

**SCIENCE**

## Ancient artifacts yield their secrets through neutron imaging

**For the first time, three-dimensional neutron images have been taken of rare archaeological artifacts here at ORNL.**

Bronze and brass artifacts excavated at the ancient city of Petra, in Jordan, were recently imaged in three dimensions using neutrons at HFIR's CG-1D Neutron Imaging instrument. The data now being analyzed will for the first time give eager archeologists and ancient historians significant, otherwise wholly inaccessible, insight into the manufacturing and lives of cultures that once occupied settlements within the Roman Empire, Middle East, and Colonial-period New England.

The samples that were imaged in 3-D in August came from the collections of the Joukowsky Institute for Archaeology and the Ancient World at Brown University. They include an elaborate hanging bronze oil lamp, a large Roman coin, and — most charmingly — a standing dog figure, which might have been either a religious dedication or perhaps a toy. Although their original provenance is unknown, they are all excellent examples of common metal finds from antiquity.

Principal Investigator Krysta Ryzewski, an assistant professor of anthropology at Wayne State University, and her co-PI Brian W. Sheldon, professor of engineering at Brown University, were loaned the artifacts for study by Professor Susan E. Alcock, director of Brown's Joukowsky Institute.

The neutron imaging beam is a huge step forward for these scholars. "Archaeologists and scientists can obtain

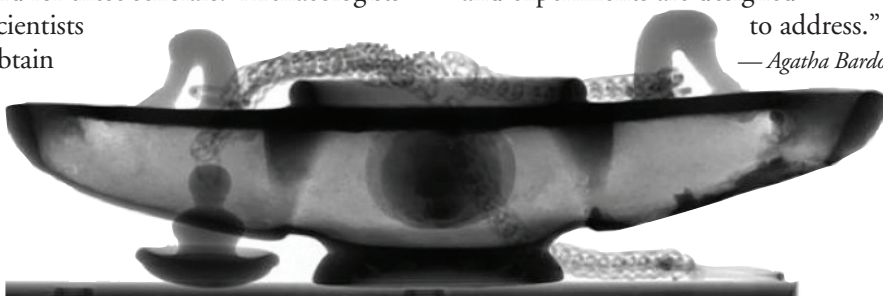
relatively little information about the manufacture of archaeomaterials, ancient objects and the materials from which they are constructed from external surfaces alone," says Ryzewski. "The only source of information about how these objects were constructed comes from their material properties and composition."

Imaging archaeological objects comprehensively and systematically with neutrons only became possible with the development of the CG-1D Prototype Beamline. "A vast array of archaeological objects and research questions about ancient and historical technological development can now be posed," says Ryzewski. "The CG-1D beam line offers an invaluable alternative for performing non-destructive, non-invasive analysis."

CG-1D data can reveal the raw materials used, manufacturing techniques, historical development of alloys and composite materials, and geological origins of ores and clay. On the cultural side, researchers can learn about the activities of daily life that such objects served for ancient people.

"Archaeologists can now begin to reconstruct past networks and patterns of resource extraction, trade and exchange, environmental impacts of industrial activities on ancient landscapes, and the transmission of craft production traditions over time," Ryzewski says. "These are some of the questions our current research and experiments are designed to address."

— *Agatha Bardeel* 🌿



*Neutron radiograph of an ancient Greek lamp.*

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"The CG-1D beam line offers an invaluable alternative for performing non-destructive, non-invasive analysis."

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## Coutant still consulting on thermal discharge



Chuck Coutant enjoys a day of fishing with his grandson, Alex. (Photo submitted).

**Chuck Coutant arrived at ORNL in 1970 to manage the newly established aquatics lab.** The focus for the lab was the study of thermal discharge from nuclear power plants into surrounding water and the impact of those discharges on the environment.

Forty-one years later and retired from ORNL, Chuck now works as a consultant with utility companies that must study and report their thermal discharge procedures, policies and environmental impacts to keep their Nuclear Regulatory Commission licenses and state pollution discharge permits current.

For instance, Chuck worked with the Southern Company to prepare environmental studies, reports and testimony necessary for the company to obtain an NRC license to construct two additional units at the Vogtle Nuclear Plant in North Georgia.

“When those units are up and running, they will be the first new ones that have been built and put into operation since the 1970s,” Chuck said.

Thermal discharge is an issue that concerns all utilities utilizing nuclear power. Chuck’s background in this field at ORNL has enabled him to fill a niche that is in demand.

“Plant discharge relicensing occurs every five years, and thermal discharge issues and how they are dealt with are always important factors that are carefully studied during the permitting process,” Chuck said. “It is important to have this type of information available when a utility’s application is being evaluated by the NRC and state regulatory agencies. Doing this type of work keeps me hopping.”

Chuck has also assisted plants in Connecticut, Virginia, and Rhode Island—among other locations—with their license application preparations.

“Working as a consultant, I can do a lot of this at home, spending the appropriate time necessary to complete the work but proceeding at my own pace,” Chuck said. “However, I still insist

when I get involved with a project that I visit the site and check out the procedures they have in place. I can produce a much more thorough report that way.”

In addition to his consulting activities, Chuck, who retired from ORNL in 2005, remains active in several environmental science organizations. He is a past international president of the American Fisheries Society, attending many of its regional and international conventions, one of which he helped organize in Nashville.

Closer to home, Chuck is the secretary of the Friends of ORNL. He and wife Nancy were also longtime board members of the Oak Ridge Civic Music Association. Chuck served for six years, three as president. In spite of the fact they are no longer on the board, many of the different arts organizations in Oak Ridge still feel the Coutants’ positive impact from those Civic Music Association years.

Nancy, who has been involved in a number of community organizations, as well, enjoys a bit of fame that not many people know about. Growing up in the Eastern Pennsylvania community of Nazareth near Allentown, she went through school with longtime racecar driver Mario Andretti.

“A lot of people find that more interesting than what I’ve done,” Chuck said with a laugh. —Fred Srohl 🌿

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“Doing this type of work keeps me hopping.”

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## Clamping down on copper theft

### ORNL expertise helps utility secure substation against copper thieves

Upswings in the price of copper have inspired thieves across the country to steal any amount of the valuable metal, widely found in applications from catalytic converters to HVAC units. In addition to contributing to the high costs of replacing the stolen material, hastily attempted copper thefts can result in utility blackouts and deaths by electrocution.

In 2009, an attempted theft of copper cable at a Power Marketing Administration substation sparked an explosion and fire that tripped three transmission lines offline. Although the utility recovered by rerouting the substation's power, other power providers have experienced blackouts and loss of service from similar copper theft attempts.

The 2009 incident resulted in more than \$1 million in damages. As part of the response efforts, the Department of Energy's Office of Health Safety & Security collaborated with ORNL and multiple subcontractors to help assess the substation's vulnerability and implement cost-effective security measures designed to prevent future theft attempts.

"ORNL's expertise in systems integration and vulnerability assessment gave us the requisite knowledge to help this site with its security upgrades," said project manager Brigham Thomas of ORNL's Global Nuclear Security Technology Division.

A team including representatives from ORNL, DOE, the utility and several subcontractors installed a comprehensive and affordable perimeter security system consisting of energy efficient lighting, surveillance cameras that operate in a high voltage environment and an anti-cut, anti-climb fence system with integral intrusion detection cable. Engineers from ORNL's facilities and operations directorate helped ensure safe construction practices. The complete system protects a perimeter area of 3600 linear feet.

"ORNL's expertise in systems integration and vulnerability assessment gave us the knowledge to help this site with its security upgrades."

The security system installation, calibration and performance testing were completed in early 2011. Since the implementation, the substation has not reported any security issues. Thomas says the utility is now looking at funding projects to replace fences at similar sites that could be attractive to copper thieves.

"The utility has made this type of fence their new standard," Thomas said.—*Morgan McCorkle*



ORNL experts helped install a cost-effective security system to guard a utility substation against copper thefts.

## Club ORNL events

Get the details and latest news online via <https://info.ornl.gov/sites/clubornl>. Request an XCAMS account, which will allow you to participate in these events or contact Lara James at 865-576-3753 or [jamesla@ornl.gov](mailto:jamesla@ornl.gov).

- Nov. 19** UT vs. Vanderbilt - Football Game
- Nov. 24** Little Women, The Musical  
Oak Ridge Playhouse
- Dec. 9-11** Biltmore Estates Overnight
- Dec. 10** Cats - Tennessee Theatre
- Dec. 18** Special Clayton Christmas Concert
- Dec. 23** Ice Skating



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## Now you see it . . .



The smokestack that served ORNL's original steam plant was dismantled piece by piece earlier this year.

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“The Recovery Act funds gave us the opportunity to jumpstart the process of cleaning up the central campus and in the process, rid the Lab of a lot of legacy waste and potential hazards.”

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If you haven't visited ORNL in the past four or five years, a trip today will reveal a lot of empty spaces where buildings once stood, particularly in the central campus area.

Several of the D&D projects (D&D stands for decontamination and demolition) were aided by American Reinvestment and Recovery Act funding, which in many cases made the difference in the central campus cleanup projects going forward.

“The Recovery Act funds gave us the opportunity to jumpstart the process of cleaning up the central campus and in the process, rid the Lab of a lot of legacy waste and potential hazards,” says Dirk Van Hoesen of ORNL's Environmental Management Program Office.

Probably one of the most celebrated — and complicated — demolition projects was the razing of Building 3026, an old radioisotope processing facility on Central Avenue. Originally a wooden structure containing hot cells and chemistry labs, the building — beyond its status as one of ORNL's homeliest and most deteriorated structures — contained radioactive materials and was considered a potential hazard.

Now all that remains of Building 3026 following a carefully conducted D&D project are two battleship-gray concrete monoliths that housed the hot cells. They will come out in a future project.

To the west, a number of structures that housed support facilities are now concrete pads used for parking. The old ORNL cafeteria, located at Central and Third Street and renowned for its great food and not-so-great location (it sat across the street from an underground waste tank farm), was, in 2008, one of the first central campus structures to be demolished.

The Quonset-hut-styled structures in the 2000 complex were erected shortly after World War II. They were probably meant to be only temporary, but they lasted more than 60 years until they were torn down last year.

Several smokestacks accent the ORNL skyline. One of them disappeared this summer: the 2011 stack, which served the original ORNL steam plant, was taken down piece by piece.

Most of these demolition projects have occurred on the north side of Central Avenue. Two on the south side took away some of the last remaining examples of Manhattan Project architecture, originally built for the short term. Building 3550 was a multi-sectioned wooden structure used for chemical separation labs and offices. The last remaining wing was torn down this summer. Another old structure, which was once used for training and thus called “the little red schoolhouse,” has also left the premises.

Other buildings that have gone by the wayside in recent years are Building 1000, the former administration building located on the west end and, on the east end, Building 5000, the former visitor processing center and Lab Protection Division main office, which was the main entry portal for many Lab staff members.

Building 3012 was from the Manhattan Project and Cold War eras, but its trusty and stout rolling mills were used by Corporate Fellow Amit Goyal in the 1990s to develop ORNL's groundbreaking RABiTS high-temperature superconducting wire.

ORNL's central campus cleanup is clearing out old and disused buildings from the mid-twentieth century to make way for new facilities for science in the twenty-first. —Bill Cabage 🌿



Building 3550, one the last Manhattan Project-era frame structures, was torn down this summer.



## Our Wigner Fellows

ORNL recently welcomed its newest early career researchers under the Wigner Fellowship program. The two-year fellowships are named in honor of Eugene P. Wigner, Nobel laureate and ORNL's first director of research and development.

Wigner Fellows must be exceedingly well qualified, be no more than three years beyond the doctorate, and must not have engaged in more than one post-doctoral position. Nearly 100 outstanding researchers have come to ORNL through the Wigner Fellowships.

Satyabrata Sen joined the Computer Science & Mathematics Division as a Wigner Fellow in February 2011. Following schooling in his native India, he received his doctorate in electrical and systems engineering from Washington University in St. Louis in 2010. During his doctoral studies, he received the second place award in the student paper competition at the Fifth International Waveform Diversity & Design Conference 2010.

Satya joined the Complex Systems group where his work with Jacob Barhen focuses on the area of statistical signal processing, asynchronous distributed tracking, and their applications in radar, communications, and sensor arrays.

Outside of work, Satya enjoys traveling, photography and playing soccer and badminton.

Laurene Tetard joined the Measurement Science and Systems Engineering Division as a Wigner Fellow in May 2011. Laurene received her master's degree with a concentration in nanotechnologies and nanosciences at the University of Burgundy in Dijon, France, and a doctorate in physics from the University of Tennessee. The same year, she received a Chancellor's Honor for Extraordinary Professional Promise and received an R&D 100 award for her work on subsurface imaging at the nanoscale.

Her research in the Imaging, Signals, and Machine Learning group involves subsurface imaging and chemical characterization of soft matter materials at the nanoscale, with direct applications to bioenergy research and biology.

In her free time, Laurene enjoys spending time with friends, cooking, traveling and hiking.

Matt Reuter joined the Computer Science and Mathematics Division as a Wigner Fellow in August. He received his doctorate this year in theoretical/computational chemistry from Northwestern University. During his graduate studies, Matt was supported by a DOE Computational Science Graduate Fellowship.

His work with Bobby Sumpter focuses on modeling disordered nanomaterials and understanding how disorder affects electron dynamics.

Matt, who is originally from Michigan, enjoys endurance and distance running, playing trombone and cooking.

Satyabrata, Laurene and Matt join current Wigner Fellows Xiaoshan Xu, who is working in the Low Dimensional Physics group; Alok Kumar of the Biosciences Division; Songhua Xu, working in modeling and simulation in the Computational Sciences and Engineering Division; Mark Berrill, who is developing computer models for energy science in CMSD; and Krzysztof Miernik in the Physics Division's Decay Spectroscopy group.—*Bill Cabage* 🌱



Current Wigner Fellows with Lab Director Thom Mason (extreme right) are (seated, left to right) Mark Berrill, Satyabrata Sen, Laurene Tetard and Ivan Vlasiouk; (standing) Songhua Xu, Xiaoshan Xu, Alok Kumar, Matt Reuter and Krzysztof Miernik.

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“Nearly 100 outstanding researchers have come to ORNL through the Wigner Fellowships.”

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# THE NEWS

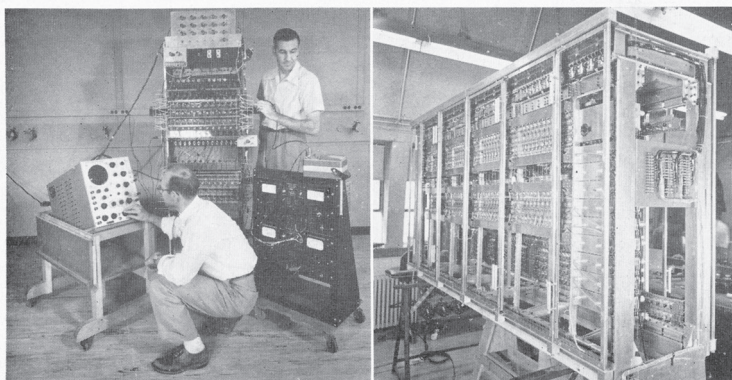
## OAK RIDGE NATIONAL LABORATORY

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Friday, October 19, 1951



**ORNL ELECTRONIC BRAIN IN THE MAKING**—William Gerhard, left, and Earl Burdette, engineers of the ORNL Instrument Department, are shown at work on an experimental ten-stage shifting register of the type to be used in a high-speed, electronic computing machine to be built for the Laboratory. The project is being carried on at Argonne National Laboratory. Pictured at right is a strip view of the computer at Argonne National Laboratory that serves as a model for the machine being constructed there for Oak Ridge National Laboratory. The intricate appearing mechanism shown consists of the switching circuitry of 1024 storage registers, which constitute the machine's memory system. When completed, the ORNL computer will have many of the best features of the most outstanding computing machines yet devised. (Photos courtesy Argonne National Laboratory.)

### Electronic Brain With "Memory" Being Built For Use At ORNL

Machine Now Under Construction at Argonne Expected to be Put into Operation in 1952

An electronic brain that "remembers" is now under construction for Oak Ridge National Laboratory. To be built along the lines of such computing machine marvels as the ENIAC, the SEAC, and the Marks I, II, III, the ingeniously designed mechanism is expected to have one of the highest computing speeds of any such device in operation, it has been announced by Dr. A. S. Householder, chief of the Mathematics Panel.

The machine, which is now in its early stages of construction, is being built at Argonne National Laboratory, where experience has already been gained in the design and construction of such devices.

Work on the new computer is expected to be completed by the spring or summer of 1952. Quarters planned for its occupancy will be in the new Research Laboratory building.

The computer will have the approximate dimensions of eight feet in height three to four feet in width and eighteen to twenty feet in length. Its weight will be about 20,000 pounds.

Four engineers of the ORNL Instrument Department, Earl Burdette, R. J. Klein, J. W. Woody, and William Gerhard, are now at Argonne National Laboratory doing the major part of the work in building the machine.

Dr. Householder and Drs. C. L. Perry and Lewis Nelson, also of the Mathematics Panel, have made frequent trips to Argonne.

### Dr. Boyd Receives Southern Chemist Award for 1951

For distinguished service in the profession of chemistry in the South, Dr. George E. Boyd, associate director of the Oak Ridge National Laboratory Chemistry Division, has been selected as recipient of the Southern Chemist Award for 1951. Announcement of Dr. Boyd's selection for the honor was made by Dr. Frank A. Anderson, of the University of Mississippi chemistry department and chairman of the Memphis ACS Section of the American Chemical Society. Dr. Anderson made the

### ORINS-ORNL Offer Computing Course

A course in the techniques of preparing problems for high speed digital computing machinery will be given by the Special Training Division of the Oak Ridge Institute of Nuclear Studies in cooperation with the Oak Ridge National Laboratory. The course will begin on December 3, 1951, and run for two weeks.

It is expected that the program will be of unusual interest to prospective Oak Ridge research participants in the field of mathematics or to university mathematicians having need of computing machinery in their research.

The great economy of solving problems by computing machines, as well as the prospect of time becoming available on these machines due to the large number now under construction, are expected to add to the value of the course.

The course will be centered around the computing machine now being built for Oak Ridge National Laboratory, although only minor scheduling changes are required for a number of other types of computing machinery. The ORNL machine will be a single address electronic automatic computer based on the Institute for Advanced Study machine.

Dr. Alston S. Householder, chief of the ORNL Mathematics Panel, will be course director. He will be assisted by staff members of Argonne National Laboratory, the Los Alamos Scientific Laboratory, the Computer Branch of the Office of Naval Research, and the Institute for Advanced Study.

Morning sessions of the course will be devoted to lectures and afternoon sessions to conferences and supervised problem preparation.

### ORNLers Win Large Share of Prizes in Camera Club's Annual Print Competition

The annual salon of the Carbide Camera Club was held Tuesday evening, October 9, at Ridge Hall, in a joint meeting with the Oak Ridge Camera Club.

The salon is the highlight of the year's activity for the club. Five classes of black-and-white prints and four classes of color-slide competition were presented. A total of 150 entries were contributed by Carbide Camera Club members.

Vince Moore, Y-12 photographer, judged the black-and-white prints, and J. E. Westcott, chief of the local AEC photography section, judged the color-slide entries.

Seven ORNLers were among the winners in the salon. High-point winner in the black-and-white class was Stephen Hluchan, Instrument Department, who carried away first, second, and third places in the animal class, second and third in architecture, and a second in the still-life



**CAMERA CLUB PRESIDENTS LOOK AT A PRINT**—left, president of the Carbide Camera Club; right, president of the Oak Ridge Camera Club. The print shown is Herman Dickerson's Y-12 photograph of a competition held at the Carbide Camera Club.

## Sixty years ago this month

### Taken from *The ORNL News* for October 1951

- A regular customer of the Lab's five-year-old isotopes program has been Ohio University, using the radioactive isotope phosphorus 32 in the treatment of chronic leukemia and other abnormal cell growths.
- Marion Hoppe, secretary in the Chemical Technology Division, is a contender for the Babe Didrickson Zaharias athletic crown as an all-around sportswoman.
- The Lab's Health Physics Division, assisted by Dow Chemical, launched what is likely the first mobile, cross-country radiological laboratory for civil defense. Equipment includes quartz-fiber electroscopes, used for analyses of air and water samples in areas crippled by atomic attack.
- ORNL to receive an electronic brain that "remembers." Built by Argonne National Laboratory, the electronic computing machine will be able to perform logical operations at the rate of thousands per second.
- Dr. George Boyd, associate director of the ORNL Chemistry Division, receives the Southern Chemist Award for 1951. His research in ion exchange chromatography has attracted widespread interest in the U.S. and abroad.—prepared by ORNL History Room volunteers



## From the Lab Director

**We have good news about several of our researchers.** Andy Christianson of the Neutron Scattering Sciences Division is the 2012 recipient of the International Union of Pure and Applied Physics' Young Scientist Prize for his research in the structure and dynamics of condensed matter. Andy was one of our first Clifford Shull fellows. Witek Nazarewicz has received the prestigious 2012 American Physical Society Bonner Prize in nuclear physics, for his impressive catalog of work in nuclear physics. Cam Hubbard has been elected a Fellow of ASM International on the strength of his neutron residual stress research and Andrew Wereszczak has been elected a Fellow of the American Ceramic Society for his work in ceramic science and technology.

The annual LDRD Poster Session was once again an exposition of creative thinking and solid science. I was proud to present this year's Best of Show awards to Ji Won Moon, for the Seed Money category; Ranga Vatsavai, for the Director's R&D category; Thomas Ward, for the Wigner Fellow category; and Wyatt Tenhaeff, for the Weinberg Fellow category. Congratulations also go to the Sustainable Campus Initiative for the recognition by the Tennessee Chamber of Commerce as winner of the Large Business Environmental Excellence Award.

My traveling included a trip to Washington, D.C., to participate in the National Lab Director's Council meeting with Secretary Chu. I met with several DOE staff members while I was there. In Hamilton, Ontario, I participated in the Forum on International R&D at McMaster University, including serving on a panel titled "University International R&D Collaboration: The Role of the Government." I made another trip to Washington for budget discussions as Congress continues its work to resolve the FY12 budget.

At the annual Wigner Fellows reception in October we welcomed the newest participants in this prestigious program — Satyabrata Sen, Laurene Tetard, and Matt Reuter — and honored those who have completed their fellowships. Since the program was established in 1975, it has brought 96 outstanding researchers to ORNL. Close to three-quarters of them have elected to continue their careers at the Laboratory.

I also had the pleasure of participating in the ribbon-cutting ceremony for the new Ultratrace Forensic Science Center that is being established in Building 1005. The center is a joint effort by staff from the Energy and Environmental Sciences, Facilities and Operations, Global Security, Nuclear Science and Engineering, and Physical Sciences directorates, with support from DOE. As its first major success, the center was completed on time and under budget, with outstanding safety performance.

Congratulations to Randall Snyder, winner of the Ford pickup truck on Facilities & Operations' Safety Appreciation Day. Randall is a pipefitter at the Spallation Neutron Source. John Hensley of Logistical Services won the \$5,000 first-line supervisor award. To be eligible for the drawings, the staff members had to meet certain requirements: no recordable injury and no government vehicle accidents. Be sure to keep safety at the forefront when working at home and driving.

*Thomas Mason*

Thom Mason



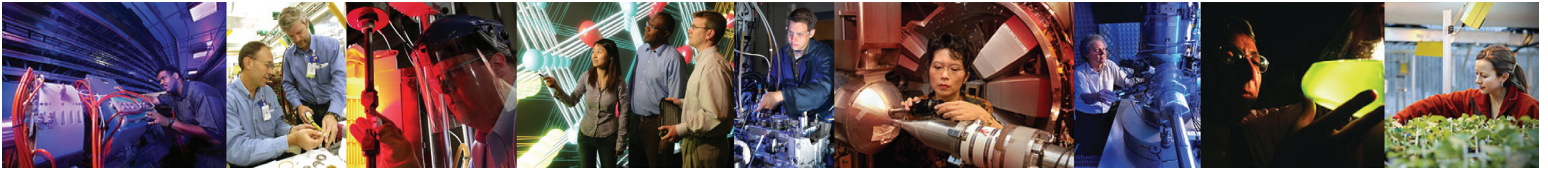

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"The annual LDRD Poster Session was once again an exposition of creative thinking and solid science."

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*Herb Debban presents Randall Snyder, a pipefitter at the Spallation Neutron Source, the keys to a 2011 Ford F-150 pickup, this year's Safety Appreciation Day grand prize.*



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## AWACS: Refueling on the go

About three times a year, the 134th Air Fueling Wing at McGhee Tyson invites a handful of local employers to take part in the Community and Civic Leader Orientation Flight, which allows civilians to fly in a plane that's refueling another, also in flight.

Cindy Mayfield, manager of the diversity and international office, spent two and a half hours in a KC-135 flying over Kentucky and witnessed pilots refueling an airborne warning and control system, or AWACS. With the rumble of the engines, the sight of blue skies and green quilted patterns below, and a continuous supply of adrenaline, Cindy was intrigued from takeoff to landing.

"It was fun and amazing to watch what they do. I have even more appreciation for veterans and what they do to serve our country," Cindy said.

"When I got off the plane, I said, 'I want to do this again.'"

—Cindy Mayfield with Emma Macmillan (*intern*)

