Solutions

U.S. Army Combat Capabilities Development Command
Chemical Biological Center

NEWSLETTER
Q2 FY2020

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Director's Message

Past, Future Accomplishments Start with People

Eric L. Moore, Ph.D., is the director of the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center, the only chemical and biological defense technology center of its kind. He is a member of the Senior Executive Service and is an expert in chemical and biological defense and medical countermeasures.

Prior to his selection as Center director in October 2017, Moore served in various roles at the Defense Threat Reduction Agency including chief of the Advanced and Emerging Threat Division, chief of the Basic and Supporting Sciences Division and senior science and technology manager for chemical medical countermeasures.

WITH THE START OF A NEW CALENDAR YEAR, it's natural that we reflect on our accomplishments and look forward to the challenges that lie ahead. It's been a year of changes and accomplishments at the CCDC Chemical Biological Center, and you'll find articles featuring some of our most successful people, projects and programs of 2019 in this issue of Solutions.

It is not a coincidence that I list people first. The quality of our projects and programs is a direct reflection of the innovation and professionalism of our people. As Army Chief of Staff Gen. James C. McConville notes in The Army People Strategy, "We win through our people, and people will drive success in our Readiness, Modernization and Reform priorities. We must take care of our people."

Our most impressive accomplishments over the past year have been achieved by people from different disciplines and organizations working together toward common goals. For example, Soldiers, scientists, engineers and program managers from multiple organizations came together to design, prototype and demonstrate the upgraded sensor suite of the Nuclear, Biological and Chemical Reconnaissance Vehicle. The new sensor package allows Soldiers to perform threat detection remotely and on the move, greatly improving their margin of safety.

We expanded our communication with Soldiers throughout the year, allowing for person-to-person interactions early in the development process to help us make sure that our modernization efforts are focusing on the right requirements. Efforts like the CBRN Warrior Integration Program (CWIP) and the Warfighter Innovation Leveraging (Mission) Expertise (WILE-E) programs bring Soldiers into the Center to meet and work with our technical experts.

We sent our people in the field in demonstrations and exercises like Perceptive Dragon 3, Joint Warfighter Assessment 2019 and the Chemical Biological Operational Analysis 2019, allowing them to see first-hand how Soldiers use their equipment in the execution of multi-domain operations.

We continued long-standing collaborative programs like Coffee with Colleagues, which brings together hundreds of Center employees from various disciplines to showcase their work and to learn about the contributions their colleagues make to our collective mission. And we celebrated with events like the Gas Mask Dash race and fun run and the dedication of our statue, "Cum Scientia Defendimus–With Science We Defend" in honor of our employees and the Soldiers they serve.

We are committed to ensuring that today's workforce has access to the educational and training tools needed to maintain the expertise required to protect Soldiers from chemical and biological threats.

The Combat Capabilities Development Command is at the forefront of the Army's efforts to enhance readiness and lethality, modernize doctrine and equipment, and reform business practices to save money and reinvest in the Army modernization priorities. It's our people who will drive us to success. As noted in The Army People Strategy, "equipment does not learn, understand, innovate, build cohesive teams, or exercise judgment – people do."

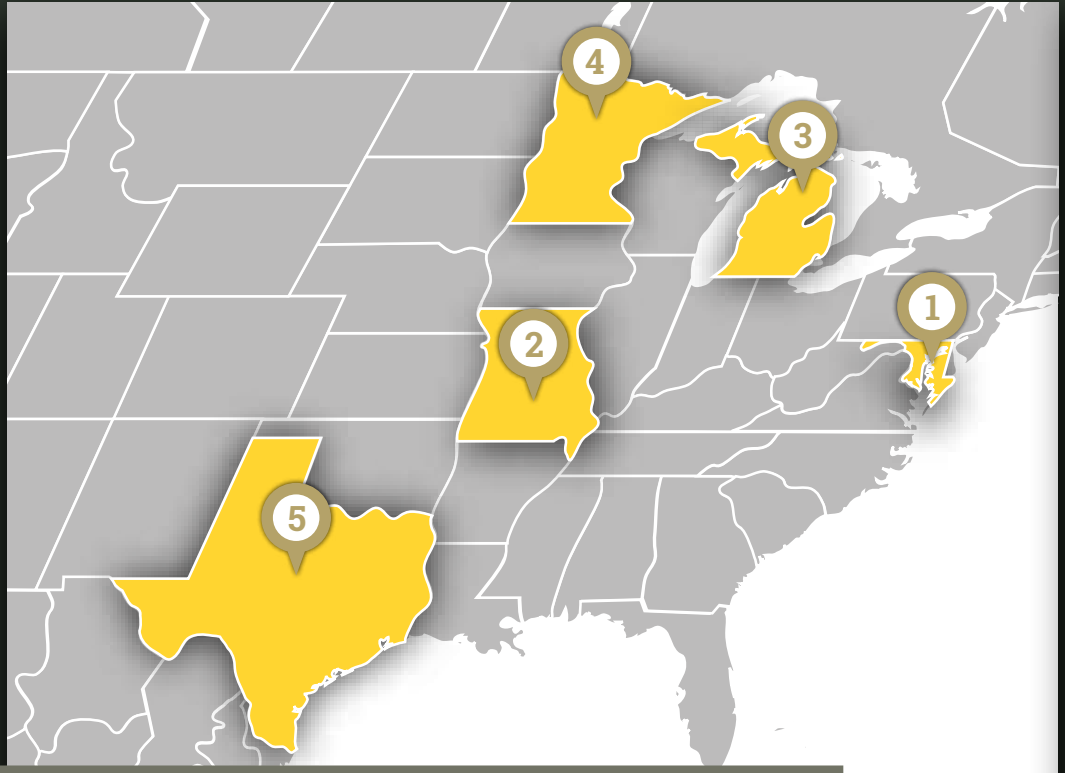
At the Chemical Biological Center, we are committed to ensuring that today's workforce has access to the educational and training tools needed to maintain the expertise required to protect Soldiers from chemical and biological threats. We will continue and expand our efforts to create a pipeline of talent focusing on science, technology, engineering and mathematics as well as diversity to help ensure that our next generation workforce is up to the challenge of protecting our Soldiers on tomorrow's battlefield.

Finally, as we drive into a new year, I invite the entire Center workforce to join me in reaffirming our commitment to the Army Values – Loyalty, Duty, Respect, Selfless Service, Honor, Integrity and Personal Courage. These values provide our moral compass, an infallible point of reference. They drive our efforts against detractors like sexual harassment and assault, substance abuse, discrimination, domestic and workplace violence, and suicide. When in doubt, we can turn to the Army Values for a powerful affirmation of what is right.

I look forward to a year of challenges, a year of innovation, and a year of victories. I look forward to a year spent with the outstanding people of the CCDC Chemical Biological Center.

"People first — winning matters — Army strong!"

Eric L. Moore, Ph.D.
Director, CCDC Chemical Biological Center



CCDC Chemical Biological Center In the Field

THE CCDC CHEMICAL BIOLOGICAL CENTER 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, 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 **Maryland** – Center personnel participated with Joint Product Manager Chemical, Biological, Radiological, Nuclear and Explosives Analytics and Response Systems to field the Analytical Laboratory System-Material Work Order (ALS-MWO) to the 32nd National Guard Bureau civil support team located in Fort Meade, Maryland in September. The ALS-MWO allows the civil support teams to respond to CBRNE incident sites with identification and assessment of hazards, advice to civil authorities, and facilitation of follow-on military forces during emergencies and incidents.

2 **Missouri** – CCDC Chemical Biological Center's Advanced Design and Manufacturing Division worked with CDTF leadership at Fort Leonard Wood to conceptualize and produce entirely new training environments that provide a heightened sense of realism and immersion through high-resolution, high-quality background imagery composed of HD composite photography and 3D renderings.

3 **Michigan** – Center employees traveled to Warren, Michigan in September to provide engineering support of the M26 Field Maintenance Technical Manual validation and verification. CBC members provided input to troubleshooting and maintenance work packages as well as information on parts availability, nomenclature, part numbering, usage and technical characteristics. The updated technical manual will provide warfighters with updated and enhanced instructions on how to maintain M26 Joint Service Transportable Small Scale Decontaminating Apparatus.

4 **Minnesota** – CCDC Chemical Biological Center personnel led the Joint Project Manager Chemical Biological Radiological Nuclear Sensors team Dismounted Reconnaissance Sets Kits and Outfits (DR SKO) missions at Camp Ripley in Little Falls, Minnesota Sept. 29 through Oct. 2. Center personnel led training and fielding support for the operator and maintainer-level training to the Minnesota Army National Guard's 434th Chemical Company. The DR SKO is a set of mission-specific kits that significantly improves the warfighter's capability for detection and presumptive identification, personal protective equipment, decontamination equipment, marking, sampling, decision analysis, reporting and support tools.

5 **Texas** – CCDC Chemical Biological Center representatives observed preliminary tests in October of the Agnostic Compact Demilitarization of Chemical Agents Expeditionary Destruction System (EXDS) at the Southwest Research Institute in San Antonio, Texas. This DARPA-funded project seeks to develop EXDS's unique technology for use by the military to destroy chemical agents in the field. EXDS will be transported to APG for additional testing with actual mustard and GB chemical agents in 2020.

6 **Japan** – Center personnel provided equipment assessment and operator refresher training to the 311th Military Intelligence Brigade at Camp Zama, Japan Oct. 28 through Nov. 1. Employees provided technical assistance for the M50 Joint Service General Purpose Mask, M4 Joint Chemical Agent Detector, AN/UDR-13 Radiac Set, AN/VDR-2 Radiac Set, M41 Protective Assessment Test System, and AN/PDR-75A Radiac Set to ensure warfighter proficiency and readiness.

A member of the West Virginia National Guard 35th Civil Support Team wears a prototype of the CCDC Chemical Biological Center respiration protection system as he performs a mock chemical materials investigation of a building.

Photos by Shawn Nesaw

More Time in the Hot Zone

Center develops lighter, longer-lasting respiratory protection system

By Brian B. Feeney, Ph.D.

WHEN AN INDUSTRIAL ACCIDENT releases toxic industrial chemicals, the first responders are usually that state's National Guard civil support team (CST). They suit up in full-body protective gear and enter the hot zone. One of the major challenges they face is how long their respiratory protection system allows them to stay there.

Currently, responders often rely on a closed-circuit self-contained breathing apparatus (SCBA) within a full protective ensemble which is hot, heavy and thirsty – heat builds up inside it, it weighs 36 pounds, and the wearer cannot drink water while in it. It has a four-hour use limit and requires wearing a bubble suit that restricts motion and increases thermal burden on the user.

A 'Closed System' Closes in on Time

"The 'closed' in closed system is that the user inhales and exhales on the same breathing loop, no exhalations are made to the outer environment. But it comes with a four-hour time limit," said Jon Sampson, a U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center mechanical engineer. He is the project team leader for the research in designing the replacement system, known as the Full Spectrum Respiratory Protection System (FSRPS).

"Civil support team responders have told us that the four-hour time limit in the current system really reduces their effectiveness," Sampson said. "When they suit up they have to do equipment checks and then get to the mission site, and upon leaving the site have to be decontaminated, all the while using up time within that four-hour window. On average, they have only one hour in the hot zone."

Also, the problem of heat stress in the current system can be reduced by using ice to cool the breathing loop, but ice is very heavy, logistically complicated to supply, and it melts fast. And, the need to rehydrate during a mission is not addressed at all.

Building a Better System

Presented with these limitations, the CCDC Chemical Biological Center design team got to work. "We knew we had to center our solution around mission availability – more time in the hot zone. We also knew we had to reduce weight, lower the internal temperature, and get rid of the need for ice," said Sampson. "So we teamed up with one of our sister Army research laboratories, the CCDC Soldier Center, and used a couple of their design innovations. These included adding a streamlined, body-forming uniform with built-in chemical agent protection and a tube for hydration to our system.

The team also used an existing technology when they added a cooling plate to replace bags of ice. They even added miniature fans. They were able to further reduce weight by incorporating ultra-high-pressure gas cylinders which can hold the same amount of oxygen in a much smaller and lighter container. The team fitted all the external parts together in a compact, easy to don and remove backpack weighing only 24 pounds.

However, the real breakthrough that dramatically increased time on site for CST members was to employ two different respiratory protection modes in one system, making this a combined unit respirator.

In "PAPR" mode, a powered air purifying respirator uses a fan to push ambient air through the filter, purifying it as it

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enters the suit and maintaining positive pressure. It can be used for eight hours. Adding PAPR to the closed circuit gives operators up to 12 hours of protection.

Closed-circuit SCBA mode uses the existing closed-circuit technology of carbon dioxide absorption from the breath stream combined with injections of oxygen to maintain the optimal levels of oxygen while keeping carbon dioxide to a minimum. It also replaces ice with a much lighter cooling plate and uses the M53 mask with its hydration tube. It can be used for three hours, but the design team is confident that it can be extended to at least four with some further design optimizations.

By switching between modes in response to the threat level around them, operators no longer have to dig into their precious four hours of closed-circuit time while going through equipment checks, while being transported to the site and during decontamination.

Warfighter Testing

The entire effort was funded by the Defense Threat Reduction Agency (DTRA) and they had a big test waiting for this system. Called the Chemical Biological Operations Analysis (CBOA), it was established to test emerging chemical and biological defense technologies. It was held on Aug. 22 at Camp Dawson in Kingwood, West Virginia.

Industry, academic, and government laboratories were invited to bring their latest chemical and biological defense prototypes to place in the hands of warfighters to use in realistic missions. The military operators then provided candid feedback on the prototypes' usefulness and recommended improvements.

The 35th West Virginia National Guard Civil Support Team located in St. Albans, W.Va., was assigned the task of testing the Full Spectrum Respiratory Protection System prototype. The 35th's mission is to support civil authorities at a domestic chemical, biological, radiological, nuclear or explosive (CBRNE) incident site by identifying agents and substances, assessing the consequences, advising on response measures, and assisting with requests for additional state and federal support.

During CBOA, two teams from the 35th practiced investigating an abandoned structure containing a series of rooms for the presence of CBRNE materials. One team wore the current system, the other wore the FSRPS prototype. The team with the FSRPS prototype had all the advantages of available drinking water, a body cooling system, more time on site, and no bubble suit. These operators reported back that they were very satisfied with all the advantages offered by the ensemble and were very glad to have the longer mission duration.

Next Steps

With this phase of prototype development completed, Sampson and his design team will work with manufacturers in private industry to develop a next generation prototype that combines all the innovations they have created thus far plus further refinements based on their latest laboratory-generated performance data. This next generation prototype will be subjected to rigorous field testing, and that data will be incorporated into the design of the final system. Ultimately Sampson looks forward to the system's widespread use by National Guard CSTs all over the nation.

Members of the West Virginia National Guard 35th Civil Support Team wear prototypes of the CCDC Chemical Biological Center respiration protection system in a side-by-side comparison test with current respiratory protection technology.

New CBRNE Urban Training Area in the Works

By Gay Pinder

THEY SAY IT TAKES A VILLAGE to raise a child. For Carrie Poore, Ph.D., Advanced CBRNE Training Branch chief, it takes a village, or something much like one, to properly train Soldiers to recognize the manufacturing of weapons of mass destruction (WMD) made from chemical, biological, radiological, nuclear and/or explosive (CBRNE) materials. Soon a combination of double-wide modular homes, shipping containers and large sheds will form a mock village at the U. S. Army Combat Capability Development Command Chemical Biological Center to provide an ideal urban training environment for recognizing WMD targets.

"If you're doing something nefarious, would you do it somewhere where someone is going to find you?" Poore said. "Where's the one place that you could do it and nobody is going to find you? In your house. Having this training environment where we can simulate housing is important because Soldiers need to know how to recognize agent activities in a house."

National Guard Bureau weapons of mass destruction (WMD) civil support teams (CSTs) respond when local law enforcement encounters a suspicious chemical, biological, radiological or nuclear set up. "CSTs are requested by their state or territory leadership to respond and characterize a site by taking a sample which is then assessed to see what processes are occurring at that particular location," Poore said. "It is a public safety matter. You want to make sure the people in the surrounding area aren't in any danger."

There are 57 civil support teams around the nation. Each state has at least one, the District of Columbia has one and the territories of Guam, Puerto Rico and the Virgin Islands each have one.

Poore's team trains the CSTs in how to identify small or large-scale WMD production sites, basic agent characteristics, what personal protective equipment (PPE) to wear, how to wear it, and how to conduct decontamination should a CST come in contact with agent. Agents that can be used as WMD include anthrax, sarin, lewisite, VX, botulinum toxin, smallpox and other chemical and biological materials.

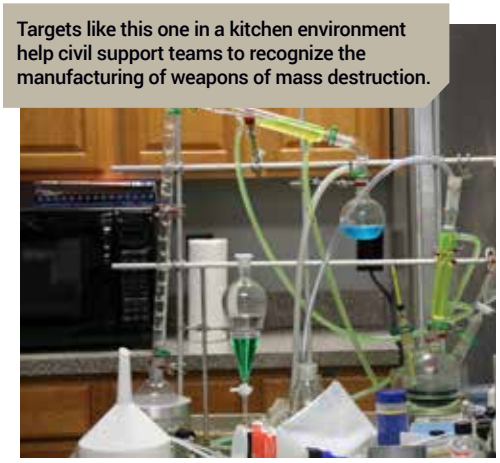
"We start with classroom activities where we go through chemical and biological agents and their characteristics, then we go to hands-on activities," Poore said. Hands-on training includes knowing how a processing target operates. "We can do everything from a hardware store bucket model process to a more sophisticated set up consisting of glassware that you would see in a synthesis laboratory," Poore said. "We'll often have them go to their area hardware store and have them design their own clandestine lab. The best way to teach them how to mitigate an agent processing target is for them to understand how it works."

Until two years ago, the Advanced CBRNE Training Branch had a training village on post at Skipper's Point to conduct that hands-on training. "There was an area of Soldier housing that was no longer in use," Poore explained. "We asked if we could use it until the houses were torn down."

While constructed on post, the houses were operated by an outside contractor. Through a series of liability waivers, the Advanced CBRNE Training Branch was allowed to use the houses for about 10 years. "When we had Skipper's Point, we had about 52 houses," she said. "You just don't come across places like that very often. We could set up a number of training scenarios and just leave them."

Photos by Gay Pinder

Engineering Technician Alfred Ciolfi of the Advanced CBRNE Training Branch stands with new containers that will simulate home environments for Soldier and first responder urban training.



Targets like this one in a kitchen environment help civil support teams to recognize the manufacturing of weapons of mass destruction.

Designed to offer unique scenarios for training using simulant chemical and biological agents, the unused housing could accommodate 20 teams without needing to rearrange any scenarios.

Time finally ran out on the agreement and Poore's team had to stop using the housing units. "We have to set these scenarios up all over post now to offer enough scenarios to adequately train teams," she said.

Poore said her team has become adept at transforming any available building into an appropriate training site, but they are actively working on building a new village. "One of the advantages of Skipper's Point was that it was a community of houses," Poore said. "So CSTs would respond to the scenarios as if they happened in a community. We want to re-establish that as quickly and as cheaply as possible."

Right now, Poore has the funds to purchase three double-wide modular homes, eight 20 ft. and 40 ft. Conex boxes (shipping containers) and two sheds. "I have four 40 ft. ConEx boxes paid for; there are two across post waiting for site approval to put them in place and there are two more on the way," Poore said.

"We're going to rig the ConEx boxes with doorways so we can set them up in one configuration and then change them again to allow a completely different configuration. We can exploit the properties of all of the different boxes/sheds/modular buildings so we can change the overall structure of the houses as needed," she said. The ConEx boxes can be lifted with a crane or forklift, both available on post.

Collaboration Made NBCRV's Sensor Suite Upgrade Possible

Provided by CCDC Chemical Biological Center and JPEO-CBRND Public Affairs Offices

Photos provided by JPEO-CBRND Public Affairs

WHEN CONFRONTED WITH CHEMICAL, BIOLOGICAL, RADIOLOGICAL AND NUCLEAR (CBRN) THREATS, Soldiers must rely on advanced capabilities to save lives. The quick delivery of this specialized equipment, including vehicles, sensors, sampling tools and software, requires expert collaboration and an innovative acquisition process. Time is of the essence on the battlefield.

In late 2018 and early 2019, the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center and the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND) embarked upon a collaborative modernization effort to enhance the capabilities of the main vehicle used by CBRN Soldiers – the Nuclear, Biological and Chemical Reconnaissance Vehicle (NBCRV).

Using a new acquisition process to accomplish the upgrade of the sensor suite package on the NBCRV allowed the collaborative team to experiment with rapid prototyping and test early opportunities to quickly deliver the capability to the Soldier. The new process followed the model developed by the Army Futures Command's Army Modernization Priorities in late 2017, which lead the Army to undertake a series of modernization and acquisition reforms aimed at promoting efficiency and cost-effectiveness.

The modernization of the sensor suite package incorporated six specialized chemical agent sensors into one uniform package, bringing the NBCRV sensor capabilities up to date with current technologies and ultimately readying the NBCRV for modern Army maneuver support. The upgraded sensor suite package will help reduce Soldier exposure to CBRN threats because it will perform remote and on-the-move detection.

"At its core, the current NBCRV is 23-plus-year-old technology and in that 23 years technology has grown and developed, but so have the threats," explained Lt. Col. Jeffrey Strauss, JPEO-CBRND Joint Project Manager for Reconnaissance and Platform Integration. "Due to its wide usage among the CBRN community and our mission to support CBRN Soldiers, developing a suite of sensors that met modernization and readiness expectations of the U.S. Army was our goal."

New Acquisition Process

Instead of using the traditional approach, the acquisition process became streamlined through a modified work order (MWO), allowing equipment to be modified after fielding. JPEO-CBRND used the MWO as the NBCRV fielding took place 23 years ago. This process led to expedited acquisition to meet the Army's capability and readiness standards through rapid prototyping.

Pivoting away from the traditional programming, this process involved a series of steps before product development, including material solution analysis, prototyping, technology maturation and risk reduction. Strauss reflected on the streamlined acquisition by adding, "The rapid prototyping on this project allowed us to get the project to the Soldier, then quickly figure out what didn't work, so the team could learn early, find solutions and press forward."

The timeline was aggressive. In just 150 days, the team of teams would design the package, procure the sensors, develop

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The integrated CBRN mounted reconnaissance capability was demonstrated at the Joint Warfighter Assessment 2019 on a manned Stryker NBCRV and an unmanned ground system called the Squad Maneuver Equipment Transport

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the software, assemble the prototype and test all components internally before presenting six complete sensor suite upgrade prototypes to stakeholders at the Joint Warfighting Assessment (JWA) 2019.

"Our goal is to support the warfighter by delivering the best equipment, at the right cost, and at the right time," said Douglas Bryce, Joint Program Executive Officer. "This means looking at our acquisition approach and deciding on a path that best meets these goals. For the NBCRV SSU, switching from a traditional acquisition strategy to one of rapid prototyping made the most sense and, as we saw at JWA 19, it was a successful approach."

According to the U.S. Army website, JWA 19 is the U.S. Army's leading modernization assessment; weaving material solutions, multi-domain operations (MDO), MDO formations, concepts and capabilities at echelon into the Army's largest joint, multinational, live, virtual and constructive exercise aligned to the U.S. Indo-Pacific Command area of operations. JWA 19's mission is to provide critical insights and feedback on Army modernization efforts.

"The nature of the project was intense because we quickly needed to address the changing and evolving threats on our adversaries' side through a faster and leaner acquisition process to prepare early for the potential CBRN threats," said Joel Gwinn, JPEO-CBRND Capability Set 2 project lead.

The Right Team Assembled For A Collaborative Effort

Selecting the right team for the project proved critical to its success. JPEO-CBRND led the new acquisition process and served as project lead, while members of the U.S. Army CBRN School at Fort Leonard Wood provided insight on the future mission that would help drive the sensor integration, fabrication, and software support provided by the Chemical Biological Center.

"I have never seen this level of collaboration amongst enterprisers as we have before this project," said Scott Kimmell, deputy commandant of the U.S. Army CBRN School, senior lead for capability development. "There were no lulls or doors separating communication between capability and advanced developers. We achieved more than we imagined."

Eric Moore, Ph.D., Director of the CCDC Chemical Biological Center shared similar praise, "This was collaboration at its best. Our researchers provided the expertise and critical knowledge needed to mold JPEO-CBRND and the CBRN School's vision into a working application."

The CCDC Chemical Biological Center's Product Development Facility provided design and fabrication support while the Center's NBC Battlefield Integration Branch provided software development and training support over the course of the project.

With a path forward and a razor-thin timeline to develop working prototypes ready for testing the following April, teams got to work.

"Leadership involvement from all teams helped drive the collaboration. Knowing there was buy-in from a higher level and open lines of communication with leadership allowed us to adhere to timelines setting us up for success," Gwinn said.

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The NBCRV SSU integrated six CBRN sensors with communications equipment, unmanned aerial vehicles, unmanned ground vehicles, and computing equipment.

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Using the new acquisition process customized and implemented by JPEO-CBRND, the Center partnered with the Defense Production Agency Joint Technology Office to determine what was physically achievable when developing the SSU using a combination of knowledge of current and future technology. At the same time, the Defense Threat Reduction Agency (DTRA) worked to design potential alternatives for technologies and determined if the new technologies met military requirements, once developed.

An exciting innovation in this project involved the use of augmented reality. The Center used a Microsoft HoloLens to see the current NBCRV with digital holograms overlaid on top of the vehicle. Together, subject matter experts from the science and technology, acquisition and academic communities used the lenses to observe the new design before it was created, thus creating a mechanism for experts in all fields to collaborate using the early opportunity to address issues, fix them and get the final product to the Soldier.

Software and Hardware Development

To achieve the Army's goals of readiness and modernization, JPEO-CBRND assessed available technology to upgrade the sensor suite package on the NBCRV allowing it to autonomously perform reconnaissance. As part of this process, JPEO-CBRND also faced the challenge of identifying technology suitable for all CBRN sensors given that chemical, biological, radiological and nuclear agents are not built and created the same.

Using the identified technology, a team of engineers at the Chemical Biological Center's NBC Battlefield Integration Branch, developed the complex software required to allow Soldiers to operate all of the new sensors, the Deep Purple Unmanned Aerial Vehicle (UAV) and the technology that would translate all the data from those sensors to usable information for the Soldier and the chain of command.

Maxwell Bottiger and a team of software engineers at the Center worked to develop the user interface and auto-piloted software Soldiers would use from inside the NBCRV to run reconnaissance missions, interrogate potential chemical threats and provide useful information back to leadership and to other troops.

To develop the housing and layout of the sensor package, the team looked to the Center and its rapid prototyping capabilities to address challenges.

"With the goal aimed at developing a proof of concept for the Army to sink its teeth into, we challenged ourselves to think like an operator," said Peter Bryant, industrial specialist at the Center. "In doing so, careful consideration was taken for sensor placement around the vehicle -- that they all worked in concert with each other -- so the entire package met the needs of the Soldier."

The Center brought its rapid prototyping capabilities to bear to seamlessly support sensor integration, fabrication, and software development.

"The rapid prototyping capabilities of the Center are a real asset to not only Center researchers but to our partners," said Moore. "The ability to design and fabricate something brand new or make an improvement on a current technology makes us agile and highly sought after, especially as new acquisition projects like this one become more common."

"This rapid prototyping approach, along with working closely with the maneuver community, is a great example of how we can operationalize technologies on behalf of the warfighter," Moore added.

Strauss agreed. "As a government facility, the Center was able to leverage government labs, was familiar with core technology, was more able to adapt to change and had previous experience with sensor suite technology," he said.

VIP Day served as the first touchpoint for the team of teams in development of the sensor suite upgrade. With the sensor suite at 85 percent completion, the team tested the new technology in front of senior executive

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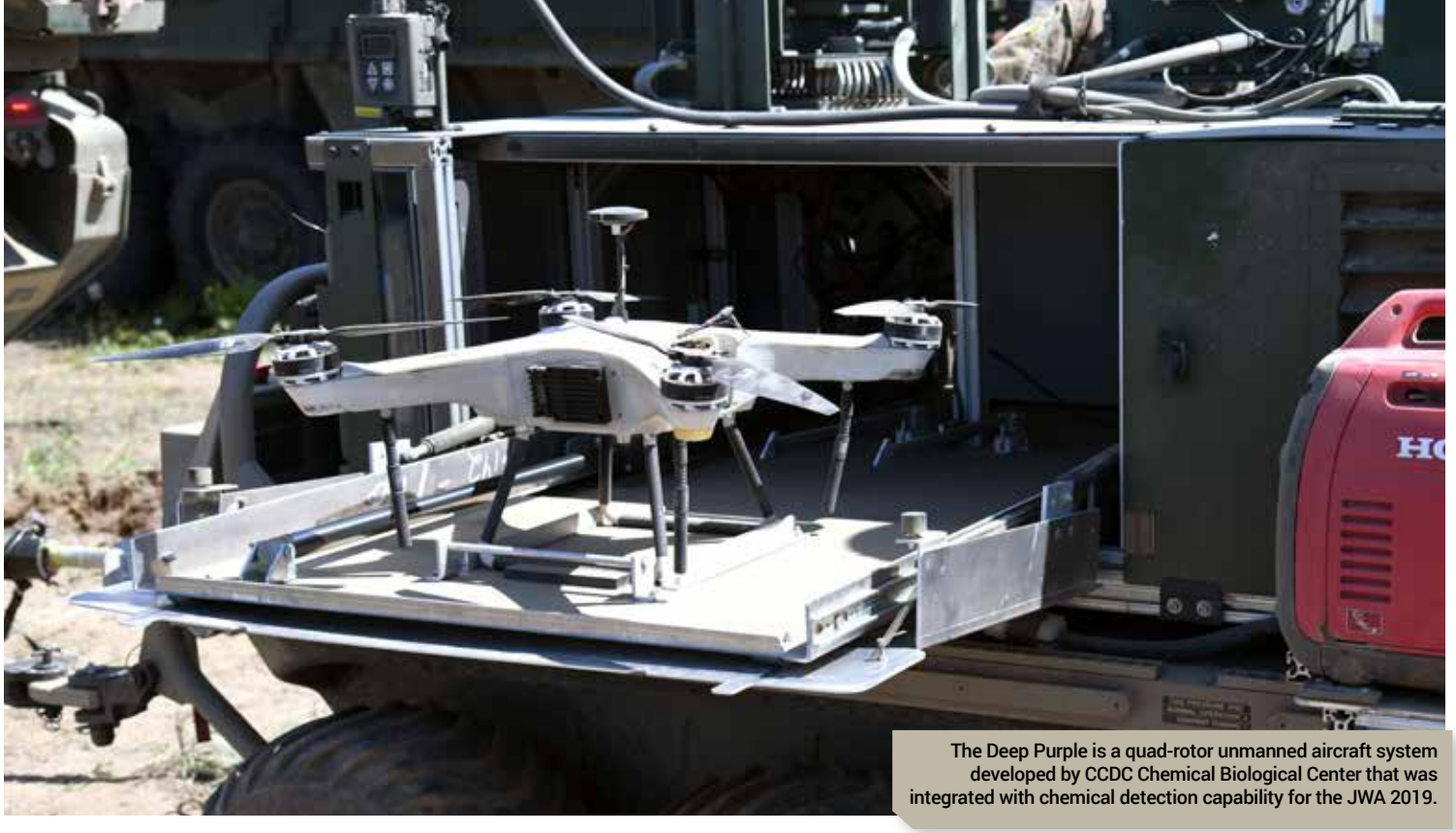
The NBCRV SSU uses unmanned systems teaming with a manned platform, leveraging land and air robotic platforms and sensor technologies to detect and identify hazards and communicate back to the commanders making decisions.



The Deep Purple is a quad-rotor unmanned aircraft system developed by CCDC Chemical Biological Center that was integrated with chemical detection capability for the JWA 2019.

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leadership across JPEO-CBRND, the Center, the CBRN School and DTRA. Using the feedback received, the teams made adjustments to the structure and layout of the sensors in preparation for the second test at JWA 19.

Strauss felt very positive with the overall outcome of VIP day. "The collaboration was exposed to the next layer of management, showing what collaboration and teaming could do in a short amount of time," he said. "VIP day got the stakeholders to continue to want to partner with JPEO-CBRND and the CCDC Chemical Biological Center. The consensus was this was an unprecedented leap forward in capability."

Training for JWA '19

The Alabama National Guard (ANG) sent a team of Soldiers to train on the operation of the NBCRV and the new sensor suite package in preparation for JWA 19.

"JPEO-CBRND chose the ANG Soldiers because a team was needed that wasn't familiar with the system. This allowed us to train them sufficiently, which demonstrated the usability of the system," explained Dale Perry, JPEO-CBRND field operations lead for the NBCRV Team.

Once the Soldiers began training on the system, development teams transitioned to a training and support role, eliciting feedback and incorporating specific changes to the system. The Soldiers spent a month training at the Center to operate the vehicle and its sensors effectively.

To ease the pressure of training on several brand-new systems, Center engineers transferred the same software from inside the NBCRV onto tablets. The Soldiers trained in a classroom using the tablet simulators before stepping in the vehicle which allowed for early Soldier feedback. "Working closely with Soldiers made the changes to the software turnkey," said Bottiger.

"We received Soldier feedback one day and by the next training session, their feedback was incorporated into the training simulator," Bottiger said. "By the time the Soldiers were heading to JWA 19, they were well trained and ready for the assessment."

Center and JPEO-CBRND subject matter experts (SMEs) attended the training sessions to field questions and troubleshoot issues with the Soldiers, something Sgt. Chantelle Colbert of the 690th CBRN Company, Alabama National Guard appreciated. "SMEs were on-site to replace software and walk us through processes so we could learn to troubleshoot independently," Colbert said.

"During the training in Aberdeen, if we found anything that could have been improved, or anything that could help the systems or help the Soldier's ease of use with the systems, SMEs were on the spot to make those changes," said Sgt. Brittany Mattison, 690th Company. "They made so many changes and improvements to the systems in just that short amount of time, and it is really amazing to see. As a Guardsman, you don't really get to see or do this type of stuff often, so it was a privilege."

Based on feedback from the SMEs involved, the NBCRV's JWA 19 debut ran smoothly, performing well in all scenarios in the demanding landscape of the Yakima Training Center in Washington.

Looking Ahead

Moving forward, the team will assess how the vehicle performed, make refinements and provide guidance to contractors working on Capability Set 2, which will make improvements to the first iteration, all in preparation for JWA 20 in Poland.

"We know what we know about the adversaries and, based on lessons learned through the development of the original sensors, we know what our gaps were with the old systems," said Gwinn. "The collaborative process will continue while adhering to another fast timeline during the development of Capability Set 2 with the goal of fielding the SSU in 2022."

The Army must also use current information to predict possible future CBRN threats and use that knowledge to make additional technological advancements to the sensor suite. Beyond that, improvements to increase the speed of maneuver, increase adaptability to different environments, increase capability for stand-off detection and create a more deliberate system are important goals for the team to meet.

With CBRN threats evolving quickly, it is imperative the Soldiers receive advanced capabilities to address the threats and protect themselves. In order to recognize, research and produce these capabilities, JPEO-CBRND, the Center and industry partners must continue to use the rapid prototype acquisition process and collaborative team model. Timeliness, accuracy and efficiency remain the most important components in getting capabilities to the Soldiers."

Photos by Shawn Nesaw

Master Sgt. John Binot speaks with John Davies during one of the final WILE-E meetings at the Center.

Soldiers and Scientists Share Perspective and Knowledge

By Shawn Nesaw

TWO SOLDIERS WITH REAL-WORLD EXPERTISE and knowledge of the chemical and biological defense challenges facing warfighters on the Korean peninsula spent 10 days sharing that knowledge with researchers at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center.

Capt. Matthew Grout and Master Sgt. John Binot, Soldiers from the U.S. Army 1st Theatre Tactical Signal Brigade, Camp Humphreys, Republic of Korea visited the Center for a 10-day professional development assignment under the Center's Warfighter Innovation Leveraging (Mission) Expertise and Experimentation (WILE-E) program.

This latest interaction with warfighters continues a WILE-E initiative to open lines of communication between scientists and Soldiers to encourage better and more frequent interactions.

After participating in "deep dive" discussions on chemical hazard mitigation and several days of focused dialogs with the WILE-E team and subject matter experts (SME) from different branches of the Center, the warfighters provided researchers with a chemical, biological, radiological, and nuclear (CBRN) overview of the Korean theater. A "town hall" open Q&A session followed allowing researchers to further explore topics with the warfighters.

"The purpose is to provide CBRN knowledge and professional development to key military members in a tactical unit, and to share warfighters' perspective with CCDC CBC staff on unit CBRN defense needs and to help with current and future needs," said Megan Hower, WILE-E program architect.

The WILE-E Program

WILE-E is a Center-led initiative to bring a multidisciplinary team of Center scientists, engineers, technicians, analysts and logisticians together to solve Soldiers' real-world operational challenges. Direct interactions with Soldiers allow scientists and engineers to focus on providing the Soldier with meaningful solutions. At the same time, Soldiers learn more about the work being done in support of CBRN defense and gain a better understanding of what the Center can do for them.

At the onset of the WILE-E program, the team received a simple problem statement, "Slime happens, how do we get back in the fight?" Over the course of the next few months the team began to be challenged by a more basic problem — communication.

With this problem in mind, the WILE-E team moved to shortcut traditional channels of communication by hosting events bringing together warfighters and SMEs from commodity areas within the Center—detection, protection, and decontamination—to collaboratively tackle the problem of contamination mitigation through an operational lens. WILE-E unofficially dubbed these events FOXCONs, or future oriented experimenter conventions.

The FOXCONs were the first solution or prototype developed by WILE-E in an effort to err on the side of action and fail early.

"Communication between the Soldier and the scientists was, and still is, a real stumbling block in the research and technology community," said Ann Kulisiewicz, research chemist. "By identifying modernization opportunities during our FOXCON sessions that are actually relevant to the Soldier, it created an opportunity to open new lines of communication and fortify those lines for future engagements."

The Center's civilian workforce can sometimes feel far removed from the warfighter, leading to the development of technologies and "solutions" that don't solve the warfighter's real problems.

"I think we could have a bigger influence if we had more direct contact with the warfighter," said Kulisiewicz. WILE-E was an opportunity for Center researchers to stop and think, to consider the possibilities, to identify the true warfighter needs, and have meaningful discussions to determine the best course of action.

One of the main ways Center researchers currently interact with Soldiers is through the CBRNE Warrior Integration Program, but it was clear to the WILE-E team that touchpoints had to be increased. Through WILE-E, Soldiers were coming to the Center more frequently and meeting with several SME's during the course of their visit to ensure they had the most impact.

The first phase of WILE-E resulted in a lot of networking but also new relationships and even projects. Several projects were started between warfighters and SMEs based on technologies. "They talked about a problem and a SME was doing some research that could help," said Kulisiewicz.

"It's been a good experience; I've learned a lot," she continued. "Especially in terms of requirements. It's nice to take a step back from the research and the final product and think about what the requirements should be versus what they are on paper."

"It's important that access to the warfighter is easier for the next team," said Don Lail, multimedia specialist at the Center. "We have worked to blaze trails to the warfighter, we want to make sure those trails are maintained."

Warfighter Insights

Though many Soldiers participated in discussions with the WILE-E team throughout the summer, one FOXCON participant—Scott Farrar, of the U.S. Army CBRN School—

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arranged for two CBRN Soldiers to visit the Center directly from active duty in Korea. One of these Soldiers was Master Sgt. John Binot.

"These are age-old problems, but Soldiers have never had a platform to discuss the issues like this," said Binot. "Now you have the Soldiers involved to pinpoint the issues they face which steers the direction of the solution. We're moving in a way to benefit the warfighter."

"It's really important and I think a group like this needs to be enduring. They need more Soldiers, more warfighters, in these groups so researchers can get a more well-rounded understanding of the problems," Binot said.

Binot is familiar with interfacing with researchers. He supported Tactical Cross Domain Solution, ongoing improvements to Dismounted Reconnaissance Sets Kits and Outfits, and has participated in tabletop discussions like the ones with the WILE-E team.

"Letting warfighters guide discussions early on in the development process has a lot of benefits including cost efficiency and potentially less iterations of a product before fielding to the warfighter," Binot said.

During the day's tabletop discussions with the WILE-E team, Binot reflected on his field experiences and the biggest challenges he and his team face during missions.

"Assessment and documentation of a site have a lot of challenges," he said. "We have very little time to document a site which means snapping a few photos and filling out reports while wearing bulky protective gloves which makes writing an arduous task."

In a technology-centered world, the solution to Binot's challenge might seem simple, a specialized camera or maybe augmented reality, but Binot doesn't see it that way.

"While technology does have its place and can be very helpful in the field, many warfighters would attest to the fact that technology does fail, sometimes at the most inopportune times, which means relying on my mind. The training we've had will almost always be faster and more reliable than a piece of equipment."

"It's that mindset, that feedback that truly helps move the needle for the WILE-E team," said Kulisiewicz. "Researchers need to know how the warfighter thinks, feels and acts because those aspects will help us researchers give warfighters the real solutions they need. But researchers might never hear that type of feedback because they don't have access to warfighters frequently enough."

Another Option

Throughout the course of WILE-E, it became apparent the CBRN community had resources they didn't realize were available. Those resources are the men and women trained as CBRN Soldiers once they complete their enlisted career.

Currently, many CBRN Soldiers, after completing their military careers, will transition to large chemical companies or a similar field because "that's where their skills take them, the skills they gained in their enlisted career," said Lail.

"There's an opportunity for CBRN Soldiers to transition to civilian positions at the Center following their enlistment," Lail said. "The Army has already invested a lot of time and money into these specialists, so it makes sense to bring them back so we can hear their perspective."

It's unclear if there's a formal process to make a transition from CBRN military service to CBRN civilian service but the team sees a benefit in defining a process in order to make it a viable option.

"You need someone in the room during development who can lend their in-the-field expertise early on to influence the design process. It would save you time and money in the long run," said Lail. "If we started to bring Soldiers into civilian roles at the Center, we would eventually have an entire culture more focused on relevant operational problems."

"We're trying to build an environment that opens the conversation between SMEs and Soldiers to solve big problems and develop solutions that meet the warfighter needs the first time," he continued.

At the conclusion of their time at the Center, Grout and Binot presented to the Center's workforce, translating the warfighter's operation perspective in such a way that the researchers could relate to it and could assess how their current research or potential research could better address the warfighter's needs.

"It was clear during the presentation that some researchers were surprised by what they were hearing," said John Davies, a Center research physicist on the project team. "While we're in the business of 100 percent decontamination, Capt. Grout said warfighters would like an 80 percent clean up solution. Something that would allow warfighters to keep moving instead of having to stop or slow down the mission because they came across a CBRNE hazard."

The two Soldiers received dozens of requests for further discussions from researchers and program managers following the presentation.

While the first iteration of the WILE-E program has come to an end, the team laid the foundation for what the WILE-E program could be, opening a lot of doors to further the communication efforts across the Center and taking steps to nurture the relationships between Soldiers and the civilian workforce.

Capt. Matthew Grout and Master Sgt. John Binot took time to present operational information from the field to the Center's workforce in an effort to increase transparency for researchers.

Sgt. 1st Class Robert Olson and Jennifer Sekowski, Ph.D., talk with Soldiers about the Pocket Detection Pouch at DTRA's most recent CBOA event.

U.S. Army Photos

Center Invests in Easy-to-Use, Lightweight Field Screening

By Brian B. Feeney, Ph.D.

SIZE, WEIGHT AND POWER - when it comes to chemical and biological detection in the field, keeping these requirements to a minimum can make a very big difference. With individual detection instruments adding up to ten pounds or more to a Soldier's already full pack, U.S. Army Combat Capabilities Development Command Chemical Biological Center scientists Jennifer Sekowski, Ph.D., and Kelley Betts wanted to know if there might be a better way. Could something small, lightweight, power-free and inexpensive perform as well as traditional detection equipment, but also be small enough to fit in a Soldier's pocket?

The idea for the Pocket Detection Pouch (PDP) came about when Betts, a scientist and an Army wife, began to question why so many biological detection technologies require tubes or cassettes to operate. With the average Soldier carrying at least 60 pounds of equipment, Betts understood that every ounce added to a Soldier's gear matters, and wondered - was there a way to put a combination of both chemical and biological detection technologies into something lightweight and cheap, like a plastic bag?

"I questioned the traditional paradigm that threat agents can only be analyzed using a test tube or cassette," said Betts. "I wondered if we could test using something different, like perhaps a pouch.

To make it work, the pouch had to be designed with a one-way flow so that a single liquid sample could be squeezed into individual compartments, each containing a unique detection test. Also, because the device was designed to require no power to operate, any test results would have to be colorimetric and readable by eye. After a lot of trial and error, an assortment of heat sealers and plastic bags, and a very messy kitchen, a prototype for the Pocket Detection Pouch was born.

The idea for the pouch was further developed when Sekowski proposed the technology to the Chemical Biological Center IDEAS Program, where she was awarded $65,000 and six months to develop the technology to simultaneously test for the presence of synthetic opioids and chemical agent by using lateral flow immunoassays as well as M8 and pH paper-based assays.

Short for Innovative Development of Employee Advanced Solutions, the IDEAS program was started in 2012 to award seed money to Center researchers with promising ideas. Under this program, Sekowski, Betts, and colleague Dan Angelini, Ph.D., who is experienced in sample collection, further refined the Pocket Detection Pouch's design to be about the size of a credit card when folded and also included a variety of sampling devices that could be tailored to different user requirements. They also made the outer layer of the pouch out of a thicker plastic bag material to provide a better level of containment.

The PDP is made to easily fit inside a Soldier's pocket, and at less than half an ounce, is so lightweight it can be carried anywhere without adding to a Soldier's already heavy load. To use the device, a sample of suspect material is placed inside the primary compartment where water or a buffer is added. The liquid is then squeezed down into the individual testing lanes containing the individual colorimetric tests.

After about 10 minutes, if a color change occurs, the yes/no results are compared to a key card included in the pouch and the Soldier can immediately alert his or her commander whether more determinative sensors need to be brought to bear. The PDP is designed to provide presumptive identification of agents in the field, but is also designed to store a sample for any needed follow-on testing.

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The lightweight Pocket Detection Pouch easily fits in a Soldier's pocket and requires no power source.

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Under the 2019 IDEAS program, the PDP was successfully shown to detect the presence of synthetic opioids and chemical agent, but Sekowski and Betts don't want to stop there. They hope to adapt commercial DNA-based biological detection, as well as existing up-and-coming paper-based explosives, chemical, and radiological detection methods into the PDP to provide what they refer to as "the full CBRNE" in one shot.

Sekowski and Betts would also like to develop the PDP for wide area surface sampling by connecting the PDP with the Mano, a one-handed wide-area environmental surface sample collection device developed at the Center. The Mano was designed to simplify sampling while wearing mission oriented protective posture (MOPP) gear in hazardous environments. By attaching the PDP to the Mano, immediate testing of samples in the field could be performed to help Soldiers and their commanders make immediate operational decisions, as well as allow for follow-on testing of those samples back in the laboratory.

The PDP was championed by Sgt. 1st Class Robert Olson, the Center's technical noncommissioned officer.

"It is imperative that the warfighter is included in the beginning idea stage," said Olson. "Doing so allows researchers to learn directly from the warfighter how their idea can improve the overall performance of the Soldier's mission."

Additionally, Carrie Poore, Ph.D., the Center's Advanced CBRNE Training Branch chief, was able to get the pouch into the hands of National Guard Soldiers taking courses offered by her branch. The Soldiers provided valuable constructive feedback to help refine the PDP's practicality and design. For example, they suggested adding a strip of tape to both sides of the sample holding compartment at the top of the bag so that someone in the field wearing protective gear could collect the sample using heavily gloved hands.

Olson also supported the PDP's participation in DTRA's FY19 Chemical/Biological Operational Analysis (CBOA) Technology Concept Feedback Tent where it received positive and constructive feedback by participating warfighters.

Chemical Biological Center Develops Software to Track Deadly Materials

By Brian B. Feeney, Ph.D.

DEPARTMENT OF DEFENSE (DOD) RESEARCH LABORATORIES HANDLE SOME OF THE MOST DEADLY AGENTS and toxins in the world in order to research technologies to defend warfighters against them. Accounting for those materials as they move from the laboratory in which they are generated to other research laboratories around the nation and the world to their ultimate deactivation is vital. DoD stood up the Biological Select Agents and Toxins (BSAT) Biorisk Program Office (BBPO) in 2016 to ensure that BSAT materials tracking and accountability meet the highest standards possible.

That's where the Combat Capabilities Development Command (CCDC) Chemical Biological Center comes in. Under Army Directive 2016-24, the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND) holds direct responsibility for the information system that tracks and maintains BSAT materials. To accomplish this mission, JPEO-CBRND needed customized software that would be absolutely reliable for use by DoD laboratories that handle BSAT material. That's when the phone rang at the Center's Knowledge and Data Management Branch located at Rock Island Arsenal, Illinois.

Although there was an existing BSAT tracking software program developed by a contractor already in existence, it had numerous bugs and could not support new features necessary to expand and refine tracking. The BBPO and JPEO-CBRND wanted software that could evolve over time to keep up with new and emerging BSATs, new best practices based on lessons learned, and facility surety improvements. So the programmers at the Knowledge and Data Management Branch got to work.

"We wanted to design a system in which BSAT material could be sent from one principle investigator (PI) to another in a way that would fully transfer ownership of it, and we wanted to do it in a smooth way because they have enough to do as it is with their research," said Lauren Herkes, a business analyst in the branch and one of the chief architects of the software system. "So we worked closely with the PIs at the Army Medical Research Institute of Infectious Diseases, which was to be one of the first DoD labs to go online with the new system. We let them put our beta version through its paces and learned straight from them what worked well and what parts of the system needed further development."

In all, the effort took 14 months. During this time, the branch had to keep the old system going by applying the digital equivalent of band aids as needed. Then, when the launch of the new system approached, the team performed three dry runs. "We had to make sure that the transition would be flawless," said Herkes. In order to minimize disruption, they performed the actual launch during Washington's Birthday weekend in February 2018. It took the team around eight hours to make the transition, and when the researchers returned to work the next week, they had a working system that was considered a 90-percent solution.

Photo by Richard Arndt

Lauren Herkes of the CCDC Chemical Biological Center's Knowledge and Data Management Branch at Rock Island Arsenal works with the BSAT Application Dashboard.

> ***"We wanted to design a system in which BSAT material could be sent from one principle investigator to another in a way that would fully transfer ownership of it, and we wanted to do it in a smooth way because they have enough to do as it is with their research."***
>
> *Lauren Herkes, Business Analyst, CCDC Chemical Biological Center - Rock Island*

The new system received good reviews from the PIs using it. "They told us the BSAT Application Dashboard is intuitive and allows lab members to easily search and find their samples using a wide variety of search criteria," said Herkes.

The team spent the next few months perfecting and routinizing system maintenance. Now Herkes and the team perform a comprehensive test for bugs, known as a 'smoke test,' every week, and they regularly document full compliance with DoD's requirements for the system to the BBPO, the formal owner of the system. In September 2018, they added a feature that confirms the time, place and efficacy of BSAT agent deactivation. Deactivation data is both automatically routed to personnel responsible for agent destruction, and auto-archived for reporting purposes.

The other DoD laboratories that handle BSATs and use this software are the CCDC Chemical Biological Center; the Naval Surface Warfare Center Dahlgren Division in Dahlgren, Va.; the Navy Medical Research Center in Bethesda, Md; and prior to their divesture from the DoD BSAT program, the Air Force Research Laboratory at Wright Patterson Air Force Base near Dayton Ohio.

Reflecting on the achievement, Herkes said, "One main reason why the BSAT Application transition was so successful is because our team at Rock Island has very talented software developers, and they are dedicated to supporting our BSAT Application users. The other success factor was the amount of time that the researchers at the labs spent with us to help us understand their business processes, which we were then able to convert to system processes. We are fortunate to have such a great group of users to work with and we are happy to continue supporting them."


Photo courtesy Nathan Adams

Employee Spotlight: Nathan Adams

NATHAN ADAMS IS A CONFIGURATION MANAGER and Army materiel developer at CCDC Chemical Biological Center – Rock Island. He graduated from Iowa State University in 2006 with a degree in mechanical engineering and after two years in the private sector began his government career with the Center at Rock Island in 2008. Adams is a lifetime Iowan, and he and his wife have three young children. Solutions posed a series of questions to Adams recently to give readers an inside perspective on one of the Center's young engineers.

Solutions Newsletter: Why did you decide to pursue mechanical engineering as a career?

Nathan Adams: We had a college and career prep class at my high school, and a variety of professionals came to speak at our school. The one who really stood out to me was a parent of one of my classmates, who shared about his career as an engineer. It seemed like a great fit, as I was pretty good at math and loved to design and build things, and I liked that it offered a good salary on just a four-year degree.

Solutions: What led you to seek employment at CCDC CBC Rock Island?

Adams: My first job out of college was in the private sector, and I was not enjoying the work environment and the high pressure. I heard through a friend from church that an organization at Rock Island Arsenal called ECBC (now CCDC CBC) was hiring engineers, and that it was a great place to work, so I applied. After an interview and an agonizing four-month wait, I found out I got the job.

Solutions: What aspect of your job do you enjoy the most or find the most rewarding, and why?

Adams: After starting at ECBC, I was immediately impressed by the sense of camaraderie among the engineers-everyone on my team was happy to take the time to help each other with their projects, and this seemed to be true of the other teams as well. Though the operations tempo has certainly increased since I started 11 years ago, I would say that this sense of teamwork and cooperation is still very much present here.

Solutions: What is the most challenging project you've worked on?

Adams: That would be a project I'm currently working on. As the configuration manager for two chem-bio end items currently in the sustainment phase, I am responsible for ensuring that all requirements are met as these items are produced. Unfortunately, we are experiencing an issue with a performance requirement for one of the raw materials, while at the same time, demand for the end items has seen a sharp increase. We have managed to mitigate the risk through testing to ensure that the product is not affected, but the issue has kept our team very busy as we work to identify the root cause and brief status updates to our management and outside customers, while balancing a heavy workload from other sustainment and developmental projects.

Solutions: What are your career goals?

Adams: This may not be so much a personal goal as an organizational one, but I would like to be a part of growing our relationship between the sustainment engineers here at CCDC CBC Rock Island and the joint project managers, to ensure that sustainment concerns are given a priority in the early stages of a developmental program. As an Army materiel developer for a couple of programs, I do have some input, but I don't see a meaningful shift in priorities on issues such as technical data rights happening until there is greater representation in these programs from people with a sustainment background.

Solutions: Who is your hero or role model?

Adams: This is a difficult question as there have been many key influencers in my life. One of my role models would be a mentor at my church. He is diligent and hardworking and is seen by many as a leader, though not in an official capacity. He sets an excellent example as a servant leader. Another role model is a manager at work who does a great job of balancing tasks and relationships both inside and outside CCDC CBC. He values others' contributions and yet challenges them to do more. I've also seen how he has worked to build upon those relationships and grow our organization.

Solutions: What advice would you share with young STEM professionals considering careers with the government?

Adams: It is a great career move; though it may not seem as exciting as many private sector engineering openings, there are plenty of opportunities for advancement once you get your foot in the door. Additionally, the government tends to be more accommodating to family life and work-life balance than private sector employers.

Solutions: What's the most important lesson you've learned thus far in your career?

Adams: I've learned a lot about team work. I have had the privilege of being a part of a great team and being a team leader at times. As major projects or urgent tasks have come up, I've learned how to take initiative and ownership. The workload and pressure of these responsibilities has also pushed me to learn to delegate.

Solutions: You are married with three young children. How do you balance your professional responsibilities with your family life?

Adams: It starts at home. My wife has been very supportive of my career, and is an awesome stay-at-home mom to our precious kids. We are also blessed to have family within driving distance, so that is very helpful. On the other side of things, my management here at work is very good about accommodating personal plans and needs if at all possible when planning for TDY.

Center Team Leads Research in Explosives Contamination in Soil

By Gay Pinder

IN A FIRST EVER SOIL SCREENING EVALUATION, researchers at the U.S. Army Combat Capabilities Development Command Chemical Biological Center have developed a way to measure the contamination levels of explosives in soil.

Setting a Standard

"During the normal course of operations at testing or training ranges like Aberdeen Proving Ground (APG) in Edgewood, Maryland, contaminates are released into the environment and that can impact different environmental compartments such as air, water and soil. We are particularly interested in soil," said Kuperman, a research biologist.

Once contamination occurs, it must be dealt with. "The question is how do we know what 'clean' is? How much contamination can we no longer tolerate?" Kuperman posed.

If contaminants exceed certain levels, there may be repercussions such as regulatory consequences, or disruptions to site operations or training. Site compliance with government regulations is necessary to ensure contamination does not exceed a critical mark which can also affect trainees and others using the operational ranges. An array of chemicals commonly show up in soil samples at contaminated sites. The Environment Protection Agency established Ecological Soil Screening Levels (Eco SSL) for 25 common contaminants that are frequently found in soil at Superfund sites based on a wealth of scientific literature. Eco SSLs are defined as concentrations of chemicals in soil that, when not exceeded, will be protective of terrestrial ecosystems from unacceptable harmful effects. However, after conducting an extensive literature review of their own, Kuperman and colleagues Michael Simini, Ph.D. and Ron Checkai, Ph.D. (retired) found that no such standards that are protective of soil organisms existed for energetic materials – explosives and propellants.

"There are traditional energetics that have been used for decades like TNT, RDX, HMX and DNT that are continuing to be released in the environment through operations on active ranges, and on legacy sites like old ammunitions plants," Kuperman said.

Kuperman and his team conducted over 70 ecotoxicological assessments and determined toxicity benchmarks that were used by the EPA to derive draft Eco SSLs for explosives for use in the United States. They also drafted related environmental tolerance values (ETV) for use in ecological risk assessments at explosives-contaminated sites in The Technical Cooperation Program (TTCP) member countries that include Australia, Canada, New Zealand, and the United Kingdom.

The Eco SSLs are a one-way screen used in screening level ecological risk assessments (ERA) to identify those contaminants in soil that warrant additional evaluation with a baseline ERA, and to eliminate those that do not.

"Now at assessed sites when you have quantified concentrations of contaminants of concern, you can screen those concentrations against our values that we deem are safe for soil organisms," Kuperman explained.

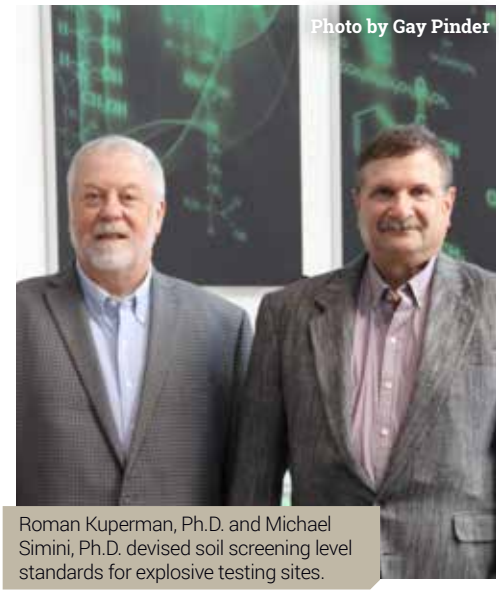


Photo by Gay Pinder

Roman Kuperman, Ph.D. and Michael Simini, Ph.D. devised soil screening level standards for explosive testing sites.

Legacy sites like some APG ranges may have areas designated as Superfund sites where the EPA has determined that a substantial health risk to people or the environment exists. Those sites may require remediation.

The decision that leads to remediation is a multi-step, multi-phased approach that starts with problem formulations.

At any given site, if an issue is found, a screening level assessment is completed. "Risk assessors collect soil samples at a contaminated site and determine what the concentrations of the contaminants are and if any of the contaminants exceed screening levels," Kuperman said. "If they do then a baseline ERA may be necessary, which is expensive and may lead to actually removing the site soil and replacing it with clean soil."

The team provided draft Eco SSLs to EPA which review the research and findings and then release the official results.

Contamination Remediation

Dealing with contamination remediation is a technical issue and there are a variety of options. In situ bioremediation allows scientists to address the problem on site. For some explosives and propellants, scientists are using microorganisms that can biodegrade them.

"Degradation of nitroaromatic explosives like TNT by bacteria is often poor because of the explosive's stable aromatic ring. Degradation rarely exceeds 40 percent. However, greater degradation rates through mineralization potentially could be achieved by using certain enzymes from white-rot fungus," Kuperman pointed out.

"The same characteristics that help white-rot fungi to break down recalcitrant lignin molecules in the decomposing wood also can be used for splitting the carbon rings in the nitroaromatic explosives. Scientists are developing strains of those microorganisms that are specifically geared toward degrading the explosives."

Some of the remediation projects are geared toward in situ or on-site detoxifying and degrading contaminants while others try to sequester the problem chemicals.

"We had some projects here on the installation where scientists were using activated carbon to sequester polychlorinated biphenyls or PCBs and mercury in our creek," Kuperman said. "As a legacy site, we take the responsibility for remediating what was done generations ago."

New Generation of Explosives

Kuperman and his team are also developing draft Eco SSLs for a whole new generation of explosives — insensitive munitions (IM) compounds. The military services are evaluating several IMs for future weapon systems to replace traditional munitions that contain highly sensitive explosives such as TNT and RDX, with the aim of improving the safety of munitions. The development of risk-based regulatory levels like draft Eco SSLs for soil organisms will advance the assessment and protection of the terrestrial environment at defense installations, in case IM compounds are released into soil environments.

"It's only a matter of time until these new explosive compounds are used in the field," Kuperman said.

Kuperman and his team are developing ecotoxicological data to fill the knowledge gaps regarding ecological risks of IM compounds released into the terrestrial environment. These data will be used to derive draft Eco-SSLs for IM compounds in soil and will also aid in making knowledge-based decisions during evaluation of the exposure risks at impacted sites. When appropriate, the data will also be used in developing remedial actions that ensure the management of defense sites as sustainable resources.

Forward thinking is what led to Kuperman and his team to receive recognition at the Pentagon with The Technical Cooperation Program (TTCP) Achievement Award. They have also contributed to TTCP with the book "Ecotoxicology of Explosives."

Working for the Warfighter

Center's CBRN Equipment Maintenance Team Keeps U.S. Forces in the Fight

By Angel S. Castro Rodriguez

Photo by Brian B. Feeney, Ph.D.

Angel S. Castro Rodriguez is an engineering technician in the Chemical Biological Center's Physical Protection Engineering Branch and leads the CBRN Equipment Technical Assessment Team. He was born in Puerto Rico and joined the U.S. Army at the age of 19. There, he served as a squad leader, a platoon sergeant, and as an observer/controller at the Fort Irwin National Training Center in charge of the decontamination operations of a chemical company. He retired in 2003 as an E-7 after 20 years of service. He started working at the Chemical Biological Center in 2005 and became a Department of the Army Civilian in 2008.

THE JOB OF THE CHEMICAL, BIOLOGICAL, RADIOLOGICAL AND NUCLEAR (CBRN) PROTECTIVE EQUIPMENT that the Combat Capabilities Development Command (CCDC) Chemical Biological Center and other U.S. Army research laboratories develop, design and help field is to keep warfighters safe in CBRN threat environments. The more confident they can be in their protection from these threats, the better able they are to stay in the fight.

The CBRN Equipment Technical Assistance Team assists Army commanders in determining the overall readiness of their fielded CBRN defense equipment. We travel to commanders' units and work directly with the warfighters to ensure the serviceability and maintainability of the CBRN equipment they depend on. We direct our services to meet each unit's individual needs, we provide guidance and mentorship on how best to maintain the equipment, and we collect their feedback so that the commander is fully appraised of how best to maintain their Soldiers' safety. We also bring that feedback back to the Center to let our equipment designers know how they can continuously improve the equipment.

These visits are not inspections. They are face-to-face training sessions with the warfighters responsible for getting the best performance out of their equipment. They typically last from one to two weeks. In that time, working side-by-side with the warfighters, we perform system checks, assess how the equipment is performing, do repairs, and take the equipment apart and put it back together. We also work with these warfighters on how to get the most out of the technical manuals that come with the equipment and how to do their own trouble shooting when they encounter a malfunction. Our goal with every visit is to return to the Center knowing that the unit is now far more capable of maintaining their CBRN equipment than they were before we arrived.

We visit a wide range of units. In addition to chemical companies and battalions, we have visited infantry, artillery and intelligence units. We have also visited many different kinds of specialized service support and combat support units. These units are spread throughout the continental United States, Europe, Japan and Korea. They include regular Army, Reserve and National Guard units. The team has the expertise to assess a wide variety of CBRN equipment. It includes personal protective equipment such as protective masks and MOPP gear; detection equipment such as the M4/M4A1 Joint Chemical Agent Detector and the Improved Chemical Agent Monitor; and decontamination equipment such as the M26 Joint Service Transportable Decontaminating System, and M12A1 Decontamination Apparatus.

Our goal with every visit is to return to the Center knowing that the unit is now far more capable of maintaining their CBRN equipment than they were before we arrived.

At the end of each visit the unit commander receives an out-brief and a final report with our recommendations for maintaining and enhancing their unit's CBRN readiness. The Center receives funds to provide this service to the field so units are not burdened with the cost of the visits.

The team consists of myself and six other CBRN equipment subject matter experts. They bring a broad range of skills to bear, including electrical engineering and chemical engineering, and are passionate about their work and the well-being of our warfighters.

Researchers Help DoD Consider Challenges of Human Enhancement

By Brian Feeney, Ph.D.

Advancements in biochemistry have unlocked the possibility of futuristic augmentations such as controlling swarms of drones via neural implants.

Illustration by Andrew Levin

PETER EMANUEL, PH.D., THE ARMY'S SENIOR RESEARCH SCIENTIST FOR BIOENGINEERING, SEES A FUTURE 30 years from now where a U.S. Soldier can direct a swarm of drones in battle through a direct brain-to-machine connection using a neural implant. The implant also allows him to see exactly what each of those drones is seeing, then digitally integrate this information in his brain and send it as data to other machines, fellow Soldiers or his command and control element.

Emanuel, who works at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center, led the study as the chair of the Red Team for this year's annual Biotechnologies for Health and Human Performance Council (BHPC), a DoD study group charged with continually assessing advances in biotechnology. The report bears the title, 'Cyborg Soldiers 2050: Human/Machine Fusion and Implications for the Future of the DoD.'

Members of the study group included several other technical experts from the Center – biologist Calvin Chue, Ph.D.; graphic artist Jason Gitlin; multi-media specialist Briana McNamara and research biologist Aleksandr Miklos – as well as top experts in bioengineering and several related fields drawn from across the DoD. Distinguished outside experts from academia were also included. The main consumer of this report is senior Pentagon leadership -- the people most in need of knowing how to ready the nation's armed forces for the magnitude of technological change to come.

Brain-computer interfacing through neural implants is only one of four radical changes in technology described in the report. They fell into these four categories:

- Direct neural enhancement of the human brain for two-way data transfer
- Ocular enhancements to imaging, sight and situational awareness
- Auditory enhancement for hearing and communication
- Programmed muscular control through an optogenetic body suit

"We already knew about some big changes on the horizon such as the synthetic biology revolution that will make it possible to turn microbes into factories mass producing all manner of materials," said Emanuel. "But this is even bigger than that. This is a fundamental re-engineering of what it means to be human. As a convergence of biology, engineering and artificial intelligence, we will be able to enhance human beings in a way that changes how they see, hear, think, communicate, and move."

Each one of these four areas of technology comes with its own set of revolutionary changes. For example, ocular enhancement could consist of overlaying data streams onto a Soldier's retinal wall and sent up the optic nerve. But it is unlikely that this data would be understood in the brain as visible light. In fact, the data stream could cover a much larger range of the electromagnetic spectrum than visible light. The Soldier might be able to see objects in the infrared range and beyond. This would be a big advantage in future battlefields which the study group foresees as largely urban or even subterranean megacities.

Similarly, auditory enhancement could not only protect a Soldier from overexposure such as a blast, but also increase sensitivity to low amplitude sounds and even infrasonic and ultrasonic sounds. As the technology further matures, the study group foresees Soldiers capable of echo-locating adversaries in the dark and using imperceptible forms of communication with each other.

Programmed muscular control through an optogenetic body suit starts with a Soldier wearing an exoskeleton suit. The Soldier has light receptors implanted just under the skin and through carefully orchestrated light impulses, the Soldier's critical muscles and nerve bundles are stimulated allowing for an external source of muscle power and even external muscular control over the Soldier. This would increase strength and endurance in battle, aid with hazard avoidance, and enable a novice to perform functions for which he or she has not been trained.

However, describing these technological changes was only one part of the report. The other part was to identify all the areas of society which will have to evolve to accommodate a radical redesign of human beings. This includes, ethical, legal, and societal rules, regulations and norms. In a society with both enhanced and non-enhanced individuals, even something as simple as negotiating a mortgage loan could become the equivalent of the loan officer trying to play chess against a supercomputer. Also, if a mechanical insert malfunctions and someone is injured, does it fall under personal injury law or product liability?

Another consideration is the aging of an enhanced Soldier. Will an aging body lose its ability to interact with implants over time? Yet another consideration is how the U.S. military will share this technology with allied nations such as NATO members so that interoperability of forces is maintained – which begs the question, what if hostile nations or non-state actors get their hands on the technology?

Underlying all of these considerations is the question of how receptive our society will be to these technologies. The report's authors were acutely aware of the depiction of futuristic warfighting technologies in popular culture. The comparison to The Terminator is inevitable. The authors consider the possibility that the public will find the idea of cybernetic Soldiers repugnant, which will slow down their adoption. In that case, other nations with different ethical and cultural traditions would exploit these technologies first and could gain an irreversible dominance in warfare.

The study group explored this issue by turning to a social scientist from the Pew Research Center who performed a survey of the American public's attitudes. Her main findings were that the more religious a person is, the more likely it is that he or she will reject the idea. Also, the greater an individual's understanding of these technologies, the more likely he or she is to be accepting of it. The study group sees surveying the attitudes of people in other cultures around the world as the as the next step.

This report is just the first step in a decades-long process of studying these technologies and readying senior DoD leadership for their use in war. The Center will have a central role in this. "The Center is well-known for bringing together biologists and engineers devoted to research and doing it together in teams," said Emanuel. "We can uniquely comprehend this future, that's why I was selected to lead it and why so many of my colleagues at the Center participated in it."

"Ultimately, these technologies will go beyond even warfighting," said Emanuel. "They are going to change how we understand the world and what it means to be human."

Photos by Gay Pinder

Peterson's completed MOF and polymer film with improved dispersion.

Research Seeks to Add Chemical Biological Protection to Warfighter Equipment

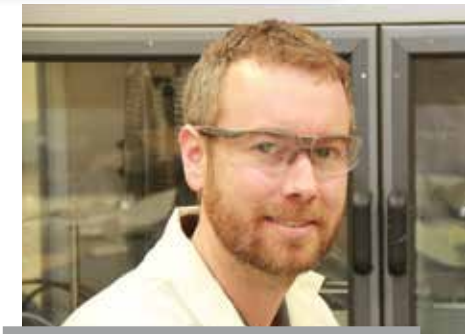
By Gay Pinder

MAKING WARFIGHTERS LIGHTER, FASTER AND MORE LETHAL ranks high on the modern Army's list of priorities and Greg Peterson hopes to contribute to this goal through chemistry. Peterson, a research chemical engineer at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center, works with metal organic frameworks (MOFs), crystalline materials with the ability to react with and decontaminate toxic substances and chemical warfare agents.

Depending on the mission, a Soldier carries about 75 pounds of gear that includes head, weapon and body subsystems. That burden may increase with the complexity of the mission. When facing possible chemical exposure, a breathing apparatus and other protective equipment can encumber warfighters, potentially making them less effective. It's Peterson's job to figure out how to protect warfighters while decreasing their overall equipment weight.

Part of an In-house Laboratory Independent Research (ILIR) project and funded by the Defense Threat Reduction Agency (DTRA), Peterson, working with Professor Thomas Epps, III at the University of Delaware, has found a more secure method to integrate MOFs with polymers.

"Basically, all equipment the warfighter wears is polymer based," Peterson said. "All clothing is made from polymers. Rubber masks, boots and gloves are all polymers as well. Kevlar, the material used in bullet proof vests, is a polymer. So if we can modify these systems to get us chemical and biological protection while retaining their underlying structural properties - that is a win."



Research chemical engineer Gregory Peterson works to combine MOFs with polymers to make decontaminating textiles to protect warfighters.

MOFs are active against chemical warfare agents, and polymers are a conduit to incorporating that activity into textiles and other protective gear. Putting the two substances together makes sense – except they make messy connections.

"They aren't similar enough so they create defects at the interface," Peterson explained.

Those defects or gaps at the interface allow opportunities for chemicals to break through the MOFs' layer of protection. Besides the unsteady relationship between MOFs and polymers, MOFs present another challenge.

"The problem with the MOF we're working with, CuBTC, is that it is not stable to moisture. If we used it as a filter it would constantly be exposed to moisture because there is humidity in the air and moisture in the breath of the warfighter, the structure of the MOF would break down." If woven in a suit, the MOF would also break down when exposed to humidity or sweat.

While Peterson didn't quite stumble upon a solution, he does admit that solving the problem came to him serendipitously.

Made of metal nodes that are connected by organic linkers, Peterson says tuning the nodes allows researchers to change the pore structure and size, the surface area, functionality and chemistry of the material. "They are really good in terms of being able to target certain chemical interactions. In our case chemical warfare agents and toxic industrial chemicals."

Peterson substituted one of the MOF's linkers, using an amine group link instead of a carboxylic acid one. "You can react the amine group and attach other molecules in a process called post synthetic modification."

Because some polymers can be incompatible with the MOF, post synthetic modification for these types of materials is important.

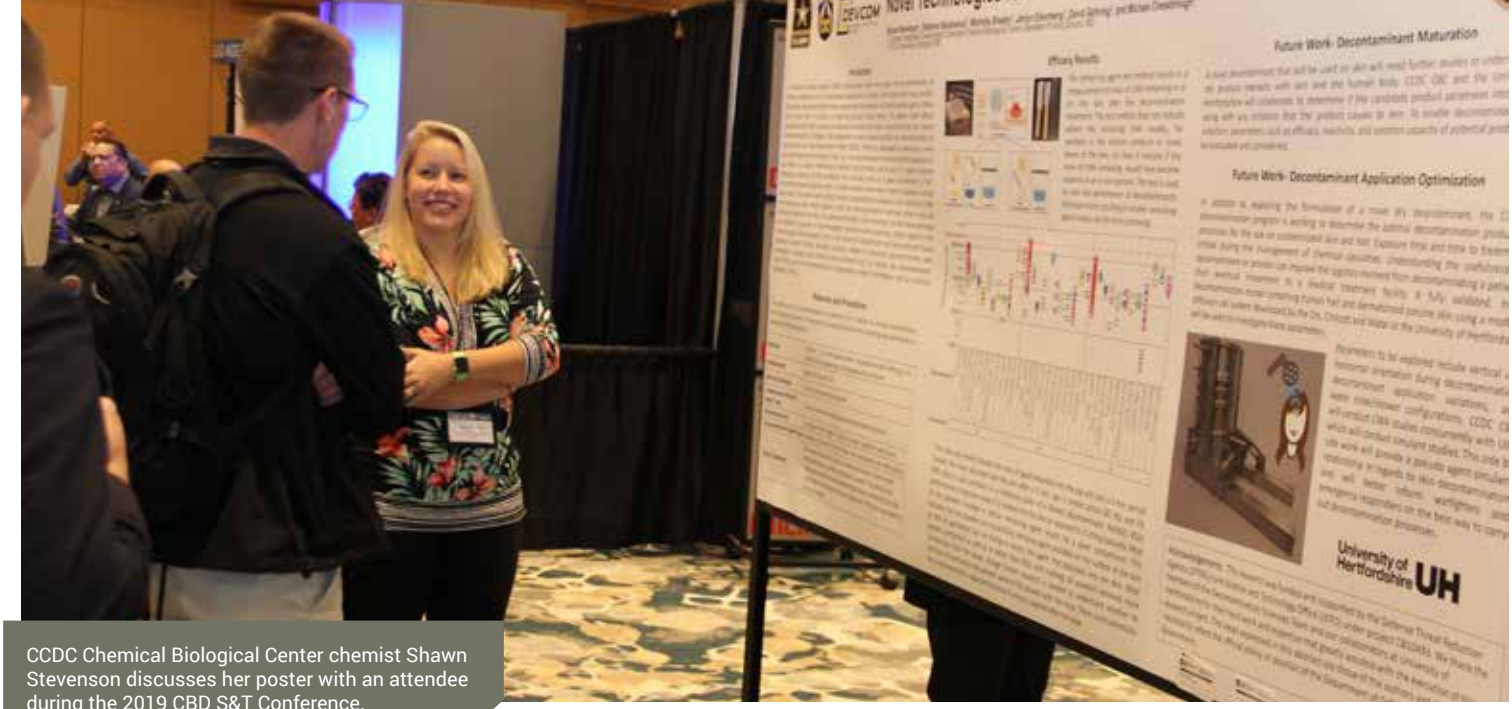
"The idea behind the post synthetic modification in this case is that you can modify the amine functional group with something that looks like a polymer," Peterson explained. "When you mix the polymer and the modified MOF together they'll have better interaction. The interface will be much more compatible."

While attempting to create a breathable rubber, Peterson added the amine group and hydrophobic tails to the CuBTC believing it would make the CuBTC more amenable to integration of polymers. "We found out it was stabilizing the MOF as well. That's actually a bigger deal."

Peterson says there are two reasons why his findings are significant. First, ammonia is a chemical that is part of testing requirements for masks and collective protection filters. His research shows that the amine group stabilizes the MOF to moisture, yet it retains the same high ammonia reaction capacity. Second, the amine group makes the MOF more compatible with polymers, allowing Peterson to move forward.

"We can begin conducting studies to see if the MOF will still block agent, wick moisture from surfaces like the skin and remain stable," Peterson said.

Success in this area could benefit the warfighter in a number of ways such as providing a more efficient filter with a broader array of capabilities than current filters.



CCDC Chemical Biological Center chemist Shawn Stevenson discusses her poster with an attendee during the 2019 CBD S&T Conference.

Researchers Share Ideas and Build Relationships at CBD S&T Conference

By Jack Bunja

THE CCDC CHEMICAL BIOLOGICAL CENTER ONCE AGAIN HAD A STRONG SHOWING during the Defense Threat Reduction Agency Chemical Biological Defense Science and Technology (CBD S&T) Conference in Cincinnati, Ohio November 18-21.

The CBD S&T Conference is the most prominent chemical biological defense conference in the country, with top chemical biological researchers gathered to compare research methods and results, and to identify opportunities to collaborate on new research.

The Center sent more than 70 people to the biannual conference and presented 43 posters and 16 oral presentations to more than 1,100 attendees from across the CBD enterprise.

Jonathan Sampson, a mechanical engineer at the Center, took advantage of this opportunity to network and provide insight into new technologies he and his team have been developing. "This conference gives us the opportunity to share our current research projects, such as the new integrated respirator system my team at the Center is working on with our peers," he said. "We use this opportunity to demonstrate our ability to come up with unique solutions to existing challenges and anticipate emerging challenges."

Since becoming a part of the Army Futures Command in 2018, the Center has embraced the Command's mission to deliver what warfighters need, when they need it, in a timely and affordable manner. The Center's contributions at the conference demonstrate this through its research findings in the areas of detection, protection and threat evaluation methods.

"This conference is an excellent opportunity for our scientists to exchange ideas with the chemical biological defense community as a whole," said Frederick Cox, Ph.D., director of research and technology at the CCDC Chemical Biological Center. "The conference gives our people the opportunity to gather together as one cohesive unit and engage with our partners. Only in a venue like this do our scientists and engineers have a chance to exchange ideas face to face with their peers and find opportunities for future collaboration and innovation to support our warfighters."

Photos by Jack Bunja

CCDC CBC research biologist Aleksandr Miklos, Ph.D., discusses detection technology at the CCDC Chemical Biological Center booth during the 2019 CBD S&T Conference.

2019

THE YEAR IN REVIEW

SOLUTIONS NEWSLETTER

MMXIX

JANUARY

Army Partners with Tech Startup to Develop Portable Biological Reader

The Center signed two technology-sharing agreements on Jan. 23 with tech startup TrekReader, an Arizona-based startup technology company. The company is now licensed to further develop Center technology that will provide Soldiers, first responders and even school nurses with a pocket-sized instrument that can detect dangerous biological and chemical substances. Center Director Eric Moore, Ph.D., and TrekReader CEO Robert Baumgardner signed a non-exclusive patent licensing agreement that grants TrekReader the rights to use the Center's VOCkit as the starting point for their product, and an associated collaborative research and development agreement that allows the parties to work together in the development of a new handheld universal reader.

Army Completes Explosive Destruction System Ops at Pueblo

Members of the Center's Chemical Biological Application & Risk Reduction (CBARR) business unit completed the destruction of 391 chemical munitions that were either recovered at the U.S. Army Pueblo Chemical Depot (PCD) or unfit for processing in the Pueblo Chemical Agent-Destruction Pilot Plant (PCAPP). This work was done using the Explosive Destruction System (EDS) in partnership with the U.S. Army Chemical Materials Activity and the Program Executive Office, Assembled Chemical Weapons Alternatives. Munitions destroyed in the campaign included M70 bombs, 105mm and 155mm projections, and 4.2-inch mortars containing mustard agent.

FEBRUARY

Chemical Biological Center Aligns Under New Command

The Army Materiel Command (AMC) and Army Futures Command (AFC) held a ceremony on Jan. 31 transitioning the U.S. Army Research, Development and Engineering Command (RDECOM) from AMC to AFC. The transfer became official on Feb. 3, and RDECOM has been renamed the Combat Capabilities Development Command (CCDC). As the Army's newest command and the largest of AFC's three major elements, CCDC comprises eight major and three international centers and research laboratories. As a component of the CCDC, the Center will play a crucial role within AFC by performing research and developing battlefield technologies that support multi-domain operations in chemical and biologically contaminated environments.

NBCRV Sensor Suite Upgrades Draw Praise from CBRN Stakeholders

The Army detects chemical biological (CB) threats in the field using an eight-wheeled fighting vehicle, called the Stryker, modified with chemical detection sensors. This version is known as the Stryker Nuclear, Biological and Chemical Reconnaissance Vehicle or NBCRV. Using current CB detection technology, the NBCRV is only able to detect threats at close range while moving slowly or completely stopped. That can directly expose the vehicle to the threat and create an easy target for the enemy. So the Center upgraded the NBCRV with a suite of its latest, most technologically advanced sensors that can be mounted anywhere on the vehicle and allow it to detect CB remotely and while moving. The upgraded vehicle was put to the test in a field exercise last February at an Aberdeen Proving Ground test range.

MARCH

Center Extends STEM Outreach to Homeschool Students

The Center's STEM Outreach Program has partnered with the Cecil County Public Library to offer its supplemental science instruction, usually reserved for area public schools, to Cecil County homeschool students. The Center brings non-traditional science projects to students in area public schools. Now, those same programs are available to home-school students, ages 11-17. This community outreach program offers hands-on demonstrations of chemical reactions and has tackled reverse engineering projects like do-it-yourself speakers and making replacement parts for pre-computer-age electronic components.

Team Puts Existing Chemical Destruction Technology to New Use at Pine Bluff Arsenal

The Army Corps of Engineers is engaged in a years-long project to unearth items that were buried at the Pine Bluff Arsenal, in Jefferson County, Ark., during operations dating back to 1941. Recovered items include suspected mustard-filled chemical agent identification sets, five German Traktor rockets and one 4.2-inch mortar. The Center, in partnership with the U.S. Army Chemical Materials Activity, recently began destroying these items using the Explosive Destruction System after adapting it to perform non-munitions destruction, too.

APRIL

Software Upgrade Could Advance Long-Range Fire Detection

Integrated Early Warning (IEW) provides advance warning to Soldiers on the battlefield for a host of different threats, including chemical and biological, so it is a top priority of the Department of Defense. The Center is at the forefront of IEW and sensor integration research, development and testing. It teamed up with the U.S. Army in a recent live-fire data collection test at Dugway Proving Ground. The technology the Center has developed to provide early warning of chemical biological threats may prove suitable to integrate with the Army's existing counterfire radars, which are designed to detect and track incoming artillery and rocket fire to determine the point of origin for counterfire measures. Center researchers hope to develop an algorithm that takes raw data from the radars and translates it into an ability to distinguish between in-flight chemical and non-chemical rounds.

State and Local Leaders Visit Chemical Biological Center During Immersion Day

In April, Aberdeen Proving Ground held an event called Immersion Day to familiarize Maryland state delegates and Harford County government officials with the unique capabilities APG offers the Army, the warfighter and nation. Throughout the day, they took advantage of the opportunity to have meaningful discussions about the Army Futures Command and the role it plays in research, development and testing, and additive manufacturing. The day included a tour of the Center's Advanced Design and Manufacturing (ADM) facility which houses a comprehensive suite of manufacturing, prototyping and fabrication capabilities designed to develop CBRNE product solutions for the U.S. Army and the U.S. Chemical and Biological Defense Program.

MAY

Coffee with Colleagues Marks 9th Year

In May, the Center held its 9th annual Coffee with Colleagues event. It drew more than 400 people together to view 125 scientific, engineering and capabilities posters. Center attendees got a glimpse at the work of other Center researchers, developers and staff. Projects in this competitive event spanned an array of topics including Multi Point Pin Technology, Metal Organic Frameworks, biologically derived nanoparticles and more that detect, shield or decontaminate chemical warfare agents.

Chemical Biological Center Holds 3rd Annual Gas Mask Dash

The 3rd annual Gas Mask Dash brought 250 runners and walkers from around the Center and the community together for a 5K race and 2 mile walk. Men, women, children and even a few four legged companions tackled the course and had a great time. Members of the 20th Chemical, Biological, Radiological, Nuclear and Explosives (CBRNE) Command joined in the run for some extra physical fitness training as well.

Cox Selected as CCDC Chemical Biological Center R&T Director

Maj. Gen. Cedric Wins, the commanding general of CCDC, the Center's higher headquarters, announced the promotion of Frederick Cox, Ph.D., to director of research and technology for the Center. Cox was appointed to the Army Senior Executive Service (SES) Corps, the civilian equivalent of a general or flag officer. Through this appointment, Cox joined a small and distinct group of senior executives tasked with providing leadership to the civilian workforce.

JUNE

Chemical Hot Air Decontamination

Center researchers have been working with a process called Chemical Hot Air Decontamination (CHAD) to remove toxic contaminants from warfighter equipment like sensitive electronics that cease operating after exposure to traditional chemical decontamination techniques, like bleach. The CHAD process can remove the chemical warfare agent within 24 to 72 hours. CHAD consists of placing a contaminated item into an enclosure and increasing the temperature of the chamber to drive off any contaminants. The chamber has a slow air flow through it, which carries away the contaminants from the item and allows for characterization of the effluent air stream.

CCDC Chemical Biological Center Statue Honors Soldiers, Scientists

The Center unveiled a permanent reminder of the relationship between Soldiers and Army researchers on June 17 in a dedication ceremony held in front of the Center's Advanced Chemistry Laboratory. More than 100 members of the Center workforce were on hand as the shroud was removed from the statue titled Cum Scientia Defendimus – With Science We Defend. The statue's more-than-two-year journey began as the brainchild of Frederick J. Cox, Ph.D., the Center's director of research and technology.

JULY

Army Researchers Look to Biology to Develop Next-Gen Power Alternatives

Center scientists are developing technologies that use the unique properties of bacterial magnetosomes – biologically-derived nanoparticles – to grow electronic components out of living bacteria. Long strings of these magnetite nanoparticles are produced within the bacteria when they are deprived of oxygen. In their search for oxygen, the strings of magnetosomes serve as a kind of internal compass that lets them navigate to a more oxygen-rich environment using the Earth's geomagnetic field. These scientists plan to use alternating layers of non-conducting nanocellulose and magnetic magnetosomes to create an ultra-thin, biologically-grown transformer. It's not a metal. It's something that's alive and maybe these could, down the line, work in materials that could self-repair—truly a revolutionary technology.

Iodine Grenade Could Provide Biological Decontamination

The ability to easily ensure that books, papers, computers, and electronics recovered by warfighters in the field are free from biological hazards is critical to military operations. Researchers at the Center are working on a device that could get the job done with the pull of a pin. Currently, the Army uses bleach, which is very corrosive and can easily destroy the files on a laptop computer. So these researchers are working on a far less destructive decontamination technology, an iodine smoke grenade. Free of propellants, the grenade works like a roadside safety flare or a bug bomb. It is effective against spores and vegetative cells and is far easier to bring along on a mission than liquid bleach.

Sprayable Decontaminant Slurry Could be in Warfighters Hands Soon

Under the current methods of material decontamination, platforms and personnel would have to leave the fight and use vast amounts of water and other resources to be rendered safe. When deployed, a decontamination slurry developed by the Center will provide more efficient and effective decontamination for vehicles and equipment on the battlefield. After three demonstrations between March and June 2019, the slurry has more than met expectations and it could be in warfighters' hands in as little as three to five years. "Just a quart-size sprayer filled with slurry can decontaminate up to 50 square feet of vehicle surface and have it back in action as fast as a warfighter can spray it," said Center chemist Joseph Myers who has been developing it over the last five years.

Rock Island Employees Expand Horizons in Mentor Program

Seventeen Center employees at Rock Island Arsenal completed a three-month journey of self-assessment and leadership skills development as they graduated from the first Mentoring Program held at the Center's Illinois site. The program pairs rising Center employees with experienced mentors and provides students with a slate of facilitated exercises and guest speakers, all aimed at helping employees learn about themselves, their coworkers and how they can best contribute to the organization. The program has been a staple of employee development at the Center's main campus at Aberdeen Proving Ground since it began in 2012.

AUGUST

CBOA Provides Opportunities to See New Technologies in the Field

Researchers from the Center met with warfighters and other stakeholders to showcase and gather feedback on emerging chemical and biological defense technologies during a training event at Camp Dawson, West Virginia Aug. 17-23. The Chemical Biological Operational Analysis (CBOA), developed and executed by the Defense Threat Reduction Agency, provides researchers an opportunity to elicit warfighter feedback during the technology development process. The week-long event drew hundreds of scientists, engineers, warfighters and stakeholders to engage in meetings, discussions and demonstrations of emerging technologies. The Center showcased six technologies at CBOA with 26 subject matter experts in attendance as warfighters conducted simulated missions.

Biologists Develop Rad Plan to Test Protective Suits

When the U.S. Army Chemical, Biological, Radiological and Nuclear School's Joint Experimentation and Analysis Division (JEAD) needed to find a way to get more mileage out of the expensive protective suits worn by Army civil support teams in radiological environments, they looked for answers from a team of biologists at the Center's BioTesting Division located at Dugway Proving Ground in the Utah desert. They worked with JEAD researchers by simulating radiological fallout in the Center's Aerosol Simulant Exposure Chamber using a fluorescent dust known as Glo Germ. Evaluators examined the suits under a black light and removed samples from the suits to determine their level of contamination. They further examined and photographed the samples under a fluorescing microscope.

SEPTEMBER

Center Designers Deliver Realism to CBRN Warfighters

Since 1999, the U.S. Army Chemical Materials Activity's has used its Chemical Defense Training Facility (CDTF) to create an immersive training experience for warfighters. However, as digital technology advanced, the time came for a dramatic upgrade. So a team of designers from the Center's Advanced Design and Manufacturing (ADM) Division were asked if they could use composite photography and 3D renderings to transform this training area from a simple brick and mortar room into a vastly more realistic graphics technology-enabled training space. The team used virtual reality to replicate real-life chemical threat scenarios warfighters could find themselves in. This entailed diving deep into the minute details of what a crumbling building looks like after an explosion, the textures of rock, steel and glass, as well as perspective. After several iterations, the end result is second to none in terms of realism and detail.

Mobile Test Chamber Eases Challenges for Conducting Gas Mask Tests

Conducting protection factor tests is a challenge for researchers when it comes to shooting a weapon while wearing a gas mask. Center researchers needed a way to conduct live-fire tests from inside a test enclosure while maintaining the correct concentration of aerosol simulant to ensure proper test results. The enclosure also had to be mobile enough to easily transport to firing ranges or other customer test sites. So they modified what was readily available, an off-the-shelf, inflatable paint spray booth. It inflates just like a bouncy house you see at a child's birthday party. The research team added ventilation ports into the interior of the chamber so that aerosol simulant can be pumped into the chamber directly through the blower which is also used to inflate it. This ensures uniform aerosol concentration throughout the interior which meets the joint service standard for conducting protection factor testing.

OCTOBER

Unique Team Handles Army's Chemical and Biological Packaging

Military packaging requirements are stringent. They depend upon expertise to ensure that items packed can withstand all types of transportation, survive long-term storage, stand up to temperature extremes, and be accessed easily by the end user. This is particularly true of chemical and biological packaging. The Center's Packaging Handling, Storing & Transportation Branch gets that job done for the Army, as the 20th Chemical, Biological, Radiological, Nuclear and Explosive (CBRNE) Command can attest to. The 20th CBRNE Command used to procure supplies through local purchases or supply systems, causing warfighters to wait weeks, even months to receive some items. Now, the Center's Packaging Handling, Storing & Transportation Branch provides the 20th CBRNE Command with chemical and biological packaging using its specialized knowledge of chemical biological technology and equipment, achieving the speed and reliability of delivery the 20th needs.

NOVEMBER

Moore Named FLC Lab Director of the Year, Center Receives FLC Excellence in Technology Transfer Award

Center Director Eric L. Moore, Ph.D., was named Laboratory Director of the Year by the Federal Laboratory Consortium (FLC) Mid-Atlantic. Moore earned the award for his outstanding contributions to the overall enhancement of technology transfer for economic development and for accomplishments related to the transfer of technology from a federal laboratory to industry. Also, nine Center employees received an award for their outstanding work in transferring federally developed technology to industry.

Soldiers Brief Center Scientists on Challenges, Concerns in Korea Theatre

Soldiers from the U.S. Army 1st Theatre Tactical Signal Brigade, Camp Humphreys, Republic of Korea visited the Center for a 10-day professional development assignment under the Center's Warfighter Innovation Leveraging (Mission) Expertise and Experimentation (WILE-E) program. This latest interaction with warfighters continues a WILE-E initiative to open lines of communication between scientists and Soldiers to encourage better and more frequent interactions.

DECEMBER

Center Team Leads Research in Explosives Contamination in Soil

Researchers at the Center have developed the first-ever soil screening levels to use in measuring the amount of contamination in soil at explosives training grounds. The Environmental Protection Agency has established Ecological Soil Screening Levels (Eco SSL) to determine when remediation is required. The Center's research team has greatly contributed to this effort by conducting over 70 ecotoxicological assessments and determined toxicity benchmarks. The EPA will use this data in drafting further Eco SSLs for explosives.

New CBRNE Urban Training Area Planned; Modular Design Will Allow for Greater Flexibility

The Center's Advanced CBRNE Training Branch is creating a new training area to teach Soldiers to recognize the manufacturing of WMDs made from CBRNE materials. It will include a combination of double-wide modular homes, shipping containers and large sheds to form a mock community at the Center to provide an ideal urban training environment for recognizing WMD targets. It will be used to train National Guard civil support teams which are the nation's first responders when local law enforcement suspects that it has encountered a CBRNE production set up.

Photos provided by DoD

Marines use a sensor-mounted unmanned ground vehicle to check for chemical biological contamination before they enter a simulated hostile village during Perceptive Dragon 3.

Perceptive Dragon Exercise Proves Benefits of Integrated Early Warning Technology

By Brian B. Feeney, Ph.D.

DURING A CHEMICAL OR BIOLOGICAL AGENT ATTACK, a commander has to fight uncertainty and confusion just as much as the agent. The Defense Threat Reduction Agency (DTRA) Chemical and Biological Technologies Department and the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND) are keenly aware of this and are actively advancing technologies to better identify chemical biological threats, establish situational understanding, and continuously monitor responses to the threat.

Key to this effort is DTRA's Integrated Early Warning advanced technology demonstration (ADT) annual exercise, known as Perceptive Dragon. In September, the Combat Capabilities Development Command (CCDC) Chemical Biological Center used DTRA's third Perceptive Dragon demonstration to showcase the value of the software system developed through its Integrated Early Warning (IEW) program in a complex exercise involving both a Marine Air-Ground Task Force and an Air Force expeditionary operations unit at Marine Corps Base Quantico, Virginia.

The demonstration included an amphibious raid on an island by U.S. Marines, establishment of a lodgment on the island with both Marine and Air Force units, maneuver to a mainland with the Air Force unit and, finally, destruction of the enemy by the Marines in an urban battle – all set in a chemical biological environment.

As part of the exercise, members of the Center's Nuclear, Chemical, and Biological Battlefield Integration Branch provided software plug-ins that they developed to directly input IEW data into each service's existing common operational picture software. At the brigade level, the Marines used the Joint Tactical Common Operating Picture Workstation (JTCW), and in the Air Force Joint Operations Center they used the Joint Warning and Reporting Network (JWARN).

"The Center used its own software, called Parrot, to parse relevant data coming from multiple sources and move it throughout the squad and company level networks using the Army's Integrated Sensor Architecture (ISA) protocol," said Maxwell Bottiger, a senior computer engineer at the Center. Those sources included chemical and biological detectors mounted on Marine and Air Force unmanned aerial and ground vehicles (UAVs and UGVs); acoustic and seismic sensor feeds; radar feeds; intel feeds; force protection assets such as cameras; and even physiological status monitors attached to the Marines' and Airmen's bodies that measure heartbeat, body core temperature, and a calculation of heat strain.

All of this data was made available via ISA to individual Marine and Air Force company-size units through an existing localized software called the Tactical Assault Kit (TAK). TAK resides in an Android phone or tablet and through a set of plugins developed by the Center. It can control a UAV or UGV, read the sensors mounted on them, and post alerts. Marines and Airmen on the squad level were able to feed this data to the broader JTCW or JWARN network at the battalion level. "Thus, the Center's IEW architecture proved itself to be both horizontally and vertically integrated," said Bottiger.

"All this data provided potentially lifesaving information from the squad level all the way up to the battalion level by providing a bird's eye view of the chemical and biological agent threat picture on the battlefield," said Fiona Narayanan, chief of the Center's Nuclear, Chemical, and Biological Battlefield Integration Branch and project team lead.

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"This software came with a new and important capability for IEW. Command and control at the battalion level could easily be overloaded with incoming data if it received an unfiltered amalgamation of all squad and company level data. So, the Center, in partnership with commercial vendors, developed software that correlates all of the local data into an overlay map color-coded by hazard. This capability gives commanders unrivaled chemical biological situational understanding at a level of detail customized to their needs," Narayanan added.

The software generates an overlay map that allows battalion level commanders to direct the chemical biological response. Marine and Air Force units could be told whether and when to don protective gear or be given a path to simply move around identified hot zones. This big picture data was also used to arrange the logistics for getting protective gear to units quickly and set up decontamination stations for simulant-exposed Marines and Airmen.

The Center also used a commercially built software program to combine the data coming from each of the chemical biological sensors to identify indications of the presence of agent below the detection threshold of any individual sensor. In Perceptive Dragon 3, the system collected sensor data to do just that and succeeded in identifying simulated agent at very low levels that had eluded any single sensor. The data was used by command and control to direct the force on the ground to suit up in time or stay out of the area.

Marines and Airman use a sensor-equipped drone to enter an area suspected of chemical or biological contamination during Perceptive Dragon 3 at Marine Corps Base Quantico Sept. 16-19.

Participants in Perceptive Dragon 3 use advanced software to correlate all of the area sensor data which is then integrated into an overlay map color-coded by hazard.

As the exercise progressed, the plot thickened. A force protection camera feed identified a suspicious looking adult who moved a 55-gallon drum out of a warehouse and into the urban area. A sensor-bearing Marine Corps drone followed him. An Air Force unit did a sensitive site assessment of the warehouse the drum was taken from. Using chemical sensor payloads on both a UAV and a UGV, they were able to inform the commander that there was not a chemical biological threat. The Air Force unit then simulated blowing up the warehouse.

Next, a Marine unit entered the village and began investigating the building that the suspicious male moved the drum into. The Marines used a UAV and a UGV to place chemical biological sensors around it. Both vehicles also had video cameras which gave the Marine unit and its commander ongoing birds-eye view surveillance. Physiological Status Monitors were used to monitor the Marine squad; using this technology, the squad leader was able to monitor his squad's vitals in real-time. The exercise then simulated the suspect blowing up the building. The Marine unit entered the blown up building in protective gear to perform a chemical biological assessment.

The exercise concluded with an IED going off near the Marines performing the assessment. The sensors on the UAV detected that the IED detonation included simulated agent dispersal, sent out the warning immediately, then delineated the zone of contamination. All the while, a second UAV kept a continuous video feed going to the Marine unit commander.

In the exercise debrief, the Marines and Airmen who participated shared their excitement about this new technology with the Center's personnel. "We didn't need to go downrange, we could just use the drone. That kept everyone safer and gave us all the time we needed to test by using it instead," said Cpl. Riley Bush of the 1st Marine Division.

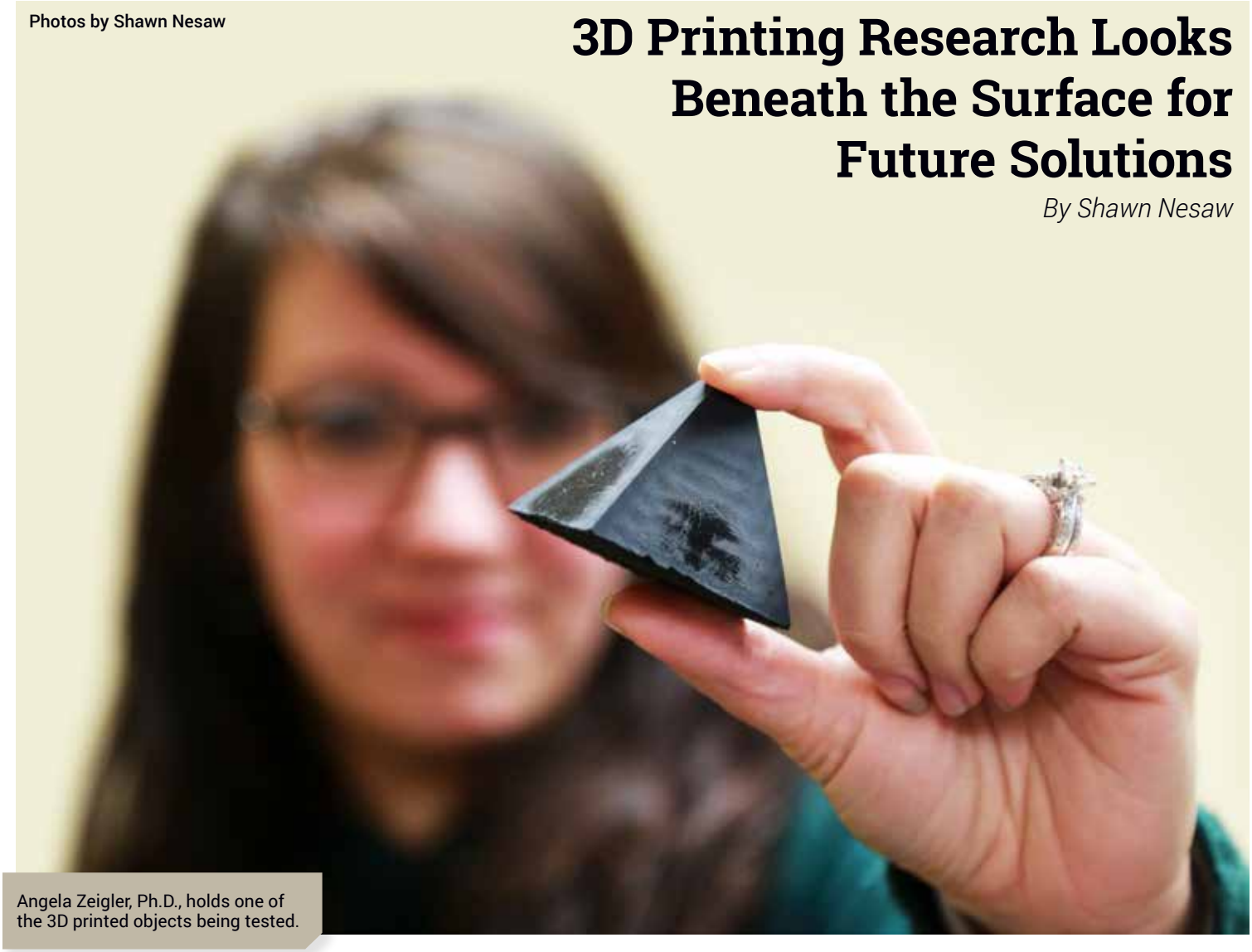
"It was a good asset," added Lance Cpl. Bruno Gonzales, also of 1st Marines. "You could see where everyone was downrange, see the hazard cloud, and see where it will get to."

Staff Sergeant David Cheatum of the U.S. Air Force's 87th Civil Engineering Squadron agreed. "We're not putting anyone in harm's way. We are so far back that if there was contamination there, we wouldn't be affected by it. The system saves time, saves people, and saves manpower."

Photos by Shawn Nesaw

3D Printing Research Looks Beneath the Surface for Future Solutions

By Shawn Nesaw



Angela Zeigler, Ph.D., holds one of the 3D printed objects being tested.

A GAS MASK IS A NECESSITY ON THE BATTLEFIELD. Every warfighter receives one and is trained to use it. But what if it's damaged or doesn't fit right? Getting a new one when you're halfway around the world could take time and negatively impact missions. In the age of 3D printing, it's imaginable to 3D print a protective mask for a warfighter on demand. But do we know enough about 3D printers and the material they use to rely on it to keep warfighters safe from a chemical or biological agent attack?

Jerry Cabalo, Ph.D., and Angela Zeigler, Ph.D., researchers at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center, would argue no, which is why they have embarked on a new study that looks beneath the seemingly solid structure of 3D printed objects to identify pores and voids that would allow harmful materials to pass through the object.

"We don't really understand 3D printed material very well," Zeigler said. "We're interested in understanding how a chemical diffuses through a 3D printed material. We developed a Surface Science Initiative plan to better understand 3D material and the pores and voids in a material."

Technological advances in the past 20 years have allowed the U.S. Army and other branches of the military to leverage emerging technology for the good of the warfighter and 3D printing is one such technology. While 3D printing, a form of additive manufacturing, might not feel "emerging" these days, with the pace of new technology quickening every day, the techniques, materials and possibilities are still fairly untapped.

Cabalo and Zeigler worked with the Center's Additive Manufacturing facility to 3D print hundreds of 1-inch by 1-inch square chips of different 3D printing materials and of different thicknesses. Once all the chips were printed, they began data collection.

"We're looking to map out the space throughout a seemingly solid 3D printed object," said Zeigler. "In doing so, we'll be able to determine the diffusion threshold of each material."

Beyond that, they would like to understand the fundamental process of molecular diffusion through porous material. This knowledge will potentially give the Army the capability to use 3D printing to develop warfighter personal protective equipment. A combination of computational modeling and experimentation will further the understanding of how porosity affects the movement of toxic chemicals.

It turns out, those 3D printed objects, while they may appear solid, actually contain lots of hollow space. If researchers are to one day 3D print gas masks, they're going to need a printer and a material that can print materials with little to no voids which allow chemicals to permeate.

The research consists of laboratory data and modeling data. The laboratory data is collected by Mark Varady, Ph.D., and Melissa Hulet, researchers at the Center, using a vapor testing method where each 1x1 inch 3D printed chip is sandwiched between two silicone blocks. On one side, a given vapor passes through the 3D printed material and on the other side dry nitrogen sweeps across the material, capturing any vapor that breaks through the material. That information is sent to a mass spectrometer that detects whether any vapor diffused and how much made it through the material.

3D printed materials, both the chips and a few more complex 3D structures, are sent to the CCDC Army Research Laboratory

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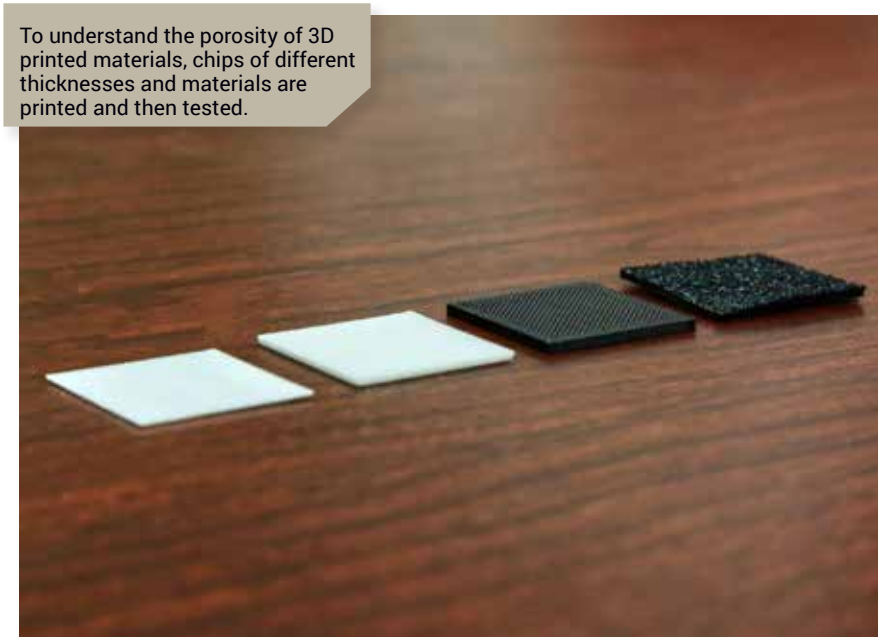
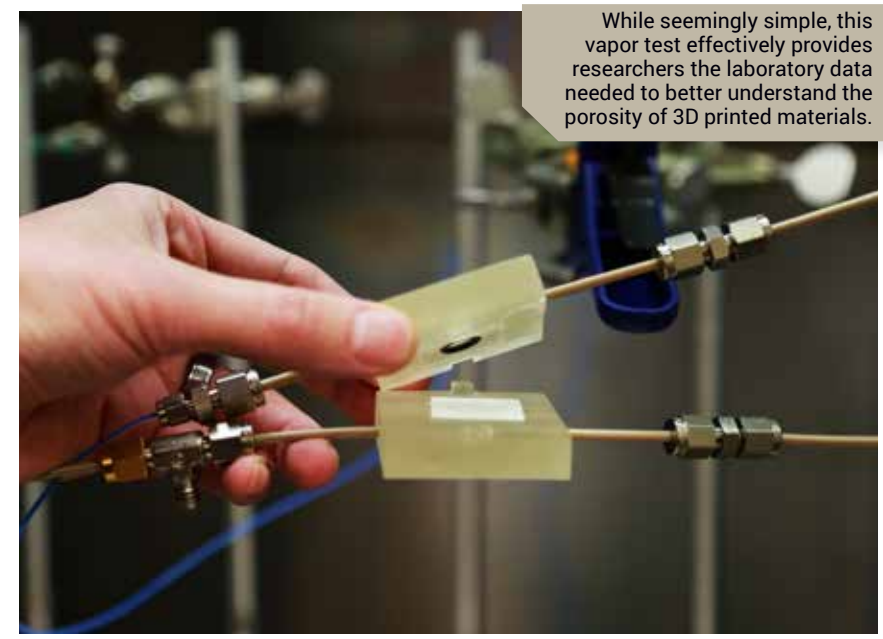
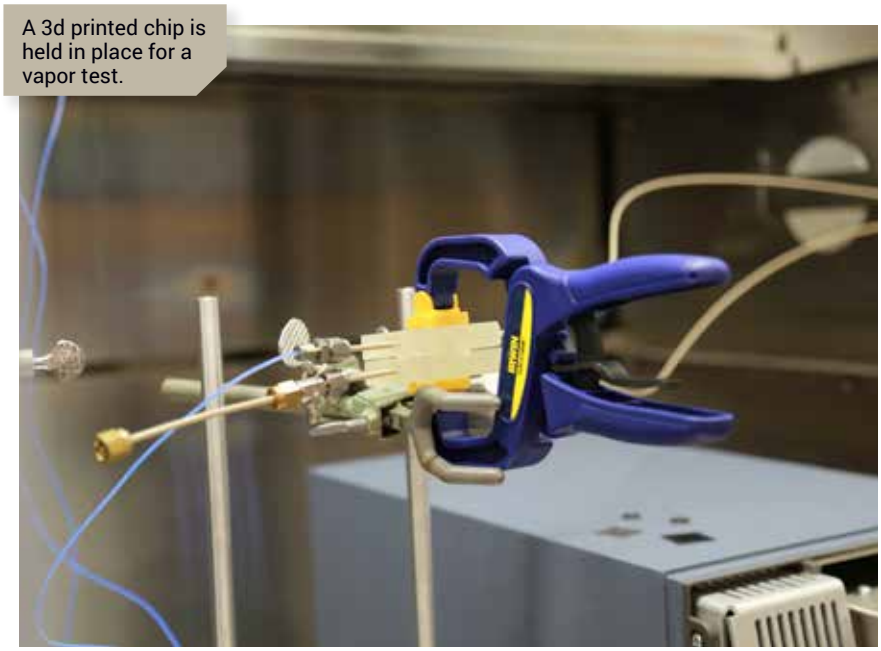


To understand the porosity of 3D printed materials, chips of different thicknesses and materials are printed and then tested.



While seemingly simple, this vapor test effectively provides researchers the laboratory data needed to better understand the porosity of 3D printed materials.



A 3d printed chip is held in place for a vapor test.

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where they are processed using a new technique called micro CT, similar to a large x-ray scan. The micro CT scans provide a representation of the pores and voids of 3D printed material. Zeigler and Cabalo are able to quantify the data and visually represent the voids in the 3D printed material, inching closer to a better understanding.

Taking the research a step further, the team partnered with Roseanna Zia, assistant professor of chemical engineering at Stanford University, who specializes in colloidal dispersion and diffusion modeling. As experts in the field of diffusion modeling, Zia and her team are creating dynamic models to realistically simulate the diffusion of chemicals through the 3D printed material based on the data Ziegler and Cabalo provided.

"The data is great but having models that show diffusion through a 3D printed material makes the data really work for us," Cabalo said. "Once we have a model that properly predicts what happens, we can dig in deeper to see how porosity controls permeation. The models are also more visual, so they help us communicate our findings to a wider audience."

The team is still in the throes of research -- printing, testing and gathering more data and developing more models that will lead to the comprehensive toolkit they envision.

While 3D printing is currently used in the field, it's not used to print protective masks and suits and the printers and material are fairly standard. In the future however, as the Army looks to home in on the best printers and best material for specific functions, like augmenting collective protection efforts. This fundamental testing could end up impacting requirements and military doctrine related to 3D printers and printer material.

"When you look at the complexity of 3D printing, there are so many variations. Having a set standard for creating protective equipment is necessary," Zeigler said. "We hope our research influences future decisions."

As rapid prototyping and development remains a focus area for the Army, more fundamental research like this will be important to ensure that an in-depth understanding is captured before making bigger decisions that impact the warfighter.

"It's our duty to ensure warfighters are prepared to combat chemical, biological, radiological and nuclear threats during missions," Zeigler said. "We're always thinking of the next quick, low cost solution that lessens the weight burden but increases warfighter effectiveness. 3D printing certainly has its benefits, so we want to ensure it provides a reliable, effective solution."

Collaboration Corner

Photos by Gay Pinder

Carmen Krieger, FLC MA deputy regional coordinator; Charles (Blake) Sajonia, tech transfer professional; Matthew Jones, technology transfer specialist; Eric Moore, Ph.D., CCDC Chemical Biological Center director; Amanda Hess, business manager, Strategic Initiatives Group; Debra Thedford, associate director, Strategic Initiatives Group .

Center and Partner Recognized for Excellence in Technology Transfer

By Gay Pinder

NINE SCIENTISTS AND BUSINESS PROFESSIONALS aligned with the Combat Capabilities Development Command Chemical Biological Center received the award for Excellence in Technology Transfer from the Federal Laboratory Consortium (FLC), Mid-Atlantic Region.

The FLC Excellence in Technology Transfer Award recognizes employees of member laboratories and non-laboratory staff who have accomplished outstanding work in the process of transferring federally developed technology.

The product – Solid Decontamination (decon) Blend – neutralizes biological and chemical threats such as nerve agent, opioids and anthrax pathogens. The Chemical Biological Center developed and tested the dry decontaminant as part of the Center's ongoing search for easily deployed advanced countermeasures against harmful chemical and biological agents.

This continuing mission propels the Center to seek outside partners to speed innovation and ramp up production to have products in the hands of warfighters faster.

The recipient of the transfer is MQM Solutions, Inc., a Cleveland-based company that focuses on decontamination and other aseptic technologies in the form of consumable products for commercial and defense markets.

"It's a win for all involved," said Matthew Jones, technology transfer specialist. "We both recognized the potential for a great partnership and it's nice to be recognized."

Tim Meilander and Iain McVey of MQM Solutions initiated the tech transfer by approaching Department of Defense technology transfer partnership intermediary, TechLink, in Bozeman, Montana, and the Center's tech transfer staff in Maryland for assistance in licensing the Army technology.

"My colleague, Iain McVey, and I have spent more than 15 years focusing on decontamination technologies to meet the requirements and needs of the U.S. Department of Defense," said Meilander, MQM managing director. "We knew the decon blend was desired by the government and we were confident it would be of value to the commercial market,"

The CCDC Chemical Biological Center and MQM signed a collaborative research and development agreement on January 30, 2019 to evaluate decontaminant formulations for neutralization of opioids, utilizing the Army's decon technology. Within a month, the T2 partners also signed a patent licensing agreement. In June MQM Solutions sold its first decon-based commercial product. The product is now marketed as Decon PLUS.

The rapid turnaround time from patent licensing to manufacture is exactly the agile and responsive culture that the Center nurtures.

"The decon blend project with MQM is the poster child for how to do technology transfer right," said Eric L. Moore, Ph.D., CCDC Chemical Biological Center director. "It was an exceptionally short transitional time frame, but we hope to replicate that experience as we move forward."

The following received recognition for participation in the decon blend technology transfer:

CCDC Chemical Biological Center

- George Wagner, Ph.D. – Research Chemist (Retired)
- Kevin Morrissey –Decontamination Sciences Branch Chief
- Lawrence Procell – Research Chemist (Retired)
- Matthew Jones – Technology Transfer Specialist
- Charles (Blake) Sajonia – Technology Transfer Professional
- Amanda Schenning – Research Scientist

MQM Solutions

- Timothy Meilander – Managing Director for Business Development and Engineering
- Iain F. McVey – Managing Director for Science and Technology

TechLink

- Marti Elder – Certified Licensing Professional

CCDC Chemical Biological Center's Eric L. Moore Named Lab Director of the Year

By Gay Pinder

THE FEDERAL LABORATORY CONSORTIUM (FLC) MID-ATLANTIC has named U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center Director Eric L. Moore, Ph.D. Laboratory Director of the Year. Moore earned the award for his outstanding contributions to the overall enhancement of technology transfer for economic development and for accomplishments related to the transfer of technology from a federal laboratory to industry. Support of FLC activities, internal accomplishments, industry involvement and community service were also criteria for selection.

Named director of the Chemical Biological Center in November of 2017, Moore energized technology transfer at the Center. "It is an honor for me to accept this award. While my name is on the award, we have an excellent technology transfer office and it is a testament to their hard work that they created an opportunity for me to be honored in this way."

"Technology Transfer is essential to what we do. We want to see our work commercialized and applied in the real world," Moore said.

To assist in meeting the goal of real world application, Moore looks to partners in academia and industry to commercialize Center intellectual property and seeks to engage with diverse minds to discover untapped innovation. He encourages collaboration with diverse partners who offer synergistic capabilities.

"They'll take that technology and enhance it," Moore explained. "Commercializing military technology also helps the public become familiar with our technology."

Moore gives his team credit that Center subject matter experts were already engaging with partners, and that he merely kicked outreach up a notch.

One recent technology transfer success saw MQM Solutions go from agreement to market in just six months. The company, which specializes in offering decontamination solutions to industry and first responders signed a cooperative research and development agreement in January 2019 for the Army's patented Solid Decontamination Blend. The following month they signed a patent license agreement. By June, the company had completed its first sale of the decon blend, now called Decon Plus.

"That's our gold standard," Moore said. "We won't always have transfers that occur that quickly, but we are going to push to have others move faster."

Moore admits that internal projects can sometime languish or Army priorities may change before a project reaches fruition, but says the key to project success is to continue efforts to involve industry as development partners. He sees offering industry the opportunity to closely interact with the warfighter as part of that plan.

> ***"We pride ourselves on working safely with surety materials and this is an exciting way for industry and academia to work with us through leveraging technology transfer authorities."***
>
> *Eric L. Moore, Ph.D., Director, CCDC Chemical Biological Center*

Moore sees myriad mutual advantages in industrial and academic partnerships through technology transfer. Research and development collaborations, education development and internships allow the military and its partners to share their unique strengths.

"We seek engagement with diverse minds," Moore said. "It's no secret that we aren't getting the amount of STEM talent that we once did. So by working with our partners, it allows us to leverage folks in that dwindling talent field."

On the other hand, Moore points out that the Army is particularly skilled at working with surety compounds.

"Many of the companies that have the capabilities to develop new technologies require chemical agent testing. They can leverage our unique facilities and expertise for this testing. We pride ourselves on working safely with surety materials and this is an exciting way for industry and academia to work with us through leveraging technology transfer authorities."

To Moore, a project's success is measured by its delivery to the warfighter, first responders or other end users.

"It's critical. Some of these companies are not encumbered in ways that we are. We have a lot of technology development that is evolutionary, but in order to move to the next stage of the game changing, disruptive technologies that we want to build, it's going to take working with the community of other great people with great ideas to make real those game changing technologies."

Carmen Krieger, FLC Mid-Atlantic Deputy Regional Coordinator and Eric L. Moore, Ph.D., Director, CCDC Chemical Biological Center.

Photo by Gay Pinder

CCDC Chemical Biological Center's Director of Engineering Suzanne Milchling watches Jade Tyson score points during a STEM video game competition.

In the Community: Center Engineering Director Judges Local STEM Youth Carnival

By Gay Pinder

ON A NOVEMBER SATURDAY MORNING when most kids are asleep, playing sports or streaming their favorite shows, dozens of middle schoolers turned out for the inaugural Right Stuff STEM Carnival held at the Edgewood Boys and Girls Club.

"The purpose of this carnival is to provide middle and high school students with an opportunity to learn about STEM careers, interact with senior leaders from Maryland state and county government as well as private industry and Department of Defense senior leaders in a fun and engaging environment," said Sharon Jacobs, event coordinator and founder of New Service Training Employment Program, a non-profit youth workforce training organization and sponsor of the event along with Huntington Ingalls Industries.

The event included STEM-related activities like how to build a functioning electrical engineering device, an exhibit of STEM careers and a video game competition based on biology, chemistry and mathematics concepts.

Five teams from Cecil County and Harford County Boys and Girls Clubs competed in the video game face off. U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center's Director of Engineering Suzanne Milchling presided as judge for the Aberdeen team were she noted their scores for each segment of the game and reported them to the game official.

Coming out on a Saturday morning was no sacrifice for Milchling.

"I really like to promote STEM. I recognize that we need the next generation workforce. We need to start working on that especially to improve the demographics," she said.

"There are not that many females. We are doing a lot better than we started. Being a female role model really helps and it's something I like to do."

Other judges included Terry Martin, executive officer for the Engineering Directorate, CCDC Chemical Biological Center; Harford County Councilman Andre Johnson; Steve Overbay, Harford County Office of Economic Development; Frank Kellner, Harford Mutual Insurance Company and Steven Alexander, business development, Huntington Ingalls Industries.

Video games highlighted the carnival with several stations offering virtual STEM experiences including flight simulation.

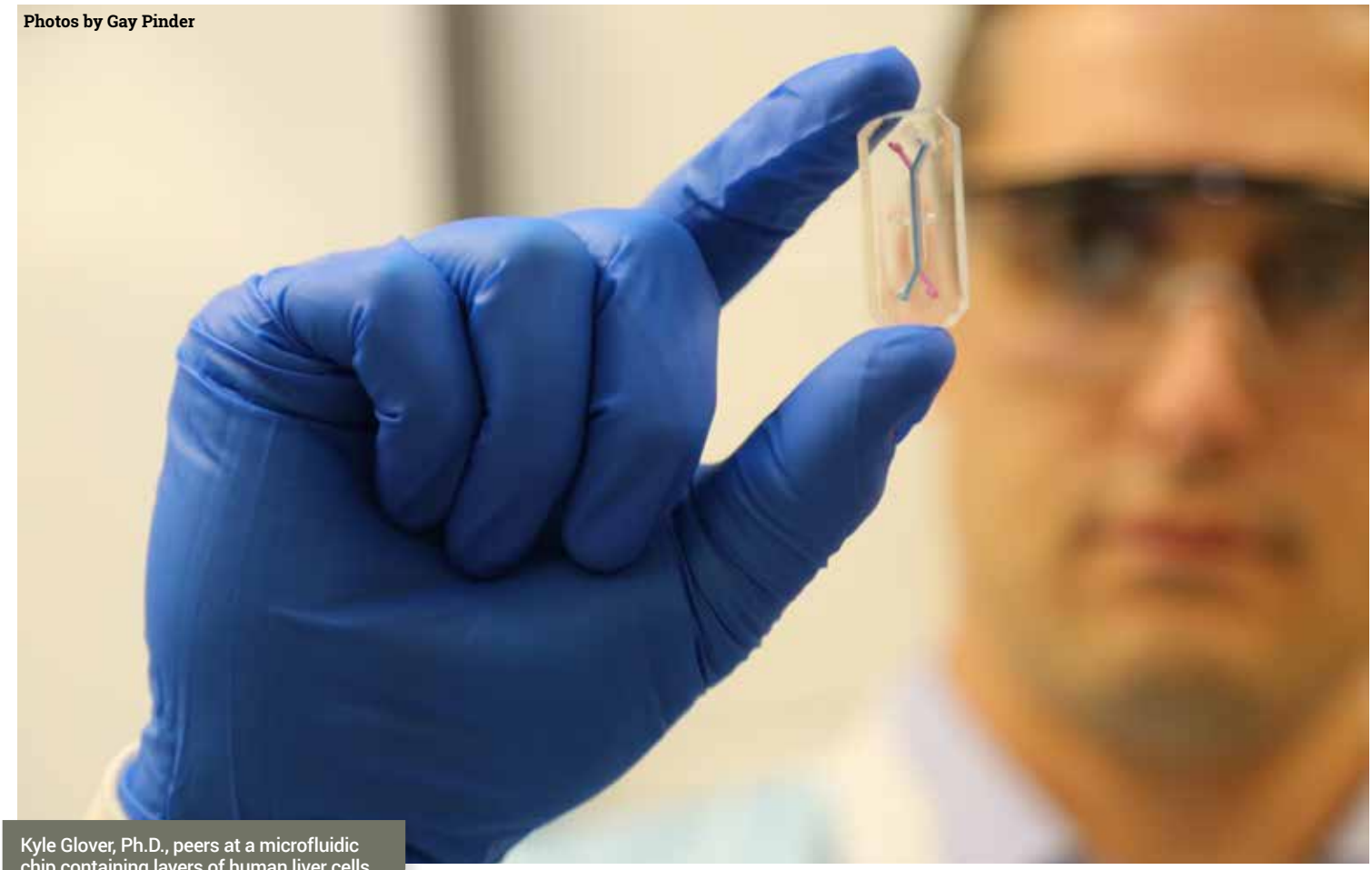
"The number of video games that we have that are STEM-related technologies that the youth can play with provides them the opportunity to kind of learn by accident," Jacobs said. "It is the 'gotcha' part of what Patriot Technology Training Center has set up to help kids learn about science. We're trying to get students here in Harford County to realize that STEM careers are fun careers."

Milchling pointed out that STEM events like the Right Stuff STEM Carnival are mutually beneficial.

"It really helps the next generation workforce get to know who we are and what we do at the Chemical Biological Center," she said. "Kids are more likely to work near where they live and where they grew up, where they are close to family, so it will help with workforce retention.

Judges were randomly assigned to competition teams. Charles Frederick, Gabriel Johnson and Jade Tyson made up the winning Aberdeen team judged by Milchling.

Photos by Gay Pinder



Kyle Glover, Ph.D., peers at a microfluidic chip containing layers of human liver cells.

Organ-on-a-Chip Takes a Closer Look at Human Liver Cells

By Gay Pinder

SOMETIMES, FOCUSING ON DETAILS CAN LEAD TO UNDERSTANDING the bigger picture. That's the approach Kyle Glover, Ph.D., and his team at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center are using to further his research in micro physiological systems, also known as Human-on-a-Chip.

"There are researchers and companies out there whose main function is to create a full physiological system with multiple target organs including the lungs, liver, kidney and heart all connected and working together to test the toxicity of certain compounds," said Glover, "The other approach is to become much more sophisticated with individual organs and that's what we are funded to do."

With joint funding from the Defense Threat Reduction Agency and the Defense Advanced Research Projects Agency (DARPA), the Micro Physiological Systems Rapid Threat Assessment (MPS RTA) project has come far enough to open a new lab at the Center in January of 2020—a lab that doesn't include animals.

The Leading Edge of Human System Models

"Our work concentrates on the functions of multiple types of liver cells and eliminates the use of animals for research," Glover said.

Under the co-funded project, Glover, Tyler Goralski, Ph.D., and Jennifer Sekowski, Ph.D., are charged with transitioning to the Center two MPS systems that came to the market in 2019, and then using those systems to examine human cells from the top down via leading-edge cell and molecular based methods.

"Those MPS companies have mastered the liver, so that's the starting point for our models," Glover said.

Moving from multiple organ systems to one organ takes human-on-a-chip to organ-on-a-chip. Producing cultures or organoids that replicate the entire physiology of the liver reflects the sophistication Glover seeks.

"These types of systems provide researchers with more human-like cultures than what they used to use 20, 30 years ago when we could grow human cancer cells in a dish, but they weren't representing what happens physiologically," Glover said. "Now we're growing fully functional normal cells in physiological conditions, so it has a lot more potential. Human tissue to start is really the solution."

The microfluidic chip contains multiple liver cell types and can replicate specific functions like bile duct function, venous blood flow, steatosis, inflammation and hepatic fibrosis.

"You have a layer of hepatocytes. You have an endothelial cell layer and you actually have enough space in the chip membrane to have Kupffer cells to replicate an immune response, and stellate cells to replicate liver fibrosis," Glover explained. "It's pretty state of the art."

The layers of multiple cell types—called three-dimensional cells—are a boon for researchers.

"The idea of three-dimensional cells has changed since ten years ago when we were growing balls of cells and calling them three

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dimensional. They were better than a 2D culture, but they were a ball of potentially the same cells and we were limited in the kind of information we could derive."

Glover said that in the past, two-dimensional cell cultures, in conjunction with colorimetric assays, could help researchers predict some compound concentrations to be acutely toxic just by dosing those cells and then exposing them to a colorimetric toxicity assay – cell dyes that indicate a loss in viability after exposure.

"At the end of the day, we could at least tell you if something was toxic or not, but we had no idea to what degree or why it was toxic."

Now that cells have more structure and flow, allowing them to behave more human-like, scientists are learning more.

Glover's research into replicating the physiological functions of the liver on a chip comes down to solving a Department of Defense and, ultimately, a warfighter need.

"The chemical and biological weapons threat list is growing," Glover says. "It's never going backwards."

The odds of warfighters encountering unknown substances grow. A micro physiological system can provide Center researchers with a pipeline to analyze the molecular events that occur with an unknown agent.

Deeper Understanding in Record Time

"While the MPS can help us answer questions quickly like how does the unknown act on human cells, and do the cells react in a way that looks like a known compound, we can also use those same human cells to rapidly model the molecular mechanism underlying that behavior," Sekowski said.

Under the rapid threat assessment portion of the MPS-RTA project, Sekowski and others in the multi-omics team (Trevor Glaros, Ph.D.; Elizabeth Dhummakupt, Ph.D.; and Phil Mach, Ph.D.) can answer more detailed questions such as the nature and timing of the molecular target interactions, do these molecular targets have potential as biomarkers for detection or diagnostics, and can they be addressed with known countermeasures? Using measurements of gene and protein expression and the metabolome, the RTA team is able to rapidly model a complete mechanism of actions of the unknown, and share that data with other collaborators within the Army who will then develop novel countermeasures.

"This makes decision making quicker by orders and orders of magnitude," Glover said. "That is the biggest selling point here. It's the rapid response element. Right now, if you had something truly unknown come along, it may take one to two years before we can determine the level of exposure that we need to protect against."

This combined MPS-RTA approach will help researchers characterize more compounds simultaneously, Glover believes, with a two-year research period yielding the results of 10 compounds instead of just one.

"We want information out quicker and more compounds through the door. Funders want to see research in applied fashion. They want to see this put into action," Glover said. "We're shooting high. That's a dramatic improvement."

The ability for this team to reach high is supported by its perpetual quest for professional development. Center scientists recently attended training at Emulate, Inc., a Boston company that recreates true-to-life human biology systems. Their founders pioneered organ-on-a-chip technology at the Wyss Institute for Biologically Inspired Engineering at Harvard University. Follow up training sessions have been scheduled at Center laboratories to prepare researchers to transition technology to modernized capabilities for the warfighter.

The MPS-RTA research team: Kyle Glover, Ph.D., Molecular Toxicology Branch chief; Dan Angelini, Ph.D., research biologist; Tyler Goralski, Ph.D., research biologist; Jen Horsmon, Ph.D., biologist. Not pictured are Jennifer Sekowski, Ph.D.; Trevor Glaros, Ph.D.; Elizabeth Dhummakupt, Ph.D.; Phil Mach, Ph.D.; Russ Dorsey, Ph.D. and Erin Gallagher, Ph.D.

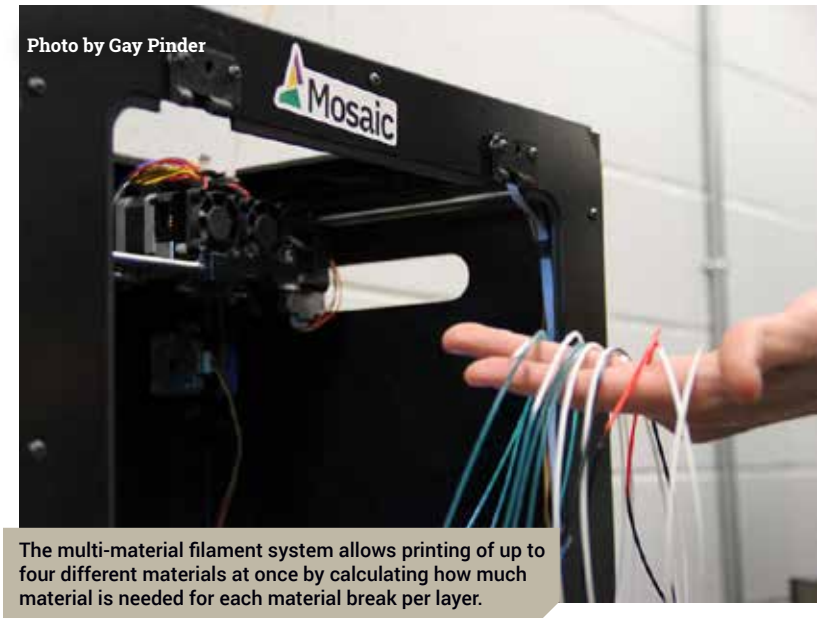

Photo by Gay Pinder

The multi-material filament system allows printing of up to four different materials at once by calculating how much material is needed for each material break per layer.

Capabilities Spotlight: Upgrades Enhance Researcher's Rapid Prototyping Capabilities

By Gay Pinder

NEW EQUIPMENT IN THE MAKERSPACE FACILITY at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center is helping researchers design and produce special parts for their projects.

"We've added the capability of running two different materials in the same build," said Bradley Ruprecht, engineering technician. "We've had the capability to do that, but some new machines have come on the market that do a better job."

Additive manufacturing has come a long way since its beginnings in the mid-1980s. Where machines once used layers of paper to build a wood-like item, they now use thermo-plastic filaments to build intricate pieces.

One of those machines has helped one research team apply for a patent for a new ion mobility spectrometry drift cell design. A drift cell separates ions based on their size to charge ratios as they drift down the known length of the drift cell towards a detector.

"We are using the machines in MakerSpace to test whether additive manufacturing is a viable method for accurately reproducing a drift cell of a preprogrammed and known length. This is important because the length of the drift tube produced by the manufacturing process will affect the performance of the detector and its overall accuracy," said Brian Hauck, Ph.D., a contract research chemist at the CCDC Chemical Biological Center.

Besides the conductive and nonconductive varieties, other thermo-plastics now include elastomerics with ridges and soluble support materials with complicated geometry.

The use of additive manufacturing or 3D printing can help researchers speed up the prototyping process. Researchers can print parts specific to their needs early on. 3D printing also saves time because researchers don't have to rely on another person or team to fabricate parts. It provides flexibility. If an idea for a part doesn't work, researchers can redesign and print another iteration.

Another MakerSpace upgrade relates to machine design advances that make working with more than one material easier to accomplish.

"Some of our machines have two nozzles that deposit materials, but they are at the same height and when the process switches between them, both nozzles are hot even when it's not in use and it has the tendency to ooze and drip material. If you have a little mixing of materials, you could have a problem," Ruprecht said.

For the drift tube that could mean a short circuit leading to the inability to guide the ions through the tube.

The new printers solve the material spill problem in three ways. One printer has retractable nozzles on a single head, another has independent heads and the third solution is a called a multi-material filament system.

Imagine printing out a toothbrush that has a rigid handle with an area that is rubber, say for a thumb grip. The multi-material filament system will calculate how much rigid plastic is needed, then connect to that the amount of rubberized material needed so it combines two or more source filaments into one thread for each layer of the toothbrush.

For making larger items, MakerSpace will soon install a Hewlett-Packard multi-jet fusion printer that uses a nylon powder. It will be an improvement over a similar printer now in use that uses a tiny laser beam to raster each layer. The HP model uses a combination of an inkjet head and an infrared lamp to shape and harden the layers making it much faster than the current printer.

Not yet installed but on Ruprecht's list of additions to MakerSpace is a bio printer.

"We've had a lot of requests for it in the last year," he said.

Bio printing provides the ability to make a 3D 'scaffold" out of collagen, an algaenate or some other biological material that is seeded with living cells. The cells are cultured, multiply and turn into living tissue, Ruprecht explained.

"We'll be able to manufacture structures with living cells to mimic organs and tissue," he said.

Producing structures that mimic human organs and tissue provides a superior research environment when investigating the effects of chemical warfare agents on people.

Once they settle on a printer and the MakerSpace staff is trained, bio printing will be available for researchers.

Ruprecht admits that learning all the ins and outs of additive manufacturing might be a bit intimidating, but says the knowledge is worth mastering.

"We provide education and training. We train researchers on how to use CAD – computer aided design - so they can create their own three dimensional parts. We teach them how to use the 3D printers," Ruprecht said. "We have had some researchers really take to it."

For researchers not quite sure about the technology, MakerSpace personnel are there to help.

"It's learning skills and learning processes and the materials available to augment their process, but we also consult and help point people in the right direction," he said.

Publications and Patents

QUARTERLY LISTING

This page contains the peer-reviewed journal articles published on research conducted by Center scientists between June 2019 and September 2019 and U.S. patents recently awarded to the Center between June 2019 and December 2019.

PUBLICATIONS (CCDC CHEMICAL BIOLOGICAL CENTER AUTHORS ITALICIZED)

Title: Degradation and Detection of the Nerve Agent VX by a Chromophore Functionalized Zirconium **Author(s)**: De Koning, MC; ***Peterson, GW***; Van Grol, M; ***Iordanov, I; McEntee, ML*** **Source**: CHEMISTRY OF MATERIALS **Volume**: 31 **Issue**: 8 **Pages**: 7417-7424 **DOI**: 10.1021/acs.chemmater.9b02073 **Published**: SEP 24 2019

Title: Quantification of Interlaboratory Cell-Free Protein Synthesis Variability **Author(s)**: Cole, SD; Beabout, K; Turner, KB; Smith, ZK; ***Funk, VL***; Harbaugh, SV; ***Liem, AT; Roth, PA***; Geier, BA; ***Emanuel, PA***; Walper, SA **Source**: SYNTHETIC BIOLOGY **Volume**: 8 **Issue**: 9 **Pages**: 2080-2091 **DOI**: 10.1021/acssynbio.9b00178 **Published**: SEP 20 2019

Title: Rapid Liquid Chromatography Tandem Mass Spectrometry Method for Targeted Quantitation of Human Performance Metabolites in Saliva **Author(s)**: ***McBride, EM; Lawrence, RJ***; Mcgee, K; ***Mach, PM***; ***Demond, PS; Busch, MW***; Ramsay, JW; Hussey, EK; ***Glaros, T; Dhummakupt, ES*** **Source**: JOURNAL OF CHROMATOGRAPHY A **Volume**: 1601 **Pages**: 205-213 DOI: 10.1016/j.chroma.2019.04.071 **Published**: SEP 13 2019

Title: Spectroscopically Resolved Binding Sites for the Adsorption of Sarin Gas in a Metal Organic Framework: Insights Beyond Lewis Acidity **Author(s)**: Harvey, JA; ***McEntee, ML; Garibay, SJ; Durke, EM***; ***DeCoste, JB***; Greathouse, JA; Gallis, DFS **Source**: JOURNAL OF PHYSICAL CHEMISTRY LETTERS **Volume**: 10 **Issue**: 17 **Pages**: 5142-5147 **DOI**: 10.1021/acs.jpclett.9b01867 **Published**: SEP 5 2019

Title: Paper Spray Ionization: Applications and Perspectives **Author(s)**: ***McBride, EM; Mach, PM; Dhummakupt, ES***; Dowling, S; Carmany, DO; Demond, PS; Rizzo, G; Manicke, NE; ***Glaros, T***; **Source**: TRAC-TRENDS IN ANALYTICAL CHEMISTRY **Volume**: 118 **Pages**: 722-730 **DOI**: 10.1016/j.trac.2019.06.028 **Published**: SEP 2019

Title: Neurosteroid and Benzodiazepine Combination Therapy Reduces Status Epilepticus and Long-Term Effects of Whole-Body Sarin Exposure in Rats **Author(s)**: Lumley, L; ***Miller, D; Muse, WT***; Marrero-Rosado, B; de Araujo Furtado, M; Stone, M; ***McGuire, J; Walley, C*** **Source**: EPILEPSIA OPEN **Volume**: 4 **Issue**: 3 **Pages**: 382-396 **DOI**: 10.1002/epi4.12344 **Published**: SEP 2019

Title: Metal Hydroxide/Polymer Textiles for Decontamination of Toxic Organophosphates: An Extensive Study of Wettability, Catalytic Activity, and the Effects of Aggregation **Author(s)**: Dwyer, DB; Liu, J; Gomez, JC; ***Tovar, TM***; Davoodabadi, A; Bernier, WE; ***DeCoste, JB***; Jones, WE **Source**: ACS APPLIED MATERIALS & INTERFACES **Volume**: 11 **Issue**: 34 **Pages**: 31378-31385 **DOI**: 10.1021/acsami.9b10440 **Published**: AUG 28 2019

Title: 110th Anniversary: Molecular Structure Effects on Mass Transfer of C-10 Hydrocarbons in BPL Activated Carbon **Author(s)**: ***Tovar, TM; Mahle, JJ; Knox, CK***; LeVan, MD **Source**: INDUSTRIAL & ENGINEERING CHEMISTRY RESEARCH **Volume**: 58 **Issue**: 33 **Pages**: 15271-15279 **DOI**: 10.1021/acs.iecr.9b02377 **Published**: AUG 21 2019

Title: Covalent Poly(lactic acid) Nanoparticles for the Sustained Delivery of Naloxone **Author(s)**: Kassick AJ; Allen HN; Yerneni SS; Pary F; Kovaliov M; Cheng C; Pravetoni M; Tomycz ND; Whiting DM; Nelson TL; ***Feasel, M*** **Source**: APPLIED BIO MATERIALS **Volume**: 2 **Issue**: 8 **Pages**: 3418-3428 **DOI**: 10.1021/acsabm.9b00380 **Published**: AUG 19 2019

Title: Fabrication of Anisotropic Silver Nanoplatelets on the Surface of TiO2 Fibers for Enhanced Photocatalysis of a Chemical Warfare Agent Simulant, Methyl Paraoxon **Author(s)**: ***Kuhn, DL; Zander, Z; Kulisiewicz, AM; Debow, SM***; Haffey, C; Fang, H; Kong, XT; Qian, YQ; ***Walck, SD***; Govorov, AO; Rao, Y; Dai, HL; ***DeLacy, BG*** **Source**: JOURNAL OF PHYSICAL CHEMISTRY C **Volume**: 123 **Issue**: 32 **Pages**: 19579-19587 **DOI**: 10.1021/acs.jpcc.9b04026 **Published**: AUG 15 2019

Title: Simulation of Microparticle Inhalation in Rhesus Monkey Airways **Author(s)**: Geisler, TS; Majji, MV; ***Kesavan, JS; Alstadt, VJ***; Shaqfeh, ESG; Iaccarino, G **Source**: PHYSICAL REVIEW FLUIDS **Volume**: 4 **Issue**: 8 **Article Number**: 083101 **DOI**: 10.1103/PhysRevFluids.4.083101 **Published**: AUG 9 2019

Title: Ligand-Directed Reticular Synthesis of Catalytically Active Missing ZirconiumBased Metal-Organic Frameworks **Author(s)**: Chen, ZJ; Li, PH; Wang, XJ; Otake, KI; Zhang, X; Robison, L; Atilgan, A; Islamoglu, T; ***Hall, MG; Peterson, GW***; Stoddart, JF; Farha, OK **Source**: JOURNAL OF THE AMERICAN CHEMICAL SOCIETY **Volume**: 141 **Issue**: 31 **Pages**: 12229-12235 **DOI**: 10.1021/jacs.9b06179 **Published**: AUG 7 2019

Title: Insight Into Organophosphate Chemical Warfare Agent Simulant Hydrolysis in Metal-Organic Frameworks **Author(s)**: ***Ploskonka, AM; DeCoste, JB*** **Source**: JOURNAL OF HAZARDOUS MATERIALS **Volume**: 375 **Pages:** 191-197 **DOI**: 10.1016/j.jhazmat.2019.04.044 **Published**: AUG 5 2019

Title: Offline Next Generation Metagenomics Sequence Analysis Using MinION Detection Software (MINDS) **Author(s)**: ***Deshpande, SV; Reed, TM***; Sullivan, RE; Kerkhof, LJ; Beigel, KM; ***Wade, MM*** **Source**: GENES **Volume**: 10 **Issue**: 8 **Article Number**: 578 **DOI**: 10.3390/genes10080578 **Published**: AUG 2019

Title: Detection of Protein Toxin Simulants from Contaminated Surfaces by Paper Spray Mass Spectrometry **Author(s)**: Wichert, WR; ***Dhummakupt, ES;*** Zhang, CS; ***Mach, PM***; Bernhards, RC; ***Glaros, T***; Manicke, NE **Source**: JOURNAL OF THE AMERICAN SOCIETY FOR MASS SPECTROMETRY **Volume**: 30 **Issue**: 8 **Pages**: 1406-1415 **DOI**: 10.1007/s13361-019-02141-6 **Published**: AUG 2019

Title: Synthesis of N-Pyridyl Hydroxylamines via Copper-Catalyzed Cross-Coupling **Author(s)**: ***Torruellas, C***; Hsu, FL; ***Walz, AJ*** Source: SYNTHESIS-STUTTGART **Volume**: 51 **Issue**: 15 **Pages**: 2891-2896 **DOI**: 10.1055/s-0037-1611836 **Published**: AUG 2019

Title: Progress Toward an Ideal IR Obscurant with a Self-Heating Synthesis of Short, Thin Cu Nanowires **Author(s)**: ***Zander, Z***; Cruz, M; Granado, M; Kim, M; Wiley, B; Bruce, C; Alyones, S; Au, L **Source**: JOURNAL OF DoD RESEARCH & ENGINEERING **Volume**: 2 **Issue**: 2 **Pages**: 100-107 **Published**: AUG 2019

Title: Surface Chemistry of Sulfur Dioxide on Zr(OH)(4) Powder: The Role of Water **Author(s)**: ***McEntee, ML; Peterson,GW; Balboa, A; Iordanov, I***; Balow, RB; Pehrsson, PE **Source**: JOURNAL OF PHYSICAL CHEMISTRY C **Volume**: 123 **Issue**: 28 **Pages**: 17205-17213 **DOI**: 10.1021/acs.jpcc.9b00790 **Published**: JUL 18 2019

Title: Air, Water Vapor, and Aerosol Transport through Textiles with Surface Functional Coatings of Metal Oxides and Metal-Organic Frameworks **Author(s)**: Pomerantz, NL; Anderson, EE; Dugan, NP; Hoffman, NF; Barton, HF; Lee, DT; Oldham, CJ; ***Peterson,GW***; Parsons, GN **Source**: ACS APPLIED MATERIALS & INTERFACES **Volume**: 11 **Issue**: 27 **Pages**: 24683-24690 **DOI**: 10.1021/acsami.9b04091 **Published**: JUL 10 2019

Title: In Situ Chemical Analysis of Geology Samples by a Rapid Simultaneous Ultraviolet/Visible/Near-Infrared (UVN) Plus Longwave-Infrared Laser Induced Breakdown Spectroscopy Detection System at Standoff Distance **Author(s)**: Yang, CSC; Jin, F; Trivedi, S; Brown, E; Hommerich, U; Nemes, L; Samuels, AC **Source**: OPTICS EXPRESS **Volume**: 27 **Issue**: 14 **Pages**: 19596-19614 **DOI**: 10.1364/OE.27.019596 **Published**: JUL 8 2019

Title: The Essential Role of Hypermutation in Rapid Adaptation to Antibiotic Stress
Author(s): Mehta, HH; Prater, AG; Beabout, K; Elworth, RAL; Karavis, M; ***Gibbons, HS***; Shamoo, Y
Source: ANTIMICROBIAL AGENTS AND CHEMOTHERAPY **Volume**: 63 **Issue**: 7 **Article Number**: e00744-19 **DOI**: 10.1128/AAC.00744-19 **Published**: JUL 2019

Title: Evaluation Of A Lateral Flow Immunoassay for the Detection of the Synthetic Opioid Fentanyl
Author(s): ***Angelini, DJ; Biggs, TD; Maughan, MN; Feasel M***; Sisco, E; ***Sekowski, JW***
Source: FORENSIC SCIENCE INTERNATIONAL **Volume**: 300 **Pages**: 75-81 **DOI**: 10.1016/j.forsciint.2019.04.019 **Published**: JUL 2019

Title: Single-Component Frameworks for Heterogeneous Catalytic Hydrolysis of Organophosphorous Compounds in Pure Water
Author(s): ***Garibay, SJ***; Farha, OK; ***DeCoste, JB***
Source: CHEMICAL COMMUNICATIONS **Volume**: 55 **Issue**: 49 **Pages**: 7005-7008 **DOI**: 10.1039/c9cc02236h **Published**: JUN 21 2019

Title: Solid-Phase Detoxification of Chemical Warfare Agents Using Zirconium-Based Metal Organic Frameworks and the Moisture Effects: Analyze via Digestion
Author(s): ***Wang, H; Mahle, JJ; Tovar, TM; Peterson,GW; Hall, MG; DeCoste, JB; Buchanan, JH; Karwacki, CJ***
Source: ACS APPLIED MATERIALS & INTERFACES **Volume**: 11 **Issue**: 23 **Pages**: 21109-21116 **DOI**: 10.1021/acsami.9b04927 **Published**: JUN 12 2019

Title: Bioderived Protoporphyrin IX Incorporation Into a Metal-Organic Framework for Enhanced Photocatalytic Degradation of Chemical Warfare Agents
Author(s): ***Lee, MS; Garibay, SJ; Ploskonka, AM; DeCoste, JB;***
Source: MRS COMMUNICATIONS **Volume**: 9 **Issue**: 2 **Pages**: 464-473 **DOI**: 10.1557/mrc.2019.22 **Published**: JUN 2019

Title: The Structural and Biochemical Impacts of Monomerizing Human Acetylcholinesterase
Author(s): Bester, SM; Adipietro, KA; ***Funk, VL; Myslinski, JM;*** Keul, ND; Cheung, J; Wilder, PT; Wood, ZA; Weber, DJ; ***Height, JJ;*** Pegan, SD
Source: PROTEIN SCIENCE **Volume**: 28 **Issue**: 6 **Pages**: 1106-1114 **DOI**: 10.1002/pro.3625 **Published**: JUN 2019

Title: Proteomic Characterization of Immunoglobulin Content in Dermal Interstitial Fluid
Author(s): Arevalo, MT; ***Rizzo, G;*** Polsky, R; ***Glaros, T; Mach, PM***
Source: JOURNAL OF PROTEOME RESEARCH **Volume**: 18 **Issue**: 6 **Pages**: 2381-2384 **DOI**: 10.1021/acs.jproteome.9b00155 **Published**: JUN 2019

PATENTS

Mutant OPAA Enzyme with Increased Catalytic Efficiency on Organophosphorus Compound GP
Patent Number: 10,335,465
Issued: July 2, 2019

Mutant OPAA Enzyme with Increased Catalytic Efficiency on GP
Patent Number: 10,363,289
Issued: July 30, 2019

Sampling and Detection Kit for Chemical and Biological Materials
Patent Number: 10,408,809
Issued: September 10, 2019

Mutant Organophosphorus Acid Anhydrolase Enzymes Having Increased Catalytic Efficiency on V-agents
Patent Number: 10,421,952
Issued: September 24, 2019

Enhancement of Adsorption via Polarization in a Composite Material
Patent Number: 10,427,134
Issued: October 1, 2019

Non-Consumable Respirator Training Filter
Patent Number: 10,460,627
Issued: October 29, 2019

Canine Scent Detection Training Device and Method
Patent Number: 10,485,219
Issued: November 26, 2019

Use of Metal-Organic Frameworks and Metal Oxides for Sensing Chemicals Using Electrical Impedance Spectroscopy
Patent Number: 10,495,592
Issued: December 3, 2019

Every year, CCDC Chemical Biological Center 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 presentations the workforce will participate in between January 2020 to March 2020.

Look Who's Talking

Conference Name: 11th Multidimensional Chromatography Workshop
Topic: Passive sampling, comprehensive chromatography and comparison of operationally relevant atmospheres
Location: Honolulu, HI
Date(s): 3-8 January 2020

Conference Name: 2020 ASM Biothreats
Topic: Innovations in Biothreat Detection
Location: Arlington, VA
Date(s): 27-30 January 2020

Conference Name: 2020 ASM Biothreats
Topic: Department of Homeland Security Biodetection Technology Enhancements Program PBI Evaluation
Location: Arlington, VA
Date(s): 27-30 January 2020

Conference Name: 2020 ASM Biothreats
Topic: Nanopore Sequencing for Biosurveillance in South Korea
Location: Arlington, VA
Date(s): 27-30 January 2020

Conference Name: 2020 ASM Biothreats
Location: Philadelphia, PA
Date(s): 22-26 March 2020

Solutions

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Send article suggestions, questions or comments to:

CCDC Chemical Biological Center Public Affairs Officer Richard Arndt at richard.m.arndt.civ@mail.mil.

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