives Training Team joined the 23rd Chemical, Biological, Radiological and Nuclear Battalion stationed in South Korea to provide training aimed at improving knowledge of CBRN threats and ability to assess, exploit and mitigate CBRN hazards. More on page 4.

Camp Red Cloud, South Korea - RDECOM ECBC personnel provided expertise in the area of collective protection as bunkers at the installation were assessed and modernization updates were made to the collective protection filtration system and personnel decontamination station.

3

Maribyrnong, Victoria, Australia - Assisting the Australian Department of Defence, RDECOM ECBC personnel continue their remediation efforts of an obsolete research and development facility. Learn more about The Chemical Biological Application and Risk Reduction business unit's recovery capability on page 28.

Soldiers from the 23rd CBRN work through the construction of a small scale laboratory setup.

RDECOM ECBC Team Trains U.S. Soldiers Abroad

By Shawn Nesaw

The 23rd Chemical, Biological, Radiological and Nuclear (CBRN) Battalion stationed in South Korea took part in a series of training events to improve knowledge of CBRN threats and increase the ability to assess, exploit and mitigate CBRN hazards.

The Soldiers of the 23rd CBRN Battalion had the opportunity to refine their skills while also receiving advanced instruction in other areas such as lab processes. The Soldiers improved their recognition of chemical and biological agent production processes through the training, which was provided by a team of scientists from the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC) and National Guard Bureau's Combating Weapons of Mass Destruction Branch.

The training consisted of basic chemistry, overview of biological agents, introduction to laboratory set-ups, sampling operations and a tabletop exercise (TTX) where trainees were required to evaluate a lab setup, identify the set-up, determine appropriate equipment and establish the most effective and safe area to take a representative sample.

Continually learning and honing skills is especially important to the 23rd CBRN Battalion. "The 23rd CBRN is the only CBRN Battalion on the Korean Peninsula. No one else can do what we do," explained Army Chief Warrant Officer Mazie Benefield. "They rely on us to assess, exploit and mitigate CBRN hazards so maneuver forces can accomplish their mission."

> ***"Training like this helps us improve our capabilities and our teamwork."***
>
> *Army Chief Warrant Officer **Mazie Benefield***

Provided by the Advanced Chemical, Biological, Radiological, Nuclear and Explosives Training Team (CBRNE) Training Team, the training is provided for customers around the globe to better prepare them for future missions in which contact with CBRN threats may occur.

The Advanced CBRNE Training Team, located at the RDECOM ECBC, provides a direct relationship between the subject-matter experts and customers in support of CBRN awareness and readiness.

"Our mission is to support the warfighter - we've dedicated our science to their operational success," said Carrie Poore, Ph.D., advanced CBRNE training branch chief and biologist.

"We apply our science in the field and impart our knowledge on customers so they understand the science and the equipment to ensure they have a knowledge base about threats they may face and how to think critically, applying what they've learned in training to assess and mitigate those threats."

Training varies depending on the customer's mission and can have as little as one person participating or as many as 300. Additionally, training takes place in a variety of settings but usually includes a mix of classroom time and field work to ensure trainees receive the hands-on experience that best aids them in accomplishing their mission efficiently and safely. "Our team always trains the end-user based on their specific mission and the circumstances which they may encounter," said Poore.

The training provided was well received by the 24 trainees who always welcome more knowledge and understanding to better handle the threats they may encounter in the field.

Future training may consist of longer timeframes, deep-diving into solely chemical or biological threats.

"Training like this helps us improve our capabilities and our teamwork," said Benefield. "Any time Soldiers get an opportunity to do training like this in smaller groups, it fosters team building and everyone gets more out of the training."

Gen. John M. Murray recites the commissioned officer oath of office during his promotion ceremony held at the newly appointed headquarters location for Army Futures Command in Austin, Texas.

Secretary of the Army Mark T. Esper spoke Aug. 24, 2018, in Austin, Texas, during activation of the Army Futures Command.

Army Futures Command Prepares for Operation

Provided by U.S. Army Public Affairs

Army Futures Command, which began operations on July 1, will lead the Army's future force modernization enterprise. The command is expected to assess the future operational environment, emerging threats and new technologies in order to develop and deliver concepts, requirements, future force designs and modern materiel solutions to meet our Soldiers' wartime needs.

The Army has worked hard increasing current readiness and strengthening its combat formations. Futures Command will provide that same focus to future readiness by fine tuning and implementing the service's modernization strategy to increase the Army's lethality against near-peer competitors in tomorrow's conflicts.

"The establishment of the Army Futures Command is the best example of our commitment to the future readiness and lethality of the force," said Secretary of the Army Mark T. Esper. "Army Futures Command will help fulfill the Army Vision by addressing the key shortcomings of the current acquisition system, providing unity of command, effort and purpose to the entire modernization enterprise."

Futures Command will lead the Army's force modernization efforts; it is charged with providing Soldiers the weapons and equipment they need, when they need them. This new four-star command will complement the Army's other four-star headquarters – Forces Command (FORSCOM), Training and Doctrine Command (TRADOC) and Army Materiel Command (AMC) – and is scheduled to reach full operational capability in summer 2019.

> ***"Army Futures Command postures the Army for the future by providing strategic direction, integrating the Army's modernization enterprise, aligning resources to priorities and delivering superior materiel solutions to our Soldiers consistent with the Army Vision."***
>
> *Secretary of the Army **Mark T. Esper***

"This is a big year for the Army because we believe that we need to significantly reform the way the Army does research and development, testing and evaluation, procurement and everything else that contributes to the modernization process," said Army Chief of Staff Gen. Mark A. Milley.

Establishment of the command marks the most significant reorganization of the institutional Army since 1973, when it created FORSCOM and TRADOC. Unique in structure and design, it is being headquartered in Austin, TX to better partner with academia, industry and innovators in the private sector, while providing a good and affordable quality of life for Futures Command personnel.

When it reaches full operating capacity in summer 2019, the headquarters will comprise about 500 personnel. Sub-organizations, many of which currently reside within TRADOC and AMC, will transition to Army Futures Command in the coming months. The Army has no plan to physically move units or personnel from these commands at the present time.

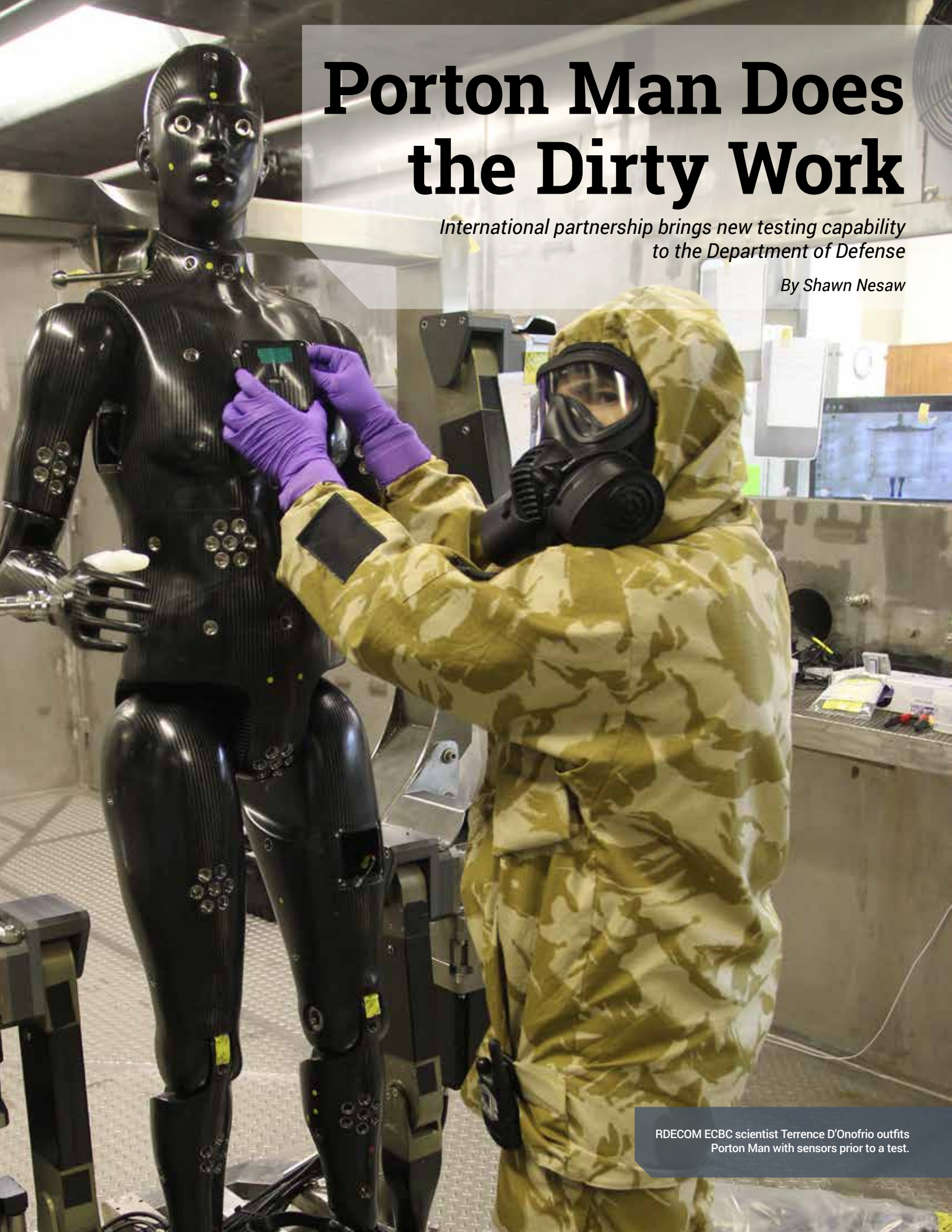
"This is not about moving lots of people from other commands," said Under Secretary of the Army Ryan D. McCarthy. "Army Futures Command can be best characterized as a restructuring and de-layering to maintain the 'best in breed' in all military capabilities."

Army Futures Command also oversees the Army's eight Cross-Functional Teams (CFT), which are aligned with the Army's six modernization priorities. Each CFT is expected to facilitate faster acquisition decision making by Army senior leaders in order to meet the needs of the future force, consistent with the Army Vision.

Porton Man Does the Dirty Work

International partnership brings new testing capability to the Department of Defense

By Shawn Nesaw



RDECOM ECBC scientist Terrence D'Onofrio outfits Porton Man with sensors prior to a test.

An array of sensor ports on the Porton Man allow data to be accurately and efficiently collected for analysis.

An international partnership with the United Kingdom has brought a new chemical and biological protective suit testing capability to the U.S. Department of Defense, with U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC) scientists leading the U.S. side of the effort.

The partnership with the U.K.'s Defence Science and Technology Laboratory (DSTL) is part of a larger effort to share information for the good of the bilateral chemical and biological defense community and the warfighter, expanding knowledge and capabilities for both nations.

Currently, the Joint Service Lightweight Integrated Suit Technology (JSLIST) is the fielded protective suit system used by U.S. warfighters, but JSLIST is due for an upgrade. As U.S. Army priorities change, a more effective, less restrictive protective suit system is necessary.

Once chemical and biological protective suit systems are created, they are put through a rigorous test and evaluation process to ensure they meet the needs of the user. Part of the standard battery of tests includes a human volunteer to wear the ensemble in a simulated environment – known as a Man in Simulant Test (MIST). The partnership with the DSTL makes available a new way to test using high tech mannequins and live chemical warfare agent.

This isn't your department store window mannequin though. Porton Man, as he is named, is a carbon fiber, fully-articulated mannequin used to test the effectiveness of chemical and biological protective suit systems. The mannequin was created by i-bodi Technology and DSTL.

Standing 5'10", Porton Man is covered with several hundred half-inch ports to hold passive cumulative sensors, manually inserted to provide spatial information on how the system is performing. Additional sensors, similar to those used for the U.S. MIST, can be incorporated into the test to cross-compare against U.S. results.

Porton Man also uses six miniaturized Joint Chemical Agent Detectors (JCAD) which fit inside fist-sized body cavities in the mannequin, providing scientists with real-time data during the course of a single test. "Real time data is some of the most unique information we garner from Porton Man because it shows at which range of motion, orientation, actions and time increments the ensemble performed well or poorly," explained RDECOM ECBC research chemist Terrence D'Onofrio, Ph.D.

> ***"A transition like this doesn't come around too often, if ever."***
>
> *RDECOM ECBC Research Chemist* ***Terrence D'Onofrio, Ph.D.***

D'Onofrio leads the U.S. involvement in the Porton Man research and has been doing so since 2016 through the Army's Engineer and Scientists Exchange Program (ESEP), which provides collaborative research opportunities with U.S. allies.

What started out as a mission to simply learn about system-level testing quickly turned into something much bigger. Simultaneously, but separate from D'Onofrio's ESEP assignment, the Defense Threat Reduction Agency Research and Development Chemical and Biological Technologies (DTRA/RD CBT) leveraged their existing U.S./U.K. collaborative partnership to research chemical protective ensemble methodologies. DTRA/RD CBT personnel supported upgrades to Porton Man by providing real-time sensors and sending U.S. suits to DSTL for testing and performance characterization.

As D'Onofrio's initial ESEP assignment was ending, both countries saw the importance of the unique information gained from Porton Man. DTRA/RD CBT requested D'Onofrio's assistance with the ongoing collaboration.

With DTRA/RD CBT support to extend the assignment, the U.S. Chemical Biological Defense Program (CBDP) began the process of transitioning Porton Man from a science and technology research tool to a test and evaluation capability for U.S. acquisition programs. D'Onofrio worked with the U.S. CBDP community and DSTL to develop a validation plan, enabling the transition. The process of stakeholder interaction, plan development, testing, data analysis, report documentation and approval signatures was completed in about a year.

In June 2018, Porton Man was endorsed by the Army, which allows data derived from Porton Man to be used for acquisition programs. Porton Man is now validated as an official test method for the U.S. CBDP.

"A transition like this doesn't come around too often, if ever," said D'Onofrio. "It's a big win in the chem-bio community."

In the case of Porton Man, the U.S. didn't have the capability on-hand, so it sought it out through a partnership with a trusted ally. "Our partnership benefits both nations. We all bring unique expertise and skill sets to the table and we all improve as we work together," said D'Onofrio.

During a test, which takes about three days from set up to sample collection, Porton Man is outfitted with all the sensors necessary for the test which will collect any chemical

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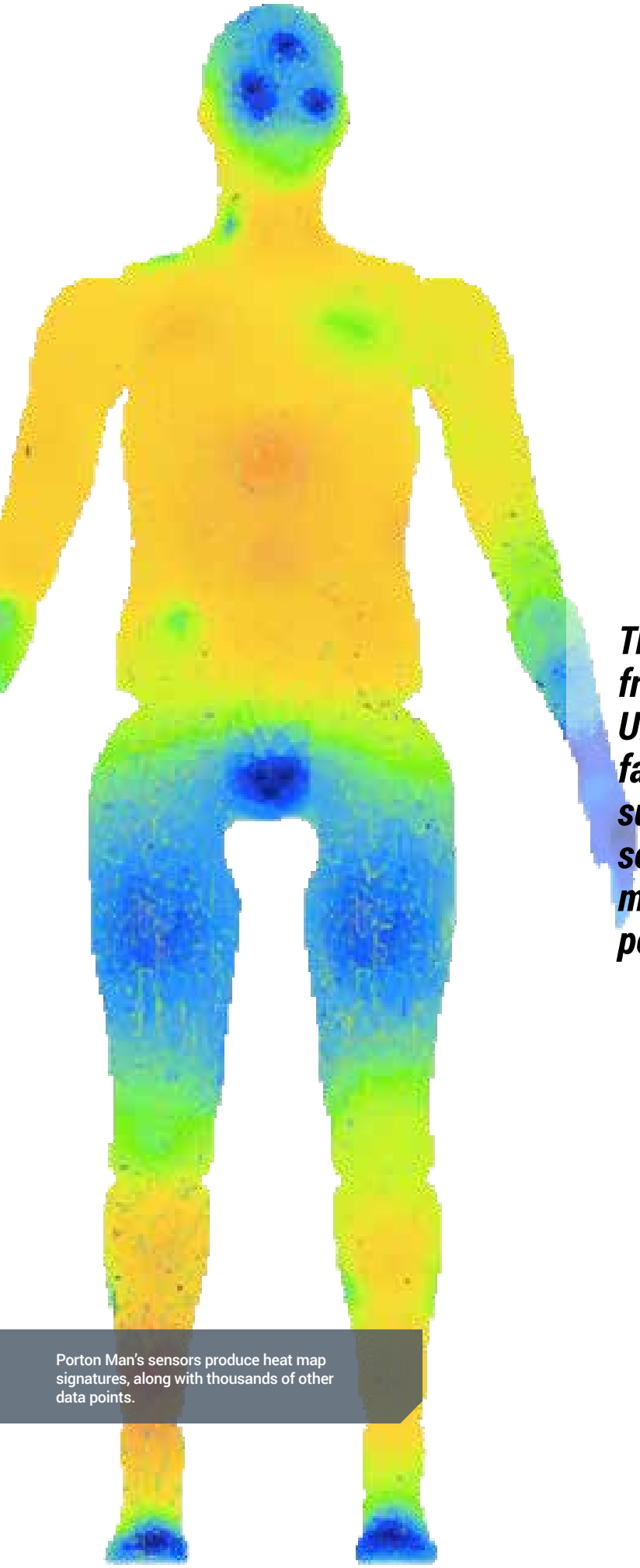


Porton Man's sensors produce heat map signatures, along with thousands of other data points.

material that penetrates the suit during the test. Then the mannequin is dressed in the protection ensemble system slated for testing. For the initial validation, the team has focused on sulfur mustard vapor testing.

Mustard vapor is then pumped into the testing chamber and the mannequin is programmed through a series of movements such as walking, running and kneeing, with various orientations to the wind. The team is stationed outside the sealed, stainless steel chamber at a control station where they control the amount of agent entering the chamber; monitor referee sensors for humidity, temperature and other factors; and control Porton Man's movements and direction.

Once the test is complete, scientists enter the chamber wearing protective suits to retrieve the sensors from Porton Man. Scientists then analyze how much agent penetrated the suit system through advanced computer programs and develop next steps for improvement of the suit system. From one Porton Man test, scientists will garner more than 5,000 data points. The results of Porton Man tests are studied alongside the results to human tests using agent simulants.

"We compare MIST test data, using real warfighters in a simulated environment, to Porton Man, a simulated person in a real environment, because it allows us to see an overall picture of a specific protective suit system and will ultimately inform decision makers on which protective suit system is best," explained D'Onofrio.

Through heatmaps and data charts from a specific test, D'Onofrio and his U.K. partners can identify flaws like a faulty zipper or weak elastic around a suit's waist skirt. Due to the real-time sensors, the team can determine which movements allowed the most agent to penetrate the suit.

Through heat maps and data charts from a specific test, D'Onofrio and his U.K. partners can identify flaws like a faulty zipper or weak elastic around a suit's waist skirt. Due to the real-time sensors, the team can determine which movements allowed the most agent to penetrate the suit. For example, a test may show that a particular design allowed more agent penetration when standing still than it would when running.

Leveraging shared facilities aligns with Deputy Assistant Secretary of Defense for Chemical and Biological Defense international task force goals to provide the best information and capabilities for the benefit of the U.S. warfighter.

D'Onofrio awaits the go-ahead to return to the U.K. to assist with further research, method validation and cross-training of Porton Man test procedures. The U.S. will provide suits, funding and subject matter expertise, through D'Onofrio and others, for future collaboration efforts. The international team will continue testing new materials and off-the-shelf products. Future research will expand the capabilities to include liquid mustard or nerve agents.

"Results of Porton Man can ultimately inform a fielding decision for the next generation of CB protective suit systems as part of a formal acquisition program," said D'Onofrio. "Furthermore, they can impact tactics, techniques and procedures that warfighters use in the field, based on the suit and the threat."

Handheld Genomic Sequencer Shows Promise in Field Demo

By Brad Kroner

The MinION, a handheld genomic sequencer, showed promise in field demonstrations during testing at the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC).

Owned by Oxford Nanopore Technologies and released to scientists for testing in 2013, the MinION is a DNA/RNA sequencer that the U.S. Army sees as a potential, all-purpose biothreat detector.

"Initially, we imagine being able to use the MinION in conjunction with the current biological detection technologies, but eventually, all we'll need is the MinION," said Cory Bernhards, Ph.D., a research microbiologist from the Defense Threat Reduction Agency (DTRA) who conducts research in the BioSensors Branch at RDECOM ECBC.

Not only can the MinION detect known threats, it can sequence unknown threats, too. These unknown biothreats include emerging and genetically modified pathogens.

"There's no capability right now to detect an unknown biothreat," Bernhards said, referring to field-deployable detection. "The current technologies are only looking for specific targets."

By identifying biothreats – known and unknown – on the battlefield, warfighters can respond accordingly to prevent or treat exposure.

Initially, its handheld size proved to be both an advantage and a limitation; while portable, it lacked the ability to produce high quality data in the field. However, ongoing breakthroughs have enabled the MinION to analyze a sample in an hour, without high-powered lab equipment, even in low resource environments, as shown during field tests.

Conducted at Aberdeen Proving Ground and coordinated by the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense, the field test put the MinION in the hands of operators from the 20th Chemical, Biological, Radiological, Nuclear and Explosives (CBRNE) Command and the 32nd Civil Support Team (CST).

In the field test, there were two bacterial samples, one for the 20th CBRNE Command and one for the 32nd CST. Both operators required just a couple training sessions before successfully using the technology.

The MinION, a handheld genomic sequencer, potentially has a future with the U.S. Army as an all-purpose biothreat detector.

"We just did two short training sessions, and by the demonstration, they were able to do it by themselves," Bernhards said. "You don't need that much training to do this as long as you have some lab experience. Our goal is to get this to the point where any Soldier can use it with little to no laboratory experience."

The field test was also conducted completely offline, proving the MinION can work without an internet connection. The demonstration utilized offline bioinformatics data analysis software called "MINDS" which was developed by the Detection Spectrometry Branch at RDECOM ECBC. The MINDS software application provides instant analysis for detection and classification without prior knowledge of the organism in the sample.

"We wanted to make sure that we could do this offline," Bernhards said. "You're not going to have a reliable internet signal on the battlefield."

"They've used the MinION in West Africa during the Ebola outbreak, in Antarctica and even on the International Space Station," Bernhards added. "Obviously, it's field deployable so we want to get it in the hands of the warfighter so they can use it on the battlefield to identify any biological threat. This can identify any bacterium, any virus."

Additional projects are planned in the coming months, including one where the MinION will be used to test air filter samples from the New York City subway.

"We're going to see if the background in those filters would disrupt the sequencing," Bernhards said, noting that skin cells, hair and microbes will be present. "In the lab, we'll spike the filters with a known agent and determine at what concentration we can detect that."

There are still obstacles to overcome before MinION can be fielded.

"What we've been trying to do here is simplify the procedures and sample preparation, reduce the required equipment and power, and cut the time down," Bernhards said. "We're making good progress, and we have it down to about an hour."

The goal is to cut the overall time needed to prepare and sequence a sample to 40 minutes.

Oxford Nanopore is soon to release new technologies that will help researchers cut down the process. One is an automated sample and library preparation device that is currently being tested at RDECOM ECBC. Another device coming out at the end of the year will allow fully automated sequencing.

Jim Baker, Ph.D. and Harry Salem, Ph.D. stand in recognition for their induction into the RDECOM ECBC Hall of Fame.

Influential Scientists Celebrated for Careers of Excellence at Inaugural Hall of Fame Ceremony

By Brad Kroner

The U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC) inducted two longtime employees into its new Hall of Fame.

James Baker, Ph.D., who spent nearly half a century at RDECOM ECBC, and Harry Salem, Ph.D., who serves the Center's chief scientist for life sciences, were officially named the first two inductees into the Center's Hall of Fame during a ceremony on Aug. 16.

"Both of these men represent the best of RDECOM ECBC," said Center Director Eric Moore, Ph.D. "They contributed to making RDECOM ECBC what it is today, and I am privileged to lead it. I stand on the shoulders of giants."

The Center established its Hall of Fame to honor the contributions of RDECOM ECBC community members.

"Just last year, we celebrated our 100th anniversary which was more than just a historical milestone, it was a celebration of excellence in the chem-bio defense space," Moore said. "The Hall of Fame is a small step toward recognizing the people who played a significant role in that history of excellence and will become an enduring tradition here at RDECOM ECBC."

Baker, who worked his way up from research chemist to associate director, was remembered for his leadership and presence at the Center. Recognized internationally, he became the sixteenth American to receive the German Golden Cross of Honour.

"I'm very honored by this recognition," Baker said. "There's nothing better than to realize that your colleagues honored your work and honored you, and in some cases loved you."

Moore, who began working at the Center after Baker's retirement, praised Baker as a foundational leader and integral part of the community.

"I always knew Dr. Baker as someone who got work done," he said. "Dr .Baker was an integral part of RDECOM ECBC, and he was never afraid to say what needed to be said. He is being honored not only for his technical contributions but for the legacy he left and the way he mentored others."

In written remarks, past RDECOM ECBC Director Joseph Wienand attributed part of the Center's success to Baker.

"What I remember and cherish about you is how you took care of our young people as a mentor and coach," he wrote. "Much of the success RDECOM ECBC has enjoyed over the last 40-plus years has been due to your dedicated thoughtfulness for others."

Salem, who continues to work at age 89, has worked at the Center since 1984, after spending many years in the pharmaceutical industry. At the Center, Salem oversaw the testing of the currently-fielded U.S. protective suit – the Joint Service Lightweight Integrated Suit Technology. Currently, his work focuses on stem cell research and the "organ on a chip" program, which implants organoids – a collection of cells from a specific organ – into a microchip for testing.

"I'm very excited and flattered and honored to even be considered for this Hall of Fame," Salem said. "I've done my best, let's put it that way. I had a lot of help from some smart people. My successes are all due to the people that worked for me in the labs."

Moore said that Salem's work made a lasting impact on millions, or even billions, of people, noting that during his time in the pharmaceutical industry Salem helped create extended wear contact lenses and the drugs NyQuil and Contac.

"Dr. Salem was involved in all of these things," Moore said. "He's impacted millions and maybe billions of people, nationally and internationally."

Rick Decker, a former RDECOM ECBC director, remarked that nobody works as hard as Salem. "Dr. Salem continues to be one of the hardest working people at RDECOM ECBC," he said. "When papers are still coming across your desk at 7 or 8 p.m., you better know that Dr. Salem is still working hard."

Moore said that Salem is always focused on "writing the next chapter." What Baker and Salem have in common, Moore said, was a willingness to help others.

"A consistent theme that you see with both of these gentlemen is that they gave back," Moore said. "They made sure a succession plan was in place to ensure success for future generations of scientists."

Clockwise from top:

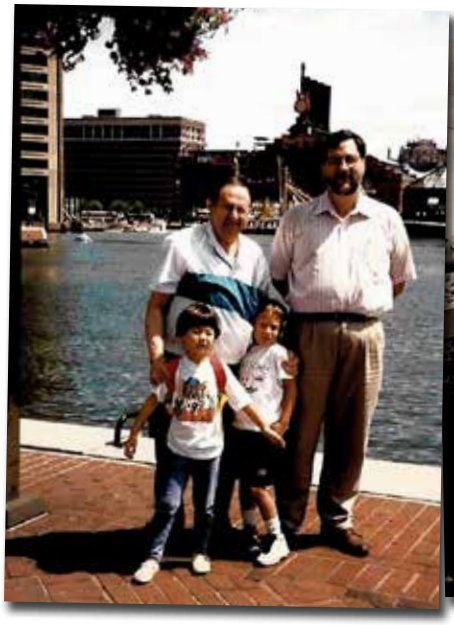
- ***Jim Baker, Ph.D. (left) and Harry Salem, Ph.D. (right) witness the unveiling of their Hall of Fame plaques.***
- ***Harry Salem, Ph.D. and Jim Baker, Ph.D. enjoying the Hall of Fame reception.***
- ***Family, friends and colleagues await the start of the Hall of Fame ceremony.***
- ***Maj. Gen. Cedric Wins (left) and Eric Moore, Ph.D. (right) stand as the colors are presented.***

"What I remember and cherish about you is how you took care of our young people as a mentor and coach…Much of the success ECBC has enjoyed over the last 40-plus years has been due to your dedicated thoughtfulness for others."

Former RDECOM ECBC Director ***Joseph Wienand***

"Dr. Salem continues to be one of the hardest working people at ECBC. When papers are still coming across your desk at 7 or 8 p.m., you better know that Dr. Salem is still working hard."

*Former RDECOM ECBC Director **Rick Decker***



Working for the Warfighter

Sustaining a Ready Force

By Yuliya Rutherford

Yuliya Rutherford is a general engineer with RDECOM ECBC's Sustainment Engineering Division located at Rock Island Arsenal, Illinois. She holds a Bachelor of Science degree in mechanical engineering with a minor in mathematics from St. Ambrose University in Davenport, Iowa.

Readiness—the Army's top priority—not only means a well-trained force, but also well-maintained equipment, vehicles and materiel that are essential for a successful mission.

At U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC), our objective is to ensure Soldiers are ready to face chemical and biological threats anywhere in the world, so they can protect themselves and others and return home safely.

The Center is a leader in chemical and biological technology—from concept to development, test, fielding and sustainment. While much of RDECOM ECBC focuses on research and development of new technologies, our team at Rock Island Arsenal specializes in maintaining existing technology and equipment that is currently used on the battlefield.

In the past year, our team's support has improved equipment operational readiness by 40 percent across five missions.

Our expertise in sustainment engineering includes contamination avoidance, collective and individual protection, decontamination, configuration management and quality assurance. We partner with the U.S. Army Tank-Automotive and Armaments Command (TACOM) and the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND) to address needs of the sustainment community. As the designated engineering support activity for all TACOM-managed CBRN equipment, RDECOM ECBC brings a deep technical understanding and a century of historical knowledge to the table to tackle challenges and offer solutions related to sustainment of these critical capabilities until they reach the end of their lifecycle.

The interaction with our troops is incredibly valuable...we gain information that can influence decisions on future requirements and inspire innovation in technology.

As part of our role, we support training for operators and maintainers.We go directly to the units in the United States and overseas to provide hands-on instruction on proper use and performance, configuration, preventative maintenance, cleaning, storing and trouble-shooting. We also perform onsite assessments of their cache of equipment and provide refresher training prior to deployment. Our recent training missions include:

- M12A1 Decontamination Apparatus operator- and maintainer-level training for the U.S. Army Reserves 135th Chemical Company, Machesney Park, Illinois;
- M26 Joint Service Transportable Decontaminating System-Small Scale (JSTDS-SS) new equipment training for Soldiers stationed Camp Humphreys and Camp Casey, Republic of Korea;
- M26 JSTDS-SS training, technical support and trouble-shooting at Marine Corps Air Station, Miramar, California.

In the past year, our team's support has improved equipment operational readiness by 40 percent of affected systems across five missions.

The interaction with our troops is incredibly valuable for everyone. We gain perspective from those with boots on the ground about how the equipment is used in the field, which gives us information that can influence decisions on future requirements and inspire innovation in technology. In turn, our Soldiers get customized instruction, the opportunity to ask questions about operability that dive deeper than reading the equipment manual—and ultimately, the confidence that both they and their equipment are ready to fight and ready to win.

Volcanic fissures spurt out lava and toxic gas in Pāhoa, Hawaii May 25, 2018.

RDECOM ECBC Advises First Responders in Wake of Volcanic Eruption

By Brad Kroner

As emergency service personnel in Hawaii rescued evacuees and contained damage following the eruption of the volcano Kilauea, scientists at the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC) provided their expertise to help safeguard the health of first responders.

The volcano's continued eruption cast ash and chemicals into the air, posing a health concern for first responders. For a century, RDECOM ECBC scientists have developed equipment to protect warfighters for situations where they may be exposed to chemicals on the battlefield.

Chemicals of concern include sulfur dioxide, hydrogen sulfide and hydrochloric acid. At certain concentrations and length of exposure, sulfur dioxide and hydrogen sulfide can cause life-threatening respiratory issues, especially for those with lung diseases like asthma. Hydrochloric acid can causes severe burns, irritation and respiratory system issues. "Both the National Guard and the U.S. Navy came to us with questions about these chemicals in the atmosphere and protections available for those chemicals," said Greg Peterson, an RDECOM ECBC chemical engineer. "Our role is to tell them how best to use the filters, problems to look out for and things to be aware of."

Peterson said he shared technical details on several filters, estimates on their duration and potential problems like oxygen-depleting atmospheres and filter fires. Peterson said he was aware of one report of oxygen depletion.

Three filters were used by responders in the Kilauea crisis — the M61, C2A1 and the GP filter — and all were developed at RDECOM ECBC. Each protects against the same threats, but they are used on different masks.

"They're good against chemical warfare agents and acid gases," Peterson said. "Differences arise from the needs of the user. For example, the M61 filter is used on the M50 Joint Service General Purpose Mask, while the GP filter is used on the M53 Chemical Biological Mask used by Special Operations. The two have different specifications."

All the filters use high-efficiency particulate air (HEPA) filtration and activated carbon to protect the user. HEPA filters block soot, ash and other aerosols.

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RDECOM ECBC scientists advised first responders on how to use various filters, such as the M61 filter.

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Activated carbon limits the effects of chemical threats through adsorption and chemical reaction. At some point, Peterson said, the filters would have to be replaced, as soot could clog the filter or the capacity of the carbon is used up.

During response operations, the Navy sent a used mask to the lab for evaluation. Peterson and his team responded immediately, analyzing the filter for degradation and performance.

"The filter we received weighed a lot more than a typical filter," Peterson said. "This could be due to soot and ash from the volcano. It could also be from water loaded on the carbon. Or it could be from other contaminants."

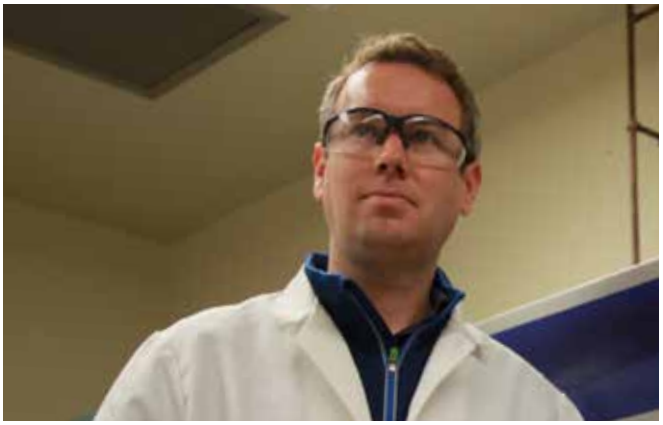
"We are working with the Navy to develop a standard operating procedure for logging data when using filters so we have more information when we go to test it," Peterson added.

After the evaluation, Peterson determined that the masks were well-equipped to serve the needs of responders.

"In this case we're seeing low concentrations of chemicals," he said, noting that the masks are designed for higher concentrations.

Through working with the National Guard and the Navy, Peterson hopes to gain new perspectives that lead to new ideas.

"At the end of the day, our primary goal at RDECOM ECBC is to support the warfighter," Peterson said. "This reach-back support leads to mission readiness and provides the warfighter the means to successfully complete the mission."



"This reach-back support leads to mission readiness and provides the warfighter the means to successfully complete the mission."

RDECOM ECBC Chemical Engineer ***Greg Peterson***

A warfighter handles a JCAD SLA during a field test.

JCAD Model Tests for Opioids, Illegal Drugs

By Brad Kroner

The Joint Chemical Agent Detector (JCAD), a longtime tool used to detect chemical warfare agent (CWA) in the field, is undergoing modifications to detect illegal drugs, including opioids like heroin and fentanyl.

This upgrade, developed by the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC), comes concurrently with modifications enabling the JCAD to detect explosive compounds. Both capabilities are expected to undergo field testing in the coming months, giving warfighters the chance to demonstrate the technology and provide feedback to its developers.

Referred to as the JCAD Solid Liquid Adapter (SLA), the upgrade was developed to give warfighters the ability to test for additional threats without creating another, separate device. Explosive detection capabilities are added by placing the JCAD into a cradle with additional software.

"There was the desire to take something that was already fielded and expand its capabilities without changing its hardware or requiring additional equipment," said Mary Wade, Ph.D., branch chief for detection spectrometry, noting that every Army unit is equipped with a JCAD.

In addition to serving the warfighter, the JCAD SLA is also expected to help law enforcement officers and first responders with its opioid-detection capability.

"The opioid crisis has caused so many deaths in the community, and law enforcement is looking for help," Wade said. "Last year, Aberdeen Proving Ground hosted an opioid summit as part of its commitment to fighting this epidemic, and our hope is that this technology helps law enforcement do their job even better."

Patrick Riley, a research chemist involved in the project, said drug detection is becoming a greater emphasis among law enforcement experts fighting this epidemic.

"There's an important shift to being able to detect these compounds in the field," he said.

In addition to testing for opioids, the JCAD SLA will be able to test for cocaine, methamphetamine and tetrahydrocannabinol (THC), the active ingredient in marijuana.

"With the legalization of marijuana in a lot of states, there really isn't a breathalyzer-like test to determine intoxication, so that's another thing we were looking at," Riley said.

The capability will soon be put into the hands of warfighters and first responders.

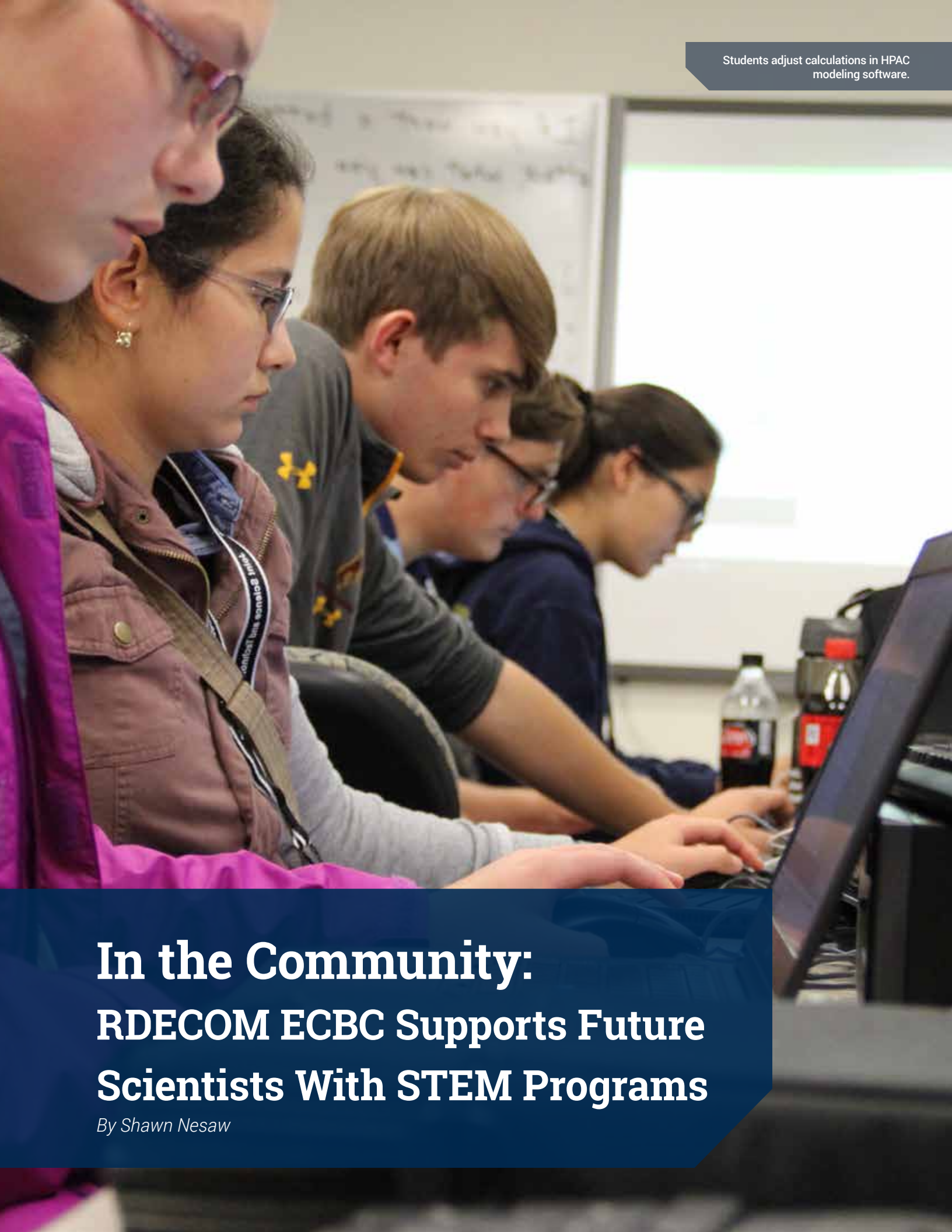
"We probably have one more year before this is fielded," Riley said, noting that the JCAD SLA is going to undergo a field demonstration coordinated by the Joint Project Manager for Nuclear, Biological, Chemical Contamination Avoidance (JPM NBC CA), which is funding the project in conjunction with an Army Technology Objective.

John Jump, JPM NBC CA's system manager for survey and analytical systems, said that the JCAD SLA is "exactly what we've been looking for to improve our detection capabilities."

Past solid-liquid detectors were too large for field deployment, Jump said, but the JCAD SLA provides an effective alternative.

"The technology that we had been using was too big but this technology seems like it's going to get the job done," he said. "I believe this is really what the users have been looking for with the solid-liquid detector."

"It's primarily a human factors test," Jump said. "We're determining if the operators can use it effectively and how they proceed with the mission after detecting a threat."

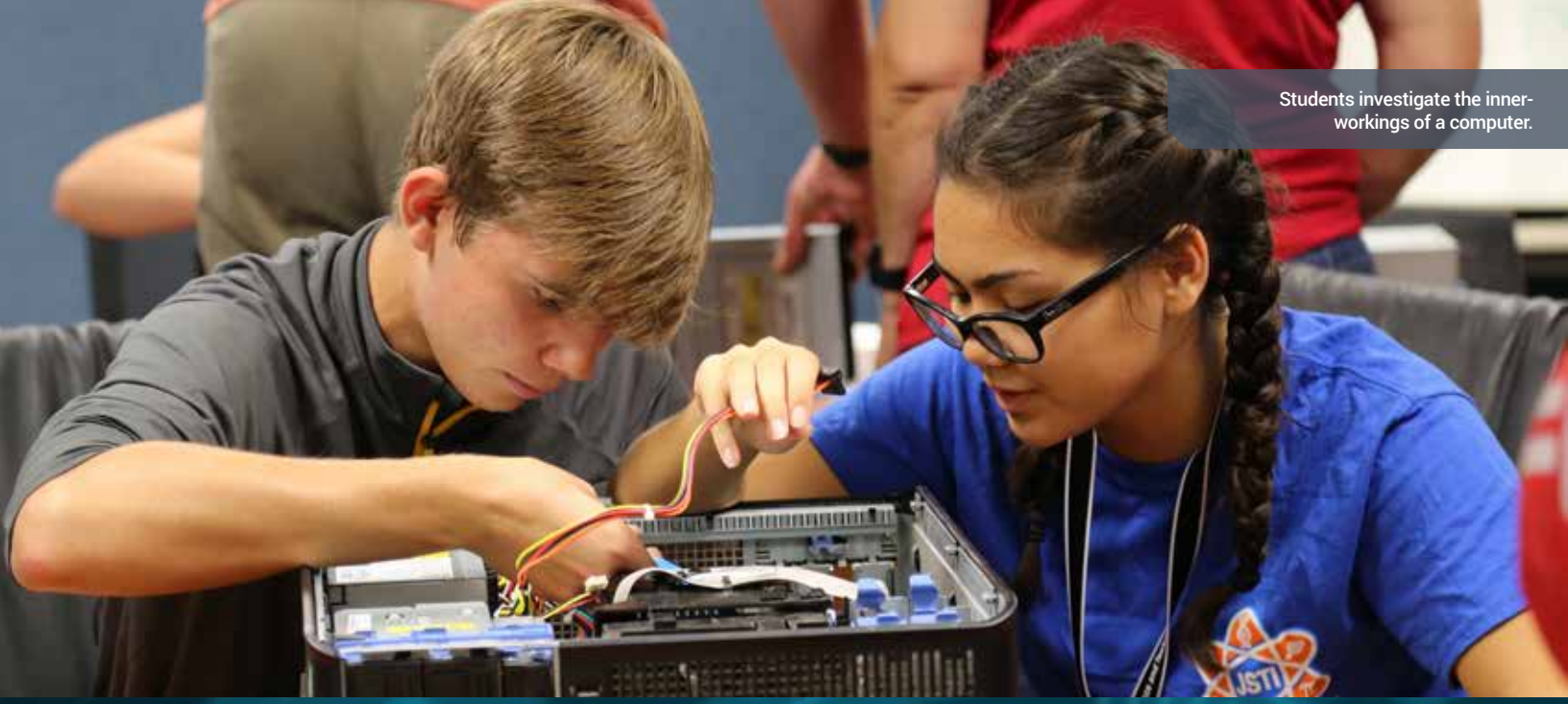


Students adjust calculations in HPAC modeling software.

In the Community:

RDECOM ECBC Supports Future Scientists With STEM Programs

By Shawn Nesaw



Students investigate the inner-workings of a computer.

High school students from around the country took part in a two-week Science, echnology, Engineering and Mathematics (STEM) program hosted by the Joint Science and Technology Institute (JSTI) at Harford Community College to learn from and engage with some of the brightest minds in the chemical and biological defense community.

Through the JSTI summer program, students are mentored by Department of Defense scientists at the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC). Funded by the Defense Threat Reduction Agency (DTRA), the program grants opportunities to students from as far away as Guam and as nearby as Aberdeen, Maryland.

Since its inception in 2012, the JSTI program has promoted STEM-related topics to students with a wide range of skills, backgrounds and interests. In 2015, DTRA invited the modeling and simulation practitioners within the RDECOM ECBC Research & Technology Directorate to get involved.

"Some students come to us with little to no STEM experience so this is the first time many have engaged in this type of curriculum," explained Michael Kierzewski, the Center's Modeling, Simulation and Analysis (MSA) Branch chief. "Others have experienced STEM in their schools or sought out opportunities to engage with STEM on their own time."

Kierzewski's classes focus on how math allows us to understand our physical world using probability, statistics and experimentation to develop system models and ultimately make useful predictions about how systems are likely to function. Students complete several projects, including one called the "statapult" where students must use information provided by instructors to set up, characterize and reach a target at a specified distance using the catapult-like device.

"Once we give the final information on the distance, students can make the correct calculations and hit the target within just two adjustments," said Kierzewski. "They are very accurate and solve the problems quickly."

Students also had a chance to work with the Hazard Prediction and Assessment Capability (HPAC), a deployable modeling software used to assist in emergency response to hazardous agent releases.

Given variables such as wind speed, geographic coordinates and the type of chemical agent being dispersed, students input data into the computer program and see the results on screen, depicted in a red and yellow map.

RDECOM ECBC computer scientist Nirmala Pinto, who was the primary instructor for the class, reflected on her students' performance after using HPAC.

"They problem solve in their own way, so as instructors, we need to also adapt slightly – we need to be open to new ways of thinking," explained Pinto. "When they ran into a problem, they used their phone or the internet to find the information they needed to solve the problem."

The rigorous program provided by JSTI ensures students are constantly challenged and learning new things they can apply in their future studies.

"I'm learning a lot of things I didn't know about but I'm also getting a more solid understanding of other concepts I've already learned," said Corey Chisholm, a rising high school junior from Delaware. "I'll definitely be able to apply the things I've learned here in my classes next year."

Students also had an opportunity to set foot inside RDECOM ECBC's Modeling, Simulation and Manufacturing Branch facility, where they learned about the inner workings of computers through a guided computer tear-down to examine the parts inside.

Others learned about packaging development in the packaging branch of the Advanced Design and Manufacturing Division. Students designed and developed packaging to protect an egg from breaking when dropped from a height of seven feet. They also developed static sensors to monitor the amount of static electricity buildup within a given package.

"The skills learned over the two week class utilize all aspects of STEM," said Bob Pazda, Supervisory Electronics Engineer of RDECOM ECBC's Electronic Design and Integration Branch. "They learned how to solder and develop circuitry, design parts for 3-D printing, problem solve and think critically. The lessons learned are invaluable for these future scientists and engineers."

The experience gave students an inside look at some of the career opportunities available related to STEM subjects.

Maryland native, Anna Hillburgh reflected, "This two-week experience was very beneficial to me and my peers and has increased my interest in STEM. Very few of my classmates back home had an opportunity like this so I'm truly thankful for it."

"The JSTI programs are a great way for us to share our time and talents with the next generation of scientists," Kierzewski said. "Our role in the chem-bio defense space is more than just research for the warfighter. It's to inspire and encourage students to pursue careers in STEM fields."

Jerry Cabalo, Ph.D. and high school teacher Tyler Dufrene work with an aerosol test chamber.

Science Teachers Work Alongside Army Researchers to Hone Laboratory Skills

By Shawn Nesaw

June, July and August – That's the answer to a quip about the best parts of being a teacher.

While some teachers certainly take off to recharge their batteries each summer, for some, there is no academic off-season and for a choice few, part of their summer vacation included a trip to the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC) at Aberdeen Proving Ground, Maryland.

The Joint Science and Technology Institute is a residential research experience, funded by the Defense Threat Reduction Agency (DTRA). The two-week Science, Technology, Engineering and Mathematics (STEM)-intensive program at the RDECOM ECBC took teachers out of the classroom and into the labs for the opportunity to experience real-world laboratory science and gain practical knowledge they can take back to their schools and apply in their lessons with students.

Six teachers from around the country worked side-by-side with research scientists at the Center on a variety of experiments such as aerosol detection, biological sample collection and mass spectroscopy.

Joan Rome, a high school chemistry and biology teacher at Hahnville High School in Boutte, Louisiana worked with research biologist Daniel Angelini, Ph.D., on an environmental surface sampling project.

"Joan had the opportunity to see applied science in the lab and work through the full scientific process – design, preparation, execution, analyzation and write up," explained Angelini. "The environmental surface sampling experiment Joan worked on ultimately applies to the warfighter, but basic components have beneficial application in the classroom for students."

Rome came across the opportunity through a friend towards the end of the school year. She applied but was put on a waiting list. Lucky for her, days later she received her official acceptance and invitation.

"It was a very eye-opening experience, one I will cherish for the rest of my life," Rome reflected. "My job is to prepare students for higher-level science applications, and this experience has given me new tools and ideas for use with students."

The DTRA teacher mentor program is a huge benefit to teachers but also to scientists and the Center.

LEFT: Teacher Joan Rome works with RDECOM ECBC research biologist Daniel Angelini on environmental surface sampling.

RIGHT: Tyler Dufrene (left) and Jerry Cabalo, Ph.D., (right) in the lab.

"Overall, the program conveys the real-world experience and translates to the classroom," Angelini said. "Teachers reach a wide audience of students, so by providing real-world laboratory experiences to teachers like Joan, we ultimately reach those students through her lessons during the school year."

Rome plans to use what she's learned at RDECOM ECBC to meet Next Generation Science Standards, a new set of research-based science standards developed by states to improve science education for all students. Rome's home state of Louisiana is one of more than 20 states that have adopted these new science standards.

"Experiment design is a critical component for scientists so it's one of many things I'm aiming to incorporate into my lessons more frequently to prepare students for undergraduate education," Rome said.

In another RDECOM ECBC facility, research chemist Jerry Cabalo, Ph.D., mentored Tyler Dufrene, a fourth-year chemistry teacher also from Louisiana, in the study of biosensors. Cabalo worked with Dufrene on the testing of an Army-developed sensor alongside a similar, ally-developed sensor. Dufrene helped generate biosimulant aerosol and analyzed the data from the Army-developed sensor with Cabalo guiding him throughout the process.

Dufrene also learned about fluorescence spectroscopy and how it is used in the detection of bioaerosols. Together, they developed ideas for classroom demonstrations of important chemical processes, such as explosions. These ideas are meant to inspire high school students to continue with careers in the STEM professions.

Developing ideas for classroom demonstrations of important chemical processes will help Dufrene answer the all-important student question, "Will we ever use this in real life?" once the school year gets underway.

The program was an amazing experience for Dufrene. Besides learning about ongoing research pertaining to the safety of the warfighter, Dufrene had opportunities at the RDECOM ECBC he would likely not have experienced otherwise.

"I learned how to conduct higher-level experiments in a scientific and professional manner as well as refine my laboratory skills and research methods so that I can improve instruction in my classroom," explained Dufrene. "Interacting with distinguished scientists provided me with a newfound perspective on research and STEM."

Cabalo sees the DTRA program as more than just a teacher mentor program but a means of inspiring future generations of scientists.

"Teachers who participate in the DTRA program are helping America maintain the technological edge by taking their experiences here and sharing them with their students, ultimately inspiring the next generation of STEM professionals," Cabalo explained. "The technological edge helps preserve the lives and health of the warfighters who defend our nation so the need for more STEM professional is critical."

MUSIP students learn about the Field Deployable Hydrolysis System, which RDECOM ECBC used to destroy 600 tons of Syrian chemical warfare material at sea.

Students Develop Advanced Skills Through Army Lab Internships

By Brad Kroner

Nearly a dozen undergraduate college students from across the United States participated in a 10-week internship experience with the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC).

With diverse backgrounds in physics, chemistry, biology, engineering and math, the students came from as far as North Carolina to participate in the Minority Undergraduate Student Internship Program (MUSIP). Through MUSIP, students worked with their mentors, conducted research for RDECOM ECBC and produced presentations on topics of their choice at the conclusion of their internships.

To kick off their internships, students met several RDECOM ECBC scientists and toured a number of labs and facilities.

"You guys have a lot to contribute," research scientist Steve Harvey, Ph.D., told the interns. "This is pretty exciting for us. Just because we're older doesn't mean we know it all. You have fresh, new ideas. We need help with new ideas."

From the onset of their visit, students engaged with scientists, asking questions and learning more about the Center. While touring the Advanced Chemistry Laboratory, students learned about nuclear magnetic resonance spectroscopy — a technique using magnetic fields and radio waves to analyze chemicals and reactions.

"With this tool, we can see the structure of a molecule from the peaks of the audiowaves. Exact chemical structures can be illustrated," said Dennis Bevilacqua, an RDECOM ECBC contractor. "Why do we think we might need to do that?"

"So we can identify what we're working with," answered Anika Zamurd, a Havre de Grace native studying at Harford Community College.

Zamurd, a chemist, is focused on chemistry and biology during her time with the MUSIP program. "I was amazed at how much I had learned already. I was exposed to a lot of equipment that I hadn't used before," Zamurd said. "There was new equipment and programs I had the privilege of using to simulate reactions with enzymes and proteins."

Charles Anderson, a computer scientist who studies at Harford Community College, found out about the MUSIP program the Black Engineer of the Year Awards Conference. His internship had him tasked with working with SharePoint and batchloading processes.

"It was great to learn a lot of new things and take on some new projects," he said. "I was hoping to learn more about batchloading and SharePoint processes. I just soaked up as much as I could. The experience was so beneficial to me."

Chelsey Makell, from Fairmont State University in West Virginia, said she applied to numerous internships, but RDECOM ECBC was closest to home and looked like a good opportunity.

"It was really cool to see new things like this on such a large scale," she said. "I didn't know the Army had so many branches and opportunities."

While observing one demonstration, Kurt Kunkle, a junior bioengineering student at University of Maryland, asked if researchers could put two reactants in the system and then evaluate the reaction.

"Absolutely," Answered Bevilacqua. "You can see the reaction and the byproduct. Each experiment would look unique — we do that all the time."

Kunkle said he knew about the Center from using its data for his own class projects, and he was curious about working at the Center. He worked with his mentor to identify proteins with mass spectrometry.

"I really like a lot of the work here, and I've used data in a lot of my classes," he said. "I had a great opportunity to see how the experiments were performed."

Collaboration Corner

The U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC's) workforce engages frequently with academic, government and industry professionals across the chemical biological defense community. From conference presentations and exhibition displays to formal agreements, we're constantly sharing our expertise and forging partnerships to enable us to better serve the warfighter. Here are just a few of the things we've been up to.

RDECOM ECBC Director Speaks at NDIA Conference

By Shawn Nesaw

Eric Moore, Ph.D., director of RDECOM ECBC spoke about the future of chemical biological defense at the National Defense Industrial Association Chemical, Biological, Radiological and Nuclear Defense Conference in Wilmington, Delaware.. Moore spoke about several RDECOM ECBC focus areas which align with the U.S. Army modernization strategy including advanced obscurants, non-aqueous decontamination technologies and synthetic biology. He also stressed the importance of government-industry partnerships to help improve the greater community. "We're in close collaboration with industry by means of the newly opened Defense Technology Commercialization (DefTech) Center, which allows for new capabilities development," Moore explained. Moore was accompanied by a host of Center personnel who attended his presentation and networked with others in the CBRN community at the exhibition booth.

RAMP MD Extends RDECOM ECBC Partnership to 2023

By Brad Kroner

Regional Additive Manufacturing Partnership of Maryland (RAMP MD) extended its partnership with the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC). The two organizations agreed to a five-year extension through July 25, 2023.

RDECOM ECBC Director Eric Moore, Ph.D. and RAMP MD Executive Director Rick Decker marked the occasion by signing an amendment to the existing cooperative research and development agreement during a signing ceremony at the Center's additive manufacturing facility. This amendment will allow the Center to continue to be an important partner in the advancement of additive manufacturing capabilities within Maryland.

Through workforce training, facilities access and infrastructure development, RAMP MD seeks to leverage public-private partnerships to help advance a burgeoning industry that the RDECOM ECBC has been leading in for nearly three decades. With the equipment and knowledge in-house at the Center, government, private sector and education leaders saw an opportunity to work together to improve the industry and the economy.

Q&A: Frederick J. Cox, Ph.D.

Frederick J. Cox, Ph.D., served as the Acting Director of the Research and Technology (R&T) Directorate at the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC). He exercised responsibility over the robust science and technology program at the Center, which includes 400 government and contractor personnel, and 200 buildings worth $1.8 billion located at the Edgewood Area of Aberdeen Proving Ground, Maryland and at Dugway Proving Ground, Utah. The R&T Directorate applies a broad spectrum of scientific expertise to detect, decontaminate and protect warfighters against chemical and biological warfare agents.

Prior to returning to his normal duties as deputy director of R&T we asked Cox to share his thoughts on his experience as acting director.

Solutions Newsletter: What sparked your interest in science as a young man?

Dr. Cox: A fascination with fireworks and explosives, and a general desire to know how things worked. A great high school chemistry teacher sealed the deal.

Solutions: When was the moment you knew you wanted to dedicate your time and talents to chemical biological defense?

Cox: In college, I had a great opportunity to work as a contractor part time at Naval Air Station Patuxent River doing materials analysis, and that sparked an interest in defense work. Post 9/11, I really wanted to apply my knowledge and skills in chemistry to national defense, and chemical biological defense is the place to do that. The critical moment was when I turned down a more lucrative job in chemical industry to work with a chemical biological defense contractor.

Solutions: After being a contractor for several years, when did you know RDECOM ECBC was the place for you?

Cox: My experience as a contractor was a little different than many, as I worked independently from Edgewood and worked on many Department of Homeland Security and Center for Disease Control and Prevention chemical defense projects. ECBC was always in the background, but a bit behind a curtain. I had a strong desire to be involved in the decision making, not just receiving the decisions, and so working directly for the government was the path to that.

Solutions: What would you say your science niche, expertise is?

Cox: My expertise was originally in mass spectrometry and analysis. Over time, of course, that has broadened into more applied problem solving in chemical analysis.

Solutions: As acting director for R&T, what was the greatest success accomplished during your time?

Cox: I'll leave that for others to judge, but it was very rewarding to have huddles with each of the divisions and address, in near real time, a number of issues the workforce raised during those huddle.

Solutions: What was the greatest challenge?

Cox: Balancing the competing demands between day-to-day operations and strategic engagement.

Solutions: What advice would you pass along to the next R&T director?

Cox: Visit the people and facilities on their turf as soon as you can.

Solutions: How about the workforce? What advice would you give them?

Cox: Stay engaged and take advantage of opportunities. Don't accept the status quo.

Solutions: What makes RDECOM ECBC special to you?

Cox: The people and their work. Many toil daily doing hazardous operations with little notoriety, and are truly world-class experts in their part of chemical biological defense. When they are called upon with no notice during a major crisis or event, they readily respond. Seeing people disrupt their lives to provide expert support with little tangible reward is inspiring.

Solutions: What concept or project are you most excited to see further develop?

Cox: It is hard to pick one project or area. In general, I am most excited at the concept of integrating chemical biological defense capability into more generic equipment that provides solutions for not only CB threats, but also environmental and physical support.

Solutions: Being in an administrative role means less science and more overseeing of science. How do you keep up with the ever-changing information to maintain a solid knowledge base?

Cox: I read multiple newspapers (printed and online) on a daily basis, and then do a deep dive on topics as needed, either online or an occasional journal article or book from the library. Most days I also get a handful of articles, links, or topics sent to me through formal and informal networks.

Solutions: What's your least favorite saying(s)?

Cox: "That's just not possible" or "It's not my job."

Solutions: Finish this sentence, "A wise man once told me…"

Cox: Leading by consensus is more difficult but better in the long run.

Solutions: What are you most known for?

Cox: Good question. Probably stability.

Solutions: What books are you reading?

Cox: I had a stack for summer reading but have only gotten through most of a couple. *Hellfire Boys* by Theo Emery is about the start of the chemical warfare service. *Grunt: The Curious Science of Humans at War* by Mary Roach explores the strange work DoD laboratories do.

Solutions: What volunteering are you doing these days?

Cox: Every summer I do a lot of work at my children's school, as I am on the building and maintenance committee. I just completed installing a shade structure for a playground, spread (with a few helpers) three truckloads of playground mulch, and helped manage a ceiling and lighting improvement project utilizing a state grant.

A Soldier with the 82nd Airborne Division spits into a test tube that researchers from the U.S. Army Research, Development and Engineering Command Soldier Center tested for cortisol levels during a stress shoot test.

Saliva Samples Provide Gauge for Warfighter Readiness

By Brad Kroner

Saliva samples might have implications for evaluating human performance and warfighter readiness, according to ongoing research at the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC).

By isolating and analyzing certain biomarkers found in saliva, scientists can determine a warfighter's physical condition and determine whether to pull him out of combat or to extend the recovery time before re-engaging.

"This data could help draw a correlation between various metabolite biomarkers and warfighter performance; for example relating an increase or decrease in a particular marker to performance in a drill or exercise," said research biologist Trevor Glaros, Ph.D.

Basically, this data could enable leaders to determine a warfighter's status almost like a gas gauge in a car or a health bar in a video game. In doing so, troop deployment can be made more effective and strategic, supporting Army priorities like Soldier lethality.

The study, called Monitoring and Assessing Soldier Tactical Readiness and Effectiveness (MASTR-E), started in late May and was conducted in collaboration with the RDECOM Soldier Center and numerous other Army organizations. The program is being observed at a high level, gaining the attention of multiple generals.

Research under the study is diverse and far reaching, but the RDECOM ECBC's focus is on biomarkers in saliva.

Using liquid chromatography-mass spectrometry (LC-MS), researchers are essentially isolating biomarkers of interest found in saliva and determining which ones might be the best markers of performance. For example, cortisol relates to stress and melatonin relates to the sleep cycle, while lactate relates to muscle fatigue.

Researchers performed a field study with three platoons of paratroopers at Fort Bragg, North Carolina, with saliva samples being taken before, during and after a three-day simulated combat exercise. The field test evaluated Soldiers for strength measurements, sleep, cognition, shooting performance and other exercises.

"We're looking at biomarkers and how they changed over time to see if there's a particular way they respond to physical exertion and stress," explained research biologist Elizabeth Dhummakupt, Ph.D. "With this data, we can say when a specific biomarker reaches a certain level, we should probably pull this Soldier from combat and let him recover."

"We're really focused on looking at Soldiers as they recover," she added. "At what level can we say they're ready to go back to the field?"

Following that study, researchers are now analyzing over 3,500 saliva samples for eight analytes or biomarkers that correlate to performance. As a part of this study, researchers also obtained "Average Joe" saliva samples from private companies for comparison, Dhummakupt said.

"In general, this is just a human performance study," she said. "This could mean something for athletes and even the everyday person."

Devising a process for analyzing the biomarkers required the development of a unique method that now must be refined.

"The literature is sparse in terms of providing a comprehensive technique to look at these analytes," Glaros said. "Our task in the first phase of this work was to develop a method that could rapidly and quantitatively measure these analytes in the samples."

Right now, the process takes just eight minutes, "which is pretty fast for liquid chromatography," Dhummakupt said.

With the first phase -- focused on isolating the eight analytes – nearing completion, the team is now looking for an "X-factor" that they weren't previously looking for.

"At first, we only concentrated on these eight, primary markers," Dhummakupt said. "But if we open up these filters, then you have an untargeted method where instead of only looking at a select few, I'm looking at everything. How does everything change, globally? The point is to see if there's an X-factor or a handful of other analytes that are also changing."

After refining the process and identifying key biomarkers, Glaros and Dhummakupt hope to develop an assay, which could function similarly to a pregnancy test, which could work in the field.

The multifunctional NAP-XPS system was recently installed at RDECOM ECBC.

RDECOM ECBC Expands Capability for Agent-Surface Analysis

By Shawn Nesaw

A new cutting-edge analytical instrument will grant researchers at the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC) the ability to develop highly advanced materials integral to defense technologies including surface coatings, filters and textiles that will better protect the warfighter from chemical threats.

The multisystem will be used to investigate the interaction of chemical warfare agents with the surface of protective materials at the molecular level.

Rather than using one analytical technique, the multisystem uses a combination of near-ambient pressure X-ray photoelectron spectroscopy (NAP-XPS), ultraviolet photoelectron spectroscopy, infrared reflection absorption spectroscopy and mass spectrometry techniques.

The four techniques are incorporated into a single multisystem instrument granting scientists the ability to identify reaction products and follow the chemistry occurring on the surface of materials in real time. The system provides a unique suite of techniques to reveal the surface reaction mechanisms integral for developing advanced materials.

"By testing agent reactions at near-ambient pressures, we're able to simulate real-world conditions, most closely related to what the warfighter may experience."

RDECOM ECBC Research Chemist ***Wes Gordon, Ph.D.***

Research chemist Monica McEntee, Ph.D., managed the technical design, installation and future use of the system, emphasized, "In order to solve difficult scientific questions, one technique is not enough," she said. "Each component of this system will give a new piece of information that will be combined to provide a solid understanding of the interactions between chemical threats and surfaces in real time."

The XPS component measures the number of electrons emitted when special X-rays are applied to a sample, providing detailed information about the elemental composition and state of the agent before and after a reaction has occurred.

While most XPS instruments require ultra-high vacuum conditions, this system can measure data in real time during a reaction at near-ambient pressures, similar to environmental conditions that the warfighter might experience on the battlefield. This capability is important to scientists like Wes Gordon, Ph.D., as they strive to understand how chemical agents behave in the field.

"By testing agent reactions at near-ambient pressures, we're able to simulate agent reactions under real-world conditions, most closely related to what the warfighter may experience," explained Gordon.

The multi-technique system will be used to analyze coatings, paints and other advanced surfaces for military equipment such as tanks, aircraft, weapon systems and even uniforms, to

determine if the coating's surface is resistant to chemical agent. Beyond coatings, the system will analyze emerging filtration and decontamination materials such as zirconium hydroxide and metal organic frameworks to help understand how chemical warfare agents and battlefield contaminants interact with materials of interest.

For example, when a material is exposed to sarin nerve agent, the system can analyze the agent breakdown on the material at the molecular level in real time, informing scientists exactly what elements are left on the surface, the oxidation state of the elements and the types of chemical bonds formed after a chemical reaction.

That means a lot to research chemist Erin Durke, Ph.D, who can then apply what she's learned from the analysis to modify the material to make it better and more effective at protecting the warfighter. "We can see how agent molecules break down to determine our next steps for improving material design," explained Durke.

To secure the funding, contract the best company to design and develop the system, and manage installation, Chemical Biological and Radiological Filtration Branch Chief Amy Maxwell and a group of experienced surface scientists and technicians worked closely with the Defense Threat Reduction Agency's (DTRA) Joint Science and Technology Office (JSTO) and the Government Services Administration for two years.

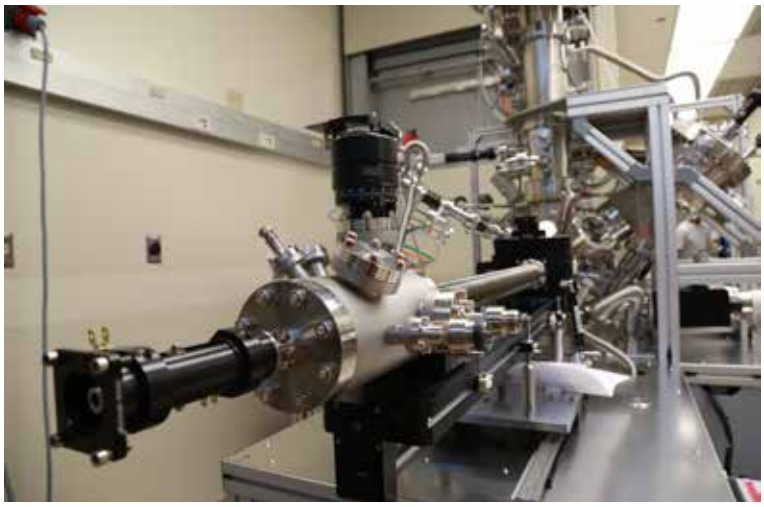
With part of its mission to innovate capability solutions, DTRA JSTO saw an opportunity to solve a capabilities gap and provided the funding necessary to bring the specialized multicomponent system project to fruition. DTRA JSTO is a driving force in the surface science field, moving many applications from basic science to more applied science to ultimately help the warfighter.

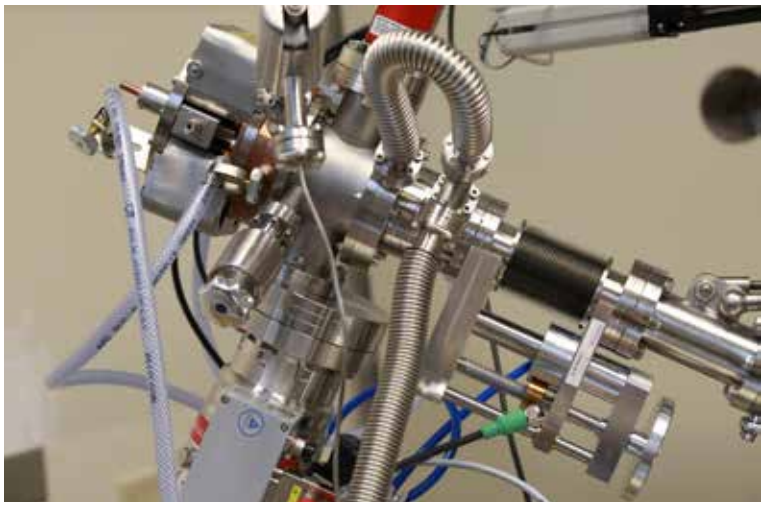
From an Army modernization and priorities perspective, the system capability aligns with goals to create next-generation combat vehicles and enhance Soldier lethality as it supports the development of new, advanced materials for coatings, filters and protective fabrics. Beyond that, the system will also allow scientists to determine basic properties and the reactive nature of advanced materials allowing for the more efficient design and development of protective technologies.

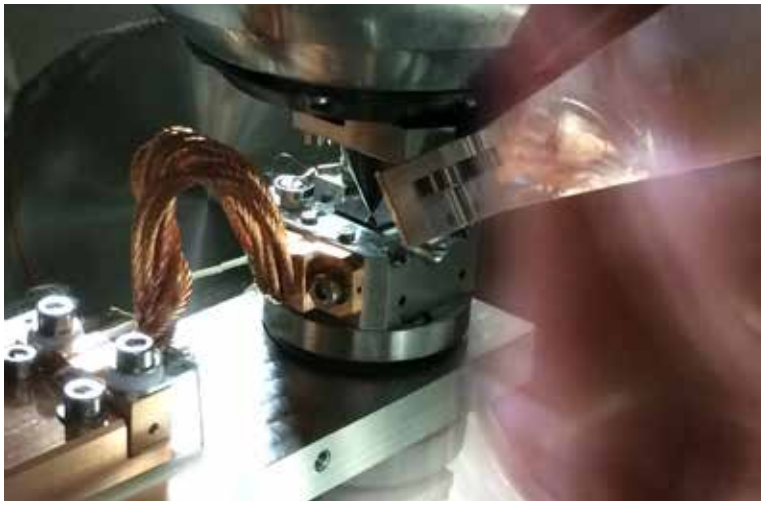
The RDECOM ECBC team will take the next year to run calibration, small molecule and simulant tests to optimize the system to its full potential. Simulant tests consist of research using chemicals similar to chemical agents without the toxic potency. Once their year of simulant testing is complete, then the system will begin testing with chemical agent.

RDECOM ECBC looks forward to sharing the highly specialized capability with other institutions, businesses and customers.

"The level of detail we will receive from the NAP-XPS is unmatched," Maxwell said. "The NAP-XPS increases the Center's surface science capabilities and also provides increased opportunity to help others. We're looking forward to some amazing collaborations in the future with national laboratories, universities, organizations and companies who can utilize the system's data and capabilities to further their research."







Rather than using one analytical technique, the multisystem uses a combination of near-ambient pressure X-ray photoelectron spectroscopy (NAP-XPS), ultraviolet photoelectron spectroscopy, infrared reflection absorption spectroscopy and mass spectrometry techniques.

Individuals from CBARR participated in a hands-on training exercise to learn more about recovery operations during a training event hosted at the Edgewood Area of Aberdeen Proving Ground in August 2016.

Solutions Spotlight: CBARR Recovery Capability

By Shannon O'Hare, Contributing Writer

The Chemical Biological Application and Risk Reduction (CBARR) business unit of the U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC) specializes in performing chemical and biological operations worldwide.

CBARR's broad range of capabilities has allowed the organization to conduct chemical weapon destruction operations, environmental monitoring and sampling, and analysis of chemical destruction technologies. The mission has required the organization to perform activities in more than 30 states and eight countries. The organization partners with commercial clients; federal agencies such as the Environmental Protection Agency, Department of Homeland Security and Centers for Disease Control and Prevention; foreign governments and multinational teams to accomplish complex missions requiring operational knowledge, chemical weapons expertise and diplomatic sensitivity.

The organization serves as the operational arm of the global mission to rid the world of chemical weapons. Key accomplishments include supporting the United Nations Special Commission in Iraq to perform verification and destruction of Iraq's weapons of mass destruction facilities and weapons; assessing and monitoring chemical warfare agent storage and destruction sites in Albania; destroying the Syrian chemical weapons stockpile aboard the Motor Vessel Cape Ray as part of an international operation on behalf of the Organisation for the Prohibition of Chemical Weapons; and destroying chemical weapons that have been recovered across the United States.

Recovering Critical Infrastructure

Imagine a terrorist attack involving chemical agent occurring in the New York City subway system – the largest rapid transit system in the world by number of stations, boasting 472 stations in operation. In 2017, the subway delivered over 1.72 billion rides, making it the busiest rapid transit rail system in the West.

Emergency response is the most exercised and strategized aspect of this kind of domestic terrorist attack. Local, state and federal agencies respond to investigate, secure a perimeter and ensure the safety of people immediately impacted. However, an aspect often overlooked is recovery.

Recovery is a deliberate process to remediate an area potentially exposed to chemical or biological agent for reuse or demolition. CBARR's recovery capability splits into two distinct situations, recovery for reoccupation, and recovery for demolition and disposal.

If an incident involving chemical or biological threats, to include a terrorist attack, should occur at an airport, subway or building, a systematic approach to decontamination and validation of suitability for re-occupancy is necessary. This effort requires coordination with local, state and federal agencies.

"The recovery phase of an event like the New York subway scenario is typically the longest phase – one where you must evaluate the extent of contamination, quickly evaluate decontamination methods and apply resources to rendering the vast transportation network safe," said Brian O'Donnell, project manager at CBARR.

While safety is always the first priority, the impact of such an attack quickly becomes a financial liability to the city and the local businesses serviced by that station. It is estimated that one station closed for 30 days would have a negative economic impact of nearly $10 million.

A CBARR technician conducts operations on a neutralization tower as part of the demolition of a pilot plant facility at the Edgewood Area of Aberdeen Proving Ground.

CBARR operators remove metal from a toxic chamber that was previously used by the Australian Department of Defence for chemical agent training at the Defence Site Maribyrnong in Australia.

CBARR has established multiple processes to recover key infrastructure in a scenario like this. The team would employ a process to partner with a broad range of stakeholders to define and contain the contaminated area, establish engineering controls to allow operators to enter and limit impact to the surrounding area, decontaminate, remove infrastructure, validate that the area is safe for reentry and prepare for reconstruction as necessary. CBARR's core operations involve sample collection, environmental monitoring, waste management and removal, and chemical agent operations to allow full team readiness to deploy immediately, reducing the economic impact sustained during recovery.

Eliminating Environmental Hazards

Other situations involving chemical agent have occurred since the early twentieth century, but that only in the past 30 years, have been recognized as potential environmental hazards. As more hazardous areas are identified, the need for recovery grows.

"Contaminated areas pose a danger to surrounding communities, not to mention these areas could be repurposed to boost local and national economies," said Amy Dean, project manager at CBARR. "As a result, CBARR applies its years of experience and is called upon to apply expertise to eliminate chemical and biological hazards."

CBARR's ongoing mission dealing with chemical weapons is a national asset available to respond quickly to recovery needs around the world. This can alleviate the financial burden of other agencies having to train and maintain an operational asset that potentially never gets used.

Recovery for reoccupation requires CBARR personnel to arrive shortly after an incident, evaluate the suspected area of contamination, develop a plan and begin recovery efforts. Dean explained, "Our evaluation can guide client decision making in terms of whether the issues can be mitigated or if the threat is too great and require infrastructure to be demolished."

The mission is not without challenges. "Some of the more difficult challenges with a recovery mission include the classification and segregation of mixed waste, for example asbestos material that may be agent contaminated. We must ensure that all potential agent sources have been identified and remediated," explained O'Donnell.

Obsolete Labs and Facilities

In some cases there are buildings or facilities that have been used for chemical and biological production, testing or research that are no longer desired due to their age, condition or a change of mission. In these cases a systematic approach is necessary to decontaminate the building, dispose of any hazardous waste and to deem the building as safe/ready for demolition.

On Aberdeen Proving Ground (APG), since the early 1990's, CBARR has employed the capability for the decontamination, equipment removal and verification sampling of the Edgewood pilot plant, which ultimately led to the demolition of the facility. The team then partnered with the U.S. Army Chemical Materials Activity to prepare 13 former-chemical agent production buildings on the installation for demolition. Now, CBARR is engaged in a broad demolition project with installation management organizations to prepare 62 buildings and slabs for demolition across APG.

These local successes have allowed the organization to expand the capability globally. Since 2013, CBARR has conducted operations in support of the Australian Department of Defence to remediate, sample and remove contaminated equipment from a former chemical and biological weapons defense research facility in Maribyrnong, Australia. This multi-year project is paving the way for a $1.5 billion residential construction project.

CBARR plays a critical role in ensuring the safety of its workers and the surrounding community, minimizing further impact to the environment and providing quality remediation and recovery techniques that ultimately lead to stronger national security.

Shannon O'Hare is a program manager for CBARR.

Look Who's Talking

Every year, RDECOM ECBC personnel attend dozens of conferences and engagements across the country and around the world, sharing their expertise in the chemical biological defense space with stakeholders, community members, decision-makers and peers. The following list details many of the speaking engagements and presentions the workforce will participate in between Jan. 1, 2019 and Mar. 31, 2019.

Conference Name: Conferences for Undergraduate Women in Physics

Topic: Dr. Soliz will inform attendees of her career path and the technologies and capabilities resident to the Edgewood Chemical Biological Center; network with students, peers, and potential collaborators.

Personnel: Jennifer Soliz, Ph.D.

Location: Tuscaloosa, AL

Date(s): Jan. 18-20, 2019

Conference Name: 2019 American Society for Microbiology Biothreats

Topic: Rapid Sample-to-Answer for Fieldable Genomic Sequencing-Based Biothreat Identification

Personnel: Peter Emanuel, Ph.D., Calvin Chue, Ph.D., Bryan Rivers, Mark Karavis

Location: Arlington, VA

Date(s): Jan. 29-31, 2019

Conference Name: 58th Society of Toxicology (SOT) Annual Meeting & ToxExpo

Topic: Defense Threat Reduction Agency (DTRA) funded Systems Biology Program with concurrence of the DTRA Program Manager Poster presentation addressing In House Independent Laboratory Research (ILIR) funded project data

Personnel: Elizabeth Dhummakupt, Ph.D., Daniel Angelini, Ph.D.

Location: Baltimore, MD

Date(s): Mar. 10-14, 2019

Conference Name: PITTCON 2019

Topic: Development of Paper Spray Ionization for the Warfighter

Personnel: Trevor Glaros, Ph.D.

Location: Philadelphia, PA

Date(s): Mar. 17-21, 2019

Let's Collaborate!

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Contact the Technology Transfer Office!

We offer a wide range of chemical and biological expertise, cutting-edge facilities and innovative technology solutions to our partners.

Our partners include:
- Government agencies
- Private-sector companies
- Academic institutions

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usarmy.ecbc.techtransfer@mail.mil
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Publications and Patents

Quarterly listing

This page contains a list of U.S. patents recently awarded to the RDECOM ECBC and a list of peer-reviewed journal articles recently published on research conducted by RDECOM ECBC scientists. Both lists span dates from May 1, 2018 through September 30, 2018.

PUBLICATIONS

(RDECOM ECBC authors in bold)

Title: Total Synthesis of Chaetoglobin A via Catalytic, Atroposelective Oxidative Phenol Coupling
Author(s): Kang, H; Kozlowski, MC; **Torruellas, C;** Liu, J
Source: POLYMER **Volume:** 140 **Pages:** 140-149
Published: September 21, 2018

Title: Three-Dimensional Carbon Nanotube Yarn Based Solid State Solar Cells with Multiple Sensitizers Exhibit High Energy Conversion Efficiency
Author(s): Grissom, G; Jaksik, J; **McEntee, M; Durke EM**; Sayeeda TA; Cua M; Okoli O; Touhami A; Moore HJ; Uddin MJ
Source: SOLAR ENERGY **Volume:** 171 **Issue:** 10 **Pages:** 16-22
Published: September 1, 2018

Title: Sensitive Detection of Live Escherichia Coli By Bacteriophage Amplification-Coupled Immunoassay on the Luminex® MAGPIX Instrument
Author(s): Mido, T; Schaffer, EM; Dorsey, RW; Sozhamannan, S**; Hofmann, ER**
Source: JOURNAL OF MICROBIOLOGICAL METHODS
Volume: 152 **Issue:** 9 **Pages:** 143-147
Published: September 2018

Title: An Estimate is Worth About a Thousand Experiments: Using Order-Of-Magnitude Estimates to Identify Cellular Engineering Targets
Author(s): Metcalf, KJ; **Lee, MFS;** Jakobson, CM; Tullman-Ercek, D
Source: MICROBIAL CELL FACTORIES **Volume:** 17
Article Number: 135
Published: August 30, 2018

Title: Electron Injection From A Carboxylic Anchoring Dye to Tio2 Nanoparticles in Aprotic Solvents
Author(s): Fang, H; Wu, YH; **Kuhn, DL; Zander, Z; DeLacy, BG;** Rao, Y; Dai, HL
Source: CHEMICAL PHYSICS **Volume:** 512 **Special Issue:** SI
Pages: 93-97
Published: August 17, 2018

Title: Assessing Deep and Shallow Learning Methods for Quantitative Prediction of Acute Chemical Toxicity
Author(s): Liu, RF; Madore, M; **Glover, KP; Feasel, MG;** Wallqvist, A
Source: TOXICOLOGICAL SCIENCES **Volume:** 164 **Issue:** 2
Pages: 512-526
Published: August 2018

Title: General Approach to Estimate Error Bars for Quantitative Structure-Activity Relationship Predictions of Molecular Activity
Author(s): Liu, RF; **Glover, KP; Feasel, MG;** Wallqvist, A
Source: JOURNAL OF CHEMICAL INFORMATION AND MODELING **Volume:** 58 **Issue:** 8 **Pages:** 1561-1575
Published: August 2018

Title: Trace Level Analysis of Sarin and VX in Food Using Normal Phase Silica Gel and Ultra-Performance Liquid Chromatography-Time-of-Flight Mass Spectrometry (UPLC-TOF-MS)
Author(s): Bae, SY; Winemiller, MD
Source: JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY
Volume: 66 **Issue:** 29 **Pages:** 7846-7856
Published: July 25, 2018

Title: Dielectrophoretic Nanoparticle Aggregation for On-Demand Surface Enhanced Raman Spectroscopy Analysis
Author(s): Salemmilani, R; Piorek, BD; Mirsafavi, RY; **Fountain, AW;** Moskovits, M; Meinhart, CD
Source: ANALYTICAL CHEMISTRY **Volume:** 90 **Issue:** 13
Pages: 7930-7936
Published: July 3, 2018

Title: Comparative Characterization of the Sindbis Virus Proteome from Mammalian and Invertebrate Hosts Identifies nsP2 as a Component of the Virion and Sorting Nexin 5 as a Significant Host Factor for Alphavirus Replication
Author(s): Schuchman, R; **Kilianski, A;** Piper, A; Vancini, R (Vancini, Ricardo); Ribeiro, JMC; Sprague, TR; Nasar, F; Boyd, G; Hernandez, R; **Glaros, T**
Source: JOURNAL OF VIROLOGY **Volume:** 92 **Issue:** 14
Article Number: e00694-18
Published: July 2018

Title: Stand-Off Deep-UV Raman Spectroscopy
Author(s): Arnold, BR; Cooper, CE; Matrona, MR; **Emge, DK;** Oleske, JB
Source: CANADIAN JOURNAL OF CHEMISTRY **Volume:** 96
Issue: 7 **Special Issue:** SI **Pages:** 614-620
Published: July 2018

Title: Synthesis and Characterization of Segmented Polyurethanes Containing Trisaminocyclopropenium Carbocations
Author(s): Lambeth, RH; Baranoski, MH; Sayage, AM (; Morgan, BF; Beyer, FL; **Mantooth, BA;** Zander, NE
Source: ACS MACRO LETTERS **Volume:** 7 **Issue:** 7
Pages: 846-851
Published: July 2018

PATENTS

Non-Energetic Resin-Based Ogive Smoke Fill
Patent number 10,053,395
Issued 21 Aug 2018

Cable Tie With Multi-Slot Head For Attachments
Patent number 10,053,268
Issued 21 Aug 2018

Pyrotechnic Iodine Smoke Generation For Counter-Biological Application
Patent number 10,028,504
Issued 24 Jul 2018

OPAA FL - A Mutant Enzyme With Increased Catalytic Efficiency on Organophosphorus Compound GD
Patent number 9,976,130
Issued 22 May 2018

Self-Indicating Porous Metal Hydroxides Incorporating Metal Reactants For Toxic Chemical Removal and Sensing
Patent number 9,958,397
Issued 1 May 2018

Solutions

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Send article suggestions, questions or comments to:

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