Edgewood Chemical Biological Center
Aberdeen Proving Ground, MD

Issue 35

CB QUARTERLY

HISPEC - High Hopes to Meet Biodetection Challenge

ECBC's Eye in the Sky

ECBC Engineer Selected as AMC Engineer of the Year...See Page 31

The headquarters of the Edgewood Chemical Biological Center (ECBC) is located at the Edgewood Area of Aberdeen Proving Ground, MD.

ECBC is one of a few of the Army's and Department of Defenses' total lifecycle research, development and engineering centers. It possesses a full spectrum of capabilities ranging from basic and applied research, technology development, engineering, system acquisition to fielding and ultimately demilitarization.

This publication is prepared at the Edgewood CB Center. We publish this information under the auspices of AR 70-45, R&D Scientific and Technical Information Program, which states that "The objectives of the S&TI Program are to—

a. Improve the flow of technical information into, through, and from the Department of the Army in order to

(1) Secure economies by reducing RDTE lead time and by eliminating unnecessary duplication of effort,

(2) Improve RDTE program management and execution, and

(3) Support the information needs of scientists, engineers, and managers."

AR 70-45 further states "Department of the Army elements will provide for adequate interchange of technical information among themselves and with their contractors, the other military departments and Federal agencies, and, to the maximum extent consistent with national security, the U.S. scientific, technical, and academic communities."

This document is distributed to over 1,200 addressees throughout the Joint Services, industry, and academic R&D community, and it could be a vehicle to publicize what is going on where you are. Please submit articles to Director, Edgewood Chemical Biological Center, ATTN: AMSRD-ECB-AP-B, Aberdeen Proving Ground, MD 21010-5424, or by electronic mail to cet@sbccom.apgea.army.mil. All submissions are accepted at the discretion of the editor and are subject to editing.

For additional information, please contact our copy editor at (410) 436-5383 or DSN 584-5383.

Table of Contents

DETECTION TECHNOLOGY: EXPANDING THE PROTECTIVE ENVELOPE

by Jeff Hinte

"Because reliable detection is so important, it is one of ECBC's primary research and development missions."

There's an old axiom that reads "an ounce of prevention is worth a pound of cure." In the world of chemical and biological defense, you similarly could say that an ounce of warning is worth a pound of antidote. Warfighters in the field today are equipped with state-of-the-art masks and other protective devices. However, those tools are effective only when they have enough warning to utilize them. From another perspective, false alarms—while preferable over too few alarms—can adversely affect operational tempo by causing troops to stop mission activities to don their protective gear needlessly.

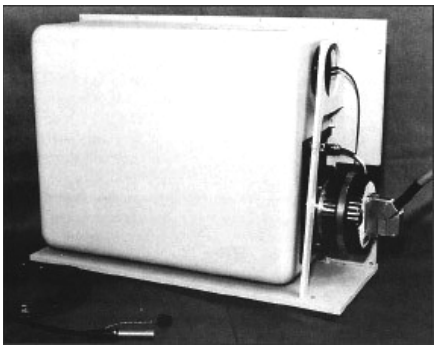
Because reliable detection is so important, it is one of ECBC's primary research and development missions. In this issue of the CB Quarterly, we review in brief several of our most exciting and important advances in detection technology. Standoff detection is an area where we are truly pushing the envelope of where technology will allow us to go. Today, that means laser-based detection devices and the use of raman spectroscopy for identification of threat agents. Our Artemis standoff program is advancing the pace of science, developing LIDAR sensors able to detect and identify CB agent clouds, in aerosols as well as vapor form, at distances of 3 miles or more. Our point detection programs are just as strong, refining today's detectors and crafting the equipment for tomorrow—always working towards greater efficiency and accuracy with lighter weight and broader spectrum of detectable substances.

I invite you to review the following pages for a taste of what our scientists and engineers are working towards in the field of detection. While our mission includes all aspects of detection, protection and decontamination, we realize that the ability to avoid contamination altogether is preferable to even the best decon and protective measures. The personnel behind ECBC's detection programs are working hard to provide the best equipment possible to our warfighters, providing them with that vital ounce of prevention.

If you are interested in learning more about any of the detection technologies we discuss in this issue, please do not hesitate to contact ECBC's Technical Outreach staff at 410-436-2031 or through our website at www.ecbc.army.mil.

Mr. Jeffrey Hinte
Director, Advanced Planning and Initiatives
U.S. Army Edgewood Chemical
Biological Center

TECHNOLOGY UPDATE: RAMAN SPECTROSCOPY



The proverbial "holy grail" of detection technology is an accurate, reliable standoff capability that can alert personnel quickly to the presence and type of threat agents. Progress in remote chemical agent detection has been substantial in recent years, particularly in the area of Raman spectroscopy. Using Raman signatures, ECBC has embarked on efforts to develop detection devices that can identify specific chemical agents from a distance, regardless of their physical form or the characteristics of the surface they contaminate.

Recently, ECBC and ITT Industries participated in a successful test of Raman spectroscopy technology in support of the Joint Project Manager for NBC Contamination Avoidance. Cooperating ECBC and ITT researchers measured the UV Raman spectra of both traditional chemical blister and nerve agents and nontraditional agents, including some 30 compounds and simulants. The ongoing effort to measure Raman signatures of chemical agents, toxic industrial chemicals, simulants and typical inteferents will lead to a reference library of Raman signatures. ECBC will be able to load this information into detection devices that use Raman spectra and more accurately identify and discriminate specific chemical agents from a short distance.

Raman spectroscopy uses molecular light scattering phenomena to selectively detect the presence of chemical agents by way of spectral fingerprinting. Substances have unique Raman signatures resulting from differences in their chemical structures; for example, clear plastic has a distinct signature that is very different from the signature of asphalt, or any other substance. Chemical agents have a unique signature as well, and this signature can provide a way to remotely detect and identify the presence of agent. In collaboration with ITT and Brookhaven National Laboratory, ECBC recently demonstrated the ability of Raman spectroscopy to detect and identify chemicals on surfaces.

ECBC and ITT Industries conducted field tests on a Raman spectroscopy-based system at Dugway Proving Ground under the auspices of the JPM Contamination Avoidance. The system was mounted on a HMMWV platform.

Under the leadership of Dr. Steven Christesen, the ECBC and ITT teams coordinated a series of laboratory and field research to bring this promising detection technology to the point where it is ready to transition into an Advanced Concepts Technology Demonstration. This effort will introduce the Joint Contaminated Surface Detector (JCSD), which is a detector concept that applies Raman spectroscopy to short-range standoff detection. The JCSD, mounted within a High Mobility Multi-purpose Wheeled Vehicle (HMMWV), uses a laser to illuminate a surface contaminated with agent. The light is reflected by the agent back to the JCSD where the pattern is received, separated, analyzed, and processed into a chemical fingerprint, and compared against a database of known Raman signatures. The results of this comparison will identify the agent. Detectors utilizing Raman spectroscopy are able to assess liquids, gases, solids and aerosols, and enjoy negligible variations in signatures or signal strength regardless of surface texture or reflectivity. Raman signatures are not distracted by water in either liquid or vapor form.

ABOUT RAMAN SPECTROSCOPY...

At ECBC, scientists are always looking for new ways to shed light on chemical and biological detection. Dr. Steven Christesen takes that challenge literally, having spent more than 20 years developing a technology that uses reflected laser beams to detect the presence of threat agents.

Dr. Christesen, a member of the Laser Standoff Detection Team at the Edgewood Chemical Biological Center, saw the potential of Raman (rah-MON) spectroscopy early in his scientific career when he was a graduate student at the University of North Carolina in the late 1970s. On the advice of a friend, Christesen joined ECBC fresh out of graduate school in 1981, and he's been advancing the state of the art in detection ever since.

"I've worked in bioflourescence and other detection techniques, but I've always maintained my work in Raman, at least on the side," said Christesen.

Raman spectroscopy is a technology that can be applied to the detection of chemical or biological agents. According to Christesen, the technology is a light scattering technique that uses a laser as the light source. When the laser's light is projected outwards, it scatters off the molecules in the target and is reflected back to the source. The vast majority of the reflected light is of the same wavelength, but a small percentage is scattered at wavelengths shifted from the laser's wavelength. The difference in wavelength is due to the molecular structure of the target material, which has scattered a small portion of the laser's beam. The individual molecules that make up the target material—for example, chemical agents—can vibrate only at a certain frequencies. The wavelength of the reflected light, or spectrum, represents those vibrations. When the returned spectrum is matched to the known characteristics of chemical or biological threat agents, the presence and nature of the agent can be determined.

"It's like getting a molecular fingerprint," said Christesen. These identifiers can be returned from samples in solid, liquid or gaseous forms; however, today's emphasis is on the detection of liquids on surfaces, biological aerosols collected on a solid substrate, and chemical agents in water.

Christesen has stayed interested in this area of research in large part thanks to the advances made possible with ever-evolving technology. The advent of smaller systems, smaller lasers and improved power requirements make practical applications of Raman spectroscopy possible. The hardware, says Christesen, has finally caught up to the science.

"There are commercially available hand-held Raman spectroscopy devices for certain applications," said Christesen. "The size of the Raman detector depends upon the requirements for sensitivity and specificity."

Many of today's systems can be powered by standard wall plugs, or even by batteries in the case of handheld or portable units. The Army's Technical Escort Unit utilizes portable Raman spectroscopy devices to analyze unknown samples contained in clear glass containers.

Clearly, today's technologies provide useful detection capabilities. Progress marches onward, however. The current research focus is on surface-bound chemical agents, as well as chemical agents in water. According to Christesen, a technique known as surface-enhanced Raman spectroscopy will likely have the largest impact on the development of Raman-based chemical agent detection systems for water monitoring.

"By nature, the reflected light provides a rather weak signal," said Christesen. "Certain metal substrates—especially gold and silver—enhance the Raman signal by increasing the strength of the electromagnetic field observed by the molecules. The sensitivity requirements for a water monitor necessitate the use of an enhanced Raman technique."

Surface-enhanced Raman spectroscopy is just one way the area is evolving. The technology's biodetection applications are garnering increased attention, and efforts are ongoing to improve the repeatability and sensitivity of test results across the board. Easier portability is a goal for future detectors, and an important part of making powerful Raman systems fieldable.

"In five years, I'd hope we see fielded surface detection systems," said Christesen. "With the companies and people working on this technologies, I think that such a system is a realistic goal."

EYE IN THE SKY: THE LATEST IN PASSIVE STANDOFF CHEMICAL DETECTION

An alarm sounds and the soldier immediately knows that his M21 Chemical Agent Alarm has detected either nerve or blister agent vapors in the air somewhere within an approximate five-kilometer radius. This chemical agent detector is providing real-world protection for our warfighters in today's battlefields. However, scientists and engineers at the Edgewood Chemical Biological Center have the mission of advancing the state of the art in detection technology—providing improved reliability, range and ultimately warfighter survivability.

That next generation of chemical agent detection systems is off the drawing board. ECBC is contributing to the ongoing development of emerging systems, including the Joint Service Light Weight Standoff Chemical Agent Detection system, a passive standoff detection system.

In a hypothetical application of the emerging technology, a helicopter or an Unmanned Aerial Vehicle (UAV) equipped with detectors will fly over and scan hundreds of square kilometers, including highly urbanized areas, for chemical agents rather than waiting until chemical agents are within the five kilometers range that defines today's equipment. The airborne detectors will relay back digital images of the scanned area, alerting the commander to where chemical agent clouds are located, what agents are in the cloud, and how much area will fall under the cloud. While this scenario is still only on paper, it is rapidly becoming reality.

Using hyperspectral imaging (HSI) spectrometers, ECBC researchers have successfully developed two notable HSI systems: the TurboFT and the Adaptive Infrared Imaging Spectroradiometer (AIRIS). The HSI spectrometer can record a digital image of the battlefield at thirty or more discreet spectral frequencies, allowing the instrument to detect and uniquely identify the presence of multiple chemical vapor plumes. Because each chemical possesses a unique signature or "spectral fingerprint," the spectral dimension provides a means to identify the chemicals present. The commander now has a chemical agent map of the entire area covered by his helicopter or UAV.

The TurboFT is a very-high-speed Fourier Transform Infrared (FTIR) spectrometer that has been demonstrated at speeds of up to 360 frames per second for a 16-pixel imager—the fastest FTIR imaging system ever constructed. This success alone is a significant technological achievement in the sensor field. This achievement was demonstrated in the Airborne Chemical Imaging System (ACIS) Defense Technology Objective (DTO) that was completed during fiscal year 2002. Since then, the design has been expanded to a 64-pixel format that will be delivered and tested during fiscal year 2004. This 64-pixel focal plan array will provide ultra wide area coverage during the scanning process. The 64-pixel TurboFT is the first commercial lightweight high-speed imaging FTIR ever developed, and its novel spaceframe design results in a small sensor package that is deployable in helicopters and UAVs. The TurboFT has demonstrated its efficacy for airborne use aboard a UH-1 helicopter.

The AIRIS system is a high-resolution infrared imaging system that uses a 256x256-pixel format. This allows a more detailed imaging of an area for discerning chemical agent vapors. When factors of wind direction are taken into account, the AIRIS system can pinpoint the release location of the chemical agent. The system has been tested for airborne use aboard a UH-1 helicopter in an urban area using the inert trace gas sulfur hexaflouride as the airborne agent. Sulfur hexaflouride is used in a variety of medical and sports applications, including the inflation of tennis balls.

Advanced prototypes of these two systems are currently under development by ECBC in support of the Wide Area Aerial Reconnaissance (WAAR) Defense Technology Objective (DTO), which seeks to further develop the capability for wide-area imaging of chemical vapor threats using airborne reconnaissance.

HISPEC HAS HIGH HOPES TO MEET BIODETECTION CHALLENGE

Devising a reliable passive standoff detection device for biological aerosols presents a challenge for scientists. Recently, however, ECBC scientists have discovered they can apply successful chemical detection technology to the biological realm with a few adjustments to accommodate the unique characteristics of biological agents. The High-Sensitivity Spectrometer (HISPEC), one of the Center's most promising detection technologies, has been successful in early tests against a biological challenge. The HISPEC is based upon the same technology used in the M21 Automatic Chemical Agent Alarm.

The HISPEC is a Fourier Transform Infrared (FTIR) spectrometer designed to be an order of magnitude more sensitive than the chemical agent detectors listed above. In fact, it is the most sensitive commercial FTIR field spectrometer ever constructed. It uses optics and moving mirrors to divide incoming light into an interference pattern, allowing analysis of spectra that may identify the presence of a biological agent. A highly sensitive infrared radiation detector is used to monitor the interference pattern. In order to minimize electrical noise and permit very sensitive measurements, the detector is kept at very low temperatures below –300 degrees Fahrenheit.

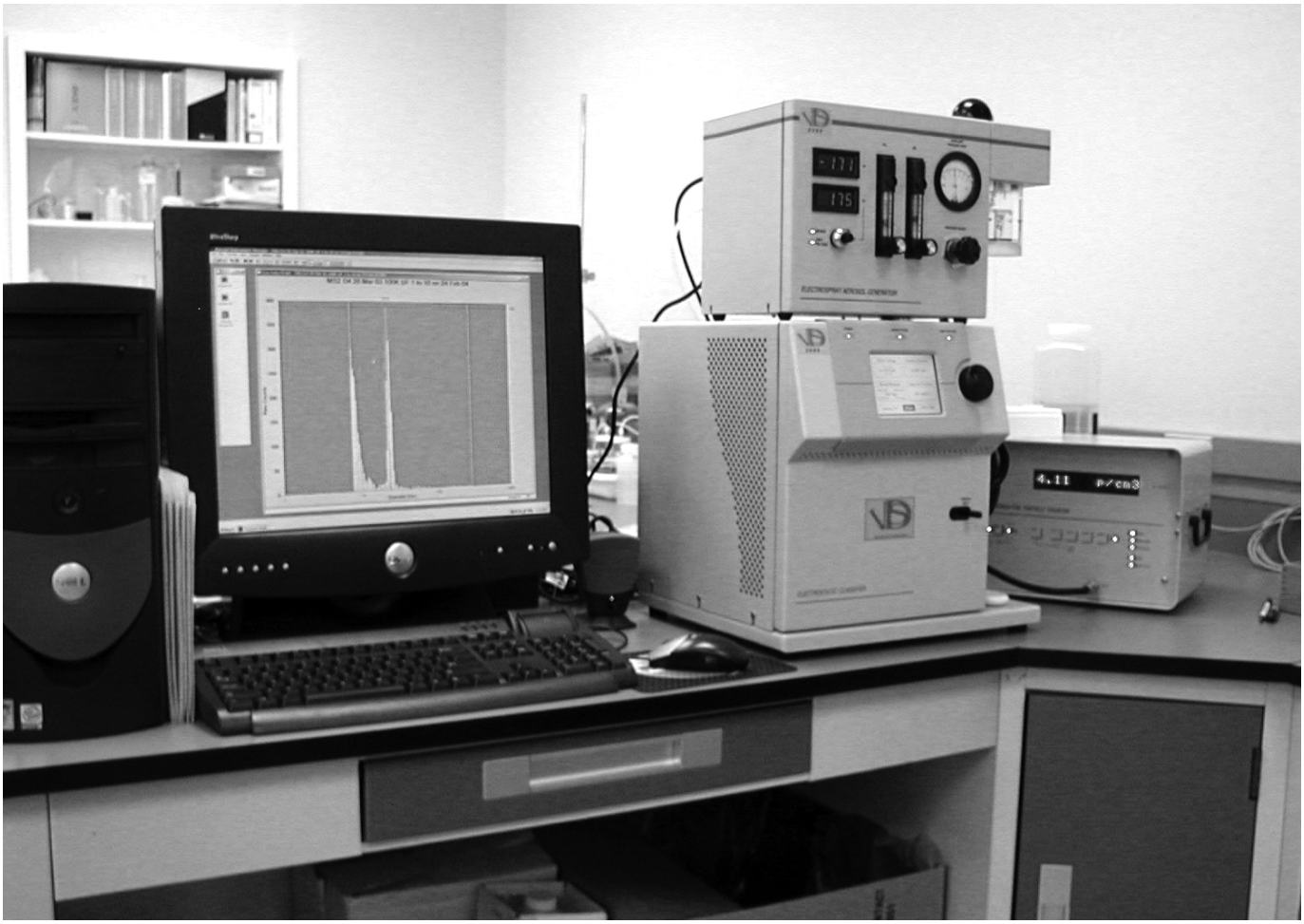
Researchers at ECBC have recently demonstrated the ability of the HISPEC to detect and identify the anthrax simulant bacillus subtilus in the field. These initial experiments have produced encouraging results for these efforts to adapt passive standoff detection technology for use against biological agents.

IDENTIFYING UNKNOWNS: ECBC'S SOLUTION TO BIOLOGICAL DETECTION

"Researchers Create Virus in Record Time"—two weeks to be precise—reads the title of an article that appeared in the November 14, 2003, issue of the Washington Post. Since this is the second reporting of a man-made virus, it is evident that scientists now have the capability to splice together bits of DNA in the laboratory and create new viruses for purposes of good or evil. Health symptoms and diseases caused by these man-made viruses may mimic known diseases but will not respond to treatment. How do you separate and begin to identify these man-made viruses since they will not exist in the available taxonomy of viruses?

The Edgewood Chemical Biological Center, as the Army's lead laboratory for non-medical chemical and biological defense, has been working on this challenge for many years—well before science's ability to create new viruses developed. Biological detection has always presented challenges not present in chemical detection. In contrast to chemical weapons, biological agents are live agents and are easily camouflaged by the wide spectrum of naturally-occurring and harmless substances in the atmosphere. In addition, the effects of biological agents generally take longer to manifest themselves, by which point personnel cannot take protective measures. A reliable detection capability is critical.

When these factors are combined with the emerging need to identify unknown agents, the scope of the challenge for ECBC becomes evident. Fortunately, the Center has developed, patented and continues to refine a promising solution. The Integrated Virus Detection System, a patented and licensed technology from ECBC, will detect and separate these unknown viruses along with naturally



occurring viruses from any liquid sample such as water, blood, or urine. The IVDS detects viruses by counting viral particles in a given sample and sorts them by size. Each virus has its own particular size ranging from 10 to 300 nanometers—a nanometer is one billionth of a meter. The size of the virus can identify the family of viruses to which it belongs, thus helping to identify unknown viruses by comparing its size and characteristics to know quantities. Once the unknown virus is separated from the sample, a polymerase chain reaction assay (PCR) can be conducted to further identify the virus.

The IVDS can separate viruses from a sample in less than 15 minutes without false positive or false negative results because it does not rely on chemical reactions to trigger responses associated with certain substances.

For an unknown virus, the information derived from the IVDS will identify physical characteristics that will fall within the viral "window," and more importantly will fall between the characteristics of known particles. This gives researchers an idea of what sort of virus the unknown quantity is.

The components of the IVDS are all off-the-shelf pieces. The filters used in the sorting process are reusable and easily replaceable if necessary, as in the case of dangerous or contagious samples. The National Institute of Standards and Technology (NIST) has calibrated the counting feature of the IVDS to verify its accuracy and efficiency.

According to Dr. Charles Wick, leader of the chemical and biological point detection team at the ECBC and developer of IVDS, the equipment could be reduced in size to a loaf of bread, if necessary.

Dr. Wick's team is currently developing techniques for collecting airborne virus samples since the system currently analyzes only liquid samples. A future effort is focused on the creation of an internal virus library for IVDS by loading the existing virus taxonomy into a computer database. This would eliminate a considerable amount of time needed to compare the results from the IVDS to the existing virus taxonomy by hand for identification. A virus taxonomy library incorporated in the IVDS would allow comparison of the unknown virus with all known viruses in a matter of seconds.

With continued development and advancement through the Army technology program, the IVDS is sure to play a significant role in battlefield and homeland defense, especially now that science allows the creation of new and unique biological threats.

WITH A THIRTY DAY DEADLINE, ECBC TEAM DEVELOPS METHOD TO SIMULTANEOUSLY DETECT UP TO FOUR BIOLOGICAL AGENTS

The Edgewood Chemical Biological Center team supporting the Joint Service Agent Water Monitoring (JSAWM) program is making revolutionary strides in biodetection technology. Most recently the team developed a hand-held microarray capable of detecting up to four biological agents in a water sample on one test ticket, an advancement that can potentially save millions of dollars in detection equipment expense. But the innovation doesn't stop here. Through cross-team collaboration staff further developed new test analysis methods leading to additional cost savings.

While industry has been striving for years to develop a protein microarray for multiple biological agent detection, the ECBC JSAWM team attributes their rapid success in doing so to the diverse scientific expertise at the Center. A huge hurdle in developing this new capability was the control of protein orientation on a solid surface and denaturization, or unfolding of protein and loss of 3-D structure. Specialized nanomanipulation materials and techniques were used to overcome this challenge. ECBC researchers supported early research developing these techniques making the technology available for the JSAWM team's use today.

In an effort to augment expertise in the behavior of biological receptors at the nano-scale level, the team collaborated with ANP Technologies, a company working promising nanomanipulation methods. The partnership proved a success as researchers enhanced bioassay performance through unique manipulation of biological receptors.

A second hurtle in developing the protein microarray was procurement of a scanner/reader that could read both line and microarray formats. Dr. Jensen of ECBC Passive Standoff Detection Team combined specialized signal processing algorithms with inexpensive commercial scanning technologies to create a new reader that provides readout signals and enables detailed analysis of sensor performance.

BG Reeves examines test tickets capable of detecting multiple agents.

Upon briefing the acquisition community of these latest developments the JSAWM team was quickly assigned the daunting task of developing a multiplexed assay microarray within 30 days. The effort encompassed not only developing the assay, but also fast-tracking rigorous analysis of the technology's performance. "Our realization of this feat was almost serendipitous," said JSAWM project lead, "I don't think we would have been able to develop the detection technology in such a short time-frame had all the players across the detection business area not been present."

Researchers began developing the hand-held assay using the novel nanomaterial technology. Within record time they were able to detect up to four agents with comparable or improved sensitivity with less reagent. According to researchers, this maneuver alone could result in considerable cost savings by consolidating four separate biological agent tests into one unit.

The new assays were smaller and lighter than standard test tickets and more effectively reduced cross reactivity which can lead to poor test results. Further, the new tickets successfully tested untreated water, including tap water (standard test methods ordinarily test samples treated with a pH buffered saline only).

In the past, the JSAWM team conducted validation testing of detection tickets using a manual scanner. To circumvent this time-consuming process, the team tapped the vast skill sets offered by the passive standoff detection team to develop an improved reader that ran on semi-automated imaging software. The replacement package not only reduced operational costs, but also reduced equipment costs.

By the close of their 30-day deadline, the ECBC JSAWM team successfully developed a multiplexed hand-held assay microarray that is lighter, more effective, and cheaper than the single agent detection ticket. They likewise reduced test validation costs and performance. When briefed on the status of the initiative, BG Steve Reeves, Joint Program Executive Officer for CB Defense stated, "given the huge potential of this program, cost avoidance to the services, and the opportunity for rapid technology transition, we want this project to move forward as quickly as possible."

The JSAWM team's landmark work in water monitoring is tribute to ECBC's broad-based in-house expertise and employee dedication, further demonstrating ECBC's reputation as a premier chemical and biological defense leader.

INTERNATIONAL COLLABORATION LEADS TO A POTENTIAL INCREASE IN WATER MONITORING SENSITIVITY

Clean drinking water, something most of us take for granted, is difficult to come by when you are a soldier operating in unfriendly territory. Through an international cooperative agreement, ECBC and the Uniformed Services University of the Health Sciences (USUHS), Bethesda, Md., have partnered with the Singapore DSO National Laboratories to combine two advanced technologies, Gas Chromatography-Ion Mobility Spectrometry, or GC-IMS, and solid phase microextraction, or SPME, for chemical detection in drinking water. Under the auspices of the U.S. Department of Defense's Joint Service Agent Water Monitor (JSAWM) program, ECBC investigators continue to make unprecedented progress in developing and refining these technologies to monitor drinking water supplies. Singapore's DSO National Laboratories and Defence Science and Technology Agency (DSTA) have been addressing the need to monitor water supplies for six years. Through an international cooperative agreement, ECBC and the Uniformed Services University of the Health Sciences (USUHS), Bethesda, MD have partnered with the Singapore DSO National Laboratories to combine two advanced technologies, Gas Chromatography-Ion Mobility Spectrometry, or GC-IMS, and solid phase microextraction or SPME for chemical detection in drinking water.

Researchers at DSO National Laboratories are among the world leaders in the application of SPME technologies for analyzing chemical warfare agents in complex media. Likewise, the researchers at ECBC are recognized as leaders in ion mobility spectrometry. Coupling the expertise from these two organizations has led to a dramatic increase in the ability to detect chemical agents in water. Preliminary results are encouraging with data pointing to a potential increase in detection sensitivity compared to earlier methodology/technology versions.

Needle-like in appearance, the SPME device is a versatile, thinly coated fiber that when dipped into a liquid, extracts a sample through adsorption. The USUHS and DSO SPME researchers have made far-reaching advances with the technology. Trials in Singapore in August 2003 demonstrated that SPME coupled with several analytical instruments can dramatically increase sensitivity.
At Edgewood in February of this year the team partnered with ECBC to demonstrate that SPME used in conjunction with the GC-IMS, leads to a potential increase in detection sensitivity over using GC-IMS alone.

The GC-IMS is a portable, stand-alone detection system, created and developed by the CB Point Detection Team, that couples GC, a process used to separate thermally stable, volatile compounds with an IMS detector device, a method that identifies unknown components by ionizing the material and then examining its behavior and movement. Neatly fit into a briefcase, the GC-IMS relies on a "sniff and tell" method to detect agent. The system works by heating microliters of an unknown liquid to approximately 250-270 degrees Celsius. The sample is then vaporized and "sniffed" into the GC column where the vapors are separated into individual compounds. The compounds are then processed through the IMS system. The combination of GC and IMS was shown to provide identification capabilities.

"The GC-IMS was often used in the field to monitor for biological aerosols. Now we're trying to adapt the technology to detect chemical agent in liquids," said ECBC CB Point Detection Team biodetection projects coordinator, Dr. A. Peter Snyder. Thanks to the ECBC Team's recent technology improvements such as modularization of GC-IMS components, the system can more easily be repaired, upgraded and utilized in the field. To ensure usability of the hybrid technology, the ECBC, USUHS and DSO National Laboratory scientists

collaborated with representatives from the Marine Corps' Chemical Biological Incident Response Force in February 2004. Working with surrogate chemicals, the military representatives used the modified equipment and provided insight as to how the equipment could be tooled to best meet operational needs. In return the men and women in uniform were given the opportunity to train with genuine equipment in a controlled environment.

"We're looking at cutting-edge research and development... the more practice these guys get using the equipment the better they are at handling it," said CDR Phil Smith, MSC, USN of Naval Medical Center San Diego, Industrial Hygiene Department, and USUHS Adjunct Assistant Professor.

According to ECBC International Division Chief, Dr. George Famini, further testing will be conducted to fine-tune the SPME and GC-IMS combined system prior to fielding, though researchers are working as fast as they can to transition the unit to the acquisition program where it will be fielded to the warfighter.

A SHORT HISTORY OF DETECTORS

From the sniff test to remote sensing ECBC works to deliver better detectors.

They say that necessity is the mother of invention. Necessity was also the parent of the Edgewood Chemical Biological Center's chemical and biological agent detection program. During WWI, when chemical weapons were used on the battlefield for the first time, the United States could identify chemical agents in its laboratories but had no detection capability for its soldiers in the field.

Instead, the World War I warfighter had to rely on his sense of smell and perception of throat and nose irritation to detect chemicals on the battlefield. Since most of the World War I chemical agents had identifiable odors, the nose was the best detector of the presence of chemical agents. Troops quickly learned that German mustard agent smelled like mustard, while Allied mustard agent smelled like garlic. Gas scouts were trained and positioned to provide advance warning of an incoming gas cloud. In situations when troops already had their masks on and needed to verify the continued presence of chemical agents, they performed what became known as the sniff test. This involved pulling the edge of the gas mask away from the face to allow outside air to enter the mask. If chemical agents were present, the unique odor would alert the soldier to remain masked. Unfortunately, the sniff test was inaccurate for low levels of chemical vapor, and a soldier would gradually lose his ability to detect low levels of mustard agent after conducting sniff tests for several hours at a stretch. Obviously, the sniff test posed extreme danger to personnel.

The distinct risks and unreliability of the sniff test spurred the Chemical Warfare Service—ECBC's progenitor—to test several concepts for a vapor field detector that did not involve removing the gas mask, marking the beginning of the development of detection systems. Early systems were basic, requiring precise conditions and long periods of time before delivering a reading that was usually non-specific. In fact, many of these devices still exposed personnel to potentially deadly quantities of agent and failed to detect large concentrations of some chemical warfare agents.

In December 1933, the chief of the Chemical Warfare Service acknowledged the Army's desperate need for a chemical agent detector by requesting that a military requirement be established. In 1934, a requirement visualizing an item that could "detect with great rapidity the presence of one chemical agent in the atmosphere, primarily mustard gas, in the presence of other chemical agents" was issued. This requirement would not be met until World War II.

Chemical agent detectors continued to evolve as allowed by advancing technology and scientific knowledge. However, the need for a biological agent detector was not apparent to the Army until rumors of the extensive Japanese and German biological warfare programs arose during World War II. The field detection of biological agents, however, was not feasible with the current technology, and

developing and standardizing such a capability posed a tremendous challenge. This need would not be filled for 50 years, forcing the Army to rely on field sampling and laboratory identification.

The limits of field sampling without a detection capability were clearly demonstrated during a major biological warfare scare during WWII. Starting in December 1944, the Japanese began sending unmanned balloons holding bombs over the United States. The initial concern was that they held biological agents, and the Chemical Warfare Service dispatched specialized teams of biological warfare officers to sample the bombs' contents. Without a field detection capability, these samples had to be sent to Fort Detrick, Md., for analysis, creating a significant delay in identification. Fortunately, all the samples tested negative for biological agent. The lack of biological agent field detection remained a problem throughout the 1950s despite recognition of its importance. Technological challenges in biodetection drove the focus of work towards refinement of sampling methods instead.

Even beyond the end of WWII, work continued to bolster the military's chemical agent detection capabilities. The inability to instantly detect nerve agents and to sound an alarm to alert surrounding troops was the primary concern throughout the 1950s and 1960s. Although field detector kits were updated to detect the latest generation of chemical agents, the kits only provided confirmation of an attack, not advance warning. Eventually, the original initiative to develop an automatic nerve agent alarm was split into various programs focused on different applications, including field alarms, remote sensing alarms, and installation alarms for production and storage facilities. In 1968, the Army standardized the M8 (E61) Portable Automatic Chemical Agent Alarm. The four-year development program was one of the most significant accomplishments in chemical defense and eliminated a major deficiency that had rendered U.S. soldiers vulnerable to a surprise nerve agent attack.

Early work on automatic biological agent field alarms during the 1960s resulted in the development of several concepts, none of which completed development during the decade. The Biological Detection and Warning System (BDWS) started development in 1974 to meet the long-standing need for a field biological agent detection system. The BDWS consisted of the XM19 Chemiluminescence Biological Agent Automatic Alarm, the XM2 Biological Agent Sampler, and a M42 Alarm. The BDWS continued in development until 1983, when the program was canceled because the XM19 Alarm failed technical and user testing.

The BDWS would have been forgotten if it was not for Operation Desert Shield/Storm in 1990 and 1991. In response to an emergency requirement for a biological detector, the XM2 Sampler was taken "off the shelf," refurbished, tested, and prepared for deployment to Saudia Arabia by January 1991. To complement the XM2 Sampler, the Army issued disposable Sensitive Membrane Antigen Rapid Test (SMART) Biological Agent Detector Tickets, which worked with the XM2 to give an indication of the presence of a specific biological agent. SMART Tickets were rushed into production at the rate of 30,000 per month to support the XM2 Sampler. By the middle of March 1991, 11 XM2 Samplers were deployed to the frontlines with over 20,000 SMART Tickets. Although the XM2 Sampler played a critical role during Desert Storm and was hailed as an extremely successful and reliable system, the unit was never standardized.

Obviously, chemical agent detection also was part of the defensive posture in Desert Storm. Standardized in 1981, the M8A1 Alarm was established as the Army's single most important chemical detection capability. By 1987, more than 32,000 units were in the field. During Operations Desert Shield and Desert Storm in 1990 and 1991, the U.S. Army utilized over 12,000 M8A1 Alarms as its main chemical agent detection capability.

Work commenced in the 1980s to develop a lightweight chemical detector, a concept made feasible by the rise of microprocessors as a viable technology. The Chemical Agent Monitor (CAM), standardized in 1988, was a hand-held device for monitoring chemical agent contamination on personnel and equipment. The small unit weighed about five pounds and was one of the first truly portable chemical agent detectors.

The 1990s saw 40 years of work to produce an effective remote detection capability come to fruition. The conceptualization of a remote sensing chemical agent alarm began in the 1950s, but research on the project continued

into the 1970s and 1980s. In 1992, the Army type classified the XM21 Remote Sensing Chemical Agent Alarm for low rate production. Following some additional development work, the M21 Remote Sensing Chemical Agent Alarm was standardized in 1995. The M21 incorporated an automatic scanning passive infrared sensor that detected nerve and blister agent vapor clouds up to five kilometers away.

After the Gulf War, General Colin Powell testified to Congress that the United States was vulnerable to biological warfare in large part because the military had been unable to standardize a dependable biological agent detector. This spurred development of the XM31 Automatic Biological Agent Alarm (BIDS), which was type classified limited procurement in 1995 as the first biological agent alarm and standardized in 1996 as the M31. The BIDS was a suite of sampling and detection equipment mounted in a standard HMMWV platform. Each BIDS could provide around-the-clock monitoring for biological agents with identification of the agent provided within 30 minutes of the initial alarm.

Another milestone in modern detection was the XM93 Nuclear, Biological and Chemical Reconnaissance System (NBCRS), also known as the Fox. This six-wheeled armored vehicle was put into limited production by the Army during Operation Desert Shield in 1990. The XM93 Fox was a dedicated system of NBC detection, warning, and sampling equipment integrated into a high speed, high mobility armored carrier. The Fox was capable of performing NBC reconnaissance on primary, secondary, or cross-country routes throughout the battlefield and had the capability to find and mark CB contamination. The Fox was subsequently standardized and remains in use today, having received a steady string of upgrades.

The state of the art has progressed rapidly in just a few short decades, from no more equipment than the human sense of smell to remote detectors employing lasers to discern agent type and concentration. ECBC is working with these emerging technologies to provide the warfighter with devices that will deliver reliable standoff detection as well as faster, more accurate and more dependable point detection. In addition to improved effectiveness, scientists and engineers at the Center are working to endow detectors with reduced power requirements, more compact dimensions and lighter weight, and mobile detection capability.

History derived from U.S. Army Research, Development and Engineering Command Historian Jeffrey Smart's article entitled "History of Detection."

CHALLENGES FOR TOMORROW: THE FUTURE OF DETECTION

As one of the Department of Defense's lead chemical and biological defense laboratories, ECBC always has its eye on the horizon to discern what tomorrow's challenges will demand of technology and products. In the world of chemical and biological detection—a field that is relatively young, dating only to the early 20th century—the potential for enhanced performance is significant. The detection teams at the Center pursue tomorrow's innovations while also evaluating what existing deficiencies need to be corrected before the next generation of detection technology can take hold.

Today's detection equipment, while increasingly effective, has a number of shortfalls that impact logistics more than performance. Typically, detectors are large and heavy. They have substantial power requirements that demand generators or result in short battery life. Trained personnel are required due to their complex set-up, operation and maintenance procedures, and separate detectors are required for nuclear, chemical and biological threats. Many of these specialized detectors are again limited to certain types of threats within the classifications of chemical, biological or nuclear agents. Also, not surprisingly, these detectors are expensive to build, deploy and maintain.

Ongoing research is working to improve detector performance in these critical logistics areas. For example, the Joint Chemical Agent Detector—a joint services project to which ECBC contributes expertise—has the potential to reduce size, weight and cost while achieving improved battery life in a chemical point detector. The handheld unit, scoped to provide advance detection and warning,

is a combined portable monitoring and small point chemical agent detector for aircraft, shipboard, and individual soldier applications. The requirements for this pocket-sized detector state that it should automatically detect, identify, and quantify chemical agents inside the aircraft or ship, providing protection for the individual warfighter. The engineers and scientists behind the JCAD are working to create a rugged, versatile device that is sufficiently sensitive to warn personnel before exposure to a harmful dose of chemical agent while being resistant to environments with a high concentration of substances that could trigger false alarms.

While this promising work is happening here and now, ECBC is focused on tomorrow's challenges. Looking ten years ahead to the state of the art in 2014, Dr. Kirk Phelps, senior team leader for chemical and biological detection at ECBC, envisions a full set of nuclear, chemical and biological point and standoff detectors with the ability to detect a wide range of threat agents and selected toxic industrial materials. Phelps predicts that nanotechnology, the emerging field that will allow us to make smaller, stronger, lighter and more effective products, will be in full-force as a mature field in ten year's time. Nanotechnology will be the tool that helps ECBC scientists and engineers surmount many of today's challenges of size and logistical burden. The number of required detectors for a given set of tasks will be reduced, with dramatic reductions in dimension and weight with commensurate cuts in power requirements and operating costs.

While there is no crystal ball to tell exactly where technology will go and what benefits we will realize, ECBC uses its personnel and expertise to create blueprints for the future of detection every day.

MODULAR LABORATORY SUPPORTS OPERATION ENDURING FREEDOM

by Joanne Coale, GEO-CENTERS

Background

Forensic quality analytical information is an essential tool in the war on terrorism. At the Edgewood Chemical Biological Center (ECBC), there is a team of people, known as the Edgewood Chemical Biological Forensic Analytical Center (EC/B FAC), who have been meeting and exceeding external customer requirements and Army interests in the development of mobile chemical and biological analysis systems for over a decade.

Developing transportable laboratories requires the evaluation of state-of-the-art, highly technical, emerging technological trends and the selection of appropriate novel technologies based on a variety of criteria such as engineering, technical risks, and logistical burdens. The EC/B FAC has developed several comprehensive (chemistry, biology, radiology, and high-explosive residue) transportable laboratories for customers with national- and international-level missions that include the execution of the Chemical Weapons Convention (CWC) and Weapons of Mass Destruction (WMD) counter-measures. The EC/B FAC

provides field hardware, field methodology, and customer training, providing an analytical process that integrates desperate disciplines into comprehensive, turn key packages that can be deployed to remote regions with little or no logistical support and that produce data that withstands the most intensive and critical reviews.

Mobile Laboratory Support in the Mid-East

Mobile laboratories, which were designed, developed, and transitioned by the EC/B FAC, were deployed to directly support our soldiers on the battlefield during both major operations of Operation Enduring Freedom. These laboratories have literally changed the way wars are fought. From funding to fielding, these unique, state-of-the-art mobile analytical laboratories took less than 4 months to deliver. They may be regionally or internationally deployed providing a high throughput sample screening and analysis capability. The systems, supporting the continental United States, are easily deployed OCONUS supporting our operational decisions and our war fighters and peacekeepers abroad. Having such a capability in field (or in theater) has allowed for near real time and real time assessments of both intelligence samples, military threats to our forces, and environmental samples to determine the presence of toxic industrial materials within a 24-hour window of time. Previously, this type of assessment was traditionally accomplished in a 3-4 week timeframe, greatly reducing the commander's ability to make timely operational decisions based on highly reliable analytical data. The rapid-assessment transportable laboratory provides the capability to identify chemical and biological warfare threat agents in the field (CONUS and OCONUS). Materials requiring more intensive analysis are sent to "Gold Standard" laboratories for confirmation of only those samples worthy of definitive analysis, forensics quality data and determination of attribution. The accomplishment has allowed our warriors to retrieve critical information in an extremely timely manner while operating in a highly mobile and extremely harsh environment.

In late February 2003, one of the mobile laboratories with chemists from ECBC deployed to Northern Kuwait with the 75th Light Infantry Brigade in support of Operation Iraqi Freedom. These dedicated Department of Defense civilians are subject matter experts who operate the sophisticated analytical instrumentation that was needed to support ongoing operations. The laboratory was contained in a CONEX (a Container Express), which was mounted on a flatbed trailer and transported from location to location by a Truck Tractor. Approximately four days after setting up in Northern Kuwait, the war began and the unit packed up and moved to Southern Iraq.

The time in the "sandbox" was like a bad camping trip!

A View from the "Sandbox"

Several ECBC chemists provided insight into their deployment with the mobile laboratory in Iraq. Mr. Michael Cain, an ECBC chemist, said, "Although our deployment to the "sandbox" was a lot like being on a bad camping trip, there were some challenges and some pleasurable experiences. One correlation with camping is you have to be flexible and willing to make concessions. The team member adapted very well the inconveniences of "camp" life."

"There were instances where you had to be there to experience it. When the oil fields were on fire, we stood on the CONEX container and tried to take pictures. One of the biggest surprises during my time in theater was to find a portable Post Exchange (PX) in the middle of Iraq in the middle of the war. I believe it was from Wright-Patterson Air Force Base and manned by a female who had volunteered to be there," Mike said.

The entire unit consisted of approximately 300 people, and Mike related that he felt very comfortable in the convoy as it moved across Iraq as it was obvious that this large group could defend themselves. An emotional and extremely heartwarming experience was the trip across the Tigris-Euphrates Valley. "As we encountered the Iraqi people, it was like being taken back to biblical times," he said. "They carried bottles of water from the river and herded sheep or goats. You could identify those who were richer as they had donkeys. As we traversed through Iraq to Baghdad, everyone we encountered was waving and welcoming and enjoyed the candy bars from our MREs that we tossed to them as we passed by."

ECBC chemist, Ms. Janet Brzezinski, was deployed with the laboratory and in the following paragraphs she provides her perspective.

"I approached this deployment as an "adventure" and an opportunity to serve my country. I had deployed previously and had experienced harsh conditions, but this was worse. I did, however, learn a lot. I saw and experienced first hand how our soldiers had to live and adjust to the adverse conditions," she said.

"Some people may think it was an easy assignment. There is nothing easy about responding to scud alerts early in the morning (before day break), having to don MOPP (Mission Oriented Protective Posture) gear, and get into concrete bunkers. In addition, our camp in Baghdad experienced mortar fire. On March 2nd, which was my birthday, our food tent was destroyed by fire. The quality of the food went down significantly. Also, we always seemed to be surrounded by pests—flies, mosquitoes, sand fleas, or scorpions. Water was a limited commodity, which restricted our opportunities for bathing and washing clothes," she continued.

"Initially, we slept in 50-person canvas tents (which were not coed and did not have heat or air conditioning). Our compound was made of different units, and I shared a tent that was filled to capacity with other females. During the frequent sand storms, fine sand came through the canvas of the tents. The air was like smog, and I had a cough for the first two weeks. At a later location, our tents were vinyl and less fine sand came through. Once we entered Baghdad, we used abandoned homes and had "female" houses. However, no matter what the structure, we slept on cots the entire duration of the deployment. It was like a five-month camping trip," she continued.

"You don't realize how much you can miss a washer and dryer until you do not have them," she said. "We had a laundry service of sorts (third country nationals), but clothes came back wrinkled and not as clean as when we sent them. At one point, we had some military laundry services, but for the most part, I washed my clothes in a small tub. I hung the clothes to dry on 550-cord that was strung between tents. The clothing dried very quickly because of the low humidity."

"During the move from Southern Iraq to Baghdad, I flew in a Chinook. It was an interesting experience. I saw trenches that had been dug and criss-crossed the desert. I'm not sure if they were dug to slow down the troops movement. I also saw families living in three-sided tents in the middle of nowhere."

"There were three Chinook aircraft in the convoy. The one I was traveling in developed engine problems, and we had to set down on the highway. Since our aircraft contained the bulk of the supplies, we had to unload it and try to cram everything into the other two aircraft. The Iraqi people seemed to appear from out of nowhere wanting whatever we could give them. The military created a protective circle around the downed aircraft until everything had been transferred, and then we continued on. The crew of the disabled aircraft was able to get airborne and continue on to our destination."

"The last place I stayed before my return to the United States was in a house on one of the presidential compounds. The house had been extensively looted down to the toilets and showerheads. I lived with five other females in what had previously been the kitchen area; there were no cabinets or anything that would normally identify a room as a kitchen."

"Thanks to Bob the Builder, a nickname given to a member of the group who was extremely innovative, we did have electricity, running water and air conditioning for a limited period of time. Bob the Builder found a generator that was intended as a backup and got it running."

"When asked if she would volunteer for another deployment, Janet responded "Yes, but not for a 6-months duration—it was too long."

CONUS Replacement Center (CRC)

A third chemist from the Edgewood CB Center, Mr. Eric Stevens, was deployed to replace Mike who had to return to the United States. Eric's deployment was unique in that he processed through the CONUS Replacement Center (CRC) in El Paso, TX. Our other chemists had deployed directly from the local installation. All deployments are now processed through the CRC.

At the CRC, those being deployed receive:

- Medical clearance
- Vaccinations
- Briefings on the customs of the people in the area
- Briefings on regulations that they are subject to while deployed
- Gear (e.g., protective equipment, cold weather gear)

Eric said that when he arrived at the CRC, he was placed with a group of approximately 300 people being readied for deployment. About 50 percent of the group was civilians. He likened the experience to a "bad boot camp." He said that they were housed in barracks, confined to the post, and transported by bus from location to location. Eric said, "They were astounded with the number of civilians. They tried to function as they do with military, calling for formations in the morning to ensure everyone was present. The civilians didn't know how to do 'formations,' and some became frustrated. Luckily, we had someone in our group who was reservist and could guide us on the expectations."

Once he was declared ready for deployment, Eric flew from El Paso to Kuwait However, when he arrived in Kuwait the lab had already moved into Baghdad, and they weren't sure what to do with him. Eventually, he boarded a Chinook and headed to Baghdad where he joined Janet and the other members of the team in the presidential compound. By this time, it was early May and Eric spent his time at this location until he returned to the United States.

Eric explained that now everyone who is scheduled for deployment is processed through the CRC. Eric said, "This makes sense since they stockpile all the necessary supplies and equipment. I had three duffle bags and a pelican case that I had to lug around with me, but they think it best to equip you for an extended stay." He concluded by saying that his only negative experience was the apparent disconnect between the CRC and his sponsoring agency—not knowing what to do with him when he arrived in Kuwait.

Unique Quality Control

At ECBC, mobile labs are designed, developed, and fabricated under the EC/B FAC's registration by the ISO 9001 and the ISO/IEC 17025 Standard. The standard is specific to laboratory operations, appraises quality control, proficiency, operator adeptness, and overall laboratory performance. The ability to perform field analysis under this stringent standard is unique in the world.

When talking about the competence of the mobile laboratory, Mike Cain emphasized that the ECBC quality control process enabled the team in Iraq to do their job and maintain the same quality control in the field that they would have in the fixed site laboratory. "The quality control process and forethought of the EC/B FAC quality manager precipitated the inclusion of guidelines and standards in the mobile lab that ensured proper chain-of-custody, sample collection and preparation, sample analysis, and final report preparation as close to what is done in the fixed-site laboratory as possible. In addition, the ability to reach back to the fixed site laboratory at ECBC was phenomenal," he said.

Summary

Since the development of the first treaty compliance laboratory, a series of events and products that have profoundly influenced strategies used by the Army, law enforcement agencies, treaty inspection verifications, and the protection of our Nation as a whole have taken place.

BRIEFS

STATIONS OF ROBOTIC MONITORING (STORM). ECBC developed a mobile, high throughput biological monitoring lab known as STORM. The STORM lab is a 35-foot long, self-contained mobile laboratory with the capacity to perform biological analysis on over 200 samples per day against 7 target biowarfare agents. The STORM lab includes a robotic sample prep station, multiple PCR (polymerase chain reaction) analysis stations, and high-speed immunoassay analysis instrumentation. In addition, the lab is capable of classical microbiological screening to include sample prep, sample culture (plates), and florescent microscopy. The STORM mobile biomonitoring lab became operational in January 2004.

NATIONAL RESEARCH COUNCIL (NRC) "HOW CLEAN IS SAFE?" MEETING. In November, representatives of ECBC attended the NRC meeting on "Standards and Policies for Decontaminating Public Facilities Affected by Exposure to Harmful Biological Agents: How Clean is Safe?" The NRC will conduct this study to address the issue of appropriate cleanup levels for decontamination of public facilities affected by exposure to biological agents. The committee will determine doses associated with a range of infection levels and describe how these data could be used to assist in establishing acceptable levels of decontamination for selected organisms. The committee will also evaluate existing quantitative risk assessment models or develop new models appropriate for the selected organisms, if necessary. This NRC study is sponsored by the Department on Homeland Security and the Lawrence Livermore National Laboratory.

FDA MOBILE LABORATORY PROJECT. Through an Interagency Agreement (IAA), the FDA and ECBC have partnered to build and field mobile laboratories with chemical and microbiology analysis capabilities. With these labs, the, FDA will be able to increase their presence at ports of entry to our country. Secondly, and as importantly, these same mobile laboratories will be capable of responding to a potential terrorist incident in the contiguous United States.

ENVIRONMENTAL TOXICOLOGY TEAM ASSISTS WILDLIFE INTERNATIONAL. Scientists Anne Sinderman and Jerry Frey of Wildlife International, Ltd. met with members of the Environmental Toxicology Team, U.S. Army Edgewood Chemical Biological Center. The Wildlife International Scientists requested help solving problems they encountered with Earthworm Toxicity Testing. ECBC scientists reviewed test procedures currently being used by Wildlife International, and suggested changes in order to improve the toxicity endpoints and meet validity criteria. The modified procedures will be incorporated into laboratory procedures at Wildlife International, and test results using the new approach will be reported.

HOMELAND SECURITY RESEARCH CENTER DEVELOPING RESEARCH PROPOSAL WITH ECBC ENVIRONMENTAL TOXICOLOGY TEAM. The aquatic fate of Chemicals of EPA Interest (CEPAI) is being explored by The Water Security Team of the EPA National Homeland Security Research Center. At their request, members of the Environmental Toxicology Team are collaborating on developing a proposal to investigate the aquatic fate of CEPAI in natural waters. Interest has been elevated due to threat of terrorist attacks on drinking water supplies. Currently, incomplete data sets for substrates, catalysts, and aqueous media, all contribute to increased uncertainty and a lack of data adequate for use in predictive models that require reaction conditions characteristic of natural water systems. Effects on hydrolysis rates and degradation by-products formed by association with dissolved humic materials in source waters (e.g., well, reservoir, and tap waters) will be investigated. Results will provide data to be used for assessing CEPAI threat.

MOBILITY INVENTORY CONTROL SYSTEM (MICAS). The first fielding of MICAS was achieved at Pine Bluff Arsenal, AR, in December. A materiel fielding team, consisting of representatives from TACOM ILSC SBC, ECBC-RIA, U.S. Air Force and ECBC, fielded MICAS and provided training to operators and administers of the system. Upon installation, MICAS provided an immediate impact in shelf-life management of the GO-TO-WAR Chemical Defense Equipment items located at PBA. Because MICAS automatically flags items with expired or extended shelf-life dates, condition codes were changed on several items. The MICAS functionality prevented expired assets from being classified as mission capable stocks ready for reissue to warfighters.

UPDATES

NBC DEFENSE EQUIPMENT

Individual Protection

M40/M42 Series Mask

- The technical data portion of the procurement package input for various mask components for the M40A1 and M42A2 masks were compiled, reviewed and certified. The inputs provided were to support the acquisition of mask spare parts as well as the acquisition of components to support mask facepiece rebuilt at Pine Bluff Arsenal. A total of six mask components were reviewed/certified. Support from the ECBC Packaging Office at Edgewood was required during the certification process in order to update various special packaging instruction documents that contained superceded specifications and callouts.

- A spare part buy previously resulted in a request for review and update, for part number 5-1-1086, Coupling Half, Quick Disconnect. Portions of the technical data had been revised. Recent activity prompted additional coordination and discussion with the Configuration Control Board (CCB) Chairman and Rock Island counterparts. Packaging technical data has been revised to update format, and clarify the wrap applied to the item as well as inspection of the unit pack bag. Packaging quality assurance information was coordinated with Standardization and Specifications Team, Rock Island counterparts and the IPE Team CCB Chairman and changes will assure receipt of properly packaged items.

- The final updates are being made to the M42A2 Mask technical data package to allow use of the M45 Mask hose assembly in lieu of the M42A2 Mask hose assembly. This hose substitution was proven out under an Operation and Support Cost Reduction (OSCR) engineering study of the use of the M45 Mask hose assembly as a replacement for the M42A2 Mask hose assembly. The OSCR study disclosed equivalent performance of the M42A2 Mask regardless as to which hose assembly configuration used.

Collective Protection

M48A1 Gas Filter

- Several of the recent filter problems with the M1A1 Tanks at the Idaho Army National Guard (IDARNG) were related to flooding of the M48 filters with water. A moisture/corrosion test is being conducted to determine the rapidity with which water in the presence of ASZM-TEDA (activated impregnated carbon adsorbent) degrades the mechanical structure of the M48A1 filter. This knowledge will allow the PM-Abrams to determine a realistic period between visual inspections of the M48A1 filters installed in the M1A1/M1A2 Tanks. For the test, 30 samples of the filter's aluminum screen were placed into test. These samples will be examined periodically during the current one-year test period.

M93 GPFU

- In December a member of our Packaging Team attended a Collective Protection Equipment meeting where the contractor (Rotron) for the M93GPFU was seeking a certification as to the several M93GPFUs shipped from Afghanistan being free of contamination. It appears the contractor was worried about contamination related to the Gulf War Syndrome. Currently no requirement or certification specific to Gulf War Syndrome exists. The specialist explained that before any shipment can leave the theater they must pass the Military Customs Inspector (MCI) requirements in accordance with Army Regulations. Part of those requirements is that the items be free of soil and dirt (the prime carriers of possible agriculture contamination). As such they pose no restriction to U.S. Customs or the Department of Agriculture and are allowed unrestricted entry into the U.S.

OBSCURATION AND DECONTAMINATION SYSTEMS

Decontamination

- M12A1 Diesel Engine Driven Decon System – In September, the M12A1 DED Verification workshop was held at 84th Chemical Battalion, Fort Leonard Wood, MO. The Operators Manual was successfully verified. This upgrade manual supports all the fielding for the M12A1 DED Upgrade effort. Individuals from ECBC, Decon/Smoke Team and SBCCOM (RI) along with soldiers from the 84th Chemical Battalion participated on this verification.

HAND HELD ASSAY (HHA) PANELS ADVISORY MESSAGE

The TACOM-SBC Item Manager, in coordination with ECBC (RI) and the Critical Reagent Program (CRP) released a TACOM-SBC supply advisory message (SAM) 04-04-004 on 2 Dec 03. The purpose of the SAM was to provide notification to the users that operational HHA Panels are available and that training HHA Panels will be available shortly. The SAM describes the unit of issue, AMDF price, shelf life, use, storage, and handling and disposal requirements. The SAM also states the operational HHA Panel is a sensitive item and should be stored, handled and disposed of accordingly. The CRP prior to transitioning to TACOM-SBC handled supply management of the HHA Panels.

ARMY KNOWLEDGE ONLINE ADMINISTRATOR, PACKAGING

ECBC received four notifications of completed technical data actions for Special Packaging Instructions (SPIs): P5-1-1081, P5-19-853, P5-19-11232 and P5-19-1175. The documents were loaded to the AKO web site.

AKO PACKAGING LIBRARY - LOCATION OF PACKAGING TECHNICAL DATA

Packaging technical data in Special Packaging Instructions (SPI) format continues to be available on the AKO website, for access by the Field and others. The location has been changed from an SBCCOM location to the RDECOM Knowledge Collaboration Center. Written instructions for access to the new location can be obtained upon request by contacting rosey.poole@us.army.mil. Four revised SPIs were loaded to the Packaging AKO website upon completion of Configuration Control Board action and processing.

EIA DATA INTERCHANGE STANDARD 836

The Product Data Management is in the process of developing the capability to import/export data to/from our Product Center database in the EIA 836 XML schema. Current capabilities/limitations were presented at the EIA 836 quarterly meeting in January. EIA-836 is a comprehensive industry standard that will serve as the industry and DoD canonical reference for Configuration Management (CM) data definition and relationships, and as a reference to be used to model, build, evaluate, or map to any current or future system or database containing CM information.

MASK FILTER SERVICEABILTY STATUS - QUARTERLY UPDATE

The quarterly advisory update to SB 3-30-2 informing the field of the current shelf life status of mask filter lots has been compiled and prepared. The update reflects the recent quarter's surveillance test results from the Pine Bluff Arsenal test lab on existing lots of filters. In addition, new filter lots being introduced into the inventory from current production contracts are included in the update. The field advisory message has been forwarded for final review and release. The information issued in the field advisory message will also be available on line at the Army Electronic Product Support (AEPS) website.

DOT APPROVALS FOR MULTIPLE ROUND CONTAINERS

ECBC – Rock Island worked with ARDEC (Packaging) to get the Department of Transportation (DOT) Competent Approval Authority extended for another 4 years so that the multiple round containers can be used for public domain transport of leaking chemicals found at formerly used defense sites. Single round containers that previously passed public domain transport tests were also included in this authority to ensure availability of an adequate supply of containers to satisfy future requirements.

HELP LINES/TOLL-FREE NUMBERS

Chemical Equipment	TEL: CONUS 1-800-831-4408 FAX: 1-410-436-3912 (TOLL CALL) EMAIL: ceh@apgea.army.mil
Smoke/Obscurants	TEL: 1-888-246-1013 FAX: 1-410-436-2702 (TOLL CALL)
Environmental Quality	TEL: 1-410-436-6588 (TOLL CALL) FAX: 1-410-436-8484 (TOLL CALL)

ECBC'S DECONTAMINATION TECHNOLOGY LICENSED BY GENECOR INTERNATIONAL, INC.

Mr. Jim Zarzycki, ECBC's Technical Director, announced our recent patent licensing agreement with Genencor International, Inc. Under this agreement, which was signed on February 13, 2004, Genencor will manufacture and sell ECBC's patented OPAA and OPH enzymes. This enzymatic decontamination system is non-toxic and environmentally safe—a significant difference from caustic chemical decontamination solutions of the past. Designed to neutralize nerve agents, it also has efficacy against organophosphorus pesticides. The enzyme-based catalytic decontaminants can be utilized in military operations as well as in civilian first responder and homeland defense applications.

Our agreement with Genencor, a dominant corporation in the enzyme production market sector, will allow the ECBC-developed technology to benefit the maximum number of people. By licensing our enzymatic decontamination system for commercial production and sale, this technology will become available as an environmentally sound, cost-effective option for a range of military and civilian applications. Under the terms of this agreement, the Center will retain Government purpose rights and receive earned royalties on a percentage of net sales. For ECBC's part, we are fulfilling our responsibilities under law and DOD Directive to make technology, which may have dual use capability (i.e. commercial and military uses) available to the private sector.

COLLABORATION

Recent achievements and significant actions in our continuing commitment to technology transfer follow:

COOPERATIVE R&D WITH INDUSTRY AND ACADEMIA

Cooperative Research and Development Agreements (CRADA)

ECBC signed a CRADA with Bruker Optics, Inc. (BOI) in Aug 03. The purpose of this CRADA is for ECBC and BOI to collaborate on developing methodology and technology, based on FTIR spectroscopy, for detecting trace amounts of CB WMD and TICs in ambient, environmentally-sensitive sites.

A CRADA was signed with General Dynamics Land Systems, Sterling Heights, Michigan in October. The objective of this agreement is to conduct collaborative research and development towards an improved carbon filter demonstration/development in support of the Future Combat Systems program.

A Statement of Work (SOW), representing a second endeavor under the CRADA between ECBC and Alion Science and Technology Corporation, was approved in December. Under the auspices of this SOW, Alion Science and Technology Corporation may obtain technical assistance from ECBC for a task relative to the chemical incineration of chemical agents in a partially enclosed vessel.

A CRADA was signed between ECBC and Battelle Memorial Institute in December. This is a comprehensive agreement including cooperative efforts involving CB infrastructure protection; rapid prototyping; domestic terrorism technologies and equipment; safety and health/ risk management; information acquisition, processing, and dissemination; and pyrotechnics.

A CRADA was signed with Intralytix, Inc., Baltimore, Maryland, in January. The objective of this agreement is the production of a range of host-specific bacteriophages targeting food pathogens. The product (individual monophages and/or mixtures of monophages) will be tested against various food pathogens for bactericidal activity by Intralytix; and tested against viral threat simulants by ECBC.

A CRADA was signed with 20/20 Gene Systems, Inc., Rockville, Maryland, in January. The objective of this agreement is to identify and validate biomarkers indicative of exposure to low-level chemical warfare agents (CWAs) that can be detected in hair follicles of persons and animals exposed to low levels of various CWAs. It is hoped that these biomarkers, once validated, could become the basis of new rapid diagnostics and field tests to assess CWA exposure on the part of soldiers and civilians in a convenient and non-invasive manner. Scientists from ECBC and 20/20 Gene Systems were introduced at the 26 Mar 03 APG-TEDCO showcase held in the Edgewood area of APG. Maryland's TEDCO, under its Federal Laboratory Partnership Program, will provide initial funding for proof-of-concept studies.

Interagency Agreements (IAA)

An IAA between ECBC and the USDA'S Food Safety & Inspection Service (FSIS) was signed in September. Under the auspices of this agreement, ECBC will provide technical support and expertise to FSIS to conduct analyses and potential storage of food samples for the presence, exposure, release(s), and/or detection of biological agents that may present an imminent and substantial danger to the public health or welfare of the environment as it is in support of emergency responses.

An IAA with the Department of the Treasury's Alcohol and Tobacco Tax and Trade Bureau (ATTTB) ATTTB was signed in September. Under the auspices of this IAA, ECBC will provide Weapons of Mass Destruction Employee Awareness Training to the staff and management of ATTTB. This training will be conducted at two sites–Washington, DC, and Cincinnati, OH.

An IAA between ECBC and the U.S. Army Engineer Research and Development Center (ERDC) was signed in October. This agreement addresses collaborative research

and development on water supply protection, infrastructure protection, and environmental and homeland security.

Testing Services Agreement (TSA)

ECBC signed a TSA with QuickSilver Analytics, Inc. in Aug 03. The purpose of this TSA is to perform DMMP life, air flow resistance, aerosol penetration, and gas life leakage testing of carbon adsorbers and particulate filters manufactured by QuickSilver.

A TSA with GEOMET Technologies, LLC, was signed in Aug 03. Under the auspices of this TSA, ECBC will conduct production acceptance testing of chemical defense coveralls, to include liquid agent contamination/vapor penetration and vapor agent contamination/vapor penetration testing.

A TSA with Microsensor Systems, Inc., was signed in October. Under the auspices of this TSA, the Applied Test Team will evaluate new SAW polymer coatings, MIME materials, and concentrator materials to verify the detection characteristics of sensors designed to detect and identify various CW agents. This characterization process involves introducing varying quantities of a known substance under various operating conditions to determine the best detection parameters.

A TSA with InnovaTek, Inc., was signed in October. The purpose of this TSA is to characterize two of InnovaTek's aerosol samplers.

A TSA with Flanders Filters, Inc. was signed in December. Under this agreement, the Engineering Services Business Unit will be performing qualification testing of HEPA filter media.

A TSA with American Technology Corp. was signed in January. Under this agreement, ECBC will perform chemical agent testing of rubber swatches from the MCU-2A/P Second Skins that ATC is producing for the Air Force.

A TSA was signed with Air Cleaning Technologies, Inc. to evaluate the performance of carbon adsorbers for airflow resistance and DMMP life.

A TSA was signed with AQF Technologies Inc. to test the DMMP life and air flow resistance of carbon adsorbers.

An Amendment to the TSA with Aearo Company was approved in February. Under the amendment further testing of Aearo's full-facepiece, air-purifying respirator (APR) SGE400/3 will be conducted and Aearo will submit it's Forsheda F2/A4 APR for similar testing. The purpose of the testing is to determine if APR's will be protective enough for approval under the NIOSH CBRN standard.

A TSA with GEOMET Technologies, Inc., was signed in February. Under the auspices of this agreement, ECBC will perform chemical agent testing of Integrated Toxicological Agent Protective Suit (ITAPS) materials

A TSA with Lockheed Martin Systems Integration, Owego, New York, was signed in February. Lockheed Martin is developing several configurations of a mail screening system to protect mail handlers from bioaerosol hazards. These configurations incorporate an ultra-violet laser induced fluorescence (UVLIF) technology to trigger the system when a biohazard is suspected. The objective of this TSA is for ECBC to perform development testing of Lockheed Martin's UVLIF trigger technology and provide support testing in Lockheed Martin's evaluation of their system performance against a realistic mailroom environment.

A TSA was signed with Scott Health and Safety Products was signed in February. This agreement provides for performance testing of the Joint Service Aircrew Mask and other Scott respirators and self-contained breathing apparatuses. ECBC is in a unique position to perform such testing due to our SMARTMAN testing technology.

Patent License Agreement (PLA)

The terms of a PLA with EAI Corporation for the Air-Transportable Modular Analytical Laboratory have been modified from an exclusive PLA to a non-exclusive PLA effective in January.

An exclusive Patent License Agreement with Genencor International, Inc., was signed in February. Genencor International, Inc., is a diversified biotechnology company that develops and delivers innovative products and services into the health care, agri-processing, industrial and consumer markets. Under the auspices of this agreement, Genencor International will commercialize and manufacture OPAA and OPH enzymes to decontaminate certain organophosphate-based nerve agents. Marketing plans call for the enzymes to be made available to military and civilian first responders, such as firefighters, police and hazardous material response teams. The enzymes neutralize chemical agents and have the benefit of being non-toxic, non-corrosive and environmentally benign. This agreement was negotiated and effected through the support and efforts of Mr. Jim Zarzycki, Technical Director; the invention team of Drs. DeFrank, Cheng, and Rastogi; Mr. John Biffoni

and Ms. Vicki Upchurch, RDECOM Legal Counsel; Mr. Blake Sajonia and Ms. Christina Frain, APG Business Development Office (BDO). Ms. Frain made the initial contact with Genencor International during the BDO's survey and search for licensing partners.

POC: Office of Research and Technology Applications, DSN 584-4438, commercial (410) 436-4438, or E-mail to technical.outreach@apgea.army.mil.

Patent Activity for FY2003

During FY03, ECBC processed 16 invention disclosures and 17 new patent applications. Sixteen new patents were issued. A list of each of these is provided below:

Issued Patents:

"Tactical Thermal Luminescence Sensor for Ground Path Contamination Detection," U.S. Patent 6,464,392 issued 15 Oct 02.

"One-Step Purification Process for Organophosphorus Hydrolase Enzyme," U.S. Patent 6,469,145 issued 22 Oct 02.

"Method and Apparatus for Counting Submicron Sized Particles," U.S. Patent 6,485,686 issued 26 Nov 02.

"Method and System for Detecting and Recording Submicron Sized Particles," U.S. Patent 6,491,872 issued 10 Dec 02.

"Methods and Apparatus for Detecting Lesion-Induced Resonances in Deoxyribonucleic Acid Via Millimeter or Submillimeter Wave Spectroscopy," U.S. Patent 6,500,618 issued 31 Dec 02.

"Device and Method for Inspection and Detection of a Material by Observing a High-Voltage Waveform Produced by that Material," U.S. Patent 6,512,355 issued 28 Jan 03.

"Pyrotechnic Burster Composition," U.S. Patent 6,521,064 issued 18 Feb 03.

"Rifle-Launched Non-Lethal Cargo Dispenser," U.S. Patent 6,523,478 issued 25 Feb 03.

"Decontamination Methods for Toxic Chemical Agents," U.S. Patent 6,537,382 issued 25 Mar 03.

"Smoke Generating Compositions and Methods of Making the Same," U.S. Patent 6,558,487 issued 6 May 03.

"Automated Sample Processing for Identification of Microorganisms and Proteins," U.S. Patent 6,558,946 issued 6 May 03.

"Chemical Agent Simulant Training Composition," U.S. Patent 6,566,138 issued 20 May 03.

"Absolute Reference Aerosol Sampler", U.S. Patent 6,584,865 issued 1 Jul 03.

"Device and Method for Detection and/or Inspection of Conductive Particles Using High-Voltage Field," U.S. Patent 6,590,375 issued 8 Jul 03.

"Automatic Gain Control System for Use with Multiple Wavelength Signal Detector," U.S. Patent 6,594,000 issued 15 Jul 03.

"Microbial Biodegradation of Phosphonates," U.S. Patent 6,599,733 issued 29 Jul 03.

Patent Applications Filed:

"Twist Lock Mounting System," Application Number 10/638,736 filed 11 Aug 03.

"Sample Heater Assembly and Method of Use Thereof," Application Number 10/633,773 filed 4 Aug 03.

"Methods for Determining the Presence of Staphylococcal Enterotoxin a Gene in a Sample," Application Number 10/631,224 filed 28 Jul 03.

"Automated Biological Agent Testing System," Application Number 10/617,274 filed 10 Jul 03.

"Device and Method for Neutralizing Chemical Agents," Application Number 10/617,275 filed 10 Jul 03.

"Microbial Biodegradation of Phosphonates," Application Number 10/436,342 filed 12 May 03.

"Rifle-Launched Non-Lethal Cargo Dispenser," Application Number 10/372,357 filed 24 Feb 03.

"Particle Aerosol Belt," Application Number 10/300,496 filed 20 Nov 02.

"Air-Permeable Enclosure for Preventing the Spread of Chemical and/or Biological Agents and Method of Use Thereof," Application Number 10/273,026 filed 17 Oct 02.

"Method and Kit for Decontaminating Surfaces Contaminated with or by Liquid Chemical Warfare Agents," Application Number filed 10/273,023 17 Oct 02.

"Packaging System for a Product Provided by Mixing Two or More Components," Application Number 10/299,093 filed 18 Nov 02.

"Incendiary Device," Application Number 10/341,924 filed 14 Jan 03.

"Methods for Detecting Bacteriophage MS 2," Application Number 10/328,226 filed 23 Dec 02.

"Air Sampling Method and Sensor System for Spectroscopic Detection and Identification of Chemical and Biological Contaminants," Application Number 10/359,494 filed 6 Feb 03.

"Chemical/Biological Helmet," Application Number 10/354,630 filed 30 Jan 03.

"Remote Panoramic Infrared-Imaging Spectroaradiometer with Integrated Encrypted Broadcast Beacon," Application Number 10/370,312 filed 13 Feb 03.

"Bioprocess for the Production of Recombinant Anti-Botulinum Toxin Antibody," Application Number 10/414,555 filed 14 Apr 03.

Invention Disclosures:

"Portacount Docketing Station Power Supply/Diagnostic Tester/Time of Use Meter," received 30 Oct 02.

"Large-Scale Tank/Dispensing System for DECON GREEN Possessing Integral Compartments & Mixing Capability," received 1 Nov 02.

"Recirculation Jacket Carbon Filter Bed," received 18 Nov 02.

"Micro UV Dectector," received 20 Nov 02.

"Catalytic Decontamination Detoxifying C/BW Hazardous Materials for Military & Non-Military Applications," received 22 Nov 02.

"Small Quantity Toxic Material Preparation/Containment System," received 12 Feb 03.

"Batch Super Critical Water Oxidation (Batch-SCWO)," received 24 Feb 03.

"Bioprocess for the Production of Recombinant Anti-Botulinum Toxin Antibody," received 6 Mar 03.

"An Improved Method for Decontamination Adsorption Decomposition of Chemical Agents," received 15 Apr 03.

"Biological Defense Masks," received 28 Apr 03.

"Activated Vapor Treatment for Neutralizing Warfare Agents," received 8 May 03.

"Mask Leakage Test Peripheral Seal," received 15 May 03.

"Enhanced Chemical/Biological Protection," received 3 Jun 03.

"Manufacture of 120mm Cartridge that Produces White or Colored Smoke," received 5 Jun 03.

"Next Generation Chemical/Biological Mask," received 22 Jul 03.

"Dry Powder Dispersion System for the Inhalation of Emerging Chem/Bio Threat Materials," received 24 Sep 03.

TECHNICAL INDUSTRIAL LIAISON OFFICE

Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR)

Small businesses can propose new ideas to meet the military's research and development needs through the SBIR and STTR programs. Businesses with less than 500 employees are eligible to compete in these programs. Under the STTR program, the small business must team with a research institution. The DOD publishes two SBIR solicitations and one STTR solicitation every year. Each solicitation contains numerous topics addressing various research and development requirements.

The SBIR process is conducted in four steps: Phase I, Phase II, Phase II Plus, and Phase III. Phase I evaluates the scientific and technical merit, and feasibility of a novel concept during a six-month study. Phase II is the development of a prototype, while Phase II Plus expands on Phase II with an effort to meet the product, process or service requirements of a third-party investor. Phase III does not provide SBIR funding but is the commercialization of the results of Phase II in the form of a viable product or

non-research and development service for sale to military or private sector markets. Phase III is funded either privately or through a Department of Defense acquisition program. All SBIR money goes to the small business with the ultimate goal of commercializing the technical achievements of the research and development.

Recent SBIR Phase I contracts were awarded to:

- Protein Sciences Corporation for the development of a new baculovirus transfer vector which will lead to improved expression and production of proteins for biotechnology applications.

- Zaromb Research Corporation for the development of an electrostatic precipitation-based aerosol collector.

- NOVELX, Inc., for the development of a compact scanning electron microscope (SEM) with X-ray analysis capabilities for mobile homeland defense, commercial, and military applications.

- Chesapeake PERL, to improve upon technologies for the expression and manufacture of recombinant proteins in insect larvae.

- Physical Sciences, Inc., for the development of an Acoustic-Optic Tunable Filter for imaging spectroscopy in the 8 to 11micron thermal infrared spectral region. The technical objective of the effort will be to demonstrate the feasibility of the resulting imaging system for chemical and biological detection.

- Foster Miller Inc. for the development of improved infrared screening smokes using carbon nanotubes.

- Two companies (Lynntech Inc. and Calibrant Biosystems) for the development of multi-dimensional approaches to the extraction and purification of proteins. Such proteins would have applications in armor, power, soldier health and performance, and sensors.

Recent STTR Phase I contracts were awarded to:

- Seashell Technology LLC. This company has developed a surface coating method that will improve the dissemination of high aspect ratio obscurant particles.

- Srico, Inc., to develop techniques for the improved frequency conversion efficiency in shifting received 3 to 5 micron mid-wave band LIDAR signals to the 1.5 micron optical telecommunications band. Such improvements will lead to improve sensitivity of standoff chemical and biological detection systems.

- Manning Applied Technologies, to develop an optical trigger technology based on electrostatic concentration, acoustic focusing, and particle capture onto a porous substrate for optical interrogation. The proposed system will continuously monitor the air for potential biological threat agents.

- Lynntech, Inc., with support from Penn State University, for the development of a bio-fuel cell with stabilized enzymes on metallic supports.

- Seashell Technology, in conjunction with the University of California at San Diego, for the development of obscurant particles that can be designed to have peak extinction coefficients at specific wavelengths.

Recent STTR Phase II contracts were awarded to:

- Pacific Advanced Technology to develop a prototype long-wave infrared hyperspectral imaging system specifically designed to detect chemical contamination on surfaces.

- For further information regarding the SBIR/STTR programs, go to http://www.acq.osd.mil/sadbu/sbir/

Broad Agency Announcement (BAA)

The following BAA contracts have recently been awarded:

- The University of Missouri-Rolla that includes several tasks for the improvement of future obscuration systems as set forth in Objective Force goals. Specifically, the contractor will design and develop: 1) effective multi-spectral obscurant materials; 2) an improved Vehicle Engine Exhaust Smoke System; 3) modeling and simulation tools for obscurant smokes; 4) field instrumentation for smoke cloud monitoring; and 5) amphibious and lightweight aerial robotic obscurant projectors.

- Idaho State University, to demonstrate the use of high-intensity pulsed radiation for bio-agent defeat and then develop radiation-producing, high dose-rate accelerators, potentially portable, that can destroy CB agents without harming nearby materials, people, or facilities.

- 3M Company, to develop and commercialize an inexpensive and robust, hand-held sensor that can be used by military field personnel with minimal training to detect specifically and selectively low levels of biowarfare (BW) agents. 3M will combine its state-of-the-art materials and manufacturing strengths with surface acoustic wave (SAW) sensing technologies to mass-produce real-time, highly-sensitive handheld BW agent biosensors.

- Block MEMS, LLC, to develop and build an inexpensive, ultra-small, ultra-lightweight, Fourier-transformed based chemical agent point sensor.

- Institute for Systems Biology, to continue the development of a computational operating system termed Cytoscape that will make it possible to define the regulatory and physiologic networks of potential bioterrorism organisms that will be essential to identifying new diagnostic, therapeutic, and ultimately preventive strategies.

- Advanced Technologies and Applications, Inc., for software enhancements to the Frequency Agile Laser LIDAR system, which would make the instrument more user-friendly and provide an easy-to-read, real-time mapping and detection display.

- Kansas State University, to develop and conduct an exercise simulation and tabletop seminar that will explore and evaluate agricultural infrastructure and emergency capabilities in the response to and consequence mitigation of a distributed and widespread agroterrorism attack by means of a foreign animal disease.

- Georgia Institute of Technology for the development, testing, modeling, and analysis of innovative IR and multispectral obscurant materials and systems, and evaluation of the effectiveness of IR and multispectral obscurants under battlefield conditions.

- HandyLab, Inc. and Calspan-UB Research Center, Inc. will be integrating recently developed techniques for chip-based sample preparation, real-time PCR, and immunoassay with gel-pad microarrays for biological agent detection and identification in a hand-held device.

- Diversa Corporation to make use of the company's enzyme discovery and directed evolution technologies to identify catalytically efficient and stable enzymes that will detoxify all of the primary classes of chemical warfare agents.

- TNO Prins Maurits Laboratory (the Netherlands) to establish procedures and protocols for the determination of botulinum toxins in simulated real-world samples by mass spectroscopic methods.

BAA ECBC-0 4, updated from ECBC BAA 2002, is now open and available at http://www.ecbc.army.mil/about/baa2004.doc. The BAA remains open continuously and prospective contractors can submit a proposal at any time.

For additional information on the Technical Industrial Liaison Office at Edgewood, please call Commercial (410) 436-2031 or DSN 584-2031, or E-mail technical.outreach@apgea.army.mil

INTERNATIONAL COOPERATIVE R&D

The Technical Cooperation Program (TTCP) Chemical, Biological, and Radiological Defense (CBD) Group

Members of ECBC's Environmental Toxicology Team have been invited by WPNS TP-4 (Energetic Materials and Propulsion Technology) of the TTCP to provide leadership as US Army experts in the area of Environmental Toxicology and Risk Assessment for materials of military importance. Dr. Roman Kuperman has been nominated as a Key Technical Area (KTA) Lead for the KTA entitled Development of Environmental Threshold Values for Defense Sites Contaminated with Energetic Materials and Dr. Ronald Checkai is a National Co-Chair and the Army Steering Committee Representative for the USEPA-sponsored Ecological Soil Screening Levels (Eco-SSL). TTCP Panel and KTA meetings are being organized for February 2003, at the Defense Science and Technology Organization (DSTO), Edinburgh, South Australia.

US/UK/CA CBR MOU

ECBC hosted the US/UK Joint Venture Oversight Group (JVOG) in July. The JVOG has a US/UK bilateral policy and operations focus co-chaired by DUSD (TSP &CP) and DG-ISP. Approximately 40 people in various organizations responsible to policy, R&D, Medical Health Issues and Operations were involved in the meeting.

Quadripartite Working Group on Nuclear, Biological, and Chemical Defense

The final draft of Quadripartite Standardization Agreement (QSTAG) 1292 (Guidance for Supporting the Management of a Situation Involving Improvised Chemical, Biological, and Radiological Devices), developed by the U.S., was received for ratification action. It has been forwarded to TRADOC, AF, MC, and CMLS for review and completion of the ratification implementation data sheet. The aim of this QSTAG is to ensure that commanders and their staffs are familiar with the guidance that would support management of a situation involving CBR devices

The International Division hosted a U.S. Position Meeting in October, in preparation for the 17th Meeting of QWG/NBCD, which was held in Australia, in November. As part of the American, British, Canadian, and Australian (ABCA) Armies' Standardization Program, the QWG focuses on achieving standardization of equipment and concepts of use among the ABCA nations in the area of NBC Defense. Representatives from USANCA, USACMLS, NATICK, and ECBC met to review their positions on approximately 67 draft and final Quadripartite Standardization Agreements and Quadripartite Advisory Publications. The revised positions were forwarded to HQDA for approval prior to presentation at 17 QWG/NBCD.

The 17 QWG/NBCD was held in November at the Land Warfare Development Centre (LWDC), Tobruk Barracks, Puckapunyal, Victoria, Australia. The Standing Chairman, Dr. C. Davidson, opened the meeting by welcoming the delegates from U.S./UK/CA, AS, and NZ. AS Brigadier Wayne Bowen also welcomed all of the international delegates to Puckapunyal and LWDC. He confirmed the requirements and responsibilities of the QWG to transition to the new ABCA Structure. He further confirmed Australia's commitment to the conduct of the QWG/NBCD. Final agreement at this meeting was achieved on eight Quadripartite Standardization Agreements (QSTAGs) and one Quadripartite Advisory Publication. Those agreements were transmitted to the ABCA Program Office for ratification and/or promulgation action. It was unanimously agreed by QWG/NBCD that five critical high-level issues be carried forward and addressed under the auspices of the new program structure. QWG/NBCD developed a prioritized listing of critical high-level issues for migration to the new program structure to include production of a Coalition NBCD Handbook. Further, QWG NBCD developed a second listing of extant QSTAGs requiring revision within the next year to avoid ABCA Armies' use of dangerously outdated concepts and procedures. Listed in priority order, each issue must be addressed and standardization achieved to ensure coalition force interoperability and survivability in WMD environments. The U.S. delegation included U.S. Army Chemical School, Natick Soldier Center, USANCA, and ECBC representatives.

Canada/United Kingdom/United States (TEWG) Meeting

Dan Nowak attended the CAN/UK/US Test Evaluation Working Group (TEWG) meeting conducted at Defense Research and Development Canada Suffield in February. He presented the concepts and ground rules for conducting Technology Readiness Evaluation (TRE) and identified where Test Operating Procedure (TOP's) were needed to support future TRE's. The TEWG included review of the Tri-National test program and identified areas of potential cooperation. One discussion group addressed the Decontamination test requirements for future test programs and the need to develop a Tri-national Test Operating Procedure (TTOP).

Japan Science and Technology Forum

Dr. Famini attended the U.S./Japan Science and Technology Forum Working Meeting, held in Crystal City, VA in November. The meeting addressed ongoing collaboration between the U.S. DOD and JDA, and potential projects could be undertaken as collaborative projects. Dr. Famini addressed potential cooperative projects in biological detection and individual protection. In addition, Dr. Famini raised the issue of exchange of information related to demilitarization of chemical weapons. Although the U.S. and Japan have had several Data Exchange Annexes, all have expired, and the new DEA have not yet been signed by Japan. Dr. Famini raised the concern that if action is not taken by Japan soon, cooperation on issues related to the CWC might have to be suspended. Japan promised to address the issue immediately, and to discuss how the U.S. and Japan might increase cooperation on CWC related problems.

U.S. Army Sponsored Multinational Force Compatibility Conference

Members of ECBC's International Programs Division attended this conference at the Logistics Management Institute in Tyson's Corner, VA, in November. The event was hosted by the Office of the Deputy Chief of Staff of the Army, G3, for U.S. representatives to ABCA and NATO as well as RDECOM International Points of Contact. The purpose was to improve participants' understanding

of the Army's international cooperative and standardization programs and facilitate exchange/feedback on current activities.

Visits

Drs. George R. Famini and Raymond A. Mackay visited the Singapore DSO National Laboratories in August. The visit coincided with testing being conducted under the U.S./SN CB Agent Water Monitoring Project Agreement, where the project officers successfully demonstrated the use of solid phase microextraction with a field portable gas chromatograph-mass spectrometer. In addition, initial discussions were held under the newly signed PA on Chemical Suit Testing. Under DEA 1583, discussions continued on topics for future collaboration. One area discussed as promising was fate and effects. Although the SN program in this area is smaller, their focus has been on materials not currently considered by the U.S. program.

Dr. George R. Famini visited the Chung Shan Institute of Science and Technology (CSIST) in August. The purpose of this visit was to determine the possibility of collaboration between ECBC and CSIST. With the new Master Information Exchange Agreement (MIEA) being finalized, the International Technology Center-Far East requested that discussions be initiated on potential collaborative areas. Several areas in CB Defense were discussed. These will be the topic of follow-up meetings once the MIEA is implemented.

Mr. N. Yamashita and a delegation from NEC visited ECBC in September. The visit included briefings from NEC on their Miniaturization Technologies, ECBC provided overview briefings from the Technical Director' Office as well as Engineering and Research & Technology Directorates, and a courtesy visit with MG Doesburg. In addition, Mr. Smart hosted a Historical Tour. The Japanese purpose was to explore the potential for application of miniaturization technologies to systems under development at ECBC.

Mr. Ueda Naruhiko (LTG Retired, Senior Executive Director) and four others from the Defense Research Center, Japan visited ECBC in September. The visit included general briefings on ECBC.

(Ret BG) Shmuel Keren (Director), Dr. Stefan Deutsch (Directorate of International Programs & Cooperation Defense R&D), (Col. Ret.) Jacob Nagel (Acting Head of Military R&D), and Col. Tal Yeshaya (Israel Embassy) Israel, visited MG Doesburg in September.

Dr. Ang Kiam Wee and Ms. Loh Wai Leng of the Singapore DSO National Laboratories visited ECBC, Natick, AFMESA, and NSWC Dahlgren in November under the auspices of DEA 1183 between ECBC and DSO. Their visit focused on CB collective protection systems and verification. Additionally, collaborative discussions were held at Natick regarding the Protective Suit Development and Evaluation Project.

Captains Allan Hollink, Alex Thomson, and Greg Fish, of the Australian Army, visited ECBC in December. The purpose of the visit was for Australian personnel to gain a greater understanding of U.S. CB defense programs/ activities as they take on similar roles in their own military. The visit included overview briefings on ECBC, the Engineering and Research & Technology Directorates, as well as the Homeland Defense Business Unit. Additionally, the visitors toured the Process Engineering Facility.

Dr. Ronald T. Checkai, US Assistant Project Officer (US-APO) for the US/GE Environmental Technology Data Exchange Agreement (DEA-A-94-GE-1311/1520/ 1521/1522) coordinated with new German-APO LBDir Erwin Bernhard, Federal Office for Defense Technology and Procurement (BWB-AT II 1), at Julius-Leber-Kaserne, Berlin, Germany. Discussion topics included framework, working agenda, and logistics for the upcoming General Meeting of the US/GE Environmental Technology DEA, scheduled for Julius-Leber-Kaserne, in February 2004. LBDir Bernhard and Dr. Checkai will Co-Chair this technical exchange meeting of leadership and experts. APO's are the technical leaders who coordinate the efforts of the respective Technical Project Officers (TPO's) for the interrelated US/GE Environmental Technology DEA Annexes, focusing on the topics Hazardous Materials/Material Substitutes/Air Quality (1311), Soil Contamination/Remediation (1520), Water Contamination/ Remediation/Purification (1521), and Demilitarization of Conventional Weapons (1522).

Dr. Matsuo Kobayashi, Chief of the NBC Defense Section of Japan's Technical Research and Development Institute (TRDI) along with members of the Japanese Ground Staff Office, visited in January. The purpose of the visit was to continue dialog on developing closer cooperation between ECBC and TRDI in several areas of chemical and biological defense. This meeting was intended to reinforce the need for a continued exchange between the two organizations. In addition, the visit helped to identify critical areas that could benefit from a more comprehensive collaboration between TRDI and ECBC, in the form of a Cooperative R&T MOU. Specific topic areas discussed for potential cooperation include: a) Biological Detection,

b) CB Protective Suit Technologies; c) Collectors and Concentrators; and d) Standoff Detection. Each of these will be a topic for further discussion in February in Japan.

Mr. Eiji Kato, Deputy Director, along with other members of the Abandoned Chemical Weapons Office (ACW), visited ECBC/CMA in February. The purpose of the visit was for CMA to provide the ACW with informal feedback on their plans for the removal and destruction of chemical weapons left by Japan in China after WWII. The ACW and ECBC have been negotiating an agreement to facilitate exchange of information and experiences between the organizations as the Japanese continue this project. Discussions during this visit reinforced the importance of establishing a formal agreement and focused efforts on developing a bilateral MOU. Specific technical areas discussed included: a) Excavation and recovery of buried chemical munitions; b) Technologies for destroying chemical weapons; c) Health risk assessment; and d) Environmental protection and remediation.

Dr. Lee Fook Kay, Deputy Director of the Singapore Defence Medical & Environmental Research Institute (DMERI@DSO), and Ms. Sng Mui Tiang visited ECBC in February. The purpose of the visit was to discuss ongoing and potential future collaborative activities under the auspices of the US/SN Water Monitoring PA and DEA 1583. Specific technical areas discussed included low dose toxicology, CB detection and verification, agent water threat, and agent fate.

POCs: ECBC International Division, Commercial (410) 436-2552/5375, DSN 584-2552/5375, or Commercial (410) 436-5252, DSN 584-5252, and International Office-NSC, Commercial (508) 233-4218

OPERATION NOBLE EAGLE AND IRAQI FREEDOM AWARDS CEREMONY

On February 26, 2004 ECBC held an awards ceremony for it's civilians who volunteered to deploy in support of Operations Noble Eagle and/or Iraqi Freedom. We had 11 individuals who sacrificed personal comforts aside to do what had to be done in order to preserve our freedom. They were gone for relatively long periods of time and some volunteered to return for a second tour. They were in hostile environments, sometimes right behind the troops. That makes a statement about the people and about the organization.

During the ceremony, ECBC's Technical Director, Jim Zarzycki said, "If you look back at ECBC's history, you'll see that we have a tradition of doing these types of things – supporting the CB program and supporting the warfighter. This says to me that ECBC truly is a "hands on" organization. There is a slogan that we use on a lot of our briefing charts that we support "across the entire lifecycle." It is not just a slogan. It is true. This says something about how deeply committed the organization is to its mission to support the warfighter and the Chemical Biological Defense program. There is nothing more than a manager can ask for than to have a workforce that is passionate about what they do. This is exemplified by the 11 individuals we are recognizing today."

Also in attendance at the ceremony was COL Henry J. Davis, U.S. Army Research Development and Engineering Command (RDECOM) Chief of Staff. He was representing MG John C. Doesburg, Commander of RDECOM and GEN Paul J. Kern, Commander of the Army Materiel Command. COL Davis said, "Our senior leadership fully understands the contribution that ECBC is making to the nation. On behalf of senior leaders, 'thank you'."

A letter from General Larry R. Ellis was presented to ECBC that spoke of the support of our citizen soldiers, and recognized the entire Center. Mr. Zarzycki also accepted a plaque for the Center.

Following is a listing of the individual recognized.

Dr. Lynn Hoffland
Mr. Earl Austin
Mr. Michael Cain
Mr. Jude Height
Mr. Gary Doggett
Mr. Stanley Ostazeski

Individuals not present at the ceremony.

Ms. Janet Brezezinski
Mr. Stephen Lawhorne
Mr. Eric Stephens
Mr. Douglas Nichols
Mr. Michael Pena

ECBC ENGINEER SELECTED AS AMC ENGINEER OF THE YEAR

Mark Schlein (left) with Colleague

Mark Schlein of ECBC's Engineering Directorate has been selected as the winner of the prestigious Army Materiel Command's Engineer of the Year Award. The Advanced Design & Manufacturing (ADM) Team Leader was selected for this honor based on his vast achievements in engineering as well as his generous civic and humanitarian contributions.

A subject-matter expert in modeling, design, engineering, finite element/kinematic analysis, rapid prototyping and manufacturing, he has helped shape the ADM team which today provides full-service engineering support to meet the diverse engineering and manufacturing requirements of the warfighter and homeland defense community.

During his tenure at ECBC, Mr. Schlein established the Rapid Technologies Laboratory consisting of five prototyping technologies, fused deposition modeling, sterolithography, selective laser sintering, investment casings, and layered object manufacturing. He has been the driving force behind a half-dozen patents attesting to his remarkable zest for innovation. Further, under his leadership, the ADM team provided critical support during Operation Iraqi Freedom, Operation Noble Eagle and Operation Desert Storm. Assistance included accelerating preparation of technical data packages and system modification of the Skid Mounted Decontamination Apparatus M12A1, and rapid design and concurrent retrofitting of support systems and equipment for the Joint Biological Point Detection System.

He received the award in January at the National Press Club in Washington, D.C. As further tribute to Schlein's dynamic accomplishments, his nomination has been forwarded to the National Society of Professional Engineers as the Department of Army Federal Engineer of the Year nominee.

MARYLAND GOVERNOR SUPPORTS ABERDEEN MAGNET SCHOOL

Dr. Harry Salem, Chief Scientist and the Edgewood CB Center's representative to the Aberdeen Magnet School Steering Committee attended the Aberdeen High School: A Day of Celebration on September 16, 2003.

The event was highlighted by the visit and keynote address by Maryland Governor Robert Ehrlich who presented a check for $958,000 of State funding to be used to build the High School's 3rd floor for the Science and Mathematics Academy. Many State and local dignitaries were present, MG Doesburg, Commander of the Research, Development and Engineering Command, told the audience that the most important guests present were the high school students, since they are our future. He also stated the importance of science to society and the world, and that graduates of this Science and Math Academy may eventually be recruited by APG to join the world-renowned scientists already working at APG, and that some of the graduates may even go on to win the Nobel Prize. He pointed out that he too is a scientist, trained in chemistry. Scientists and mathematicians from APG would partner with the academy to give seminars and demonstrations.

Dr. Bill Richardson of the Army Alliance, and a former technical director of the Edgewood CB Center, in his remarks told the audience that they were getting a first hand lesson in civics. The culmination of 3 and a-half years of efforts by government, schools, military and private citizens working together have made this a reality. To date, in addition to the $958,000 presented by the governor, $500,000 and $750,000 have already been received from the State and Federal governments, respectively.

The Academy will revolutionize the manner in which science and mathematics are taught, and classes are slated to start as a magnet school in the fall of 2004. Qualified students in the Aberdeen area will receive a certain number of preferential spots in the school. All of the speakers, who addressed the assembly, stressed the importance of the partnerships that were established to accomplish the goal.

The concluding remarks by Donna Clem, Coordinator for the Academy, and 2003-04 Harford County Public School Teacher of the Year, who also served on the Steering Committee, stated that the students of the Academy would have access to state-of-the-art equipment and professional expertise. She concluded by thanking everyone and stated the "this has been a wonderful day".

ECBC BIDS FAREWELL TO A GREAT LEADER

ECBC, the Engineering Directorate, and the CB community at large bid farewell to a great leader. On February 1, 2004, Merlin Erickson—a man who dedicated his career to protecting the U.S. warfighter—retired from government service after 34 years.

Erickson joined ECBC as Director of Engineering in July 2000. He arrived at the Center with an ambitious plan for modernization and change, bringing with him a wealth of expertise garnered from previous positions he filled as Deputy Project Manager for NBC Defense Systems, Director of Concurrent Science and Engineering, Deputy Program Manager for Smoke and Obscurants and Deputy Program Manager for Binary Munitions.

While Erickson was recognized as a talented engineer, he will be remembered as a strong and compassionate leader. According to Joe Weinand, Engineering Directorate's acting director, Erickson made it a point to set aside time for his staff and base decisions on good judgment versus what was popular. "One of the foremost traits of a great leader is that they will do what's right when nobody is looking...Merlin made it a habit to do the right thing...with no expectation of glory, promotion, or praise, " said Weinand.

This remarkable spirit of doing the right thing inspired Erickson to enter into public service. At a directorate gathering Erickson once recounted the story of an uncle who while on duty in Hawaii, was present the day the Japanese bombed Pearl Harbor. According to Erickson, his uncle's unit had guns but no bullets to fire and protect their fellow countrymen with while under attack. Taking his uncle's angst and frustration to heart, Erickson swore he would do everything humanly possible to ensure history would not repeat itself.

True to his word, Erickson has dedicated his career to ensuring the warfighter is best equipped to handle even the most dangerous situations. While at ECBC he saw the redesign of the M12A1 decontamination system deployed to Iraq in six short months. In the days just after the September 11, 2001 terrorist attacks, ECBC was sought out by virtually every domestic agency to provide chemical and biological defense assistance, Erickson led the Engineering Directorate in meeting that need.

During his dinner U.S. Army Research, Development and Engineering Commander, Major General John C. Doesburg, presented Erickson the Exception Civilian Service Award in recognition of his 38 years of government service. "It is my distinct honor and privilege to recognize Merlin," said Doesburg. "Tonight, we came to say farewell, but more importantly, thank you." Brigadier General Steve Reeves, former Program Manager of NBC Defense during Erickson's tenure as the Deputy Program Manager, regaled Erickson as a person who "doesn't pull his punches; someone of absolute integrity", a description echoed throughout the evening in presentations honoring Erickson's many career achievements. ECBC's Technical Director, Jim Zarzycki, presented Erickson with congratulatory letters from Senators Barbara Mikulski and Paul Sarbanes, an official citation from Governor Robert Ehrlich, and a personal letter of thanks from President Bush. Colonel Debra Thetford also presented a letter of thanks on behalf of Brigadier General Pat Nilo, the US Army Chemical School Commander, who was unable to attend the event.

In honor of Erickson's departure and the invaluable mark he has made upon the Engineering Directorate, the team has initiated an award dedicated to staff who exemplify Erickson's spirit of tackling even the least rewarding job. Called the "Doer of Deeds Award," recipients will have their name engraved on a plaque displayed within the Engineering Directorate. Of course the first recipient entry will read, "Merlin L. Erickson, January 2004."

PEOPLE

ECBC GARNERS THREE AMC GREATEST INVENTIONS OF 2002

AMC announced its ten winners for the "AMC's Greatest Inventions of 2002". Of the ten winning inventions, three of the winning inventions were developed by ECBC scientists and engineers. The winning ECBC inventors are: Automated Biological Agent Testing System (ABATS), Dr. Peter A. Emanuel; Biological Attack Warning System (BAWS), Team Members: Dr. Richard R. Smardzewski, Mr. David W. Sickenberger, Mr. Felix L. Reyes, Mr. J. Michael Cress, and Ms. Karen L. Vado; and Advanced Chemical-Biological Mask, Team Members: Mr. Corey M. Grove, Mr. Stephen E. Chase, and Mr. William M. Fritch, Jr. Winners of the "AMC's Greatest Inventions of 2002" were recognized by GEN Kern and LTG Cody in a November awards ceremony at Fort Belvoir, VA. Congratulations, ECBC inventors!

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) COMMITTEE

Elaine Stewart-Craig is a charter member of a new ASTM Committee, E54 on Homeland Security Applications. The scope of this committee is to develop standards and guidance materials for homeland security applications and coordinate existing ASTM standardization related to homeland security needs. This coordination will include the apportioning of specific requests for homeland security standards throughout ASTM's existing committee base.

ECBC CHIEF SCIENTIST PARTICIPATES IN BRIEFING TO CONGRESSMAN GREENWOOD

Dr. Harry Salem, ECBC Chief Scientist, and a member of the Society of Toxicology's Regulatory Affairs and Legislative Assistance (RALA) Committee participated in a Congressional Information Briefing for Congressman Jim Greenwood in September. The topic of the brief was "The West Nile Virus and Public Health". Congressman Greenwood commented on the importance of this issue, and the potential risk of exposure to pesticides being used to respond to the West Nile Outbreak. The objective of RALA Congressional Information Briefings is to promote the use of sound silence in policy decision-making.

ECBC HAS FEB FINALISTS

The Baltimore Federal Executive Board has notified ECBC that the following individuals well be recognized during their Excellence in Federal Career Awards Luncheon in May:

Gold/Silver Finalists:

Frank Evans, *Outstanding Supervisor Grades 12 & Below*
Dr. George Wagner, *Outstanding Professional, Technical, Scientific & Program Support*
Elizabeth Tedpahogo, *Outstanding Clerical*
Karen Heroux, *Rookie of the Year Professional*

Bronze Winners:

Thomas Rosso, *Outstanding Supervisor Grades 13 & Above*
John Scwarz, *Outstanding Par-Professional, Technical, Scientific & Program Support*
Melanie Pender, *Outstanding Clerical*
Kenneth Leaf, *Outstanding Trades or Crafts Employee*
Deborah Menking, *Outstanding Professional (non-Supervisory)*

ONSITE — 2004 TWELFTH INTERNATIONAL CONFERENCE ON-SITE ANALYSIS®...the lab comes to the field℠ with SamPrep℠ CONFERENCE & EXHIBITION

by Monica J. Heyl

Ms. Monica Heyl of the Mobile Labs & Kits Team, ECBC, was the chairperson of the On-Sight Scientific Board and the lead for this year's conference, which was held in Arlington, VA, in January 2004. This forum provides an opportunity for the people who are the foundation of Field Analysis to meet with colleagues, share in discussions, give input, and get ideas for the future well being of the industry. The continued drive for micro/miniaturization, portability and rugged construction impervious to ambient factors is of paramount importance for field analytical instrumentation. The analytical instrument is becoming more sophisticated, yet simpler to use, versatile, and more rugged. Since 1986, these conferences have generated the enthusiastic response that has resulted in the creation of this international meeting of manufacturers, researchers, and end-users.

- Ms. Heyl welcomed the participants to the conference and opened the Plenary session on Tuesday morning. The Plenary speakers and their topics included:

- Dr. Benjamin Garrett, FBI Laboratory Division, Hazardous Material Response Unit, "Case of Mistaken Identity: The Perils of OnSite Analysis."

- Dr. Bob Brackett, Food and Drug Administration, "The FDA Role in Counter Terrorism."

- Ms. Diane DiPetro, USDA Homeland Security, "The USDA Homeland Security Overview."

- Dr. John Vitko, Department of Homeland Security, "Department of Homeland Securities Initiatives."

- Dr. Dennis Reutter, ECBC Forensic Analytical Center, chaired the session on Chemical Agent Detection. Topics of other sessions included Technologies Supporting Homeland Security; Biological Agent Detection; Analysis, Resources and Availability from the Responder's Perspective; Environmental Chemistry/Site Remediation; Chemical/Biological Sensors and Electronic Noses for Homeland Security; Chemical/Biological Terrorism – Drug Analysis; and Successful ON-SITE Assays/Analyses.

Over 60 exhibits were set up in the Grand Ballroom, and on Wednesday a poster session was held in the exhibit hall. The Defense Threat Reduction Agency for Chemical and Biological Defense and the U.S. Army Research, Development and Engineering Command were co-sponsors for OnSite'04.

AN EDGEWOOD INVASION OF THE 2003 JOINT SERVICE SCIENTIFIC CONFERENCE ON CHEMICAL AND BIOLOGICAL DEFENSE RESEARCH

ECBC was well represented at this year's Joint Service Scientific Conference on Chemical and Biological Defense. Jim Zarzycki, ECBC Technical Director, kicked off the meeting with an opening presentation on recent accomplishments in the CB defense arena. Center scientists played significant roles during the event chairing 6 out of 13 sessions.

Sharing the Center's broad sweeping expertise in CB defense, ECBC presenters briefed the audience on topics including standoff detection, collective protection, threat agent properties, advancements in aerosol science, toxicology and decontamination. In addition, staff co-authored more than 6 subsequent presentations and took part in over 33 poster sessions.

The annual Joint Services Scientific Conference on CB Defense Research is a critical meeting of key scientists and decision-makers in CB defense and homeland security. By sharing at the event the Center's wealth of expertise in CB detection, protection and decontamination, ECBC not only furthered the Center's mission to protect the warfighter, but also more firmly established the Center as a premier leader in CB defense.

SYMPOSIA

In September

Dr. Paul Fedele and Ms. Elaine Stewart-Craig presented and answered questions about US Army test methods for chemical protective clothing at the ***Fall 2003 American Chemical Society National Meeting***, in New York City, NY. The invited presentation supports efforts to develop standards for personnel protective equipment for first responders who may face terrorism involving chemical or biological warfare agents. The symposium was chaired by Dr. James Ziegler, of DuPont, and provided an opportunity for researchers and first responders to exchange information on first responder needs and new equipment development.

Dr. Paul Fedele, presented details of the Military Improved Response Program report, "Risk Assessment of Using Firefighter Protective Ensemble with SCBA for Rescue Operations during a Terrorist Event," at the ***Seventeenth Biennial Symposium on the Occupational Heath Hazards of the Fire Service***, sponsored by the IAFF, in San Francisco, CA.

Dr. Dennis Reutter and Dr. Lynn Hoffland attended the ***"Workshop on Analysis of Chemicals Related to the Chemical Weapons Convention."*** The conference offers a free exchange of information and strategies used to perform OPCW Proficiency Tests and are used by the OPCW to help train the Laboratory staff of Nations that would like to become OPCW "Designated" for sample analysis.

Ms. Dorothea Paterno and Mr. Michael Williamson recently attended the ***Third European Symposium on Aerobiology (TESA)*** held at University College, Worcester, UK. TESA has delegates from 26 countries, mostly within Europe. There was an informative discussion with the delegates that revolved around new sampling techniques and data archiving. Future collaboration was established with a member of the Royal Society's Detection and Decontamination of Chemical and Biological Working Group.

Mr. Bill Loerop, Ms. Cynthia Swim and Dr. Steve Harden were invited to speak at the ***Chemical Biological Detection Symposium*** that was a preliminary to the ***Federal Biological-Chemical Detection Conference.*** Mr. Loerop and Ms. Swim spoke on Stand-Off Detection technologies and technologies that are emerging through the Technical Base Program; Dr. Harden spoke on fundamentals of science and technology of chemical detectors based on Ion Mobility Spectrometry technology.

In October

Dr. Ronald T. Checkai, of ECBC's Environmental Toxicology Team, was an invited speaker for the ***Symposium on Department of Defense Training Ranges and Munitions Constituents,*** at ***The 19th Annual International Conference on Soils, Sediments and Water,*** at the University of Massachusetts, Amherst. Dr. Checkai spoke on the topic of incorporating Bioavailability and Soil Boundary Conditions into the Ecological Soil Screening Level (Eco-SSL) process for Ecological Risk Assessment, and research efforts by the Environmental Toxicology Team on developing benchmark values for metal toxicity to soil invertebrates. Dr. Checkai is the U.S. Army Eco-SSL Steering Committee Representative and a National Task Group Co-Chair for the National Eco-SSL effort, which represents a collaboration among the U.S. Environmental Protection Agency (USEPA), U.S. Department of Defense (DoD), U.S. Department of Energy (DOE), States, universities, and industry.

A ***NATO Advanced Research Workshop "Emerging Biological Threat"*** was held in Budapest, Hungary. Dr. Akbar Khan, of ECBC's Research and Technology Directorate, was the co-director. A total of 40 scientists participated in the workshop from 10 different countries. Scientists from both medical and non-medical commands of the US Army presented their seminars on this important subject. Dr. Raymond Mackay, Director of Research and Technology, chaired and presented a special seminar on status of emerging chemical threats. Dr. Khan also chaired and presented a seminar on "biological toxins and super-antigens as an emerging biological threat". The sponsors were NATO, Army Research Office, US Navy, Baxter Vaccines, and Hungarian Society of Microbiology.

Dr. Akbar Khan attended and presented an invited lecture on "Microarrays for Detection and Diagnostics" at the ***13th Hungarian Society of Microbiology in Hungary.***

At the invitation of COL (P) Lillie, Commandant of the U.S. Army Chemical School, Dr. Sharon Reutter presented a briefing on "Animals as Detectors" at the ***2003 Chemical Warfighter's Conference*** at Fort Leonard Wood.

Several of ECBC's Laser Standoff Detection (LSD) Team personnel chaired, presented at, and/or attended ***SPIE Conferences on Chemical and Biological Point Sensors for Homeland Defense and Chemical and Biological Standoff Detection,*** held in Providence, RI. The Keynote speaker was LTC John Carrano who is the head of DARPA's Semiconductor Ultraviolet Optical Sources (SUVOS) program. Other presentations included work on surface-enhanced Raman for homeland defense, FTIR sensors for WMD detection, a personal alarm monitor for first responders, and the collection of fluorescence spectra of ambient aerosols. The conference chairs were Arthur Sedlacek III (BNL), Steven Christesen (ECBC), Richard Colton (NRL), and Tuan Vo-Dinh (ORNL). The Standoff Detection Conference included sessions on Instrumentation, Biological Aerosols, and Contaminants on Surfaces. Anna Wong, ECBC, was the Surface session chair. Cynthia Swim and Richard Vanderbeek, ECBC, were authors of papers on an all-solid-state LWIR laser source and backscatter measurements of aerosolized CB simulants in a novel vortex chamber, respectively. A presentation entitled "Remote Detection of Biological Aerosols at a Distance of 3 km with a Passive Fourier Transform Infrared (FTIR) Sensor," by Dr. Avishai Ben-David and Dr. James O. Jensen, was present by Dr. Jensen. The paper presented measurements taken at Dugway Proving Ground (07/02) and analyzed with hyperspectral detection, identification and estimation algorithm. The results are encouraging as they suggest for the first time (to the authors' knowledge) the feasibility of detecting biological aerosols with passive FTIR sensors. The conference proceedings will document all of the presentations, and will be published by SPIE in the near future.

In November

An invited talk entitled "Surface-enhanced Raman Detection of Chemical and Biological Agents in Water" was presented by Dr. Steven Christesen at the ***2003 FACSS Conference*** in Ft. Lauderdale, FL. The presentation was part of the session on Enhanced Raman Spectroscopy for Bioanalytical Applications chaired by Dr. Nick Fell of the Army Research Lab. The Joint Services Agent Water Monitor (JSAWM) Program funded the research presented.

Dr. Salem, ECBC's Chief Scientist, presented an invited seminar entitled "The Water We Drink - Is it Safe?" at the ***U.S. Army Center for Health Promotion & Preventive Medicine.*** Drs. Harry Salem, (ECBC), Gargan (CEHR), Burrows (CHPPM), Christopher Whalley, (ECBC), and Charles Wick, (ECBC), authored the presentation.

ECBC's Operational Toxicology Team member, Dr. Christopher Whalley gave an invited presentation to a ***National Research Council (NRC)*** ad-hoc committee tasked to provide technical guidelines for the development of standards and policies for decontaminating public facilities affected by exposure to harmful biological agents. This committee's effort is sponsored by the Department of Homeland Security and Lawrence Livermore National Laboratory. Dr. Whalley's presentation, entitled "Infectious Doses", was presented at the ***Keck Center of the National Academies*** in Washington D.C. One key effort of this committee is to establish doses associated with a range of infection levels and to describe how these data could be used to assist in establishing acceptable levels of decontamination for selected organisms. This was the first meeting of this committee and the efforts of this and other speakers will allow the committee to put its task into perspective.

Dr. Ronald T. Checkai of ECBC's Environmental Toxicology Team, gave an invited presentation at the ***2003 Annual International Conference on Soils Sediments and Water,*** at the University of Massachusetts, Amherst. Dr. Checkai was invited to speak in the DoD Session on Training Ranges and Munition Constituents: Challenges and Solutions. Dr. Checkai's technical presentation was entitled Bioavailability and Soil Boundary Conditions for Ecological Soil Screening Levels: Benchmarks for Metal Toxicity to Soil Invertebrates.

Members of ECBC's Environmental Toxicology Team provided professional leadership in a variety of roles at the ***Annual Meeting of the Society of Environmental Toxicology and Chemistry (SETAC),*** in Austin, Texas. Dr. Ronald T. Checkai, Dr. Roman G. Kuperman, Dr. Michael Simini, Mr. Mark V. Haley, Mr. Carlton T. Phillips, Ms. Nancy Chester, Mr. Jan Kolakowski, and Mr. Steve Anthony, authored six technical presentations on the fate and ecotoxicological effects of militarily important materials in both terrestrial and aquatic environments, and environmental chemistry. In addition, Dr. Kuperman Chaired the Contaminated Soils Work Group and a Technical Session, Dr. Checkai (founder) and Dr. Simini (Co-Chair) provided leadership for the SETAC Liaison

Representatives to corresponding professional societies; and Dr. Checkai as a member of the Editorial Board met to address technical issues for SETAC's International Journal, and coordinated a meeting of the Tri-Service Ecological Risk Assessment Work Group (TSERAWG).

The Molecular Engineering Team recently presented the following posters at the ***2003 Joint Service Scientific Conference on Chemical and Biological Defense Research*** in Towson, MD: "A 1000-L Scale-up Fermentation of Escherichia coli Containing pVSEOP7 for Production of Organophosphorus Hydrolase", Dennis C. Lukens; "Production and Validation of an IgM Antibody for the Detection of Spore-Forming Bioagents", Jun T. Park, Ameneh M. Arasteh, Frank J. Kragl, Sumi Chung, Darrel Menking, Kevin P. O'Connell, and James J. Valdes; "In Vitro Toxicology Validation Study", Cheng J. Cao, Janna Madren-Whalley, Chundakkadu Krishna, and James J. Valdes. The Biotechnology Team presented the following posters at the conference: "Catalytic Buffering: Development of Fluoride-resistant Klebsiella pneumoniae Ureases", Ilona J. Fry and Joseph J. DeFrank; "Compatibility of CW Agent Degrading Enzyme with Disinfectants", Tu-chen Cheng, Vipin K. Rastogi, Steven P. Harvey, Abraham L. Turetsky, and Joseph J. DeFrank; "Natural Products as Environmentally Benign Biological Warfare Agent Decontaminants", Abraham L. Turetsky, Ilona J. Fry, Diane L. Dutt, and Jerry W. Pfarr.

In December

Dr. Roman Kuperman, ECBC Environmental Toxicology Team, presented the program-final briefing on the Development of Ecological Toxicity and Biomagnification Data for Explosives Contaminants in Soil (SERDP CU-1221) to members of ***Strategic Environmental Research and Development Program (SERDP) and Environmental Security Technology Certification Program (ESTCP), and the SERDP/ESTCP Review Committee.*** This report summarized details of the research efforts and results generated by the Environmental Toxicology Team on the ecotoxicity of the energetic materials (EM) RDX, HMX, 2,4-DNT, 2,6-DNT, and TNB in soil. This briefing culminated a three-year research effort investigating the toxicity and bioaccumulation potential of these EMs in soil receptors, including plants and invertebrates. The project generated Toxicity Benchmarks that will be used for developing Ecological Screening Levels (Eco-SSL) for explosive contaminants in soil. The plant-based Toxicity Benchmarks for nitroaromatic EMs have been successfully transitioned to the U.S. Environmental Protection Agency for review and Eco-SSL development. Once approved, these Eco-SSLs can be used in Ecological Risk Assessment at Superfund sites nationwide.

ECBC's Environmental Toxicology Team, co-authored eight research presentations at the ***2003 Partners in Environmental Technology Technical Symposium & Workshop,*** in Washington, DC. Their technical presentations covered a wide range of topics concerning SERDP-funded ECBC research programs, including ecotoxicity, bioavailability and bioaccumulation of contaminant explosives in soil. The Symposium was co-organized by SERDP and the Environmental Security Technology Certification Program (ESTCP). SERDP is the DoD Corporate Environmental R&D Program that is planned and executed in partnership with the Department of Energy (DOE) and U.S. Environmental Protection Agency (USEPA).

In January

Dr. Harry Salem represented DoD at the ***Interagency Coordinating Committee on the Validation of Alternative Methods (ICCVAM) Strategic Planning Meeting*** that was held at the National Institutes of Health in Bethesda, Maryland. DoD is one of 15 federal agencies that provided 47 representatives to the committee. DoD's participation is a Congressional requirement of the National Defense Act of 1993 that directs the Secretary of Defense to establish aggressive and targeted programs to replace, reduce and refine current uses of animals (H. Report 102-527; 102D, 2nd Cong. Session). The Strategic Planning Meeting was held to define the challenges, future direction, strategic priorities, key objectives anticipated over the next 3 years, and a road map to address these.

Dr. Christopher Whalley participated in a Department of Homeland Security (DHS) and National Research Council (NRC) sponsored ***Workshop on Standards and Policies for Decontaminating Public Facilities Affected by Exposure to Harmful Biological Agents*** in Washington, D.C. The NRC committee elected to host the present workshop which focused on four main themes: 1) the biology and infectivity of harmful biological agents; 2) detection and environmental assessment; 3) risk assessment; and 4) public health. The NRC committee hopes that the open discussion involving all participants will expose the committee members to a diversity of perspectives that would shape their findings and recommendations. The NRC committee will author a final report to be delivered to the DHS later this year.

Upcoming

A paper entitled, "Ion Mobility Spectrometry (IMS) for Real Time Chemical Agent Detection, Identification and Quantification in the Air and on the Ground" by Vince McHugh, Gretchen Blethen, and Brian Ince, CB Point Detection Team, and by Steve Harden, Rob Schafer, and Stephen Harper, Geo-Centers, Inc., has been accepted for presentation at the ***8th International Symposium on Protection Against Chemical and Biological Warfare Agents*** in Gothenburg, Sweden, 2-6 June 2004. The paper is a synopsis of the results of ECBC development and field testing of a chemical detection and identification system, called SPIDER (Spectrometric Point Ionizing Detector Expendable/Recoverable) that is the payload of a mini-UAV designed to penetrate chemical vapor plumes in the atmosphere.

PUBLICATIONS

BOOKS, JOURNALS AND MAGAZINE ARTICLES

Frontline First Responder published a Homeland Defense Business Unit article in its September issue. The article, titled "It Takes a Community: The Army's Integrated Bioterrorism Response Model," describes the major consequences of biological terrorism and suggests a number of emergency response strategies. The article was co-authored by Robert M. Gougelet, MD, assistant professor of emergency medicine at Dartmouth Medical School, and Dr. Mohamed Mughal of ECBC's Improved Response Program.

A manuscript entitled "Detection, Identification, and Estimation of Biological Aerosols and Vapors with a Fourier-Transform Infrared Spectrometer," by Avishai Ben-David and Hsuan Ren, was published in the **Journal of Applied Optics** (Appl. Opt. 42, 4887-4900, 20 August 2003). Hyperspectral algorithms based on radiative transfer theory and statistical signal processing methods were developed to address the problem of detecting aerosol clouds and measuring small quantities of chemical vapors with a passive Fourier-Transform Infrared (FTIR) spectrometer. The algorithms were applied successfully in two experiments: (1) to detect and identify Bacillus subtilis var. niger (BG) bio-aerosol spores and kaolin dust at a 50 m distance in an open-air release, and (2) to measure the time-dependent concentration of a small amount of TriEthyl Phosphate (TEP) vapor in a closed chamber. In the algorithms a subspace orthogonal projection operator is used to statistically "subtract" the large thermal background contribution to the measurements and a robust maximum likelihood solution is used to deduce the target (aerosol or vapor cloud) spectrum and estimate its mass-column concentration. A Gaussian-mixture probability model for the deduced mass-column concentration is computed with an expectation-maximization algorithm to produce the detection threshold, probability of detection and probability of false alarm.

A paper entitled "Detection And Identification Of Bacteria Using Direct Injection Inductively Coupled Plasma Mass Spectroscopy" by Dr. Steve Lev and Dr. David Schaefer (both from Towson University), and Dr. Amnon Birenzvige, ECBC, was accepted for publication in Talanta. The work was funded from the Towson University Summer Intern Study Program.

Ms. Ann Butrow, of ECBC's Agent Chemistry Team and Dr. Rickey Seyler, Kalbsey Corp. published a paper entitled "Vapor Pressure by DSC: Extending ASTM E 1782 below 5 kPa" in **Thermochimica Acta** (Vol. 402, p. 145). The paper describes efforts to optimize experimental parameters for measurement of vapor pressure using differential scanning calorimetry at pressures below the current lower limit of the ASTM method. Increasing the pressure range over which accurate data can be generated will improve our capability to meet customer program needs.

Dr. Roman Kuperman, of ECBC's Environmental Toxicology Team, co-authored a book chapter on assessing risks to biological receptors from chemicals in soil. This book resulted from the Pellston Workshop on Assessment of Contaminated Soils. It provides in-depth review and critical appraisal of scientific subjects relevant to understanding the impacts of chemicals on soil ecosystems. The complete reference is: Wentsel, R.S., Beyer, W.N., Edwards, C.A., Kapustka, L.A., and Kuperman, R.G. (2003), "Effects of Contaminants on Soil Ecosystem Structure and Function." Pp. 117-159. In: Contaminated Soils: From Soil-Chemical Interactions to Ecosystem Management (R.L. Lanno, Ed.). SETAC Press.

An article entitled, "Evaluation of in vitro Methods for Monoclonal Antibody Production" was published in the **Bioprocessing Journal**, 2003, 2, 49-56. The authors were Dr. Jun T. Park, Dr. Cheng J. Cao, S.J. Cork, Dr. Kevin P. O'Connell, Darrel E. Menking, T. Coliano and Dr. James J. Valdes.

A paper, "Selection and Characterization of Peptide Mimotops Binding to Ricin", was published in **Biotechnology Letters**, 2003, 25 (19), 1671-1675. The authors were Dr. Akbar Khan, Dr. Cheng J. Cao, Roy G. Thompson and Dr. James J. Valdes.

A manuscript entitled "Sequencing Batch Reactor Biodegradation of Hydrolyzed Sarin as Sole Carbon Source" co-authored by Dr. Steven P. Harvey, Laurie F. Carey, Paul C. Bossle, Nicholas D. Gillitt, and Clifford A. Bunton has been accepted for publication in the **Bioremediation Journal**. The manuscript details the hydrolysis of sarin, its subsequent biodegradation in a sequencing batch reactor, aquatic tox analysis of the effluent, and the immobilization of methylphosphonic acid in Phoslock.

The November issue of the journal, **Structure**, has published the article entitled "Bacteriophage MS2: Molecular Weight and Spatial Distribution of the Protein and RNA Components by Small-Angle Neutron Scattering and Virus Counting." The paper was the result of the joint study conducted by Dr. Deborah Kuzmanovic (Geo-Centers, Inc. - formerly NIST), Dr. Ilya Elashvili (R&T Dir, Biotechnology Team), Dr. Charles Wick (R&T Dir, Point Detection Team), and NIST scientists. Two major findings are: (1) Small Angle Neutron Scattering (SANS) confirmed that the Integrated Virus Detection System (IVDS) developed by Dr. Wick at ECBC is an accurate means of counting virus particles, and (2) The combination of the IVDS and SANS creates a novel tool for the identification and classification of unknown viruses.

Members of ECBC's Environmental Toxicology Team authored a research paper, "Manganese toxicity in soil for Eisenia fetida, Enchytraeus crypticus (Oligochaeta), and Folsomia candida (Collembola)," which was published in **Ecotoxicology and Environmental Safety**. The U.S. Environmental Protection Agency in conjunction with stakeholders, is developing Ecological Soil Screening Level benchmarks for contaminants most frequently found at Superfund sites. Scarcity of available published information about Mn toxicity to soil invertebrates necessitated the study to fill this knowledge gap. This project will produce benchmark data for the development of an Eco-SSL for Mn for soil invertebrates and had to meet specific criteria defined by Environmental Protection Agency.

The book, "Riot Control Agents, Issues in Toxicology, Safety, and Health", edited by Dr. Eugene Olajos (ECBC) and Dr. Woodhall Stopford (Duck University) has been recently published (**CRC Press**, January 2004). The book provides information regarding the history, chemistry, biology and medical aspects of Riot Control Agents and will serve as an authoritative resource on the subject.

An article "Genomics, Proteomics and Conputational Toxicology as Future Tools in Assessing the Health Hazards of Riot Control Agents" has been published in the book entitled, "**Riot Control Agents: Issues in Toxicology, Safety, and Health** (CRC Press, January 2004)."

TECHNICAL REPORTS

Published technical reports, when available, should be requested from the Administrator, Defense Technical Information Center, ATTN: DTIC-FDRB, 8725 John J. Kingman Road, Ste 0944, FT Belvoir, VA 22060-6218.

Report No.	Title	Author(s)
ECBC-CR-062	Field-Deployable Chemical Point Detection Network, October 2003, UNCLASSIFIED - public release.	C. Pennington
ECBC-SP-015	Proceedings of the 2002 Joint Service Scientific Conference on Chemical & Biological Defense Research, 19-21 November 2002, July 2003, UNCLASSIFIED - public release.	D. Berg
ECBC-TN-015	Characteristics, Sampling Efficiency, and Location of Aerosol Losses of the Navy's Interim Biological Agent Detector System (IBADS), September 2003, UNCLASSIFIED - limited.	J. Kesavan A. Hottell
ECBC-TR-277	Decontamination Efficacy of FAST-ACT (Phase I, Test Service Agreement Project No. 0219T), March 2003, UNCLASSIFIED - limited.	P.W. Bartram J.T. Lynn

ECBC-TR-278	Decontamination of Contaminated Topical Surfaces with Adsorbents and Adsorbent in Solvent Slurries, April 2003, UNCLASSIFIED - limited.	P.W. Bartram J.T. Lynn
ECBC-TR-283	Non-Lethal Capability Set Protective Equipment Vulnerability Study Over the Temperature Range of 50 to 120 F, April 2003, UNCLASSIFIED – limited.	D.J. Weber J.W. Molnar
ECBC-TR-285	A 1000-L Scale-Up Fermentation of Escherichia Coli Containing pVSEOP7 for Production of Organosphosphorus Hydrolase, July 2003, UNCLASSIFIED – limited.	M.H. Kim D.C. Lukens V.K. Rastogi T-C. Cheng J.J. DeFrank J.J. Valdes
ECBC-TR-291	Biodegradation of Hydrolyzed Mustard from an ACWA Projectile Washout Study, August 2003, UNCLASSIFIED - public release.	M.A. Guelta L. Fazekas-Carey
ECBC-TR-294	Physical Property Data Review of Selected Chemical Agents and Related Compounds: Updating Field Manual 3-9 (FM 3-9), September 2003, UNCLASSIFIED - public release.	P.A. Abercrombie
ECBC-TR-296	Test Results of Phase 3 Level B Suits to Challenge by Chemical and Biological Warfare Agents and Simulants: Summary Report, July 2003, UNCLASSIFIED - public release.	R.S. Lindsay S.A. Procell F.C. Baldauf A.G. Pappas
ECBC-TR-301	Test Results of Phase 3 Level A Suits to Challenge by Chemical and Biological Warfare Agents and Simulants: Summary Report, August 2003, UNCLASSIFIED – public release.	R.S. Lindsay S.A. Procell F.C. Baldauf A.G. Pappas
ECBC-TR-302	Decomposition Kinetics of Chemical Agents on FAST-ACT (Phase II, Test Service Agreement 0219T) September 2003, UNCLASSIFIED – limited.	P.W. Bartram J.T. Lynn
ECBC-TR-306	Chemical Filtration Performance of a PTSA System Phase I; Chloroethane, Cyanogen Chloride, Ammonia and 2-Chlorethyl Ethyl Sulfide Pulse Testing, July 2003, UNCLASSIFIED – public release.	J. Mahle W. Gulian D. Mancinho L. Buettner
ECBC-TR-308	Evaluation of An Optical Imager As a Detector For Chemical Munitions, September 2003, UNCLASSIFIED – public release.	B. Nelson A. Birenzvige W.J. Underwood
ECBC-TR-309	Determining the Extent of Reaction of Soman on Core-Shell Metal Oxides, Quantification by Fournier Transform Infrared Spectrometry, September 2003, UNCLASSIFIED - limited.	P.W. Bartram J.M. Lochner

ECBC-TR-310	High Energy & Chemical Blast Analysis August 2003, UNCLASSIFIED – limited.	R. Redmond P. Walter A. Birenzvige
ECBC-TR-312	Test Results of Phase 3 Level A Suits To Challenge by Chemical and Biological Warfare Agents and Simulants: Executive Summary, August 2003, UNCLASSIFIED - public release.	R.S. Lindsay A.G. Pappas
ECBC-TR-313	Derivation of the Chemical Agent Vapor, Aerosol and Rain Threat for the Artemis, September 2003, UNCLASSIFIED - public release.	M.S. DeSha
ECBC-TR-314	Supercritical Carbon Dioxide Interaction with Polymeric Materials: Desorption Diffusion Coefficient Measurement, September 2003, UNCLASSIFIED - public release.	B.S. Ince W.J. Shuley
ECBC-TR-316	Thermal Swing Adsorbtion Studies for Air Purification, July 2003, UNCLASSIFIED – limited.	J.J. Mahle D.K. Friday
ECBC-TR-318	Computational Studies on Adamsite, June 2003, UNCLASSIFIED - public release.	W.E. White
ECBC-TR-323	Infrared Spectroscopic Observations on the Fate of Organophosphorus Compounds Exposed to Atmospheric Moisture, Part I. G-Agents and Related Compounds, July 2003, UNCLASSIFIED – public release.	R.J. Piffath
ECBC-TR-333	Development of an Objective Method of Respiratory Protective Mask Lens Fogging: Data Acquisition and Image Processing Proof of Concept, August 2003, UNCLASSIFIED - public release.	D.M. Caretti K.M. Coyne
ECBC-TR-335	Inhalation Toxicity of GF Vapor in Rats as a Function of Exposure Concentration and Duration and Its Potency Comparison to GB, August 2003, UNCLASSIFIED - public release.	J.S. Anthony M.V. Haley J.H. Manthei R.A. Way D.C. Burnett B.P. Gaviola D.R. Sommerville R.B. Crosier R.J. Mioduszewski S.A. Thomson C.L. Crouse K.L. Matson
ECBC-TR-336	Hydrolysis of Levinstein Mustard (H), August 2003, UNCLASSIFIED – public release.	D. Rohrbaugh G. Wagner K. Sumpter S. Harvey

ECBC-TR-337	Mathematical Limits on Differences Between a Population and a Subpopulation, August 2003, UNCLASSIFIED - public release.	R.B. Crosier
ECBC-TR-338	Domestic Preparedness: Protection Factor Testing of the 3M Breathe Easy (BE-10) Powered Air Purifying Pressure Respirator (PAPR), September 2003, UNCLASSIFIED - public release.	A.D. Seiple A.G. Pappas
ECBC-TR-339	Hydrolysis of Lewisite: Theoretical Analysis of Possible Products, August 2003, UNCLASSIFIED - limited.	W.E. White
ECBC-TR-340	Advanced Incendiary Tool, December 2003, UNCLASSIFIED – limited.	E. Song G.V. Tracy J.A. Domanico
ECBC-TR-341	Use of Acoustic and Seismic Sensor for CB Detection and Early Warning, December 2003, UNCLASSIFIED – limited.	C. Reiff M. Fargues D. Gonski A. Birenzvige
ECBC-TR-342	Use of Magnetic Bead Resin and Automated Liquid Handler Extraction Methods to Robotically Isolate Nucleic Acids of Biological Agent Simulates, September 2003, UNCLASSIFIED – public release.	T.C.M. Seegar P.A. Emanuel A.M. Bailey I. Fruchey
ECBC-TR-343	Concept Development for Next Generation General Purpose Mask (Phase 1), September 2003, UNCLASSIFIED - limited.	C.M. Grove S.E. Chase
ECBC-TR-348	Evaluation of Chemical Protective Mask Leakage Test Devices, September 2003, UNCLASSIFIED - limited.	M. Goodman R. Kuhns B. Witherspoon L. Saubier K. Shirakawa
ECBC-TR-349	Review and Recommendations for Human Toxicity Estimates for FM 3-11-9, September 2003, UNCLASSIFIED – limited.	S. Reutter L. Miller, Jr. D. Sommerville
ECBC-TR-350	Pentavalent Arsenic Compounds: Potential Chemical Warfare Considerations, November 2003, UNCLASSIFIED - limited.	W.E. White

Return Address:
EDGEWOOD CB CENTER
AMSSB RAS B BRUCKSCH E3330
5183 BLACK HAWK RD
APG MD 21010-5424

STANDARD
U.S. POSTAGE
PAID
APG, MD
PERMIT NO. 1