

LSU RESEARCH

The Constant Pursuit of Discovery >>>>>>>>> Office of Research & Economic Development >>>>>>>>> 2015 - 16





Louisiana Energy

12 Energy in the Bayou State

20 Newton's Solution

24 Delving into the Deep

30 A Better Tomorrow

3 Research News

7 Scholarly Cinema

10 Finding the Formula

36 From Sea to Sky

41 Introductions: Scott C. Hagen

42 Research Initiative Snapshot

44 Career Retrospective: Mary Manhein

48 Accolades

50 Going the Distance

52 Rainmakers

54 Media Shelf

From the Vice President

In the 2012 Strategic Plan, the Office of Research & Economic Development laid out seven key focal areas, and in the past year we have made major strides in each of these areas. This issue of the *LSU Research Magazine* highlights outstanding energy-related research from across our campus.

As the state's flagship public university, LSU's mission is to serve the interests of the entire state and the nation. Louisiana is a national leader in energy extraction and production, as well as energy-based manufacturing. LSU's energy-related research spans a wide range of topics, including upstream oil and natural gas drilling and production, sustainable energy and energy efficiency, nuclear energy, and their environmental and socioeconomic impacts.



LSU's energy research performance over the past seven years has been impressive, with total energy-related research funding of more than \$97 million from federal and state agencies as well as industry partners. This funding includes a number of large, high-profile research programs such as the Energy Frontier Research Center, the AgCenter and College of Agriculture's biofuels research, and a number of oil-spill related projects.

Our innovative, interdisciplinary projects bring together researchers from all of LSU's colleges and departments and play an important part in our state's economic development. Approximately 300,000 people work along the Gulf of Mexico in the energy industry, and LSU inspires and trains the next generation of leaders through a number of degree, minor, and certificate programs. In addition, LSU researchers collaborate with industry leaders on cutting-edge projects from process innovation to using oil rig's remotely operated vehicles for marine biology observations.

I hope that you will enjoy the stories and articles about our research and will visit our website (research.lsu.edu) for more details.



Kalliat T. Valsaraj

Vice President, Research & Economic Development

*Charles and Hilda Roddey Distinguished Professor of Chemical Engineering and
Ike East Professor of Chemical Engineering*

LSU RESEARCH

LSU Research is published annually by the Office of Research & Economic Development, Louisiana State University, with editorial offices in 134 David F. Boyd Hall, LSU, Baton Rouge, LA 70803. Any written portion of this publication may be reprinted without permission as long as credit for *LSU Research* is given. Opinions expressed herein do not necessarily reflect those of LSU faculty or administration.

Send correspondence to the Office of Research & Economic Development at the address above or email research@lsu.edu. Phone: 225-578-5833. Visit us on the Web at: research.lsu.edu

Louisiana State University and Office of Research & Economic Development Administration

F. King Alexander, President

Richard J. Koubek, Interim Executive Vice & Provost

Kalliat T. Valsaraj, Vice President, Research & Economic Development

Stephen David Beck, Associate Vice President, Research & Economic Development

K. Gus Kousoulas, Associate Vice President, Research & Economic Development

LSU Research

Publisher and Executive Editor: Stephen David Beck

Editor: Alison Lee Satake

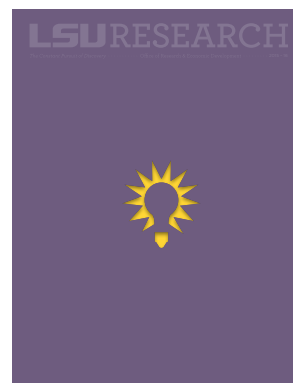
Coordinator: Holly Carruth

Contributing Writers: Ernie G. Ballard, Sandra Castillo, Sydney Dunn, Billy Gomila, Tara H. Kistler, Aaron Looney, Stephanie Malin, Alison Lee Satake, and Christine Wendling.

Design: Stephen Radcliffe/LSU Division of Strategic Communications

Contributing designers: Lindsay Denehy, Jewel Hampton, Sydney Langlois, and Maggie Mosby.

Photographers: Eddy Perez and Jim Zietz



About the cover: the die-cut lightbulb represents innovation as well as energy. Our research spans the spectrum helping improve our daily lives from advances in healthcare to today's energy demands. LSU research faculty are engaged in the constant pursuit of discovery. Come discover with us.

LSU IS AN EQUAL OPPORTUNITY/ACCESS UNIVERSITY
Produced by the LSU Division of Strategic Communications
353-0024 • 2M • 10/15



Physicist Gathers the Breakthrough Prize for Research on the Expansion of the Universe

– By Sandra Castillo

LSU physicist Bradley Schaefer is part of the Supernova Cosmology Project, which debunked the theory that the expansion of the universe was slowing down. This discovery earned Schaefer and his colleagues the 2015 Breakthrough Prize in Fundamental Physics. Schaefer contributed to the breakthrough discovery that the expansion of the universe is actually accelerating.

“I feel honored and lucky to have been part of the Supernova Cosmology Project team that discovered dark energy, setting up fun discoveries and mysteries about the origin and fate of our universe,” Schaefer said.

Schaefer and the Supernova Cosmology Project research team share the award with the High-Z Supernova Search Team, which arrived at the same finding.

This discovery changed the world as we know it and created a new field of study into the nature of dark energy. Their groundbreaking finding also offers some scientific predictions for how the Earth will end. According to the researchers, a consequence of this acceleration is that the universe will continue expanding forever, becoming colder and emptier as time goes on.

Silicon Valley venture capitalist Yuri Milner founded the Breakthrough Prizes in 2012 to honor significant contributions to the world’s understanding of physics.

Materials Engineer Named to National Academy of Inventors

– By Christine Wendling

LSU Professor of Mechanical Engineering Wen Jin Meng was named a Fellow of the National Academy of Inventors, or NAI. Meng hopes that receiving this prestigious academic distinction will underscore the important role LSU plays in promoting engineering and technology education and development in Louisiana.

“I am honored to be elected a National Academy of Inventors fellow. This election validates our R&D efforts from understanding fundamental materials behaviors to developing process designs and manufacturing protocols so discoveries from our laboratories may one day become real devices with positive societal benefits,” Meng said.

Meng is the founder of Enervana Technologies LLC in Baton Rouge, which designs and manufactures metal-based microsystems. He has invented and co-invented a range of designs including fuel cell components, automotive components, microscale devices, and microfabrication technologies. He has worked on seven U.S. patents, and his inventions provide low-cost, high-output manufacturing of metal-based microdevices.

Meng has been on the LSU College of Engineering faculty since 1999. He received his doctorate in applied physics from the California Institute of Technology, served as a post-doctoral research fellow at Argonne National Laboratory in the Materials Science Division, and worked as a staff research scientist at General Motors/Delphi R&D Center. He has published numerous journal articles and book chapters in addition to serving as a member of the editorial board for *Microsystem Technologies*.

To be elected as an NAI Fellow, one must be a named inventor on a U.S. patent and be nominated by peers in the field for contributions to innovation in patents and licensing, for contributions to innovative discovery and technology, or for significantly impacting society and supporting the enhancement of innovation.

Including Meng, there are 414 NAI Fellows representing more than 150 research universities and governmental and nonprofit research institutions.

The 2014 NAI Fellows Selection Committee included recipients of U.S. National Medals, inductees to the National Inventors Hall of Fame, members of the National Academies, and senior officials from the U.S. Patent and Trademark Office, Association of American Universities, American Association for the Advancement of Science, Association of University Technology Managers, National Inventors Hall of Fame, and other NAI Fellows.



LSU Tigers' Trainer Employs New Technology for Research into Head Trauma

- By Billy Gomila

After the stadium lights fade, many football players suffer from headaches, memory loss, and a heightened prevalence of other neurological disorders. Many of these problems can be linked to Chronic Traumatic Encephalopathy, or CTE, which medical researchers have linked to repeated blows to the head.

In order to remain at the forefront of research in this area, LSU Director of Athletic Training Jack Marucci has experimented with various methods of tracking collisions among LSU Tigers football players.

Marucci outfitted players with i1 Biometrics Vector mouthguards. A sensor in the mouthguards registers and collects data on collisions, which Marucci and his training staff record and track.

"We really wanted a better way to collect data," Marucci said. "We're always looking into technology for stuff like this, and these mouthguards not only record collisions, but they give

you a 3-D model of the entire skull, so you can not only tell when players get hit in the head, but also where."

Marucci has long theorized that long-term head trauma is much more tied to long-term exposure to repetitive blows, like what can happen through a typical spring-summer-fall practice schedule.

"It's not the big hits. It's the accumulation of all those little ones that does the most damage," he said.

A typical blow to a football player registers at a g-force of somewhere between 20 and 30. Players can be vulnerable to concussions when that number goes over the 90 G mark. A low impact car crash registers about 10 to 30 G. A car's air bag deploys at about 60 G. Over the course of a season, Marucci has found that offensive linemen tend to sustain the highest number of blows, at nearly 300.

In the past, Marucci tried attaching accelerometers to players' helmets, which would register movement and when



Geneticists Pinpoint Obesity DNA Markers

– By Stephanie Malin

Researchers have long understood that obesity is influenced by genetics. However, three researchers at Pennington Biomedical Research Center recently uncovered new data on the contributing factors of obesity by collaborating on two of the largest genetic studies of the disease.

Assistant Professor Mark Sarzynski, Professor Claude Bouchard, and Associate Professor Tuomo Rankinen joined more than 400 researchers from around the world to combine genetic information from numerous studies. The researchers analyzed the DNA of about 340,000 people and identified 97 genetic markers associated with obesity, 56 of which were discovered for the first time.

“This information is something that we can use in the future as targets for treatment,” Sarzynski said. “Using this information, we may be able to figure out how these genes are tied to our brain and our appetite, and we may be able to move toward personalized medicine. One day we may be able to go in and get our genetic markers genotyped, and the doctor may be able to tell us what genetic markers we have and what specifically needs to be done to help manage our weight.”

This opens up new pathways to obesity research.

“We’ve been wondering and hypothesizing for a long time and finally now we have the technology to generate the data and to analyze the data to get a better idea of what is really going on at the molecular level,” Rankinen said.

In the second study, Rankinen and his colleagues found 49 new genetic markers that contribute to where fat is stored in the body, 33 of which are newly discovered. They also found that women are affected more by genetic markers than men.

Unraveling the complexity of these genetic markers is just the beginning of working to treat obesity, but it is something that may help scientists understand the triggers of common chronic disease, such as diabetes, as well as who is at risk.

“The way we look at and treat obesity is being transformed,” Rankinen said.

All three researchers will continue their work looking for genetic markers that contribute to obesity in the next phase of the project.

the helmets received blows, but this didn't quite give LSU a full representation of what was happening to the players.

“The biggest thing is these readings can show us who is also using the crown of their head to deliver blows themselves,” Marucci said.

However, the mouthguards are not a diagnostic tool. Every individual player reacts differently to head impacts. The players who have previously sustained concussions are more susceptible to future ones. LSU began using ImPACT testing, developed in 1997 by doctors in Pittsburgh, which establishes a baseline of neurological activity against which any impairment can be compared.

Marucci thinks that the data they have collected can further research into traumatic brain injury, better inform coaches and training staff across the country, and improve practice habits. He, in concert with i1 Biometrics, plans on reporting the findings to the NCAA at the sports organization's conference. He also believes the technology could spread to other levels of the game, including peewee football.

The next new technology for the Tigers' 2015–16 season will be lightweight circuitry woven into “smart fabric” to collect the same data more comfortably for the players.



Ornithologists Discover New Evolutionary Theory

– By Sandra Castillo

Related bird species, such as Darwin’s finches, that vary in beak size and behavior specially evolved to their habitat, are examples of a process called speciation. It has long been thought that dramatic changes in the landscape are the main driver of species divergence. However, a new study shows that speciation can occur regardless of dramatic changes in geography.

Researchers from the LSU Museum of Natural Science have found that time and a species’ ability to move play significant roles in the process of speciation. This research was published in *Nature*.

“The extraordinary diversity of birds in South America is usually attributed to big changes in the landscape over geological time, but our study suggests that prolonged periods of landscape stability are more important,” said Robb Brumfield, museum director and one of the lead authors of the study.

Brumfield’s team examined the genealogy of 27 species of birds in the most biodiverse region in the world, the Neotropics.

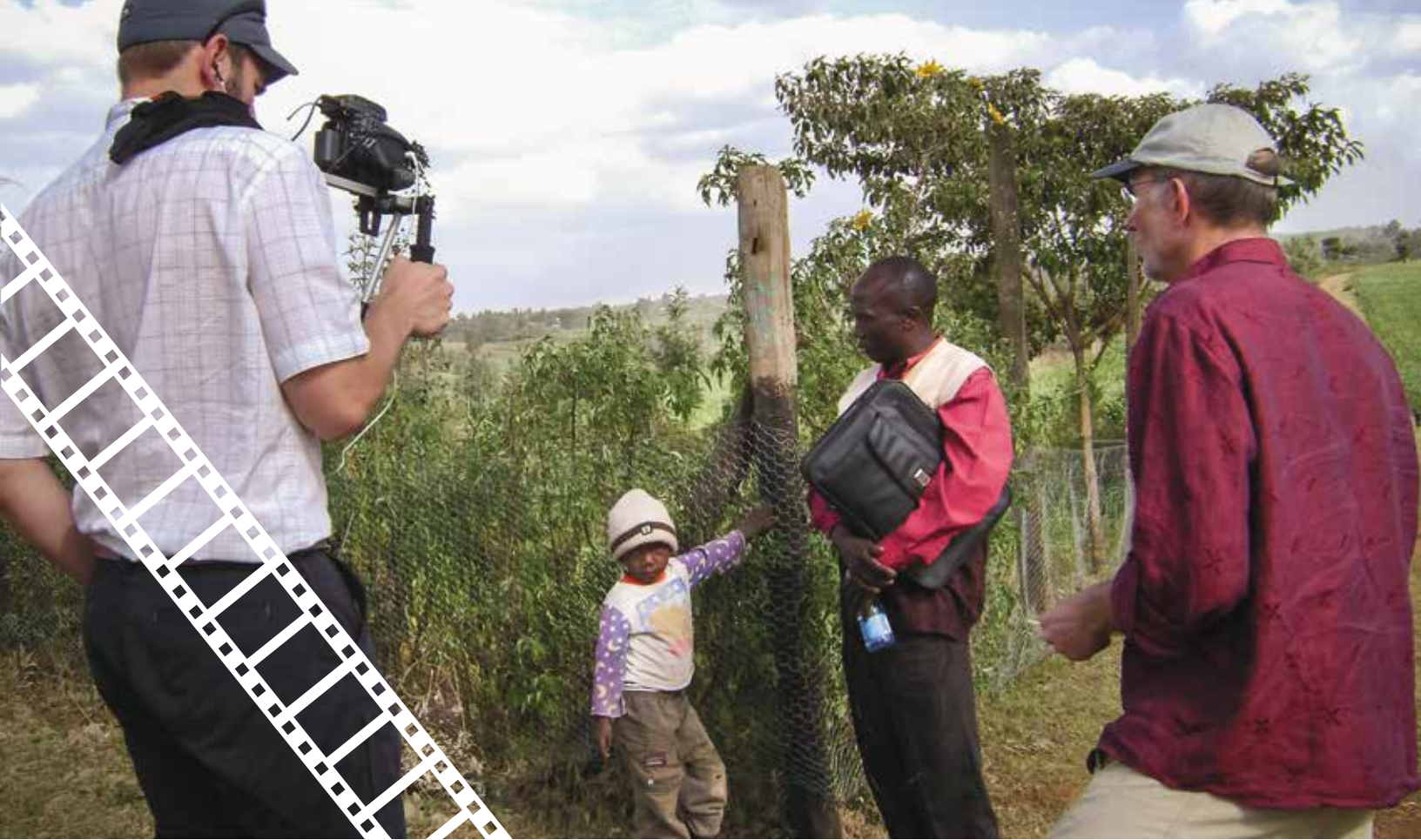
“By using detailed samplings of many bird lineages, we were able to get a clearer and larger picture of when and how

species formed within those lineages,” Brumfield said.

The genetic data showed multiple instances of species divergence across the Andes Mountains that varied over time. This shows that rather than being the primary cause of speciation, the formation of the Andes Mountains had an indirect effect on diversification and can act as a semi-permeable barrier.

The researchers then investigated how the life history and ecology affected speciation among the 27 lineages of birds. They discovered the longer a species can inhabit an area, the more likely it will disperse and diverge. Also, the less mobility a species has, the more likely it will diverge. For example, birds restricted to the forest floor showed significantly higher species diversity than birds that inhabited the forest’s open canopy. These findings have conservation ramifications. If a species cannot inhabit the same area for an extended time, it will not have the opportunity to evolve and continue.

“Our results suggest that human alterations of the landscape can effectively kill the speciation process,” Brumfield said.



Scholarly Cinema

By Christine Wendling

Traditional Research Moves into the 21st Century

Innovation and technology, as they relate to education, often bring to mind science and engineering rather than the arts and humanities. However, LSU sociologist Wesley M. Shrum actively works to defy that assumption.

Sociology is the study of the development and structure of human society. Sociologists traditionally collect and record their findings on a particular culture or social group by writing a report called an ethnography. Ethnographies are often published as books or in peer-reviewed academic journals, which have been the primary indicator of academic advancement from time immemorial.

However, Shrum opts for a different method to report ethnographic data—video. He feels the academic world needs to adapt to how humans process and acquire knowledge in the 21st century, namely through audio-visual means.

“We used to say jokingly back in the 1990s, that when a tourist with a video camera is collecting richer and more powerful data than a sociologist or a social scientist, that’s pretty bad. These technologies are now widely available and easy to use,” Shrum said.

However, Shrum is quick to emphasize that he feels researchers should still continue writing and publishing peer-reviewed articles. Rather than replace one form of data collection with another, he feels scholars should add this new tool to the academic arsenal.

Thus, Shrum began to ponder how he could add legitimacy to what previously was not considered an academic medium.

He also knew the key to academic validity in all scholarly publications lies in the peer review process, in which a panel of experts in a particular field review another expert’s work and verify the validity of the findings.



Sociology professor Wesley M. Shrum conducts ethnographic research in Kenya in 2010. Photo courtesy of Wesley M. Shrum, LSU.

Ethnografilm is his answer.

To marry the peer review process and film, Shrum co-founded the first film festival to bring together juried ethnographic films by academics and documentary filmmakers.

Ethnografilm is held annually in Paris, France. Shrum serves as the executive director and works closely with Greg Scott, an associate professor at DePaul University in Chicago. Ethnografilm creates an environment where videos are considered an acceptable scholarly product, which enables researchers to create scholarly audio-visual work.

In addition, Shrum serves as associate editor of the *Journal of Video Ethnography*, which consists entirely of video essays.

“There are many film journals, but they’re text-based journals about film and ours is a film journal. It’s a journal of films only. There is no text,” he said.

While both Ethnografilm and the *Journal of Video Ethnography* are peer-reviewed, the journal adheres to a strict academic review process by scholars. Since the film festival is designed to broaden the base of people who can participate, including the general public, reviewers come from both the academic and nonacademic world.

Theory into Practice

Shrum’s zeal for academic innovation and incorporating technology is not limited to boosting the work of others. He also produces his own video ethnographies including, most recently, *Women of the Storm*. The film records the pursuits of an all-female citizens group by the same name in the aftermath of Hurricane Katrina. They successfully lobbied Congress to tour the city of New Orleans post-Katrina and survey the damage, garnering support from the federal government for recovery efforts.



Women of the Storm. 2015. Broadcast on WLAE, New Orleans.



Women of the Storm. 2015. Broadcast on WLAE, New Orleans.

Shrum was drawn to this powerful group while filming in New Orleans in the wake of the storm. He described the devastation as looking like an atomic bomb had hit the city. There were miles and miles of unending destruction. The extent was impossible to convey in words or photos, so the Women of the Storm pushed for Congress to come see it for themselves. The group didn't have any particular agenda, but strongly felt that if members of Congress came and saw the damage, they would be moved to do something about it.

Women of the Storm shows how severely the destruction of the city of New Orleans from Katrina personally impacted the women involved with the project. Many wondered whether they would ever return to their homes. The anguish of seeing how this disaster affected their families, friends, and community motivated them to do something about it. Their founder, Anne Milling, called on the women to use their "southern belle charm" and issue an invitation to Congress to come to south Louisiana to examine the wreckage.

To make a statement to Congress, they carried "blue-tarp blue" umbrellas, the same shade as the blue tarps used to cover damaged roofs post-Katrina. This created a powerful visual brand and identity on Capitol Hill. As the press caught wind of the Women of the Storm and their flashy umbrellas, the congressional representatives also began to pay attention. The Women of the Storm met with several members of Congress and issued elegant, embossed invitations to come to New Orleans.

Thirty-six members of the House of Representatives came to New Orleans and met with the Women of the Storm. According to Milling, each person who came to the city later became an advocate in helping to rebuild south Louisiana.

Their next project, an attempt to have the 2008 presidential debate hosted in New Orleans, did not succeed. Following this, they decided to refocus their efforts on a broader issue rather than specifically the city of New Orleans. They began to emphasize the importance of coastal wetlands restoration, which affects all of the Gulf states. They incorporated women from all around the region in their coalition. Their combined efforts propelled the passage of an act that dedicates 80 percent of the Deepwater Horizon oil spill Clean Water Act penalties to Gulf Coast restoration. The Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act—or RESTORE—was signed into law in 2013.

This little-known women's group had a large impact on the political climate in New Orleans, both in the immediate aftermath of Hurricane Katrina and even years later with their coastal wetlands restoration efforts.

Shrum took care in showcasing the organizers' influence while maintaining academic distance.

One claim raised early on in the film is that women organize and participate in civic activism better than men. Political commentator and LSU graduate James Carville states in the film: "If you want to talk about something, call a man. If you want to do something, call a woman." However, Shrum never inserts himself into the film, always letting the women and their supporters speak for themselves.



Women of the Storm. 2015. Broadcast on WLAE, New Orleans.

"I don't know if there'll ever be another group like them. Certainly, you have to seize the moment. And Women of the Storm, Anne Milling, and the executive committee were the right people for this time and place to help the city and the state," Shrum said.

Finding the Formula

Where Chemistry Creates Diversity

By Tara H. Kistler

A 2006 study found that racial diversity in group settings enhances the thought process, evoking creativity and innovation. Another study examining the role gender diversity plays in financial performance found that when women are represented in top management positions, there is an increase in a firm's value and financial gains.

There are a variety of ways to achieve diversity, but there are no definitive guidelines on what the "right" combination is to attain it. The building blocks of diversity begin in education. At LSU, educators are formulating a tactic that begins with recruiting a diverse faculty.

The *Journal of Chemical Education* named LSU the top university in the nation in granting doctorates in chemistry to women and underrepresented minorities. Although the distinction was unexpected, the achievement was no accident. University officials have been working to advance diversity at LSU over the past several years.

LSU has made diversity one of its top priorities. In its mission statement, enhancing diversity at the university is a core institutional value. Among those paving the way are Vice President for Strategic Initiatives Isiah Warner, who holds the titles of Boyd Professor and Philip W. West Professor of Analytical and Environmental Chemistry, and Vice Provost for Diversity Dereck Rovaris Sr.

Rovaris began his position at LSU in June 2014. Since then, he has worked with the Office of Human Resource Management, or HRM, faculty and staff to kick-start a campaign to recruit a more diverse and representative faculty.

Since last August, a series of workshops and trainings have been rolled out for faculty search committees. The workshops and trainings explain why LSU is pursuing the diversity initiative and how diversity is economically appealing. Additionally, they share how students and the LSU community as a whole benefit from a diverse group of faculty.

"The question was once raised to me that if we increase our student diversity, wouldn't that help increase our faculty diversity?" Rovaris said. "It will help, but it won't solve the problem. Faculty diversity will increase student diversity because students will

want to learn from faculty who are enriched culturally. It's good for everyone."

Rovaris is not alone in this stance. Several studies have confirmed the benefits of diversity in informational and social settings. When people are brought together to solve problems as a group, they bring different opinions and perspectives, which provokes deeper thought.

"Our students hit the ground running because they've sat by someone or had a class taught by a professor from a totally different culture than their own. That alone enriches their ability to work among diverse groups," Rovaris said.

The Office of Diversity and HRM are working to not only educate the university's departments on diversity, but to improve the systems to increase diversity in the faculty applicant pool, the finalists, and the selection of new faculty. They created a three-phase reporting process. When a position review begins, a report is sent to the committee breaking down the demographics of race, gender, and ethnicity of the entire applicant pool. Another report is generated after the selection is narrowed down to the finalist.

"The goal is to try and make sure that if we started off with a certain number of women or Latino applicants, for example, but end up with none of them represented in the finalist selection, then we find out why," Rovaris said.

In addition to devising and improving the process, the Office of Diversity and HRM combine their efforts in working with other constituencies, such as Warner's Office of Strategic Initiatives and the LSU chemistry department.



Catalyst for Change

Warner joined LSU in August 1992. When he arrived, LSU historically had never had more than three African Americans in the chemistry graduate program at the same time. However, that began to change quickly.

“When I came in, we had two African American students.

I brought in 10 graduate students with me, five of which were underrepresented minorities,” Warner said. “But all of a sudden, that number started growing, and we had 11 African Americans in the program.”

Now, the chemistry department has an average of 30 African American students in the graduate program. The department also leads the country in the number of women Ph.D. candidates. The department now has eight female faculty members as well.

“We have a diverse faculty who are interested in working with these students. In fact, a number of faculty are fighting to get these students into their groups,” Warner said. “Without the entire department buying into this, it wouldn’t have happened.”

Diversity in the chemistry department doesn’t focus solely on gender and race. The department is comprised of students, faculty, and post-doctoral researchers with various backgrounds and ethnicities. Warner says he loves the diversity within his research lab and attributes it to the group’s success. Students and post-doctoral researchers from China, Nepal, India, and Pakistan are currently conducting research in the Warner lab.

Warner and his research associate Noureen Siraj are working on groundbreaking research on organic compounds, which they’ve named Groups of Uniformed Materials Based on Organic Salts, or GUMBOS.



Since 2008, Warner has devoted his research to these organic compounds, which have a variety of unique properties. His interest in the subject began with research on ionic liquids, or a salt in a liquid state, and the ways in which they can be manipulated by different catalysts. That inspired him to think about manipulating the chemistry of solid-phase materials. From there, the GUMBOS’ solid-state version of ionic liquids was formed. The applications have gone beyond what was expected, so much so that it has been difficult to focus on just one or two areas.

Ionic Innovation

Organic compounds offer several benefits. They are inexpensive compared to synthetics and more environmentally friendly as well as non-toxic and flexible. In fact, some of the most basic yet heavily relied upon devices are derived from organic compounds, such as the flexible technology used for smartphone screens. The GUMBOS have also led Warner and Siraj to new and innovative findings such as a chemotherapeutic agent that through nanotechnology not only kills cancer cells, but also is non-toxic to normal, healthy cells.

The real-world applications for Warner’s research on GUMBOS are numerous.

“We try one area, and it really takes off and so on. Every area is just so exciting, and that’s why we’re working so hard on this new technology,” Warner said.

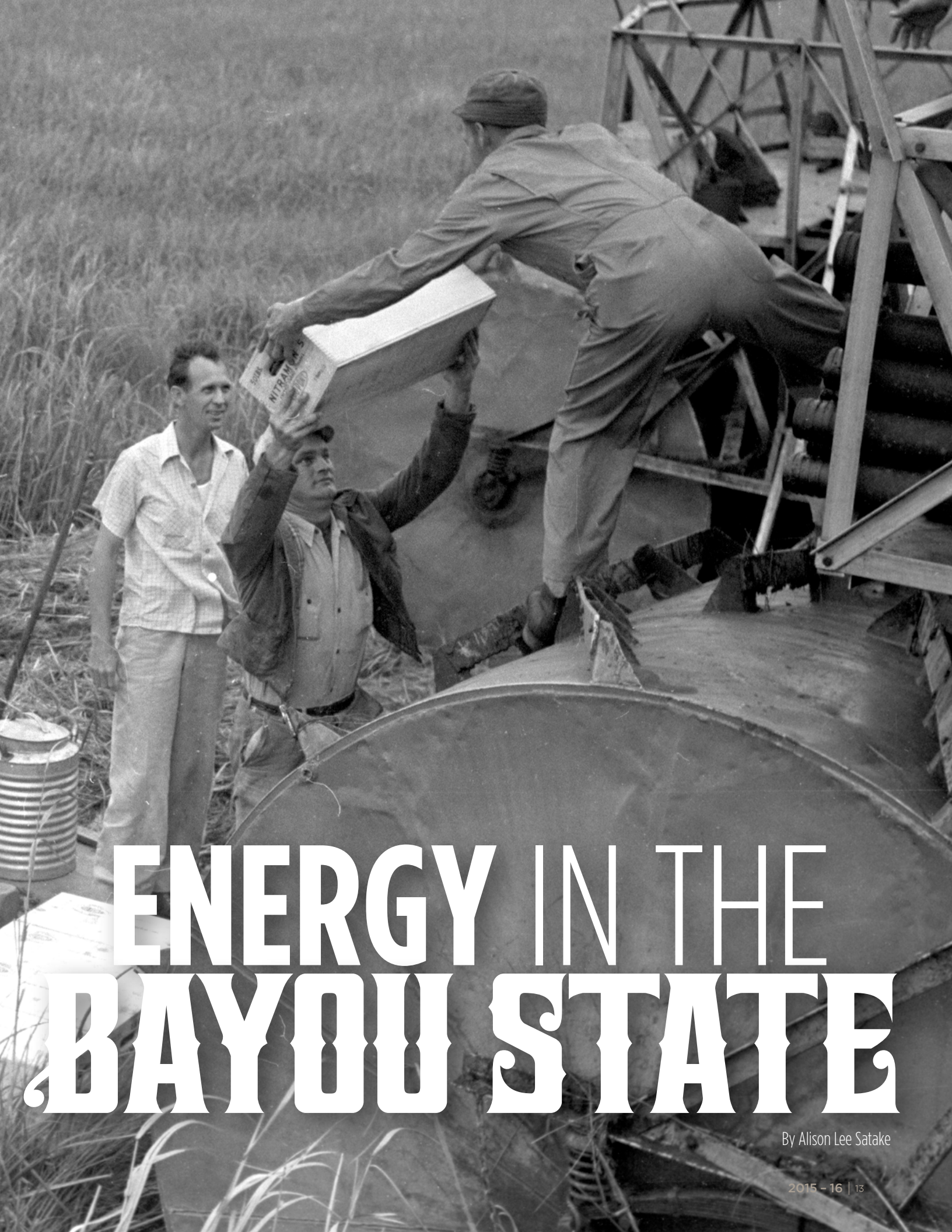
In addition, his research on GUMBOS has led Warner to work on organic compounds that emit blue light. Typically, synthetic chemical compounds are used in blue LED lighting. However, since Organic-based Blue Light Emitting Diodes, or OLEDs, entered the market in 2001, Warner has been researching the potential of GUMBOS to improve efficiencies for lighting, solar energy, and harvesting energy.

“If we achieve what we hope to with our compound, it will be something no one has done before. It will be amazing,” Warner said.



State-wide Impact





ENERGY IN THE BAYOU STATE

By Alison Lee Satake

Louisiana has the prime geological ingredients and conditions for naturally occurring crude oil. The first residents of the region saw it seep up from the ground even before its modern-day uses and profitability were identified. It was applied as medicine by Native Americans while early explorers called it “stone pitch” and used it to seal their ships. The sediments, salt, temperature, and timing of geologic events all contributed to the right recipe that put south Louisiana’s abundant crude oil, and subsequent energy industry, on the map, according to the Louisiana Department of Natural Resources.

No other industry had as much of an impact on the shaping of Louisiana’s economy, geography, culture, and society as the developing oil and gas industry in the 20th century. Louisiana’s first oil well was drilled in 1901. A group of businessmen and landowners in Jennings, La., pooled their resources and asked oil prospector Walter Scott Heywood to oversee the development of the Jennings Oil Company and the state’s first oil well. Born in Cleveland, Ohio, Heywood was a professional musician who had mined for gold in Alaska before prospecting for oil in California and Texas. He signed on as the superintendent for the first oil well drilling project in Louisiana, which was located on a privately owned rice field. However, sand clogged the Jennings oil well until it eventually had to be abandoned, according to the “History of the Offshore Oil and Gas Industry in Southern Louisiana,” produced by the LSU Center for Energy Studies for the Department of the Interior.





Heywood continued to conduct business in the burgeoning Louisiana oil industry. He worked closely with newly elected Gov. Huey Long and eventually served as a member of the Louisiana Mineral Board and as a state senator. He died in Jennings in 1950.

The bayous and other bodies of water in South Louisiana became hotbeds for fossil fuel production by the late 1920s and 1930s. Local shrimpers, trappers, and farmers applied their knowledge of the area and were hired at higher and steadier pay than their previous occupations to help small and large oil companies navigate the coast in search of oil. Companies began to flood Louisiana, with the biggest being Shell, the Texas Company, and the California Company. The job opportunities also drew workers from north Louisiana, Arkansas, Oklahoma, and Texas to the region.

Technology Leaders

As demand for oil increased, new ways to find oil deposits at greater depths became essential. The Gulf Coast pioneered using geophysical technology for more advanced oil exploration. One tool that was used in the 1920s and 1930s was the refraction seismograph, which sends sound waves down through the earth and records the reverberations that detect oil-bearing formations. This technology transformed oil exploration throughout the U.S., particularly along the Texas-Louisiana Gulf Coast.

Another tool used for oil exploration was the torsion balance, consisting of two weighted beams suspended by a wire that detects gravitational variation at different sites. About 79 oil fields in the Gulf Coast were discovered using the torsion balance from the 1920s to 1938 before it was replaced by a simpler device called the gravimeter, according to the Society of Exploration Geophysicists.

Advances in geophysical technology opened the pathway for oil exploration to move from onshore marine environments to off the shore and into the Gulf of Mexico. In 1947, the first offshore oil well that was out-of-view from land was completed off Morgan City, La. Kerr-McGee and Phillips Petroleum led this first far-offshore drilling project with a group of other companies.

During World War II, Louisiana housed military facilities that built equipment and landing craft for the war. After the war, oil companies bought the surplus boats, equipment, and technology to use in offshore oil exploration and drilling.

Pictured on opening spread: Seismograph operations of Humble Oil and Refining Company near Golden Meadow, Louisiana. Unloading from bateau to marsh buggy in early morning. Marsh buggies are left in the marsh and contact between them and the quarter boat is maintained by bateau and speed boat. Photo by Russell Lee, 1950. Pictured at left: Drilling a hole with a hydraulic drill. Water for the drill is obtained from slush pits dynamited in the swamp. This water is then forced to the drill by centrifugal pump powered by an outboard motor head. Photo by Russell Lee, 1947. Louisiana images from the Standard Oil (NJ) Collection, Archives and Special Collections, University of Louisville.





The three cat crackers of the Baton Rouge refinery. Cumene plant in the foreground. Photo by Edwin and Louise Roskam, 1943. Pictured at left: Aboard the tug *Bertha* towing a 7,000 barrel barge of crude oil from Bayou de Glaise to Baton Rouge. Whiskey Bay Pilot Channel. K.J. Marioneaux, pilot. I.J. Marioneaux, pilot. Lowering the pipeline hose to load up with crude oil. Photo by Arnold Eagle, 1946. Louisiana images from the Standard Oil (NJ) Collection, Archives and Special Collections, University of Louisville.

“The military technology and military surplus equipment has a lot to do with why we can do offshore,” said David Dismukes, director of the LSU Center for Energy Studies. “The [World War II landing craft] is the predecessor of the modern-day drill ship.”

As the offshore oil industry grew, towns along the Alabama, Mississippi, Louisiana, and Texas coast grew to support the new industry. More than 4,000 offshore oil platforms are located within 200 miles of this stretch of coastline, according to the LSU Center for Energy Studies.

Today about 300,000 people work along the Gulf of Mexico in the energy industry. The Gulf Coast imports about 60 percent of all of the crude oil in the U.S., and about 40 percent of the refining capacity in the U.S. is located in this region.

“It’s a very concentrated and important area of the country,” Dismukes said.

We have geologists and geographers, as well as people who specialize in nuclear science, engineering, statistics, and economics. We focus on issues that affect the citizens, the environment, and the economy of Louisiana.

— David Dismukes,
Director of the LSU Center for Energy Studies



Baton Rouge tank farm of Plantation Pipe Line Company. In foreground is manifold, which controls flow to and from 48 tanks on farm. Photo by Sol Libsohn, 1944. Louisiana images from the Standard Oil (NJ) Collection, Archives and Special Collections, University of Louisville.

Louisiana is not only a producer of hydrocarbons, but also a major consumer through the state's petrochemical industry, which uses natural gas and other types of hydrocarbons as fuel. The synthetics produced here are used in a variety of products from carpets to tires to cosmetics.

Information Hub

With all of the industrial activity in the region, Dismukes' Center for Energy Studies at LSU serves as a source for information and a convener of experts. When the public sector—including policymakers, regulators, and taxing authorities at the state and federal level—need information to formulate decisions that will affect the ever-evolving industry, they approach the Center for Energy Studies. For example, when clean energy initiatives such as capturing carbon for credits were being proposed, Dismukes and colleagues ran

the analyses for the cost and logistics behind these proposed policies.

“My company does not have the resources or research expertise for in-depth analysis of many energy issues, so the Center for Energy Studies provides a lot of value to us. Anything that is produced by the Center for Energy Studies is held in the highest regard by all parties throughout the energy industry in Louisiana,” said Emile Cordaro, governmental affairs manager for American Electric Power.

In the aftermath of Hurricane Katrina, many people were scrambling for information on which refineries were out and how much production was down. Due to the center's previous work creating Geographic Information Systems, or GIS, on the area's energy industry infrastructure, it became a valuable resource for this information.



The Plantation Pipe Line Company operated by Kinder Morgan, 2015. Photo by LSU.

“We have geologists and geographers, as well as people who specialize in nuclear science, engineering, statistics, and economics. We focus on issues that affect the citizens, the environment, and the economy of Louisiana,” Dismukes said.

Through the center’s industry advisory committee, Dismukes maintains a network of energy industry leaders in the region. The Center for Energy Studies convenes Louisiana energy industry decision-makers through its annual Energy Summit and events throughout the year such as the screening of documentary film *Fracknation*.

“To some people, it might not seem like a lot. But in the energy business here in Louisiana, when we get 200 people to show up, that’s pretty much every energy industry leader in the state,” he said. “When you have that many people showing up on a consistent basis and interacting, I feel like we’re doing our jobs.”

Fundamental Economics

When the Federal Reserve stopped increasing the money supply by backing off from Quantitative Easing, the dollar became stronger. Because crude oil is valued in dollars, its price was driven down. However, demand for crude did not increase. Dismukes saw that a correction in oil prices was due, but he did not think the price would drop so low.

“That’s why the solution to this is going to be a combination of two things: how will supply react to these lower prices and how quickly will people come back in terms of their economic activity? That’s one of the reasons why I think people are anticipating that we’ll wind up staying through this for the better part of 2015 at least,” Dismukes said.

Newton's Solution

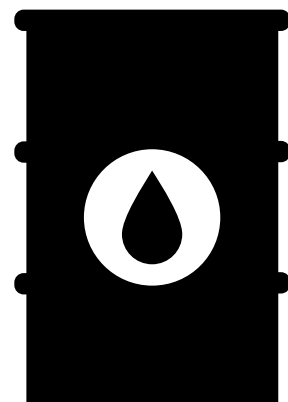
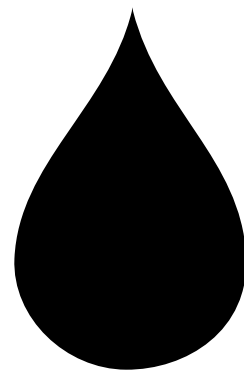
By Alison Lee Satake

Sir Isaac Newton's discovery of gravity—every object in the universe attracts another object with a force that is proportional to their masses—is a fundamental concept from which discoveries have abounded throughout the natural world.

The idea that a heavy object falls faster than a lighter object, a concept discovered in the 17th century, has inspired a solution for a modern-day problem.

In drilled oil fields around the world, large deposits of “black gold” are left behind. The most common methods to extract oil recover only about 5 to 10 percent of it. As a result, in Louisiana, there are still about 12.5 billion barrels of oil remaining in oil fields that have already been drilled. In the U.S., there are about 450 billion barrels, and worldwide, there are about 2 trillion barrels left untapped.

One of the traditional methods used to extract oil is called water alternating gas, or WAG. In this process, carbon dioxide—or CO_2 —and water are pumped into the ground as alternate slugs.



Dandina Rao, a petroleum engineer and scholar, has dedicated his career to finding a way to extract more resources cost effectively. He critically examined the WAG process, which had shown 60 percent recovery rates in lab experiments. But in the field, the CO₂ and water passed over pockets of oil, rather than sweeping it all out to producing wells as it was designed to do. At first, Rao thought of ideas to improve WAG, such as adding foaming surfactants to improve reservoir sweep by the CO₂ or adding a polymer to increase the viscosity of the water. Then, like Newton, it hit him: gravity causes the CO₂ to rise to the top while the heavier density water falls down to the bottom. The ensuing unswept pocket in the reservoir that is not penetrated by either CO₂ or water leaves the residual oil reserves virtually untouched.

Rao's ah-ha moment led him to take the water out of the equation and simply pump CO₂ gas into the top of depleted oilfields, where oil and water remain. The results were groundbreaking. By pumping CO₂ into the top of the reservoir at a high pressure, all of the heavier liquids—oil and water—drain downward. Then, horizontal wells at the bottom of the pay zone capture the draining oil and draw it to the surface.

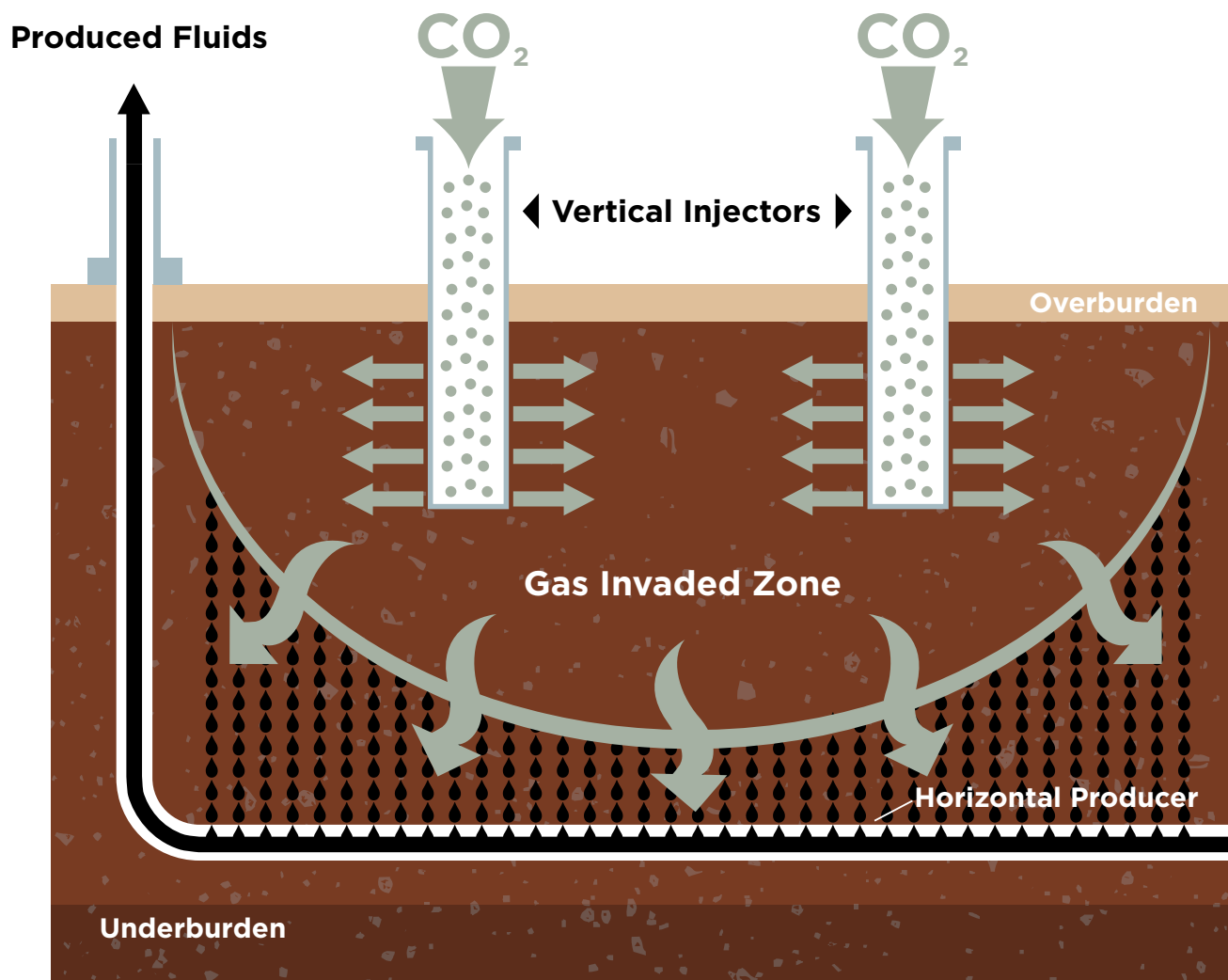
“It’s like a rain of oil and water coming down,” Rao said.

Rao and his graduate student researchers at LSU identified three physical processes that are at play during his newly discovered Gas-Assisted Gravity Drainage, or GAGD, enhanced oil recovery method. First, the injected gas displaces residual oil at the oil-gas interface in the reservoir. Secondly, as discussed earlier, gravity has a

It’s like a rain of oil and water coming down.

— Dandina Rao,

Emmet C. Wells Distinguished Professor of Petroleum Engineering





Dandina Rao, Craft & Hawkins Department of Petroleum Engineering professor, works with students to develop the next generation of energy industry technology.

hand in draining the oil downward. Lastly, trapped oil begins to flow down channels of drained oil in a process called film flow.

“These three physical mechanisms in the GAGD process could offer faster rates and higher oil recovery factors,” Rao said.

Traditional oil recovery processes, like WAG, also inject purified CO₂ into the oil well. The pure CO₂ mixes with the oil, which is called miscible gas displacement, and enhances the oil recovery. However, purifying the gas can be costly. In contrast, the GAGD process works well with pure or impure CO₂, which can be miscible or immiscible. That means that gas can be injected relatively directly from the flue gas of a smokestack back into the ground and can activate GAGD. This gives the GAGD process the added advantage of sequestering CO₂.

“By not having to separate the CO₂ and by using the entire gas stream as it comes out of the flue stacks,

you’re saving 75 percent of the raw material cost of your project. That is a tremendous benefit on the profit side,” Rao said.

Researcher Spotlight

As a young engineer, Rao began to specialize when he left his home country of India to pursue a master’s degree in chemical engineering at the University of Saskatchewan in Saskatoon, Canada. (Canada is a world leader in oil and gas extraction and petroleum engineering.) He arrived in Saskatoon in January, on a day that was -40 degrees in both Fahrenheit and Celsius.

After completing his master’s degree, he received his doctorate at the University of Calgary. In 1984, he began to work as a research engineer for several energy companies including Shell Canada. In 1999, he joined the faculty of the Craft & Hawkins Department of Petroleum Engineering at LSU.



Dandina Rao's Gas-Assisted Gravity Drainage, or GAGD, process demonstrated at the LSU Innovation Park. Photo by LSU.

"It's fascinating to think that the best we can do after years and years of primary depletion and secondary water flooding, 50 to 60 years of doing this, you get only one-third of the oil out, at best 35 percent of the oil out, and you leave 65 percent of the oil in the ground," he said. "That's why I was fascinated by this field of enhanced oil recovery technology, because it gives us a second shot to go after that remaining 65 percent."

Next Steps

Rao is currently in discussion with several energy companies that are interested in licensing GAGD. Until then, he and his graduate students will continue to push the boundaries of enhanced oil recovery. In his lab, they are able to test oil recovery processes and rock-fluid interactions under pressures up to 20,000 pounds per square inch, or PSI, and temperatures up to 400 degrees Fahrenheit.

"I've built a lab that's pretty unique in the world," he said.

Rao's next goal is to create the Louisiana Center for Oil Recovery Enhancement, or LaCORE, to bring industry professionals and university researchers together in order to research, develop, and deploy new technologies in the oil fields. The University of Wyoming in Laramie created a similar Enhanced Oil Recovery Institute and has since seen oil production increase. About 6 million barrels of oil were produced from enhanced oil recovery projects in Wyoming in 2009, according to the institute's website.

"We Louisianans need a center for enhanced oil recovery at LSU. We have the man power, the determination, the knowledge, and the students who can make it happen," Rao said.

Delving Into the Deep

In Search of Energy Resources and Biodiversity in the Gulf of Mexico

By Tara H. Kistler

The planet we call home is a wondrous mystery. Much about Earth is still waiting to be discovered. This rings even more true in regards to the vast, alien landscapes of the ocean, which covers more than 70 percent of our planet.

Although they may seem at odds, oceanographers and deep water oil and gas explorers share a common interest — to better understand and document our oceans.

Oceanographer Mark Benfield partners with Gulf of Mexico energy companies that utilize remotely operated vehicles, or ROVs, for oil and gas exploration. Benfield, who is a professor in the LSU Department of Oceanography & Coastal Sciences, trains these commercial ROV operators on how to observe, identify, and capture unique marine organisms on video. The energy industry is part of this large-scale scientific project and has a front-row view of marine life in the Gulf beneath their facilities.

The Gulf Scientific and Environmental ROV Partnership using Existing Industrial Technology, or Gulf SERPENT, project studies and collects data on the distribution and biodiversity of marine organisms living in the Gulf of Mexico. Before Gulf SERPENT there was little opportunity to witness these animals in their natural habitat because there are so few research ROVs; that's what makes this project unique.





Gulf SERPENT captured this rare image of the oarfish, and some of the only existing footage in the world of this animal alive. Photo courtesy of Gulf SERPENT.



Histiototeuthis squid captured on camera by an ROV conducting work for Chevron aboard the *Discoverer Clear Leader*. Photo courtesy of Gulf SERPENT.



A six-foot-long *Magnapinna* or Bigfin squid at 7,000-foot depth in the Gulf of Mexico captured on camera during *Globetrotter 1* rig operations for Shell. Photo courtesy of Gulf SERPENT.



From left to right: ROV operator Tyger Dodd and LSU post-doctoral researcher Matt Kupchick in the ROV cockpit aboard the *Vantage Titanium Explorer* chartered by Petrobras America. Photo by Mark Benfield, LSU.

“We don’t understand very much about the ways these animals move and live. Our primary objective is to understand biodiversity—specifically, what animals are present, where they are found, when they are present, and what they are doing,” Benfield said.

The idea of using the energy companies’ ROVs for scientific research came to Benfield, during his post-doctoral work with LSU School of the Coast & Environment Associate Dean Richard Shaw. While assisting Shaw with his previous research, the two were doing a lot of work on shallow water platforms.

“I started realizing that on the deeper vessels, they had these ROVs. And I thought it would be really cool to find a way to use them for science,” Benfield said.

While looking for an opportunity to partner with deep water oil and gas exploration companies for science, he discovered SERPENT, a global network of partnerships between the energy industry and scientists, which is based in Southampton, England. He joined the network and formed Gulf SERPENT in 2006. He has spent the

The value is priceless. At least you have some idea of how conditions have changed after an incident and what you need to get back to, rather than just working with a worst case scenario estimation.

— Mark Benfield,
Professor of Oceanography & Coastal Sciences



Piglet squid recorded at 3,000-foot depth in the Gulf of Mexico during operations for Petrobras America by the *Vantage Titanium Explorer* rig. Photo courtesy of Gulf SERPENT.

past nine years collecting data, cataloging and sorting observation video clips, identifying species, and building the Gulf of Mexico marine database.

Benfield and his team have captured never-before-seen images and video of marine animals inhabiting the Gulf of Mexico such as the Arctic Greenland Shark. This cold-water shark is known to occupy the waters of the far north Atlantic. So it came as a surprise when one was captured on camera in 4 degree Celsius waters in the Gulf of Mexico. According to Benfield, this was the first time this species of shark had ever been seen in this location. Benfield and his team soon discovered that as the shark travels south, it plunges into deeper water. Since the first sighting, the team has made several more Greenland Shark observations. The ROVs have also captured footage of an enormous jellyfish called *Stygiomedusa gigantea*. It is 20 feet long and its bell is 3 feet in diameter. This particular sea creature is another species that, up until recently, was not known to reside in the Gulf of Mexico. It is a rare find but Gulf SERPENT has seen nearly a dozen of them.

Although these, among the many other findings, just scratch the surface, Gulf SERPENT also benefits the oil

and gas industry. From the ROV footage, Benfield and his team can present quantitative data and images of what original or normal conditions are like in the marine environment before the next oil spill or other incident.

“The value is priceless,” Benfield said. “At least you have some idea of how conditions have changed after an incident and what you need to get back to, rather than just working with a worst case scenario estimation.”

Gathering this information takes a lot of time, effort, and hard work from Benfield, his colleague Matt Kupchik, and the ROV pilots-turned-marine biologists.

When a new industrial partner is introduced or a company plans to drill in the Gulf of Mexico, Benfield makes a trip to the rig and walks them through SERPENT, explaining what the operation is and what they are looking for. A large part of the process is discussing the project’s approach, beginning with how Gulf SERPENT provides advice and tested mechanisms for ROV operators to become part-time marine biologists.

“They become the oceanographers,” Benfield said.



Professor Mark Benfield and an ROV aboard the *Vantage Titanium Explorer* chartered by Petrobras America. Photo by Matt Kupchick, LSU.

In addition to training, scientists arrange regular visits to offshore oil and gas platforms, where they can survey vessels, semisubmersible drilling rigs, and production platforms. This is also important for working with the ROV pilots and encouraging them to conduct research during stand-by time and to process samples. So little is known about the deep sea that this unique partnership between scientists and the energy industry advances our knowledge exponentially.

Benfield continues to improve the project's research methods and data collection. He is building a new device that will attach to ROVs and enable them to collect specimens from which DNA can be used for identification.

"The big challenge is identifying the animals. You really can only get so much information from a photo," Benfield said. "So often we can't tell you what species

it is, but we can say what family it belongs to. So hopefully this device will be something we can add down the road."

While working on SERPENT, Benfield has had the opportunity to partner with several companies in the oil and gas industry. Not only do the oil companies and scientists get an idea of what conditions are like, the general public gets an opportunity to see marine life that they otherwise wouldn't see through the online database of images and videos.

"It's the most fun of all the research I've done, and it's a chance to work with industry," Benfield said.

To view Gulf SERPENT images and video, visit the project's website and YouTube channel.



A Better



Tomorrow

Public and Private Partnerships Advance Clean Energy

By Alison Lee Satake

Protecting the environment and sustaining our way of life are challenges being tackled by policymakers, business leaders, and researchers. Clean energy poses an opportunity to increase energy efficiency and to develop alternative fuels that can be better for the planet as well as the bottom line. According to the Pew Charitable Trust, the clean energy sector is projected to produce about \$1.9 trillion in revenue worldwide through 2018. The opportunity is enormous. And industry looks to research universities, like LSU, to help them pave the path toward a better future.

Renewables and environmental issues already comprise the majority of LSU energy research funding today, according to a recent LSU Energy Initiative Task Force report. Researchers across campus, but particularly those in the LSU AgCenter, the College of Agriculture, the College of Engineering, and the College of Science are engaged in research in the clean energy sector.

Krishnaswamy “Kumar” Nandakumar, a Gordon A. and Mary Cain Endowed Chair in the LSU Cain Department of Chemical Engineering, has created a collaboration among colleagues in the petroleum and mechanical engineering departments to solve problems and to develop better practices for industry. This collaboration named EPIC for Enabling Process Innovation through Computation was created to work on ways to improve the manufacturing of chemicals and gasoline. The engineers use advanced computer simulations to analyze and improve processes so they are less environmentally threatening and more energy efficient.

“The way we are taking fossil fuels and burning them up and putting them into the atmosphere with accumulated CO₂ and global warming is a real challenge. If we don’t address it now, the global warming problem will become irreversible,” Nandakumar said. “That means instead of relying entirely on fossil fuels, we need to rely more on renewable fuels. Louisiana is a great place for renewable resource development, because we have a lot of sun, plenty of water, and plants grow very well here.”

Natural Resources

In the middle of a sugarcane field, LSU AgCenter Vice Chancellor John Russin shows how researchers are developing new methods to produce biofuels using Louisiana crops and infrastructure. The Sustainable Bioproducts Initiative is one of the federally funded energy projects at LSU. About 75 percent of LSU’s energy-related research is supported by federal funding institutions such as the National Science Foundation.

A \$17 million grant from the Department of Agriculture is funding the research on a high-fiber sugarcane called Energy Cane and sweet sorghum as well as the production, harvest, processing, and transportation logistics of biofuels in the southern U.S. The Sustainable Bioproducts Initiative aims to use existing sugarcane processing factories, which typically operate only three months out of the year in Louisiana. The initiative is developing a business case to use these resources the rest of the year, which will offer growers and processors another opportunity to produce additional high-value products. Sweet sorghum also can grow on marginal lands; therefore, it will not displace land for food crops.

“While natural gas, oil and coal, and other carbon-based technologies have been in place for many years, the future lies beyond those. We are working very closely with our colleagues in the public and private sectors to develop alternatives to traditional energy sources and to build a sustainable future, while maintaining energy independence,” Russin said.

Hot Water

A few years ago, LSU geologist Barbara Dutrow worked with a multidisciplinary team to help target the ideal location for a geothermal well in southern California, which now supplies power to the area. To understand the longevity of the geothermal system, the scientists



LSU AgCenter Vice President John Russin. Photo by LSU.

took rock samples every few feet as they were drilling in order to map the temperature profile of the area. Because Dutrow specializes in mineralogy, the company that owns the well contracted her to analyze mineral compositions in contact with the geothermal fluids as well. Understanding how the fluids and minerals interact under specific pressures and temperatures helps predict the chemical reactions in the subsurface that could facilitate or impede energy production and the potential corrosion problems when the hot fluids surface and cool in a geothermal pipeline.

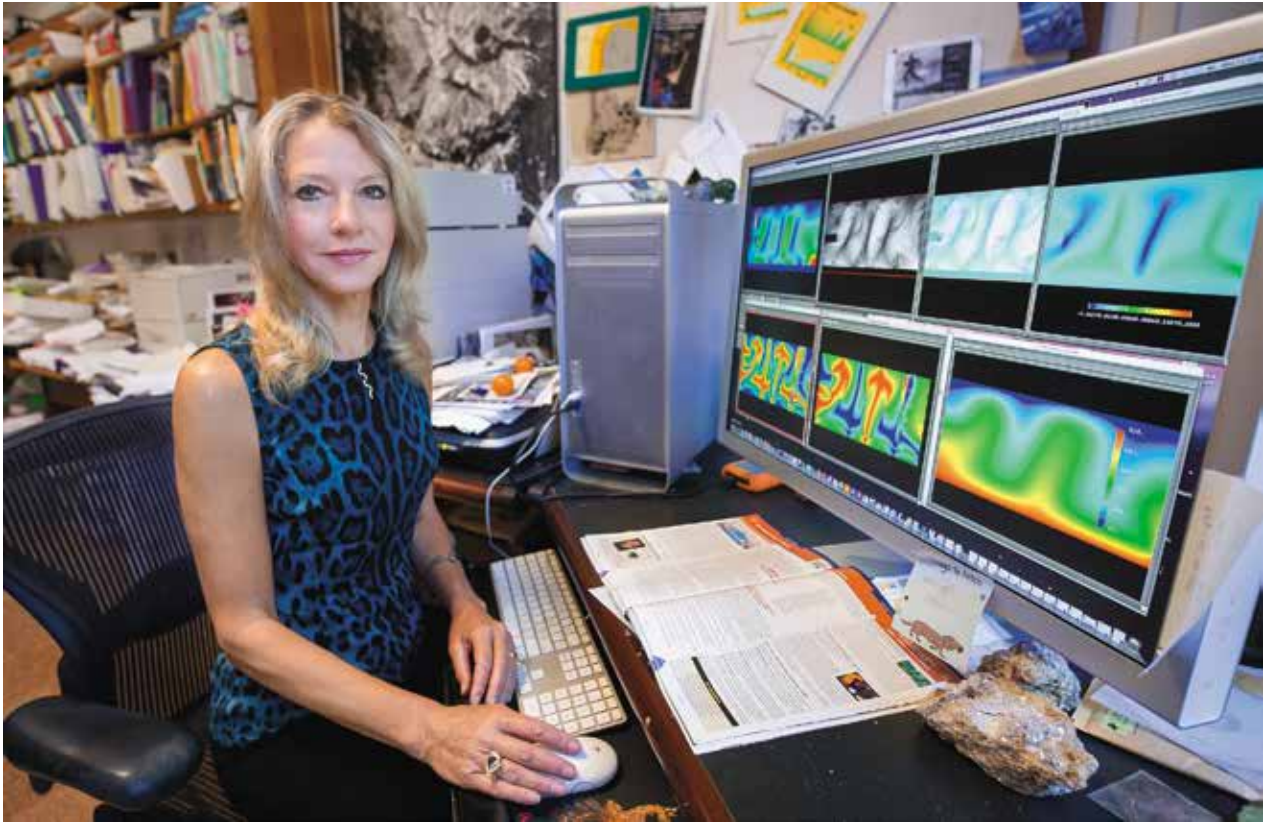
Because minerals comprising the host rocks for the geothermal system change depending on the pressure and temperature, a series of index minerals that form at specific temperatures assist geologists, including Dutrow, in tracking the system through time to figure out at which temperature it now resides.

“The composition and stability of the minerals is key. Understanding those factors is how I started studying geothermal systems,” said Dutrow, who is the Adolphe G. Guyemard professor of geology at LSU.

For example, she has a granite-like rock in her office from the Geysers geothermal field in northern California that has veins of tourmaline filling its tiny fractures. Through chemical analysis of the minerals, she can identify where in the geothermal lifecycle this rock is including whether the geothermal system is prograding, or heating up, or retrograding, or cooling down. This can indicate how much longer a geothermal system can produce energy.

She also is involved in studying low temperature geothermal systems in Louisiana. One of her students, Tessa Hermes, received funding from the Louisiana Board of Regents for her master’s degree research on the geothermal potential of northeastern Louisiana, where there is higher than normal heat flow.

“There seems to be some high heat flow areas across parts of northern Louisiana. We’re not really sure of the source. But it looks like those areas could be targets for geothermal energy production,” Dutrow said. Dutrow also collaborates with researchers in the Craft & Hawkins Department of Petroleum Engineering on geothermal systems in southern Louisiana. This



Barbara Dutrow, Adolphe G. Gueymard Professor of Geology. Photo by LSU.

project, funded by the Department of Energy, targets low-temperature geothermal systems.

She specializes in fluid-mineral interactions that extend from geothermal systems into deeper earth, some 20 kilometers deep and up to 700 degrees Celsius. The interactions are recorded in the minerals.

“We can read the rock record by looking at the mineral chemistry,” she said. And it’s exciting. “You get to understand the evolution of the earth and its processes—including how geothermal systems evolve.”

Out of the Box

Mathematician Blaise Bourdin describes himself as “application agnostic.” However, shortly after he joined the faculty at LSU, he began collaborating with faculty from the mechanical engineering, geology, and petroleum engineering departments. His colleagues saw the practical application of his research on fracture mechanics. That’s how he says became interested in geothermal and conventional reservoir simulation.

There seems to be some high heat flow areas across the U.S. We’re not really sure of the source. But it looks like those areas could be targets for geothermal energy production.

— Barbara Dutrow,
Adolphe G. Gueymard Professor of Geology



Krishnaswamy "Kumar" Nandakumar, a Gordon A. and Mary Cain Endowed Chair in the LSU Cain Department of Chemical Engineering. Photo by LSU.

For the past five years, his research has been funded by Chevron. However, the company's contract with Bourdin has morphed with trends in the industry. For example, when the Department of Energy was investing in geothermal systems in 2008, his research for Chevron involved reservoir stimulation for enhanced geothermal systems. Since then, the shale boom has increased the industry's interest in hydraulic stimulation.

In hydraulic fracturing or fracking, a horizontal well is drilled and then perforated by high-pressure water, which creates cracks where hydrocarbons in the rock can be harvested. How far apart the water should be injected and how and where the cracks will grow is difficult to predict. Fracking brochures may depict equidistant cracks that grow symmetrically. However, in reality, that is never the case.

"If one [crack] gets slightly ahead of the other, the other one won't have enough pressure, energy, strength, or oomph to go while the other one keeps going," he said.

Classical methods in fracture mechanics also require already knowing when and where a crack will go. Plus,

field experiments are nearly impossible because of the underground depth and inability to visualize the crack pattern. Therefore, numerical simulations have a strong appeal.

With funding from the National Science Foundation, Bourdin was part of a research group that developed a computer model that can predict through numerical simulation how and where a crack will nucleate then grow in any condition.

"The advantage of our model is you don't need to know beforehand where your crack is going to go and that's very important in the context of hydraulic fracturing because the problems are so complex that it's difficult to use basic intuition," Bourdin said.

Bourdin's research has focused on brittle fracture, which occurs in material that breaks sharply but can be put back together, such as glass. However, upon further investigation of the experimental data, he noticed that the rocks at fracking depth may not be brittle. So one of the graduate students he is advising, Erwan Tanné, who is pursuing his doctorate at the École Polytechnique in France, is working on applying the model to cracks in materials that are permanently deformed when broken, which are called ductile fractures. They behave differently than brittle fractures and appear to be anomalies.

Another one of his graduate students, Chukwudi Chukwudozie, who is pursuing his Ph.D. at LSU in petroleum engineering, did computations on the flows in the fracture and reservoir and also observed a new phenomenon. Closely formed cracks sometimes grow in opposite directions.

Chevron sees value in applying the variational fracture models Bourdin and his research team developed to its reservoir simulations.

"My understanding is they are quite intrigued by our new findings because we don't make all of these classical assumptions. These unexpected fracture patterns are something they are really interested in investigating," he said. "The strength of the university is not the things that we have. It's the ideas we can come up with."

Bourdin has a history of questioning assumptions. He recalls an experiment in the scientific literature that said that if you crack a piece of glass, it will create more beautiful, oscillating cracks. But he struggled with duplicating this experiment in his computations until one day he emailed one of the authors. The author replied immediately confirming that what Bourdin was seeing in his numerical simulations was what the author had seen in the experiment, but he had assumed the experiment had been failing and threw away those outlying samples.

"It's important to understand your assumptions," he said. "You tend to ignore the evidence if it doesn't fit with your mind frame, but reality is richer."

New Frontier: Catalyzing Clean Energy

From cooling your home in the summer to driving your automobile around town, energy plays a role in everyday life. James “Jerry” Spivey, the James McLaurin Shivers professor of chemical engineering, strives to make it better.

Spivey, who joined the LSU College of Engineering’s Cain Department of Chemical Engineering in 2003, develops advanced research tools to more efficiently convert resources—like natural gas, biomass, or coals—into clean energy and higher value products.

“My research, more specifically, focuses on catalysis,” he said, noting catalysts are materials that accelerate the rate of chemical reactions. “We develop catalysts, we analyze them, we test them, and we try to understand the fundamental processes.”

Spivey first began working with catalysts as a graduate student at LSU, where he carried out research on a catalytic refinery operation. After graduation, he spent 20 years working at a contract research organization, where his interests in catalysts and energy evolved.

During that time, he also began working closely with the Department of Energy, a relationship that has carried into his current ventures at LSU. Since 2009, Spivey has led a \$20 million frontier research center called the LSU Center for Atomic Level Catalyst Design, funded primarily by the federal agency.

The Center, which is now at the end of its funding period, is one of 46 Energy Frontier Research Centers, or EFRCs, established by the federal government to “accelerate high-risk, high-reward fundamental research that will provide a strong basis for transformative energy technologies of the future.”



James “Jerry” Spivey, the James McLaurin Shivers professor of chemical engineering. Photo by LSU.

The Center—which involves 11 partner institutions, 21 Principle Investigators, and approximately 50 graduate students and post-doctoral researchers—brings together a team of researchers whose goal is to advance the tools of computational catalysis, materials synthesis, and characterization.

“As of today, those three areas are not bridged,” Spivey said in a recent interview. “We cannot seamlessly design a catalyst atom-by-atom. For example, after someone designs a catalyst on a computer or solves the equations that tell how the atoms are arranged in a catalyst, the catalyst must be synthesized with the atomic precision that corresponds with the computation. Once that’s done, the third step is to characterize the catalyst. There are limitations in each capability. So what we are trying to do in our Center is use facilities, like the synchrotron, to bridge those capabilities.”

Simply put, Spivey said: “The goal of the Center was to

advance tools to do things they couldn’t do before.” Years later, he said, the group can point to a number of examples where they accomplished that goal.

The team’s work with the chemical company Albemarle to develop a way to convert natural gas into clean fuels is one example. Another is a project, sponsored by Chevron, to convert synthesis gas, which is a mixture of hydrogen and carbon monoxide, to alcohols. The list goes on.

But there’s still much ahead, he said, and his team is preparing for the next Energy Frontier Research Center Program announcement.

“One of the things I think people have little understanding of is how energy impacts their lives,” Spivey said. “We take for granted that we can flip our light switch, and the lights turn on. We take for granted that we breathe air that is not completely polluted. There are a lot of smart, dedicated people working on solutions to make it better, including us.”

By Sydni Dunn

From Sea to Sky:

What Corals and Satellites Can Tell Us about Climate Change



Scientists are studying oceanic climate change at LSU through two very different approaches: using historical ocean temperature data derived from corals found in both the Caribbean and the South Pacific, and using satellite imagery of the Gulf of Mexico, the Caribbean, and the East Pacific to study the effects of currents and water temperature on the formation and intensity of hurricanes. Department of Geography & Anthropology associate professor Kristine L. DeLong investigates shifts in sea surface temperature and ocean circulation over long periods of time. Taking a different tack, Nan D. Walker—the director of the Earth Scan Laboratory, the J. P. Morgan Distinguished Professor in Coastal Studies, and an associate professor in the Department of Oceanography & Coastal Sciences—uses satellite measurements of sea surface temperatures, data that are captured in real time to investigate air-sea interactions impacting hurricane intensity changes within the Western Hemisphere.

The Deepwater Horizon oil spill as viewed from the MODIS sensor. Surface oil appears bright within the sun-glint portion of the image and dark outside of the sun-glint. A remnant filament of oil, visible as light transitioning to dark, extends southeastward towards the Loop Current. Photo by Earth Scan Laboratory.

Historical Data Analysis

Working in the Florida Keys, the Gulf of Mexico, and the South Pacific near New Caledonia, about 1,200 miles east of Australia, DeLong studies variations in skeletal remains of large boulder-size corals to assess changes in sea surface temperature and ocean circulation, thus determining temperature patterns over the course of several hundred years. Some of the corals with which she works

can have a life span of 800 years. For example, her temperature reconstruction from the Dry Tortugas, the westernmost part of the Florida Keys, spans 274 years, and the reconstruction from New Caledonia covers 350 years.

In the study from the Dry Tortugas, the reconstructed temperature data reveal that from 1780 to 1890, summer temperatures cooled by one to two degrees on average. The cooler temperatures were the result of shifts in a large current in the Gulf of Mexico called the Loop Current and the Western Hemisphere Warm Pool, which influences precipitation in Central and North America. DeLong's findings were confirmed in this study by historical temperature records that date from the post-Civil War era and that were maintained at Fort Jefferson in the Dry Tortugas.

One of the conclusions of her work is that summer sea surface temperature extremes are increasing. Since 1985, the mean sea surface extremes in summer indicated in the coral samples exceed the long-term summer average from 1794 to 2008.

DeLong reconstructed sea surface temperature and oceanic water mass shifts in the South Pacific spanning the past 350 years using isotopic and trace element analysis. Her analysis showed a very large change—in fact, a “wholesale shift”—in currents during the 1950s, a finding that DeLong is still pondering. She finds as temperatures in the southwest Pacific grew warmer over time, colder currents shifted to the south.

“Global warming is exponential,” she said. “Currently, a huge amount of heat goes into the oceans.”

Along with that heat, the amount of carbon dioxide that dissolves into the oceans is also increasing. This carbon dioxide becomes carbonic acid, which dissolves not only the corals, but also the calciferous shells of such organisms as plankton, oysters, crabs, and other shellfish.

The Intergovernmental Panel on Climate Change, or IPCC, which is backed by the United Nations, predicts that all large coral reefs will be destroyed by 2100. However, many coral reef experts believe these reefs may be gone by 2050.

“The economic impact of the loss of the corals and hard-shelled animals will be devastating to the many communities that depend on them for a livelihood,” she said.

Furthermore, the disparity between food sources that are land based and those that are derived from the oceans effects how the public perceives threats to the ocean environment.

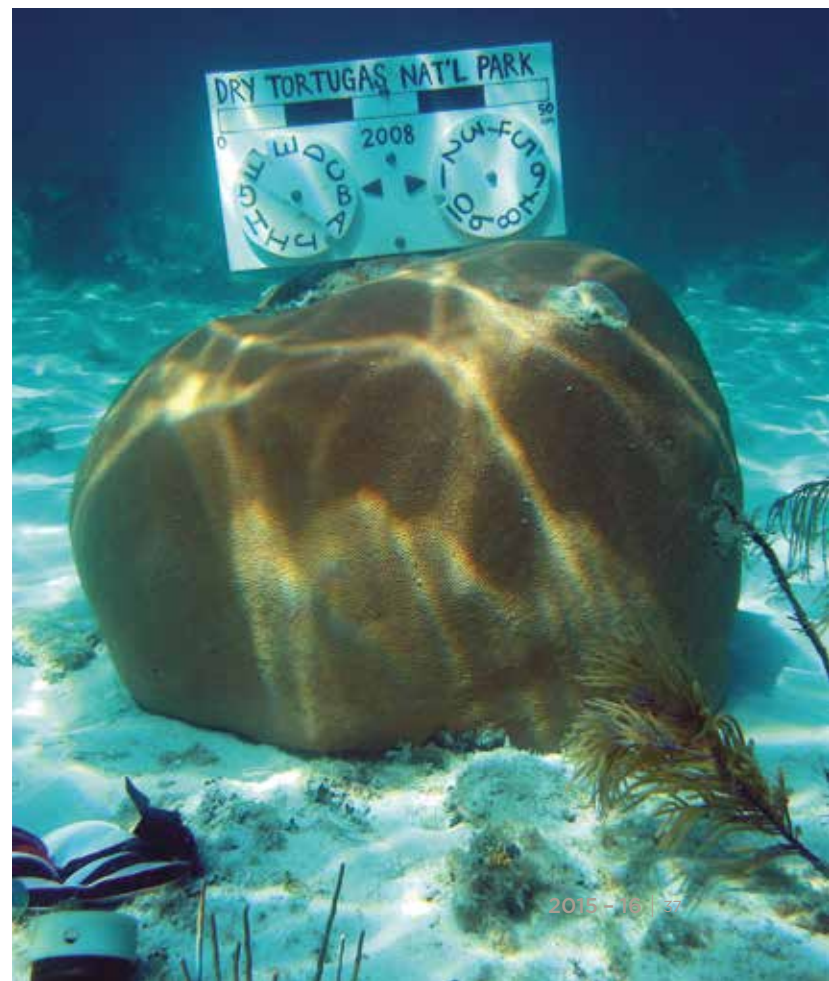
“Man has evolved ownership of crops and animal herds raised on land,” she said. “But no one ‘owns’ the oceans. Because no one has ownership, it’s more difficult to get people to understand that they have a stake in protecting the oceans.”

In addition to her recent studies in the Florida Keys and in the South Pacific, DeLong is continuing to work toward developing similar temperature reconstructions for coastal Mexico, the northern Gulf of Mexico, and Haiti. Her research in Haiti will examine 200 years of run-off and sedimentation and is designed to provide land managers in this deforested and agriculturally poor country with valuable data.

Keeping an Eye on Hurricanes and Ocean Eddies

While historical data provides information on future trends, sometimes knowing exactly what is going on now is critical. Walker’s work with the Earth Scan Laboratory, or ESL, is making satellite-derived information on oceanic, atmospheric, and coastal land environments available in near real-time.

The ESL was established in 1988 by Oscar Huh of the LSU Coastal Studies Institute. It is now also under the Department of Oceanography & Coastal Sciences within the School of the Coast & Environment. The ESL operational team consists of Walker, computer system manager Alaric Haag, as well as graduate and undergraduate students. Their work includes



Corals in the Dry Tortugas in 2008. Photo courtesy of Kristine L. DeLong, LSU.



Department of Geography & Anthropology Associate Professor Kristine L. DeLong conducting field work on corals in the Dry Tortugas in 2008. Photo courtesy of Kristine L. DeLong, LSU.

supplying data and images to the public and to a wide range of collaborators through the ESL website. They work in cooperation with federal and state agencies and industry to develop and disseminate accurate information that improves the surveillance and understanding of the complex and rapidly changing environments in Gulf of Mexico.

Three sensitive antennas located on the LSU campus receive real-time satellite measurements that Walker and students use to monitor and study air-sea-land interactions related to storms.

The largest of these antennas measures 4.4-meters across and is mounted on the roof of LSU's Howe-Russell-Kniffen Geoscience Complex. It is programmed to track three NASA satellites as they orbit the earth from pole to pole. Two of these satellites are part of the NASA Earth Observing System fleet and are equipped with the Moderate Resolution Imaging Spectroradiometer, or MODIS. It was designed to collect imagery data in 36 unique bands, with a maximum spatial resolution of 250 by 250 meters, to enable monitoring many of earth's processes.

MODIS data have been used at ESL to detect and track river and flood waters, algal blooms, and oil spills, and to plan field sampling campaigns on short notice. For example, Walker and her team used MODIS images to determine where to physically measure sediment inflow into Lake Pontchartrain at the Bonnet Carré Spillway as part of a National Science Foundation project on the impacts of the 2011 Mississippi River flood event. These images, which are updated daily, are also valuable for tracking river waters within river diversion regions such as Davis Pond, a primary site for coastal restoration efforts. In 2014, the ESL began receiving and processing measurements from a new NASA satellite sensor, Suomi NPP VIIRS. This sensor has similar capabilities but yields finer detail in ocean and atmospheric measurements.

A 3.7-meter fixed antenna captures data from GOES-East, one of the National Oceanographic and Atmospheric Administration's, or NOAA's, Geostationary Operational Environmental Satellites, which is used at LSU to track storms and ocean currents. This satellite, which maintains a geostationary orbit over the earth's equator at 75° W, keeps a near-constant vigil on atmospheric and oceanic conditions that affect the weather. It provides ESL researchers with real-time data, delivered in 15-minute intervals, of the Western Hemisphere Warm Pool region, which includes the Gulf of Mexico. Access to these data in real time allows the ESL team to monitor and study ocean temperatures and other conditions that affect tropical storm formation and intensification.

The smallest 1-meter antenna tracks data from NOAA's Polar Orbiting Environmental Satellites, or POES. These

satellites orbit Earth and cross both poles 14 times each day. They are equipped with the Advanced Very High Resolution Radiometer, or AVHRR, sensor that measures five spectral bands of energy with a 1.1 kilometer resolution. By combining the band measurements in various ways, scientists monitor and study ocean and land temperatures, water turbidity, atmospheric conditions, and even land vegetation.

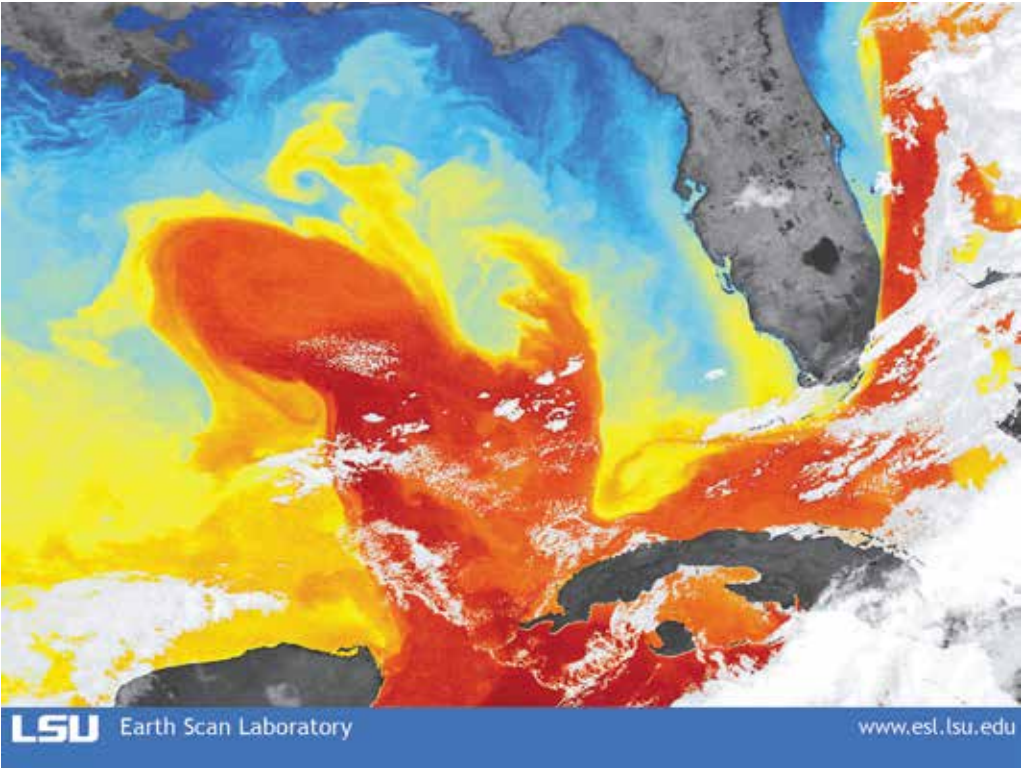
ESL began receiving AVHRR data in 1988, 10 years after the first POES satellite with an AVHRR sensor was launched. A 37-year long data archive acquired from a sequence of 15 consecutive POES satellites provides scientists with the longest continuous satellite history of sea surface temperatures globally, which is an invaluable record for recent climate studies.

Walker and her graduate students have been focusing on the ocean's effects on hurricane intensity. They track currents in the Gulf of Mexico and stress the importance of three specific types of Gulf currents: the Loop Current, warm-core eddies, and cold-core eddies. The Loop Current is an integral part of the Gulf Stream system, linking the Yucatan Current to the Florida Current. The large volumes of warm water that it brings into the Gulf increase evaporation and, subsequently, precipitation over the central and eastern U.S. Warm-core eddies measure hundreds of kilometers in diameter and are known to separate from the Loop Current after it intrudes far north into the central or eastern Gulf of Mexico. Once a warm-core eddy becomes free of the Loop Current, it drifts at about five to six kilometers per day westward, either toward Louisiana or Texas, affecting this global hotspot for oil and gas production. Cold-core eddies are smaller, more numerous, and move much more quickly than warm-core eddies. They typically move 35 kilometers per day, but have been tracked moving as fast as 70 kilometers per day along the outer margin of the Loop Current.

The counter-clockwise rotation within cold-core eddies induces strong upwelling at the eddy center, a process that brings cold water to the surface from depths as great as 100 meters. Cold-core eddies are especially important to the health of the Gulf because they bring nutrients to the surface in deep water, creating algal blooms that attract marine animals to areas that are typically known as biological deserts.

Walker also noticed that when cold-core eddies interact with hurricane-force winds and waves, extreme cold water upwells to the surface, and it can reduce a hurricane's intensity almost immediately.

"Hurricane Ivan in 2004 provided the first clear example of this process because the clouds cleared out quick enough so we could view two areas of extreme cooling from 30° to 20° Celsius, or 86 ° to 68 ° Fahrenheit, related to two cold-core eddies along Ivan's track. Ivan's wind



This temperature image acquired by the AVHRR in April 2003 reveals the high-velocity Loop Current surging northward and beginning to shed a warm-core eddy. Smaller cold-core eddies surrounding the Loop Current margin create an ideal habitat for fish spawning. These upwelling regions are nutrient rich, enhancing the biological activity in surface water. The warmest waters are depicted in red and the coldest waters in blue.

speed decreased twice after interacting with both cold-core eddies,” Walker explained.

Hurricane Katrina in 2005 provided another good example of the rapid impacts of cold water upwelling as Katrina decreased from category 5 to category 4 over a cold-core eddy soon before landfall. In one case in the Eastern Pacific, the cold water upwelling was so rapid and cold that it quelled a major hurricane, downgrading it to a tropical storm within 24 hours.

“I wish that happened more often in the Gulf!” she added.

Conversely, the Loop Current and warm-core eddies are known to fuel hurricane intensification. Hurricanes Katrina and Rita in 2005 both intensified rapidly as they encountered the Loop Current and warm-core eddies, deep reservoirs of warm water with almost unlimited energy for a moving storm system.

However, predicting hurricane or tropical storm intensity at landfall continues to be a challenge. Hurricane forecast model technology is just beginning to incorporate the details of the Loop Current and eddies, using satellite measurements as their guide. Incorporating both oceanic and atmospheric satellite data into the models will ultimately improve accuracy and our ability to predict deadly storms.

In addition to tracking storms, Walker and her colleagues also study the effects of Gulf currents on other phenomena, including oil spills. After the 2010 Deepwater Horizon oil spill in the Gulf of Mexico, Walker collaborated with University of Colorado–Boulder researcher Robert Leben to apply a numerical computer model of ocean currents based on sea surface height satellite data to simulate how and where the oil was transported.

The model successfully re-created the flow of oil toward the Loop Current and showed how its motion into the deep Gulf was due to both warm-core and cold-core eddies along the northern margin of the Loop Current. Satellite data products developed from several satellites demonstrated that three cold-core eddies merged unexpectedly, leading to a reversal in oil motion toward the Loop Current. Luckily the wind and eddy motion resulted in an accumulation of oil in the cold-core eddy, sparing the sensitive corals along the Florida Reef Tract from oiling.

The ESL team has been developing products to support research, education, and emergency response since 2000. An extensive archive of Earth Scan Laboratory images and recent satellite acquisitions and animations can be viewed at www.ESL.LSU.edu.

Q&A

Scott C. Hagen

The new John P. Laborde Endowed Chair for Sea Grant Research and Technology Transfer



Q: Why did you choose to come to LSU?

A: First and foremost, it is because LSU is committed to the coast. Two of the seven focal areas of the strategic plan of the LSU Office of Research & Economic Development are directly related to my scholarly interests: Coastal Sustainability & Environment and Core Computing/High Performance Computing. Many of the other focal areas are also of particular interest to me. I learned about the M.S. degree in Coastal & Ecological Engineering that builds a bridge between my home department, the Department of Civil & Environmental Engineering, and the Department of Oceanography & Coastal Sciences. The strong desire to do transdisciplinary research is here and is further exemplified through the LSU Center for Computation & Technology. During the recruitment process, I contributed to a proposal with LSU faculty from across the campus, and we were awarded a National Science Foundation, or NSF, Coastal SEES grant! Clearly, there are tremendous opportunities for me to expand my research program, collaborate, learn new things, and make a lasting impact.

Q: What led you to pursue research in coastal hydroscience and engineering?

A: It really started back when I was an undergraduate student at the University of Iowa. I worked at the Iowa Institute for Hydraulic Research. (It has since been renamed IIHR—Hydroscience & Engineering). The IIHR faculty took me under their wing and gave me a chance to excel. That led to an NSF Research Experience for Undergraduates, which evolved into my Ph.D. at the University of Notre Dame. The cumulative experience inspired me to consider the many dimensions of computational hydraulics and to establish a coastal hydroscience lab at the University of Central Florida. Now that I am at LSU, the process has come full circle as I have recently been named to the advisory board for IIHR—Hydroscience & Engineering.

Q: What are your goals and vision for your research at LSU?

A: Much of my work of late involves the study of the coastal dynamics of relative sea level rise. My students, colleagues, and I have been able to develop models that project how the coast may evolve as a function of not only subsidence and sea level rise, but also under a changing climate. As the sea level rises, the coastal hydrology will change as well. If we experience greater levels of eustatic, or worldwide, sea level rise, it will be because of higher annual temperatures, which will lead to changes in precipitation patterns, etc. I believe that the better we understand these potential future conditions, the better we can engineer and manage the resilience of our built and natural environment.

Of course, the backbone of my research program has been and always will be computational modeling of tides, wind-waves, and hurricane storm surge. I intend to play a part in making LSU a preeminent institution for simulating those and related processes. Through the marine extension agents of the Louisiana Sea Grant program, we also can inform and enable emergency managers, and fulfill a traditional mission of our land-grant institution.

Q: Tell us how your research focus area in “massively parallel, high performance computational modeling of ocean, coastal, and inland shallow water flows” can be applied to the region and the U.S.?

A: The tide and hurricane storm surge models that my students and I develop incorporate millions of data points to describe water depths, topography, vegetative properties, and infrastructure. At each of these points, we calculate the time-dependent water elevation and velocity. Without massively parallel, high performance computational resources it is not possible to carry out the simulations of water flow from the deep to the shallow regions and over the land mass and infrastructure. With the resources that we have and will continue to build upon at LSU, we can apply such computer models to major U.S. coastlines such as the Gulf Coast and the East Coast. Our grants from the NSF, the National Oceanic and Atmospheric Administration, the U.S. Fish & Wildlife Service, the Department of Homeland Security, and others demonstrate that this coastal research is and will continue to be applied throughout these regions. Most importantly, our work aids coastal planners, engineers, and emergency managers around the U.S.

Q: What are your proudest professional accomplishments thus far?

A: It is certainly quite an honor to be named the Louisiana Sea Grant Laborde Chair. In my family, I am also part of the first generation to be college educated, and I am the first to receive a Ph.D. So, that is also meaningful. I have worked with numerous undergraduate and graduate students who also are the first in their family to go to college. To share the success and joy with our families as the first generation to attend college is very special.

Q: Why is it important to you to include students in your research?

A: In the end, our students provide our proudest moments. Very few scholars will write a book or a journal article that will influence researchers beyond their lifetime, but our students can build upon what we establish and extend it to future generations. I am here because someone else cared to help me along, and it is my duty to carry on that tradition through teaching and mentoring.

Research Initiative

The Office of Research & Economic Development has established the following **research focus areas**. Here are some of the highlights from the past year.



Materials Science & Engineering

LSU's College of Engineering and College of Science faculty received \$20 million in NSF funding for advanced manufacturing research. The Consortium for Innovation in Manufacturing and Materials, or CIMM, develops the fundamental scientific and engineering knowledge to advance applications in 3-D metal printing and multi-scale metal forming. CIMM is led by Michael Khonsari, LSU DOW Chemical Chair and Professor of Mechanical Engineering and Wen Jin Meng, Williams Professor of Mechanical Engineering. LSU also established the Institute for Advanced Materials, or IAM, for materials science and engineering research.



Biological, Biotechnological & Biomedical Research

The Louisiana Biomedical Research Network, or LBRN, was recently awarded \$18.5 million from NIH. Boyd Professor Thomas R. Klei in the LSU School of Veterinary Medicine Department of Pathobiological Sciences leads this project that facilitates quality biomedical research activities throughout the state of Louisiana. LBRN's research, education, training, and mentoring programs focus primarily on undergraduate institutions, including historically black colleges and universities.



Conventional & Renewable Energy

LSU's total energy-related funding over the past seven years has been about \$97.9 million for 153 individual projects. LSU's renewable energy research accounts for 44 percent of all energy-related LSU research or about \$43 million, according to a recent report by the LSU Center for Energy Studies.



Come learn about the world around us at the **LSU Science Cafe**.

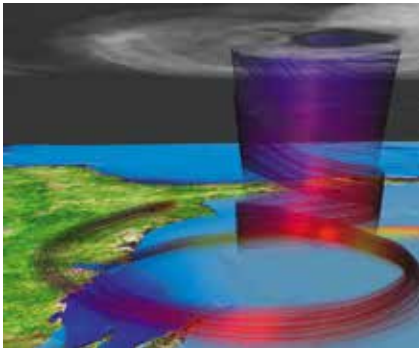
LSU Science Cafe is a free monthly public talk by a faculty member. Topics range from the arts and humanities to the physical sciences. The event is held the last Tuesday of every month at Chelsea's Cafe located at 2857 Perkins Road in Baton Rouge. Doors open at 5 p.m. Talk begins at 6 p.m. For more information, visit: www.LSU.edu/ScienceCafe.

Snapshot



Core Computing / High Performance Computing

The LSU Center for Computation & Technology has joined the OpenPOWER Foundation, an open development community based on the POWER microprocessor architecture, where community members work collaboratively to address critical big data, cloud, and application challenges, to reimagine the data center, and produce innovative systems designs. Because the POWER architecture is designed for big data and cloud applications, LSU will be able to add its own innovations and create new applications to provide solutions for a variety of research problems and societal needs.



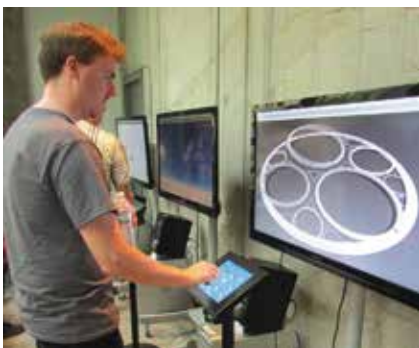
Coastal Sustainability & Environment

LSU coastal and computer scientists and engineers received NSF funding to improve the critical tool called ADCIRC, which is used to forecast large storms as they approach coastal communities. Led by Center for Computation & Technology Adjunct Professor Hartmut Kaiser and Department of Oceanography & Coastal Sciences Professor Robert Twilley, the STORM Project will make this important coastal modelling tool faster and more dynamic.



Individual Behavior & Community Context

Since the Deepwater Horizon oil spill in 2010, LSU researchers have worked with residents in coastal Louisiana to collect information on the mental and physical health impacts of the disaster. Associate professors of sociology Tim Slack and Troy Blanchard received \$1.2 million in funding from the Gulf of Mexico Research Initiative to expand their research. They will survey a large, targeted geographical region in order to collect an array of information on demographically diverse coastal communities and a variety of coastal industries



Communication & Expression

The LSU Center for Computation & Technology and College of Art + Design hosted the 2015 New Interfaces for Musical Expression, or NIME, the premier international conference in designing human-computer interfaces and interactions for musical performance. About 212 researchers and practitioners attended NIME from 28 countries, and 103 individual organizations and universities. Led by experimental music and digital media assistant professors Jesse Allison and Edgar Berdahl and Creative & Digital Initiatives Director Stephen David Beck, NIME featured 15 installations, 27 concert pieces, 32 demos, 65 papers, 50 posters, and nine workshops.

THE BONE LADY

By Ernie G. Ballard

WHEN she arrived at LSU in 1976 to study English, Mary Manhein was focused on sentence structures, Southern authors, and completing her degree while raising two elementary school-age sons.

More than 30 years later, as her career is winding down, Manhein is one of the most well-known forensic anthropologists in the nation, thanks to her work assisting law enforcement agencies locally, regionally, and nationally on cases of missing and unidentified persons.

Manhein, the former director of the LSU Forensic Anthropology and Computer Enhancement Services, or FACES, Laboratory, officially retired from LSU on April 30, 2015. Manhein, who also served as director of the Louisiana Repository for Unidentified and Missing Persons Information Program, said that she feels it is time to turn over the reins to the next generation.



“It has been the most amazing ride,” Manhein said. “In my youth, I could never have imagined such a career.”

Manhein was always intrigued by the science behind forensic anthropology, and her interest was first peaked as a senior English major at LSU.

“I took a class in anthropology when I was a senior and absolutely fell in love with it,” Manhein said.

Over the years, Manhein has consulted on hundreds of forensic cases, including massive disasters such as Hurricanes Katrina, Ike, and Isaac; Shell Oil and Exxon explosions and the resulting fires; and multiple high-profile serial killer cases, to name a few. Her name is immediately associated with human remains cases recovered from remote locations across Louisiana, earning her the moniker “The Bone Lady.”

“We wish Mary well in her retirement,” said LSU President F. King Alexander. “She has been a pioneer in the rising field of forensic anthropology. She’s helped to

It has been the most amazing ride.
In my youth, I could never have
imagined such a career.

— Mary Manhein
The Bone Lady



Left: Staff at the LSU FACES Laboratory use skeletal forms, like the one pictured here, for facial reconstruction. Above: In a career spanning more than three decades, Manhein has examined mummies, helped solve missing persons cases, and assisted the police in tracking down serial killers.

teach the next group of forensic anthropologists and has provided a great example of the dedication and tireless work it takes to help solve these cases. She has truly made an impact on Louisiana with her work on the missing person database and her efforts with law enforcement. We are going to miss having ‘The Bone Lady’ on campus.”

Manhein noted that the most rewarding part of her job has been working with the families of victims and helping to solve the many cold cases of unidentified persons.

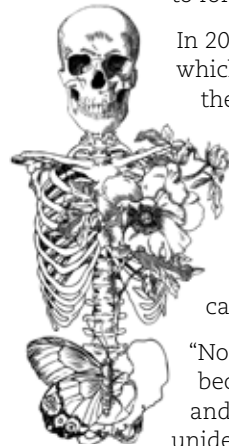
“It is such a wonderful reward to help these families find their loved ones, to help these families get some peace,” Manhein said.

After receiving her English degree, Manhein pursued a master’s degree in anthropology. She volunteered with anthropology professor Doug Owsley in the university’s new forensic anthropology lab and began working on forensic cases in 1981.

After Owsley left for a position at the Smithsonian, Manhein continued working in the lab, along with teaching in the evenings, and earned a research associate position in the department. In the early 1990s, Manhein christened the forensic anthropology lab as the Forensic Anthropology and Computer Enhancement Services, or FACES, Laboratory.

Shortly after, Manhein started pursuing her goal of building a comprehensive database for unidentified and missing people in Louisiana.

“With the help of so many people in 2006, we were able to formalize it,” Manhein said.



In 2006, Manhein initiated a state bill, which ultimately became a law, to create the comprehensive database. To date, the Louisiana Repository for Unidentified and Missing People remains the most comprehensive state database of its kind in the entire country and has been successful in solving local cold cases and others from across the U.S.

“No other state has what we have, because we are aggressively going out and seeking all cases that deal with unidentified people [and] all cases that deal with missing people,” Manhein said.

Manhein and the FACES Lab staff travel across the state to conduct workshops and meet with police departments to share information about Louisiana’s database. They work with local law enforcement agents, who add missing and unidentified cases into the system. The FACES lab, in turn, works with the



As part of her interest in our cultural past, Manhein enjoys shopping for antiques, sometimes bringing her dog along to sniff out good deals.

agencies and families of the missing or unidentified persons to complete a DNA kit and crosscheck that information in the national missing persons' database.

"We've been very fortunate that we've been able to do this, because we have employees whose time is dedicated to doing it. That, in itself, is unique," Manhein said. "No other state has people going out and doing what we're doing."

Manhein noted that much of the success of the database is based on the DNA assistance the FACES Lab receives from the Louisiana State Police Crime Laboratory. The DNA profiles developed by the crime lab are then uploaded by the state police into the national Combined DNA Index System, or CODIS, database for comparison with cases from across the country.

In addition to working with law enforcement, Manhein and the FACES Lab are nationally known experts in forensic anthropology and facial reconstruction. From time to time, the lab is brought in to help with cases that are more historical in nature.

"It still keeps you in the field," Manhein said. "But it separates you completely from the devastation of working with family members of the missing persons. It's a relief, yet it's a scientific puzzle."

Manhein, a self-proclaimed lover of puzzles and mysteries, has an interest in the cultural past, and her research has included projects like the excavation of Civil War battle sites such as Port Hudson, archaeological work on the Louisiana State Capitol grounds, and salvage archaeology at historic cemeteries such as New Orleans' oldest formal cemetery, Colonial St. Peter Street.

Manhein and the FACES Lab were also tapped to assist the National Oceanic and Atmospheric Administration, or NOAA, to complete facial reconstructions on two soldiers found aboard the Civil War vessel, the *USS Monitor*.

The project garnered international media coverage, and Manhein and some of her staff participated in the *USS Monitor* 150th anniversary celebration.

In a project closer to the LSU campus, Manhein and her team were asked to help uncover a 2,300 year old mystery. They joined an international team of researchers to study the "Princess of Thebes" mummy in the Louisiana Art & Science Museum's Ancient Egypt Gallery in downtown Baton Rouge in 2007.

After studying the mummy's bone structure, Manhein and the FACES Lab were able to determine that the "Princess of Thebes" wasn't a princess at all.

"The best determination is that she is a he," Manhein said at the time.

The FACES Lab was also able to determine that the museum's mummy was about 25 to 30 years of age at the time of death, stood between 5'5" and 5'6", and weighed about 124 to 132 pounds.

Manhein is a Fellow in the American Academy of Forensic Sciences, a former deputy coroner for East Baton Rouge Parish, and former member of the Louisiana Sentencing Commission. She is also a member of the national Disaster Mortuary Operational Response Team, or DMORT, and assisted with the recovery of the astronauts from the *Columbia* crash. Her forensic anthropology case work and research have been highlighted in numerous television programs, and she has given hundreds of talks nationally. She has been invited to lecture at New Scotland Yard twice.

Manhein's research has included publishing standards for facial tissue depths to assist with creating 3-D facial reconstructions of unidentified people. She also works on NSF-funded research on algorithms for computer restoration of fragmented skulls with Xin Li, who has



In 2015, Manhein was given LSU's honorary Doctorate of Humane Letters for her outstanding contributions to the field of forensic anthropology.

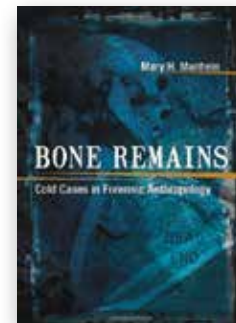
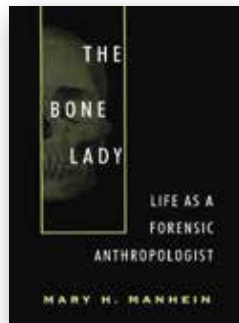


a joint appointment with the Division of Electrical & Computer Engineering and the Center for Computation & Technology. She has published three nonfiction books on her work, including *The Bone Lady: Life as a Forensic Anthropologist*, *Trail of Bones: More Cases from the Files of a Forensic Anthropologist*, and *Bone Remains: Cold Cases in Forensic Anthropology* through LSU Press. She has

also delved into the world of fiction with *Floating Souls: The Canal Murders*, the first in a series of novels set in New Orleans. Added to these is a nonfiction manuscript she is co-authoring with Jessica Schexnayder, one of her undergraduate students, on endangered historic cemeteries in Louisiana's coastal regions.

Manhein said that one of the most enjoyable parts of her career has been teaching thousands of LSU students about anthropology. She has been the recipient of various teaching awards throughout her years at LSU and has served as thesis advisor for close to 60 master's students in anthropology. Additionally, she has been a co-advisor for 20 natural science master's degree candidates.

Manhein's future plans include writing; traveling with her husband, Bill; visiting family; and contemplating a new career.



Manhein has published three nonfiction books on her work, including *The Bone Lady*, *Trail of Bones*, *Bone Remains*, and has delved into the world of fiction with *Floating Souls: The Canal Murders*, the first in a series of novels set in New Orleans.

Cancer Researcher Receives the 2015 Distinguished Scientist Award

By Stephanie Malin

William Hansel, a 96-year-old scientist, continues to work every day in his office at Pennington Biomedical Research Center to find a cure for cancer.

Hansel helped develop a new and groundbreaking drug that will hit the market. A first of its kind, the drug works by using lytic peptides to target and destroy the outer cell membrane of cancer cells. The drug then makes its way inside the cell where it prevents unhealthy cells from replicating.

After conducting 40 years of animal science research at Cornell University, Hansel accepted the Gordon D. Cain Professorship at LSU. Seven years later, his wife, Milbrey, died of ovarian cancer.

“Her clinician said, we need more people like you working to find a cure for cancer,” Hansel said. Thus, he changed the focus of his research.

For his work in biomedical research, Hansel received the 2015 Distinguished Scientist Award from the Society for Experimental Biology and Medicine.

While his focus is singular—curing cancer—Hansel says his biggest triumph was his role in World War II, where he served as a captain and helped lead the way to victory at the Battle of the Bulge.

LSU Awards \$500K for Faculty Innovation

By Christine Wendling

To promote technology and innovation, LSU awarded the second phase of the Leveraging Innovation for Technology Transfer, or the LIFT² grant program. Fourteen grants totaling \$500,000 have been awarded to faculty at all five LSU research campuses: six were awarded to LSU, four to LSU Health New Orleans, two to the Pennington Biomedical Research Center, one to LSU Health Shreveport, and one to the LSU AgCenter.

“This continued support of LSU’s entrepreneurial enterprise increases the number of inventions that are available for licensing,” said Arthur Cooper, CEO of the LSU Research & Technology Foundation.

The following are the recipients of the LIFT² Awards.

LSU

- Arash Dahi Taleghani, Craft & Hawkins Dept. of Petroleum Engineering, and Guoqiang Li, Dept. of Mechanical & Industrial Engineering: “Shape Memory Proppants to Allow for Increased Production in Oil and Gas Wells”
- Dandina Rao, Craft & Hawkins Dept. of Petroleum Engineering: “Enhanced Oil Recovery for Secondary and Tertiary Well Production”
- Wanjun Wang, Dept. of Mechanical & Industrial Engineering: “Laboratory Device and Media to Allow for Multi-step Laboratory Tests”
- Shane Stadler, Tapas Samanta, Philip Adams, and David Young, Dept. of Physics & Astronomy: “Advanced Materials (Magentocaloric) for Improved Cooling to Reduce Current Refrigerant Needs”
- Mandi Lopez, Dept. of Veterinary Clinical Sciences: “Innovative Orthopedic Device for Improved Control in Tensioning and Attaching Tissue-to-Bone Grafts”
- Edward Shihadeh and Anthony Reed, Dept. of Sociology: “Student Retention Software and Predictive Modeling for Improved Student Success”

LSU Health New Orleans

- Charles Hilton and John T. Paige, School of Medicine: “Development and Dissemination of a Software Interface”
- Francesca Peruzzi, Stanley S. Scott Cancer Center: “Development of miR-3189-3p as a Therapeutic for the Treatment of Glioblastoma”
- Seth Pincus, Dept. of Pediatrics: “Improved Double Variable Domain Antibodies to HIV”
- Hong Xin, Dept. of Pediatrics: “Peptide Vaccines and Related Antibodies Protect against Fungal Infections”

Pennington Biomedical Research Center

- Thomas Gettys, Basic Science Core: “Signaling Defining the Ranges of Dietary Methionine and Cysteine Restriction Essential to Biological Efficacy”
- Eric Ravussin, Clinical Science Core: “Effect of 2-week Overnight Moderate Hypoxia on Glucose Tolerance in Individuals with Type 2 Diabetes”

LSU Health Shreveport

- Gulshan Sunavala-Dossabhoy, Dept. of Biochemistry & Molecular Biology: “Optimizing Delivery of a Tumor-affecting Protein via Absorption through the Mouth”

LSU AgCenter

- Niranjana Baisakh, School of Plant, Environmental & Soil Sciences: “Development of Drought and Salt Tolerant Corn with an Acti Depolymerizing Factor Gene from a Louisiana Native Extremophile Smooth Cordgrass”

U.S. Department of Energy Funds Statewide Neutron Scattering Research

By Sandra Castillo

Faculty and graduate students from Tulane, University of New Orleans, Louisiana Tech University, and LSU are conducting a collaborative research initiative to expand the fundamental understanding of advanced materials. The Louisiana Consortium for Neutron Scattering, or LaCNS, was granted \$4.9 million for three years from the U.S. Department of Energy's Experimental Program to Stimulate Competitive Research.

John DiTusa, LSU physics professor and the project's principal investigator, said this research could have an impact on computer speed, and memory and efficiency of power transmission lines. The technology is also expected to cut costs and create advances toward new and better devices.

The grant will also fund the research of faculty, graduate, and undergraduate students at all four Louisiana universities. At LSU, it will fund 10 faculty, eight graduate students, six post-doctoral researchers, and one visiting faculty member.

"Part of our mission is to excite and train the next generation of scientists who will be experts in both the science and neutron scattering techniques," DiTusa said.

Neutron scattering is one of the few techniques available that can probe the structure and dynamics of materials over a broad range of time, length, and energy scales.

Compared to universities in Europe, the U.S. has lagged behind in providing opportunities for university students and faculty to use neutron scattering facilities. Most U.S. neutron scattering research occurs at national labs.

"We have to change this in the U.S. and start developing our own students who are experts in this field," DiTusa said.

Researchers Expand Gulf Oil Spill Work

By Christine Wendling

In 2015, the Gulf of Mexico Research Initiative, or GoMRI, announced \$140 million in BP-funded consortium grants to study the effects of the Deepwater Horizon oil spill. Out of the 47 grant proposals received for the 2015-17 program, the money was awarded to only 12 collaborative projects, one of which will assess the oil spill's impact on human health in coastal communities.

Created in 2010, GoMRI is a 10-year research initiative funded by BP. The GoMRI Research Board, who makes the decisions about funding, is headed by 20 experts in science, research administration, and public health.

"It was clear that research on public health is needed," said Rita Colwell, chairman of the GoMRI Research Board. "I'm pleased that in this round of awards there are funds to study public health issues in the Gulf of Mexico region associated with the oil spill."

Since 2010, LSU researchers have collected data on the mental and physical health impacts of the oil spill on residents in coastal Louisiana. LSU researchers were awarded \$1.2 million from GoMRI to continue this research as part of the Consortium for Resilient Gulf Communities project. This consortium, which consists of experts from RAND Corporation, Tulane University, Louisiana Public Health Institute, the University of South Alabama, and LSU, received a total of \$8 million to extend the research on the Gulf Coast communities that were impacted most directly by the oil spill.

"We are also funding research focused on increasing our knowledge of the biology of the Gulf and the interaction of oil with the ecosystem," Colwell said.

The Coastal Waters Consortium, composed of LSU and 13 other institutions and led by the Louisiana Universities Marine Consortium, received funding to expand upon its research on the impacts of petroleum pollution on marine and coastal ecosystems. The multi-agency consortium was granted \$16.1 million to continue its research. This research, which includes work from more than 20 researchers, has evolved to examine how larger scale impacts such as sea-level rise, salinity changes from proposed freshwater diversions, warming temperatures, and changes in animal and plant life will interact with future oiling events.

"Our research expertise at LSU benefits the entire Gulf Coast region, particularly our most vulnerable communities. Grants such as GoMRI offer valuable opportunities for our region to convene the best minds to address our most pressing environmental concerns today," said Kalliat T. Valsaraj, LSU vice president of research and economic development.

To celebrate success and acknowledge exceptional achievements in research and scholarship, LSU's Office of Research & Economic Development presents two faculty members with the Distinguished Research Master Award each year. At the same time, the LSU Alumni Association and the LSU Graduate School recognize two graduate students for excellence in their academic efforts with the Distinguished Dissertation Award.

By Aaron Looney

Since 1972, the LSU Council on Research has presented the university-wide Distinguished Research Master award in recognition of outstanding faculty accomplishments in research and scholarship. The recipients are chosen by the council from nominees proposed by the university community. Each year, one recipient is chosen from the arts, humanities, social sciences & behavioral sciences disciplines, and another from the science, technology, engineering & mathematics—or STEM—disciplines.

Distinguished Research Masters

The Distinguished Research Masters award provides winners a salary stipend and the University Medal—the symbol of exceptional academic accomplishment at LSU.

Distinguished Research Master of Arts, Humanities, Social Sciences & Behavioral Sciences

Elisabeth “Lisi” Oliver (in memoriam)

Oliver, who passed away unexpectedly on June 7, 2015, was an Alumni Professor in the LSU Department of English and the Interdepartmental Program in Linguistics. She received her bachelor's degree in theater and speech from Smith College, and her master's degree and doctorate in linguistics from Harvard University. Her research centered on the laws of early medieval England. She was the author of two books, the first on the laws of Kent from 600-700 AD, both the first writing in the English language and the first legal text for the Anglo-Saxon territories, and the second on personal injury laws in England and on the continent from 450-900 AD. She was one of two Americans and the only woman who served on the literary board of the Early English Laws Project, an international collaboration to produce new editions of Anglo-Saxon laws. She served the project as editorial supervisor for texts in Old English. Her recent work was focused on a new edition and commentary on the Anglo-Saxon laws of Alfred the Great, which were compiled in the late ninth century.



Distinguished Research Master of Science, Technology, Engineering & Mathematics

Jorge Pullin

Pullin is the Horace Hearne Chair in Theoretical Physics in the LSU Department of Physics & Astronomy as well as the co-director of the Horace Hearne Jr. Institute for Theoretical Physics. He served for a time as the interim director and focus area head of the LSU Center for Computation & Technology and is the founding editor of the journal *Physical Review X*, published by the American Physical Society.



He received his master's degree and doctorate in physics from the Instituto Balseiro in Bariloche, Argentina. His research addresses the interface between gravity and quantum theory, specifically in the area of loop quantum gravity. His research has involved probing how space-time inside black holes is affected by quantum theory. He now also focuses on the foundations of quantum mechanics.

Distinguished Dissertation Awards

The LSU Alumni Association and the Graduate School sponsor two Distinguished Dissertation Awards, one in the arts, humanities, and social sciences and one in science, technology, engineering, and mathematics. The awards have been presented annually since 1983. The two awards are given to doctoral students whose research and writing demonstrate superior scholarship. Graduates at any of the three commencements in a calendar year are eligible for nomination. A committee of the graduate faculty selects the winning dissertations. Award recipients receive a monetary gift and a certificate of commendation.

Josephine A. Roberts Alumni Association Distinguished Dissertation Award in Arts, Humanities & Social Sciences

Monica Miller

Miller received her bachelor's and master's degrees in English from the University of Tennessee-Knoxville and her Ph.D. in English with a minor in Women's and Gender Studies from LSU in 2014. She currently holds a Marion L. Brittain Postdoctoral Fellowship at the Georgia Institute of Technology. Her dissertation, "Lop-Sided, Scarred, and Squint-Eyed: Ugly Women in the Work of Southern Women Writers," has earned high praise for its clear and compelling writing and the implications for further research into the subject of the "ugly woman" in southern writing. Drawing from a wide array of disciplines such as philosophy, sociology, gender and queer theories, literary criticism, anthropology, and psychology, Miller analyzes how the "ugly" woman bucks gender roles and offers alternative lifestyles to those of traditional courtship and marriage for southern women. Her work consists of the analysis of the ugly woman role in the works of famous southern authors such as Alice Walker, Eudora Welty, Katherine Anne Porter, and Margaret Mitchell.

Her dissertation advisor said her work turns "critical attention away from the spectacular 'grotesque'—a concept with a long history in southern literary studies—and toward the merely 'ugly,' a category that . . . disrupts, distorts, and leaks through the boundaries that define southern gender relations."



At the Distinguished Dissertation awards presentation were, from left, Vice President of Research & Economic Development K.T. Valsaraj, award recipients Devendra Pakhare and Monica Miller, Graduate School Dean Gary Byerly, and LSU Alumni Association President and CEO Cliff Vannoy.

LSU Alumni Association Distinguished Dissertation Award in Science, Technology, Engineering & Mathematics

Devendra Pakhare

Pakhare earned his bachelor's degree in chemical technology in Mumbai, India, and his Ph.D. in chemical engineering from LSU in 2014. He is currently a staff scientist with Pyrochem Catalyst Company. His dissertation, "Catalytic Active Site, Mechanistic and Kinetic Studies of Dry (CO₂) Reforming Methane over Lanthanum Zirconate (La₂Zr₂O₇) Pyrochlores," studied the fundamental steps of the dry reforming of catalysts known as pyrochlores. His work sought to understand the inevitable deactivation of catalysts due to carbon deposition and sintering due to high temperatures. A catalyst with high thermal stability and resistance to carbon deposition is needed for natural gas reforming. Pakhare studied transition metal substituted lanthanum zirconate-based pyrochlore catalysts for natural gas reforming, which have the unusual ability to selectively substitute specific atoms in the structure of the catalyst while maintaining their thermal stability.

His dissertation research consisted of fundamental studies on pyrochlores to understand the active sites and determine why these materials show unparalleled performance toward natural gas reforming. His work was conducted in LSU laboratories as well as national labs including the Oak Ridge National Laboratory and National Energy Technology Laboratory. There is a license agreement in place to commercialize pyrochlore materials in the catalyst industry. Pakhare's dissertation research will be instrumental as he continues to work on establishing these pyrochlores as commercial catalysts at Pyrochem Catalyst Company. His research has been featured in eight publications in major scientific journals.

Rainmakers

As a top-tier research institution, LSU's research faculty are proven leaders in their field, performing at truly outstanding levels each day. LSU's Office of Research & Economic Development, with the support of Campus Federal Credit Union, takes the opportunity each year to acknowledge some of our many outstanding faculty with the Rainmaker Awards for Research and Creative Activity.

By Aaron Looney

Faculty members chosen as Rainmakers are those who balance their responsibilities in the classroom with securing external funding for their research and broadly disseminating their findings not only to the scholarly community but to society as a whole. Rainmakers are exemplary representatives of LSU, who garner both national and international recognition for their innovative research and creative scholarship, while also competing for external funding at the highest levels and attracting and mentoring exceptional graduate students.

Each of the following award-winning faculty members has met one or more of the criteria for high-quality research or creative activities and scholarship, which include but are not limited to publication in a high-impact journal(s); highly cited work; external awards; invited presentations at national and international meetings; high journal publication productivity; critically acclaimed book publication(s), performance(s), exhibit(s), or theatrical production(s); high grant productivity; and, for more senior candidates, outstanding citation records and high-impact invited presentations at national and international meetings. Two awards are granted at each career level including the Emerging Scholar, Mid-Career Scholar, and Senior Scholar levels.

Emerging Scholar Award

Arts, Humanities, Social or Behavioral Sciences

Megan Papesh, assistant professor in the Department of Psychology, received her bachelor's degree in psychology from Baldwin-Wallace College in Berea, Ohio, in 2005, and her master's and doctoral degrees in psychology from Arizona State University in 2008 and 2012, respectively. She is the head of the department's Papesh Eye Movements, Memory, and Attention Laboratory, which conducts research on core cognitive processes related to human perception and memory. In her research, Papesh is especially focused on the role of memory within core human cognitive processes. Using convergent techniques, she examines how people perceive

and remember information within and beyond the laboratory. Specifically, her current research examines three related aspects of human cognition: the processes underlying the encoding and storage of episodic memories; the nature (i.e., form and specificity) of memory retrieval; and the functional role of eye movements during cognitive activities, with special focus on reading processes in monolingual and bilingual individuals.

Science, Technology, Engineering or Mathematics

Francisco Hung is the Paul M. Horton Associate Professor in the Cain Department of Chemical Engineering and an adjunct professor at the Center for Computation & Technology. He has an undergraduate degree in Chemical Engineering from Universidad Simón Bolívar in Caracas, Venezuela, and a Ph.D. in Chemical Engineering from North Carolina State University. After working for two years as a postdoctoral researcher in the Department of Chemical and Biological Engineering at the University of Wisconsin—Madison, he joined the faculty at LSU in 2007. Hung has received such honors as a CAREER Award from the National Science Foundation in 2013, and the Ralph E. Powe Junior Faculty Enhancement Award from Oak Ridge Associated Universities in 2008. Hung's research is focused on investigating different interfacial systems using computer simulations at the atomic and molecular level of detail.

Mid-Career Scholar Award

Arts, Humanities, Social or Behavioral Sciences

James Matthew Fannin is an associate professor of rural and community development economics in the Department of Agricultural Economics & Agribusiness at the LSU AgCenter. He came to LSU in December 2003 after receiving his Ph.D. in Agricultural Economics from the University of Missouri. In addition to teaching and advising students in regional economics and community development, his academic program includes research and extension components. Fannin's

research focuses on evaluating strategies around rural physician recruitment and retention as well as analysis of rural hospital funding policies. His current research focuses on the financial resiliency of rural county and parish governments to tropical natural disasters amidst changing federal policies. His research extends into his extension activities where he has worked with individual parish and municipal governments to evaluate their financial vulnerability against future natural disasters and capacity for resiliency. His teaching, research, and extension programs have been supported by about \$4 million in external grants and contracts, resulting in scholarship published in all three legs of the land grant mission. In addition, Fannin also serves as associate director of analytic and academic programs for the Rural Policy Research Institute at the University of Iowa.

Science, Technology, Engineering or Mathematics

Parampreet Singh is an assistant professor of physics in the Department of Physics & Astronomy. He received his Ph.D. from the Inter-University Center for Astronomy and Astrophysics at Pune, India. He worked as a post-doctoral assistant at Penn State University and as a distinguished research fellow at the Perimeter Institute for Theoretical Physics in Waterloo, Canada, before joining LSU in 2010. His research has been featured in a BBC documentary on the Big Bang and has been covered in various popular science magazines. Singh has received numerous honors, including the Vainu Bappu Gold Medal by the Astronomical Society of India and the S. Chandrasekhar Award from the International Society on General Relativity and Gravitation in 2010. Singh's research delves into investigations of the origins of the universe and the way properties of space and time emerged during its birth. It is based on the ideas of loop quantum gravity—a unification of quantum mechanics and Einstein's theory of general relativity.

Senior Scholar Award

Arts, Humanities, Social or Behavioral Sciences

Edward Shihadeh is a professor and chair of the Department of Sociology. He received his Ph.D. from Penn State University and joined the department in 1992. His current research focuses on Latinos and crime, and the conceptual framework that Latino communities in the U.S. are split into two separate social worlds—older immigrants living in organized communities with low crime rates, and new immigrants living in disorganized neighborhoods with high crime rates and social problems. Understanding this duality in the Latino experience helps resolve the so-called “Latino paradox,” the apparent conundrum that Latino crime rates are far lower than expected given their high rates of poverty. Shihadeh's research has been extensively reported in the media. He is



At the LSU Rainmakers event were, left to right, Vice President of Research & Economic Development K.T. Valsaraj, Senior Associate Vice President of Research & Economic Development Matt Lee, Campus Federal President and CEO Dawn Harris, Associate Vice President of Research & Economic Development Gus Kousoulas, Assistant Professor of Physics Parampreet Singh, Professor and Chair of Sociology Edward Shihadeh, Paul M. Horton Associate Professor Francisco Hung, LSU AgCenter Associate Professor James Matthew Fannin, Assistant Professor of Psychology Megan Papesh, and Executive Vice President & Provost Stuart Bell.

also committed to teaching and mentorship, having earned 10 teaching awards and placing numerous graduate students in tenure-track faculty positions. Shihadeh is also dedicated to service and created the interdisciplinary Crime and Policy Evaluation Research Group, or CAPER, at LSU, through which he is leading the recruitment and retention efforts that increased LSU's incoming freshman class by 15.3 percent in 2011. Shihadeh also currently heads the LSU data analysis team and is a special advisor to the East Baton Rouge Parish District Attorney's Office for the Baton Rouge crime reduction effort known as BRAVE. After receiving about \$4 million in funding, the initiative has successfully reduced violence in Baton Rouge by about 35 percent over the past year.

Science, Technology, Engineering or Mathematics

James V. Moroney is the Strevia Alumni Professor in the Department of Biological Sciences, working in biochemistry and molecular biology as well as cellular, developmental, and integrative biology. He obtained his Bachelor of Science degree in biochemistry from SUNY in Buffalo, N.Y. From there, he obtained his Ph.D. in the Department of Biochemistry, Cell and Molecular Biology at Cornell University. He conducted his post-doctoral research at Michigan State University and has been at LSU since 1986. As a plant molecular biologist, Moroney focuses his research on photosynthesis—the conversion of carbon dioxide and water into carbohydrates using light energy. Working with both plants and algae, he and his research group noticed that most algae are more efficient than terrestrial plants in acquiring CO₂ from the environment. Now, he is involved in an international collaboration to introduce algal CO₂ concentrating mechanisms into crop plants with the aim of improving photosynthesis. His research is funded by both the National Science Foundation and the Bill & Melinda Gates Foundation.

All Rainmaker recipients receive a one-time stipend of \$1,000 and a plaque in recognition of their achievements.

For more information about the Rainmakers Awards, visit www.lsu.edu/research.

For more information about Campus Federal, visit www.campusfederal.org.

Media Shelf

Complicated Grief



Laura Mullen,
Director of LSU
Creative Writing
Program

Laura Mullen
describes her work,
Complicated Grief,
as a hybrid genre

text. It is a mixture of poetry, lyric essay, and fiction—a 21st century effort to find raw honesty, trust, and love. It includes a fictional retelling of “Little Red Riding Hood” and interactions with images of women as seen by male authors, such as “The Lady of Shalott.” Mullen also includes a personal essay about a childhood trauma in an attempt to confront the issues of molestation and to find truth and meaning behind it. *Complicated Grief* is a bold, personal, and self-reflective quest to solve the modern-day question of identity.

Construction of Social Psychology



Edited by Brij
Mohan, Professor
Emeritus of Social
Work

Brij Mohan taught
human behavior and
social environment
at LSU for many

years, and his area of expertise is the complex dimensions of human social development. His recent publication, *Construction of Social Psychology*, is a collection of research submitted by social psychology professionals, teachers, and students. It discusses the archaeology of social psychology, current issues in social psychology, and the social psychology aspects of human development as well as comparative connections across disciplines. It contains 49 peer-reviewed chapters collected from scholars at home and abroad.

The Cottoncrest Curse



Michael Rubin,
Adjunct Law
Professor

*The Cottoncrest
Curse* immediately
embroils the reader
in a 19th-century
murder mystery. The

Cottoncrest plantation is believed to be cursed, and that curse has led to the deaths of Col. Augustine Chastaine and his wife, Rebecca. Did they commit suicide, or was it the otherworldly force of the plantation’s curse that took their lives? The local sheriff believes it to be a homicide and sets out to track down the killer. The story spans three generations—Cottoncrest as it was in the 19th century, in the 1960s, and in the present day—and shows how the mysterious deaths have affected all those associated with the plantation for more than 100 years. Rubin weaves in a multifaceted tapestry of Louisiana culture as a backdrop to the tale, incorporating Cajun, French, and Jewish cultural artifacts and their relationships to one another into the plot.

The Krio of West Africa: Islam, Culture, Creolization, and Colonialism in the Nineteenth Century



Gibril R. Cole,
Associate Professor
of History

*The Krio of West
Africa* is a history
of the society of
freed African slaves
who resettled in

Freetown, Sierra Leone, in the late 18th century. A “Krio,” sometimes interchanged with “Creole,” is a cultural and language group centered in Sierra Leone—but also found in other parts of West Africa—which was believed to be a monolithic Christian community. Cole questions that assumption, which was based on scarce evidence, and uncovers new evidence that shows a vast amount

of religious, ethnic, and cultural diversity within this permeable society. Cole discusses compelling evidence that Islam may have been more influential to Krio society than Christianity.

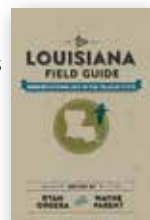
“Light Years”



Co-directed by
Wesley Shrum,
LSU Professor of
Sociology, and
Greg Scott, DePaul
University Associate
Professor of
Sociology

This short film was created to launch the 2015 International Year of Light—a festival in Paris, France, which highlights the importance of light and optical technologies to the development of society. “Light Years” is a five minute, black-and-white film constructed as a mini murder mystery. It features clips of five film noir villains, most notably Peter Lorre from *M*, throughout the history of noir from the 1930s to the 1980s. In the film, the “people” being murdered are cameras, and they are killed by a Fresnel lens. The Fresnel lens was originally invented for use in lighthouses but was later used for movie and theater lighting. In the film, the lens is held up to the sun and used to burn up the cameras as they film their own self-destruction. “Light Years” can be viewed at www.ethnografilm.com.

The Louisiana Field Guide



Co-edited by Ryan
Orgera, Alumnus,
and Wayne Parent,
Professor of Political
Science

*The Louisiana Field
Guide* is a fun and
exhaustive collection

of things to know about this colorful southern state. It includes chapters on Louisiana geography and environment, history, cultures, literature, languages, Carnival, food, politics, music, architecture, and of course, LSU football. Designed

to appeal to locals, newcomers, and visitors, this humorous yet poignant reference book paints a portrait of Louisiana that is larger than life. It strikes a balance between mentions of Louisiana's most famous city, New Orleans, and other lesser-known, but equally intriguing, areas of the state. It features famous authors such as Kate Chopin, famous music such as "Iko Iko," and beautiful, haunting black-and-white photographs of New Orleans' cemeteries and historic country plantations.

Peace Haven

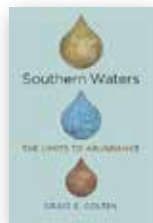


Co-produced by Pallavi Rastogi, Associate English Professor, and Areendam Chanda, Associate Economics Professor

The film, *Peace Haven*, stars Soumitra Chatterjee, Poran Bandyopadhyay, and Arun Mukhopadhyay as three elderly friends preparing for their deaths by building their own mortuary. Proper death rites are integral to practicing Hinduism, and it is vital that offspring conduct the ceremony for their deceased parents. However, the friends' concern was born from the fact that all of their children live abroad. When another friend in the village dies, he cannot afford to have his body preserved and has to be cremated before his son can fly in from the U.S. Although there is a nearby morgue called Peace Haven with the ability to preserve bodies, it is reserved only for the rich and powerful. From this tragedy, the trio begin a quest to build their own mortuary and to preserve the meaningfulness of their lives after death. *Peace Haven* encapsulates their journey. Rastogi and her husband, Areendam Chanda, served

as co-producers on the film, which was directed by Suman Ghosh.

Southern Waters: The Limits to Abundance



Craig E. Colten, Professor of Geography & Anthropology

Throughout history, nothing has been more important to the safety and

economy of south Louisiana than the Mississippi River and surrounding waterways. From the beginning, control of the river has influenced everything from coastal and riverside land development to trade booms and the outcome of war. Colten, author of *Southern Waters*, is the Carl O. Sauer Professor in the Department of Geography & Anthropology. His book reveals the rich history and importance of water, or the lack thereof, to the entire Gulf region. He focuses, in particular, on how 20th-century urbanization is challenging sustainability from the fishing industry to flood control. In addition, he offers a guide to navigating a looming water shortage in the region.

Trayvon Martin, Race, and American Justice: Writing Wrongs



Edited by Kenneth J. Fasching-Varner, Rema E. Reynolds, Katrice A. Albert, and Lori L. Martin, Associate English Professor

Lori L. Martin is an editor and contributor to *Trayvon Martin, Race, and American Justice: Writing Wrongs*. Her essay, "Been There Done That," links the killing of Trayvon Martin to the injustice of the 1931 Scottsboro defendants and the murder of Emmett Till. Other contributors to the volume write about the racial wrongs and the lived experiences of people of color in the period following the

tragic killing of Martin. This work is not only a collection of academic chapters but includes creative writing as well. It asks difficult questions in order to illuminate a more nuanced understanding of race. The editors hope the volume will provide readers with a sense of empowerment and liberation, afford an opportunity to reflect upon a national tragedy, and reveal truths about race in our society that often remain unsaid.

Working Congress: A Guide for Senators, Representatives, and Citizens



Edited by Robert Mann, Manship Chair of Journalism

Robert Mann teaches political communication and researches political history

and communication at LSU. His newest publication, *Working Congress: A Guide for Senators, Representatives, and Citizens*, discusses how U.S. public opinion of Congress has reached a historic low in recent years and explores the reasons behind this drop in approval. It also shows how the refusal of Republicans and Democrats to cooperate with each other has fostered mistrust among many American citizens. Contributors to the book include retired members of Congress from both sides of the aisle who discuss why the increased partisan schism is a major reason for the current governmental dysfunction. *Working Congress* also offers potential solutions for how to get the two major political parties to work together on common goals in a realistic way.





If you are an LSU researcher with a story to share, then the Office of Research & Economic Development wants to hear from you. We are looking for items for next year's issue of *LSU Research*, including your publications, results, awards, and anything in between.

We can also help you spread the word about your work. If you are interested in reaching a wider audience through social media, blogging, media outreach, and more, let us know. Send an email to asatake@lsu.edu or call 225-578-3870.

Gifts to the LSU Foundation advance academic excellence by supporting students, faculty, staff, and projects like those highlighted in this issue. If learning about the research happening at LSU has inspired you to give, please visit www.lsufoundation.org/give or call 225-578-3811.