



# Applied Research & Technology Program NEWSLETTER



Program of Distinction  
Ogden College of  
Science and Engineering

Issue 5 2nd & 3rd Quarter---October 2004 thru March 2005

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*A  
Program of Distinction*

**Western Kentucky University**

**Ogden College of  
Science and Engineering  
Applied Research and  
Technology Program**

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## The Center for Cave and Karst Studies

Western Kentucky University, Dept. of Geography and Geology

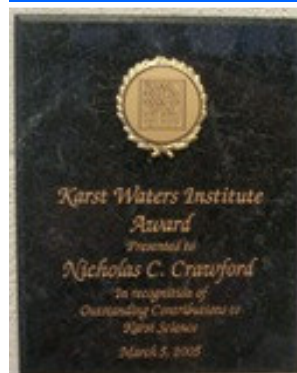
### Dr. Nicholas Crawford Director, Center for Cave and Karst Studies Receives National Award

Dr. Nicholas Crawford, Director of the Center for Cave and Karst Studies, Department of Geography and Geology, received the *2005 Award for Outstanding Contributions to Karst Science*. The Karst Waters Institute (KWI) presented Dr. Crawford with the award at a banquet in his honor on March 5, 2005 at Mammoth Cave, hosted by WKU's Hoffman Institute and the Cave Research Foundation. Dr. Crawford's after dinner presentation was entitled, "Karst Education: Student Involvement in Field Research".

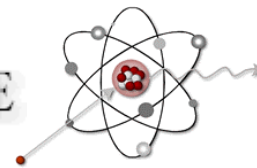
Dr. Crawford founded the first cave and karst center in the U.S. in 1978. Since then hundreds of students have participated in applied research dealing primarily with contaminated karst aquifers, sinkhole collapses and other karst environmental problems. Dr. Crawford founded the now Internationally-recognized Karst Field Studies program in 1980.

~Submitted by

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# APPLIED PHYSICS INSTITUTE



## Applied Physics Institute

RadRobot is a WiFi controlled mobile radiation detector. The project is still en route to completion but will be presented at the Homeland Security conference in April 2005. The project is based on a need to detect radiation without harming humans through exposure. The device consists of a controlled vehicle via wireless communication via WiFi. The robot is mounted with a sodium iodide detector (NaI(Tl)) for gamma ray detection and a WiFi video camera for vision in the field. Thus the robot is equipped with all necessary instruments to perform radioactive detection and identification.

What does one do with all the radioactive detection readings? Tim Morgan, senior physics major, is creating a program that answers this question. We use a method called triangulation: with three intensity readings from the detector, coupled with positions of the robot, we can determine the location of the radioactive source. The method is incorporated into a computer program that will eventually be packaged into one program that allows a user to control the robot and find the radioactive source.

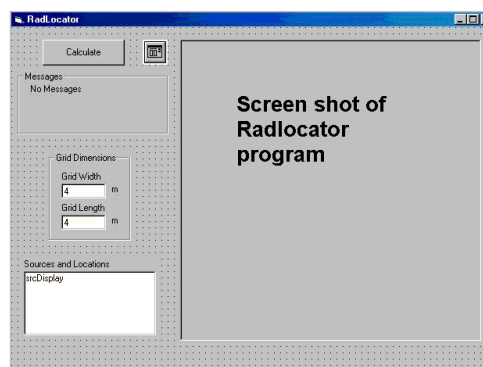
RadRobot is just one of the many projects API is producing. We are always looking into exciting new interdisciplinary research opportunities. *(Written by Tim Morgan, Student Researcher, Applied Physics Institute)*

*~Submitted by Phil Womble  
Director, Applied Physics Institute  
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Camera View as seen from RadRobot



*The RadRobot & Laptop Control*



## The Applied Physics Institute Adapts to Extreme Makeover

The Applied Physics Institute (API) has relocated to another building. Last July, the staff moved their services to its third location within three years. This time, it's permanent.

Under the supervision of Dr. Phillip Womble and Dr. Alex Barzilov, the staff has comfortably settled into their new building located near the corner Nashville Road and Campbell Lane. Though the new facility is now part of WKU's Center for Research and Development, it previously served as a north wing to the old Bowling Green Mall and is across from WKU's inner mural sport complex.

The major advantage linked to the move relates to the institute being positioned in a high tech corporate environment that will allow the staff more hands on experience with commercial clients. Within the University's Center for Research and Development is the Small Business Accelerator, whose primary purpose is to create incentives that will attract companies to come to Bowling Green because of the useful resources Western has to offer. API is allowing this vision to become a reality. Just recently, the Electronic Warfare Associates (EWA) Government Systems, a Homeland Security company that provides information technology products and services to the U.S. Department of Defense, moved in next door to API. The institute has already submitted proposals to do various tasks for the company and recently began working on an identification project as well. Other nationally recognized companies have also shown interest in being part of the new accelerator, giving API bright hopes for the future.

Though the location makes the institute more distinct, the size of the new building is also receiving praise from the staff. Previously, the institute was located in South Campus in a 6,000 sq. ft. office space. According to Dr. Womble, the new area is three times the size of the old building. API's new home is 15,000 sq. feet and offers the staff plenty of space to manage all their projects. The facility is equipped with a two large experimental areas that allow the students and professors to perform radiation-related and other experiments, and mechanical facilities for various applications. The building also provides the team with two conference rooms for presentation and meeting purposes.

The Applied Physics Institute is proud of its new location and the advantages of being a part of the WKU Center for Research and Development. The staff looks to their new, permanent home as a window of opportunity for future progress and growth in diversified areas.

*~Submitted by Dara Hardin  
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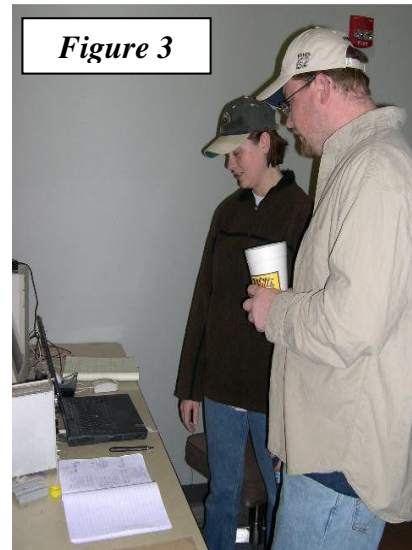


*Figure 1*

**Figure 1:** Senior Applications Engineer, Jon Paschal, demonstrating how to use the wireless detector component of the RadCard system in the experimental area.



**Figure 2:** Student workers, Sarah Witten and Josh Hardy, making adjustments to a project in the mechanical testing area. **Figure 3:** Linsay Hopper and Jon Paschal work on a geological application of radiation technology project in the new building. **Figure 4:** Big Red finds his new home on top of the API experimental area. **Figure 5:** Sarah Witten, Jon Witten, and Lindsay Hopper conduct testing of a long range wireless system on top of the new API building







The **Architectural & Manufacturing Sciences Institute** is pleased to showcase two of our recent projects. We currently have two new custom residences under construction.

The **Tisdale Residence** (*Figure 1: Below left*) is a two-story traditionally styled brick home for the family of Kirk and Shelly Tisdale. The Project was designed and coordinated by **WKU** seniors Ashley Huff of Louisville and Jed Peterson of Bowling Green. These two Architectural Science majors developed and produced the design from Concept through Construction Documents. **AMSI** is grateful for the instrumental participation of Shelly Tisdale in the creation of their new home. It is currently being built in the Fountain Trace Subdivision located in Warren County.

The **Woods Residence** (*Figure 2: Below right*) is a two-story Arts & Crafts style home for the family of Emmett and Lisa Wood. The Project was designed and coordinated by **WKU** senior Jed Peterson and recent graduate LaDonna Payne of Portland, Tennessee. This house was developed from Concept through Construction Documents with the valuable input and inspiration of Lisa Wood, the Office Associate for the **ARTP**. It has been a true pleasure to work with Lisa and Emmett in the realization of their new home. It is currently being built by Todd Davis Construction in Bowling Green.

These two homes are excellent examples of the work of **AMSI**. It is our primary mission to engage students with real-world projects to augment their academic studies at Western. All design projects are performed under the supervision of licensed architect and **AMS** professor Neal Downing, AIA. As director of the Institute, it is my distinct privilege to highlight the significant efforts and accomplishments of these talented young designers.

~Submitted by Neal Downing

Director, Architectural & Manufacturing Sciences Institute

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## Hoffman Environmental Research Institute: Several ARTP Centers Collaborate on New Project Using Radioactive Nuclear Bomb Fallout as Cave Sediment Tracer

New M.S. thesis research by graduate student Ben Tobin (advised by Steve Kenworthy) involves a unique collaboration by scientists from WKU's Department of Geography and Geology, Hoffman Institute, Applied Physics Institute, and Center for Cave and Karst Studies. Tobin will study sediments within the Mammoth Cave System and other caves to learn about their deposition histories, and in particular to see if they contain signatures of the region's history of land use—for example the dramatic shift in agriculture that took place beginning in the late 1700's with the arrival of European settlers and their farming practices. Part of the research involves measuring when different layers of sediment were washed into the cave system, and one technique for measuring these ages that the project is using is an innovative method using a radioactive isotope of the element cesium ( $^{137}\text{Cs}$ ) as a tracer. Starting in 1954, with open air testing of extremely powerful hydrogen fusion nuclear bombs, small amounts of cesium 137 blanketed the earth as radioactive fallout. The isotope binds tightly to soil particles, so that sediments that washed into caves before that date have no measurable cesium, and many later types of sediment do. Measurement of  $^{137}\text{Cs}$  at WKU's Applied Physics Institute, in collaboration with Dr. Phil Womble and his staff, can thus allow a measurement of sediment accumulation rates.

Similar methods were successfully used by Hoffman Institute graduate student Bill Curry, who in a 2002 thesis measured sedimentation rates associated with logging in Alaska's Tongass National Forest. Curry also showed that enough bomb-generated cesium was present in sediments in Lost River Cave beneath Bowling Green to make the method viable in south Central Kentucky.

~Submitted by Chris Groves

Director, Hoffman Environmental Research Institute

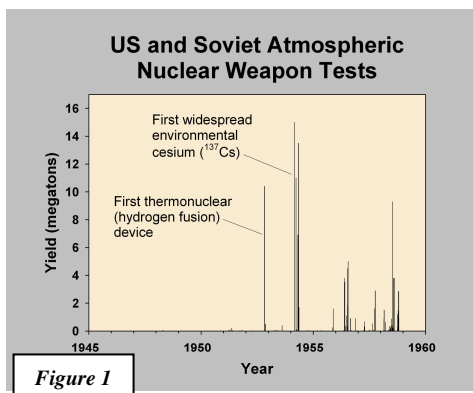


Figure 1



Figure 2

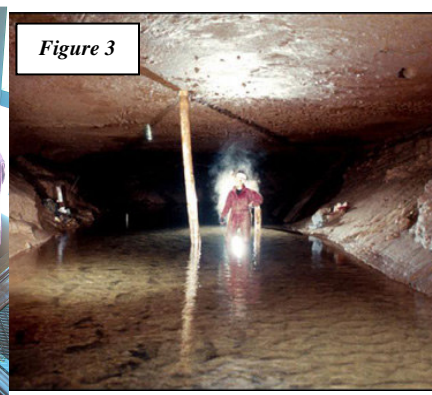


Figure 3

**Figure 1:** Graph showing early history of US and Soviet nuclear weapons testing, with widespread production of atmospheric cesium 137 beginning in 1954 from very powerful hydrogen fusion bombs. Note that at the scale of this graph, the two nuclear bombs dropped on Japan in mid-1945 are too small to be seen. **Figure 2:** Graduate student Ben Tobin relaxes at a recent Geological Society of America Conference, where he presented results from his thesis research. **Figure 3:** Tobin and his colleagues are studying the history of sedimentation at this location in Mammoth Cave's Logsdon River. Photos by Chris Groves.



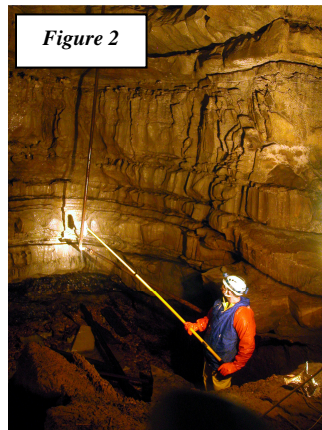
## Hoffman Institute Begins Collaboration on Karst Groundwater Quality with USDA ARS Scientists

After several years of planning and project design work, Hoffman Institute scientists and students have begun a new collaborative research effort with the newly established US Department of Agriculture Agricultural Research Service (USDA-ARS) research station established last year at WKU's farm in Warren County. Dr. Carl Bolster, a hydrologist who recently joined the ARS team, will be the primary USDA scientist on the project. The purpose of the work, which is expected to run for at least five years, is to better understand relationships between animal farming practices and groundwater quality in karst aquifers. These groundwater systems are easily contaminated by bacteria and nutrients resulting from land application of animal waste, and the long-term aim of the research is to identify optimum farming methods that not only help protect karst groundwater quality, but balance that need with the economic and cultural needs of the farmers who live on the landscape.

The project site is at Cave Spring Caverns in northern Warren County, a large cave that runs underneath several agricultural fields. Within the cave several underground waterfalls exist that allow sampling and analysis of soil water which has infiltrated through the soil beneath the agricultural fields. This unique field study will allow direct measurement of the impacts of agricultural land use on water quality in the subsurface. In the current phase of the project, we are installing sophisticated monitoring equipment, including the use of computer data loggers which allow 24 hour a day sampling of flow and chemical conditions within the cave at very high resolution.

A great benefit of the project is involving both undergraduate and graduate students who are already getting hands-on experience in all aspects of the research, including field and laboratory work and data analysis. It is anticipated that numerous master's thesis research projects will result from the project, and using undergraduates to assist on these projects will in turn provide great learning opportunities for them as well.

~Submitted by Chris Groves



**Figure 1:** WKU Geology major Ben Estes examines computer data loggers that record water flow and chemical conditions every two minutes. **Figure 2:** Stacy Antle, research technician with the USDA ARS collects a water sample from a waterfall within the cave, using a collection device that allows him to avoid a soaking while sampling. **Figure 3:** Alanna Storey, a WKU undergraduate from Bowling Green, takes pH readings from the waters of Barrel Falls within Cave Spring Caverns. Photos by Chris Groves.



## WKU Geoscientists Initiate New China Cave Research Project

Bowling Green, Ky. - Western Kentucky University Geoscience faculty and students have begun a new cave and karst research project in China's Hunan Province. At the request of the local government in the city of Chengzhou in southeastern Hunan, a group from WKU's Hoffman Environmental Research Institute is studying the karst area that contains Wanhuayan, or Ten Thousand Flowers Cave, during several trips to China this winter. Wanhuayan is a well-known tourist cave where visitors travel in one entrance and out another, according to Dr. Chris Groves, who directs the Hoffman Institute within WKU's Applied Research and Technology Program. Dr. Groves recently visited Wanhuayan and other nearby caves and met with Chinese scientists and officials to plan the project. The exit of the tour leaves the cave by climbing up through a spectacular 260-foot deep shaft.

The Chinese contacted the WKU group with a request to organize an expedition to explore and map side passages in the cave that have not been completely explored, as well as other nearby caves that might connect to Wanhuayan. The WKU group also will conduct fluorescent dye tracing studies to gain more information on the routes of the area's underground river systems. Several caves in the area have never been entered because the local people lack the ability to negotiate many entrances that consist of deep vertical shafts, Dr. Groves said. The officials hope that discoveries of new areas in the cave will allow them to further develop new tours in the cave, eventually to attract additional tourists to the area, he said.

"This is a great situation because a project like this allows our group to explore and study great new Chinese caves, while simultaneously providing a service to the local government there, and hopefully economic development for local residents" Dr. Groves said.

Like other parts of southwestern China's rural karst regions, the area is relatively poor, and the ability to attract additional tourists to the area offers a potential resource for sustainable economic development. About eight million people in the southwest China karst region live below China's poverty level, which is defined as an income of 625 Chinese Yuan, equivalent to about \$75 per year.

WKU's Pat Kambesis will lead a nine-person expedition to the Wanhuayan area in early March. The expedition team will include WKU geoscience graduate students Andrea Croskrey, Ben Tobin, and Johanna Kovarik as well as several of Dr. Groves' Chinese colleagues from the Institute of Karst Geology of China in Guilin. WKU scientists have collaborated on numerous projects with the Institute over the past nine years.

*~News release written by Tommy Newton January 4, 2005*

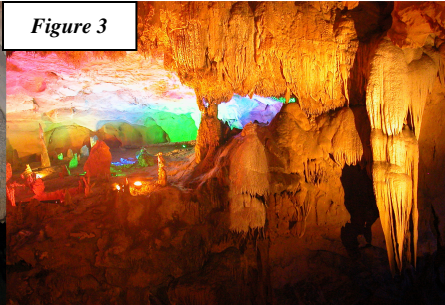
Figure 1



Figure 2



Figure 3



**Figure 1:** The entrance to Wanhuayan (Ten Thousand Flowers Cave), where a spring 2005 WKU mapping and hydrologic research expedition is planned. **Figure 2:** Chinese government officials, scientists and a news crew at the beginning of an incompletely explored passage within the cave for which Chinese officials have requested WKU help with exploring and mapping. **Figure 3:** A scene within the tourist-accessible section of Ten Thousand Flowers Cave. Like many other Chinese caves that have been developed for tourism, multi-colored lighting displays are very popular.



# Students Present Biotechnology Research at KAS Meeting

Twelve undergraduate and graduate students from the Biotechnology Center presented their research at the annual Kentucky Academy of Science Meeting. The meeting was held in Murray, KY, November 4 to 6. The students came from six different biotechnology research groups: Brittany Sutherland, Thomas Dodson, and Natalina Elliott from Dr. Larry Alice's group presented their findings on the flora of Bhutan and plant classification based on DNA. Michael Risner and Eric Vukmanic from Dr. Joe Bilotta's group talked about their results on zebrafish learning and eye physiology. Lydia Kullman and Josh Watson from Dr. Cheryl Davis' group presented new insights into host-parasite relationships and into taste bud development. Jaivonna Crook from Dr. Claire Rinehart's lab presented her findings on computer-based structure predictions for proteins. Amanda Morris and Srikanth Aakula from Dr. Ken Crawford's lab talked about their results on corneal endothelial cells in the eye of cattle. Angela Thacker and Mark King from Dr. Nancy Rice's lab presented new insights into gene expression in lung cells and protein interactions in muscle cells. Srikanth Aakula won the award for best graduate student presentation in Physiology and Biochemistry. Brittany Sutherland and Thomas Dodson tied for the award of best undergraduate presentation in Botany and Microbiology. Amanda Morris won second place for best undergraduate presentation in Physiology and Biochemistry.

*~Submitted and approved by*  
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**Figure 1:** Zebrafish from Dr. Joe Bilotta's Lab.

**Figure 2:** Dr. Larry Alice in his lab with the two undergraduates Natalina Elliott (left) and Amber Hogard (right).



# *The Kentucky Climate Center*

at WESTERN KENTUCKY UNIVERSITY 

## **Hazard Mitigation Planning**

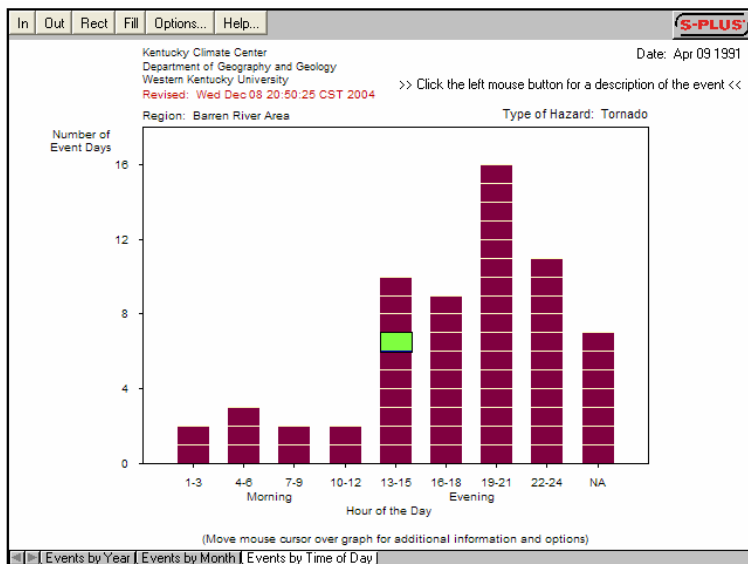
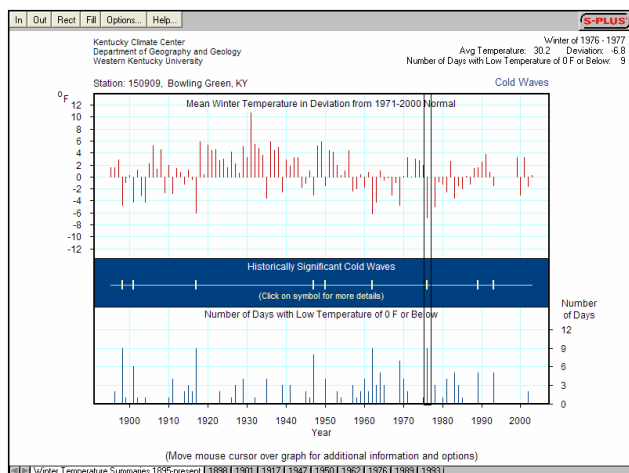
Kentucky is at risk for a variety of natural hazards, many of which are related to weather and climate. An average of nearly ten tornadoes strike in a given year. Floods along the Ohio River and its tributaries, and flash floods in areas of rugged terrain pose a threat to lives and property. Severe storms can bring damaging winds, lightning, hail, and tornadoes. Drought, often in combination with summer heat waves, can not only ruin farmers' crops and homeowners' lawns, but also threaten municipal water supplies. Winter storms bringing snow and ice, often followed by frigid temperatures, can leave transportation at a near standstill.

The Barren River Area Development District (BRADD), representing a ten-county region in south central Kentucky is developing a Hazard Mitigation Plan in conjunction with the Federal Emergency Management Agency, the Kentucky Division of Emergency Management, and the Kentucky Climate Center. The planning process relies heavily on citizen participation and has included public meetings hosted at the BRADD office, as well as meetings held in each of the ten counties.

In an attempt to help citizen committees assess the risks that their communities and counties face, the Kentucky Climate Center has developed an online interactive database documenting the historical occurrence of disasters in the region. Dr. Stuart A. Foster, State Climatologist for Kentucky, indicated, "instead of producing a written report with charts and graphs that would be out of date after the next disaster, we wanted to develop a web-based product that citizens could use interactively and that we could update regularly." Two students, Christina Henry, a graduate student in geoscience, and Ashley Littell, an undergraduate in geography, played important roles in developing a database that documents the historical events. They identified accounts of historical disasters from the National Climatic Data Center's *Storm Data* publication and local newspaper archives available at the Kentucky Library on Western's campus. Records from the database were then processed to generate a set of interactive graphs that summarize the occurrence of events by year, month of the year, or hour of the day, as appropriate. Users wishing to assess the risk of a given type of hazard can view a graph online, and extract additional information by either moving the computer mouse cursor over the graph or clicking on the graph to learn more about an event.

~Submitted by Dr. Stuart A. Foster  
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*The Kentucky Climate Center*  
at WESTERN KENTUCKY UNIVERSITY

## BRADD Natural Hazard Risk Assessment Information

Section A

Please select from the following options

Flash Floods

Floods

Section B

Please select from the following options

Hail

Thunderstorm Winds & Lightning

Tornadoes

Section C

Please select from the following options

Cold Waves

Ice & Snow Storms

Section D

Please select from the following options

Droughts

Heat Waves



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