Solutions

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

NEWSLETTER
Q3 FY2019

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Director's Message

"We're all in."

In a recent visit to the Center, Maj. Gen. Cedric T. Wins expressed this mantra in support of the mission and vision of the new U.S. Army Combat Capabilities Development Command (CCDC) under the Army Futures Command (AFC). As we move forward as the CCDC Chemical Biological Center, we all must subscribe to the idea of working together, not only here at the Center between colleagues but together with industry, academia and the other organizations under the CCDC umbrella.

Innovating at the speed of relevance – one of AFC's main goals – would be impossible to accomplish alone. While our expertise is a key piece of the solution, our hidden power is in how we integrate with, enhance and learn from our partners. Ensuring Army readiness, building a modern force and doing both of those in a timely fashion, takes the power of the collective.

For our workforce, collaboration comes easy, as we pride ourselves in the broad range of partnerships outside the Center through agreements with industry and academia. A recent agreement with tech startup TrekReader will allow for further development of our existing technology, the VOCkit, into a pocket-sized instrument that will provide Soldiers, first responders and even school nurses with the ability to detect dangerous chemical and biological substances. We're all in.

Another collaborative effort is the Nuclear, Biological, Chemical Reconnaissance Vehicle (NBCRV) sensor suite upgrade which recently debuted to Army senior leaders and stakeholders here at the Center. This project is the epitome of what it means to be collaborative due to the vast number of people from different groups and organizations dedicating their expertise to making huge design and technological improvements to support our CBRN Soldiers. What that team of teams developed in 150 days is truly remarkable. We're all in.

I'm confident that, through the products and capabilities we provide, we will continue on our path of excellence, working together with our CCDC colleagues and partners across other disciplines to think big and deliver the best technological solutions to our Army.

Forge the Future!
Eric L. Moore, Ph.D.
Director, CCDC Chemical Biological Center

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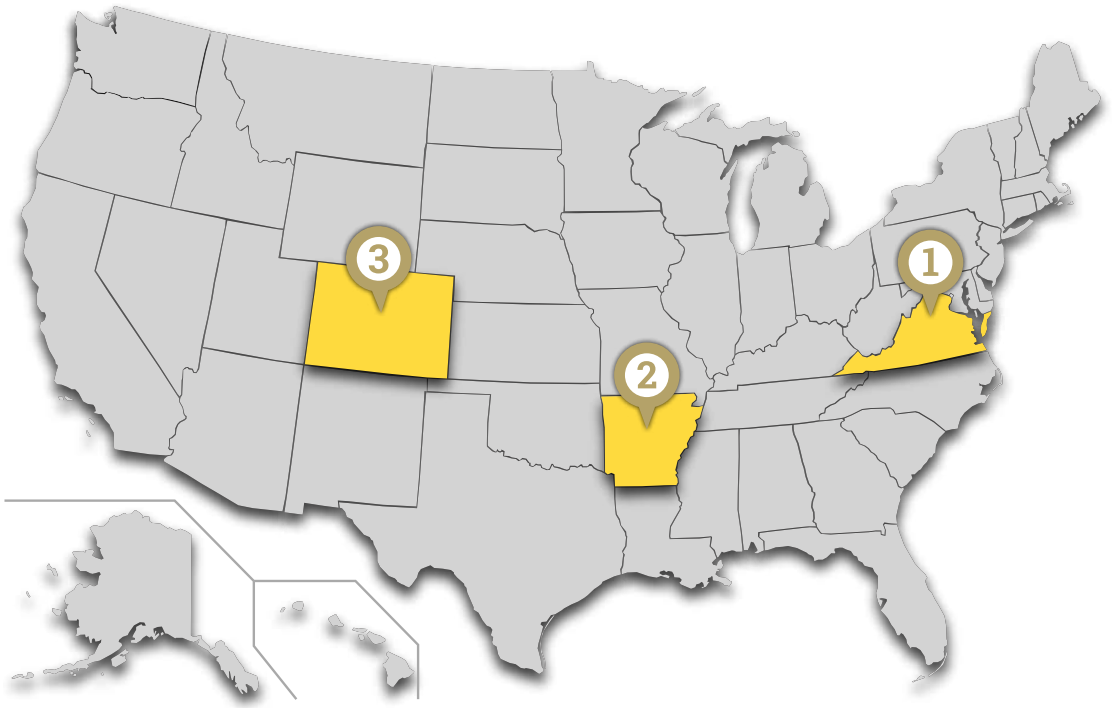

CCDC Chemical Biological Center In the Field

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 **Quantico, Virginia - Scientists, engineers and military personnel gathered for the Perceptive Dragon II integrated early warning demonstration to test the capabilities of the systems with the mission to deliver real-time information from a variety of sensors on the battlefield up the chain of command and back to warfighters common operating pictures. Read more on page 8.**

2 **Pine Bluff, Arkansas - Our operators safely executed the first destruction operation for the Pine Bluff Explosive Destruction System. In partnership with the U.S. Army Chemical Materials Activity, we will execute a mission to destroy more than 7,100 Chemical Agent Identification Sets K-941 bottles, once used for training Soldiers in the safe identification and handling of chemical agent, four German Traktor Rockets and one 4.2-inch mortar that have been recovered at the arsenal.**

3 **Pueblo, Colorado - Our operators completed the destruction of 391 chemical munitions that were recovered at the U.S. Army Pueblo Chemical Depot (PCD) or unfit for processing in the Pueblo Chemical Agent-Destruction Pilot Plant. This completion marks the end of the second destruction campaign using the Explosive Destruction System (EDS), a technology that uses cutting charges to explosively access chemical munitions, eliminating their explosive capacity before neutralizing the chemical agent. The team closed the EDS site at PCD at the end of January 2019. Read more on page 33.**

Digital Version
For the digital version of this newsletter, please visit:
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Gen. John M. Murray, commanding general Army Futures Command, and Maj. Gen. Cedric T. Wins, commanding general Combat Capabilities Development Command, uncase the official flag, signifying the transition of the U.S. Army Research, Development and Engineering Command from Army Materiel Command to AFC.

Chemical Biological Center Aligns Under New Command

Provided by CCDC Public Affairs Office

THE ARMY FUTURES COMMAND (AFC) and the Army Materiel Command (AMC) 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).

"The United States Army has been focused on the near-term for the last 18 years and rightfully so. But as we wind down and come out of the conflicts in Iraq and Afghanistan the message is very, very clear, we need to re-focus on large-scale, ground combat and we need to refocus on the future," said Gen. John M. Murray, commanding general AFC.

As the Army's newest command and the largest of AFC's three major elements, CCDC comprises eight major and three international centers and laboratories including: Data & Analysis Center; Armaments Center; Army Research Laboratory; Aviation and Missile Center; Chemical Biological Center; Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance Center; Ground Vehicle Systems Center; and Soldier Center. The international elements are the regionally aligned Americas, Atlantic and Pacific Centers.

> ***"We need to re-focus on large-scale, ground combat and we need to refocus on the future."***
>
> *Gen. John M. Murray, Commanding General, U.S. Army Futures Command*

Army Materiel Systems Analysis Activity officially became part of AFC during the ceremony and was renamed Data & Analysis Center. It was realigned with existing CCDC analysis organizations to create an integrated analysis center.

The three major elements of the AFC include: Futures and Concepts, Combat Development and Combat Systems.

As part of the Combat Development element, CCDC will focus on fundamental scientific research, technology development, engineering and analysis to support the Army's six modernization priorities: Long-Range Precision Fires, Next-Generation Combat Vehicle, Future Vertical Lift, the Network, Air & Missile Defense and Soldier Lethality. Key tenants of the CCDC's mission are speed of delivery and integrating technology into existing weapon systems.

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Maj. Gen. Cedric T. Wins receives the AFC patch during the transfer of authority ceremony.

Gen. Gustave F. Perna, Gen. John M. Murray and Maj. Gen. Cedric T. Wins salute during the AFC transfer of authority ceremony at Aberdeen Proving Ground.

Eric L. Moore, Ph.D., director of CCDC Chemical Biological Center and Meharry Medical College President and CEO James Hildreth Sr., M.D., Ph.D., attended the transfer of authority ceremony.

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CCDC joining AFC is the next step in the Army's effort to transform its approach to modernize critical core capabilities that will give Soldiers and allies a decisive edge in battle. As the modernization strategy focuses on delivering capabilities to support Multi-Domain Operations by 2028, CCDC will maintain a balance between scientific research to support MDO and technology that may not be developed until 2050 or beyond.

"As the last commander of RDECOM and the first commander of CCDC – as a Soldier of more than 30 years – I see no bitterness in what we do here today. I see a new challenge and more reason to hope as we become part of a bigger team taking bolder action to forge the future," said Maj. Gen. Cedric T. Wins, commanding general CCDC.

To prepare for the move to AFC, CCDC S&T advisors engaged with the Modernization Task Force, which became the AFC Headquarters, and the Cross Functional Teams to help drive the modernization process. The CFTs are composed of subject matter experts from the requirements, acquisition, science and technology, test and evaluation, resourcing, contracting, cost and sustainment communities.

The command also launched an across-the-board campaign plan to gain greater visibility of operations and become more effective and efficient. The campaign plan included reorganizing the command's portfolio and management structures to mirror the Army's modernization priorities and naming a lead center for each modernization priority.

CCDC collaborates with hundreds of international and domestic academic and industry partners to maintain a steady stream of world-class technology. Becoming part of AFC will enable CCDC to partner in new ways and provide greater clarity and focus for all of the Army's major commands.

"The world-class scientists and engineers, technicians and support staff of this organization are some of the most talented and respected professionals in their fields. So on behalf of the countless Soldiers you have supported while you've been a member of the AMC family for the last 4,450 days, I personally say 'thank you'," said Gen. Gustave F. Perna, commanding general AMC.

Prototype Chemical Identifier Gets Positive Feedback

Provided by CCDC Chemical Biological Center Public Affairs Office

The VK3 is a prototype chemical identifier that can identify liquids in the field, including chemical warfare agent.

A FIELD-DEPLOYABLE LIQUID CHEMICAL IDENTIFIER called the VK3 received positive feedback from warfighters and first responders in a field test funded by the Defense Threat Reduction Agency (DTRA).

During the Chemical Biological Operational Analysis (CBOA), the VK3 demonstrated its ability to identify chemical liquids in the field, including chemical warfare agent. This prototype could develop into a new, portable tool that could improve a warfighter's ability to identify agent.

Developed by scientists and engineers across multiple branches at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center, VK3 is a portable, handheld tool that uses a camera and small computer to identify chemical agent by analyzing colorimetric sensors on an assay.

The need for the technology came from a desire to ensure warfighters examining labs and substances in the field had a portable, easy-to-use tool to identify chemical threats.

"We had seen and heard that those who are tasked with sensitive site exploitation — the first people in a facility where somebody is making something – needed tools to better identify the substances being made," said Center research biologist Aleksandr Miklos, Ph.D. "Maybe it's perfectly legal and safe, but maybe they're doing something illicit and dangerous.The first examiner has to decide what tools to bring. We thought something like this with a colorimetric assay would be helpful."

To use, the operator places a colorimetric assay on the device's stage for a reference image, a drop is added to the assay. As various spots on the assay change color, they are captured by the camera and continuously analyzed by the computer to identify the substance.

An earlier version, called the VOCKit, identified chemicals based on vapors, a process similar to olfaction — the sense of smell. Now, Miklos says that taste, not smell, is a better analogy.

"This started off as something that detected vapors coming off of the sample. It was very similar to how the olfactory system works," Miklos said, noting that the device had many spots that would activate in response to vapor from a sample. "By the pattern of activation, they could identify what was present. Now, we're using a ticket you add liquid to."

Users at the CBOA found the device easy to use.

"What we were able to get was informal, verbal feedback from the assessor and from end users in the Army and civilian law enforcement," Miklos said. "Feedback was positive. They liked the size and that they could carry the entire kit around in a small container."

One thing users appreciated, according to Miklos, was the clarity in use. The device delivers clear on-screen instructions with a timer. "As soon as the system initializes, the device flashes the lights, and once it's ready, it will take pictures of the ticket," Miklos said.

The VK3 differs from other detectors, like the Joint Chemical Agent Detector (JCAD).

"The JCAD is a continuous monitor of vapor, while this would be for explicitly looking at a puddle or a container of something," Miklos explained. "VK3 is also smaller, cheaper, and requires less power than the JCAD."

Moving the VK3 forward entails additional testing and expansion of its library database. While it can currently identify multiple liquid chemicals relevant to the military, it must be trained on those chemicals to identify them successfully. Because of this, Miklos said different variants of the VK3 could be trained on different chemicals, as law enforcement users might have different needs from military users.

"It identifies what we train it against," Miklos explained. "It's still a research prototype, so we've trained it against a somewhat small list of things, about 50. The list is a mixture of chemical warfare agents, as well as some common stuff like bleach, diesel, and insecticides."

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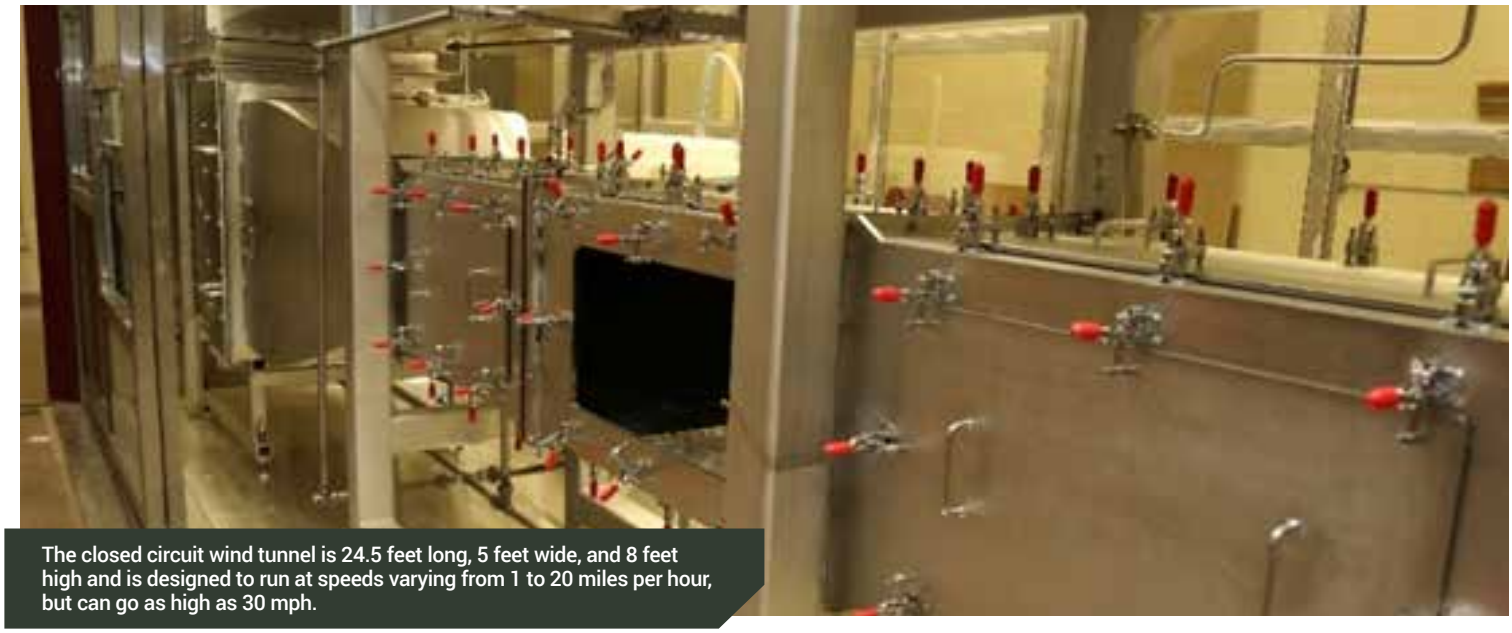
To get precise readings, the VK3 is trained on different variants of the same substance.

"We need to develop a better database to account for variability in chemicals," Miklos said. He offered bleach as a specific example, "I would want 100 bleach samples — fresh bleach, slightly old bleach, bleach that came from Europe, scented bleach. Bleach is not just bleach. We need to make sure we sampled bleach so well, that there's no room for error in detection."

On the battlefield, that variability could yield clues about whether chemical threats were "made by professionals, or in a pail in the back of a pickup truck," Miklos said.

"It's a really cool research prototype, and now we know more about how it works," Miklos said. "The question is going to be whether it gets more funding for advanced development. What we need is for someone to say, "Yes, we want it."



The closed circuit wind tunnel is 24.5 feet long, 5 feet wide, and 8 feet high and is designed to run at speeds varying from 1 to 20 miles per hour, but can go as high as 30 mph.

Army Researchers Enable Modernization with New Closed Circuit Wind Tunnel

By Ashley Mason

RESEARCHERS AT THE U.S. ARMY Combat Capabilities Development Command (CCDC) Chemical Biological Center have worked with a contractor to design and build a custom closed circuit wind tunnel (CCT) to routinely test aerosolized agents.

This capability is unique to CCDC Chemical Biological Center and enables modernization in current aerosolized agent research.

The CCT is one of several infrastructure assets the Center operates that provides full life-cycle support to chemical protection, detection and monitoring activities for the U.S. military's chemical and biological defense program.

"Our role is to ensure warfighters are optimized and able to do more with less," said Michael Ellzy, Ph.D., research chemist and project lead. "As the battlefront becomes increasingly unpredictable it is vital we know how Army materiel functions in the presence of aerosolized agents. With the new CCT, we will be able to meet the demands in early research and technology phases for eventual transition to engineered solutions."

The CCT features a custom-designed hood to enable the validation of current and future chemical, biological and explosive point and standoff detection systems. The tunnel will have the ability to provide reference points of comparison for compounds approved for outdoor testing relative to agent performance.

"Particulate matter can be contained within the circuit," said Darren Emge, Ph.D., research engineer. "This enables the researchers to run several series of studies using the same amount of agent versus the current open wind tunnels where only one type of release can be studied at a time."

The CCT has an airspeed range which can be defined by the user, allowing the ability to run the system at various speeds which allows for a more realistic examination of aerosols and vapors in various wind conditions. This feature allows the Center to mimic real world conditions not achievable using current static conditions.

The CCT system allows safe dissemination of aerosolized threat agents within operationally relevant conditions. Small scale assessment of Army materiel such as sensors, detectors, filters, mannequins and masks can be performed in the CCT against chemical agent and comparison compounds specifically approved for large scale outdoor field tests. Gathering such agent data and demonstrating the comparison between the agent and comparison compounds will support collaborative efforts with the larger test community. Currently large scale outdoor aerosol agent dissemination is not permitted in the U.S.

"Improvement in aerosol detection and identification is a priority for materiel developers of chemical and biological detection and identification systems," said Emge. "The CCT is expected to improve research findings from modeling and simulation studies because data produced is measured using the agent of interest."

Marines monitoring mission progress inside the representative Combat Operations Center (COC) during the Perceptive Dragon II demonstration.

Integrated Early Warning Sensors Provide Real-Time Battlefield Updates

By Shawn Nesaw

ON A DREARY, MUDDY MORNING in Quantico, Virginia, researchers from the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center led several demonstrations of chemical biological (CB) integrated early warning (IEW) technology during Perceptive Dragon II.

IEW technology uses data from specialized sensors to provide warfighters and decision makers with valuable information related to the battlefield, threat level and threat probability.

Perceptive Dragon I brought together new technologies for CB IEW and Perceptive Dragon II continued the effort, looking to accomplish two main goals — use IEW technology to deliver battlefield information to the Marines and relay that information to Army units in a coordinated effort.

"It's easy to demonstrate a system's capacity in a room with all the proper connections and technology in one place," said Maj. John Williams II, assistant product manager for science and technology portfolio integration at CCDC Chemical Biological Center. "It's something quite different to run a successful, real-to-life demonstration in the mud and rain. That's when you know you've got something that works."

During Perceptive Dragon II, systems engaged in a routine reconnaissance mission and an incoming fire situation which created an indirect plume of unidentified material. In both situations, IEW systems communicated information through the chain of command quickly, allowing for efficient decision making.

The demonstration utilized multiple sensors including a chemical sensor mounted on a Deep Purple unmanned aerial vehicle, Firefinder radars, a simulated light detection and ranging sensor, and radiological and nuclear point detectors. All of these sensors fed data to warfighters, providing them with better situational awareness.

"The data was fed back to the Marines and up the chain of command, giving everyone involved a picture of the battlefield in real-time," said Williams. "Both the software and the sensors pushed that early information up the chain of command so the right decisions could be made at each level."

The software and hardware necessary to provide this level of sophistication and coordination was developed by a team of experts at the CCDC Chemical Biological Center.

"The tricky part is how to coordinate and deliver the same information at the same time, to all the units, in different locations but working towards the same mission objective, so everyone involved can react accordingly," said Williams.

In the past, Perceptive Dragon demonstrations were focused on CB IEW for large installation locations. In these most recent demonstrations, the focus was the battlefield where a decentralized command structure must be addressed effectively. Units at various echelons from different armed services must be interconnected through a tactical network of radio and other sensor devices allowing leaders in each unit to see the same common operating picture at the same time.

When a deployed sensor transmits an update of a chemical threat, the CB IEW software is capable of providing information about that threat up the chain of command and onto all units common operating pictures as an overlay. All the good guys are on the same page.

Perceptive Dragon demonstrations are a coordinated effort among multiple services that allow leaders and stakeholders a chance to see the IEW technology applied in the field, usually for a specific service, such as the Marines or Air Force.

"Perceptive Dragon II demonstrated how IEW systems are meeting the needs of multiple services and how the technology can provide a shared understanding of the battlefield makeup, up the chain of command to inform decision makers," said Williams.

"By leveraging current technology, missions can be completed more effectively and efficiently," explained scientist Fiona Narayanan, Battlefield Integration Branch chief. "We observed challenges in sending data fast and frequent from multiple sensors in a battlefield scenario using the currently

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fielded technology so we set out to utilize current technology to work harder and smarter through upgrades and software development. Now, it's easy to press a button and send the information quickly and reliably."

The technology is still in the testing and demonstration phase. At each stage, more information, technology and capability is added on to previous versions.

While not every piece of the demonstration is being fielded at the present, specific parts are in the transition phase. The DragonEye Toolkit, the software used to correlate events and enable systems to talk to each other, is transitioning to Joint Project Managers Information Systems.

Additionally, some of the code in the DragonEye Toolkit is being used with nuclear biological chemical reconnaissance vehicle sensor suite upgrades which will be on display at Joint Warfighter Assessment 19, occurring April 2019.

The technology showcased during Perceptive Dragon II impacts three Army modernization priorities:

• Next-generation combat vehicles could integrate more robust, accurate sensors within vehicle design.

• The fast and reliable information dissemination to the common operating picture provides greater situational awareness, ultimately increasing Soldier lethality.

• As new ways to adapt and procure new technologies to allow for faster, independent, mobile information sharing solutions for Soldiers in disconnected or limited bandwidth environments are considered, Perceptive Dragon II will influence the Integrated Tactical Network Cross Functional Team.

DNA Tagging Detects Counterfeit Equipment

Provided by CCDC Chemical Biological Center Public Affairs Office

When exposed to a swab from Army equipment, an assay ticket will light up inside the imager. Counterfeit equipment would not make the ticket light up.

ANYONE WHO HAS EVER BEEN BURNED by a knockoff pair of designer sunglasses can tell you: counterfeit is never better than the real thing.

The U.S. Army, after learning that counterfeit equipment entered the supply chain, is developing a method for identifying counterfeit equipment by marking authentic equipment with DNA tags.

A few years ago, the U.S. Senate Armed Services Committee issued a report stating counterfeit components were frequently found in the supply chain, usually electronics.

In response, the Defense Logistics Agency (DLA) funded a project researching the use of DNA tags to track components, a program conducted by the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center. DNA was chosen for its stability; it's robust and doesn't degrade easily in different temperatures.

DNA tagging usually requires a lab and/or highly trained technicians and specialized equipment to analyze samples, resulting in longer-than-ideal wait times. Checking the tag in the field was cumbersome at best so Center biologists developed a modified approach – a field assay for identification.

"Our approach uses a DNA tag formulated so it's easy to use, requiring little instrumentation or training to verify," Matthew Lux, Ph.D., CCDC Chemical Biological Center researcher said. "You swab it, put it in a bag and, in just minutes, a pattern emerges on the ticket. If the pattern matches, you know it's authentic."

CCDC Chemical Biological Center's collaborators, Applied DNA Sciences (ADNAS), have commercial products for DNA tagging but their services require a lab. This version uses DNA as a tag without using an amplification step, making it unique. CCDC Chemical Biological Center and ADNAS are operating under a cooperative research and development agreement (CRADA).

"So what we've done is transition the proof of concept, prototype-level work to ADNAS for our approach so they can commercialize it," Lux said. "It does work, but one downside is the amount of DNA they have to put into the tag is too high for some applications, so we're hoping to obtain future funding to solve that problem. We want to work on improving the system so less DNA is required for the tags."

Beyond that, the team is also working to make the DNA tag "unhackable."

"Someone could swab our barcode, sequence it, and in theory, figure out what the tag is and put it on their counterfeit equipment," Kim Berk, Center biologist said.

The science behind the DNA tags involves a process called toeholds.

Basically, two pieces of DNA are attached, along with a fluorophore bond and a quencher, both of which can emit light.

When the pieces remain attached, they don't light up, but when the two strands are broken apart, they will light up.

Lux said the technology could also be transitioned to groups outside the military: the intelligence community, law enforcement and maybe the U.S. Treasury. These options are being explored by CCDC Chemical Biological Center and ADNAS.

The Microsoft HoloLens is a lightweight augmented reality device used for training simulations for the U.S. Army.

Synthetic Training Environments Support Warfighter Readiness

By Shawn Nesaw

AS CHALLENGES ON THE BATTLEFIELD BECOME INCREASINGLY COMPLEX, the use of virtual and augmented reality in warfighter training is rapidly increasing with the U.S. Army at the forefront.

Virtual reality (VR) is an immersive digital experience taking place within a simulated environment. VR environments can simulate 3D audiovisual aspects of real-world locations and events as well as imaginative, fantasy scenarios. The Army is currently focusing on VR's real-world applications.

VR and augmented reality (AR) hardware is becoming more widely available to consumers, and more widely used with gaming and mobile technology due to the efforts of technology giants such as Microsoft, Facebook, Samsung, and Apple.

While AR offers amusement to consumers who catch Pokémon in Pokémon GO (which uses AR to simulate animated pets in the real world as viewed through the screen of a phone), VR and AR have much more to offer toward enabling warfighter readiness.

At the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center, a team of artists and computer scientists are developing innovative ways to aid the chemical biological defense community and the warfighter through VR and AR.

> ***"VR training tools allow the trainee to learn and engage with training materials in a more interesting and immersive way, certainly more engaging than a typical classroom setting or training guide."***
>
> *Don Lail, Multimedia Specialist*

VR and AR are recognized as preferred technologies for the U.S. Army to develop more effective next-generation training tools and environments to align with the Army Modernization Strategy.

"Our team along with other organic groups within the Army are exploiting next-generation tools and technology to advance synthetic training for the warfighter and chemical biological defense," said Jeff Warwick, chief of CCDC Chemical Biological Center's Interactive Software and Visual Media Branch.

Part of the Army Modernization Strategy is Soldier Lethality, which spans all fundamentals – shooting, moving, communicating, protecting, sustaining and training. The Synthetic Training Environment (STE) is a major pillar of Soldier Lethality, and will provide the future of training for not only the chemical biological defense community but the entire U.S. military.

"Our VR/AR projects are designed to client requirements, addressing specific situations, missions or equipment. These are realistic, immersive environments, which means the training done with these types of systems are very effective," said Warwick.

One such client is the Center's Advanced Chemical, Biological, Radiological, Nuclear and Explosives Training Team. They wanted to provide CBRNE units with realistic training that allowed Soldiers to learn without the risk of exposure to chemical biological threats. The solution was a VR training environment that made Soldiers feel like they were in a clandestine laboratory.

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Through hand gestures and voice commands, operators can control custom-designed programs that leverage augmented reality glasses.

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CCDC Chemical Biological Center multimedia specialist Don Lail speaks at universities and industry conferences about the practical application of AR and training Soldiers using VR and AR.

"VR training tools allow the trainee to learn and engage with training materials in a more interesting and immersive way, certainly more engaging than a typical classroom setting or training guide," explained Lail.

The Center has already produced several VR/AR applications which provide new learning capabilities, including enabling a user to dissect a life-size model of an unmanned aerial vehicle in flight. Another application gives the user information through Microsoft's HoloLens AR head-mounted display which relates to a physical chemical and biological detector the user can manipulate. The application walks the user through a step-by-step assembly of the physical detector's various removable components and also provides an overview of the detector's operation and status.

"These AR training tools allow novice users to perform assembly, maintenance, repair, or review directly on a device as if they were a subject matter expert," explained Lail.

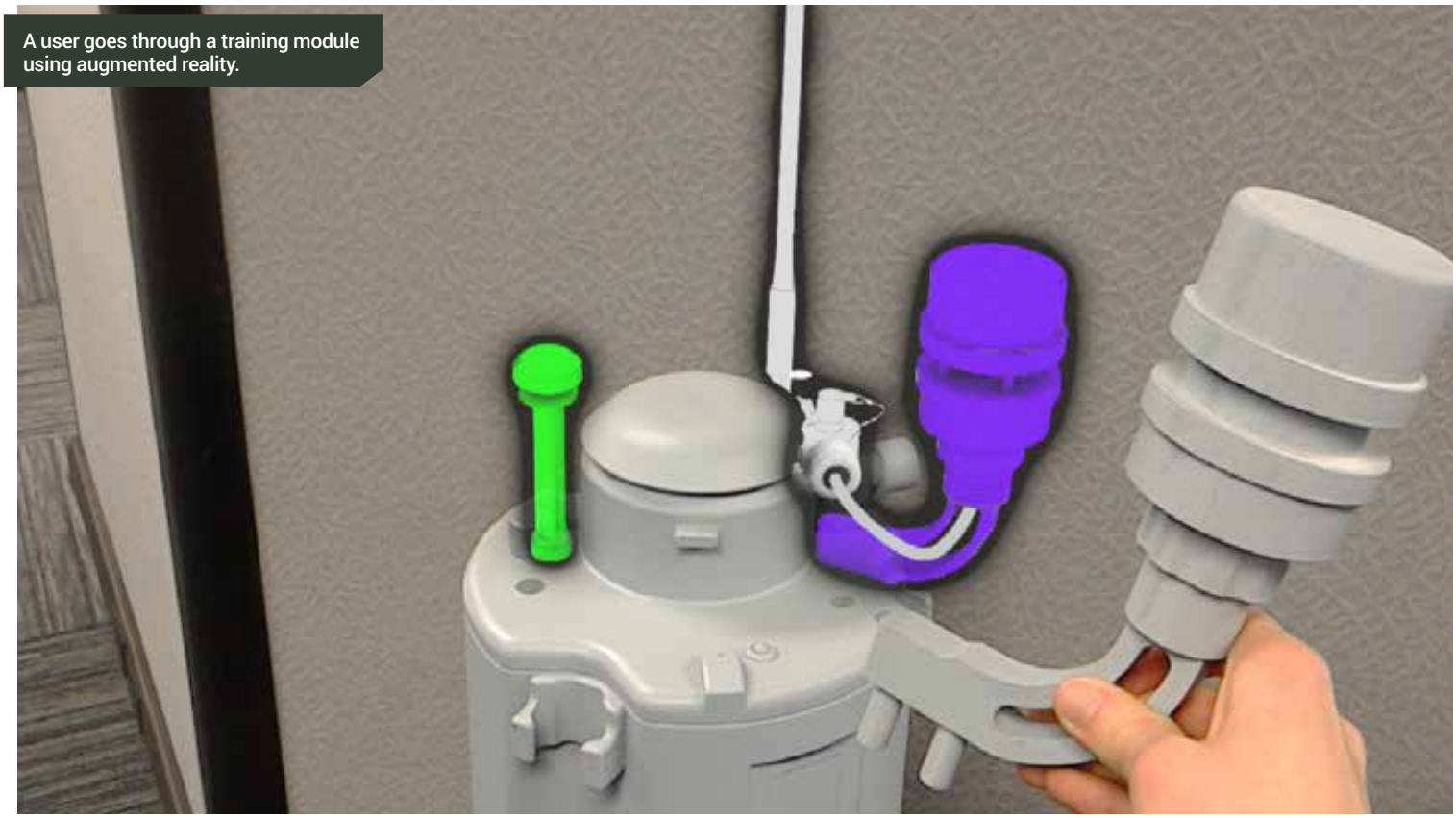
Once the hardware becomes suitable for fielding, training applications such as these could be utilized by the warfighter any place and at any time, making them true point-of-need training. These current applications are just the tip of the virtual iceberg. It is not currently known the extent to which VR/AR can be employed toward assisting and enhancing the warfighter.

"We could design a training, load it onto any number AR glasses and ship them to wherever they are needed," said Jason Gitlin, the branch's lead digital artist, "Better yet, we can adapt a program to the unique needs of, for instance, a special forces team, load up the glasses with the program, and send a set to the team to help them diagnose and solve a specific problem with a mission-critical piece of equipment."

Commercial VR/AR hardware has progressed rapidly in the past few years, becoming lighter, more comfortable, more user-friendly and most importantly, more affordable. These commercial off-the-shelf systems allow the Army to establish short and flexible development cycles which minimize costs and maximize development outcomes.

Across the Department of Defense, synthetic training tools are being employed to provide service members with the information and muscle memory necessary to enhance readiness.

"Through some of the training tools we've developed recently it's clear Soldiers internalize the training and are better prepared heading into a mission," Warwick said. "We're excited to see what's to come and the impact the tools we develop have on the warfighter."



A user goes through a training module using augmented reality.

Chains of intracellular metal nanoparticles called magnetosomes could lead to new functionalized textiles such as Soldier uniforms and protective suit systems.

Army Researchers Make Groundbreaking Advance in Nanoparticle Production

Provided by CCDC Chemical Biological Center Public Affairs Office

IN THE SEARCH FOR NEW DEFENSES against chemical, biological and radiological threats, researchers often look toward nature, where simple organisms provide clues for new ideas and new capabilities.

A variety of microbes have the ability to synthesize intracellular metal nanoparticles that could be harnessed for use in future military applications. One of these organisms, the bacteria Magnetospirillum gryphiswaldense, sequesters magnetite to form intracellular chains of microbial nanoparticles called magnetosomes. These biologically-derived nanoparticles require much less energy to make than their synthetic counterparts and have a number of superior qualities such as high chemical purity, low toxicity, good biocompatibility and environmentally-friendly production.

At the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center biologist Alena Calm, research scientist Kelley Betts, research chemical engineer Michael Kim, Ph.D., and biologist Frank Kragl are developing methods to characterize and scale up the production of these nanoparticles to better understand how biologically-derived nanoparticles could improve Army capabilities.

The initial goal was to explore the ability of these nanoparticles to provide customizable, environmentally-friendly electromagnetic pulse protective materials that fit well within the Army's Energy Security and Sustainability Strategy. Current capabilities, such as the Faraday cage, can be expensive and cumbersome in field-forward environments.

Now that they have determined how to grow the bacteria on a large scale, they're investigating military uses for the nanoparticles that they produce. While their use in medicine is well-documented in applications such as magnetic imaging, immunoassays and cancer therapeutics, their potential in military applications remain undiscovered.

"We've learned how to grow them in small and large scales. We've gotten to the stage of making and characterizing nanoparticles, and we're in the process of figuring out what they can do," Calm said. "In the next steps, we'd like to learn about what they can do for the Army. We keep getting more ideas on how to use them."

Nanoparticles have both broad and interdisciplinary applications meaning they could potentially impact the development of a variety of defense-related materials such as new classes of sensors, microelectronic devices, specialized coatings useful for next-generation combat vehicle design and functionalized textiles such as Soldier uniforms and protective suit systems.

Currently, scientists at the Center's Toxicology and Obscuration Sciences Division are electrospinning the nanoparticles in a polymer.

"If we can spin these into fibers, the material could be tested for an assortment of capabilities," Betts said.

The Center's BioTechnology Branch is partnering with the University of Delaware's College of Engineering to determine the possibilities.

This research was jumpstarted through the Center's FY18 Innovative Development of Employee Advanced Solutions (IDEAS) Program, which is designed to promote innovation and advanced development of new ideas and projects, and was subsequently supported by the Center's Biological Engineering for Advanced Materials Solutions Grand Challenge. In 2019, the newly-awarded IDEAS project titled: A Biologically-derived Transformer- "More than meets the eye…" will look to leverage these living organic materials to develop a first-of-its-kind, highly efficient, biologically-grown electronic transformer by using living bacterial cultures to grow a working laminated transformer core.

The CCDC Chemical and Biological Center is the first Department of Defense (DoD) laboratory to develop a process for scaling up the production of magnetosomes.

"This organism has been looked at for decades, but we're the one DoD lab doing so at this scale," Betts said. "We're one of the only labs to try this." Calm explained that the bacteria is notoriously tricky to cultivate. "The hallmark of these organisms is that they're difficult to grow," Calm said. "We picked this one because it is considered a 'lower hanging fruit' compared to others, and we knew it was attainable. Now that we have experience with this organism, we can go out and look at other bacteria that have this capability."

In the future, the Center's investments in synthetic biology, protein engineering, additive manufacturing and materials science may leverage these nanoparticles in innovative ways to develop new materials and manufacturing capabilities across the CCDC enterprise.

Working for the Warfighter

Developing Advanced Obscurants to Defeat Enemy Capabilities

By Larry Bickford

Larry Bickford is the branch chief of the Smoke and Target Defeat Branch for CCDC Chemical Biological Center located at the Edgewood Area of Aberdeen Proving Ground, Maryland. He holds a master's degree in engineering administration from George Washington University and received his bachelor's degree in chemical engineering from Rensselaer Polytechnic Institute.

ONE OF THE UNIQUE CAPABILITIES at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center is the development of obscuration technologies for a broad range of applications and delivery by a multitude of systems. Applications not only include screening friendly forces from enemy sight and sensors but also deception and signaling.

The current threat is evolving. The enemy has become ever-more sophisticated as technology is proliferated. The infrared region is an area where sensors, sights and seekers are commonplace and the commercial market has made them reasonably priced for purchase. Microwave sensors and seekers are also on the rise. Sensor fusion will allow enemy forces an enhanced view by piecing together the best images from several portions of the spectrum. Therefore, there is a need for multispectral obscuration.

The obscurant technology program provides advances in performance throughout the electromagnetic spectrum (ultraviolet, visual, Infrared (IR) and microwave regions) to counter enemy sensors and seekers that are also evolving. The program seeks to improve the technology through cutting edge materials science for a variety of applications.

With the emergence of the Army Chief of Staff's Modernization Priorities, the obscuration technology program is focused on the primary mission of supporting the Next Generation Combat Vehicle (NGCV). Other Army Modernization Priorities that will benefit from our technology efforts include Long-Range Precision Fires, Future Vertical Lift Platforms, Air and Missile Defense Capabilities and Soldier Lethality.

Our applied research under the Army's Science and Technology Program develops new high-performing obscurants to meet application needs. These new obscurants include a 300 to 1,000 percent improvement in bispectral (visible through far IR) obscurants, a 300 to 1,000 percent improvement in microwave obscurants and development of new spectrally selective obscurants.

Bispectral obscurants can defeat or degrade visual and IR sensors, seekers and laser range finders. Microwave obscuration has potential application in countering radars and missile seekers.

Spectrally selective obscurants are defined as obscurants that blind enemy forces but allow friendly forces to see through. Other terms used for this concept are 'one way smoke' or 'asymmetric vision' where friendly forces use superior sensors to overmatch a blinded enemy.

Since our primary effort is to support the NGCV, our program involves vehicle protection applications. The improved Rapid Obscuration System seeks to develop and demonstrate, by fiscal year 2021, a new improved vehicle protection system compatible with existing systems for short-range protection. The Extended Range Obscuration System (EROS) will engage threat systems from other incoming command and laser guided missile threats. Demonstration of the EROS system is planned for fiscal year 2023. Both vehicle protection technology efforts will be activated using integrated vehicle protection sensors through the Modular Active Protection System framework being developed by the U. S. Army Tank Automotive Research, Development and Engineering Center. To protect maneuver forces, a vehicle mountable/two-man portable medium area bi-spectral Screening Obscuration Module system will be demonstrated in fiscal year 2023.

Bispectral obscurants can defeat or degrade visual and IR sensors, seekers and laser range finders. Microwave obscuration has potential application in countering radars and missile seekers.

The future of obscuration technology will evolve over the next few years to meet the needs of the Army's priorities. The Maneuver Center of Excellence has developed an obscuration strategy for the Army. Traditionally, obscurants have been thought of as a tool to enhance survivability on the battlefield. Future concepts may expand that role to enhance lethality of U.S. forces. Artillery delivery of bispectral obscurants is a future need for a projected capability. A potential area of emphasis may be the use of obscurants to blind the enemy, thereby reducing his ability to counter our lethal weapons. Obscurants may also be used to mask the signature of our weapon systems, thereby enhancing their lethality.

Whatever the needs, CCDC Chemical Biological Center will develop and adapt the new obscuration technologies to meet those goals.

Senior leaders and VIP stakeholders observe the sensor suite upgrade atop the NBCRV at CCDC Chemical Biological Center.

NBCRV Sensor Suite Upgrades Draw Praise from CBRN Stakeholders

By Shawn Nesaw

A SNOWY, FRIGID FEBRUARY MORNING didn't stop leaders and stakeholders from turning out to view the highly anticipated Stryker Nuclear, Biological and Chemical Reconnaissance Vehicle (NBCRV) Sensor Suite Upgrade program demonstration at the Combat Capabilities Development Command (CCDC) Chemical Biological Center.

The NBCRV demonstration provided a first look for many at the brand new suite of chemical sensors deployed on the NBCRV, a huge leap forward in terms of capabilities for not only the vehicle but for CBRNE Soldiers tasked with operating and carrying out missions using the NBCRV.

"We're not writing about the future, we're not thinking about the future, we're building the future," Lt. Col. Jeffrey Strauss of the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND), Joint Project Manager for Nuclear, Biological and Chemical Contamination Avoidance (JPM NBC CA) said during his opening remarks to the audience of more than 50 people.

For years, Soldiers have used the Stryker, an eight-wheeled armored fighting vehicle and true workhorse of the Army, to address chemical, biological, radiological and nuclear (CBRN) threats on the battlefield. When modified with CBRN chemical detection sensors, the Stryker is known as the Stryker Nuclear, Biological and Chemical Reconnaissance Vehicle or NBCRV.

Currently, CBRN Soldiers investigate potential CBRN threats at close range from a slow-moving or completely stopped vehicle, sometimes directly exposing the vehicle to the threat in order to conduct sampling and often creating an easy target for the enemy. It was clear to many in the Science and Technology (S&T) community, the CBRNE community and the Army that the NBCRV had opportunities for modernization.

"This capability is meant to operate outside the threat," Scott Kimmel, Deputy Commandant of the U.S. Army CBRN School said. "NBCRV has to operate with a cavalry squadron because the days of the NBCRV being left in the rear of the fight are over."

The team developing the sensor suite upgrade had three main goals to accomplish.

The team had to develop a standalone package allowing the sensor package to be placed anywhere. To increase Soldier safety, the package needed to perform remote detection. Additionally, on-the-move detection was a necessity.

With only 150 days to produce a working prototype, teams came together to design, develop and prototype the sensor suite package. The CCDC Chemical Biological Center's additive manufacturing facility leveraged their in-house rapid prototyping capability to ensure timely delivery.

The morning's demonstration at the CCDC Chemical Biological Center's additive manufacturing facility and test range site involved one NBCRV, one unmanned ground vehicle (UGV) and one Humvee. Sensor packages were mounted atop both the NBCRV and UGV. The sensor package was also loaded on a trailer towed behind a Humvee to illustrate the sensor package's ability to be forward deployed in a variety of ways and on a variety of platforms.

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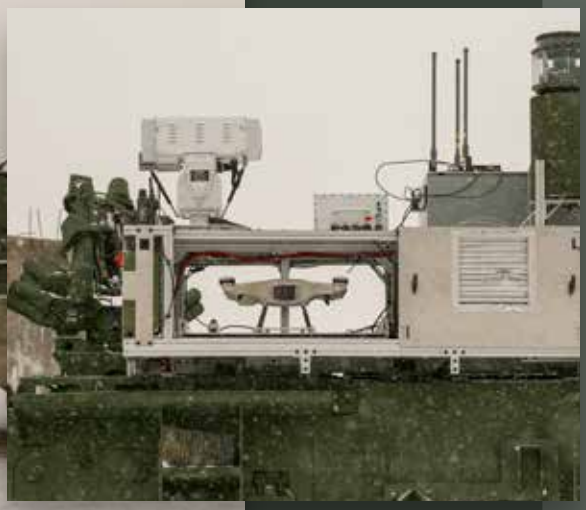

The Sensor Package

The upgraded NBCRV sensor package emphasizes on-the-move, standoff detection consisting of six sensor capabilities.

1. The Deep Purple Unmanned Aerial Vehicle equipped with the Array Configurable of Remote Network Sensors flies sensors into a chemical cloud for interrogation.

2. A Joint Chemical Agent Detector automatically detects, identifies and alarms to chemical warfare agents and toxic industrial chemical vapors.

3. A standoff detector called the improved Mobile Chemical Agent Detector detects, identifies and maps chemical weapon vapors.

4. The Vehicle Integrated Platform Enhanced Radiation Detection, Indication, and Computation is the NBCRV's internal point sensor and is specifically tailored for mounted operations in radiological-nuclear environments.

5. The Mounted Enhanced RADIAC Long-Range Imaging Networkable (MERLIN) system, which is comprised of two subsystems that are complementary but work independently of each other, MERLIN-Imager (MERLIN-I) and the MERLIN-Applique (MERLIN-A). MERLIN-I enables stationary standoff radioisotope detection and MERLIN-A consists of four sensors mounted on the corners of the NBCRV, enabling moving standoff detection.

6. The Chemical Sensor Detector analyzes ground liquids using a laser and spectrometer and is deployable on-the-move.

Continued from page 14

As the snow continued to fall, visitors and sensor operators interacted during a static display of the technology, asking questions and giving feedback. Following the static display, the NBCRV and UGV were sent into the test field to continue the demonstration. A nearby shelter offered a place for visitors to warm up and observe two mock scenarios to showcase the new capabilities of the sensor package via monitors inside the shelter.

The NBCRV marks a major milestone for the CBRNE community, not only in terms of the capability developed but in terms of collaboration among so many organizations.

"This has really been a tremendous effort to ensure we're delivering the best capabilities to the warfighter," Strauss said. "It's been a team of teams, not a singular effort, to make this all come together."

"It's taken a whole lot of folks to make this work," said Douglas Bryce, Executive Officer of JPEO-CBRND. "Our requirements generator, our S&T folks, our advanced development and our testers all have to come together and the success of the NBCRV is a great testament to everyone involved. This effort reinforces the importance of collaboration with our partners."

Aside from demonstrating what future warfighters may face in the field, the presentation also revealed a shift in how the Army thinks about chemical and biological threat detection on the battlefield.

"With these sensor upgrades, the goal is to transition from a modified Stryker to a Stryker with a sensor suite package," Peter Bryant, project specialist at CCDC Chemical Biological Center said. Bryant plays a lead role in the overall design, fabrication and installation of the sensor suite package.

The mentality shift extends beyond how the technology is deployed.

"We can't develop capabilities to complete legacy missions," Kimmel added. "We have to look at our future mission, and that future mission is stay out of the hazard and allow maneuver commanders to make decisions through better understanding of the CBRN environment."

"This is a first step toward realizing integrated early warning on the move," Daniel McCormick, deputy joint program executive officer for operations and modernization at JPEO CBRND said.

The sensor suite upgrade gives commanders time and space to make decisions.

"If we can give commanders an extra 30 seconds to help them make a more informed tactical decision," McCormick added, "then that's what we have to work towards quickly."

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Continued from page 15

"From last April at the Maneuver Support Sustainment Protection Integration Experiment at Fort Leonard Wood in Missouri to now, we've come a long way in short order. It's absolutely amazing!" said Brig. Gen. Antonio Munera. "We're all on the same sheet of music, we're all headed in the right direction for the benefit of the warfighter. It's the biggest technological leap forward I've seen in my 28 years in the Chemical Corps."

Looking forward, the concept of an easily deployable sensor package for the NBCRV platform is where the Army is heading, but the overall setup and sensor package layout will inevitably go through further development and testing before final decisions are made on the design.

"We're developing a capability to reach the 21st century," Ron Hann, Ph.D., director of the Defense Threat Reduction Agency and the United States Strategic Command Center for Combating Weapons of Mass Destruction said. "There's still work to do to improve the capability, but this is a solid step in the right direction."

Future upgrades to the sensor suite will include the addition of two new sensors to enable biological detection and assessment capabilities, as well as modifications to the overall design to reduce size, weight and power needed.

According to sensor designer Bryant, the system is meant to be somewhat modular so that, depending on the needs of the mission, Soldiers could switch out certain sensor capabilities to ensure their NBCRV is equipped with the right sensors and tools for the mission.

"As we look to integrate chemical and biological defense, it's examples like this that highlight the progress we're making," Eric L. Moore, Ph.D., director of CCDC Chemical Biological Center said. "This rapid prototyping approach, along with working closely with the maneuver community, is the crux of our mission moving forward."

This May, the NBCRV and a team of operators will showcase the vehicle's capabilities at the Joint Warfighter Assessment 2019 in Washington state.

During the post-demonstration discussion, senior leaders from across the chemical biological defense community shared their thoughts and ideas for the future of the NBCRV sensor package.

2018: The Year in Review

As our Center aligns under a new command with a new name, the following pages take a glance at our final year as U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center.

JANUARY

Moore Assumes Responsibilities of Director During Ceremony

Eric L. Moore, Ph.D., was formally recognized as the director of the U.S. Army Edgewood Chemical Biological Center (ECBC) during an assumption of responsibility ceremony at the Center. During the ceremony, Moore discussed his vision for the future of RDECOM ECBC and alignment with the Army's three main priorities: readiness, modernization and reform. "We need to envision what the future will look like and partner effectively with our (chemical and biological defense) stakeholders, academia, and industry to develop technologies that give our warfighters the competitive advantage," Moore said. "We have to ensure that we're growing the talent and infrastructure to support tomorrow's fight," he continued. "We have to make sure that we're putting the right business processes in place to deliver quality products and services to tomorrow's warfighter. And we have to collaborate with one another to deliver tomorrow's technology using common platforms."

FEBRUARY

RDECOM ECBC Division Earns Department of the Army Safety Award

The Chemical Biological Test Division of RDECOM ECBC's Engineering Directorate earned the Director of Army Safety Risk Management Award, a prestigious award presented by Brig. Gen. David Francis, commanding general of the Combat Readiness Center and director of Army Safety. "The work this team does is exponentially dangerous, and it is directly applicable to what we're going to face in the future," Francis said. "This team took the initiative and showed the leadership to take their own time and find ways to make their work safer. Their work is commendable and will improve both safety and readiness in the future."

MARCH

RDECOM ECBC Employees Honored at 2018 NMTC Visionary Awards

Alena Calm and Michael Simini, Ph.D., were honored for their commitment to community involvement and STEM outreach at the 2018 Northeastern Maryland Technology Council's (NMTC) Visionary Awards for STEM Education and Technology & Innovation Advancement. A prestigious award in the region, the NMTC Visionary Awards recognize those who contribute to building a STEM-educated workforce, advancing technology, and innovation. Calm won the NMTC's innovator award, which recognizes "exceptional personal efforts in development and implementation of innovative program(s) measurably benefiting building our STEM-educated workforce." Simini won the NMTC's mentor award, which goes to someone who is "consistently volunteering their knowledge, experiences, and wisdom by going above and beyond in using their personal time and resources simply for the love of stimulating and inspiring greatness in students or teachers or organization proteges."

MARCH

RDECOM ECBC Demolitions Begin with Amos A. Fries Research Laboratory

A decade-long initiative to remediate and demolish old buildings at RDECOM ECBC began with the remediation of the 50-year-old Amos A. Fries Research Laboratory, Bldg. E3300 in March. RDECOM ECBC's Chemical Biological Application and Risk Reduction (CBARR) unit is conducting the clean-up effort. "This demolition puts us on the right path to addressing our responsibility to the legacy buildings and our mission at Edgewood," said Col. Robert Phillips, Aberdeen Proving Ground's garrison commander. "It's reassuring to know that the people doing this have a proven track record of responsible and safe remediation and demolition. With their level of experience, CBARR is the right team for the job."

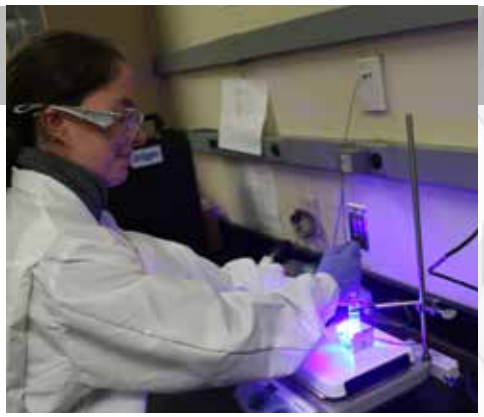
MARCH

Decontamination Technology Awaits Field Tests

A sprayable decontamination slurry, developed by scientists at the U.S. Army Edgewood Chemical Biological Center (ECBC), is a highly effective decontaminant, working through multiple mechanisms: hydrolysis and oxidation. The slurry is designed for material decontamination of equipment and vehicles – like the fender of a Humvee – but not skin. When deployed, the decontamination slurry provides a more efficient and effective decontamination for vehicles and equipment on the battlefield. Designed for immediate, material decontamination, the decon slurry can be used immediately after a vehicle is contaminated with chemical warfare agent. After getting to safety, Soldiers can mix up the decontaminant slurry, spray it on the vehicle, and return to base.

MARCH

RDECOM ECBC Research Could Lead to Self-Decontaminating Combat Uniform



Research being conducted at ECBC is exploring whether chemical weapon-neutralizing substances can be incorporated into equipment worn by warfighters. Researchers are determining how to incorporate MOFs into fabrics and textiles to give decontamination capabilities to materials. When exposed to light, these MOFs react with and excite oxygen. In turn, oxygen reacts with and combines with agent, effectively neutralizing the threat. While there are thousands of different MOFs, ECBC researchers have identified fewer than 10 with this capability. Composed of metal ions and organic compounds, MOFs take the form of powder which could be infused with fabrics and textiles. The Defense Threat Reduction Agency (DTRA) has funded a program focused on up-scaling the production MOF materials.

MARCH

Virtual and Augmented Reality a Game Changer for Soldier Learning

U.S. Army Research, Development and Engineering Command Edgewood Chemical Biological Center (RDECOM ECBC) multimedia specialist, Don Lail, spoke to a group at Towson University on mixed reality and the possibilities presented by augmented reality (AR) and virtual reality (VR) software and hardware on the future of learning. RDECOM ECBC has created AR and VR training tools that aid Soldiers in learning new, technically complex tasks such as how to safely and effectively perform sensitive site assessment in a potentially dangerous environment.

MAY

RDECOM ECBC Researchers Combine Wearable Sensors, Advanced Mass Spectrometry to Gather Life-Saving Information

Research chemist Bruce King, Ph.D., leads a team at RDECOM ECBC that is combining wearable chemical samplers and multi-dimensional chromatography to enhance Soldier protection by accurately identifying which and how much chemical warfare agent a Soldier has been exposed to. The wearable sampler clips on to a Soldier's uniform and collects information about various substances that the Soldier may have been exposed to during a mission, collecting almost everything it encounters.

JUNE

RDECOM ECBC Integrated Early Warning at MSSPIX

The Deep Purple automated drone and the onboard chemical and biological detection system called the Array Configurable of Remote Network Sensors (ACORN) were tested in the field at Fort Leonard Wood, MO. The tests were held during the Maneuver Support Sustainment Protection Integration Experiment (MSSPIX). RDECOM ECBC scientists and engineers demonstrated the pairing's ability to remotely navigate to a potential chemical biological threat, interrogate the threat and deliver findings back to the Soldiers in real time. Throughout 2018 Deep Purple and ACORNS were showcased at many trade shows and expos including the National Defense Industrial Association's CBRNE conference.

JUNE

RDECOM ECBC Advises First Responders in Wake of Volcanic Eruption

In the aftermath of the Hawaiian volcano, Kilauea, eruption, scientists at RDECOM ECBC provided their expertise to help safeguard the health of first responders. The volcano's continued eruption cast ash and chemicals into the air, posing a health concern for first responders. With a history of developing chemical and biological equipment to protect warfighters, RDECOM ECBC experts were needed to analyze and give feedback to first responders who were using protective masks. Both the National Guard and U.S. Navy looked to the Center's experts for assurance that the masks could handle what they were facing, sulfur dioxide, hydrogen sulfide, and hydrochloric acid. Greg Peterson, Ph.D. was the point of contact at the Center for the National Guard and Navy. "The masks performed well and were built to handle much higher concentrations of contaminants. The masks were well-equipped to serve the needs of the responders."

JULY

RAMP MD Extends RDECOM ECBC Partnership to 2023

On its fourth anniversary, the Regional Additive Manufacturing Partnership of Maryland (RAMP MD) extended its partnership with RDECOM ECBC. The two organizations agreed to a five-year extension through July 25, 2023.The amendment allows the Center to continue to be an important partner in the advancement of additive manufacturing capabilities within Maryland. "RAMP MD is an opportunity to push new, innovative technologies forward and to develop a sector of professional partners that we'll have outreach to in the future," Eric L. Moore, Ph.D. said. "By having commercial success, they will develop beyond our initial interactions."

AUGUST

Saliva Samples Provide Gauge for Warfighter Readiness

Research at the U.S. Army Research, Development, and Engineering Command Chemical & Biological (RDECOM C&B) Center has scientists interested in saliva. Research biologist Trevor Glaros, Ph.D. and research biologist Elizabeth Dhummakupt, Ph.D. are heading the Center's effort for discovering more about what information saliva has to offer the Army. Samples of Soldiers saliva might have implications for evaluating human performance and warfighter readiness. By isolating and analyzing certain biomarkers found in saliva, scientists can determine a warfighter's physical condition and determine whether to pull him out of combat or to extend the recovery time before re-engaging. After refining the process and identifying key biomarkers, Glaros and Dhummakupt hope to develop an assay, which could function similarly to a pregnancy test, which could work in the field.

AUGUST

Handheld Genomic Sequencer Shows Promise in Field Demo

The MinION, a handheld genomic sequencer capable of detecting known and unknown biothreats including emerging and genetically modified pathogens, is being researched by the Defense Threat Reduction Agency at RDECOM ECBC. Recent breakthroughs have enabled the MinION to analyze a sample in an hour, without high-powered lab equipment, even in low resource environments.The MinION was used in West Africa during the Ebola outbreak, in Antarctica, and even on the International Space Station. Oxford Nanopore, inventors of the MinION have released a newer version that provides fully automated sequencing.

AUGUST

RDECOM ECBC Hall of Fame Opens with Two Inductees

James Baker, Ph.D., and Harry Salem, Ph.D., were inducted into RDECOM ECBC's Hall of Fame during a ceremony held at RDECOM ECBC in August. "Both of these men represent the best of RDECOM ECBC," said Center Director Eric Moore, Ph.D. "They contributed to making RECOM ECBC what it is today, and I am privileged to lead it. I stand on the shoulders of giants." The Hall of Fame will be located in the waiting area of E3400 and is currently in development. Each year moving forward, one new person will be inducted into the hall of fame.

AUGUST

Science Teachers Work Alongside Army Researchers to Hone Laboratory Skills

RDECOM ECBC hosted a group of high school teachers during a two-week STEM-intensive program funded by the Defense Threat Reduction Agency (DTRA). Teachers were taken out of the classroom and into the labs for the opportunity to experience real-world laboratory science and gain practical knowledge to apply to lessons in their classrooms. Six teachers from around the country worked side-by-side with research scientists at the Center on a variety of experiments such as aerosol detection, biological sample collection and mass spectroscopy.

SEPTEMBER

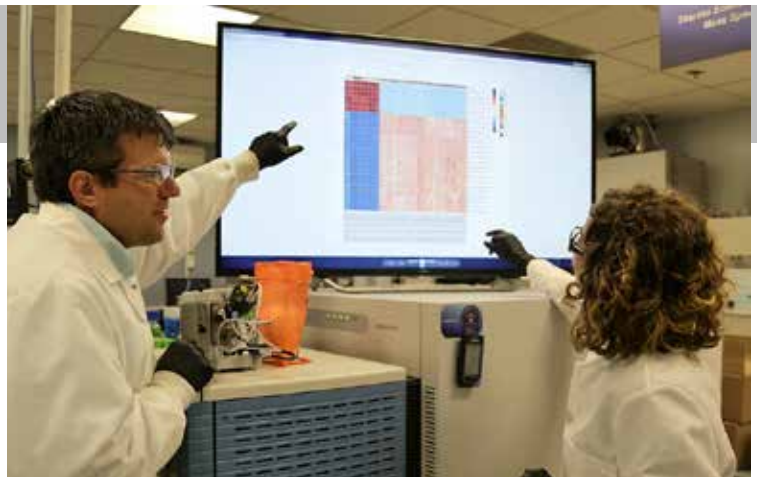
Porton Man Does the Dirty Work

An international partnership with the United Kingdom has brought a new chemical and biological protective suit testing capability to the U.S. Department of Defense, with RDECOM ECBC scientists leading the effort. The partnership with the U.K.'s Defence Science and Technology Laboratory (Dstl) is part of a larger effort to share information for the good of the bilateral chemical and biological defense community and the warfighter, expanding knowledge and capabilities for both nations. The partnership with the Dstl makes available a new way to test using high tech mannequins and live chemical warfare agent. Porton Man is a carbon fiber, fully-articulated mannequin used to test the effectiveness of chemical and biological protective suit systems.

OCTOBER

Groundbreaking Research Shows Potential to Detect Opioid Exposure

Researchers at RDECOM ECBC are setting a new course for toxicology research relating to opioids, with new findings demonstrating the potential to detect low-level opioid exposure. By looking at biomarkers in blood, scientists may be able to diagnose low-level opioid exposure as long as two weeks after the event. "This is unprecedented research that lays a strong foundation for future work in opioid exposure detection and medical responses to that exposure," Glaros said. "As opioids continue to post a significant threat domestically and on the battlefield, this research is a game changer that will help keep people safer and potentially save lives."



OCTOBER

RDECOM ECBC Expands Capability for Agent-Surface Analysis

New to the Center's capabilities, the NAP-XPS is a custom designed multisystem leveraged by RDECOM ECBC researchers to study and develop cutting edge materials integral to defense technologies including surface coatings, filters and textiles that will better protect the warfighter from chemical threats. The multisystem will be used to investigate the interaction of chemical warfare agents with the surface of protective materials at the molecular level. Center researchers will use the system to analyze emerging filtration and decontamination materials such as zirconium hydroxide and metal organic frameworks, gaining understanding how chemical warfare agents and battlefield contaminants interact with materials of interest.

NOVEMBER

Moore, Local Leaders Discuss Future at Army Alliance Breakfast

Local military and civilian leaders came together to discuss the future during the Army Alliance's annual breakfast. Director Eric Moore, Ph.D., took part in a panel of local leaders on the future of the defense community in the Edgewood community. Titled, "Shaping the Future: Growing the Edgewood Defense Community," the discussion centered on how the Army Alliance could develop the defense community, and how various government, educational and private sector institutions can collaborate to achieve that vision. Moore, along with Col. Rob Phillips, both talked about the Army's organizational change, re-aligning RDECOM ECBC under the U.S. Army Futures Command. "What's going on with the Futures Command is huge, and we know we're a hub of innovation," Phillips said. "We're in a good position here."

DECEMBER

RDECOM ECBC Highlights Technology Transfer Efforts to Stakeholders

The Center's Office of Research and Technology Application (ORTA) plays a critical role in coordinating transfer of impactful technologies to and from partner organizations. When Army technology is identified as one capable of use beyond military applications, steps are taken to transfer the technology to other industry, academia, or other government agencies. As a federal laboratory, RDECOM ECBC has the authority to transfer technology in this way. Through patent license agreements, cooperative research and development agreements and technology service agreements, partnerships and collaborative efforts are established.

Angela Sherman, chair of the American Chemical Society's Maryland Chemical Award Committee, presents CCDC Chemical Biological Center researcher Jared DeCoste, Ph.D., the Maryland Chemist of the Year award.

Army Researcher DeCoste Honored as Maryland Chemist of the Year

By Shawn Nesaw

AN ARMY SCIENTIST at the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center has been named Maryland Chemist of the Year by the American Chemical Society (ACS).

Jared DeCoste, Ph.D., received the prestigious award for to his efforts to further the understanding and development of metal organic frameworks (MOFs) for chemical, biological, radiological and nuclear (CBRN) defense applications. For the past eight years, DeCoste has been a leader in MOF research with the goal of protecting Soldiers from CBRN threats on the battlefield.

"Jared is a talented scientist and we're proud he is a member of the CCDC Chemical Biological Center Research and Technology (R&T) Directorate," said Matthew Shue, acting R&T director.

Around the Center and in his field, Decoste strives to collaborate with others.

"He is an interdisciplinary scientist who embodies what it means to collaborate across the Center," Shue explained. "Jared is extremely mission-focused. He fosters a collaborative environment to help meet customer needs head-on, developing creative solutions to directly impact the warfighter."

DeCoste's work has led to 5 U.S. patents and more than 50 manuscripts. His work has been featured in periodicals and by news outlets including Chemical and Engineering News, Materials Today, Fox News, Science Daily, CBRNE World and Nature.

DeCoste said his work as the principal investigator of the Biological Engineering for Applied Materials Solutions (BEAMS) program at the Center has been a highlight of his career, leading him to collaborate and innovate in ways that only working in a highly interdisciplinary field allows. His work has always revolved around finding unique avenues to progress science through collaboration.

"To me this award means that we are doing something right in trying to create a more open and collaborative culture," said DeCoste. "Scientists are notorious for keeping their work very close to the vest and secretive. We have shown that working together across the Center, as well as with other government organizations, industry and academia, we can accomplish so much more. The ACS is a fantastic professional organization and it is great that they are recognizing some of the great work we are doing at the Center."

"The awards committee was extremely impressed by Jared's accomplishments," said Angela Sherman, Chair of the American Chemical Society's Maryland Chemical Award Committee. "He specializes in a very challenging field and has made great strides in a short time. After reviewing Jared's work and submission materials, it was evident he was deserving for our section's highest award."

Established in 1962, the Maryland Chemist Award annually recognizes a member of the American Chemical Society, Maryland Section, for outstanding achievement in the fields of chemistry. The achievement may be in pure or applied chemistry, chemical engineering, or chemical education.

In the Community: Center Scientist Engages the Next Generation

By Shawn Nesaw

Alena Calm assists students with focusing a microscope on a fly wing.

OUR SCIENTISTS LOVE WHAT THEY DO – developing cutting edge solutions to defend against chemical and biological threats for the U.S. Army. Our scientists also love sharing their knowledge and love of science with others, namely the future scientists who will undoubtedly keep America ahead of the rest of the world in terms of detection and protection.

Alena Calm, a research biologist in the biosciences division at the Combat Capabilities Development Command (CCDC) Chemical Biological Center, is one such scientist.

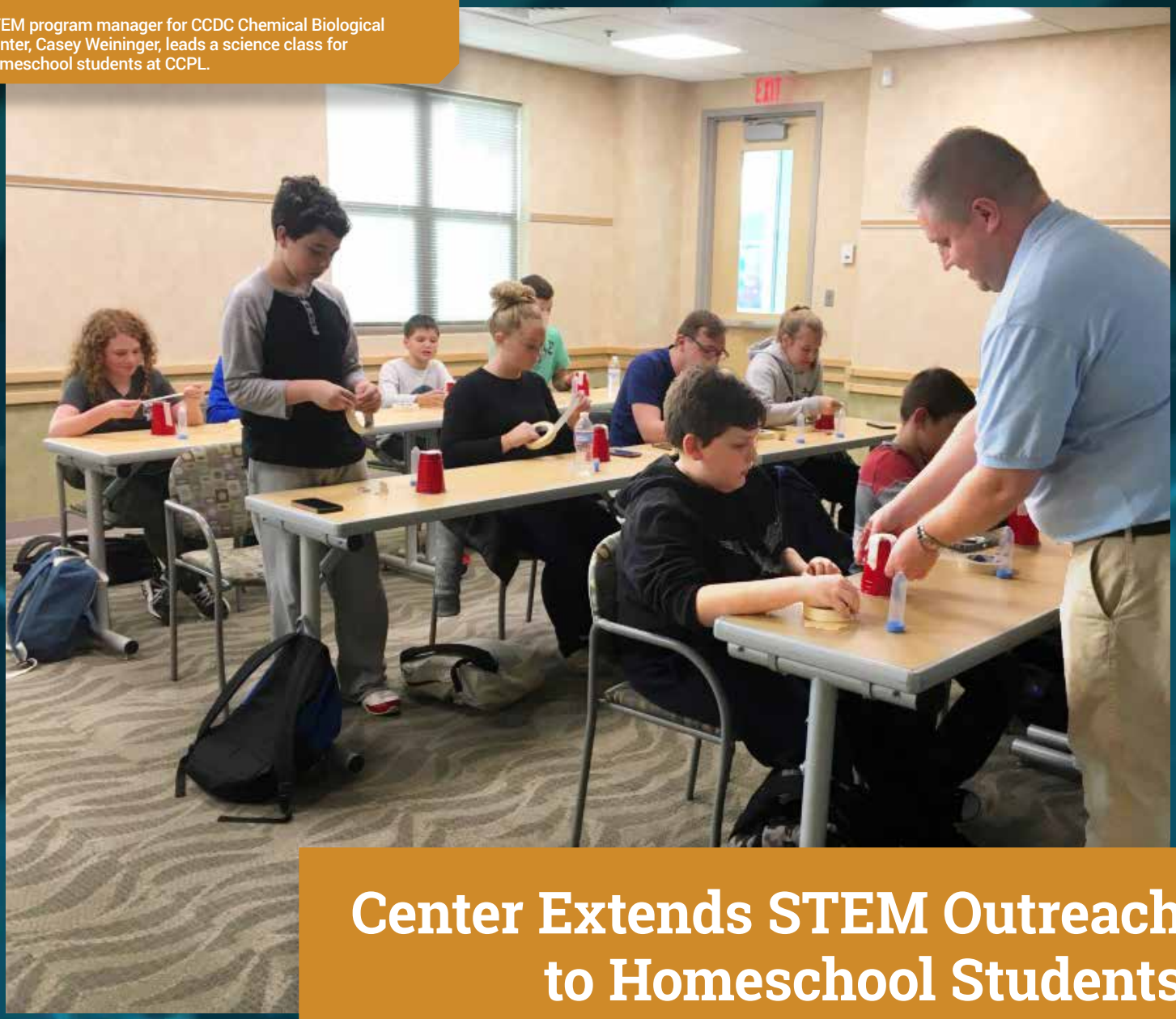
During a career day event held at St. Joan of Arc school in Aberdeen, Maryland, Calm shared her knowledge and talents with students in third through eighth grade who attend Harford County's only AdvanceED accredited Catholic Science, Technology, Engineering and Mathematics (STEM) school.

As students approached the table, they were immediately met with microscopes and samples of fly wings and a deer tick nymph to observe under the microscopes. Students took turns asking questions and peering into each microscope to get a glimpse of the fly wing and deer tick.

When asked about career day, Gabriel Buscemi, a fourth grader at St. Joan of Arc had this to say, "I love science, it's probably my favorite class."

Students from all grade levels engaged in good discussion with Calm about what they were seeing under the microscopes and about careers in sciences. Additionally, Calm shared images of magnetic nanoparticles, a new research endeavor she and her team are developing at the Center.

Calm is very active in STEM education, regularly participating in outreach efforts in both Harford and Cecil counties through science fairs, STEM days and laboratory design guidance on behalf of the Center. In 2018, she was acknowledged for her personal dedication to developing and implementing innovative programs designed to help cultivate the future STEM-educated workforce.



STEM program manager for CCDC Chemical Biological Center, Casey Weininger, leads a science class for homeschool students at CCPL.

Center Extends STEM Outreach to Homeschool Students

By Gay Pinder

THE U.S. ARMY Combat Capabilities Development Command (CCDC) Chemical Biological Center's STEM Outreach Program partnered with the Cecil County Public Library (CCPL) to offer its supplemental science instruction, usually reserved for area public schools, to Cecil County homeschool students.

As the STEM program manager for the Center, Casey Weininger has represented the Center's STEM Outreach Program since 2015, bringing non-traditional science projects to students in area public schools. Now, those same programs are available to home-school students, ages 11 – 17, who convene at the library's Afternoon Academy.

"Casey's programs are perfect for these older homeschooling students, and we began partnering with him to offer Afternoon Academy programs at a few of our branches in the fall of 2018," said Elizabeth Drummond, CCPL Young Adult Services Associate.

According to the White House STEM for All Initiative, the United States will need an additional one million STEM graduates by 2022. The Center's STEM Outreach Program was established to stimulate, in local students, an interest in science and to expose them to the many career options in the science field.

With the Center's more than 100-year history and reputation as an innovative research and development lab to advance warfighter capabilities, Weininger is able to bring resources and equipment into the classroom setting that is difficult to come by for teachers and librarians.

With Center equipment, Weininger 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.

The Center's STEM outreach program is a step in the right direction in increasing interest in science and math, and developing future scientists - a constant mission for the science community but especially for Army labs like CCDC Chemical Biological Center.

"I try to do more than just teach science," Weininger said. "If they want a career in the military or a civilian career in the sciences, we can help them get there with scholarships and internships. I want them to see all the possibilities they have right in their backyard."

"We're very excited to work with Casey again in the future," Drummond said. "We look forward to engaging in an ongoing partnership with him and the CCDC Chemical Biological Center."

Q&A: Carrie Poore, Ph.D.

CARRIE POORE, PH.D., IS A SCIENTIST, LEADER AND TEACHER who leads the Advanced CBRNE Training Branch at CCDC Chemical Biological Center. Through their work with Soldiers and first responders, Poore and her team have developed a well-known reputation for being leaders in CBRNE threat detection and sampling training and preparation. Solutions sat down with Poore recently to give readers an inside perspective of the Advanced CBRNE Branch chief.

Solutions Newsletter: When do you recall was the moment you knew you wanted to pursue science as a career?

Carrie Poore, Ph.D.: I was a little girl. I wanted to be an astronaut for the longest time as a child. I remember my mom taking me to the science museum and me always being fascinated with space and science. Science has always been an interest of mine, the analytical thinking and logic part specifically. I have always been an analytical thinker. My science and math teachers in school constantly presented their subjects with such enthusiasm that it was impossible for me to not be drawn to these areas.

Solutions: Who was your greatest supporter or mentor as you progressed in your career?

Poore: There have been so many people who supported and encouraged me throughout my career that it is difficult to thank them all. My parents, however, were always my biggest advocates and consistently encouraged me to follow my path and work hard. I have always been surrounded by such a huge support network.

Solutions: What brought you to the Center?

Poore: I never thought I'd work for the military. Especially not in the capacity I do now. During a presentation in Utah during graduate school, Dr. Vipin Rastogi approached me and suggested that I look at Edgewood Chemical Biological Center (ECBC), as it was known at the time, when I finished my graduate studies. I still had some schooling left, however, after graduate school and a postdoctoral fellowship, I contacted Dr. Rastogi and investigated some other potential job opportunities at the Center and the rest is history.

Solutions: You are chief of the Advanced CBRNE Branch. What does that role entail?

Poore: I oversee the training of many warfighters and civilians who come in contact with or have the potential to come in contact with chemical, biological, radiological or nuclear threats. I am the senior biology trainer for our group. Our team trains individuals from the military to homeland security to first responders. I manage a staff of 10 highly trained and enthusiastic chemical and biological experts, and we go all over the world to execute the classes that we do.My job is to train warfighters to do their jobs safely and I can't imagine a better career.

Solutions: What has your greatest achievement been while working at the Center?

Poore: One of the most memorable moments during my time at ECBC was in a training. A group of Soldiers were refreshing on some information and techniques to handle CBRN threats. The material wasn't new to them. After the training a Soldier approached me and said, "I have had this information five times before, but this is the first time I feel like I truly understand it. The way you presented the material helped me to understand it better." It was in that moment I knew I was in the right place for the right reason. Confirmations like that, from Soldiers who keep us safe, are what ground me and drive me.

Solutions: What is the best part of working with Soldiers?

Poore: Knowing you're impacting their success and helping them to be safe in their mission space. They play such a critical role in protecting our nation, so it is very fulfilling to me to support those who serve. They have a thankless job so helping to make their lives a bit easier makes me happy!

Solutions: If you could teach every Soldier in the Army one thing, what would it be?

Poore: How to operate safely in a potentially hazardous chemical and biological environment. If they can't protect themselves while executing a chemical and biological mission, then it is all for naught.

Solutions: What are you looking forward to the most this year (2019)? Any projects or goals you're leaning heavily on to see them succeed?

Poore: I'm looking forward to cultivating new relationships for the Center. The more people we train and educate on our successes here at the Center, the more people will realize how much of a critical resource the Center is to our Nation. My team and I meet so many people that we can help link them to the appropriate person at the Center to help solve their problems. In addition, helping to link end users, Center resources and industry and academia entities is also something of which we wish to be most effective. I want this branch to be a conduit between the Center and the community.

Solutions: What makes CCDC Chemical Biological Center special to you?

Poore: The Center is so important in the chemical and biological world. We have so many people here with such vastly different backgrounds, all bringing something to the table to help the warfighter. To be a part of this workforce where their hearts are all in for supporting our military and our nation as well as each other here at the Center, there is nowhere else I would rather be. You hear the saying that "the grass is always greener on the other side." Lucky for me, I am on the green grass already. And I have an amazing team of people that I have the pleasure of working with every day to do what we do – I may be the branch chief but I am one of them and we do the job without hesitating.

Solutions: How have you made a difference for the Center? The warfighter?

Poore: I'm a talker. I love reinforcing the great things the Center is doing. I'm always telling people about the capabilities and opportunities the Center has and provides so I'd like to think I've influenced new relationships with the Center.

As for the warfighter, I'd like to think I've helped save lives and complete missions by imparting my knowledge of chemical and biological threat detection and defense on them through the trainings the team provides. I don't think there's a person at the Center that can say they don't play a role in doing the same.

Solutions: What's your favorite saying?

Poore: It's not really a saying but more of a guiding principle for me, "Gratitude and a good attitude go a long way."

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

Poore: My dad always told me the things that happen today always seem ginormous and so impactful, however, tomorrow those same things will be minor and hard to remember and there will be new ginormous and impactful events that will take the place of those from the day before. This has always helped me to put things in perspective which has been a tremendous help all through my life.

New Obscurants Hold Potential for Blocking Infrared Sensors

Provided by CCDC Chemical Biological Center Public Affairs Office

Nanofibers created at the Center, may hold the potential to block infrared sight, creating new obscuration capabilities.

AS NEW INFRARED TECHNOLOGIES PUSH OBSCURANTS TO THE LIMIT, U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center scientists have found that nanofibers may hold the potential to block infrared sight and protect the warfighter.

For centuries, warfighters have used obscurants like smoke to evade enemies and stay safe on the battlefield.

As technology advances and new threats emerge, older capabilities must be modernized to more comprehensively obscure warfighters from enemy sight. As infrared sensors become more widespread, scientists at the CCDC Chemical Biological Center are developing infrared obscurants, which block infrared vision and are disseminated as aerosols on the battlefield.

"As sensor technologies advance, improving smoke to protect and defend the warfighter across the spectrum is more important than ever," said research chemist Danielle Kuhn, Ph.D. "Those who think of smoke as primitive are missing both the improvements to sensors and obscuration technologies. We are moving smoke into the 21st century to protect our warfighters."

"Thermal imaging and infrared sensors are becoming more accessible. You can order night vision goggles on the Internet," Kuhn said. "Having the infrared sensor technology so readily available motivates our efforts for advanced smokes and obscurants to keep our warfighters safe."

Infrared sensors and night vision goggles pose a challenge for warfighters. While smoke protects warfighters from the enemy's naked eye, they may still be exposed to infrared. But by using infrared obscurants, protection is improved.

Infrared obscurants are small aerosol particles that block infrared light, sometimes referred to as heat vision. They can be disseminated through multiple means including grenades, pyrotechnic devices and smoke generators.

"There is an enduring practical need to reduce logistics on the battlefield," Kuhn said. "With more efficient obscurants, less obscurant is needed to accomplish the mission. This is especially true of infrared obscurants."

In her search for a high performing infrared obscurant, Kuhn has turned to electrospun conductive nanofibers, which have high theoretical performance due to their electrical conductivity, shape, and size: their diameters are less than 100 nanometers. Produced through a process called electrospinning, nanofibers are also more versatile than flakes, another aerosolized material that helps block infrared.

"Theory tells us that having nanofibers make very good obscurants, and there's several reasons for that," Kuhn said. "Nanofibers tend to have high aspect ratios, and if the material is highly conductive and sized appropriately, it will attenuate obscurants in the infrared region."

Nanofibers are geometrically predisposed to having strong attenuation for infrared.

"You can relate fiber length to the frequency of oscillations of electrons across the surface," Kuhn said. "So once fiber comes into contact with a source of irradiation, electrons will oscillate across the surface of the fiber at a specific frequency. The frequency of that oscillation can be associated to a specific wavelength."

In other words, they block infrared light, making the smoke a more effective obscurant. Moreover, they may be able to be used for decontamination purposes.

"Nanofibers are multifunctional in terms of their capabilities," Kuhn said. "They have catalytic processes for degradation of chemical threats. They can also be used for decontamination purposes."

Electrospinning, a burgeoning technique that CCDC Chemical Biological Center excels in, is the capability that enables production of nanofibers.

"Electrospinning gives you a platform to make so many different kinds of compositions of nanofibers in different dimensions, so you can create exactly what you're looking for," she explained. "You can modify the composition of the fiber. You can functionalize these materials and make other composites. There's a variety of things you can do."

Kuhn added that it's a scalable process.

"If you need to make these materials on a large scale, it is possible," she said. "When you're doing research-scale work, you're working with milligram quantities, which isn't realistic when you're talking about fielding a material."

"This could be used for field materials," she said. "The sky's really the limit for what you can do with electrospinning."

Collaboration Corner: Prototype Laser Detection Device Advances With International Partnership

Provided by CCDC Chemical Biological Center Public Affairs Office

Through an international partnership with South Korea, CCDC Chemical Biological Center scientists are developing an on-the-move agent detection capability for vehicles.

A PARTNERSHIP WITH SOUTH KOREA is setting the foundation for an update to the Raman Agent Monitoring System (RAMS) project agreement, which resulted in the creation of a vehicle-mounted laser detection device.

RAMS, which began in 2013 and was demonstrated at South Korea's Changwon Proving Grounds in February 2017, uses vehicle-mounted Raman laser technology to detect contaminants and identify agent, essentially providing on-the-move agent detection.

Raman technology uses ultraviolet light to detect substances invisible to the naked eye. A vehicle using RAMS will stop on a dime upon detecting a dangerous substance that would otherwise be unseen.

Five years after the initial project started in a collaboration between South Korea and the United States, scientists are pushing for upgrades to the program.

"The South Koreans are pretty happy with what we did, and we want to move forward," said Darren Emge Ph.D., a research electrical engineer with the U.S. Army Combat Capabilities Development Command (CCDC) Chemical Biological Center.

Thanks to several technical developments, the RAMS project agreement is moving forward. This new effort, RAMS 2, is referred to as Surface Contamination Detection Optical Spectroscopy (SCDOS).

"The South Koreans made some innovations towards the end of the original project that unfortunately didn't make it into the final proposal," Emge said. "For one, they built a small, compact, air-cooled, solid-state laser deep-UV."

Emge also mentioned a cooperative research and development agreement with the University of Maryland Baltimore County (UMBC) in which CCDC Chemical Biological Center and UMBC have developed a new spectrometer which could improve performance and enhance capabilities.

"We want to marry the South Korean laser up with our new spectrometer and demonstrate significantly improved performance," Emge said.

These advances are thanks to fund matching from the Coalition Warfare Program (CWP), which leverages international partnerships to generate new ideas and advance capabilities thus enhancing the survivability of coalition forces on the modern battlefield.

Emge said that CWP funding usually helps shepherd a project to maturity and deployment.

"The idea of a CWP project is that you take an idea that's fairly mature, you finish maturing it, and in the end, it transitions to a program of record," Emge said. "RAMS started as an idea, we fixed its problems, and it competed for a major program."

International agreements also foster trust between two countries.

"The end goal of a CWP is for both countries to use the same technology," Emge said. "The South Koreans would have the K-RAMS, and we would have the U.S.-RAMS. That instills a level of trust and confidence between the two countries."

Emma Forrest, the Center's international program management specialist, said different countries may have different capabilities that may make research and development more efficient.

"The Coalition Warfare Program allows us to leverage their capabilities, and they can leverage our capabilities, so we're not reinventing the wheel," she said. "With RAMS, Dr. Emge took the prototypes from a program of record that didn't work, and he worked with the South Koreans to make it smaller, more sensitive and more durable."

"International collaboration builds relationships between the countries, and it leverages the technologies of both countries to develop a capability and get it into the hands of the warfighter more quickly," Forrest said.

"These projects are enablers for other projects," said Bob Moeller, associate director for the Center's international program office. "They might not necessarily become a program of record, but they enable an exchange of scientific information that benefits both countries and helps everyone."

The inventors of CCDC Chemical Biological Center's VOCkit observe the signing of agreements that will leverage that technology into a commercial biological reader.

Army Partners With Tech Startup to Develop Portable Biological Reader

By Gay Pinder

THE U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND (CCDC) CHEMICAL BIOLOGICAL CENTER recently signed agreements with tech startup TrekReader to develop existing CCDC Chemical Biological Center technology into a pocket-sized instrument that will allow Soldiers, first responders and even schools the ability to detect dangerous chemical and biological substances.

Signed were a non-exclusive Patent Licensing Agreement (PLA) that grants TrekReader the rights to use the VOCkit as the starting point for their product, and an associated Collaborative Research and Development Agreement (CRADA) that allows the parties to work together in the development of a new handheld universal reader.

From flu viruses to anthrax,TrekReader CEO Robert Baumgardner, Ph.D., believes the VOCkit, a tool in the Army's patent portfolio, has the potential to perform as a universal reader, allowing one mechanism to identify multiple biological threats cheaply, in minutes and at any location.

"People get sick. The sooner a person's infection can be identified the sooner parent notification, health care logistical support and/or isolation can be accomplished," Baumgardner said.

TrekReader is projected to read up to 48 different illnesses. Additionally, Baumgardner conveyed that the costs associated with extended illness can be contained or minimized to organizations.

A former technology manager with the United States Department of Defense, Baumgardner was already familiar with the Center's current VOCkit, a small electronic device that identifies chemical and biological substances. Invented and patented by Calvin Chue, Ph.D., Peter Emanuel, Ph.D., Aleksandr Miklos, Ph.D., Gregory Thompson, Colin Graham, and Jacob Shaffer with the Center's BioChemistry Branch, the VOCkit's approach involves hardware and software to quantitatively monitor assays that rely upon the appearance, disappearance, or change of chromophores or fluorophores in the visible or near-infrared regions. This approach can be used for detecting both chemical and biological threats. The VOCkit can then transmit results via smartphone.

"Our first project with Dr. Baumgardner saw the successful development of an immunoassay reader that interfaces with a cellphone, and detects viral, bacterial and fungal pathogens, so we already have a great working relationship," said Patricia Buckley, Ph.D., principal investigator on the VOCkit team.

Baumgardner agrees. "We chose to work with CCDC Chemical Biological Center because, simply put, their engineering and scientific staff have no equal, and credibility is a critical success factor when looking for further development funds."

Research and development opportunities between Army labs and private sector business is exactly what CCDC Chemical Biological Center director Eric L. Moore, Ph.D., wants more of.

"This partnership perfectly illustrates the intent of our technology transfer program – to leverage our patent portfolio and research and development capabilities to motivate private sector investment," Moore said.

Implementation of the CRADA depends on Baumgardner's ability to secure funding for the project.

"Funding is out there but finding it is the challenge," said Baumgardner. "No search has begun beyond casual discussions because the CRADA and licensing agreement had not been signed prior to this date. With the two documents, business development plan and the credentials of the TrekReader team and the Center there is a high level of confidence that we will be able to build and field this universal reader."

Designed to perform as a stand-alone unit, TrekReader will also function as part of a system. Once developed, Baumgardner plans to patent the device where it will interface with the civilian market of smartphone and physiological monitoring devices like fitness readers. TrekReader will also compliment the Army Nett Warrior End User Device, and Baumgardner plans to offer it to the United States Army Special Operations Command (SOCOM).

"I'm excited that the Center is partnering in a project with the potential to help secure the safety of Soldiers, civilians and school children," Moore said.

Analytical Framework presents in-depth information, such as combat analytics, to help stakeholders make more informed decisions.

Solutions Spotlight: Army Seeks to Expedite Acquisition Using New Data Analysis Tool

By Shawn Nesaw

DATA IS EVERYWHERE—from voter turnout and exit polls, to marketing products based on your online behavior—and it has the power to drive decisions. With such a wealth of data at its disposal, the Department of Defense constantly seeks new opportunities to utilize the data to positively affect the warfighter.

An ongoing partnership between 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) is leveraging data to simplify and expedite the Army's acquisition process under a new project called Analytical Framework (AF).

Based at the CCDC Chemical Biological Center, the AF team is made up of scientists and engineers from the Center who developed AF in a tool that combines data, analysis methods, tradespace tools, item-level tools, combat simulations and data-visualization tools to provide insights to support senior level decision making.

"AF allows decision-makers the opportunity to objectively see how a piece of technology performs in given scenarios or when paired with other technologies to form a capability set," explained Lori Remeto, director of strategic analytics for JPEO-CBRND. "Through quantitative and traceable analytics, AF narrows down the opportunity and decision space into a collection of potential capability sets optimized to reduce operational risk for the warfighter. Senior leaders are then armed with the requisite information to make strategic investment decisions and develop acquisition strategies."

The impetus of AF came when the JPEO-CBRND leadership recognized a need for a data driven, repeatable process to help with their strategic investments. JPEO-CBRND wanted to discern how their products worked together best to support the Soldier and accomplish the mission. Beyond that, it was critical that AF could help narrow options and provide objective feedback to the team about future technology and capability set investments.

Stood up officially in 2016, the AF team made CCDC Chemical Biological Center its home due to the unique expertise of the subject matter experts the Center provides in the CBRN defense space. Due to the nature of the Center, the U.S. Army's premier laboratory for chemical and biological defense research and development, AF has access to a wide range of data which helps the system accurately represent a variety of capabilities.

How Analytical Framework Operates

While AF can be used during any phase of acquisition, it is most beneficial in the front end of the acquisition process, when product design isn't fully determined. That is the optimal time to use modeling and simulation for things like sensitivity studies and tradespace analyses. The JPEO-CBRND can iterate on technologies quickly, cost-effectively and early by simulating their performance, employing the technologies virtually in combat simulations and learning from them. This insight drives where to commit resources during the development of prototypes and conducting experiments. This is the time when AF analyses are most helpful in directing decisions.

Ideally, at program inception, AF should be utilized as part of the team alongside the material developer and their doctrinal counterparts, in addition to other key stakeholders such as the Army, Navy and other services. This allows the team to collectively explore stakeholder and user requirements, develop and obtain a common understanding of requirements and needs and manage expectations of the group.

Using available data, the AF can simulate a technology's performance within given scenarios through a battle simulation program. The team reviews performance requirements and can make tradespace adjustments based on user feedback using the Engineered Resilient Systems Trade Space Analysis Tool (ERSTAT), software that helps developers weigh aspects like cost, time and capabilities against requirements in real time, to ultimately determine the best, most agreeable path forward.

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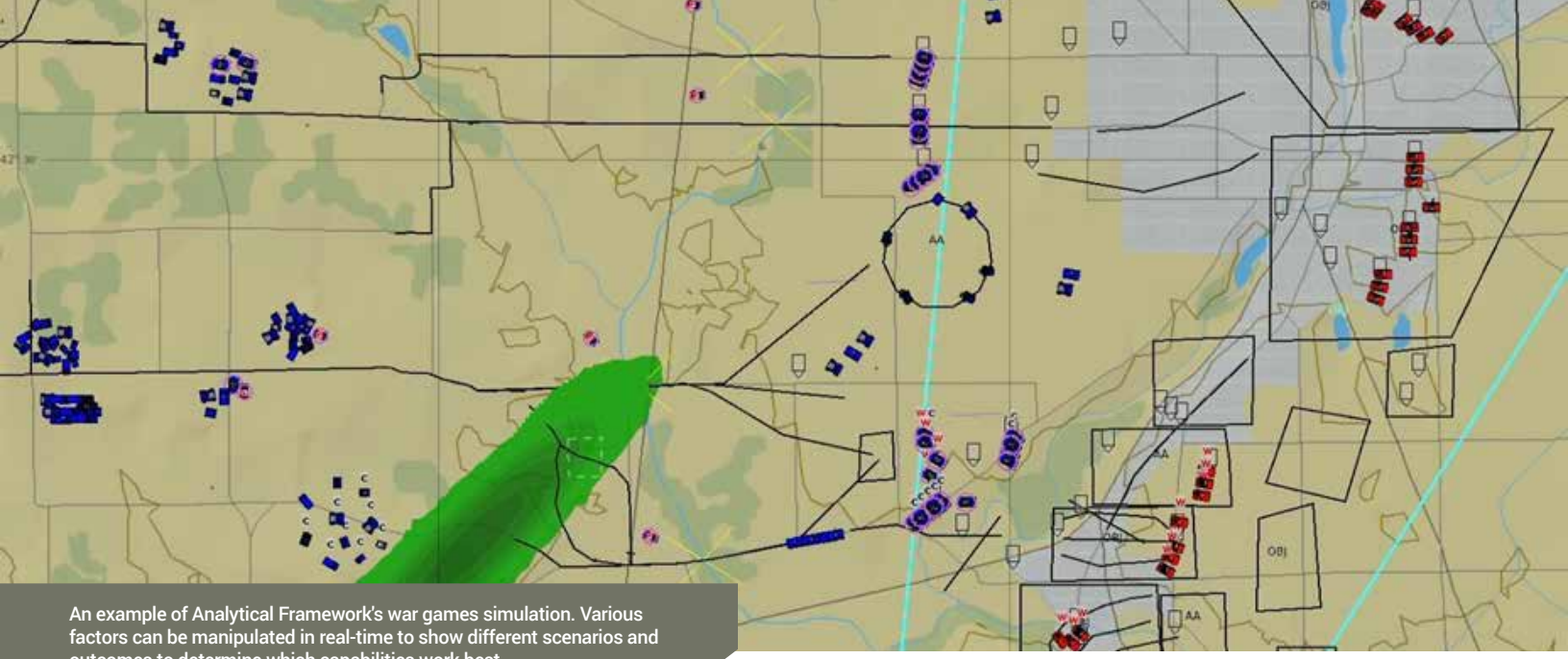


An example of Analytical Framework's war games simulation. Various factors can be manipulated in real-time to show different scenarios and outcomes to determine which capabilities work best.

Continued from page 30

"If all doctrine, organization, training, materiel, leadership and education, personnel, and facilities stakeholders, developers and users understand their tradespace, some smart decisions can be made early on in the acquisition process," said Remeto. "The tools provide an inexpensive way to explore the customer's problem set. If everyone involved agrees that two designs, instead of four, are needed, and the technology must be portable versus non-portable, we can save on development time and costs for those prototypes and we've managed a lot of the expectations of the parties involved," explained Remeto.

One of the first programs to utilize the AF is the Tactical Disablement System (TACDS). Early in the acquisition process, the AF team worked with TACDS to review and analyze their data to make informed decisions and very efficiently narrow their potential solution sets to those aligned closest to program requirements and goals.

At this point, any agency within the U. S. government looking for data to support their decision-making process can access AF. Recently, the Department of Homeland Security utilized AF to look at biological detectors and, during a separate project, the Joint Requirements Office for Chemical, Biological, Radiological and Nuclear Defense approached AF with a need to assess mission impact of a capability suite in mock battlefield scenarios. Instances like these provide evidence that word about the useful impact of AF is spreading.

"AF tools can look at multiple variables and combinations of variables simultaneously," explained Ashley Nash, deputy director of strategic analytics for JPEO-CBRND. "This allows you to see interactions and relationships between different variables and see how they affect or don't affect outcomes." Using this type of information and visualizations, a user can make effective, data-driven decisions on what really matters.

The AF toolbox is inherently set up to build on itself. Mission data, technology performance data and scenario data can be used repeatedly, augmented or replaced as new or updated data becomes available. Any time updates are made, anyone using the tool in the future benefits from those updates.

"The more data you have across multiple scenarios and technologies, the greater opportunity you have to play them together in different combinations to learn about their affects and best support the warfighter's desired outcome," explained Nash. "The data just keeps building."

How Analytical Framework Fits with the Future of the Army

One of the Army's main objectives for future acquisition and capabilities development is to use data to its advantage to make better, faster decisions. To ensure objectives like these are met, the Army established Army Futures Command (AFC) which is built upon three main pillars, one of which leans heavily on making data-informed decisions for acquisition.

The AF provides the analytics necessary to help senior leaders make such decisions in support of CBRN threat support.

"The CCDC Chemical Biological Center and AF are like a microcosm of AFC," said Remeto. "We're doing the very thing that AFC wants the entire Army to do which is let data, modeling and simulation guide the acquisition process. We're all about a learn-early, learn-fast mentality to get the right capability into Soldiers' hands quickly, as opposed to overly drawn out acquisition life cycles. Our efforts to partner up front and early with the Army's CBRN School and Maneuver Support Center of Excellence also fit squarely into the AFC paradigm to conceptualize and develop solutions from a stakeholder perspective in support of identified warfighter needs."

"Subject matter experts at CCDC Chemical Biological Center provide a wealth of knowledge for the development AF and are vital to the future development of the program," said Jayson Scott, electronics engineer at CCDC Chemical Biological Center. "With the right people and the right background, the Center is the perfect place for AF to develop."

One of the leading goals of the AF director is to reuse data, tools and technologies whenever possible. "Instead of recreating technologies," remarked Remeto, "we're investigating how we can leverage existing government-owned tools when possible as well as partnering with other organizations like the CCDC Chemical Biological Center, for the mutual benefit of all involved."

AF has benefited from the expertise of its partner organizations, and those organizations have gained access to the tools and software developed by or for AF. The future of AF aims to continue partnering within the CBRN community to create tools that can be used by anyone looking to make better-informed decisions through the use of modeling and simulation and data analytics.

"This is about embracing change and a different way of looking at problem solving," explained Nash. "In fiscally constrained environments and in the midst of the Army's readiness, modernization and reform priorities, it's important that we're technically sound, innovative and making smart decisions along the way.

Army ManTech Ramps Up MOF Production for New Filters, Textiles

Provided by CCDC Chemical Biological Center Public Affairs Office

MOF's are being considered for use in self-decontaminating suits and filter masks, among other capabilities.

RECENT FUNDING WILL ALLOW THE U.S. ARMY Combat Capabilities Development Command (CCDC) Chemical Biological Center to significantly scale up the production of metal-organic frameworks (MOFs), a promising substance with the potential to support a range of new products dealing with decontamination and filtration.

MOFs, which have proven to be highly effective filtration materials and decontaminants, are being incorporated into a range of technologies. Due to their ability to react with and decontaminate toxic substances and chemical warfare agents, they are being considered for use in self-decontaminating suits and filter masks, among other capabilities.

A relative newcomer to the field of chemical biological defense, MOFs are able to hydrolyze nerve agents and oxidize blister agents, thereby neutralizing toxic substances. When exposed to light, these MOFs react with and excite oxygen. In turn, oxygen reacts with and combines with agent, effectively neutralizing the threat. MOFs also have shown unprecedented reactivity for high volatility toxic gases such as chlorine and nitrogen dioxide.

"Metal-organic frameworks have shown significant promise in a wide range of applications," said CCDC Chemical Biological Center research chemical engineer Greg Peterson. "For the Center, these applications include filtration, protection in the form of suits, decontamination with wipes and sprays, detection and obscuration."

While MOFs have demonstrated an ability to provide unique capabilities, scaling had been a challenge due to lack of funding. However, with new funds from ManTech, a U.S. Army program that invests in emerging technologies and develops advanced manufacturing processes, the Center is contracting with a private company to scale production.

A start of work meeting was held in mid-October 2018. The Center has contracted with a private company to scale production.

"The Army ManTech Program facilitates that maturation and acceleration of advanced manufacturing processes," said CCDC Chemical Biological Center supervisory engineer Kevin Wallace, who represents the Center to the Army ManTech Office. "Currently, MOFs are produced in small volumes at a high cost. One of the main objectives is to help industry get to higher volumes and significantly drive down costs. When we accomplish that, it becomes a cost-effective enabler for filtration technologies."

Once production is scaled up, Peterson envisions being able to simultaneously incorporate MOFs into different capabilities, putting most of the initial focus on filters.

"Our initial main focus will be to develop scaled MOFs for incorporation into JSGPM M61 filters in an attempt to meet objective requirements," Peterson said, noting that MOFs offer stronger protection against threats like nerve agent and nitrogen dioxide. "Later, we will focus on developing technologies that we can push to the warfighter. These might include things like protective scarfs and reactive suits."

Peterson anticipates a two to three year timeline for incorporating MOFs into the JSGPM M61 filter.

Overall, the program is planned to continue for five years concluding in fiscal year 2022, with incremental funding each fiscal year, Wallace said.

Periodic reviews will also evaluate how the technology supports the Army's strategic priorities, like next-generation combat vehicles.

"The challenge lies in the transition to the Army Futures Command," Wallace said. Will there be work for us to demonstrate how this technology is applicable to the Army's modernization priorities? Soldier lethality is where we see MOFs having the most impact, but this is a cross-cutting technology with applicability across multiple modernization priorities."

Wallace noted that vehicles, aircrafts and ships also integrate collective protection and MOFs could be a candidate to enhance that capability.

"The purpose of it is to build up capabilities in industry that don't really exist but have an inherent benefit to the military," Peterson said. "It looks at emerging technologies and developing processes and scalability for these technologies."

Peterson said the partnership opens up a number of possibilities, including a partnership with the U.S. Army Combat Capabilities Development Command (CCDC) Soldier Center to develop a reactive suit.

"Once we hit the ground running with these filter prototypes we can really get into fabrics and textiles," Peterson added. "I don't want to just make a new filter. This opens up a whole new area for research for technologies that don't currently exist."

LEFT: Destroyed munitions are visibly documented on the last day of destruction using the EDS.

RIGHT: The final munitions of the second Explosive Destruction System campaign at Pueblo Chemical Depot in Colorado.

Army Completes Explosive Destruction System Ops at Pueblo Chemical Depot

By Shawn Nesaw

EXPERTS FROM U.S. ARMY Combat Capabilities Development Command (CCDC) Chemical Biological Center recently completed the destruction of 391 chemical munitions that were recovered at the U.S. Army Pueblo Chemical Depot (PCD) or were unfit for processing in the Pueblo Chemical Agent-Destruction Pilot Plant (PCAPP).

The operation, completed by the Center's Chemical Biological Application and Risk Reduction (CBARR) business unit, was executed in partnership with the U.S. Army Chemical Materials Activity and the Program Executive Office, Assembled Chemical Weapons Alternatives (PEO ACWA).

This completion marks the end of the second destruction campaign using the Explosive Destruction System (EDS), a technology that uses cutting charges to explosively access chemical munitions, eliminating their explosive capacity before neutralizing the chemical agent. The first campaign ended in 2016 and successfully eliminated 560 items that were deemed unfit for processing at PCAPP.

This campaign was unique in that the team destroyed chemical munitions from the stockpile that could not be processed through the main plant as well as munitions recovered at PCD by the U.S. Army Engineering and Support Center in Huntsville, Alabama. Munitions destroyed in the campaign included M70 bombs, 105mm and 155mm projections, and 4.2-inch mortars containing mustard agent.

The team completed destruction of the first munition June 26; and destruction of the last munition occurred Dec. 5. Once destruction operations were complete, the team conducted site closure activities that lasted through January.

Site Closure

The on-site team received authorization to start packing the EDS site shortly after completion of the last operation in December. In addition to packing supplies and equipment for shipment to Aberdeen Proving Ground, Maryland, the team also conducted environmental monitoring of the site and equipment to ensure there was no chemical agent contamination. This process was conducted in compliance with state safety and environmental regulatory standards. Ultimately, the team received concurrence from the Colorado Department of Public Health and Environment to close the site. This notification allowed Center personnel to remove the EDS unit from the site.

"There was a flurry of activity right after the holidays to make sure everything was accounted for and that we were leaving the site in good order, adhering to state and local guidelines throughout the closure," explained Laura Graham, CBARR's project manager at PCD.

The EDS, along with a lot of the technology needed to operate it, was sent back to the CCDC Chemical Biological Center in Edgewood, MD where it will undergo depot-level maintenance such as vessel change out, deep cleaning, and examination of all systems to ensure it's ready to deploy again.

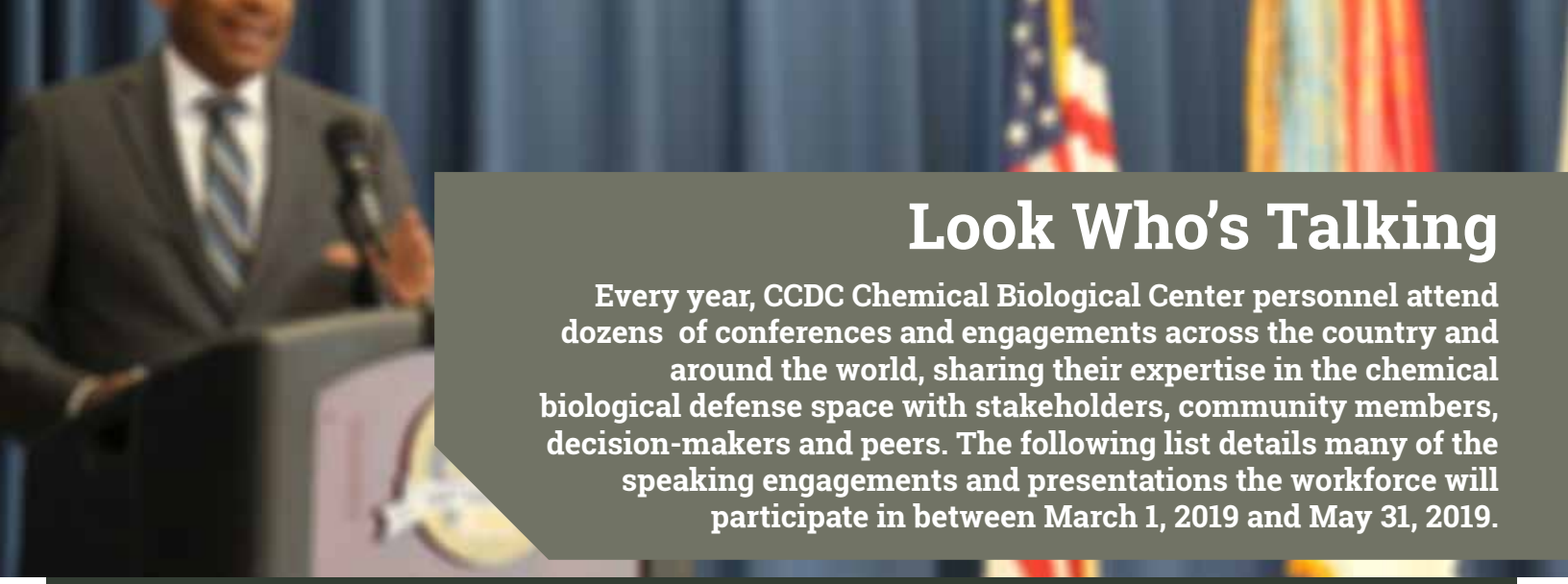
Continuing Support to Eliminate the Nation's Stockpile

While the Center has completed destruction operations at PCD using the EDS, CBARR continues to support PEO-ACWA's elimination mission at PCD as well as at Blue Grass Chemical Depot in Kentucky.

The Assistant Secretary of Defense for Nuclear, Chemical and Biological Defense Programs, and the Deputy Assistant Secretary of Defense for Threat Reduction and Arms Control have identified the United States chemical munition destruction mission as a strategic priority. The CCDC Chemical Biological Center plays a vital role in keeping the destruction mission on schedule by handling munitions that would otherwise halt standard operations at the pilot plants and cause operational delays.

"The continued destruction of the nation's chemical weapons stockpiles is critical to treaty compliance," said Tim Blades, CBARR's operations director. "It also provides an opportunity to maintain the Army's readiness in chemical weapons destruction."

In addition to the destruction operations using the EDS, the team recently deployed to Blue Grass Chemical Depot in Kentucky where it conducted an operation to obtain munitions-grade agent for use in systemizing the Blue Grass Chemical Agent-Destruction Pilot Plant. CBARR's subject matter experts and air monitoring technicians also lead waste management operations to ensure the safe transport and final destruction of secondary waste produced at PCAPP.



Look Who's Talking

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 March 1, 2019 and May 31, 2019.

Conference Name: Society of Toxicology Annual Meeting
Topic: Poster presentation on the Defense Threat Reduction Agency (DTRA) funded Systems Biology Program
Location: Baltimore, MD
Date(s): March 10-14, 2019

Conference Name: Society of Toxicology Annual Meeting
Topic: Poster presentation addressing In House Independent Laboratory Research (ILIR) funded project data
Location: Baltimore, MD
Date(s): March 10-14, 2019

Conference Name: PITTCON 2019
Topic: Podium presentation on Development of Paper Spray Ionization for the Warfighter
Location: Philadelphia, PA
Date(s): March 17-21, 2019

Conference Name: PITTCON 2019
Topic: Present work on multicomponent diffusion in polymers
Location: Philadelphia, PA
Date(s): March 17-21, 2019

Conference Name: PITTCON 2019
Topic: Electrochemistry - Biological Applications. The session covers uses of electrochemical methods for analysis of biological samples
Location: Philadelphia, PA
Date(s): March 17-21, 2019

Conference Name: 257th American Chemical Society (ACS) National Meeting & Exposition
Topic: Detection of Ricin and Abrin Toxin by Traditional and Miniaturized Direct-Analysis-in-Real-time Mass Spectrometry (DART-MS)
Location: Orlando, FL
Date(s): March 30 - Apr. 5, 2019

Conference Name: 257th American Chemical Society (ACS) National Meeting & Exposition
Topic: Distribution of the Stereoisomers of VX in Guinea Pig Tissues Following Intravenous Exposure
Location: Orlando, FL
Date(s): March 30 - Apr. 5, 2019

Conference Name: 257th American Chemical Society (ACS) National Meeting & Exposition
Topic: Presentation on research on the Surface Science Initiative Project
Location: Orlando, FL
Date(s): March 30 - Apr. 5, 2019

Conference Name: 257th American Chemical Society (ACS) National Meeting & Exposition
Topic: Presentation of work on liquid spreading on heterogeneous coatings
Location: Orlando, FL
Date(s): March 30 - Apr. 5, 2019

Conference Name: 257th American Chemical Society (ACS) National Meeting & Exposition
Topic: Charge Injection Properties in Plasmonic Nanocomposites and Thin Films
Location: Orlando, FL
Date(s): March 30 - Apr. 5, 2019

Conference Name: MOFSIM 2019
Topic: Poster presentation of work conducted at CCDC Chemical Biological Center, learning current state of the art in the modeling of MOFs
Location: Ghent, Belgium
Date(s): April 8-13, 2019

Conference Name: 2019 Materials Research Society (MRS) Spring Meeting & Exhibit
Topic: Photocatalytic oxidation in metal-organic frameworks using E. coli synthesized porphyrins ligands
Location: Phoenix, AZ
Date(s): April 22-26, 2019

Conference Name: 8th International Symposium on Physical Protection & Decontamination
Topic: Novel Approaches for Bio-decontamination of Infrastructure Surfaces
Location: Münster, Germany
Date(s): May 19-24, 2019

Publications and Patents

Quarterly listing

This page contains a list of U.S. patents recently awarded to the CCDC Chemical Biological Center and a list of peer-reviewed journal articles recently published on research conducted by Center scientists. Both lists span dates from October 1, 2018 through December 31, 2018.

PUBLICATIONS

(CCDC Chemical Biological Center authors in bold)

Title: On-Substrate Derivatization for Detection of Highly Volatile G-Series Chemical Warfare Agents Via Paper Spray Mass Spectrometry
Author(s): **Mach, PM; Dhummakupt, ES**; Carmany, DO; **McBride, EM**; Busch, MW, Demond, PS; Rizzo, GM; Hollinshead; DE; **Glaros, T**
Source: Rapid Communications in Mass Spectrometry **Volume**: 32 **Issue**: 23 **Pages**: 1979-1983 **DOI**: 10.1002/rcm.8276
Published: December 15, 2018

Title: Flexible SIS/HKUST-1 Mixed Matrix Composites as Protective Barriers Against Chemical Warfare Agent Simulants
Author(s): **Peterson, GW; Browe, MA; Durke, EM**; Epps, TH
Source: ACS Applied Materials & Interfaces **Volume**: 10 **Issue**: 49 **Pages**: 43080-43087 **DOI**: 10.1021/acsami.8b16227
Published: December 12, 2018

Title: Structural Insights of Stereospecific Inhibition of Human Acetylcholinesterase by VX and Subsequent Reactivation by HI-6
Author(s): Bester, SM; **Guelta, MA**; Cheung, J; **Winemiller, MD; Bae, SY; Myslinski, J; Pegan, SD; Height, JJ**
Source: Chemical Research in Toxicology **Volume**: 31 **Issue**: 12 **Pages**: 1405-1417 **DOI**: 10.1021/acs.chemrestox.8b00294
Published: December 2018

Title: On-substrate Enzymatic Reaction to Determine Acetylcholinesterase Activity in Whole Blood by Paper Spray Mass Spectrometry
Author(s): Carmany, DO; **Mach, PM**; Rizzo, GM; **Dhummakupt, ES; McBride, EM; Sekowski, JW; Benton, B**; Demond, PS; Busch, MW; **Glaros, T**
Source: Journal of the American Society for Mass Spectrometry
Volume: 29 **Issue**: 12 **Pages**: 2436-2442
DOI: 10.1007/s13361-018-2072-1
Published: December 2018

Title: Current Status and Need for Standards in Ion Mobility Spectrometry
Author(s): **Hauck, BC; Harden, CS; McHugh, VM**
Source: International Journal of Ion Mobility Spectrometry **Volume**: 21 **Issue**: 4
Pages: 105-123
DOI: 10.1007/s12127-018-0239-x
Published: December 2018

Title: Tracking a serial killer: Integrating phylogenetic relationships, epidemiology, and geography for two invasive meningococcal disease outbreaks
Author(s): Ezeoke, I; Galac, MR; Lin, Y; **Liem, AT; Roth, PA; Kilianski, A; Gibbons, HS**; Bloch, D; Kornblum, J; Del Rosso, P; Janies, DA; Weiss, D
Source: PLOS One **Volume**: 13 **Issue**: 11
Article Number: e0202615
DOI: 10.1371/journal.pone.0202615
Published: November 28, 2018

Title: Synthesis and Functionalization of Phase-Pure NU901 for Enhanced CO2 Adsorption: The Influence of a Zirconium Salt and Modulator on the Topology and Phase Purity
Author(s): **Garibay, SJ; Iordanov, I**; Islamoglu, T; **DeCoste, JB**; Farha, OK
Source: CrystEngComm **Volume**: 20 **Issue**: 44 **Pages**: 7066-7070 DOI: 10.1039/c8ce01454j
Published: November 28, 2018

Title: Extraction and Biomolecular Analysis of Dermal Interstitial Fluid Collected with Hollow Microneedles
Author(s): Miller PR.; Chavez VH; Polsky, R.; Taylor RM; Baca JT; Tran BQ; Boyd, G; Glaros, T; Krishnakumar, R; Sinha, A; Poorey, K; Williams KP; Branda SS
Source: Communications Biology **Volume**: 1
Article Number: 173
DOI: 10.1038/s42003-018-0170-z
Published: October 22, 2018

Title: Chemical Protective Textiles of UiO-66-Integrated PVDF Composite Fibers with Rapid Heterogeneous Decontamination of Toxic Organophosphates
Author(s): Dwyer, DB; Dugan, N; Hoffman, N; Cooke, DJ; **Hall, MG; Tovar, TM**; Bernier, WE; **DeCoste, J**; Pomerantz, NL; Jones, WE
Source: ACS Applied Materials & Interfaces **Volume**: 10 **Issue**: 40 **Pages**: 34585-34591
DOI: 10.1021/acsami.8b11290
Published: October 10, 2018

Title: Local Aerosol Composition Before and During the Transition from Coal-Fired Power to Natural Gas
Author(s): Alstadt, VJ; Jansen, KT; Ott, EJE; Altaf, MB; Freedman, MA
Source: Atmospheric Environment
Volume: 190 **Pages**: 169-176
DOI: 10.1016/j.atmosenv.2018.07.013
Published: October 2018

Title: Identification of Cholecystokinin Tetrapeptide Amide Metabolites in Liver Microsomes of Human, Rhesus Monkey, Sprague-Dawley Rat and CD1 Mouse Using Ultra-High Performance Liquid Chromatography Coupled to High Resolution Mass Spectrometer
Author(s): **Kong, L; Berg, FJ**
Source: Journal of Chromatography B-analytical Technologies in the Biomedical and Life Sciences **Volume**: 1096 **Pages**: 80-87
DOI: 10.1016/j.jchromb.2018.08.012
Published: October 1, 2018

Title: Advanced Cotton Fibers Exhibit Efficient Photocatalytic Self-Cleaning and Antimicrobial Activity
Author(s): Jaksik, J; Tran, P; Galvez, V; Martinez, I; Ortiz, D; Ly, A; **McEntee, M; Durke, EM**; Aishee, STJ; Cua, M; Touhami, A; Moore, HJ; Uddin, MJ
Source: Journal of Photochemistry and Photobiology A-chemistry **Volume**: 365 **Pages**: 77-85
DOI: 10.1016/j.jphotochem.2018.07.037
Published: October 1, 2018

PATENTS

Multivariate Digital Display Device and Method for Increasing the Separation Between Classes' Data Points in Hyperspace
Patent Number: 10,083,530
Issued: September 25, 2018

Valve/Connection System to Prevent Downstream Contamination From an Upstream Source While Replacing Filters
Patent Number: 10,105,557
Issued: October 23, 2018

Mutant OPAA enzymes With Increased Catalytic Efficiency on Organophosphorus Compound EA1356
Patent Number: 10,124,043
Issued: November 13, 2018

Apparatus for Deagglomerating and Disseminating Powders and Particulate Matter
Patent Number: 10,124,353
Issued: November 13, 2018

Zirconium Hydroxide-Based Slurry for Decontamination and Detoxification
Patent Number: 10,130,834
Issued: November 20, 2018

White Smoke Mix
Patent Number: 10,131,587
Issued: November 20, 2018

Mutant Organophosphorus Acid Anhydrolase Enzymes With Stereospecificity on Sarin Enantiomers and Uses Thereof
Patent Number: 10,143,874
Issued: December 4, 2018

Apparatus and Method for Replacing an Air Filter of an Air Filtration Mask
Patent Number: 10,159,856
Issued: December 25, 2018

Solutions

U.S. Army Combat Capabilities Development Command
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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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