2017 EDITION

SR

INSIGHT

On the Cover: Guests at Southern Research's Aug. 21 eclipse-viewing event catch a glimpse of Birmingham's 93-percent totality view. On page 12, learn how SR engineers went beyond totality to get a rare view of this phenomenon.

This Page: A welder in the shop at A&A Machine and Welding, a partner in The Prosperity Fund. On page 36, learn how this new Southern Research program is helping spur job growth in Alabama.

contents

SR SOUTHERN RESEARCH

Southern Research is a 501(c)3 non-profit organization.
www.SouthernResearch.org

Art is pictured in Southern Research's new TrainSafe biosafety lab, where researchers and clnicians are taught how to protect themselves from exposure to dangerous pathogens.

As I reflect on all that has been accomplished in 2017, I count myself grateful to be part of an organization that shows such a commitment to technical innovation and excellence.

The impact of that commitment can be measured in the benefits to those around us, whether in human health, a cleaner environment, national defense or the exploration of space.

I continue to be inspired by Frances Grace Hirs, the 17-year-old in Fairhope, Alabama, who has lived with acute lymphoblastic leukemia for most of her life. I had the privilege of meeting Frances Grace in 2016, after learning that she had been prescribed a drug developed at SR. She has handled her cancer diagnosis with dignity and fought it—and defeated it—with fierce determination. It is people like Frances Grace who remind us of the real human impact of the work we do every day, whether it's in the lab or the field.

Southern Research has a long history of significant accomplishments, and our talented team of scientists and engineers upholds that legacy through their dedication to their projects and programs. We continue to recruit the best and expand our capabilities with key hires, many of whom are featured in this publication.

One such rising star is Rita Cowell, Ph.D., who joined SR in 2017 to lead our neuroscience team. Her research examines the mechanistic underpinnings of neurodegenerative diseases—devastating conditions such as Parkinson's, ALS and Alzheimer's that currently have few effective treatments and no cures. Dr. Cowell's extensive understanding of these disorders will be instrumental in helping us discover novel treatments for these most vulnerable of patients.

Alabama's coal country has been hit hard by the decline in the coal industry, and we at Southern Research are honored to be able to help. Our new Prosperity Fund places knowledgeable, innovative partners directly inside affected communities, working hand-in-hand with local businesses to facilitate recovery and growth in a smart, sustainable way.

Much of SR's mission centers around our relationship with our communities—explaining our work to those we serve in accessible terms, and sharing our discoveries with the next generation of scientists and engineers who will carry our mission forward. Our new STEM outreach program, led by Kathryn Lanier, Ph.D., will extend educational experiences and opportunities to students across the state, engaging young people and inspiring them to pursue careers in this exciting field.

With so many areas to focus on, we highlight in this book some of the exciting discoveries within one technical area—our Energy & Environment team. Here, we are exploring possibilities for the future of energy storage, sustainable materials, greenhouse gas mitigation and even economic development in a way that creates an ecosystem of innovation and provides value to the market.

Our organization was built on the generosity of the communities in which we operate. This publication highlights a few of our long-time champions who have provided hope to so many through their support of our mission. The leaders who guide us, the community members who motivate us and the donors who sustain us are the reason that Southern Research has had such a successful year and is poised for even more accomplishments, discoveries and potential in 2018.

Arthur J. Tipton, Ph.D.
President and CEO, Southern Research

Southern Research

Global Reach, Local Impact

Southern Research's discoveries and innovations help make air and water cleaner for our communities, treat diseases in patients around the world, protect troops overseas and help launch missions to other planets. Equally life-changing is the economic impact SR has on the communities where it operates.

The Alabama Power Foundation, Robert Meyer Foundation, The Daniel Foundation of Alabama, Regions Bank, Hugh Kaul Foundation and the Susan Mott Webb Charitable Trust have made generous contributions to further our research and impact on economic development in Alabama.

OUR FOOTPRINT IN THE COMMUNITY

over 200

Projects funded in 2017

500

Total number of SR employees

8

SR locations in five different states: Alabama, Georgia, Maryland, North Carolina and Texas

15 Countries represented by Southern Research employees

2

Employees who are fellows in the National Academy of Inventors

76

Years SR has been in operation

OUR CONTRIBUTION TO THE ALABAMA ECONOMY

Statistics span from 2003 to 2015

15,894

AL jobs directly or indirectly added by SR

$1.0

Billion contribution to Alabama's overall GDP

$2.03

Economic value added for every $1 spent by SR

NEARLY

$1.7 BILLION

Economic impact on the state of AL

LIFE SCIENCES

7 FDA-approved cancer drugs discovered by SR scientists and researchers

Of the 200 cancer drugs on the market have been evaluated by Southern Research

The ADDA Drug Pipeline

32 Are being investigated

21 Are in active research

01 Is in clinical trial

850

Attendees at the SR solar eclipse event

2017 SOLAR ECLIPSE

106

News stories published on the WB-57 solar eclipse mission

13

Years SR has been a supporter of the NASA WB-57 program

3 **Terabytes of scientific data collected by Southern Research on the Sun and Mercury during the solar eclipse**

ENGINEERING + ENERGY & ENVIRONMENT

04 Inductees in the AL Engineering Hall of Fame

57 Year relationship with NASA

500 Number of AIRS/DyNAMITE technology flights

$20 MILLION

In DOE grants & contracts awarded to Energy & Environment over 6 years

→ RITA COWELL, PH.D.

Rita Cowell, Ph.D., joined Southern Research in May as chair of the Neuroscience Department as it expands research and drug discovery efforts focusing on diseases such as Parkinson's, ALS and Alzheimer's. Cowell, who comes to Southern Research after 10 years at the University of Alabama at Birmingham, is examining the mechanistic underpinnings of why people develop neurodegenerative diseases.

"Rita's extensive understanding of these debilitating neurological disorders will be instrumental in advancing our goal of discovering novel treatments for patients who desperately need help," said Mark Suto, Ph.D., vice president of Drug Discovery at Southern Research. "We believe that she is the ideal person to direct our Neuroscience Department as we strategically expand it over time into new areas of investigation that align with our drug discovery mission."

→ MICHAEL CATALANO

Michael Catalano joined Southern Research in January as vice president and general counsel, leading the intellectual property (IP) function and contracts team in working with all of the technical divisions at Southern Research to identify areas of IP growth and to cultivate external and internal operations. Catalano's 20-year career has included leadership roles in industries including commercial and corporate law, healthcare, and entertainment, where he has gained expertise in business development, acquisitions, operations and IP.

"Southern Research is pleased to welcome Michael and his remarkable legal and financial expertise," said Southern Research President and CEO Art Tipton, Ph.D. "We look forward to the impact his wide-ranging experience will have across our diverse portfolio of projects."

→ STUART STARRETT

Southern Research's Stuart Starrett, who has made many contributions to the nation's defense, aerospace and energy industries, was inducted into the state of Alabama Engineering Hall of Fame in February of 2017. During his four-decade career at SR, Starrett built a reputation as an expert in the behavior of materials in extreme environments, with vital contributions to the development of reentry nosetips for advanced defense systems. Said Keith Bowman, Ph.D., of the Air Force Research Laboratory at Wright-Patterson Air Force Base, "I equate what Stuart did for the nation's defense to what the engineers working for NASA in the 1960s did for space exploration."

Though officially in retirement, he remains an active consultant on a variety of SR engineering projects. "Stuart's technical excellence allowed Southern Research to become the leader in high-temperature materials," said President Tipton.

→ JOHN KOENIG

Southern Research engineer John Koenig was awarded the distinguished Thermal Conductivity Award by the governing board of the International Thermal Conductivity Conference (ITCC). Koenig's selection for this award was based on an evaluation of his longstanding technical achievements, his organization of the 29th ITCC and his service during two terms as chairman of the ITCC governing board.

"I am honored to be selected by my peers to join this corps of notable men and women who have contributed so greatly to the thermal conductivity discipline," Koenig said. "The ITCC and this award bring deserved recognition to a field that is integral to the defense and aerospace industries."

→ LILLIE RYANS

Lillie Ryans, an experienced contracts professional with more than three decades in the field, joined Southern Research in May as director of contracts. Ryans' past work includes pre- and post-award management for research contracts generating revenue in excess of $500 million. She now takes charge of a contracts team with a dozen staff members working in close coordination with Southern Research Drug Discovery, Drug Development, Engineering and Energy and Environment.

"Lillie has the experience and talent to help us continue and improve our strong contract processes in a way that drives additional growth," President Tipton said. "We're thrilled to have her on board."

→ MARK PATTERSON, PH.D.

Mark Patterson, Ph.D., an engineer and innovator with broad experience across a sweeping range of technology disciplines, has joined Southern Research Engineering to lead business development efforts focusing on the aerospace industry.

Patterson's considerable experience in research and development activities equips him to concentrate on identifying new business opportunities and potential collaborations with SRs's engineering team. "With his wide-ranging expertise, Mark can help us build on fields where we are already industry leaders and pinpoint new opportunities in disciplines where we can grow to become leaders," said Southern Research Vice President of Engineering Michael Johns.

→ JAY LIU, PH.D.

Jay Liu, Ph.D., an experienced biotech industry innovator and entrepreneur, joined Southern Research Drug Discovery in August as director of technology development and innovation.

In this new role, Liu, who has worked for both biotech startups and pharmaceutical industry giants, will strive to advance promising projects already in Southern Research's drug discovery pipeline along the path to product development. He will also seek to expand Southern Research's drug discovery capabilities in areas that include biologics and monoclonal antibodies, which are revolutionizing the treatment of many serious and chronic diseases. Liu's scientific background and wide-ranging industry experience in the U.S. and China will bring significant benefits to Southern Research and allow it to move into new research areas.

"One of our most important missions is identifying new therapeutics that will have an impact on people's lives," said Vice President Suto. "Jay's industry experience in both research and clinical development of new concepts will facilitate efforts to move our research from the lab into collaborations that accelerate product development."

President's Award recipient Chuck Hebert, program manager, Drug Development

PRESIDENT'S AWARD RECIPIENT

Over a 23-year career at Southern Research, Chuck Hebert, Ph.D., has brought great insight into the organization's major efforts in toxicity, specifically for reproductive toxicology. These efforts ensure the safety of consumers through rigorous scientific programs. As principal investigator (PI) on multiple significant contracts, Hebert is accountable for timely study delivery, the overall study quality and adherence to the budget for high-profile programs including the National Toxicology Program (NTP), National Institute of Mental Health and multiple National Cancer Institute contracts. He oversees and coordinates one of the largest Drug Development programs at Southern Research, NTP's Developmental and Reproductive Toxicology contract. In brief, he has been the heart and soul of the toxicology team at Southern Research. Furthermore, Hebert is broadly recognized as a dedicated mentor and trainer to junior colleagues, teaching them to be more effective study directors, PIs and team members. He is a renowned subject matter expert for toxicology, both inside and outside of Southern Research. He has also been a long-term leader in best practices for biosafety and a leader in Southern Research's Institutional Biosafety Committee for many years. This year, Art Tipton recognized Hebert for his contributions and dedication to Southern Research with The President's Award.

Southern Research Helps NASA Get Even Closer to the Sun

THE VIEW FROM THE SURFACE

Back on Earth, Southern Research hosted a free eclipse-viewing event at its downtown Birmingham campus. Visitors received solar viewing glasses to observe Birmingham's 93-percent totality, and a telescope fitted with a solar filter offered a detailed look at the sun during the eclipse.

Southern Research helped NASA get a uniquely vivid look at the sun's outer atmosphere during the August 21 eclipse, outfitting two of the organization's WB-57 high-altitude research aircraft with SR's AIRS/DyNAMITE imaging system. Southern Research engineers are now helping NASA get even closer to the sun with high-temperature evaluations of the thermal protection system on the Solar Probe Plus.

The probe, currently under construction at the Johns Hopkins Applied Physics Laboratory in Maryland, will be protected from the sun's heat with 4.5-inch-thick carbon composite shield capable of withstanding temperatures in excess of 2,000 degrees Fahrenheit. Southern Research, which has been performing such testing for NASA since the Apollo program, evaluated the mechanical and thermal properties of the materials and determined that they will hold up against the sun's radiation throughout the craft's seven-year mission. The Solar Probe Plus is slated to launch in the summer of 2018 and will travel closer to the sun than any previous spacecraft.

"The talented engineers and technicians at Southern Research have made many important contributions to the nation's space program over several decades," said Michael Johns, vice president of SR Engineering. "Solar Probe Plus is an exciting mission, and we are proud to have been part of an endeavor that will advance scientific knowledge about the sun."

FOURTH ROCK FROM THE SUN

Earlier in 2017, SR engineers conducted tests on NASA's Hypersonic Inflatable Aerodynamic Decelerator (HIAD), an inflatable heat shield designed to slow a capsule during descent through the thin atmosphere of Mars. The promising technology could help NASA land large cargo and even, eventually, people on other planets.

Three NASA AIRS/ DyNAMITE-equipped WB-57 aircraft fly over Houston.

Southern Research's Donald Darrow operated the AIRS instrument on a NASA WB-57 aircraft during the total solar eclipse on August 21, 2017.

Southern Research Gets the Best Seat in the House for Continent-Wide Eclipse

Southern Research technology and personnel had a bird's-eye view during the total solar eclipse that crossed the continental U.S. August 21. Two NASA WB-57 high-altitude research aircraft carried Southern Research's Airborne Imaging and Recording System (AIRS) nearly 10 miles above Earth for a rare look at the sun's corona and the surface of Mercury.

AIRS/DyNAMITE turrets were mounted on both aircraft to support Southwest Research Institute (SwRI), collecting data with high-speed, visible-light and infrared cameras. The total eclipse provided a unique view of the sun's outer atmosphere without the usual intense emissions from the sun itself. With the moon blocking the brighter light, researchers were also able to study Mercury using infrared to obtain data, enabling it to estimate the surface temperatures over the planet's night side.

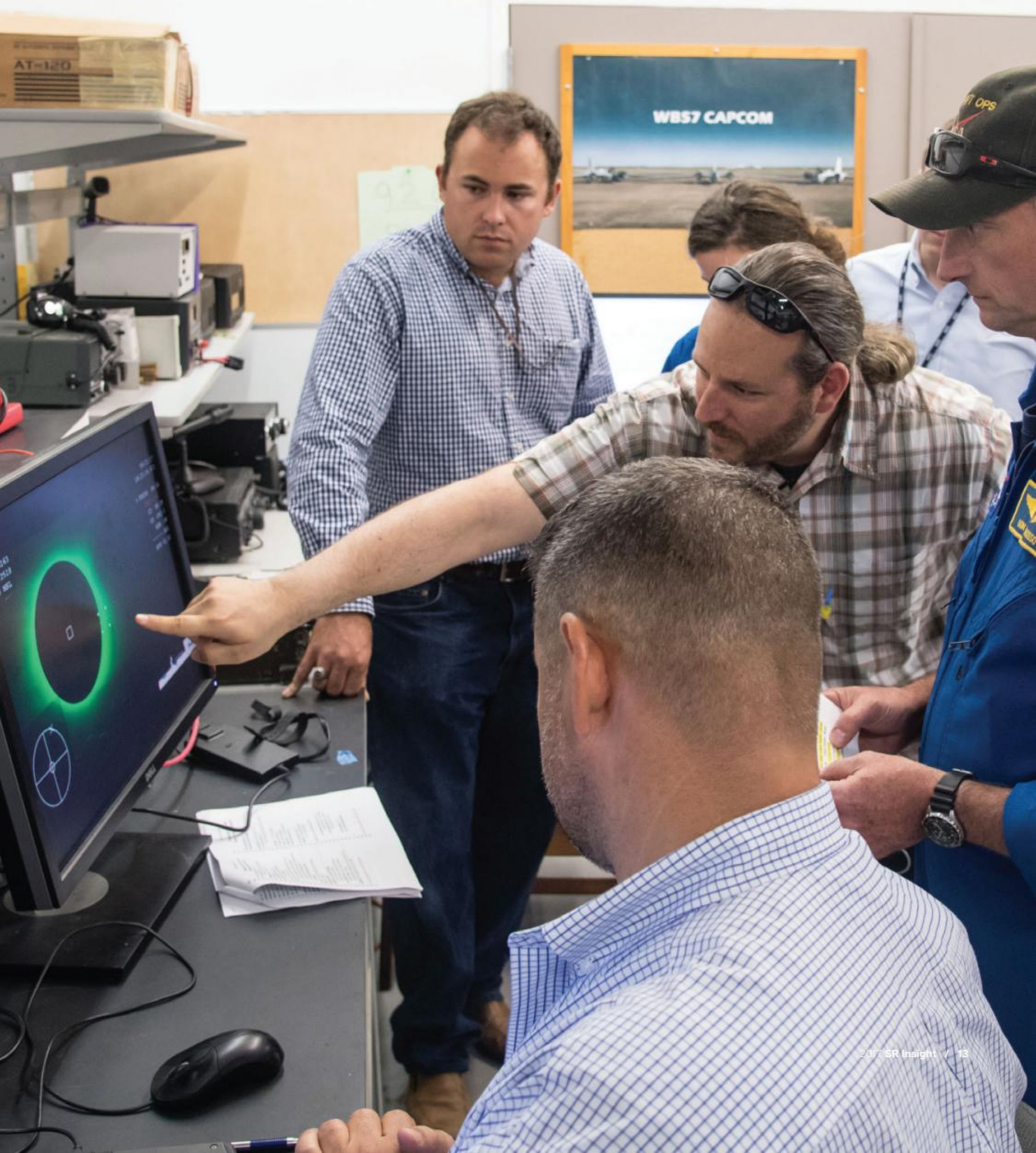
"The visible and infrared data look spectacular," said SwRI Senior Research Scientist Amir Caspi, Ph.D., principal investigator of the project. "We're already seeing some surprising features, and we are very excited to learn what the detailed analysis will reveal."

Dan Seaton, Ph.D., co-investigator of the project from the University of Colorado, said, "With the results from the WB-57s and complementary observations from space and other experiments on the ground, we have an opportunity to answer some of the most fundamental questions about the nature of the corona."

The trip was also an exceptional experience for Southern Research communications engineer Donald Darrow, who has been flying with the AIRS/DyNAMITE since 2012 and rode on the lead plane as Sensor Equipment Operator.

"Having one of the longest views of the eclipse was phenomenal—and one of the clearest, as well," Darrow said. "It could be argued that I had the best seat on the planet."

NASA ground crew coordinates with the SR engineering team on data received from AIRS during the solar eclipse.



A Contribution to Move Southern Research Forward:

JOHN A. "JACK" SECRIST III, PH.D.

Former President and CEO John A. "Jack" Secrist III, Ph.D., has been a part of Southern Research since 1979, working for 27 years as a scientist before taking that top leadership position until his retirement in 2013. At that time, it became important to him to find a new way of being involved and make a contribution to SR. "One of the duties of the retired CEO is to stay out of things and let the new regime do what it's going to do," he said.

In his retirement, Jack has had the opportunity to spend more time in his woodworking shop.

Left: It was innovators and innovations that first brought Secrist to Southern Research.

Jack and Cyndi Secrist, shown here in their Ann Arbor, MI area home.

A perfect opportunity to contribute in a meaningful way came with the launch of SR's employee give campaign in 2016. The goal of the campaign is to raise $1 million over the course of five years to fund innovative research programs, needed capital improvements, equipment purchases and other potential uses. Secrist kicked off the effort with a pledge of $500,000 to create the Encourage Innovation Fund, enhancing SR's ability to attract talented researchers and to help them thrive once they're on board.

"Because I was at Southern Research and involved with its evolution over 30-some years, if I could continue to do anything to be a benefit, no matter how small it was, I wanted to do that," Secrist said. "We wanted our contribution to be used to support innovators and innovations that would continue to move Southern Research forward."

ADVANCING SCIENCE

It was innovators and innovations that first brought Secrist to Southern Research to work in the lab of John Montgomery, Ph.D. "He was a wonderful person, an outstanding scientist and a great mentor to me," Secrist said. "I came to Southern Research specifically because I wanted to be part of that team. They were working to develop drugs to help people." He appreciated the opportunity to work with scientists in a variety of disciplines, working together under one roof to make discoveries and get them to market.

With that team, he would make great strides in the development of new anticancer, antiviral and antibacterial agents and make one of his most significant contributions to the treatment of childhood cancers.

In the early 1980s, funded by a program project grant from the NIH, SR's cancer team was investigating two potential nucleoside drugs with the potential to affect DNA function in cancer cells. However, the drugs had worrying structural issues. Secrist and Montgomery formulated a series of compounds that would perform a similar function but without the structural concerns. In 2004, clofarabine received FDA approval as the first new pediatric leukemia drug to hit the market in more than a decade. (SR Drug Discovery has created a total of seven FDA-approved drugs used in cancer treatment, including two other compounds developed at the same time as clofarabine.)

"Advancing science is always great," he said. "Having external support to move science forward in a given area was tremendous. And that involved lots of people doing lots of different things. So to me, the fun part, and the truly enjoyable part, was making new potential drugs, being a part of the activity and pursuing the activity with members of the team."

TOUCHING LIVES

Another enjoyable part for Secrist was seeing how his drug touched lives—a relatively rare experience for drug inventors, who are far removed from the clinical aspects of oncology. "As a chemist, we're at the early end of the drug development continuum, so you don't generally see the people who benefit or might benefit from the drug," he said. But he has had several opportunities to encounter, directly or indirectly, patients who know firsthand how important SR's drug discovery can be.

One such encounter was at the 2004 FDA hearing when clofarabine was approved. During the hearing, a father came forward to talk about his young son, whose leukemia hadn't responded to conventional treatments and whose life had been saved by the then-experimental drug. "He was holding the boy, who was perhaps five or six, in his arms as he spoke," Secrist said. "It was a moving scene."

The drug's significance also hit close to home this year, when he visited Frances Grace Hirs and her family at their home in Fairhope, Alabama. In 2013, as Secrist was preparing to retire from SR, Hirs was receiving clofarabine after her second relapse of acute lymphoblastic leukemia at Children's Hospital of Alabama. Now, she's a healthy, vibrant teenager, thanks in large part to his research. "It's truly great to witness that, because it's something that you've made, you've been fortunate enough to see it move through and it's rewarding," he said.

WHAT MAKES SOUTHERN RESEARCH SPECIAL

Now, in his retirement, Secrist lives with his wife, Cyndi, in a small township just north of Ann Arbor, Michigan. He devotes much of his newly discovered free time to golf and to civic involvement, in addition to his work as executive editor of the journal *Nucleosides, Nucleotides and Nucleic Acids*. (He uses his SR credentials as editor of the journal, to keep Southern Research in the public eye in every way that he can.)

"I get down to Birmingham several times a year, but it's appropriate that I be away," Secrist said. "I need to be involved at a modest level." He continues to make his contribution to Southern Research's life-changing work through on-call service—"doing whatever the folks now in charge have in mind," he said—and financial support, helping SR recruit the talent and assemble the teams that made his work there so fulfilling.

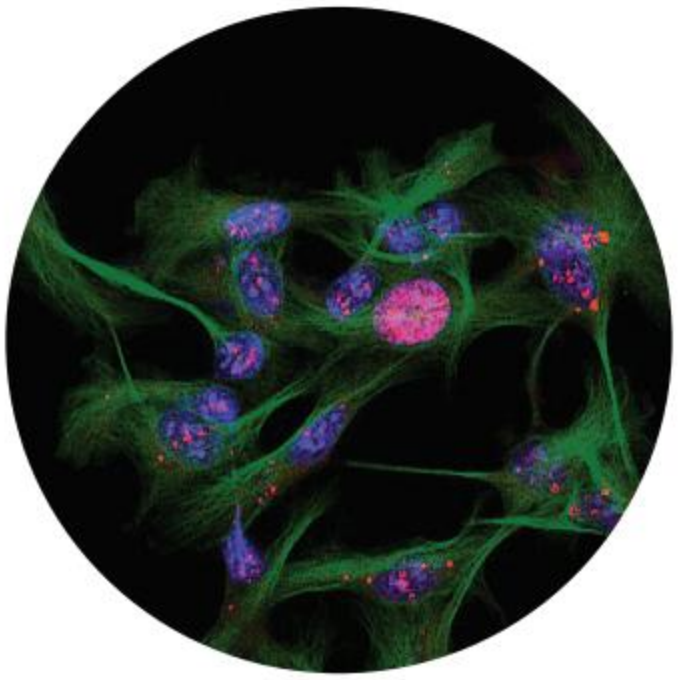
"The organization is clearly greater than the sum of its parts," Secrist said. "What has been accomplished has been accomplished in significant degree by putting together teams of people who can accomplish what they couldn't do individually. We have people who want to work together, who have skills that mesh very nicely and we look for opportunities to use those skills to accomplish things in science and engineering," he added. "That's been the difference, and that's why Southern Research is special."

Discovering Promise & Hope Through Cancer Research

Scientists in SR's oncology department are working toward new cancer treatments in immuno-oncology.

The history of cancer research at Southern Research goes back seven decades as scientists made discoveries that were groundbreaking for their time and laid the foundation for future life-changing discoveries. More than 75 years later, SR scientists are testing thousands of compounds and exploring new approaches to cancer treatment in therapeutic fields such as immuno-oncology and radiosensitizing drugs.

Not only are pioneering Southern Research scientists making discoveries that could change the path of oncology, they're having opportunities not common to most drug inventors: meeting cancer survivors whose lives have been saved by drugs developed in their lab. Survivors like Frances Grace Hirs and Allen Tucker show that SR's cancer research provides not just promise but hope, and that discoveries that start as compounds in a lab could someday bring immeasurable comfort to cancer patients and ther families.



SR's PD-1/PDL-1 checkpoint strategy offers new weapons against cancer.

RALLYING THE BODY'S NATURAL DEFENSES AGAINST CANCER

Tumor cells are able to avoid the force of the body's natural immune response by interacting with and disabling the immune system's T-cells. A strategy developed by Southern Research scientists is proving successful at targeting that interaction—called the PD-1/PDL-1 checkpoint—and unleashing the immune system to fight the cancer cells.

While the interaction is a subject of intense research within the growing field of immuno-oncology, most therapies currently on the market, while effective, require massive infusions of expensive drugs. SR's new drug is equally effective and as easy to administer as a pill.

In pursuit of the new discovery, SR researchers moved away from a traditional focus on antibodies, which remain in the system for an extended period of time and lead to side effects from the immune system being perpetually active. The checkpoint inhibitor simply blocks the interacting proteins and allows the immune system to do its job as it normally does. It has the potential to be used as treatment for many forms of cancer and even fuels hope for an eventual cure.

"It's not as simple as 'Does it kill the cancer?'" said Rebecca Boohaker, Ph.D., research assistant fellow, Southern Research Oncology Department. "We want to make sure it's doing it the right way and working on the right pathways, and that it is doing exactly what we set out to do when we targeted that protein."

ENRICHING RADIATION THERAPY

A near decade-long project at Southern Research is showing promise with the possibility of more effective treatment for patients undergoing radiation therapy. The drug, known as a radiosensitizer, would add an extra punch to that radiation, helping it more easily slow tumor growth—or wipe out the tumor entirely—with less resistance to the treatment.

Early on in the challenging project, SR scientists began exploring the biological pathways to cancer cells' survival in the face of radiation. They discovered that disrupting a tumor's self-protective mechanism made the cancer more vulnerable to radiation, giving them a strategy to find a drug without toxicity that would only be activated when radiation was delivered.

Researcher Rebecca Boohaker working on a protein targeted immuno-oncology cancer treatment.

Cancer survivor Frances Grace Hirs with President and CEO Art Tipton at a Business Council of Alabama conference in August.

To have this effect, the radiosensitizer targets a protein that binds to the DNA of cancer cells with a high-DNA repair capability, where it joins with an enzyme to initiate a repair job that saves the cell's life.

"If that recruitment is successful, then the DNA damage will be repaired, and the cancer cell will survive," said Bo Xu, MD, Ph.D., distinguished fellow and chair of Southern Research's Oncology Department. "What we're trying to do is to block this protein from finding the other one, so that the repair process will be diminished or affected. That way, the tumor cells will die."

"Our hope is that in three years, we can identify a novel class of radiosensitizers that can help the approximately two-thirds of cancer patients who will eventually receive radiotherapy," he added.

FRANCES GRACE HIRS, SURVIVOR

Acute lymphoblastic leukemia failed three times to defeat Frances Grace Hirs. The 18-year-old honors student at Fairhope High School was first diagnosed with acute lymphoblastic leukemia when she was only three. She and her parents, Debbie and Allen, had no idea then that the drug that would eventually save her life had been developed 260 miles north of their home, in the Birmingham cancer lab at Southern Research.

The family first made that trek in 2003, at which time doctors at Children's Hospital of Alabama identified her agonizing back pain as a symptom of leukemia. With the help of chemotherapy, she was soon in remission and able to return home. But they were forced to repeat the trip in 2009, when she felt a pain in her side and doctors confirmed that the cancer had returned. A second round of chemotherapy led to a second remission, which they all hoped would be for good.

The cancer returned in 2013, and now, her chemotherapy options were limited. She needed a bone marrow transfusion, but the procedure would be possible only when she was once again in remission. This time, Frances Grace's doctor recommended clofarabine—which had been discovered less than a mile away in the lab of Jack Secrist, Ph.D., at Southern Research.

The clofarabine treatment was a success, and in September of 2013, Frances Grace received the bone marrow transplant she so desperately needed.

In 2016, the Hirs family discovered that the drug that had saved Frances Grace's life was developed at SR. They made the trip to Birmingham yet again—this time for a ceremony at Children's Hospital in honor of her successful transplant, followed by a stop by SR to see the facility that had given them so much hope.

Secrist later visited Frances Grace and her family in Fairhope. "Thank goodness there are people out there doing that work," Debbie said.

ALLEN TUCKER, AND A SPECIAL VICTORY FOR SOUTHERN RESEARCH

Physicist Jim Tucker has spent most of his career attacking challenges facing aviation, aerospace and heavy industry. He joined Southern Research Engineering in materials research to make essential contributions to exploration in outer space, amid other applications. But one of his greatest connections is to SR Drug Discovery, since the division's discovery saved his son's life.

In 1996, once-healthy toddler Allen Tucker began displaying such severe and rapidly worsening symptoms that Jim and his wife, Pam, rushed him to Children's Hospital of Alabama. The diagnosis of acute lymphatic leukemia terrified Allen's parents. Then the chemotherapy began.

"It was a virtual resurrection. If you've ever seen a child with leukemia about to start the treatment, it's frightening," Tucker said. "Allen was motionless and had a morphine drip. Then they started treatment, and within two or three days, he was back. It was amazing."

Allen's resurrection was the result of therapy including three drugs developed in large part because of Southern Research. SR scientists discovered a superior method for producing methotrexate and performed the fundamental biochemistry work on 6-Mercaptopurine, and the organization held a patent on Leucoveron's method of production. On top of that, Southern Research scientists established many of the principles that paved the way for effective chemotherapy decades before Allen began his treatment.

Allen still faced a grueling two-and-a-half years of treatment, following his release from Children's, to fully eliminate all cancer cells. He's now a healthy 24-year-old—and his father is no longer wary of the word "cure." "The concept of a cure is something I can talk about 17 years later. He was 6 when he came off chemotherapy; now he's 23," Tucker said last year. "That's where Southern Research comes in."

Thank you to our generous partners Maynard Cooper and Gale and Warren Averett for supporting cancer research at SR.

IN MEMORY OF JANET HOUGHTON, AN EMIL HESS ENDOWED CHAIR IN CANCER BIOLOGY

During her four-decade research career, distinguished oncology researcher Janet Houghton, Ph.D., (shown left) studied the mechanics of how drugs attack tumors and investigated the complex inner workings of the disease at a molecular level. Tragically, in spring of 2016, Houghton was diagnosed with Stage IV appendiceal cancer.

Houghton's treatment included, among other drugs, two of the therapeutic agents that she herself had discovered early in her career, 5-fluorouracil paired with Leucovorin. However, her malignancy ultimately proved too aggressive and she passed away in October of 2017.

"Janet was a brilliant scientist whose passion for exploration and discovery really set a high standard for researchers across the world," said Mark J. Suto, Ph.D., vice president of Southern Research Drug Discovery. "Her work made a difference for many people, and we will deeply miss her expertise and optimism."

"I still remember the first time I met her during an interview and explored with her why she wanted to come to Southern Research," said President Tipton. "She knew our history in cancer research, spoke about individual members of our research teams from the 1950s forward and told me she thought that SR was the best place in the world for her to finish her career and get her ideas to the market to treat patients."

"Janet's battle with cancer, of course, started long before she was personally touched by the disease," he added. "She spent a career battling this disease and the world is better for her battles."

Rita Cowell,
fellow & chair of
the Neuroscience
Department.

Pathways to Hope for Patients with Neurodegenerative Diseases

With the appointment of Rita Cowell, Ph.D., as fellow and chair of the Neuroscience Department, Southern Research expanded its drug discovery efforts toward finding novel treatments for patients with debilitating neurodegenerative diseases.

Millions of people worldwide are affected by neurodegenerative diseases, which occur when nerve cells in the brain lose function and eventually die. The most common of such diseases in the U.S. are Alzheimer's and Parkinson's, as well as Huntington's and amyotrophic lateral sclerosis (ALS or Lou Gehrig's). "They all have characteristic symptoms related to cognitive function and movement," Cowell said, "and are distinguished from each other largely by the types of brain cells that are dying."

"We're trying to understand how different brain cells die to give rise to the symptoms people have with these different disorders," Cowell said. "There's a whole range of research groups trying to study how the disease develops in the first place—to understand how cells die, essentially. Then they're trying to figure out whether any information from that can be used to design drugs to target a pathway that could promote the survival of these cells."

Cowell, whose work on Parkinson's has been funded through a five-year grant from the NIH and support from the Michael J. Fox Foundation, said Southern Research's extensive drug discovery capabilities allow her to pursue her ultimate goal of developing a small-molecule drug that could prove useful against a number of neurological diseases.

Just in the few months since Cowell's arrival in August, she and her team have generated preliminary data indicating that drugs developed as part of Southern Research's ALS program could have previously unexpected biological effects on learning and memory. "Essentially, we took some compounds that they've been working on for years and didn't really know what the biological effects were," she said, "and we're finding out that they could have that impact."

Cowell was originally attracted to Southern Research in large part because of the opportunity to collaborate with people who can help bring drugs to market and provide resources for drug discovery within her lab. "What my lab does is more of the basic research, but just being in the vicinity of chemists who are capable of developing these drugs was attractive to me," she said.

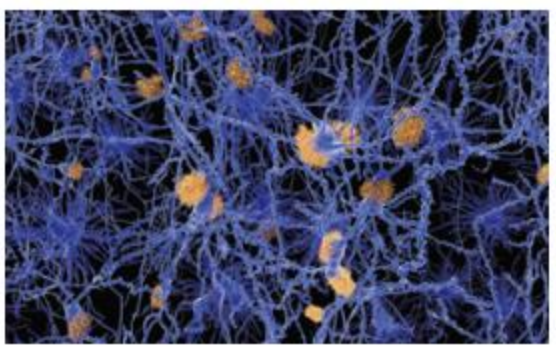
"I never thought about doing that project before I came here because I didn't have that resource, that compound series, to work with," Cowell said. "Since coming here, I was able to start on that and use some of the knowledge that I had from other projects to say, 'I think we should test these genes.'"

While the data about those compounds is still in its earliest stages, Cowell is eager about its potential impact on learning and memory disorders and neurodegenerative disorders like Alzheimer's disease in addition to ALS. "The changes were so dramatic in these growth factors and things that are related to neuronal survival and memory that it's really exciting," she said.

By focusing on factors like cognitive dysfunction that are common across different neurodegenerative disorders and targeting molecules associated with those symptoms, Cowell hopes to benefit a wider patient population. "The goal would be to find something that would essentially ameliorate a set of symptoms for these people, and it wouldn't necessarily be just for Alzheimer's, or just for Parkinson's," Cowell said.

Cowell said her work has been motivated in part by a long-standing fascination with why people behave the way they do, from not just a psychological but also a physiological standpoint.

She was particularly drawn to neurodegenerative diseases because of the effect they have on patients' personalities—an effect she observed in her own grandmother, who got Alzheimer's at a relatively young age. "I feel like I'm emotionally invested in it, because I just really care about trying to find a way to help people with those disorders," Cowell said.



Alzheimer's disease within the neuron network with amyloid plaques present.

Conquering Invisible Foes

Aedes aegypti is the breed of mosquito primarily responsible for the spread of Zika virus.

The virus research program at Southern Research was established in the 1950s and has, over its lengthy history, studied dozens of viruses and tested thousands of compounds to combat infectious diseases. Today, SR is exploring a wide array of infectious diseases, from influenza to hepatitis to HIV. The past year found progress in mosquito-borne viruses, dangerously stubborn viruses and viruses that lie in wait long after the patient appears to be cured—but can be battled, and someday defeated, by the scientists at Southern Research.

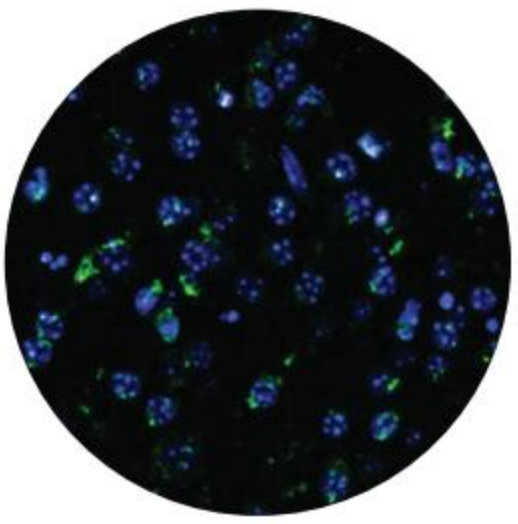
THE WORST PEST OF ALL

All mosquitos are annoying, but some have the power to be deadly. Of the approximately 175 species of mosquito in the U.S., two—Aedes aegypti and Aedes albopictus—serve as vectors for a variety of dangerous diseases. Between the two, they can cause outbreaks of dengue, yellow fever, chikungunya and Zika. That's why Southern Research scientists are performing groundbreaking research and developing drugs to treat, cure and prevent the most harmful of mosquito-borne diseases.

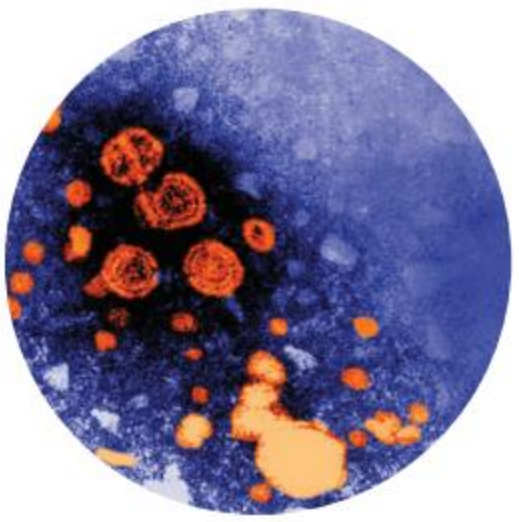
SR researchers have been evaluating vaccines that could prevent and one day eradicate dengue. That work has established active drug-screening programs against the virus and developed in vivo models to support drug development, which have helped support research into related viruses like yellow fever and Zika.

The Zika virus has presented a challenge to SR scientists, who discovered evidence of a "secondary peak"—a rebound of the virus—weeks after the virus was seemingly cleared by the immune system. The researchers hypothesized that the virus was lying dormant in the host's tissue, waiting for a change in the patient's immune status that could allow the virus to surge again.

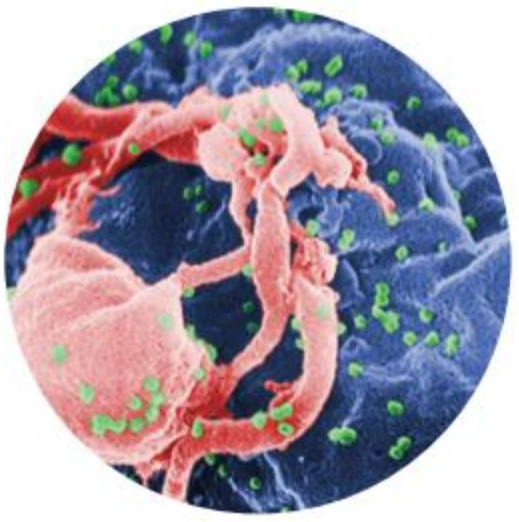
A CLOSER LOOK AT INFECTIOUS DISEASE



→ Mosquito-borne illnesses such as Zika can devastate the development of a child. Shown above when the virus is present in brain tissue.



→ The hepatitis B virus (HBV) is a small DNA virus that leads to a wide spectrum of liver disease. Shown above as a complete and infective form of the virus.



→ SR is working to develop tests that will help detect the dormant remnants of HIV. Shown above is the virus present on a white blood cell.

While SR researchers are continuing to study the Zika rebound, it's important that companies developing anti-viral therapeutics for the virus know to be aware of the phenomenon. "They'll need to study the mechanism of how the infection occurs to come up with an effective strategy for the drug," said Fusakata Koide, Ph.D., associate director of infectious disease research. "Maybe it will prevent the initial viremia, but it could come back later on."

STOPPING AN UNSTOPPABLE VIRUS

Hepatitis B affects 240 million people each year, kills at least 650,000 and is currently incurable. The stubborn characteristics of the hepatitis B virus (HBV) have slowed discovery and development of a cure to the chronic disease. Southern Research is helping to advance the search for a cure with comprehensive hepatitis B capabilities for monitoring, modeling and testing a new generation of HBV therapies.

Current antiviral therapies can stop the progress of the infection in some patients but not eliminate the virus entirely, leaving it to hide out during treatment and reappear once the treatment is complete. Patients have to receive antiviral therapies for the rest of their lives to prevent recurrence. Research into the virus's persistence could clear a path to a functional cure.

SR's new capabilities and assays can help researchers across the scientific community collaborate for more effective research. "Concerted efforts across academia, industry and government are needed," said Raj Kalkeri, Ph.D., scientist for SR Drug Development. "Collaborations across these groups with additional research funding will facilitate better understanding of HBV persistence and the development of effective strategies to advance a functional cure."

ATTACKING HIV WHERE IT HIDES

Highly effective antiviral therapies can suppress HIV to the point that it's undetectable in the blood, and HIV-infected people can lead essentially normal lives. However, they aren't cured—remnants of the virus remain in hiding spots known as "latent reservoirs" and, without the therapies, can be reawakened. "The next step in the fight against AIDS is the cure," said Mike Murray, Ph.D., director of government business development for SR Drug Development. "The question is how do you go in and get rid of the virus completely?"

To support scientists in search of a cure, SR researchers are working to develop and standardize testing assays that will help detect the dormant remnants of HIV. They're working to expand access to the Quantitative Viral Outgrowth Assay, considered the most effective testing platform for that purpose. The researchers are also working with experts in the field of HIV latency to develop alternative assays that are quicker, more sensitive and less costly, making it easier to find the virus where it hides and striking it down once and for all.

Above: TrainSafe's biosafety training classes prepare caregivers and lab professionals to protect themselves from dangerous pathogens.

PROTECTING LABORATORY AND HEALTH CARE WORKERS

Health care workers and laboratory staff are doing great work to cure and prevent disease in others. Doing so, however, puts them at risk for contracting serious infectious diseases. Southern Research's new TrainSafe program teaches those workers how to protect themselves from dangerous pathogens so the researcher or clinician doesn't become a patient.

"Southern Research is meeting a critical need by training and preparing health care workers and laboratory scientists to respond to national and global infectious disease events like Ebola, Zika and pandemic influenza virus outbreaks," said Michelle Valderas, Ph.D., TrainSafe director. "Our program marries real-world practical training with behavioral-based philosophies for the best possible outcome."

The program's first class, held this summer, drew eight laboratory professionals from around the country for the Advanced Biological Risk Mitigation Program, an intensive four-day session. Students learned not only biosafety techniques, but advice for discussing biosafety with employees and ways to lessen the risk of cyber attack.

"I think a class like this could help leadership and safety officers and scientists all learn the mindset that we're all here together and we need to make rules we can live by," said student Heather Engelmann, who came to TrainSafe from the Pacific Northwest National Laboratory in Richland, Washington. "Biosafety is the topic, but it's really about behavioral sciences and how to lead well."

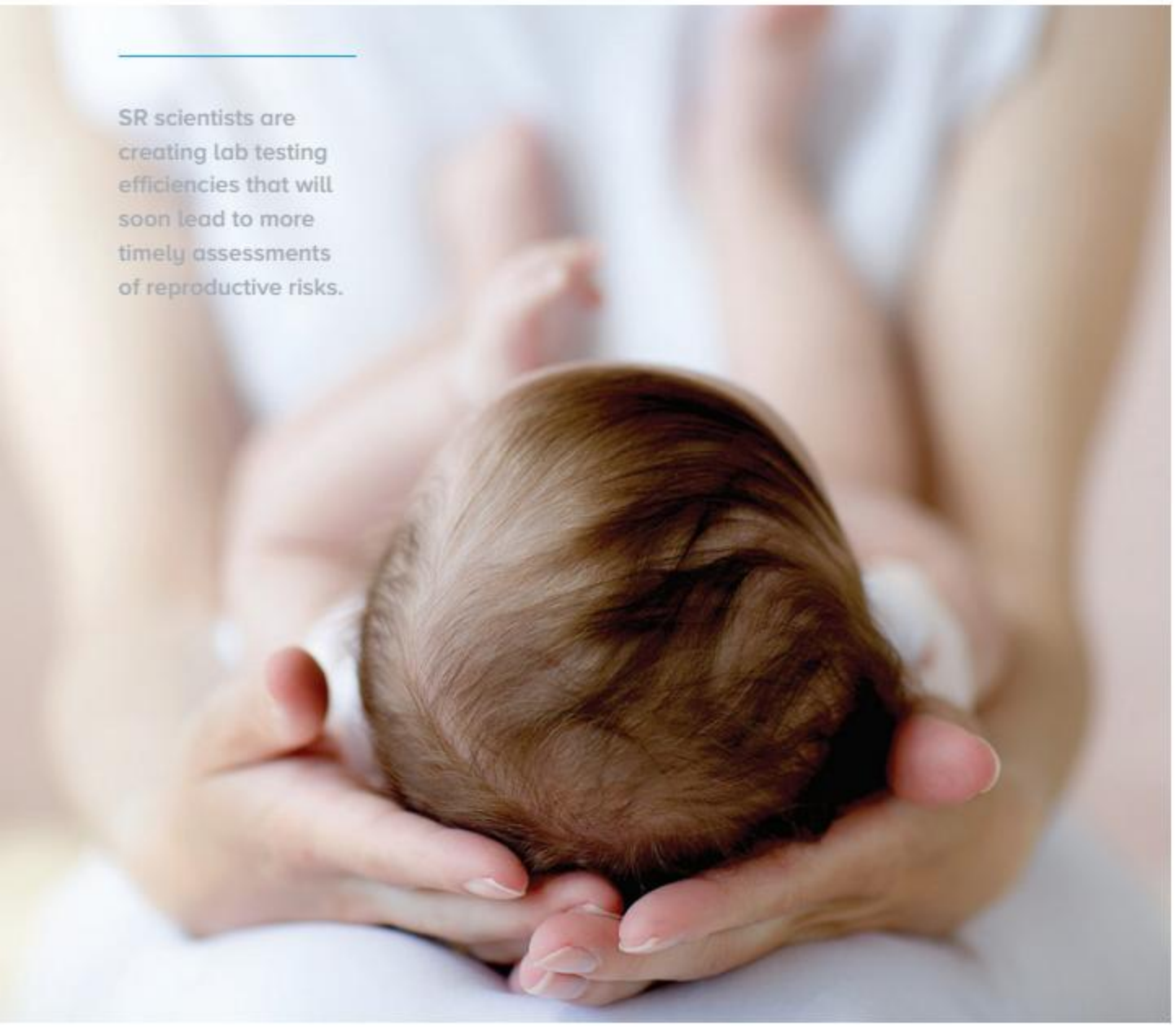
A Modern Model for Protecting the Future

Reproductive medicine has long been focused on the tiniest of patients, but scientists at Southern Research are going even smaller. Researcher Paul Bushdid, Ph.D., director of SR's toxicology and pathology services, is working to develop a new, cost-efficient laboratory test to evaluate hazards to developing fetuses. The tests will identify potential medicines, chemicals and other agents that could threaten the health of unborn children.

Bushdid's in vitro model, based on a chicken embryo, is expected to produce faster assessments of potential threats, allowing researchers to test more compounds and agents with less animal use—and do it at a reduced cost. This could reduce the cost of drug development projects. "If there are ways other than animal studies to get results—in vitro models of toxicity being one of them—we should pursue them," Bushdid said.

A major emphasis of Bushdid's research focuses on improvements to a once widely-used lab technique that also used chicken embryos. However, scientists at the time questioned whether that platform would be effective for their research due to the chicken's lack of a placenta. With three decades' worth of scientific advances, Bushdid was able to determine its applicability, lack of a placenta notwithstanding and update it for modern use.

Future improvements to Bushdid's model will include additional assessments not commonly used with in vitro models, creating "a very powerful screen for assessments," he said. "With the chicken embryo, we can look at a very wide range of developmental stages, and we can identify potential target organs. It's important to know if the agent in question is perfectly safe or has the potential to be lethal or cause limb defects like thalidomide did."



SR scientists are creating lab testing efficiencies that will soon lead to more timely assessments of reproductive risks.

Reproductive science has been a focus for Bushdid throughout his career. "It's been my personal goal in life to protect kids, before they're born or after they're born," he said. "To me, children are sacred in a world that is full of dangers. The whole purpose of everything we're doing is to make sure they are protected."

The Newest Innovation in STEM at Southern Research

Throughout its history, Southern Research has shown a commitment not just to groundbreaking research but to community involvement and engagement with the discoveries taking place within its walls.

One recent example of Southern Research's efforts in Alabama has been its ever-evolving college internship program. In its current incarnation, the program serves students from across the U.S., providing them with laboratory experience relevant to work performed in potential future careers. Additionally, in the fall of 2014, 2015 and 2016, SR's Birmingham campuses hosted high school students from across the Birmingham metro area for a behind-the-scenes look at the innovative work done by the organization's scientists and engineers.

Now, Southern Research is taking that commitment a step further with a dedicated statewide STEM program to engage aspiring scientists and engineers. The program is designed both to inspire young people to pursue careers in STEM fields and to train teachers in those fields to bring such engagement into their own classroom.

"Since its founding more than 75 years ago, Southern Research has executed on a mission to introduce young people to science and engineering, to inspire some as a career choice and for all to be citizens better equipped to make important decisions," said President Tipton.

The expansion of Southern Research's STEM education efforts is made possible by funding from the Alabama Legislature and the Community Foundation of Greater Birmingham. With the Community Foundation of Greater Birmingham's support, Southern Research has engaged in further study to determine how its STEM outreach can complement existing programs across the state and fill programmatic gaps to provide comprehensive learning opportunities in science, technology, engineering and math.

This fall, Kathryn Lanier, Ph.D., joined Southern Research as its first STEM education outreach director. She came to the organization with a doctorate in biochemistry and heavy involvement in STEM outreach. Lanier has conducted workshops for STEM educators and participated in direct engagement with students at all stages, among many educational efforts. "While biochemical research is my forté, STEM education and outreach is my passion," said Lanier, "I not only consider STEM outreach work to be a form of giving back, but I also believe regaining and promoting science and math literacy is imperative to our country's future."

Lanier will design programs that utilize Southern Research's resources to bring hands-on learning opportunities to Alabama's students. "Southern Research has all the necessary components to provide exceptional educational experiences to those across the state," she said. "We'll do this together, and I am honored to be part of it."

STATE LEADER VISITS SOUTHERN RESEARCH

In September, as part of her Listen, Learn, Help & Lead Tour, Alabama Governor Kay Ivey met with STEM Education Outreach Director Kathryn Lanier (shown left).

"It's exciting to see this unique organization expand its mission to inspire young people in Alabama, today, to explore opportunities in the types of 21st Century jobs that will move our state forward."

Benjamin Owusu, a graduate research assistant at Southern Research, works with students on STEM Day.

The Innovation Ecosystem of Energy and Environment

"The growth and development of Southern Research Energy & Environment has never been more innovation-focused, both from a cultural and a business standpoint," said SR Vice President of Energy & Environment Bill Grieco, Ph.D. "Our engineering services, technology and economic development efforts have all evolved with the needs of the market in mind to create projects that are both environmentally and economically sustainable."

"The mission of an organization like ours, non-profit in general but a science and innovation organization, is to create economic value in the communities that we serve," Grieco said. SR does that, he says, by finding great talent, providing opportunities to be innovative and putting them to work solving problems that affect the economic market. "It creates an innovation ecosystem in the organization but also, more broadly, in the community," he said. "All of this only matters if you can create real economic value that the market's willing to pay for."

Vice President of
E&E Bill Grieco.

VALIDATING THE FUTURE

Energy and Environment's work in engineering services "allows us to be the judge of what works and doesn't work," Grieco said. Currently, a team out of Southern Research's Clean Technology Development Center in Durham, North Carolina is partnering to help with independent validation of technologies in the $20 million NRG COSIA Carbon XPRIZE. The competition challenges innovators to transform how the world approaches CO_2 mitigation with the development of groundbreaking technologies that convert carbon dioxide emissions into valuable products.

SR scientists and engineers are visiting competitors around the world to validate the technology's performance based on the amount of CO_2 they're able to convert and the net value of the products created with the carbon. "We've defined the criteria for what success looks like and determined what experiments they have to run and what they have to prove," he said.

Southern Research is also collaborating with private, state and federal organizations to develop a new Energy Storage Research Center (ESRC) focused on grid-scale energy storage applications in combination with renewables in the Southeastern U.S. The center will support emerging energy storage technology by providing independent, third-party research and testing, as well as engineering and economic assessment and is currently preparing to launch its first system. In February, energy expert Bert Taube, Ph.D., joined SR to lead the energy storage program for E&E.

"We wrote the book—literally wrote a manual for the Electric Power Research Institute, the utilities and ourselves that defines how to test, what to test and what a successful outcome looks like," Grieco said. "That hasn't existed in the utilities sector. If I'm Company X making an energy storage device, and I want to sell it to a utility, I really don't know what they're looking for," he said, "and as the utility, I really don't know what I should be asking. We built that framework, and now we have a facility in the Southeast where companies can come and test."

TURNING WASTE INTO SUSTAINABILITY

SR's Durham facility is developing a process that converts biomass into acrylonitrile, the key raw material in making the highest quality carbon fibers. The acrylonitrile, a direct drop-in replacement for the petroleum acrylonitrile currently in use, is economically competitive and sustainable and lowers greenhouse gas (GHG) emissions by up to 40 percent.

With use of carbon fiber surging in fields such as aerospace, wind turbine production and automotive—use of carbon-fiber composites in the auto industry alone is expected to rise by 11 to 18 percent annually—demand for acrylonitrile has outstripped the capacity of fossil fuel-based production methods. The 20 to 25 percent cost savings and the reduction in GHG could have a significant impact over time, both with the producers of carbon fiber and further down the supply chain. "If you use this process where you start from waste biomass, you make sugar, you convert the sugar to the chemical and then you make that chemical into carbon fiber, if you put that carbon fiber into a vehicle like an airplane or a car, you lightweight the vehicle, which means it uses less fuel, so you're getting a double benefit," said Grieco.

E&E is developing a nano-engineered, catalyst-driven process for the production of light olefin, such as ethylene and propylene, by combining CO_2 from coal-fired flue gas with lower alkanes derived from shale gas. Ethylene and propylene are the highest volume petrochemicals currently in use,

SR's thermal energy storage process enables grid-scale solar power generation that strives for an economical energy storage cost target of $15/kWhth.

SR's thermochemical energy storage system uses materials that have been validated to achieve break-through capacity and durability targets during testing to 100 cycles.

SR's process for production of bio-acrylonitrile results in 15-22% cost reduction and 40% reduction in Green House Gas emissions.

Using only 8% of biomass-derived crude oil in conjunction with traditional oil will reduce overall CO_2 emissions up to 20%.

An addition of 20% biomass derived fuel to 80% petroleum fuel performed as well as 100% petroleum fuel and also provided a significant capital cost reduction.

serving as the building blocks for a variety of products such as packaging, plastics, textiles, paints and electronics. This more economical, less energy-intensive, more sustainable process promises to have a meaningful environmental impact.

PROMOTING GROWTH FROM THE GRASSROOTS

A natural outgrowth of E&E's work in validating other organizations' technology and developing innovations of its own work is supporting small businesses in building a solid foundation and growing in a sustainable way. E&E's focus on energy, chemistry and refinement of materials aligns it with industries that are currently undergoing major transitions away from a carbon-based infrastructure.

"I think we're uniquely advantaged to understand how to drive economic development in the communities that we serve," Grieco said. "Technology- or innovation-based economic development is something that's being practiced all around the world. Bringing the skills, the people, the resources and the infrastructure to bear on job creation is something that too few people are doing."

The Prosperity Fund [pg. 36] is filling that gap with its efforts to accelerate entrepreneurial activity and spark job creation in four Alabama counties rocked by the coal industry's steep downturn. In large part, it's SR's presence in the Southeast and direct, in-the-field involvement that sets it apart from larger organizations pursuing a similar mission.

"For it to be successful, it's going to happen on a local level. It has to," Grieco said. "Getting out with the communities, with the innovators, the businesses, the entrepreneurs and holding their hands and walking in their shoes." Being in the field with the small business that needs help, he said, is not just critical but necessary for the success of the project.

"The traditional way of doing things is something that E&E has really tried to avoid," Grieco said. "We try to be nontraditional. We're in industries that are incredibly traditional and incredibly conservative. To be successful as a nonprofit, or as any company operating, doing something new, you have to be unconventional. That, to me, is the definition of innovation."

Babak Hamzavy discusses with guests the R&D work being done within E&E in the solar energy industry.

CELEBRATING THE FUTURE

On Oct. 25, Southern Research hosted a special event marking the 25th anniversary of the opening of the Oxmoor campus. The facility, which officially opened its doors on Oct. 9, 1992, was largely designed by SR engineers, with flexible space and one-of-a-kind instruments invented by Southern Research staff for their groundbreaking research. The Oxmoor facility became home to discoveries that have changed the face of aerospace and defense systems. In 2016, SR Engineering was joined at the new campus by SR Energy & Environment.

"The opening of the Oxmoor campus represented a milestone for Southern Research because the facility has provided our team with a unique expansion space to help advance important programs in aerospace and defense," said President Tipton. "And with expansion, it has been a great center for our growing energy and environment focus."

"The work conducted by Southern Research at the Oxmoor campus has always focused on making discoveries that propel science and technical knowledge forward," he added. "That mission is going to continue well into the future."

Steven Puckett, manager of The Prosperity Fund, poses with partners at A&A Machine and Welding.

Right: Implementing change at the community level through The Prosperity Fund. Katherine Tucker, owner of Civil Stoneware.

A New Initiative Promises More Than Prosperity for Struggling Counties

Of all the discovery and potential that comes out of Southern Research, one initiative may be unexpected: a dose of vitality through economic development. SR established the $2.4 million Prosperity Fund to support entrepreneurial activity and job creation in counties affected by the downturn of the coal industry in Alabama.

"Southern Research was founded to help Alabama remain resilient in the face of economic change by strengthening our existing industry and helping develop new ones," said project leader Corey Tyree, Ph.D., director of Strategic Growth Initiatives for E&E. "This is about making what we have stronger, reinventing our economy."

The four counties targeted by The Prosperity Fund—Fayette, Walker, Tuscaloosa and Jefferson—have accounted for 10 percent of coal job losses in the entire country, with 12,000 jobs lost since 2012 resulting in $800 million in lost wages.

Established as a public-private partnership and backed by the Appalachian Regional Commission, the fund will connect SR with community officials and business leaders who can mentor existing businesses and startups. Business owners with experience in heavy industry, but not business development, can receive assistance with fundamental activities such as customer discovery and market research. Businesses centered around declining industries can receive guidance in finding innovative models that will provide value to their markets, and entrepreneurs can receive the support they need to make a sustainable start.

Consultant Steven Puckett was a strategic choice to serve as managing director of The Prosperity Fund. While he has an engineering background, his experience in business will best serve the people the fund is working to reach. "He's an entrepreneur," said E&E Vice President Bill Grieco. "He's a business guy who's created a bunch of small businesses, put people into business, lost in business and knows what works and doesn't work. That's the profile. You have to have individuals who are willing to take risks and who really understand what that small business owner is going through."

"The Prosperity Fund project is another example of changing views of what economic development looks like," Tyree said. "One, it aligns with the idea that small businesses are the heart of the jobs economy. And two, it's also consistent with the idea of technology-based economic development strategies, suggesting our community needs innovation assets like Southern Research to play a role in economic revitalization."

THE PROMISE OF THE PROSPERITY FUND

The objectives of The Prosperity Fund are to revitalize existing businesses and build new ones to revive the economy in struggling areas of Alabama.

- Facilitate the creation of 10 new businesses
- Assist 10 existing businesses
- Create 80 jobs through business improvement and creation efforts
- Increase business revenue by $11 million
- Leverage $6 million in private investment

The state of Alabama, Appalachian Regional Commission, Walker Area Community Foundation and Alabama Power Foundation have provided generous support to The Prosperity Fund program.

PROSPECTS FOR PROSPERITY

Though it has been operating for well under a year, The Prosperity Fund has already become active with small businesses and aspiring entrepreneurs in the affected counties. A&A Machine and Welding felt the impact of the coal industry's decline in Walker County because of shutdowns of machine shops that worked for mines. With advisers from The Prosperity Fund, A&A is working to improve efficiency and add new capabilities. Puckett has also worked with Civil Stoneware owner Katherine Tucker to help her business with product certification in California and human resources. Puckett is currently working to connect Tucker with an expert who will help her set up a new warehouse.

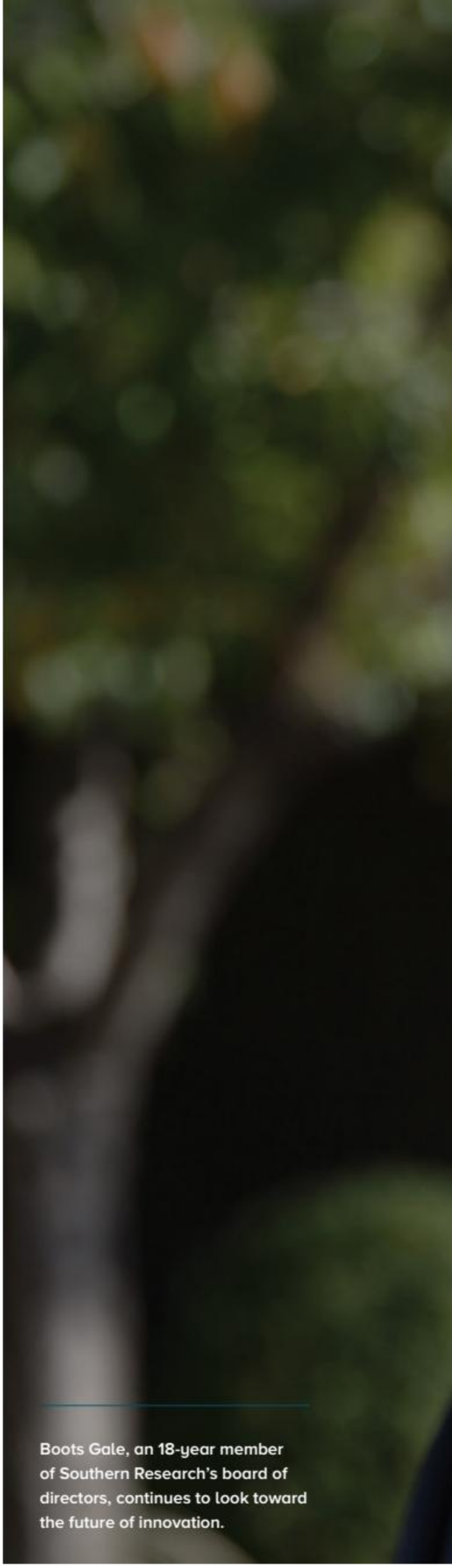
To support the initiative, SR has partnered with Bevill State Community College—students from which will soon be helping A&A improve its website. Puckett is helping the school establish an entrepreneurship program and working to connect students with businesses that need their help.

A Dedicated and Generous Partner to Southern Research:

FOURNIER "BOOTS" GALE

Fournier J. "Boots" Gale has served as general counsel and corporate secretary for Regions Financial Corporation since 2011 and was a founding partner of leading law firm Maynard Cooper & Gale, PC in 1984. He has been active in many civic and community organizations, including Leadership Birmingham and Leadership Alabama, along with work as general counsel to the Business Council of Alabama and service to the Birmingham Bar Association and the Alabama State Bar.

Somehow, amid all that community involvement, Gale has found time and financial support to dedicate to Southern Research through 18 years of service on the board of directors and considerable philanthropic development.



Boots Gale, an 18-year member of Southern Research's board of directors, continues to look toward the future of innovation.

"It's just quality" of SR's work that has kept him dedicated for nearly two decades, he said. He first encountered SR as a young lawyer, through his work with clients in the iron and steel industries, and was impressed with the organization's expertise, innovation and commitment to the community. Seeing SR's involvement with smaller companies and entrepreneurs gave him a good idea of its culture and priorities. "I had seen the organization from that perspective, and I was glad to be a part of that," he said when he was asked to serve as an independent director. Over the years, he has also made substantial financial contributions to SR for that reason.

"The success of any entity really depends on the community you serve and where you live," he said."It was a contribution to the betterment of the community we all live in, whether it's the state or the region or the city. SR and other related facilities were all growing and making a real contribution to the growth of our community and to improvements. It was easy to give back."

INPUT, INSIGHT AND ADVICE

Gale's background in the law, rather than in science or engineering, has given him a perspective that has guided his service to the board of directors. "We're trained, as lawyers, to anticipate and recognize risk of an organization or an entity that you're working with," he said. "I look at things from a risk-averse standpoint, trying to keep us away from risk and testing to see if management has considered the downside, if you will, or the legal implications of what we're doing."

With the number of government and private contracts that SR works with and the challenges it faces as a large research institution, having a guiding hand focused on legalities—rather than just the excitement and potential of new discoveries—has supported SR's mission. And he said that board members with backgrounds in other fields, such as finance, have contributed from their own perspectives and areas of expertise.

As a board member, however, he makes a conscious effort not to interfere with SR's management. "It's more strategic input, where you have a diverse board of different backgrounds and current involvement with the community or with a company that has some best practices that they can bring," Gale said. "The board's function is not to manage operations." When SR management comes to the board with questions, or when board members' experience and community affiliations can be of benefit to SR, the board provides outside knowledge and insight—not interference.

A CULTURE OF INNOVATION

Gale gives full credit for SR's success to its employees and associates. The quality of their research, the dedication of the research and support staff and the innovative work of management has gotten the organization where it is today. "We've got a great culture, and it's improved over the years and grown," he said. A welcoming environment and a commitment to innovation have resulted in low employee turnover and high enthusiasm for the work they do. "Watching it grow, and people like Art coming in after other leaders—they deserve the credit," he said.

Gale said SR was a "well-kept secret" and a "hidden jewel" until Art Tipton arrived. "Art has done a tremendous job of reaching out to the community since he joined us," Gale said. "You talked to people, and they didn't really know much about SR. Art has done a good job of getting the organization more visibility and more involvement with the community."

Over the years, Gale has been fascinated by Southern Research Drug Discovery, particularly its potential to touch lives outside of the lab. "It's the idea of people trying to provide knowledge about cancer and how to deal with all kinds of problems that so many

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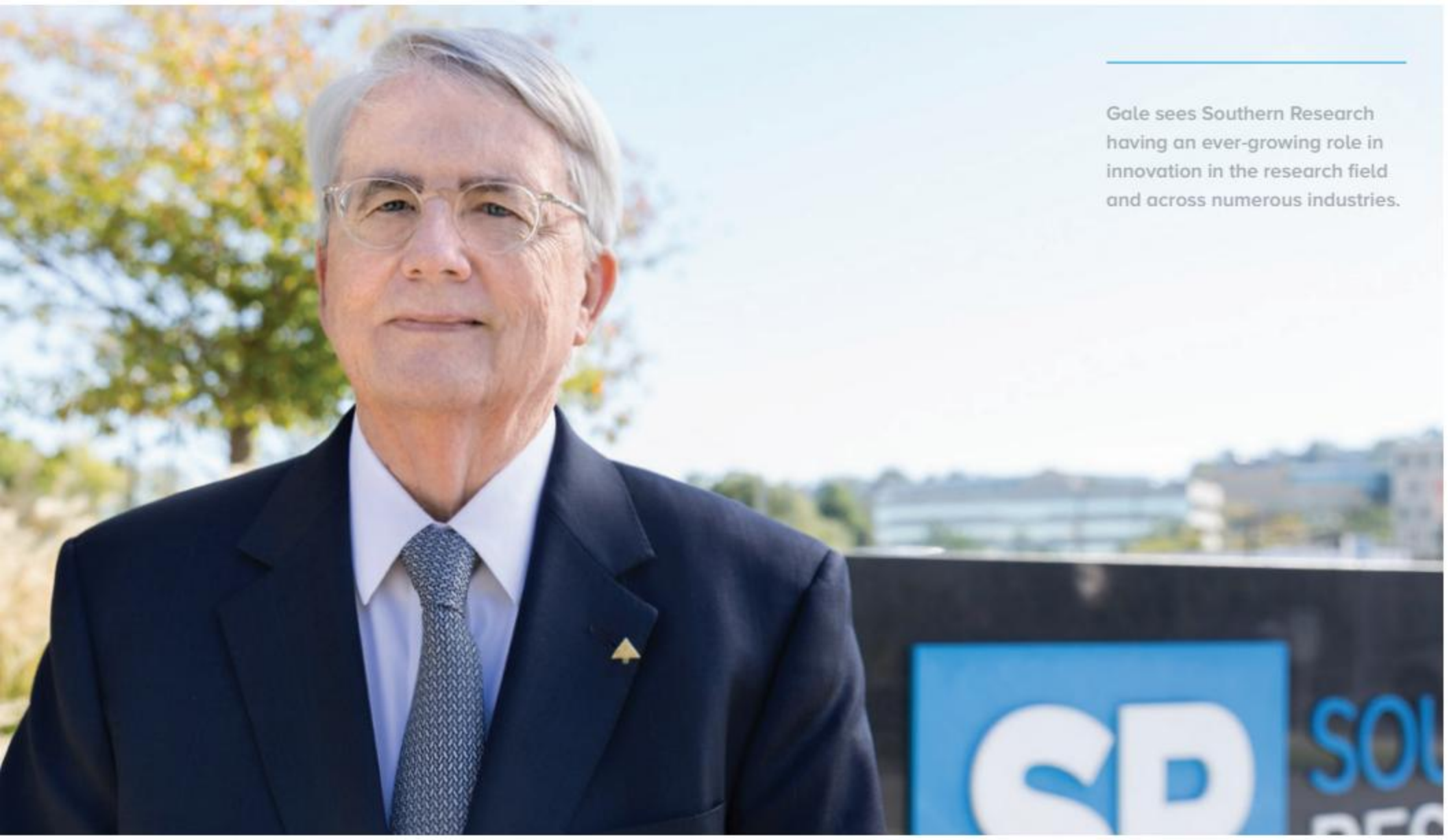

Gale sees Southern Research having an ever-growing role in innovation in the research field and across numerous industries.

people still face in their lives, and how we can help get ahead of that and continue to improve and research other drugs," he said. Knowing that the benchside research by SR's scientists will have significant real-world applications has been meaningful to him and an inspiration for his service.

Also of interest to Gale is SR's engineering work in support of the space program, "the materials and structural integrity of various things we send into space," he said. He has enjoyed opportunities, as a board member, to visit SR's Oxmoor campus, meet the engineers and see the work they have in progress. "I think our engineering department is one of the strengths of our organization," he said. And that SR is involved in such a diverse range of research fields—from cancer drugs to space-age materials to energy storage and sustainable production—makes it an exceptional institution with great accomplishments and great potential.

Because of that, he sees Southern Research having an ever-growing role in innovation in the research field and across numerous industries. "I think that a lot of our strategic direction is keeping and attracting young people, particularly in innovation. Being a major player in IT, technology growth, providing some opportunity for startups to come and locate here," he said. Gale has had an opportunity to watch SR's developments and progress over his 18 years of service, and he sees growth in the organization, in the community and in SR's influence and contribution in the future.

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The Reach of Research

Founded in 1941, Southern Research is an independent, nonprofit, scientific and engineering research organization that supports partners in the pharmaceutical, biotechnology, defense, aerospace, environmental and energy industries.

A staff of nearly 500 works across four divisions: Drug Discovery, Drug Development, Engineering and Energy & Environment. The organization pursues entrepreneurial and collaborative initiatives to develop and maintain a pipeline of intellectual property and innovative technologies that positively impact real-world problems. In every endeavor, SR is committed to providing the highest quality of service, operating at the highest levels of integrity and contributing to the betterment of humankind.

→ BIRMINGHAM, AL
SOUTHSIDE CAMPUS: CORPORATE HQ

THE ORIGINAL CAMPUS OF SOUTHERN RESEARCH WAS ESTABLISHED IN BIRMINGHAM, JUST SOUTH OF THE CITY CENTER. TODAY, THIS LOCATION COMPRISES APPROXIMATELY 310,000 SQUARE FEET OF LABORATORY AND OFFICE SPACE AND IS HOME TO SOUTHERN RESEARCH'S TWO LIFE SCIENCES RESEARCH DIVISIONS AND ADMINISTRATIVE SERVICES STAFF.

→ BIRMINGHAM, AL
OXMOOR CAMPUS: ENGINEERING & ENERGY AND ENVIRONMENT RESEARCH CENTER

THE OXMOOR CAMPUS WAS ESTABLISHED IN 1992 TO MEET THE CHANGING DEMANDS OF ENGINEERING. USING INSTRUMENTS INVENTED AT SOUTHERN RESEARCH, ENGINEERS RESEARCH SUBJECTS SUCH AS AEROSPACE AND DEFENSE. IN 2016, SR ENERGY & ENVIRONMENT MOVED TO OXMOOR, CONDUCTING RESEARCH ON SOLAR PANELS AND ENERGY STORAGE.

→ FREDERICK, MD
INFECTIOUS DISEASE RESEARCH CENTER

THE INFECTIOUS DISEASE RESEARCH TEAM PROVIDES COMMERCIAL AND GOVERNMENT CLIENTS WITH A WIDE VARIETY OF NONCLINICAL AND CLINICAL TRIAL SUPPORT SERVICES. THIS TEAM OFFERS EXPERTISE IN STUDIES THAT INCLUDE IN VITRO AND IN VIVO TESTING OF SMALL MOLECULE COMPOUNDS, VACCINES, BIOLOGICS AND OTHER INFECTIOUS DISEASES.

→ DURHAM, NC
CLEAN TECHNOLOGY DEVELOPMENT CENTER

THE CLEAN TECHNOLOGY DEVELOPMENT CENTER IS WORKING TO SOLVE MANY OF THE CRITICAL ENERGY PROBLEMS CONFRONTING OUR NATION AND THE WORLD. THIS TEAM OF ENGINEERS IS DEVELOPING NEW AND SUSTAINABLE ENERGY TECHNOLOGIES THAT WILL ENSURE CLEANER AND MORE EFFICIENT ENERGY PRODUCTION FOR THE FUTURE.

→ CARTERSVILLE, GA
WATER RESEARCH CENTER

THE WATER RESEARCH CENTER AT PLANT BOWEN FOCUSES ON ADVANCED TESTING OF WATER TECHNOLOGIES AND PRACTICES TO FIND NEW WAYS TO REDUCE, CONSERVE AND IMPROVE WATER QUALITY. RESEARCHERS INDEPENDENTLY VALIDATE AND DEVELOP NEW TECHNOLOGIES AND CONSULT ON A WIDE RANGE OF TOPICS RELATED TO WATER.

→ HOUSTON, TX
ELLINGTON FIELD

SOUTHERN RESEARCH'S HOUSTON OFFICE IS LOCATED AT NASA'S ELLINGTON FIELD. THIS TEAM OF ENGINEERS HAS WORKED WITH NASA ON ITS WB-57 PROGRAM FOR OVER A DECADE. SR ENGINEERS PROVIDE ESSENTIAL SUPPORT TO VENTURES INCLUDING DEEP-SPACE RESEARCH AND HUMAN SPACE FLIGHT MISSIONS.

Headquartered in Birmingham, Alabama, SR has labs and offices across the southern and eastern U.S. This wide footprint allows SR to make major contributions in the fields of science and engineering.

SOUTHERN RESEARCH

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Engineering | Energy & Environment Research Center
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Infectious Disease Research Center
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